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November 1982 £1

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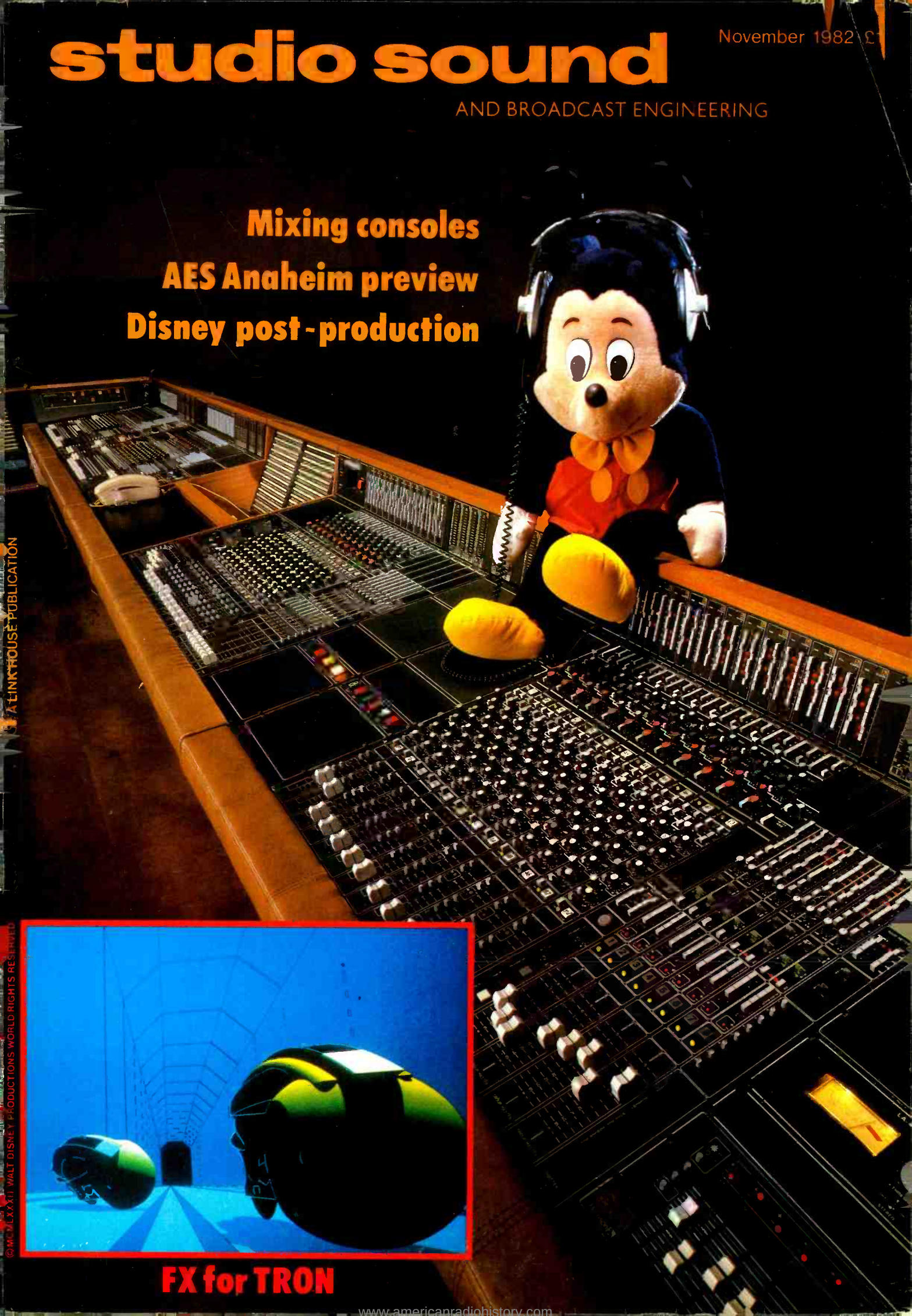

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AND BROADCAST ENGINEERING

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A LINK HOUSE PUBLICATION

ABC MEMBER OF THE AUDIT BUREAU OF CIRCULATIONS

Cover photographs by Bill Eastabrook and courtesy of Disney

Styx and Stones won't break your bones; their words may hurt you backwards

A recent arrival on my desk was a short item on something called 'backward masking'. I don't know quite whether it was designed for our *Sounds Supernatural* column or not: certainly it is more curious than metaphysical (like James Randi rather than Matthew Manning, perhaps). Apparently US Congressman Robert Dornan has introduced legislation which will require that a warning message is carried on the covers of albums including 'backward masking' messages. These are alleged to be words recorded backwards on album tracks which 'glorify Satan'. While audible when the record is reversed, these messages, alleges Dornan, have a subliminal effect when played in the usual way. Several major rock albums contain such messages claims Dornan, listing tracks by Styx, Black Oak Arkansas, Led Zeppelin and The Cars.

The last time I heard anything like this was the mild controversy over the mystery words in the locked groove at the end of The Beatles' *Sergeant Pepper* album, but this particular 'message' had the advantage that you couldn't decode it *either* way round (4.3×10^6 theories apart). From the examples given, all I can say is that if *I* wanted to put a message on an album, backwards or otherwise, I would use better English than 'Satan, Satan...he is got God...' as one (unnamed) 'message' is alleged to run. Far from being the audio analogue of subliminal advertising, as Dornan appears to think, it seems to me more a case of the audio analogue of Rorschach Blots: you hear what you want to hear. And apart from the fact that I seem to remember that subliminal *visual* advertising has a rather limited effectiveness, which is reduced to virtually zero by reversing or inverting the message, I don't see that there would be any real chance of grasping a reversed *audio* message subliminally or otherwise, even 'in the clear' unless you happen to be another Roger Ordish or a peculiarly perverse recording engineer who thinks that copying tapes backwards improves their quality (what's the truth about this, by the way?).

There may be more to this than meets the eye, of course. Congressman Dornan is a Republican and lives in California. Is this another attempt to try and damage the California recording industry?

We hope to hear more. Perhaps the ingenuity of our columnist Barry Fox will come up with something. In the meantime, the alleged originators of the alleged 'backwards masking' message which allegedly says '...There is power for Satan, he will give you 666...' might like to go back and check their Gematria. The number 666 represents a good number of things besides the 'Beast' of the *Book of Revelations*: it also refers to the power of the sun, for example, which could only be made equivalent to Satan via a very strange course of logic. Again, perhaps Dornan's Health Warning should be extended to include 'negative' (forward) lyrics...but then who will decide what constitutes 'negative'? Dornan himself? Let's play safe. A suitable message could read 'Warning: Congressman Dornan has determined that this record contains lyrics, which may, or may not, be dangerous to your health'.

Richard Elen

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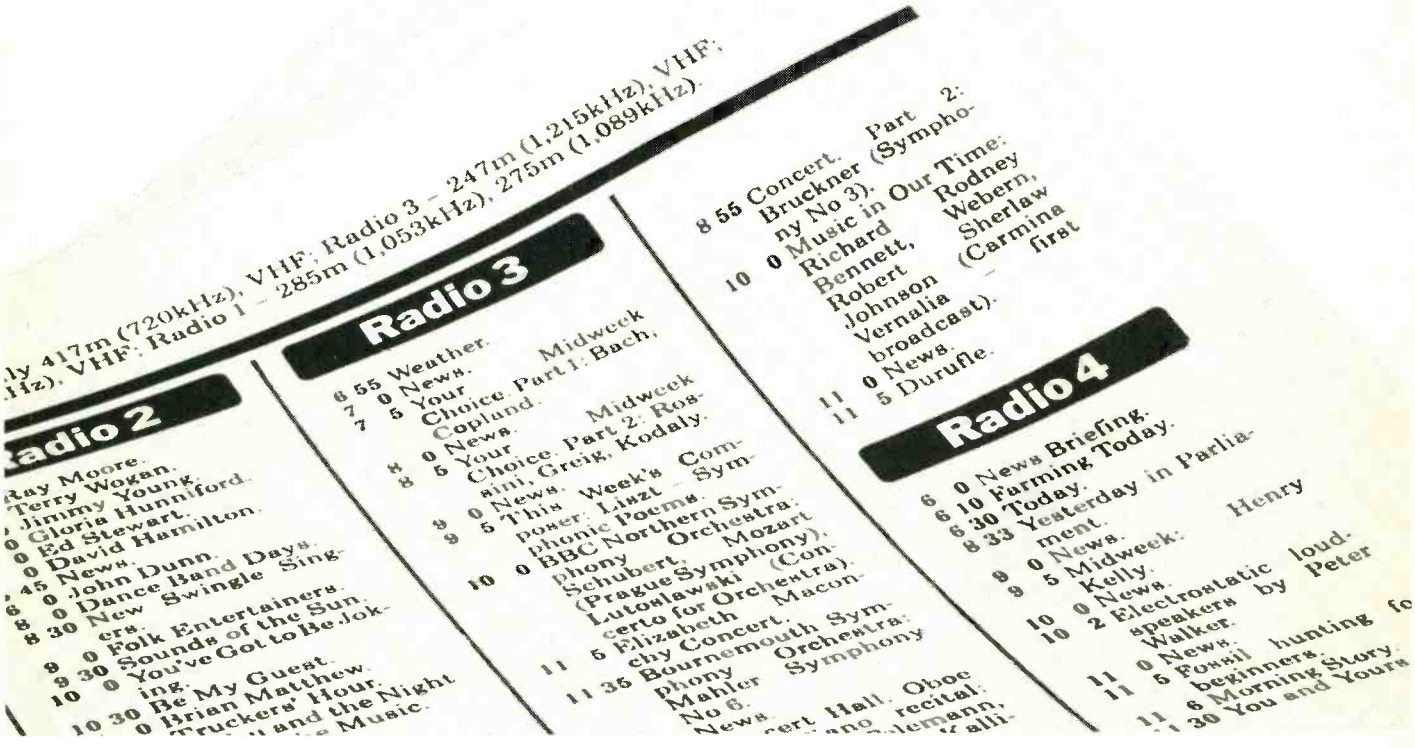

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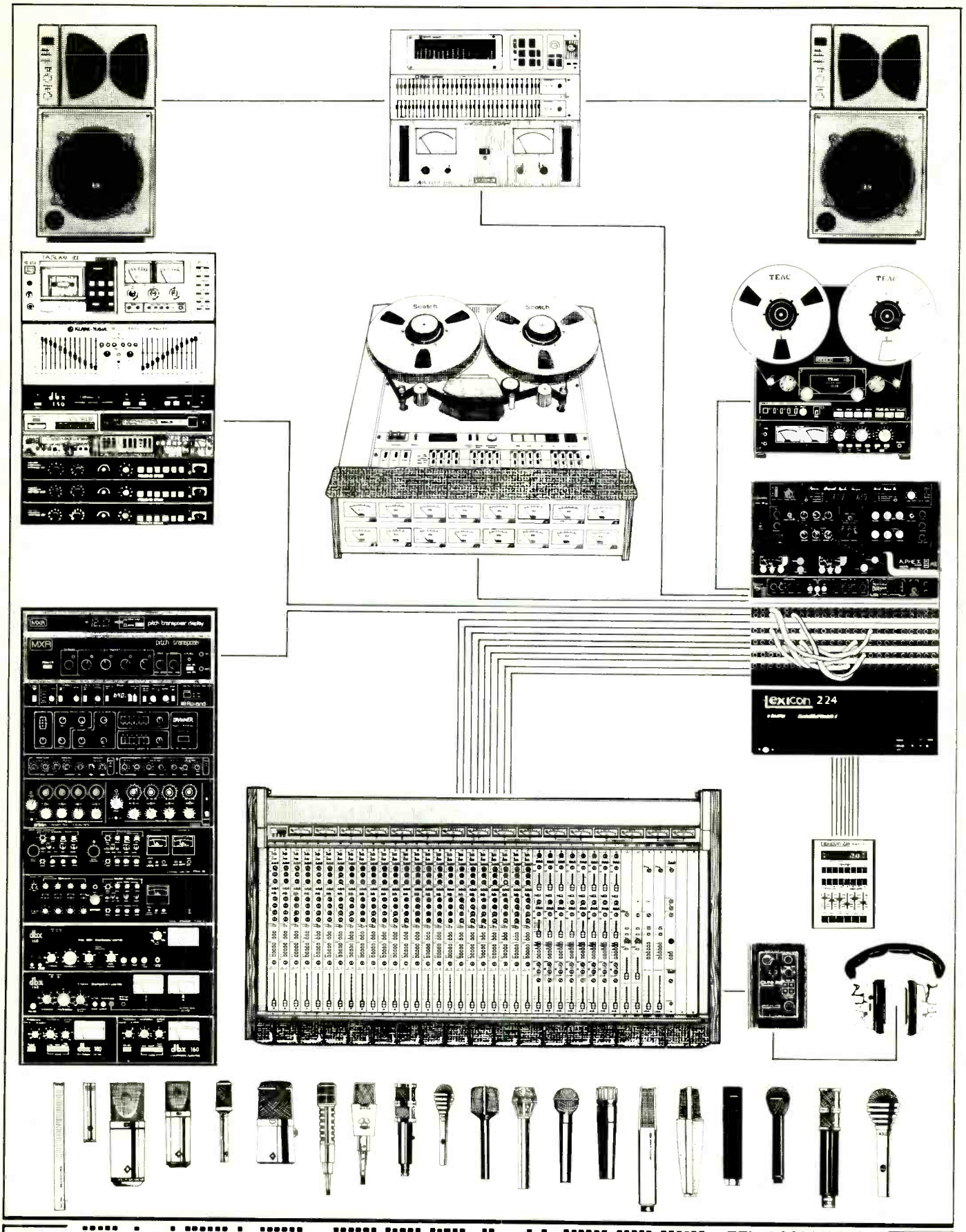

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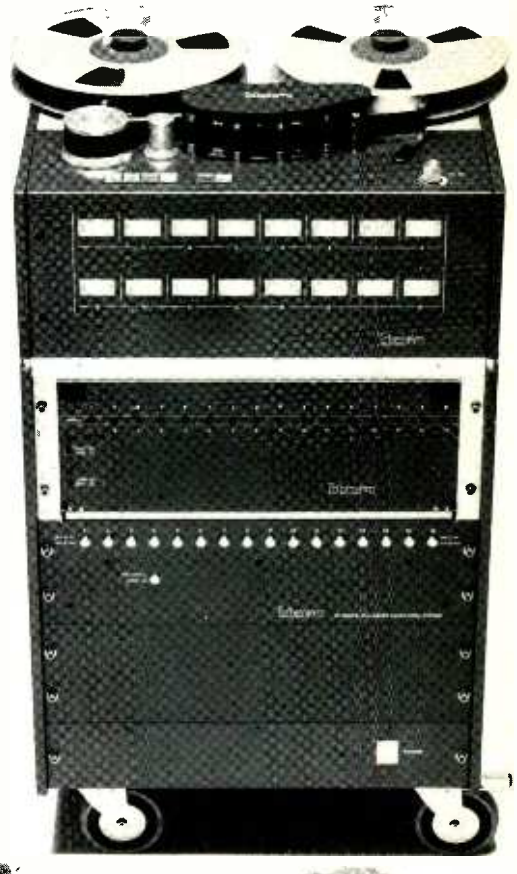

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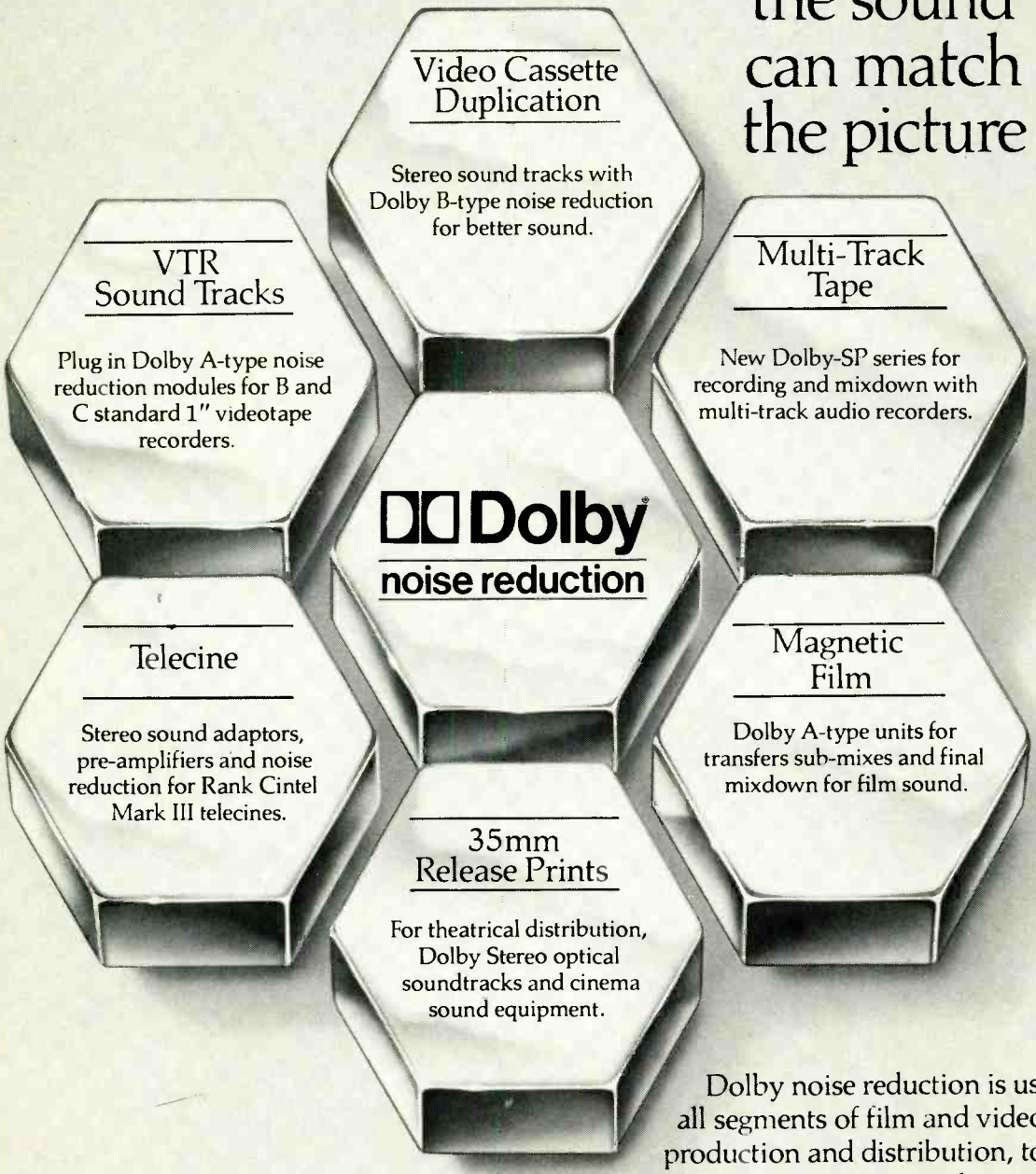

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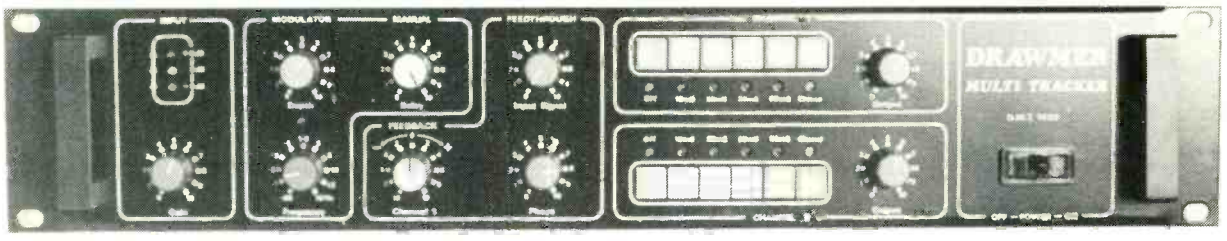

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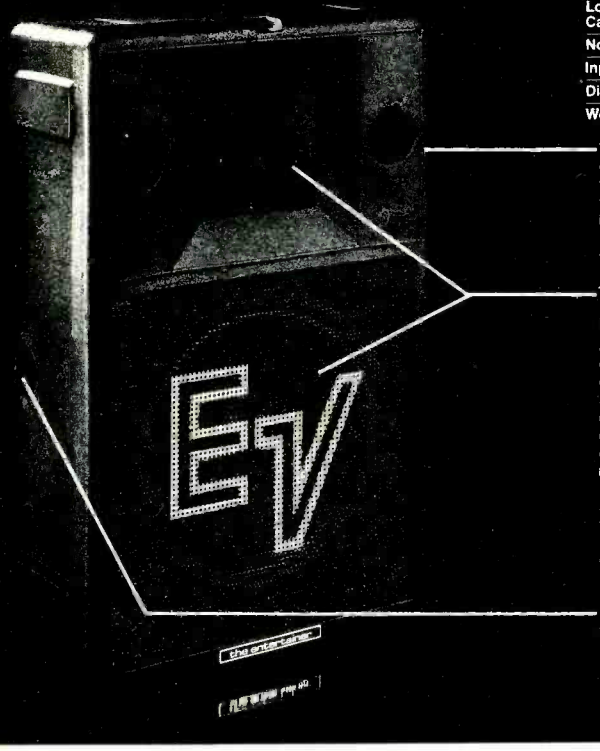

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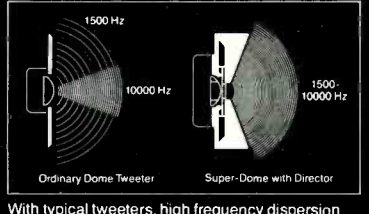

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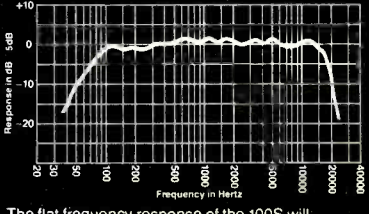

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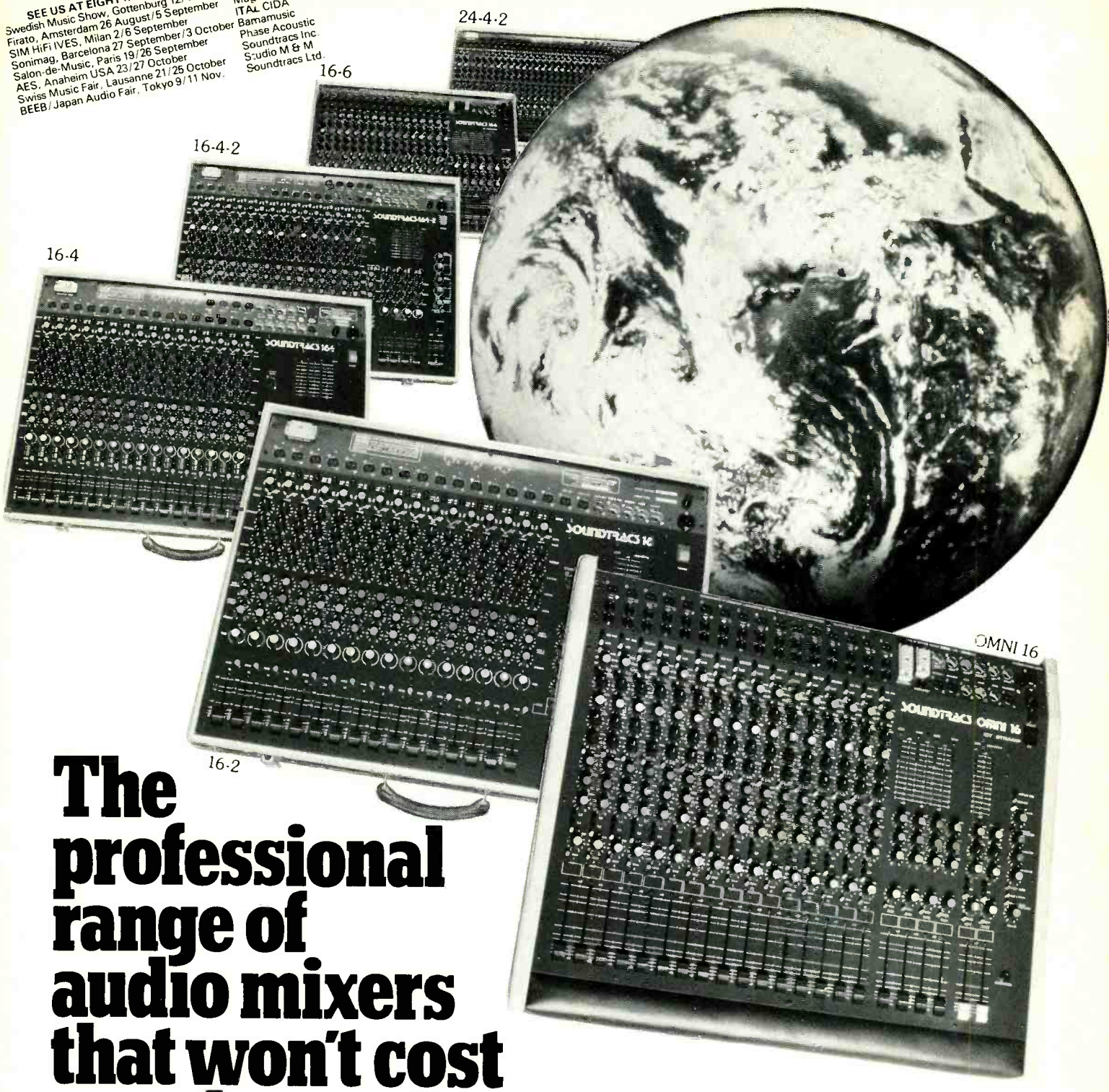

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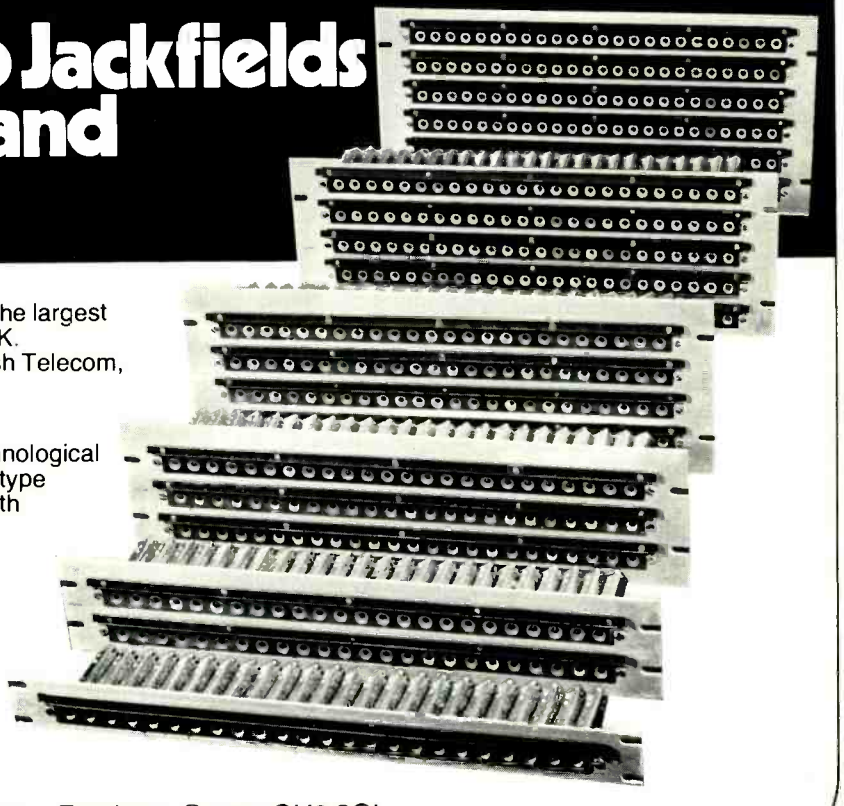

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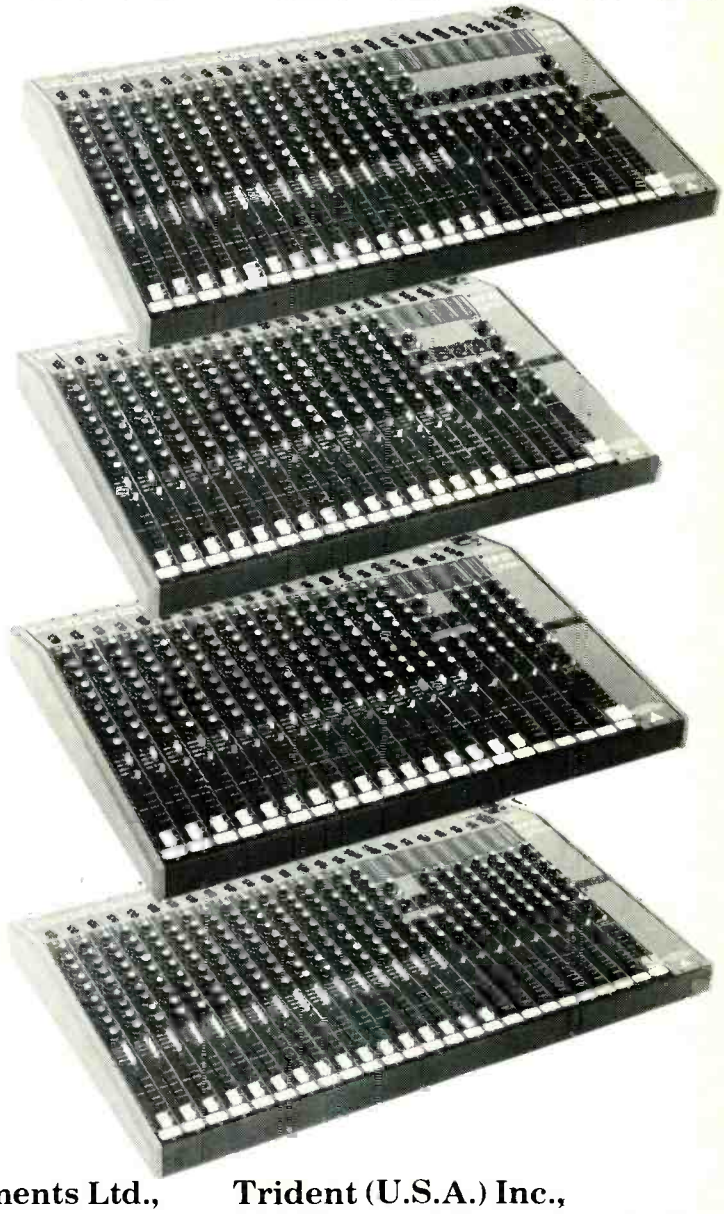

- Totally modular construction.
- Four band EQ on each input.
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- Separate mic and line inputs.
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- Accurate 12 segment L.E.D. metering.
- Rugged welded steel frame construction.
- Self contained power supply.
- Long throw faders.

All at an unbelievable price:

16-4-2 Studio or P.A.
£1,000.00 plus VAT.

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Shepperton, Middx. TW17 0QD, U.K.
Tel: Chertsey (09328) 60241.
Telex: 8813982 (TRIMIX G.)

Trident (U.S.A.) Inc.,
652 Glenbrook Road, Stamford,
Connecticut 06906 U.S.A.
Tel: 203-348-4969

Mobile One – Designed by Engineers, with Musicians in mind.

Specialist engineering to suit every type of recording situation from concerts and films to long term album work.

A completely self-contained 46 track recording control room including 2 track digital recording (24 track digital recording available on request). Up to 46 track Analogue facilities all in one unit.

Mobile One is the first choice of some of the greatest names in music:–

A&M Records; Ariola; Barclay Records; British Broadcasting Corporation; CBS Records; Decca Records; EMI Records; Phonogram; RCA Reccrds; Commercial Television; London Philharmonic Orchestra; London Symphony Orchestra; Vienna Symphony Orchestra.

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29-30 Windmill St, Tottenham Court Rd,
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Telephone: 01-580 3744
Telex: 298531

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Ferber Studios,
56 Rue Capitaine Ferber,
Paris 75020.
Telephone: 3613101

HAMBURG –
Studio Hamburg,
Tonndorfer Hauptstrasse 90,
2000 Hamburg 70.
Telephone: 66881

MILAN –
Contact: Idea Recordings
C.G.D., Via MF. Quintiliano 40,
20138 Milan.
Telephone: 5084

Equipment includes:–

- Eastlake Monitoring with JBL Drivers and Amcron Amps.
- Two MCL 24 track TR.
- Sony PCM 1610 recording system and editor.
- 52 input channels.
- EMT Digital Echo
- Noise Gates Liimiters Compressor.
- Full range Neumann AKG Bayer Sennheizer mics.
- SMPTE/EBU Time code generator.
- 50 Hz crystal sync generator.
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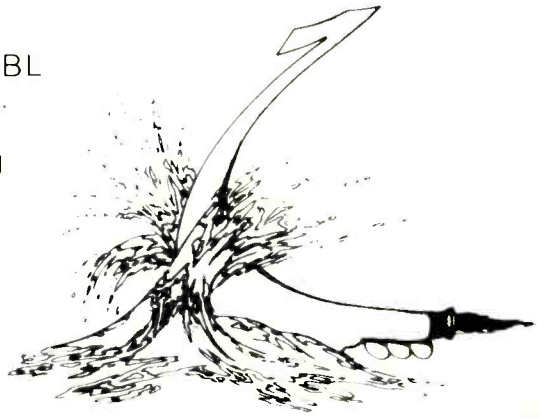

MOBILE ONE

more comprehensive – but no more expensive.

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It brings you up to date with the new
technology from Neve.
And the full range of sound mixing consoles,
and complete audio systems for
broadcasting, music and film production.

Neve

Invest in Neve –
the most natural sound on earth
starting at around £5,000

and technology

Radio "On-Air" Console

Designed for modern "On-Air" studios, the Neve 5322 console provides maximum facilities and flexibility in a highly reliable and easy-to-use unit. Up to sixteen input channels and a choice of plug-in units gives versatility in configuration and allows for expansion to provide for the needs of the future. Modular construction and standardised frame wiring enables flow-line production techniques to be employed resulting in a cost effective product retaining all the Neve hallmarks of quality and performance.

NECAM Automation Systems

Multi-Track Mixdown

The most sophisticated aid yet devised for the task of music mixdown, NECAM is not simply an automated console, it is an integrated system, responsive to the balance engineer's style and preferences and designed to simplify operations and allow more time for the creative work in mixdown. NECAM is a highly cost effective investment for today's busy studio.

Audio Post-Production in Television and Film Studios

In Television or Film dubbing theatres Necam provides a computer-aided tool for rapid artistic track building enabling the engineer to concentrate on the most critical parts of his task at any given time, no matter whether he is laying down an effects track, rock and rolling a critical post-synchronised dialogue balance or carrying out a final mix.

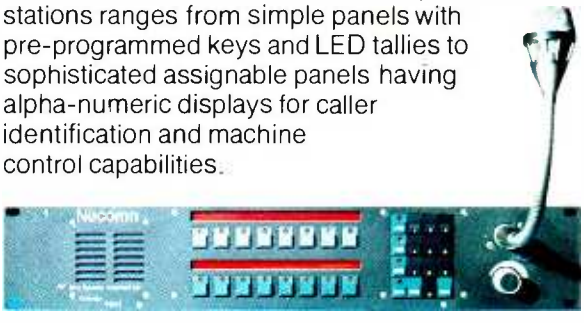
Portable and General Purpose Audio Consoles

The Neve 542 series is a range of small, compact audio mixing consoles designed for professional recording or broadcast applications.
Available in 8, 12 or 16 channel configuration the consoles provide two main and two auxiliary outputs and all inputs have a 3-band equaliser and high-pass filter.

The 8 channel console is also available in a light-weight fully portable suitcase version with integral rechargeable batteries for professional mobile applications.
A 6 channel, 19" rack-mounting unit is also available for O.B. Vehicles.

Intercom and Talkback Systems

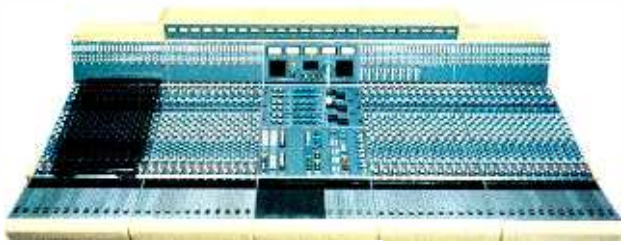
NECOMM provides a professional high-quality flexible intercommunications and talkback system for use in television and broadcasting or wherever a high-technology system is required. Using the power of distributed micro-processors together with the flexibility of user-proven software control and solid-state audio switching techniques NECOMM provides unequalled advantages over conventional systems. Standard systems are available having from 8 to 256 locations and the family of intercom stations ranges from simple panels with pre-programmed keys and LED tallies to sophisticated assignable panels having alpha-numeric displays for caller identification and machine control capabilities.



Invest in Neve quality

Production Consoles for Radio, Television and Film

The NEVE 51-Series comprises a range of versatile multiple-application audio consoles for Radio, Television and Film programme production including multi-track recording. Excellent performance designed to national and international specifications satisfies worldwide requirements.



All models are suitable for both studio and vehicle installation and have been designed to offer maximum flexibility in application with standardisation in manufacture to give a cost effective product. The range consists of four types of console, each being available in different configurations and numbers of input channels and groups. All consoles are designed for use in either mono or stereo operation and incorporate the much acclaimed Neve Formant Spectrum Equalisation (F.S.E.)
Standard consoles, available on prompt delivery, range from 12 channel/4 group to 48 channel/8 group with 24 track recording facilities. These consoles are of unsurpassed versatility in use.
The 51-Series represents the culmination of 20 years of professional audio equipment design and production by Neve.

Neve

Music Recording

The 8128 range of Master Recording and Mixdown consoles is designed to fulfil the requirements of discerning studios requiring up-to-date facilities and the optimum in Musical Sound quality. Modern technology combined with Neve's meticulous design techniques provide a dynamic range matching that required for high quality digital recording.
The finest sounding console ever, the 8128 incorporates Neve Formant Spectrum Equalisation (or F.S.E.) providing the critical engineer and producer with incomparable musical resources:–

- Carefully tailored spectrum curves preserving optimum amplitude and phase relationship, provide synergy with tone colours of musical formants.
- Generous amplitude control range provides the power needed for enhancement, tone transformation and correction.
- Unequalled transient handling capacity transmits original musical punch and sparkle.

Digital Signal Processing (DSP)

Digital Signal Processing offers immaculate performance and exciting features such as assignable controls, complete control reset (CCR) and total automation.
Our unrivalled experience combined with the power of DSP offers an exciting new approach to audio control consoles for all applications.

The sound of Neve is worldwide

Turnkey Systems

The complexity of assembling and commissioning complete audio systems is often so great that many organisations have found it expedient to delegate the responsibility for planning, procuring, installing *and* commissioning the total requirement to a single qualified supplier.
In-depth experience in the supply and installation of audio systems gained over many years has placed us in a leading position to offer such services.

Service and Installation

Our Technical Service Department maintains fully equipped base service facilities in England and throughout North America. They also operate an on-site installation and maintenance service anywhere in the world, in conjunction with our network of subsidiary companies and agents.
Training for operational and maintenance staff is normally provided at our central facility or can be arranged at customers' locations.

Special Orders

The Neve Special Orders department provides an efficient and fast design and manufacturing facility for a miscellany of small custom products or small repeat orders.
Being a self-contained unit within the Neve organisation, the service provided is quick and cost-effective whilst maintaining the usual Neve standards of quality and reliability.

Custom Engineering

In addition to our wide range of standard products, our Custom Engineering Department offers a fully consultative service to customers requiring designs to their own specification.

As the world's largest specialist manufacturer of sound control consoles, we have a wide range of modular units already designed to fulfil most of the facilities requested by our customers. These can be used to produce many different system configurations and console layouts to suit every requirement at costs lower than normally expected.

Ancillary Units

A wide range of ancillary units are available for the professional audio user, including limiter compressors and distribution amplifiers.

Neve Today

Neve has been supplying Sound Control Systems to the world's broadcast, music recording and film industries since the early 1960s.
Neve today is a dynamic, progressive company, with the enthusiasm, maturity and expertise needed to give a first-class professional service to any organisation requiring an audio system, whether it be a small portable mixing console or a complete studio installation.
Employing over 400 personnel in Great Britain with subsidiary operations in the USA and Canada, and with a world-wide network of agents and representatives, Neve is the world's foremost specialist manufacturer of sound mixing consoles and second-to-none when it comes to after-sales service and support.

Neve

Designers and builders of audio mixing, control and distribution systems in use throughout the world by leading radio and television broadcasters, production, film and recording studios.

CO DESIGN UK

Neve Electronics International Ltd.	Melbourn, Royston, Herts, SG8 6AU England Tel Royston (0763) 60776 Telex 81381 Cables Neve Cambridge
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Rupert Neve Inc.	7533 Sunset Boulevard, Hollywood, California 90046, U S A Tel (213) 874-8124 Telex 194942
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Rupert Neve of Canada Ltd.	2721 Rena Road, Malton, Ontario, L4T-3K1 Canada Tel. 416-677 6611 Telex 06-983502
Rupert Neve GmbH	6100 Darmstadt Bismarckstrasse 114 West Germany. Telex (003) 419581

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Don Larking Audio Sales

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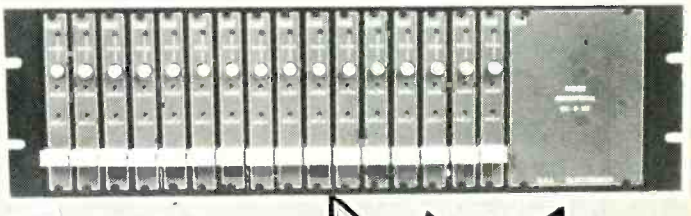
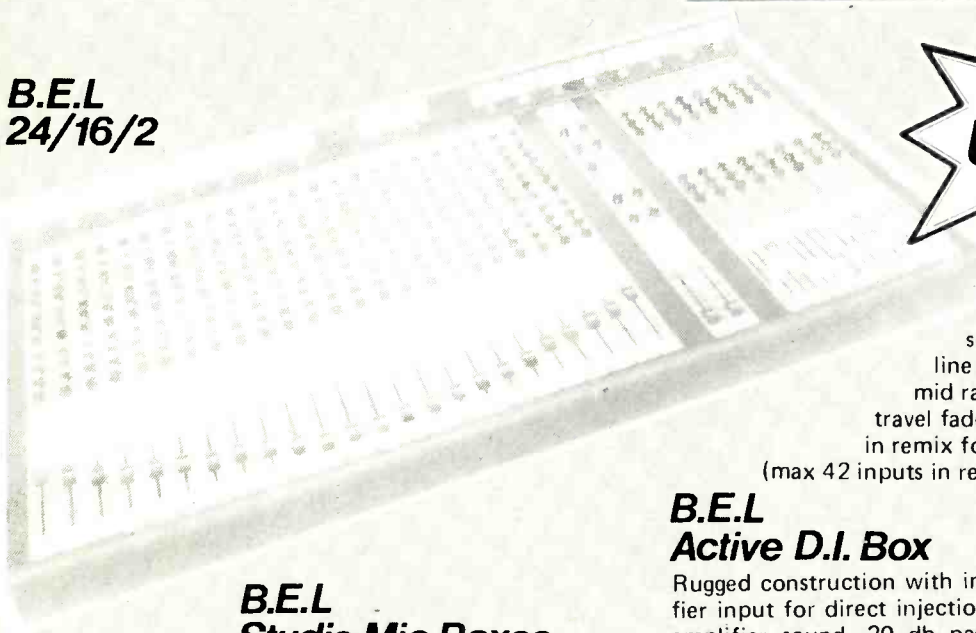
BA40 Delay line/Flanger multipurpose unit for the budget studio
BF20 Flanger True stereo flanger with V.C. In/Out. Keyable. The Professionals favourite.
8 track Noise Reduction System simultaneous encode decode with space module.

NEW 16 Track Unit

A new modular 16 track slimline version of the famous B.E.L. noise reduction system. Simultaneous encode/decode. All in one 3U unit. The ultimate in economy noise reduction systems.



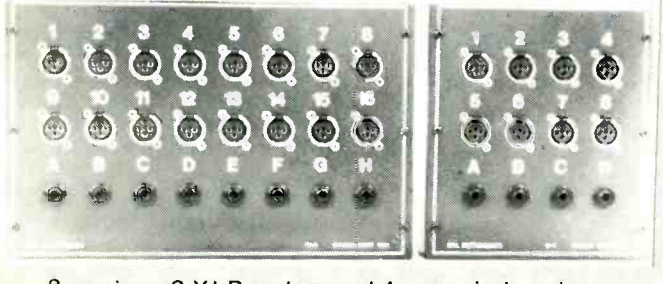
B.E.L 24/16/2



exclusive U.K dealers

First in a new range of high quality, low price modular consoles. Features; Separate Mic and line inputs; 4 band EQ (2 sweepable mid range); full 16 track routing, long travel faders; monitor section can be used in remix for sub grouping and extra inputs (max 42 inputs in remix); phantom power available.

B.E.L Studio Mic Boxes



2 versions, 8 XLR sockets and 4 stereo jack sockets or 16 XLR sockets with 4 stereo jack sockets. Rugged steel construction with 1" cable entry top and bottom. Specials available to order.

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Rugged construction with instrument input and amplifier input for direct injection while maintaining a true amplifier sound. 20 db pad. 2 outputs – XLR 600 ohm balanced output. Stereo ¼" jack socket switchable between direct out and 600 ohm floating balanced output. Powered by 9 volt battery or phantom power from desk (LED indicated).

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Sony VO1810 Umatric Recorder		**£650**			
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A selection of used equipment available from our showrooms

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Ampex ATR 100 Stereo		**£2,950**	MCI JH400 36/24		**£13,500**
MCI JH114 24T with Autolocate		**£11,000**	Neve 8058 28 CH.		**£26,500**
Lyrec 24T T/Rec with 30 memory A/locate		**£13,000**	Soundworkshop 1600 28-24 Automated Mixing Console		**£14,000**
Lyrec 24T T/Rec with RCU		**£11,000**	Decca Duplication Desk, Phasing Scope etc.		**£500**
3M M79 24T T/Rec with Sonoplan A/locate		**£11,000**	Alice 828 8-2 Mixer		**£500**
3M M79 24T T/Rec with 16T H/block		**£11,000**	Decca 12-4 Large Desk, Phasing Scope etc.		**£2,250**
Ampex MM1100 24T T/Rec with zero locate		**£11,500**	Helios PS 18/8/16		**£4,000**
Studer A80 Mk IA 16T		**£9,750**			
3M M23 8T T/Rec rack mounted		**£2,200**			
Scully 8T T/Rec		**£2,500**	Dolby M16H Noise Reduction	each	**£5,000**
Scully 8T T/Rec with Syncmaster		**£2,900**	Dolby M24H Noise Reduction	each	**£7,000**
TEAC 3440 4T T/Rec		**£600**	Dolby A360 Noise Reduction	each	**£280**
TEAC Portastudio		**£385**			
MCI JH110 Stereo T/Rec		**£2,750**	JBL L200 Loudspeakers	pair	**£1,000**
Ampex AG440B Stereo T/Rec		**£1,000**	KEF LS51A Loudspeakers	pair	**£400**
Studer B62 T/Rec - Stereo (Mint)		**£1,800**	Lockwood Majors Various	from pair	**£350**
Studer A62 Stereo T/Rec		**£750**	Tannoy Ardens	pair	**£350**
Leevers Rich E200 Stereo T/Rec		**£400**	Crown DC300 Amp		**£250**
Philips PRO36 Mono T/Rec		**£450**	Quad 405 Amp		**£175**
Studer B67 Stereo portable		**£1,500**	Quad 50E Amp	each	**£60**
Otari MX7000 Stereo		**£500**	DBX 155 Noise Reduction		**£200**
Philips PRO 51 Stereo		**£600**	DBX 122 Noise Reduction		**£220**
MCI JH110/8 8T		**£4,000**	Synton 222 Vocoders (new)	each	**£350**
Studer A80 Mk I 4T (Wired 8T) with ¼" Stereo H/block		**£4,500**	Drawmer DS201 Dual Gate		**£225**
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The whole truth.

Bipolar transistor power amplifiers are obsolete.

Now there's HH MOS-FET technology; with no thermal runaway, no secondary breakdown, simpler circuits, fewer components and superior high-end performance for better sound quality when reproducing fast transients.

Naturally, we anticipate that most professional sound engineers will be eagerly switching over to MOS-FET at the first opportunity. So to make it easier, there are 4 models (all 19″ rack mounting) with outputs from 150 to 800 Watts...and multiples thereof, using the X 300 frequency dividing network.

And once installed, our cool MOS-FET amplifiers will perform with so little distortion, that i.m.d., d.f.d. and t.i.m.d. are almost immeasurable by contemporary standards.

So at last you can boost your input with total honesty – and nothing else.

Graduate to the 80's. MOS-FET.

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Bar Hill, Cambridge, CB3 8EL.
Tel: Crafts Hill (0954) 81140
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USA: HH Electronic Inc
2500 East Fender Avenue,
Unit 1,
Fullerton, California 92631.
Tel: (714) 680 4293

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2 Rue de Tennerolles,
92210 Saint Cloud,
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Tel: (01) 602 6815

DAL 9036

CAN YOU AFFORD NOT TO AFFORD THIS CONSOLE?

The D & R series 8000 Consoles offer all facilities required of a top-class non-automated multitrack recording console. And at a remarkable price.

The result of more than ten years of research and development with a special emphasis on cost-effective design engineering.

Incorporating 24 channel routing and available with 24 or more in-line channels and subsequent 24 + monitor and effect return inputs, plus the full sized patch bay, these consoles are fully capable of driving any 16 or 24 track recorder.

For further details please contact the manufacturer:

D & R Electronica b.v.
Chasséstraat 26 - 1057 JE Amsterdam
Holland - Tel. ..31.20183556

or:

A.S.E.
Mechelen-Belgium
015-421152

D.S.N. Marketing
London - UK
01-2044234

Music Workshopen
Stockholm - Sweden
08-430288

T.C. Electronic
Aarhus - Denmark
045-6-244288

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Music Lab Soundcheck

NUMBER ONE IN AUDIO SALES

TASCAM 38 MULTITRACK

Everything the 88 had – and more! This 8 track on half-inch recorder boasts on-board varispeed, foot-switch controlled punch in/out, digital tape counter including Zero Search, and an improved tape transport handling. DBX unit also available.

EFFECTRON

Delta Lab's new digital delay line, features 1S delay at full bandwidth. A simplified control system includes a multiple repeat function and excellent flanging and chorussing effects.

As London's leading supplier of professional audio equipment, Music Lab enjoys an unrivalled reputation for sound unbiased advice, competitive pricing and reliable service.

We are main sales agents for all major manufacturers, and a wide range of their products may be compared under demonstration conditions in our comfortable showroom studio. At the same time, a talk with our experienced staff will help ensure that your operational requirements are confidently matched with the right equipment. And every product we deliver carries the full weight of Music Lab's comprehensive after-sales back-up.

LEXICON 224 DIGITAL REVERB

Probably the World's most versatile reverb system. 4 output plus variable pre-delay up to 255 mS. New 224-X features 15kHz bandwidth!

TASCAM 244

Teac's new PORTASTUDIO with improved facilities. Includes simultaneous recording on 4 tracks plus parametric EQ, digital tape counter and full stereo monitoring.

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Jeff Wayne Music	Kent Video
Sarner Audio Visual	Blackwing Studios
Genesis	Virgin Records
Middlesex Polytechnic	EMI
Pinewood Studios	London Weekend
CBS Records	Duran Duran
The Who	English Tourist Board
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Matrix Studios	Battery Studios
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Greater London Council	and many, many more...

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We continue to maintain our leadership in the Servicing field. We are a Main Agent and Service Centre for both Revox and Teac, and carry a full stock of spares for their products. Whatever the requirements, our factory-trained personnel are fast and efficient and contract field maintenance is available if required. Our manufacturing division can supply ready-made audio leads, cable harnesses and other accessories.

MUSIC LAB

THE PRO-AUDIO ONE STOP

If your business is Sound, we invite you to visit our showroom, conveniently situated in central London. Equipment can be shipped to anywhere in the World with the minimum of fuss.

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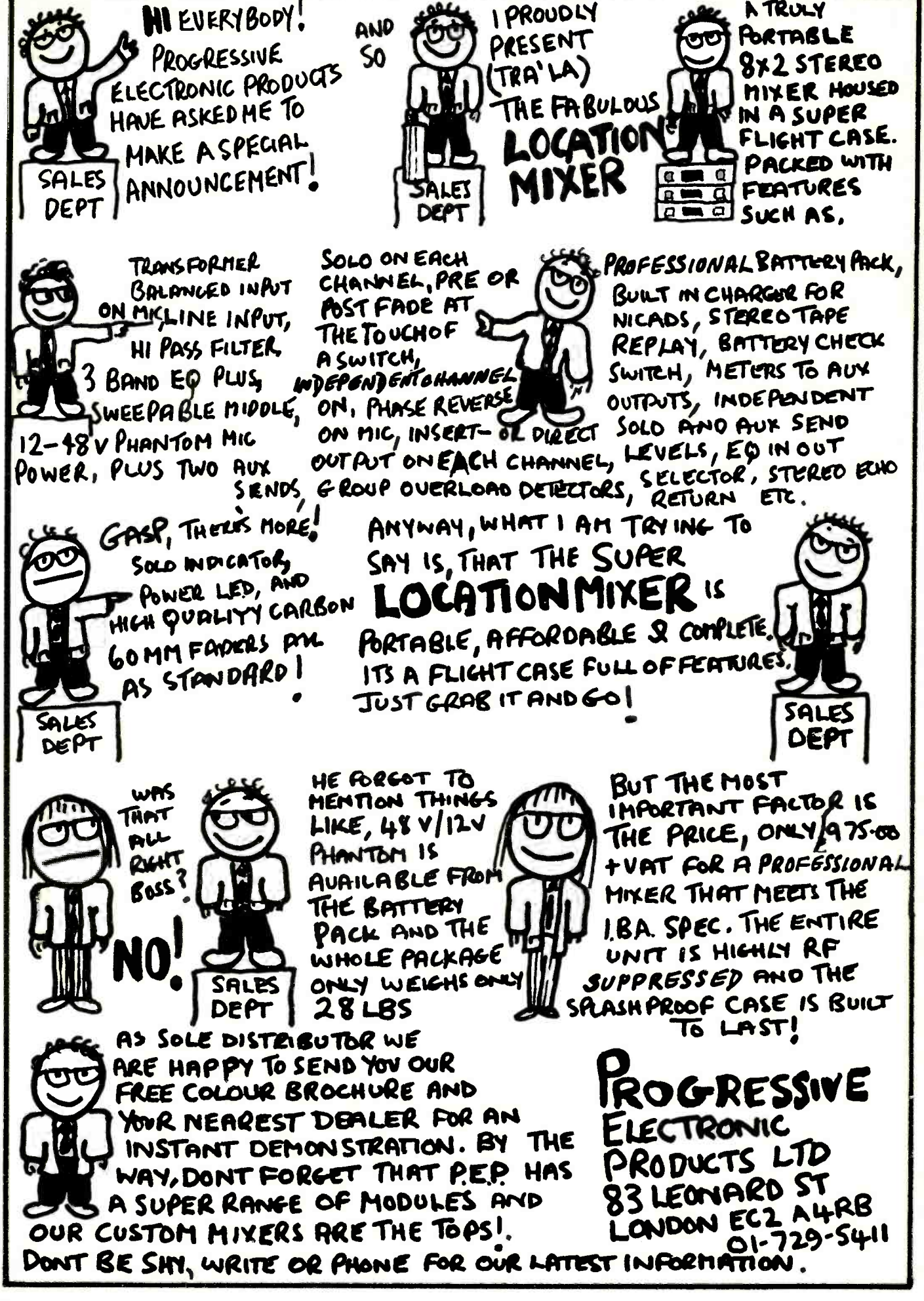
HH JBL KLARK-TEKNIK KORG LEXICON MASTER ROOM MEGA MXR NEUMANN OPBAN



diary

SSL modules stolen

The entire input/output modules from an SSL console installed in Tennessee Tonstudios in Hamburg were stolen during the weekend of July 16. The forty modules, type *SL611E*, serial numbers 1479 – 1519, were removed by thieves who broke through the main entrance doors of the facility. The console had been installed for a mere four months and the modules are valued at over £67,000. Interestingly, before leaving, the thieves cut all the studio cabling runs, indicating that the motive was more likely to be industrial sabotage rather than simple theft.

The theft follows an extensive rebuilding programme necessitated by a major fire at the facility in June 1981, which left the existing equipment coated in a PVC residue. The cause of the fire is officially unknown, but in the light of these recent developments, arson is suspected.

Peter Strueven of Tennessee Tonstudios notes that the studio has been very successful in a competitive marketplace, but cannot imagine why anyone would go to such extremes to damage their business.

Anyone with information on the missing modules, or any other information which might help to solve the mystery is invited to contact Peter Strueven on Hamburg 652 2981, SSL on (099) 389 8282 (UK) or Musicworks (USA) on (202) 333-1500. An SSL spokesman confirms that the modules would be useless on their own, and that it would be virtually impossible to make a console out of them or to resell them. *Studio Sound* will also be pleased to act as a clearing house for information on the subject.

Belgian name change

In our service guide to Studio Designers and Consultants in the July issue we mentioned Andre Patrouillie/Audiotechniek, Nossegem, Belgium. They have just informed us that they recently had a name change and are now known as Audiomedia/Andre Patrouillie. To further confuse matters they have also changed their telephone number and it should now read (02) 759.56.64.

A nightingale in Conduit Place

Thursday, July 29th, 1982 saw an important event: the visit to Syco Systems—UK distributor of sophisticated electronic music synthesisers—of Kim Ryrie, co-inventor of the Fairlight *Computer Musical Instrument* or *CMI*. It was an important day for another reason, too: to celebrate the visit, a synthesised version of Maschwitz and Sherwin's classic, *A Nightingale Sang in Berkeley Square* was realised and performed on the *CMI*—with a nightingale singing the lead line. The nightingale, in the form of a Victorian automaton replica, was sampled with the *CMI*'s sophisticated digital recording capability, and was then available to be played over a 6-octave keyboard. The piece was realised using the *CMI*'s Music Composition Language (MCL) which also enabled an introduction and the lyrics to be displayed on a monitor screen while the piece was performed. The event proved beyond a shadow of doubt—if it was not already so—that synthesisers are not cold, clinical machines incapable of evoking emotion in the listener: the experience was quite moving.

Visitors to the event included Brian Hodgson of the BBC Radiophonic Workshop, which invested in a *CMI* some months ago. He commented on the fact that regular software updates, increasing the flexibility and ease of use of the machine, are generally 'pre-released' to users, enabling them to comment on the implementation of a new or modified function. The information is relayed to Fairlight and the user's comments are incorporated, where applicable, into the final version. A large number of new facilities have been added since we reported on the machine (*Studio Sound*, February 1981), including 3-dimensional waveform display capability and other display innovations plus a sophisticated rhythm sequencer. We hope to publish an article by Kim Ryrie on the development of the *CMI* in a future issue of *Studio Sound*.

Syco Systems, 20 Conduit Place, London W2. Phone: 01-723 3844.

Address change

● Don Larking Audio Sales have moved to new premises at 29 Guildford Street, Luton, Beds LU1 2NQ. Phone: 0582 450066. The new premises will have facilities for trying new equipment in a control room environment, mikes in a studio and a second small control room and studio contains Fostex and Teac equipment for demonstration purposes.

Agencies

● Preview Two (Sound) Ltd, 37 – 39 Oxford Street, London W1R 1RE, UK, have been appointed as the new agents for Sondor Export AG of Switzerland. Their phone number is 01-437 1441.

Contracts

● Elliott Brothers has been awarded a contract to install a 24-track automated mixdown suite with VAPP facilities at De Wolfe's Islington, London, complex. In addition the company will be carrying out installation work at Red Rose Radio, Preston for Clyde Electronics.

● Neve have announced the following orders for consoles received recently: a *5106/24* with a special VCA remote unit for the Theatre-de-la-Ville, Paris so that sound balance may be adjusted remotely; a custom built 24-channel console for Erata Studios, Paris for live location recording of classical music; two *8108* consoles for the Society Francais Production, Paris, one with Necam; a *51 Series* for the Swedish Army for preparation of training programmes; a complete audio turnkey package for Damascus, Syria; an *8108/32* with Necam automation for Fantasy Records of San Francisco. Other recent broadcasting orders are covered in *Broadcast Sound*.

People

● Klark-Teknik has appointed two new directors to further the company's plans. John Austin has been made joint technical director and Gaston Goossens is appointed marketing sales director.

Forthcoming exhibitions

October 23 to 27, 1982
AES 72nd Convention, Anaheim, USA.
January 24 to 28, 1983
Midem '83, Cannes, France.
March 15 to 18, 1983
AES 73rd Convention, Eindhoven, Holland.
April 10 to 13, 1983
NAB Convention, Las Vegas, USA.
May 28 to June 2, 1983
International Television Symposium Montreux, Switzerland.
October 9 to 12, 1983
AES 74th Convention, New York, USA.

Spelling and such

Stephen F Temmer of the Gotham Organization has raised some interesting points to us with respect to the spelling and abbreviation of certain words. Firstly, he points out that 'mic' as an abbreviation for 'microphone' looks somewhat strange, and suggests that 'mike' would be a better choice, and in line with common practice. On thinking about it, we tend to agree, and have adopted this abbreviation, as has our sister publication *Broadcast Sound*.

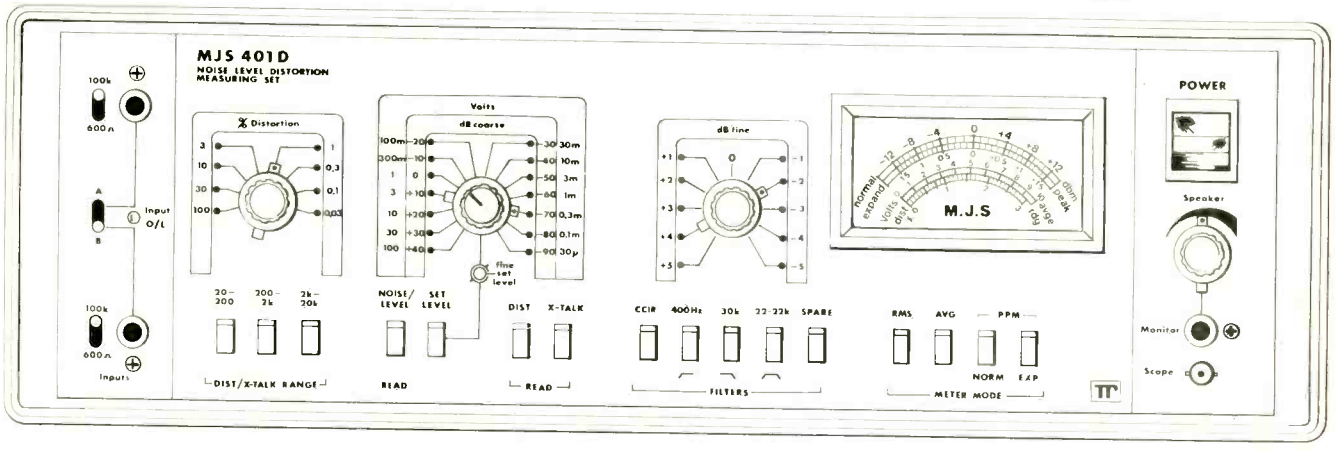
The other suggestion may be more contentious. Stephen Temmer has leafletted us about the spelling of the word defined in the OED as 'a thin circular plate of any material', ie *disk*, or, if you will, *disc*. Various long letters between this office and Mr Temmer lead us both to the conclusion that neither spelling variant has any real objective claim to the label 'correct', but that *disk* is the usual US variant, and *disc* the one most used in Britain. Our OED (the one which still has *antigropelos* – a Victorian name for waterproof leggings – in it, not the newer one) has the full reference under the entry **Disk, disc,** so presumably the OED feels that *disk* is more appropriate.

What Stephen Temmer suggests is that while there is no objective *etymological* reason for using one rather than the other, the IEC recommend and use the variant *disk*. We don't, except for computer-type storage media.

The question is, should we follow the international recommendation, or should we retain our 'English English' variant, *disc*? In general, we try to follow standards except where other forms are more readily understood (for example, we use 7½ and 15 in/s rather than 190 and 381 mm/s for tape speeds). Should we in this case? We leave it to you, our readers. We are an international magazine, and thus will not favour British entries. Just write your preferred spelling on a piece of your headed notepaper, adding comments if you have some amusing (or otherwise) observations, and send it to us. We will total the responses and follow the democratic course.

Disk or *disc*? The people decide. ■

MJS 401D Measuring Set



The 401 noise and level test set has been in widespread use since 1977 throughout the broadcasting industry. Continuous development has taken place since the 401 was first introduced to evolve it into one of the most popular, foolproof, easy-to-use and well proven test instruments in use in the professional audio industry.

Now we are pleased to announce the 401D version.

Features include:

Filters: wide band, audio band, CCIR 468 and optional.
Metering: average, RMS, quasi-peak and quasi-peak expanded (+ or − 1.5 dB full scale).
Measuring range: +40 to −90 dBu full scale.
Total harmonic distortion: auto-nulling in three decade ranges. Measurement better than 0.005%.
Cross-talk: Tracking band-pass filter synchronised via external oscillator.

The MJS 401D – another innovative tool for the audio industry from Technical Projects.

Technical Projects

Technical Projects (A member of the Theatre Projects Group)
Electrosound House, 11 Marshalsea Road, London SE1 1EP
Telephone: (01) 403 3838 Telex: 885659 Yodel G Contact: Sam Wise

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new products

Neve Digital Disc Mastering

Neve International has just released brief information about its new *9202 Digital Disc Mastering* console, or as it is more briefly known, the *9202 DDM*. In operation it will have the ability to accept and provide digital or analogue inputs and outputs and therefore can operate with a conventional analogue lathe as well as in digital applications. It is completely self-contained with an integral delay facility variable up to a maximum of 1.33 s at 48 kHz sampling rate(1.45 s at 44.1 kHz) with a further extension up to 2.66 s at 48 kHz (2.9 s at 44.1 kHz) being possible.

Other features include 4-band EQ with memorised control settings and automated motor driven faders. The software provided includes self testing facilities for all-function check on start-up or at operator's request. All the signal processing equipment is housed in a single 19 in rack mount cabinet and as the console construction is fully modular, there is a variety of configurations possible.

Neve Electronics International Ltd, Cambridge House, Melbourn, Royston, Herts, UK. Phone: 0763 60776. Telex: 81381.

USA: Rupert Neve Inc, Berkshire Industrial Park, Bethel, Connecticut 06801. Phone: (203) 744-6230. Telex: 969638.

Fostex 250 AV

Fostex has just announced a version of the *250 Multitracker* cassette recorder/mixer that is compatible with consumer cassette ¼-track format and the commercial ½-track format. In addition it also operates at 1⅞ in/s against the standard version with 3¾ in/s tape speed. For audio-visual applications it enables use with mono and stereo-plus-cue cassettes but for the musician the major interest will be the compatibility with the standard cassette format.

UK: Bandive Ltd, 8 East Barnet Road, New Barnet, Herts EN4 8RW. Phone: 01-440 9304. Telex: 25769.

USA: Fostex Corporation of America, 15431 Blackburn Avenue, Norwalk, California 90650. Phone: (213) 921-1112.

Canford Audio mike preamps

Originally designed for London Weekend Television, Canford Audio are now marketing single-channel low noise, battery-powered mike preamps. They are housed in a rugged metal case and use four PP3-type 9 V batteries. Inputs and outputs are transformer balanced with a gain of 20 dB to 70 dB in 10 dB steps. Low current consumption means an expected battery life of 25 hours. Applications for the unit include single mike applications where mixing facilities are not required or where gain is required on a mike before feeding into a long line. Twelve units were used by the *World of Sport* team for World Cup Football coverage in Spain.

Canford Audio, Stargate Works, Ryton, Tyne and Wear, NE40 3EX, UK. Phone: 089422 4515.

Stage Accompany power amps

A Dutch manufacturer by the name of Stage Accompany has just released details of a new power amplifier in their range. However as the existing range and even the company themselves are new to us they are all included as 'new products' in such detail as can be accurately extracted from the Dutch leaflets.

The company have two stereo power amplifiers, the *SA500* and the *SA900*. The *SA500* is rated at 225 W into 4 Ω, 135 W into 8 Ω with both channels operating, while the *SA900* is 425 W into 4 Ω and 280 W into 8 Ω. The units are externally similar, standard 10 in rack mounting 3 and 4 U high respectively with rear mounted cooling fans. Inputs are *XLR*-type with binding post outputs. The *SA500* has front panel indication of (or to inform that a protection circuit is operative) clipping, signal present, overload and high temperature for each channel independently. The *SA900* will have these features on future models.

Frequency response: 10 Hz to 20 kHz ±1 dB *SA500*, 6 Hz to 20 kHz ±1 dB *SA900*. THD: less than 0.08%, 20 V in 8 Ω *SA500* and 30 V in 8 Ω *SA900*. Crosstalk: −80 dB. Input impedance: > 15 kΩ. Input sensitivity: 1.55 V for 225 W into 4 Ω *SA500*, 2.12 V for 280 W into 8 Ω *SA900*. Damping factor: greater than 230:1, 1 kHz in 8 Ω. Slew rate 60 V/μs *SA500* and 50 V/μs.

SA also manufacture an electronic crossover, *Model F60* which can be used either in a stereo 2- or 3-way mode or mono 6-way. Features include subsonic and high cut filter, electronically balanced in and out with the outputs switchable to unbalanced, mute switch per band, and 24 dB/octave filters. Filters are all plug-in modules and can be easily changed for specific applications.

Stage Accompany, Industrieweg 30, 1775 PV Middenmeer, Netherlands. Phone: 02270-2157. Telex: 57680.

Milab MP-30

Swedish manufacturer Milab has announced its own version of the pressure zone-type microphone, the *MP-30*. Described as a 'pressure zone hemispherical microphone', the *MP-30* is designed around a very high quality electret capsule. The housing is machined from a solid aluminium block, making the unit very sturdy, and the mike is finished in satin black.

Two versions of the mike are available, the *MP-30* with 200 Ω balanced output, and the *MP-31*, which offers a line-level transformerless balanced output which requires a minimum input impedance of 10 kΩ. Both versions are designed for standard 48 V phantom powering.

The mike has a distinctive appearance, having a circular plate and an offset conical structure containing the capsule and electronics. The unit has a flying lead terminated in a male *XLR-3* connector.

We imagine that the microphone has a similar performance to the Crown *PZM* with the added advantage that the circular plate will facilitate dish mounting where required. The mike's details do not include the trademarks 'Pressure Zone Recording Process' or 'Pressure Zone Microphone' but we imagine that there is an arrangement with Crown and Wahrenbrock to use the terminology described above. If this is not the case, we apologise for any misuse of these trademarks.

Creative Trade CTAB AB, Knutsgatan 6, S-26500 Astorp, Sweden.

UK: AVM, Unit 21, Royal Industrial Estate, Jarrow, Tyne and Wear, NE32 9XX.

USA: Cara International Ltd, 4145 Via Marina No 120, Marina del Rey, California 90291.

Ursa major 8X32 program revision

Ursa Major have released the first major revision of the reverberation programs for the *8X32*, known as *Edition E4-1* and the end result of an eight month period of improvement. The four new programs replace all four programs in the *8X32* and retain the same names but with improvements including significantly reduced colouration, increased diffusion (echo density), improved decay envelope smoothness and the sense of ambient spaciousness (incoherence) is better.

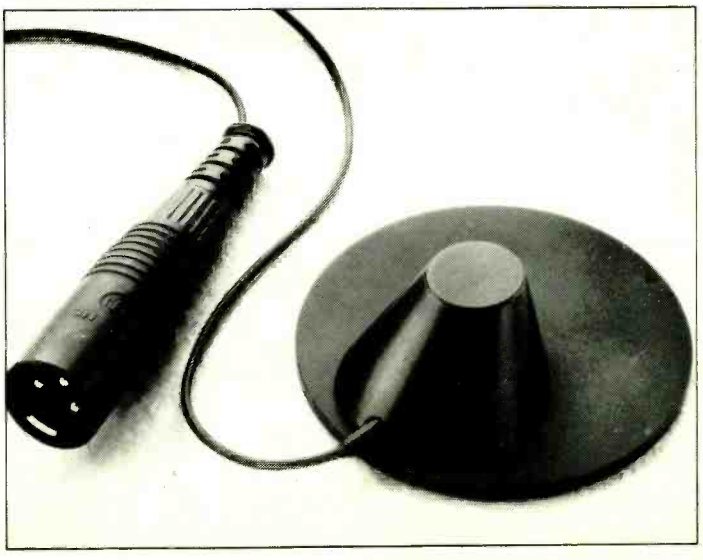
In keeping with their original commitment, these new programs will be free of charge to all *8X32* owners and come in the form of two IC PROMs that will normally be installed by the local dealer.

For the future, Ursa Major hope to develop four new programs that will also be available free of charge to owners and give eight resident programs instead of the present four.

Ursa Major Inc, PO Box 18/50 Trapelo Road, Belmont, Massachusets 02178, USA.

UK: Feldon Audio, 126 Great Portland Street, London W1N 5PH. Phone: 01-580 4314. ■

Milab MP-30—pressure zone hemispherical microphone with XLR-3 connector



The Unlimited Limiter.

In keeping with MXR's expanding commitment to the professional recording industry, our engineers have designed and built the Dual Limiter. A world class mono-stereo limiter offering total flexibility and ease of operation, the Dual Limiter produces a musically natural response in any compression-limiting application. All of this versatility is built into a compact, rack-mountable package.

The totally unique VCA's at the heart of the Dual Limiter provide an exceptionally wide dynamic range with low levels of distortion. Continuous bass distortion is much lower in level than typical compressor-limiters, allowing more freedom in setting release characteristics.

The Dual Limiter is also a forgiving limiter. Attack and release characteristics dictated by the front panel controls are modified by program dynamics and compression requirements. The slope increases smoothly past the threshold point, allowing a *gradual* transition into compression. Varying the Dual Limiter's threshold region produces a variety of intermediate slopes with the primary slope being that chosen by the slope switch. These features permit apparent dynamics to be maintained even though the dynamic range is being controllably limited.

The Dual Limiter's remarkable versatility is based on the fact that it can be viewed as two independent mono limiters that can be patched together via front panel switches for stereo limiting applications. Each channel has an In/Out switch, Slope switch, Input, Output, Attack and Release controls and an LED display, showing the amount of gain reduction. On the rear are both XLR and ¼" phone jack (ring-tip-sleeve) input and output connectors. Each channel's detector is accessible via rear panel phone jacks to permit external tailoring of the detectors' frequency response. This feature allows for de-essing (reduction of vocal sibilance) and a wide variety of frequency dependent limiting needs.

Because virtually every form of musical signal was used to evaluate the Dual Limiter's response during the initial stages of development, its sophisticated internal circuitry enables it to sound musically *natural* — even at extreme compression settings.

Balanced inputs, the ability to drive 600 ohm loads, +19 dBm input and output and standard rack dimensions (1¾" high) allow the Dual Limiter to be easily integrated into any professional system. With an extremely rugged case, metal knobs and reliable internal construction, the new MXR Dual Limiter reflects the highest professional standards and has been fully designed and built in the U.S.A.

The Unlimited Limiter — MXR's natural response to the question of performance and versatility in a space-efficient and cost-effective package. See the MXR Dual Limiter at your nearest MXR dealer.

MXR Professional Products Group

MXR Innovations, (Europe)
34 Bancroft, Hitchin, Herts.
SG51LA, Eng.
Phone 0462 31513, Tlx 826967

letters

Balanced outlook

Dear Sir, John H Roberts of Phoenix Audio Laboratory Inc has taken issue with me concerning input balance by questioning the existence of any problem at all.

I thought my article 'Balanced or Balanced?' (December 1981) stated the case and explained the reasons why occasional problems are encountered in audio systems when simple differential inputs are used. His letter makes two distinct points: (1) that a simple diff amp with equal value resistors effectively deals with common mode signals—therefore no problem; and (2) that diff inputs using large resistors are noisy while the use of 10K to 20K resistors is satisfactory.

The logic in his first point is disastrously wrong—of course common mode rejection is important—but so is audio balance. The transformer deals with both most effectively while a simple diff amp has an intrinsic static load on one input leg and a dynamic load on the other—a form of unbalance.

In the practical world this can and does cause problems with ground loops and hence gets solid state inputs a bad name in the business. My solution (Fig 4 and 5 in the article) produces an electronic analogue of the transformer (well, very close) and the proof of the pudding is that my customers are wondering where we buy such beautiful input transformers!

His second point shows a lack of appreciation of physics. Two types of noise are important in this context. Thermal noise and noise created by current passing via a grainy resistive structure.

Using modern integrated circuits, input current is so low that current produced noise is insignificant unless the resistor has a value of many megohms.

Thermal noise exists and at 20°C with a bandwidth of 20 Hz to 20 kHz, a 100K resistor will produce a noise of —102.67 dBu (referred to .775 V RMS).

In line level circuits I would hardly call that noisy.

Yours faithfully, Ted Fletcher, Alice (Stancoil Limited), 38 Alexandra Road, Windsor, Berks, UK.

XLR standards

Dear Sir, I am indeed indebted to messrs Schulein and Shinbrot of Shure for bringing to my attention the existence of the EIA standard RS-221-A and the fact that it has been adopted as an ANSI standard. During my researches for the article, several telexes across the Atlantic to colleagues in America failed to reveal the existence of any formal American standard on XLR *usage. My correspondents spoke of 'pin 3 hot' as the established practice for most companies and operators – hence my adoption of the term 'quote American Standard unquote' for the article – thus implying that it was not an official American Standard. The existence of RS-221-A in fact further supports the arguments made in my article as it largely agrees with the IEC 268 and the BS 5428 standards in recommending contact 2 as the in-phase or positive terminal.*

The problem seems to be however that RS-221-A does not go far enough in that it is only concerned with balanced microphone wiring and specifically excludes unbalanced circuits and other low level audio circuits, whereas both the IEC and BS documents deal with all three areas. This, it seems to me, is where the confusion arises.

I fully accept that the majority of Shure microphones fitted with an XLR*-type connector are wired in accordance with all three standards with pin 2 hot as messrs Schulein and Shinbrot state, but this does not apply to electronic apparatus manufactured by that same company. Reference to the technical data sheets for a whole range of Shure 'circuitry' products as they term it – eg the* M63 Audio Master *control unit, the* M67 *microphone mixer, the* M615 *analyser system, even the* A95 *matching transformer, etc, show that the whole lot are wired with pin 3 hot, and a telephone call to Shure UK's service dept confirmed that the current* Pro-Master *and the recently deleted* SR *system is the same. This practice of using one wiring standard for microphones and another for 'circuitry' products seems to be fairly widespread in America and is certainly used by Electro-Voice, and I believe by Altec as well.*

Moving on to the matter of unbalanced wiring, I am afraid that I see no sense whatsoever in adopting a different approach from that used for balanced circuits. Surely the obvious approach is the one adopted in the IEC and BSI standards whereby contact 2 remains the in-phase or positive terminal and when a balanced input is required to accept an unbalanced source, the anti-phase or negative wire – ie pin 3 – is grounded to pin 1. To me, this is just plain common sense.

Messrs Schulein and Shinbrot conclude by stating that at Shure they try to be logical – a commendable philosophy indeed and one which seems to be sadly lacking in the world at large today. However, I am afraid that I can see nothing logical in adopting one wiring standard for microphones and an exact opposite for other items of equipment intended to be used with those microphones. Still less can I see the logic in grounding the in-phase or positive wire of an unbalanced circuit on pin 1 and connecting the anti-phase or negative wire to pin 3! No wonder there is all this confusion. Our correpondents are also emphatic in stating Shure's commitment to standards. Again, I am delighted to hear it, but surely, in the absence of an ANSI or EIA standard in respect of unbalanced circuits or low level audio circuits other than microphone wiring, the obvious recourse is to those standards which do exist – ie the IEC international standard to which the ANSI respresentatives were signatories.

No, on the evidence before me, I am afraid that Shure must remain in the lower part of Table 2 in my article, although maybe they should also be included in the upper table – ie those complying with the IEC international standard – as well on account of their microphone wiring. Electro-Voice appear in both tables for the very same reasons.

May I conclude by stating how delighted I was to receive Messrs Schulein and Shinbrot's constructive and informative correspondence. The article was intended to be controversial and has certainly provoked the sort of reaction I hoped for in various quarters. So let's keep the matter alive in the hope that in due course we might have general acceptance and implementation of the IEC, BSI, and as far as it goes, the EIA/ANSI standard. Remember, pin 2 hot – but not just for balanced microphones!

Yours faithfully, Ken Dibble, 26 Warren Road, Rugby, Warwicks, CV22 5LQ, UK.

Soundfield comments

Dear Sir, May I congratulate both Mr Hugh Ford and Mr Peter Carbines on their informed articles on the Soundfield *microphone system and also take the opportunity of amplifying certain points made by them in order to avoid confusion.*

Table 1 is a little misleading in that it shows the unused by-products of the capsule outputs after adjustments have been made to achieve optimum patterns in the B-format figure-of-eight and omnidirectional signals, though it is worth noting that a 1 dB difference in sensitivity between any two capsules would reduce the 'rejection of unwanted combinations' figure from infinity to approximately 18 dB and the table does serve to show the accuracy of capsule matching.

Figure 3 does not show the frequency response of the microphone, but the response of the equalisation circuits required to produce a flat response on the B-format components of the 3-dimensional signal in order to achieve the illusion of coincidence and graphically illustrates the magnitude of incurable frequency response and phase distortions normally encountered with conventional 'stereo' microphones using two transducers, sampling only part of the original soundfield.

The comments on clipping are noted for the future but I must point out that the B-format gain control is intended as a fader and when operated around the 'zero' mark in the usual way with the PPM peaking '6', clipping will not occur until pressure levels of 124 dB SPL are achieved at the microphone. A Mark IV *version of the* Soundfield *microphone is currently under development which increases this threshold to 130 dB SPL and also answers one of Mr Carbines' comments by providing only B-format and stereo outputs, thus leaving the choice of ambisonic decoder to the individual. The price is suitably adjusted to compensate for this omission.*

The comment on clipping levels with combinations of capsules muted is not really valid, as this is not an operational condition. The capsule mute buttons are purely for circuit continuity checking.

Mr Carbines' comments on overhead sounds being realised about 5 feet from the centre position when replayed in horizontal (planar) surround sound are typical of what should be expected. Periphonic (with height) replay would be required to resolve true location of signals with a high Z content.

The head-lead connectors currently in use on the Mark IIIB *and also on the new* Mark IV *system are screw lock DIN 12-way and various lengths of head-lead are now available.*

Yours faithfully, J Howard Smith, Calrec Audio Ltd, Hangingroyd Lane, Hebden Bridge, Yorkshire HX7 7DD, UK.

Phase checker

Dear Sir, As I perused your fine issue of May 1982, I was amused to see a note in the business section about a "new" loudspeaker phase checker that was developed by Rank Wharfedale of Bradford. The description of what it does and how it does it is virtually identical to a polarity tester I designed in 1980 that was published in Recording Engineer/Producer *(October 1980) here in the States. "Oh good," I thought as I read on, "someone is finally taking my articles seriously." Then I got to the part about their filing a patent application for this unique design. Well good luck chaps, but I doubt that this concept is patentable (though it is a good idea, isn't it).*

Seriously though, I hardly feel ripped off since if they had read my original article, they would have known better than to confuse phase with polarity, which is really what we're talking about. Oh well, better luck next time.

Yours faithfully, Ethan Winter, The Recording Centre Inc., 25 Van Zant, E. Norwalk, Connecticut 06855, USA.

40 ▶

YOU CAN JUDGE US BY THE COMPANIES WE KEEP.

We've always made a point of associating with the very best names in the world of audio.

In the field of equipment rental, for instance, we provided a sound system that satisfied the exacting requirements of Genesis.

That system was driven by Amcron power amplifiers–arguably the best in the world.

And Amcron appointed us to handle their business in the UK, including the launch of their revolutionary Pressure Zone Microphone system.

After amplifiers, it was logical that we should also supply the best in loudspeakers–Gauss. Their unequalled power handling capability and superb sonic accuracy make them first choice for many PA, musical instrument and studio monitoring applications.

In the recording equipment line, we stock Fostex. They've revolutionised the field of personal multi-track recording, with 4 and 8 track machines which are well within the means of even the enthusiastic amateur.

We could carry on dropping names all day. Sony Professional. Amek/TAC concert and studio mixing consoles. Dbx, Eventide, Lexicon effects. JBL components, monitors and spares. Revox/Studer tape machines. Brooke Siren Systems. Beyer and Shure microphones and accessories.

So you can be sure that if we're prepared to sell or hire it to you, it's got to be the very best of its kind.

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letters

Polarity testing

Dear Sir, Just to say "there is nothing new under the sun", I am really pleased to let you know a polarity tester exists: the EMT 160 and, as I understand from your description of the Rank Wharfedale unit, both work the same way.

I can say it is an invaluable unit, but it is very hard to convince anybody they NEED one. It has taken me several years to convince people they need one and cannot trust scopes, ohmeter and colour of wires. That was until a good day when a finished film with a stereo track which was "out of phase" and produced a beautiful "hole in the middle" appeared when we were going for the premiere! So we bought the EMT unit, which was there collecting dust on the shelves of the importer. From that day we use and we use it, from mike to speaker through console, recorders, reverbs you name it. But outside here it is still an unknown little thing!

Yours faithfully, Phillipe Trolliet, T-12, 3155, Cote-de-Liesse, Montreal PQ, Canada H4N 2N4.

Jobs for the future

Dear Sir, My attention has been brought to a letter included in your September 1981 issue in connection with the advice on jobs for the future given by Mr Harris of APRS. It may be of interest to your readers that we at Salford College of Technology have been attempting to provide courses along the lines referred to in Mr Harris's letter. We therefore feel that young people living within travelling distance in the North West area have an opportunity to undertake part-time training and hopefully soon full-time training along the lines which Mr Harris identifies as being relevant. The College also runs courses in Band Musicianship at both foundation and advanced level in which an ability to develop an appreciation of recording techniques is made available to aspiring musicians who wish to prepare themselves for vocational work in connection with recorded music.

Interested readers who would like to know of opportunities available at the College can obtain information from:

Mr P Berg, Salford College of Technology, Department of Humanities, Adelphi Building, Peru Street, Salford M3 6EQ, UK.

Yours faithfully, J R Thomas, BSc, Salford College of Technology.

Hospital opinion

Dear Sir, I feel I must congratulate you on your excellent article 'Broadcasting in the Nineties'.

As you know, hospital radio is totally voluntary and a large number of stations provide a very local service, up and down the country. Although it broadcasts 'warts and all', its reception by listeners is proven to provide exactly what you seem to be advocating in your article.

A look at the large number of radio personalities, who now earn their living in the medium, but who got their basic training in hospital radio, further proves that talent and ingenuity, coupled with integrity, provide a service (somewhat short on high technology equipment) which can flourish within the code of practice laid down for it.

The transfer of staff to a salaried position in the medium only makes it easier for them to concentrate on their artistic talents, by having more ergonomically designed (and therefore more expensive) equipment at their disposal. In my opinion, the conclusion must be that a truly local station could survive and provide a very valuable service.

Once again, congratulations on your excellent article.

Yours faithfully, Denis B Gallnon, The Studio, Greenwich District Hospital, Vanbrugh Hill, London SE10, UK.

Azimuth checking

Dear Sir, The review of calibration tapes on page 66 of the June issue mentions a method of making accurate azimuth alignment tapes. Briefly, this is said to involve making a high-level recording of a medium to high frequency and then turning the tape inside-out to check the resultant phase error between tracks.

I hope the director of engineering of the BBC will not mind my mentioning some work I did whilst still a very junior engineer working in Technical Services (Radio) in London. I had been assigned the job of making (or checking) some BBC test tapes and wished to obtain an accurate azimuth reference. It was suggested that I try this method, which I did—with limited success. Essentially, the problem was that it was difficult to obtain sufficient output from the tape with the oxide round the wrong way. The solution suggested was to use thinner tape (eg double play) so that there was less plastic in the way, but this then gave tape transport problems such as stretching and in any case was not the type of tape intended for the final calibration exercise.

The solution was so obvious that I was most surprised to discover no one had apparently thought of it before. Instead of recording with the oxide towards the head in the first place, I simply reversed the tape before making the recording. Thus, the recording actually took place somewhere in the middle of the tape (at the boundary between the coating and the backing) instead of on the outside of the coating. The result was that playback was through only the plastic backing instead of backing and coating combined.

Recording through the backing naturally dropped the level recorded, but it was far easier to pull this up by varying bias and recording level during the initial setting-up procedure than it had ever been to try and retrieve the low level playback signal, with all its attendant noise and hum, using the original method. I hope this may be of some interest to other readers.

Yours faithfully, Dave Harris, Radio Botswana, Private Bag 0060, Gaborone, Republic of Botswana.

Aphex effects

Dear Sir

On behalf of Aphex Systems I would like to thank you for your kind and in depth review of our new Aphex II Aural Exciter. I am writing to correct one slight error and to add one comment on operating the unit:

First, the block diagram (Fig 1) on page 80, Studio Sound April 1982 issue, shows the Aphex drive summing amp reversed. This, of course, is only tangential to the contents of the article, but for those readers who are curious this should clarify the system.

Second, referring to the third paragraph on page 80, we recommend that the DRIVE control be adjusted so that the red-green DRIVE lamp is red approximately 50% of the time as viewed with programme material. There remains about 14dB of headroom above the green-to-red threshold.

This will allow greater generation of harmonic products with less actual equalisation effect in the final output and will also reduce the noise contribution of the processor, since one would thus probably end up mixing less side chain return into the final product.

Thank you again for your efforts.

Yours faithfully, Harvey Rubens, Aphex Systems Ltd, 7801 Melrose Avenue, Los Angeles, Cal 90046, USA.

Oops

Dear Sir, In Barry Fox's interesting article, Early Stereo Recording, he reported an amazing feat. The Bell Labs engineers managed to catch Stokowski's Russian Music concert before he was born and before recording had been invented. At last the time machine is here!

Yours faithfully, Richard F Schwartz, Michigan Technological University, Houghton, Michigan 49931, USA.

This was of course a typesetting error—1832 should have read 1932.

Ion support

Dear Sir, In response to the recent article on ionizers, we have had them for two years. The control room and studio have a large unit with distributors linked by high voltage wire to a power supply. The control room has twice the normal amount of ions to handle the increased concentration of bodies, smoke etc. We found immediately after installing them that cigarette smoke quickly disappeared and the air felt fresher. They run 24 hours a day in all parts of the building. The ions tend to precipitate dust out of the air onto the floor and the machinery, so you dust the console and a few days later its got another layer. But that's better than breathing it in.

The air feels good too. There really is a difference in the pollution factor.

The only negative rumour I've heard is that supposedly some types of synthesisers are sensitive to negative ions. But that's only a rumour – I haven't seen any data to support this.

Yours faithfully, Richard Robinson, Trod Nossel Recording Studios Inc., 10 George Street, Wallingford, Connecticut 06492, USA. ■

AGONY

Sweet-smelling disks?

We all know Ampex for their top-quality tape machines, but it's not so well-known in our industry that they also produce a wide range of data products, notably Winchester-type hard disk drives for computer data storage. Thus it was that a recent issue of a British computer magazine, in an article on disk terminology, published a picture of the 'Amplex *DF9000* series Winchester.'

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Evolution of the mixing console

Richard Swettenham

ONCE upon a time—and not as long ago as you might think—in a large purpose-built studio, an orchestra was rehearsed and ready for Take One. The engineer sounded a warning buzzer and all was silent. Lowering the stylus on the cutting lathe, he turned on his high stool to the mixing panel, opened the main fader, and switched on the signal light. Before him was a black box the size of the two pages you are reading, with four large knobs, marked 1 to 10, and an even larger one with many smaller click steps. Other than a few key switches, that was it. At the back of the room was a 30 in/s tape recorder, regarded as a safety back up.

This tells us that we are not looking at a pre-war Bing Crosby session, but at one of the world's great recording studios in the year 1951! By this time Disney's *Fantasia* had been made, and experimental stereo demonstrated, many years before. 'Full Frequency Range Recording' was with us, and in another part of the same building LP masters were being cut from tape.

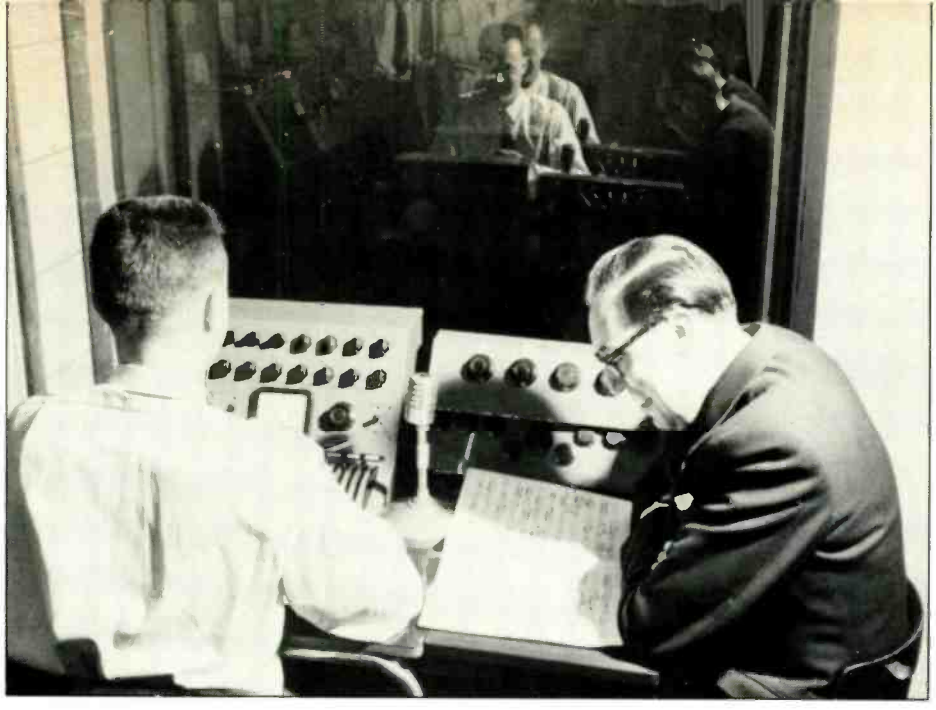
To be fair, the war had frozen all equipment replacement in Britain, and the time lag to catch up was no doubt worse in some companies than others. So-called 'drama control panels' intended for linking the output of several studios existed in broadcasting. These evolved to become the well-known pale grey panels with huge rotary knobs familiar in the BBC and in overseas networks following BBC practice. Some of these are still in use!

Equalisation? Well, the achievement of perfect flat response from imperfect microphones was the ideal, achieved, in the next generation of equipment, by what were in fact equalisers in the true sense of the word – plug-in cassettes containing passive networks designed to *equalise* out the peaks and roll-offs of the various types of pressure and velocity microphones available. Flatness was the goal, in the name of fidelity. Deliberate response modification was regarded by many old hands as cheating. Well, they said reluctantly, we will let these crazy young men have ±6 dB at any frequency; more would be bad for them, and probably won't go on the disc!

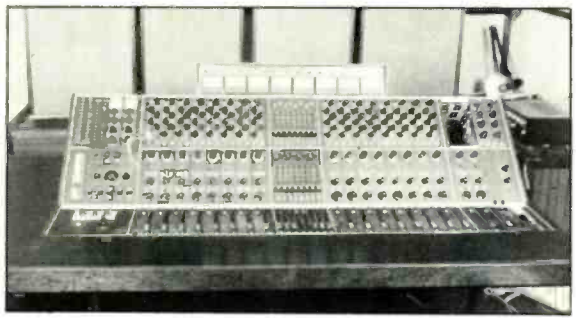
The concept of creating a sound in the control room totally unlike what could be heard by standing at any one point in the studio was only slowly being born in the minds of the more adventurous producers, and sold by them to the technicians rigorously trained in Good Engineering Practice. Microphone choice and placement was always accepted as an art, but fooling about with the audio signal was another matter. Artificial reverberation, however, had long been accepted, though it tended to be applied later to the whole mix rather than to individual inputs. Of course, with mono tape, anything you did you were committed to; reverb could not be subtracted, and only overall EQ could be modified later. So cautiousness on the session, and experimentation later with the finished track in a 'transfer room' or on cutting, was the ruling policy, unless the producer was confident and politically strong enough to have his way on the session and stand by the result.

Until the coming of multitrack tape, the motion picture industry was undoubtedly way ahead in the flexibility of what could be done in the creation of a final soundtrack, despite limitations deriving from optical recording. For the cinema, 'multitrack' and the building up and doctoring of tracks had always

Basing Street No 1, London mid 1970's (left); console for Apple Studios, London 1970 (lower left) and (below) EMI Abbey Road circa 1970 although the photo is of a slightly later date

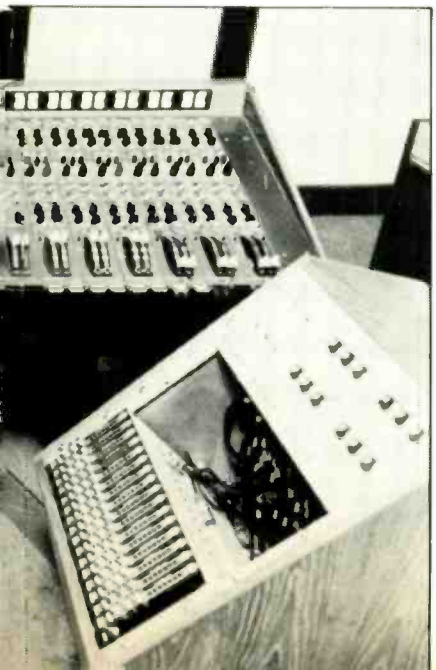


EMI Abbey Road circa 1954 (left); EMI Abbey Road circa 1960 (above); Maison Rouge, London 1976 (below) and (lower left) Steve Marriott home studio 1972



existed. The record engineer, though ahead in signal-to-noise ratio and wide range of response, would often be amazed at what was being done in a major dubbing theatre, though much of this effort and hardware existed not so much to produce effects but to remove the blemishes of original stage and location tracks.

Great emphasis was always placed on precision and repeatability of console settings. While the quadrant fader (in Britain) and the flat slide fader (in Europe) took over from the rotary knob, they remained universally of stud or step construction, and any EQ which had pots rather than step switches precisely marked in dB and frequency would be sneered at as totally unprofessional. This 'laboratory instrument' approach, found also in many types of switch and key which rising costs have since driven out of today's consoles, deserves our respect, except for the fact that creative engineers have always trusted their ears rather than panel markings, and have always felt for that 'spot between' the steps provided. The positive disadvantage of step faders, however superb the contact materials, and despite daily cleaning, was the physical fact that even a perfect instantaneous level change, on a pure sustained sound, is perceptible as a click unless the change is extremely small, or by incredible luck coincides with a zero of the waveform. There is debate today—in relation to digitally controlled attenuators—how small the steps should be, and if 256 steps are enough; it is interesting to note a fader of the early 1960s seldom had more than 35 steps for the full fader range, and this was generally accepted for many years.



The coming of stereo, which at least in Europe was strongly based on classical concert music and hence on coincident microphone technique and a serious psychoacoustic approach, if anything strengthened for a while the 'scientific precision' way of working and tightened the specs for ganged faders, ganged stepped equalisers, M-S (sum and difference) circuits with image width controls and the like. Panpots, tolerated by the purists as a necessary evil for 'sweetening' mikes added to the basically coincident-mike sound picture, were of course precision resistor networks on step switches. For a short while some major labels made separate mono and stereo tapes in separate control rooms. When this was abandoned, 'mono compatibility' was a very serious concern, panpot laws being calculated so that if a sound source was panned across the whole stereo picture width its mono level would not change by even 1 dB.

Up to this point, the mixing console had been basically a passive unit, connected to racks of valve amplifiers. Hence, circuitry was designed on classical 'constant impedance' lines with a mass of screened pair cables to and from the console at 600 Ω or lower impedance, usually all balanced. Earthing problems were minimised as each 'box of gain' had floating input and output, and its DC 0 V rail had no connection to the audio.

Every amplifier input and output was accessible at a patch bay. There were, true enough, self-contained valve consoles, particularly in American broadcast practice. In European broadcasting the construction technique was for 'amplifier cassettes' in the pedestals and the rear of the console and passive 'control cassettes' in the operating surfaces. Each amplifier cassette of course still contained its input and output transformer, and very often each one was also self-powered from the mains supply!

The arrival of the transistor as an acceptably low noise device (which happened effectively when it was realised that radio frequency receiver transistors were quieter at audio than the designated 'audio' types) made possible the 'active' console.

The author's first design of an all-solid-state console, built in 1961, was a bridge between old and new construction styles. The amplifiers were in individual cigarette-pack-size shielded cassettes, instantly interchangeable, plugging into trays in the rear of the console. Feedback gain control for each mike preamp was wired up to a front panel control. The channel equaliser was a medium impedance passive network, leading via an emitter follower to the quadrant stud channel fader. The faders were constructed in pairs for stereo ganging, with separate handles. Routing was to four virtual earth mix busses, 1 and 2 (left and right) having seven pan positions in between, 3 and 4 being independent. Four BBC-type peak programme meters monitored the busses with four small rotary stud pots for the buss/tape monitor levels. Reverb send was by a smaller slide fader for each channel, and headphone foldback was simply by two on-off switches for each channel and echo return. A submix of six rotary faders could be switched to the input of channel 1. The input controls and meters of some valve compressors appeared in the console.

Four-track recording had just arrived, and the convention was to monitor it on four speakers, the inner left and inner right being fed with tracks 3 and 4, giving either stereo band plus stereo soloists, or switching 3, 4, or both to a centre image for vocalists. With the arrival of 8-track it was obvious that eight speakers would be ridiculous, and it was realised that as many virtual images as desired could be produced by proportioning signals between two speakers. This was really the beginning of the track monitor mix system. Each track, buss or tape, then acquired a fader, slide or rotary, a pan position switch or pot, and a mute/solo switch. It was a great advantage to be able to solo individual tracks without upsetting the recorded signal.

It was realised that the mix of track monitors was a preview, except for equalisation, of the situation to be reached in mixdown, so to help the producer's impression of the finished

44 ▶

Evolution of the mixing console

product, reverb sends were added to the track monitor channels, and switching to bring the corresponding returns back into the monitor system only. Producers then decided they wished to hear immediately a monitor mix *with* equalisation, and a few consoles were built with equalisers in each track.

Besides the waste of space and extra cost involved, there is a decided danger in making this possible, as the two equalisers effectively in series on input and track may be counteracting each other, especially if the engineer sets one and the producer the other. At best, when the master tape is played 'flat' in another studio it will sound 'nothing like' what anyone remembers from the session; at worst it may be very difficult to cancel out the excess effect of one equaliser masked by the other, especially on a console which is not identical.

The author's first tactic to provide this facility economically and reduce the danger somewhat was nicknamed 'Steal-an-Equaliser' and introduced in 1971. Pressing a button 'EQ' in any track monitor 'stole' the equaliser of a certain designated input channel and lit a lamp to show it was now in the monitor path. However, if it was already in use in that channel on live input, nothing would happen until it was released by operating the channel's 'EQ Out' switch.

Recognising that one or two of several inputs going to one tape track may *have* to be equalised 'for real' on laying down the original track, those able to be 'stolen' were say 17 through 32 of a console with 16-track monitoring. The others remained available for input use, so long as the engineer took care what he was doing. As will be shown, a trend later appeared particularly in 'in-line' consoles for the provision of 'Master' functions such as 'All EQs in Monitor' which could then be overridden on an individual channel basis.

Meanwhile the demand had grown for more complicated equalisers in the console. Up to the early '70s the norm was treble and bass shelving plus a single mid range peak at five or six selected frequencies. Except for the occasional track presenting a serious problem, which could be dealt with by patching in an outboard unit of graphic or multi-knob type, this was – and remains to this day – the common denominator of general equaliser use. This type will probably be most familiar to readers in the API *550* series, being extremely compact and simple to operate. The form devised by the author at Olympic Sound Studios (London) in about 1964, and hence known as the 'Olympic equaliser' may also be of interest. Its character of sound, given mainly by the shape of the midrange curves arrived at empirically by listening tests, derived originally from the choice of particular inductors available. It could be switched to give a family of 'troughs' in the midrange somewhat sharper than the peaks, thus enabling a few notes in the range of an instrument which 'stuck out' too prominently to be reduced without sucking out too much of the midrange energy of the sound. The bass lift section, instead of the more usual shelf, levelling and continuing down to perhaps 40 Hz, was a broad peak boost, originally centred on 250 Hz, which fell back to a very small lift by 60 Hz so that hum and rumble were not exaggerated. Later versions added a choice of bass peak frequencies. The high frequency lift was in stepped shelves, but the high and low cuts were continuous roll-offs at switched frequencies, though marked as dB at 50 Hz and 10 kHz. This compromise also meant that steep cut filtering was less often needed.

For special needs, more flexibility was demanded, and the possibility to 'tune' an equaliser precisely for the instrument being handled was an obvious advantage. So the frequency steps got more in number and closer together, up to the practical limits of switch poles and capacitor values, every manufacturer having his pet list of centre frequencies, until after a few attempts to miniaturise graphics to input module dimensions, the sweep frequency or 'parametric' equaliser was generally accepted. The advantages, and the cost saving over quality switches and close tolerance components, were accepted as outweighing the loss of absolute frequency and gain accuracy between channels. Variable sharpness of peaks ('Q') enabled the engineer to find his ideal curve for every situation, but at the expense of even more knobs, often dual concentrics of which the inner knob had only the roughest correlation to scale markings. The loss of repeatability, for long considered so important, has now been slightly compensated by the invention of the mechanically-detented potentiometer, though this does not improve the resistance tolerance of the tracks inside. The process of 'everything possible in every channel' continued until a typical 1977 piece of sales literature proclaimed with pride '14 EQ and filter controls per channel' – which for 56 inputs is 784 controls to be set manually!

The process of individual track building which was made possible by 16 and 24 tracks led to a great expansion of requirement and provision for headphone cue circuits. The switches mentioned in the early example had become pots, providing two or more mixes of all input channels. But the space required for the number of separate cue sends from each channel (together with the reverb sends which already existed and were also increasing) started to become ridiculous as each player in a group asked for his own headphone mix. For the building up of tracks, musicians had also to hear all the tape tracks which had gone before, and so required again as many mixes as possible derived from track monitor. At first each recorded track was returned to an input channel as for mixdown, and then through the cue circuits of that channel. As the number of tracks recorded increased, more and more channels were used up just to carry foldback. This hardly mattered if only a few mike inputs were needed for the new tracks, but if the foldback could be taken from the track monitor, every channel would still be available for live studio input. But then, how many pots must be added to each track monitor, making a new space demand here too?

One answer which helped considerably was to matrix the sends provided by the channels and track monitors to the number of headphone feeds desired, increasing the possible choices. Each feed circuit to the studio then had a bank of buttons (or even pots, to be really elaborate) picking up whatever inputs, already mixed, were appropriate for the player. One could also add the overall mix as heard in the control room. A vocalist might for example be fed with overall mix in stereo, plus himself centre (selected to both earpieces) plus added echo return to headphones only and not heard in the control room at all, plus perhaps a piano track of the melody line to help the singer's pitch, which would be discarded in the mixdown.

It was also realised that the broadcast practice of calling all the sends 'auxiliaries' and routing them to cue or reverb as required was an acceptable economy, though it meant adding more pre/post fader switching.

One other approach was to remove all cue sends from in front of the mixing engineer and designate a 'cue mixing panel' to one side of the console, where the second engineer, with use of headphones and intercom mike could serve the artists up with what they wanted while his chief concentrated on the main sound. Several users found this helpful, but it never became widespread.

From the 8-track stage onwards, assignment switching of channels to tracks became a serious factor in the space allocation and cost of a console. Even though to this day the assignment of a channel to more than two busses is a rare requirement (except to derive more auxiliary outputs which a particular console may lack) users felt that output selector switches of however many positions were not enough. A visual presentation of assignment was desired. One suspects that the banks of lighted buttons which appeared at the 8-track stage

46 ▶

Island Mobile 1972

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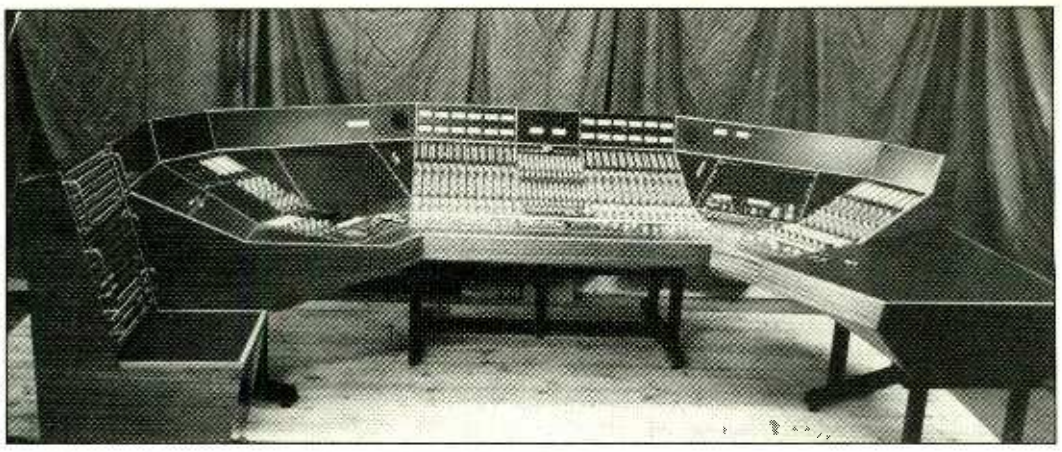
Evolution of the mixing console



Console for Studio Tempo, Montreal, 1978 at factory before shipping

were partially introduced as a client-impressing feature, and then became so entrenched that with 24 and more tracks their presence, however space consuming, had become traditional rather than totally rational.

Centrally-controlled assignment systems, elegant but perhaps luxurious cost-wise, now offer a space saving functional solution, but the need is still felt for some kind of display above the channel of the assignments made.

At this point it was reasonable to ask the question – though very few people did – if there really needed to be a mixing buss for every tape track. The more tracks available, the sooner the answer becomes 'no'. Even in the larger consoles, when the large number of mikes which it became customary to use on drum kits had been allocated to two or four tracks, we are quite fast coming down to one mike for one track. And as to sub-grouping in the mixdown process (even before considering the use of VCAs) it is difficult to conceive the need for more than eight, or at the outside 12, of such groups. The truth of this is evidenced by the fact that no sooner had the argument of 'simplicity' produced formats such as '24 × 24', everyone discovered the usefulness of a 'Direct' button to defeat the redundant matrixing and route the input direct to the same numbered track. At which point an old hand might be tempted to say 'How about – a *patch cord*?'

It became standard practice to provide, on multitrack sessions, for a stereo recording feed from the track monitor mix, to give producer and artists an immediate tape to take away and prepare for the mixdown. From this the 'in-line' console then emerged, in which stereo record output was effectively the same signal as track monitor. Channel module no.1 then contained the buss mix and output amplifiers, and the monitor controls, for *track* no.1. Being now in the same location it was easy to arrange physical switching of equalisers and auxiliary sends between input and monitor paths. The same panpot now served for both monitor and mixdown, and a changeover switch later appeared to transpose the channel fader and monitor pot, so that when laying down raw tracks at fixed levels monitor mixing was a more natural process.

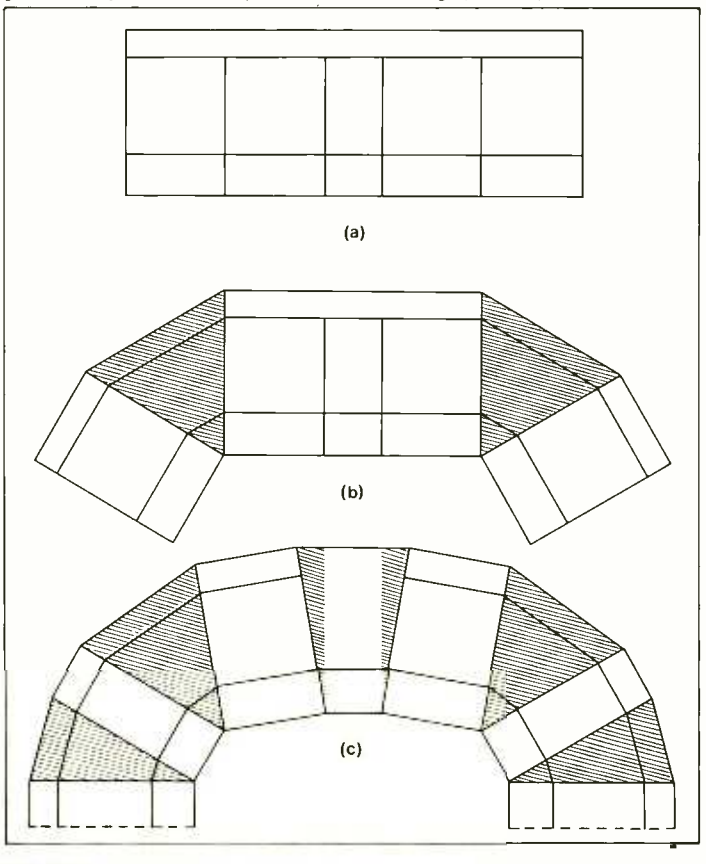
The in-line concept had great commercial advantages in simplifying construction, in that a console could now consist of any quantity of identical modules, often including the buss selection and the fader in the one long module. The only other units needed were modules for auxiliary sends, monitor selection and talk-back. Hence over the last 10 years tremendous marketing emphasis has been placed on in-line designs, to the point that newcomers to the industry might well get the impression that 'that is how a console is' in the way that every car has a steering wheel and pedals in the same place. But from the point of view of logical organisation of layout according to function and even more from ergonomic principles, a strong case still exists for the earlier alternatives.

The use of long modules dictated that the console must, except for a meter penthouse, be a flat rectangular surface set at a suitable angle. This constraint really came into being simply for ease of construction; as the length and number of modules steadily increases it becomes less and less satisfactory for sight lines and comfortable arm reach. If one sits upright with the hand resting on a fader, and then extends the arm forward and upward to shoulder height, leaning the body only slightly forward, the hand describes a curve which is part of an ellipse. The practical approximation to this in flat panels is to have two or three increasing vertical angles rising away from the operator. In the horizontal plane, there is a certain width of arm spread beyond which one must lean sideways or else roll the chair along.

This situation is greatly improved, and additional space is generated, if the rectangular module area is subdivided and the ends are pivoted towards the operator. Looking at the diagram, layout (a) shows the essential module area of a console; (b) shows shaded the additional space gained by wrapping round the outer module areas. This space may accommodate effects modules normally regarded as outboard, a mini-patchbay or matrix switching immediately visible to the operator, machine remotes, auto-locators and so on. By a further subdivision, as shown in (c), the outer extremes are brought even closer and still more space is produced.

The author has indeed been using multi-angled wraparound shapes since 1965, and claims no originality then, the British firm Pye TVT having produced sound consoles for TV studios a year or two earlier in which the console formed an almost complete multi-faceted circle, with just room for the operator to enter from the rear. The control density was very much less than we are used to today, but the total control surface available was vast.

Diagrams to show the ergonomic advantages and the extra usable space generated by the use of wraparound console design (see text)



The latest developments in remote control referred to in recent editorials give the possibility of overcoming the 'ever-increasing panel area' problem by assignable controls and multi-purpose displays. But the essential here as ever is instinctive and comprehensible presentation to the operator working under time stress.

In the early '70s, Schlumberger showed a prototype console with a single dummy 'channel module' and fader, a keyboard and video display. This was a great piece of forward thinking, with useful concepts such as memory of complete set-ups for live radio, but with the basic error that it was a computer man's approach, and the sound engineer's reaction was 'that's not how you do it!' It forced the operator to think serially, to call up *one* channel at a time and do something to it, then return to the keyboard for his next move. Meanwhile several bars of music had passed! Serial operation, to a computer, means microseconds, but unfortunately to human eyes and fingers it can be seconds. For many functions, certainly for faders, 'touch it and it happens' is essential. Hence the practical acceptance of inventions such as *Necam*, despite early scoffing at 'crude mechanical' systems.

Practical points like this bring us finally to the question posed in a recent article (D Hadler & R Neilson, *Re/p*, October 1980) on 'new' approaches to console design: 'Should the mixing engineer design his own console?' One might equally ask 'Does an astronaut design his capsule?' The answer in both cases is electronically, no, but functionally, ergonomically, absolutely yes! The aircraft designer who did not listen to his test pilots, the space engineer who didn't sit his astronauts in a mock-up, would be asking for tragically aborted missions, and *this* console designer is very certain that if he had not occupied the mixing chair for some years he would have been very unlikely to produce a notable console. ■

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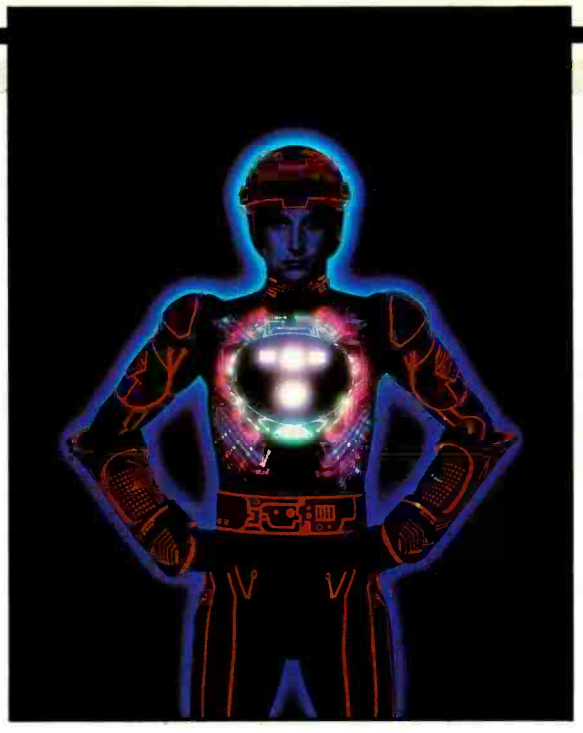


Sound FX for TRON

Bob Anthony

THE 1980s is the decade of computer applications. Hardly a business will be immune to the impact in one way or another, and the world of motion pictures is no exception.

Although traditionally an industry that resists change, there are some mavericks who, without fear of criticism or ridicule from their fellow craftsmen, insist on striving for better techniques that yield higher quality results in a shorter period of time. Two such pioneers are Frank Serafine and Gordon Ecker.

The focus of their attention for the last year has been Walt Disney's *Tron*, a high-tech rendering of the classic good versus evil confrontation featuring international domination via the world's largest computer – the ultimate alternative of electronic games – and scene after scene of spectacular special effects and state-of-the-art, computer-generated graphics. It's only logical that enhancement of such an overwhelming futuristic presentation demanded an equally progressive approach to film sound.

"It's a growing process," says Gordie Ecker. "What we're doing now we didn't do last month, and last month's ideas are far from where we started four or five months ago. Music in film is an area that's taking off. Features are becoming infiltrated by the music people with all their modern technology. It's being accepted reluctantly, but it's definitely happening. Frank, for example, has spent years in the music business, and consequently, hasn't been shackled by the old moviolas and mag film."

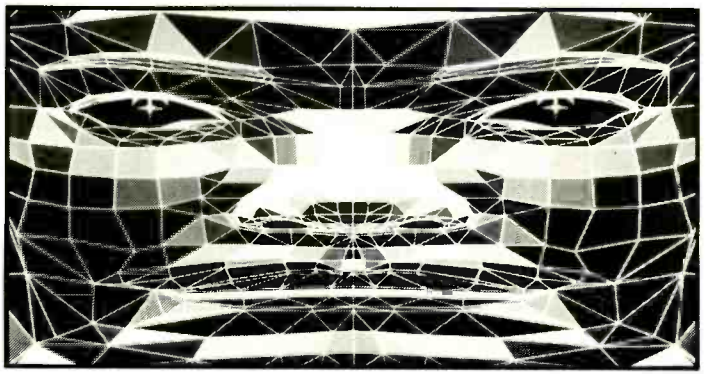
To preserve that fresh outlook towards film sound, Serafine and Ecker prefer to work at Lion's Gate, a Santa Monica, California-based complex comprised totally of creative, independent audio and visual personnel. Enjoyably, the wide range of talents available under one roof means that all film production needs can be taken care of in-house, while at the same time maintaining the ambience of an experimental New York facility.

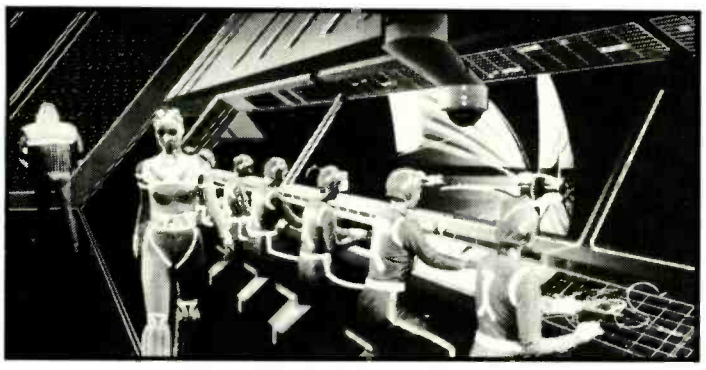
"Lion's Gate has put soil here that allows a lot of us frustrated film people to do what we want," continues Ecker. "We've all been held back by our peers in the business saying that we can't do this, or that. Here at Lion's Gate we're doing it. We're breaking all the rules."

"They say you can't put sound in the back of the theatre," adds Frank Serafine. "That's a traditional rule. Well, because it hasn't been done, we want to use that to our advantage. This film is discrete 6-stripe mag on 70 mm (the film was shot on 70 mm). We have a pan module that can pan 50 rev/s, so we're spinning sounds from speaker to speaker."

Their *modus operandi* is to apply the current technology in innovative ways. For example, an *Apple* computer with a *Visicalc* scrolling program normally designed for doing business trend analyses, now generates and prints out computerised track sheets to save time when referencing the master tape. Each of the 15 tracks has its own column, listing the sound effect and its location, while column 16 contains the names of all the elements that make up the given effect.

Likewise, a *File Manager 800* program run on an Atari computer automatically alphabetises the finished sound effects. The effects are simply logged into the computer at





random, and the computer does the sorting by sound number, category, reel number, track number, clock number, the ¼ in source it came from, time code number and description, plus any comments on where it references to the picture. According to Serafine, an effect can be retrieved by any of these parameters within 1.5 seconds.

"For instance," says Serafine, "we can type in the key word 'solar'. The computer will sort through 500 files and give us everything that's labelled with 'solar'. We then enter the necessary SMPTE numbers of the desired selection into the *Shadow* system, and both the audio and video tape machines go, in sync, right to the specific sound effect and picture location."

"Normally a third of the production time is spend looking for sound effect," adds Gordie Ecker. "Here it's not a consideration at all. We invent on the spot, and get to our library sounds in seconds without wading through a lot of ¼ in tapes and waiting until the next day to get it transferred to 35 mm mag."

The entire sound element library is transferred to a 16-track worktape on a Tascam *8516*. Only tracks 3 and 4, 7 and 8, 10 and 11, and 13 and 14 are used for stereo elements. Track 16 contains SMPTE, while all the rest are buffer tracks. "We stagger all the sound effects," explains Frank, "because our library contains percussive elements with sharp transients and heavy explosions that tend to bleed through. By buffering with open tracks, we're assured of eliminating the leakage."

The final composite sound effects master tape, which eventually goes up to the dubbing stage for transfer to film is recorded on a 16-track Ampex machine. All equalisation and processing is done while making the master. Basically, all the dubbers have to do is roll the tape.

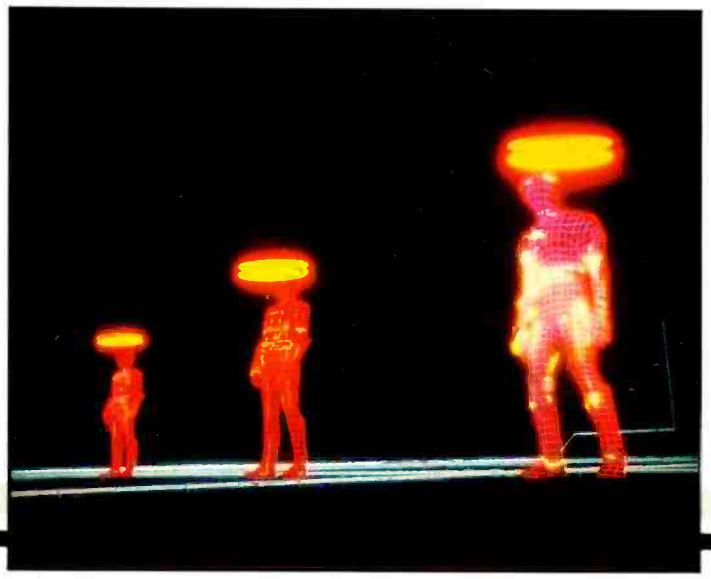
Controlling the whole show is the BTX unit, which is the mother to the two audio recorders and the Sony *VO 5850* video cassette machine. The separate BTX *Shadow* system runs just the video and the 2 in Ampex audio recorder. A servo-control mechanism allows hot-rodding from place to place on the tape. All the units, of course, are tied together with SMPTE.

The combination of the BTX and the Sony video cassette player served as a computer-age moviola that could move half a frame at a time. By marking a zero point, the machine could automatically return to that point to facilitate experimenting and rehearsing of complicated sound effects.

Serafine and Ecker received small, edited bits of the film on videotape at a time, and it was not unusual to finish a reel only to find that a change had been made. Conventionally, that would have been a major undertaking. With SMPTE, however, 50 sound elements can be moved any distance to within an accuracy of hundredths of a frame by pushing a couple of buttons.

But even though this technology allows Serafine and Ecker a great deal of freedom, every direction is well planned. Director Steven Lesberger

51 ▶



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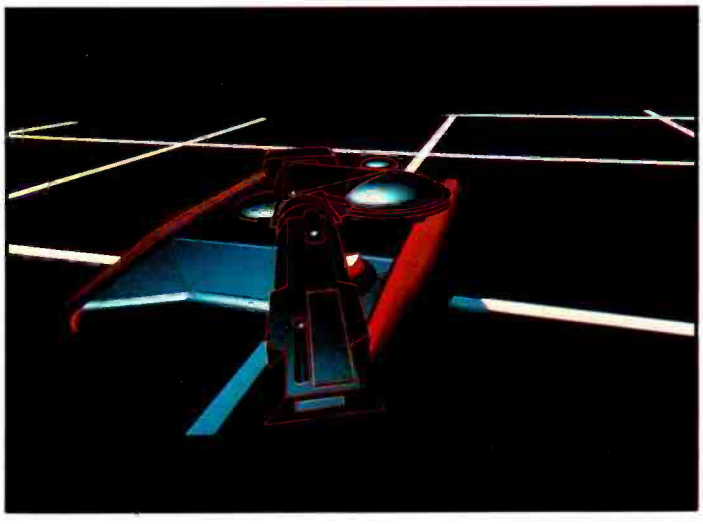

requires a developed concept before any sound is ever made. "It's not like we doodle in sounds trying to come up with something," says Frank. "Take the chime effect that goes around Sark, for instance. That took a week to figure out what to do and how we were going to do it."

There are no absolute musical colours in the film. Every effect is a combination of several sounds so that an orchestral texture is created. As Serafine points out, "I would say the soundtrack is a perfect marriage between organic and synthesised effects. Since a large part of the movie is set inside a video game, every movement, machine, or being that has an organic root sound, also has a counterpart of a video game sound. When an explosion hits a wall, we have a quantised video hit and a big military explosion, mixed together to produce a hybrid of the two. Some effects, such as the disc throws, contain up to 40 elements – eight across and five deep."

"Because this is a movie about video games," says Gordie, "we've worked a lot of little subliminal jokes into the sound track for people who know the computer sounds, *Pac Man*, motorcycle sounds, and even the talking machine recordings of the telephone operator. But they're not silly or corny, or hitting you in the face. The timing is right, and all the elements lead up to the action."

Atari loaned the project a sound developer computer floppy disk that they use to generate their game sounds. "That's how we create a lot of our hits. We record them on to the Tascam 16-track, and then lay them in position. The *Pac Man* sounds – the 'Whit, Wat Wat, Weeieieieieie' – we loaded into the Fairlight *CMI*, and then blended into the action at a low, almost subliminal level. If you know those sounds, you'll recognise them in the film."

In fact, under the guidance of expert programmer Jeff Harris, the Fairlight turned out to be indispensable for storing sounds, digital editing of sound effects, and especially for cleaning up older library sources. Once the waveform of the sound effect was displayed on the Fairlight's accompanying video monitor, a light pen could be employed to 'erase' or digitally eliminate, the noise at the beginning and end of each sound.

According to veteran film sound maker Gordie Ecker: "A lot of effects like gunshots and explosions were better recorded in the old days. Mikes are too refined now to get the same quality. A short time ago we tried recording some gunshots out in the desert near Palmdale, California. We brought along all the old Winchesters and Colts, a brand new mike and an old 8-ball mike we dug out of a file at Warner Brothers. The old mike had a lot of nice distortion, whereas the new mike caused the limiter to go on. When we got far enough away so the limiter wouldn't go off, we lost the impact of the sound."

Because *Tron* takes place in a futuristic world never before seen, almost all the effects were done especially for the movie, although many of the sound elements were recorded at random by Serafine over the past three years. "Ever since I got the Stellavox I've recorded things like Lockheed's windtunnel letting out 1000 tons of air per second just because I liked the sound. Now we're using that recording for the movie's laser lab, which looks just like Lockheed. I recorded the interior and exterior of the Goodyear Blimp in stereo, and that became the foundation of the final sound for the aircraft carrier."

A particularly interesting composite effect was the one designed to represent the light cycles – a mixture of live motorcycle and mouth. For the closeup shots, screaming Harleys were recorded on a race track in the country. Because conventional mikes picked up too much air noise, *PZMs* were attached to the side of the bike's saddlebags, and hardwired to the Stellavox that was strapped to the rider's back. On a separate pass, two *PZMs* were also stuck on his back, just inside his belt. This afforded isolation from the wind, and provided a steady 110 mile/hr motorcycle sound. Both tracks were used as the organic part of the light cycles.

The synthetic half was a combination of voice and synthesiser. an Electro-Voice *RE-20* was plugged into a pitch-to-voltage converter that controlled three oscillators of a Moog synthesiser. Because the cycles are supposed to be a harsh texture for a life-or-death battle sequence, a nasty, suspenseful chord was formed with the fundamental, flat third, and natural seventh of a diatonic scale – one note per oscillator. Serafine sang the appropriate motor pitch into the mike, which triggered the synthesiser. the gear shifting and doppler effects were impersonated vocally. On long passages, Ecker would continue with the same pitch while Serafine caught his breath and took the mike back. Because they were just triggering a synthesiser, the difference in tone quality from one voice to the next was irrelevant. Only the constant pitch was important.

To increase their signal-to-noise ratio on tape (Scotch *226*), they increased the amount of signal. "We're bending our needles," says Serafine, "and almost eliminating the noise. We're pushing the sound up so high that when the mixers get the sound down to normal levels, the noise levels drop, too. As long as the sound isn't distorted, we're in good shape."

"Most other guys don't have the faith to let these innovations go through," says Serafine of Michael Fremmer, the man who hired the personnel for the film, "but the results are worth it. And what could be better? We got paid to be inventive, and have the minds of kids."

Equipment used to produce the sound effects at Serafine FX Studios.

Rack equipment:
DeltaLab *HarmoniComputer DL-5*
EXR *Exciter*
AcoustiComputer DL-2 with memory modules
Roland pitch-to-voltage synth
Roland vocoder *SVC-350*
Sony *VL5850* video cassette recorder
Sony *TC-766-2* ¼ in deck
Lexicon *1200* audio time compressor/expander
Lexicon *224* digital reverberator
Polyphonic digital delay line
Quad-Eight *AM-23B* compressor
Maxson *AD-230* – flanger and analogue delay system
Scamp modules – compressor, parametric EQ, expander, ADT module.
Teac *C-3X* cassette machine
Apt Holman amp and preamp

Room equipment
Eastern Acoustic 2-way speaker system model *MS-50*
Auratones
Gray Labs SMPTE
BTX *4600*
BTX *Shadow Controller*
BTX *4500* edit code synchroniser
Roland *CSQ-100* digital sequencer
Tascam *8516* 16-track recorder
Ampex *MM-1100* 16-track recorder
Teac *Model 15* console
Sony *TC-766-2* ½ in deck
Panasonic TV and projector
Telegenix computer projection system
Scotch *226* tape

Keyboards
Prophet 5
MiniMoog
Fairlight *CMI*
Fender *Rhodes*

Mikes
Electro-Voice *RE-20*
AKG *D224*
Audio Technica *9-52V*
Crown *PZM*
Sennheiser *A-15* shotgun
Shure *SM-80*

Computer related hardware
Apple computer with *Visicalc*
Atari computer with *File Manager*
Atari with disk to generate computer game sounds.
Votrax *Versatile Speech Module*
Votrax *Type and Talk* speech synthesiser
A set of Mountain Hardware peripheral boards for *Apple*
Olympia *ES100 RO* printer
Epson *MX80* printer

business

BARRY FOX

Not-Fantasia

If anyone keeps back numbers of *Studio Sound,* they might like to try pulling out the August 1979 issue, and checking pages 29 and 30. For the benefit of those who don't keep back numbers, or can't be bothered to pull them out, I'll explain. In that issue we commemorated the 40th anniversary of the Disney film *Fantasia.*

It was in 1939 that Leopold Stokowski spent seven weeks with the Philadelphia Symphony Orchestra recording the soundtrack for *Fantasia* in what was surely the world's first commercial multitrack session. As much more recently reported (*Studio Sound* May 1982) Bell Laboratories spent the 30's developing stereo discs and 3-channel film recorders for concert presentations of recorded music. This gave Walt Disney the idea of making a film with both pictures and multitrack sound. With the help of RCA, the Disney Studios built a 9-track optical recorder, and used 33 microphones to cover Stokowski and the Philadelphia Orchestra. Half a million feet of soundtrack film was recorded and mixed down into a 3-channel soundtrack for Disney's animation. To expand the dynamic range by 20 dB, a fourth tone track was used to control variable gain amplifiers operating on the three audio tracks. The whole process was christened *Fantasound,* and the film was premiered in 1940. Two projectors ran together, one screening the pictures and the other reproducing the sound through a total of 90 speakers spaced behind the screen and around the auditorium.

A road show of *Fantasound* equipment was built to take *Fantasia* round the country, like a modern pop group on tour. But in 1941 the bombing of Pearl Harbour brought America into the war and put a stop to larks like *Fantasound.* Much of the original equipment was lost (one, possibly apocryphal, story has it being sunk on a ship enroute to Russia!) and *Fantasia* was released on conventional prints. These had a mono optical soundtrack which had been recorded at the time of the original multitrack. In the mid 50s Disney collected together as many of the old prints as possible and put together a magnetic stereo release in Cinemascope. Finally, when Dolby optical stereo became more popular with cinema owners than films with magnetic tracks, *Fantasia* was re-released in the Dolby stereo format. At the time of this re-release, in the late 70s, Disney Studios vehemently denied any suggestion that the soundtrack had been re-recorded. It was, they told me, the original Stokowski recording, and they sounded quite proud of the fact. How surprising therefore, that in 1981 the Disney Studios decided to junk that original, historic, Stokowski recording and replace it with something quite different.

Irwin Kostal was commissioned to re-orchestrate some of the music "to correspond with current tastes in music" (whatever that means) and re-record it all digitally. Even the voices of narrator Deems Taylor, Mickey Mouse and Stokowski himself have been dubbed by modern impersonators. According to Disney Studios, these sacrilegious acts are "dedicated by the people of Walt Disney studio as a lasting tribute to the genius that was Leopold Stokowski". Perish the thought, as some people have suggested, that Disney has dubbed on new sound because it has been costing $15,000 a year in royalties to use the original Stokowski sound.

"At last . . . as it was meant to be heard" screams the publicity for the new Disney *Not-Fantasia.* At a press show, reel one was screened in the original 4:3 picture format, with genuine Stokowski sound from a mono optical soundtrack. At the end of reel one the screen masking was pulled back into wide screen format and the not-Stokowski sound blasted forth in all the awful splendour of digital stereo. It sounded like a re-write of history in Dayglo ink: "More than forty years after its original release, Walt Disney's classic *Fantasia* is once again revolutionizing motion picture sound", says the studio in defence. Translated, this means that Disney is now denying audiences the opportunity to hear Stokowski recorded over 40 years ago with stereo techniques far ahead of their time, and thus better able than any commercial disc recordings to preserve the man's sound and genius for posterity.

The Disney Studios should be ashamed of themselves, but I very much doubt that they are. The best one can hope is that *Not-Fantasia* will do terrible business at the box office and teach the Disney vandals a lesson.

Silencing Stereo TV

Do you remember the old Burwen noise reduction system? To be strictly accurate there were two Burwen systems. One was a compander and the other a noise gate. The compander worked on a 3:1 ratio compared to 2:1 for dbx and produced some pretty dramatic effects. Unfortunately, in the early 70's when it was offered for sale, it wasn't free from nasty side effects. The system was also very expensive. In 1974 it cost £27,000 for a 16-track system.

The Burwen noise gate was also impressive but expensive, and it never caught on commercially either. Now the American chip maker, National Semiconductor, is making Burwen noise filters available as integrated circuits under licence from Burwen. National Semiconductor is calling the system DNR (Dynamic Noise Reduction) and it's being used to clean up mushy AM and FM radio signals and the dirty sound you get from domestic VTRs and stereo TV transmissions. This latter use is interesting because it points to an embarrassing mistake made by the Germans.

In an effort to protect the German electronic industry from Japanese competition (now that the PAL colour TV patents are running out) the Germans adopted a stereo TV sound transmission system which differs from that used in Japan, and which they tried, rather unsuccessfully as it is turning out, to patent. The Japanese use a multiplex system, with the second channel on an FM carrier while the Germans use a two-carrier system, with each sound channel on a separate sound carrier. To preserve mono compatibility with existing TV sets in Germany, stereo music is transmitted with a mono sum signal on one carrier and a different signal on the other. But bi-lingual broadcasts put a different language on each carrier; to prevent stereo sets ending up with a mix of two languages on each channel, the receiver decoder has to be switched, depending on the type of transmission. This switching is automatic, under the control of pilot tones broadcast along with the carriers. Unfortunately, these pilot tones tend to inter-modulate at a frequency of around 6 or 7 kHz, producing low level, but decidedly irritating, 'birdies'. Grundig is now building DNR chips into its stereo TV sets to kill these birdies. When there is no masking high level sound, the DNR filter trims the frequency band down to a few kHz. When there is sufficient programme signal to mask the birdies, the filter opens up to full bandwidth.

The Germans are very reluctant to talk about this problem since it now looks as if they made a basic design error in the system, and haven't the courage to admit it. Let's hope that if Britain ever opts for a stereo TV sound system, the problem of birdies will be thought through *before* the industry standardises on a transmission format.

CX death knell

CX seems to be on the way out. That demonstration for the British press, scheduled for last September, and then postponed, has never materialised. CBS UK now doesn't even reply to my queries. Review equipment hasn't been made available, although Angus McKenzie managed to lay his hands on some from America. He variously describes the sound of CX (in *HiFi For Pleasure* magazine) as unpleasant, intolerable and incompatible.

At the Spring 1982 Paris Festival du Son, CBS demonstrated CX in the same way that it demonstrated the system at the Berlin Radio Show in the autumn of 1981. There was no opportunity for A/B comparison of coded and de-coded material. In Paris the CBS CX stand was deserted of visitors every time I saw it. And in Berlin hardly anyone was bothering to listen.

But it seems that someone in America has been telling the press a different tale. In a piece on CX, *Billboard* magazine, in April 1982, referred to "relatively slow progress in the US" but said "CBS has made headway with CX in Europe". Well if CBS describe its progress in Europe as headway, business in America must be slow.

Meanwhile, here comes a press release from CBS, USA. We have a feeling that we only laid our hands on this by a bureaucratic oversight. It's written in double speak but surely signals the beginning of the end for CX. Instead of the single inventory approach previously promised/ threatened by CBS, the company says it is now to "begin releasing records in both CX and conventional formats". Dealers will get both CX-encoded and non-coded records together, as part of their regular orders. Quite what CBS means by saying that this "eliminates the problems of dual inventory merchandising" is anyone's guess.

The only place that CX has made any headway is in the area of videodiscs. It's being used by Pioneer for *Laservision* discs in Japan. This means (because Pioneer has taken over the Californian plant that made such a mess of pressing *Laservision* discs) that CX *Laservision* discs will slide onto the American market. And RCA will use CX to improve the signal-to-noise ratio for its stereo video discs in *Selectavision* format. But in Europe the first *Laservision* discs to hit the market aren't CX encoded. In fact I've not yet found anyone in the *Laservision* disc pressing business who even knows what CX is, much less cares.

'Armless connection

The FBI, Pentagon and CIA recently swooped on a Chicago firm which they were sure had been breaking the arms embargo to Cuba. One of their agents had got hold of an invoice which provided the proof positive needed for a raid.

The invoice quite clearly proved that the manufacturer had shipped a load of cannons and cartridges out to Cuba. It took the puzzled Chicago firm a long time to convince the raid party that the cannons were for connecting microphones and the cartridges were for gramophone pickup arms. ■

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ACES (UK)
AC Electronic Services, Broad Oak, Albrighton, Near Shrewsbury, Shropshire SY4 3AG. Phone: 0939 290574. Telex: 337492.

Ranges of consoles for 4, 8, 16 and 24-track use. Wide range of options available.

ADM (USA)
ADM Technology Inc, 16005 Sturgeon, Roseville, Michigan 48066. Phone: (313) 778-8400. Telex: 231114.

Largely broadcast consoles although the 2400/3200 Series II have multitrack capability.

ALICE (UK)
Stancoil Ltd, Alexandra Road, Windsor, Berks. Phone: 07535 51056. Telex: 849323.

Wide range of consoles from small portable to 16-channel multitrack studio models. Also custom design.

ALLEN & HEATH (UK)
Allen & Heath Brenell Ltd, Pembroke House, Campsbourne Road, London N8. Phone: 01-340 3291. Telex: 267727.
USA: Allen & Heath Brenell (USA) Ltd, 652 Glenbrook Road, Stamford, Connecticut 06906. Phone: (203) 964-1488. Telex: 996519.

Top of the range console is the *Syncon B* with maximum size of 44/24 plus automation option. *Syncon A* is a slightly simpler multitrack console. Also several ranges of smaller modular and non-modular consoles, including new models 42 series II, 2.1 series and System 8.

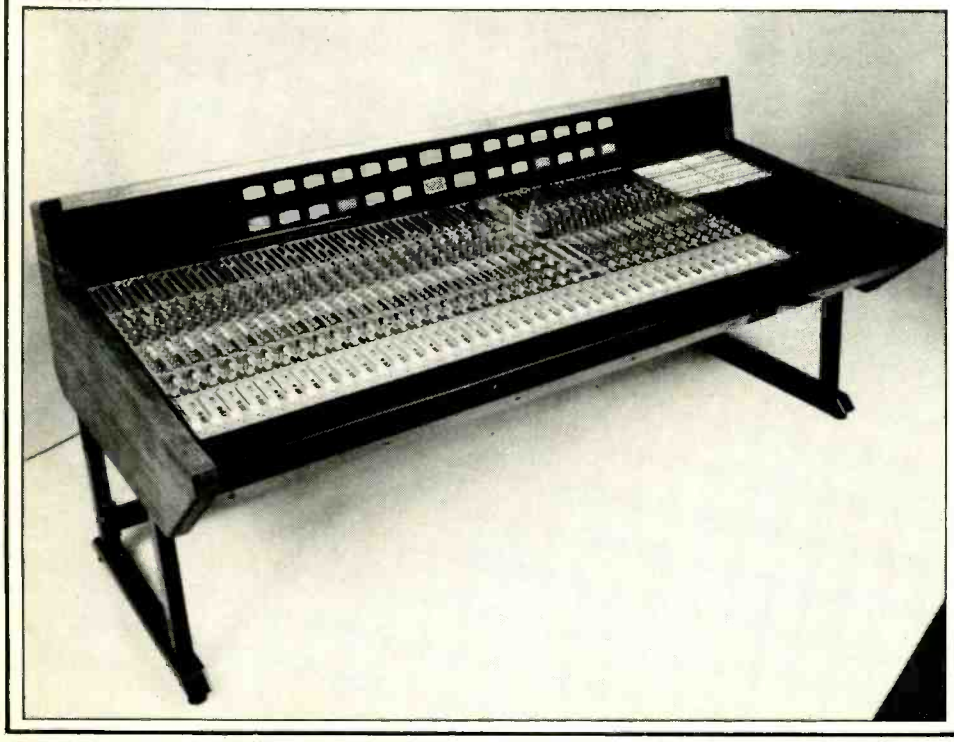
ALLINGTON (UK)
Allington Audio Developments, 14 Lenton Blvd, Nottingham, Notts. Phone: 0602 44943.

EMM range of 16/16 and 24/24 modular multitrack consoles.

ALTEC (USA)
Altec Corp, 1515 South Manchester Avenue, Anaheim, California 92803. Phone: (714) 774-2900. Telex: 655415.
UK: Rank Strand Sound, PO Box 51, Great West Road, Brentford, Middlesex TW8 9HR. Phone: 01-568 9222. Telex: 27976.

1690 8-channel recording console.

Amek M2500 24-track



AMEK (UK)
Amek Systems and Controls Ltd, Islington Mill, James Street, Salford M3 5HW. Phone: 061 8346747. Telex: 668127.
UK: Scenic Sounds Equipment Ltd, 97-99 Dean Street, London W1V 5RA. Phone: 01-734 2812. Telex: 27939.
USA: Everything Audio, 16055 Ventura Blvd, Suite 1001, Encino, California 91436. Phone: (213) 995-4175. Telex: 651485.

Several ranges of consoles including *M4000* specialised 24-buss console for post-production; *M3000*, largest multitrack console with up to 56 channels; *M2500* in-line multitrack console 36/24 standard; *Angela* series medium price consoles of 28/24 standard; *M1000* series with a choice of 17 modules and the *BC01* portable mixer.

APSI (USA)
Audio Processing Systems Inc, 40 Lansdowne Street, Cambridge, Massachusetts 02139. Phone: (617) 354-1144.

Model 3000 range of multitrack recording consoles with up to 32 channel inputs.

AUDIOARTS (USA)
Audioarts Engineering, 286 Downs Road, Bethany, Connecticut 06525. Phone: (203) 393-0887.

4000 Series, 44 Series and *8000 Series*, are modular consoles of up to 32-channel capacity and 4- or 8-track capability.

AUDIO DEVELOPMENTS (UK)
Audio Developments, Hall Lane, Walsall Wood, Walsall, West Midlands WS9 9AU. Phone: 0543 375351. Telex: 338212.
USA: Audio Developments, 1640 Fifth Street, Suite 224, Santa Monica, California 90401.

Range of portable mains or battery powered mixers and the *AD007 Mini Mixer* with 8 to 24 inputs into 4 outputs.

AUDIO HELP (France)
Audio Help, 5 Rue de Solferina, F-92100, Boulogne, Phone: (1) 609.03.11.

CS2405 modular console with up to 32 inputs and monitoring for 24-tracks. Also modular portable console.

AUDITRONICS (USA)
Auditronics Inc, 3750 Old Getwell Road, Memphis, Tennessee 38118. Phone: (901) 362-1350. Telex: 533356.

Three ranges of multitrack consoles, *Model 110-8, Model 110A* and *700 Series*, with the latter having automation capability and max of 36 inputs.

56 ▶

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John Donne, 1571-1631.

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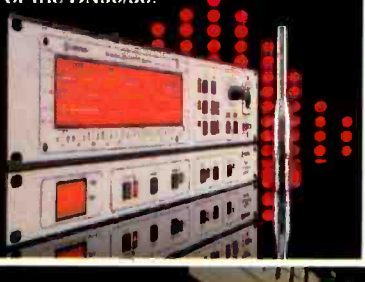

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AUDIX (UK)
Audix Ltd, Station Road, Wenden, Saffron Walden, Essex CB11 4LG. Phone: 0799 40888. Telex: 817444.

Ranges of consoles that are designed for broadcasting use but with variety of modules offering versions that are suitable for smaller multitrack applications.

BEL (UK)
UK: Don Larking Audio Sales, 29 Guildford Street, Luton, Beds. Phone: 0582 450066. Telex: 825488.

24/16/2 modular console with 4-band EQ.

BIAMP (USA)
Biamp Systems Inc, 9600 SW Barnes Road, Portland, Oregon 97225. Phone: (503) 297-1555.

Ranges of multitrack consoles with largest being 24-channel in the *42 series*.

CADAC (UK)
Clive Green & Co Ltd, Britannia House, Leagreave Road, Luton, Bedfordshire LU3 1RJ. Phone: 0582 411513. Telex: 826138.

Custom built in-line consoles from 32 to 52 channels in addition to sales service to owners of Cadac consoles including modifications and updates with automation.

CALREC (UK)
Calrec Audio Ltd, Hangingroyd Lane, Hebden Bridge, Yorkshire HX7 7DD. Phone: 0422 842159. Telex: 51311.
USA: Audio & Design Recording Inc, PO Box 786, Bremerton, Washington 98310. Phone: (206) 275-5009. Telex: 152426.

The *L* and *M Series* of consoles are intended for broadcasting studios but have the capability of multitrack operation. The *M Series* also has automation and floppy disk storage.

CANARY (UK)
Canary Mixing Desks Ltd, 159 Park Road, Kingston upon Thames, Surrey. Phone: 01-546 9540. Telex: 889294.

Range of small consoles for stereo and 4-track operation with a maximum size of 24 channels.

CHILTON (UK)
Magnetic Tapes Ltd, Chilton Works, Garden Road, Richmond, Surrey TW9 4NS. Phone: 01-876 5957.
Canada: Radio Service Inc, 2500 Bates Road, Montreal H3S 1A6.

M Series of 10 or 16 channel consoles and the *QM3 Series* of 12/4 or 16/8 consoles with 8- and 16-track monitoring respectively.

D & R (Netherlands)
D & R Electronica BV, Chassestraat 26, 1057 JE Amsterdam. Phone: (020) 183556.
UK: DNS Marketing Ltd, Westmorland Road, London NW9 9RJ. Phone: 01-204 7246. Telex: 8954243.

Wide range of consoles from the *200 Series* 6-channel, to the *1000* and *8000 Series* multitrack consoles with maximum capacity of 32 channels. Wide range of options on all models.

DYNACORD (West Germany)
Dynacord Electronic GmbH, Sienmensstrasse 41-43, D-8440 Strubing. Phone: 09421 3101.
USA: Dynacord Electronics, PO Box 26038, Philadelphia, Pennsylvania 19128. Phone: (215) 482-4992.

Range of small mixers with a variety of applications including recording use.

EELA AUDIO (Netherlands)
Pieter Bollen Geluidstechniek BV, Hondsruglaan 83a, NL-5628 DB, Eindhoven. Phone: 040 424455. Telex: 59281.
UK: Audio & Design Marketing, North Street, Reading, Berks, RG1 4DA. Phone: 0734 53411. Telex: 848722.
USA: Audio & Design Recording Inc, PO Box 786, Bremerton, Washington 98310. Phone: (206) 275-5009. Telex: 152426.

Ranges of console modules that allow assembly into a wide variety of consoles for various applications. Also the *S2000L* in-line 32-channel multitrack console.

ELEKTROIMPEX/BEAG (Hungary)
Electroimpex, PO Box 296. H-1392 Budapest. Telex: 225771.

Multitrack recording console, available with up to 30 channels.

ENERTEC (France)
Enertec SA, 296 Avenue Napoleon Bonaparte, 92505 Rueil-Malmaison. Phone: (1) 723.92.23. Telex: 203404.

Wide range of modules for assembly into variety of consoles of varying sizes.

FAIRCHILD (USA)
Fairchild Sound Equipment Corp, 75 Austin Blvd, Commack, Long Island, NY 11725. Phone: (516) 543-5200.

FPC portable console in sizes between 8/2 and 16/8 and FIC modular recording console.

FORMULA SOUND (UK)
Formula Sound Ltd, 3 Waterloo Road, Stockport, Cheshire. Phone: 061 4803781.

Custom built recording consoles.

FOSTEX (Japan)
USA: Fostex Corporation of America, 15431 Blackburn Avenue, Norwalk, California 90650. Phone: (213) 921-1112.
UK: Bandive Ltd, 8 East Barnet Road, New Barnet, Herts EN4 8RW. Phone: 01-440 9221. Telex: 25769.

2050 line mixer and *Model 350* compact 8/4/2.

HARRISON (USA)
Harrison Systems Inc, PO Box 22964, Nashville, Tennessee 37202. Phone: (615) 834-1184. Telex: 555133.
UK: FWO Bauch Ltd, 49 Theobald Street, Boreham Wood, Herts WD6 4RZ. Phone: 01-953 0091. Telex: 27502.

Several ranges of multitrack consoles of varying levels of sophistication and automation. Maximum console size in a standard format is 56 channels although the *PP-1 Series* can be far beyond that if required. Also special overbridge option for the *Alive* console to allow the use of multitrack recording from a live performance situation.

HEIL SOUND (USA)
Heil Sound Ltd, 2 Heil Industrial Blvd, PO Box 68, Marissa, Illinois 62257. Phone: (618) 295-3000.

Compact 16/3 console.

HELIOS CUSTOM AUDIO (UK)
Richard Swettenham Associates, 53 Westbury Avenue, London N22 6BS. Phone: 01-448 2582.
USA: Helios Custom Audio, 13266 Beaver, Sylmar, California 91342. Phone: (213) 362-2328.

Fully custom designed consoles for all recording requirements by original Helios designer Richard Swettenham. Construction in the UK by Tweed Audio. An update and refurbish service for all existing Helios consoles also available.

HILL (UK)
Malcolm Hill Associates, Hollingbourne House, Hollingbourne, Kent. Phone: 062780 556.

Ranges of multitrack consoles for 4- to 24-track applications, fully modular with range of options.

ITAM (UK)
Industrial Tape Applications, 1-7 Harewood Avenue, Marylebone Road, London NW1 6LE. Phone: 01-724 2497. Telex: 21879.

Models include 12/4 compact mixer with 8-channel monitoring, the *Stereo-Eight* 8/2 console and the *Sigma* multitrack console that is 16/8/16 in basic format.

INTERFACE (USA)
Interface Electronics Inc, 3810 Westheimer, Houston, Texas 77026. Phone: (713) 626-1190.

Several ranges of modular mixers of 8 to 48 inputs for 4 to 16 track use.

INTERNATIONAL CONSOLES (USA)
International Consoles Corp, PO Box 862, Utah 84601. Phone: (312) 358-4622.
UK: Feldon Audio Ltd, 126 Great Portland Street, London W1N 5PH. Phone: 01-580 4314. Telex: 28668.

58 ▶

Eventide Clockworks

The Eventide SP 2016 programmable effects processor:

The most versatile audio processing instrument ever developed is now available: EVENTIDE, with over a decade of leadership in digital audio effects again advances the state-of-the-art with the SP2016 Programmable Effects Processor. In a single 3½" rack mounted device, EVENTIDE has engineered the most powerfully versatile digital processing system ever employed in an audio component.

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The SP2016 provides EVENTIDE's Digiplex echo, our digital version of multiple-head tape echo. Exclusive features include incredibly stable operation, giving literally hours of decay time with no noise build-up.

CHORUS EFFECTS AS YOU'VE NEVER HEARD THEM BEFORE
ADT takes on a whole new meaning. "D" can now stand for dozens, not just double! Each voice can vary randomly in time, amplitude and space.

FULL BANDWIDTH DELAY
16kHz: 0 to 1.6 sec. delay in 25 microsecond steps.
8kHz: 0 to 3.2 sec. delay in 30 microsecond steps.

SELECTIVE BAND DELAY
The first in a series of dramatic new effects exclusive to the SP2016. You can separate the signal into a number of frequency bands and independently delay each band up to 3.2 seconds.

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Quality and control features far surpassing existing devices.

CLASSICAL DIGITAL LINEAR PHASE FILTERS
For PA, crossovers and EQ. Design filters to your specifications using the IEEE-compatible remote controller.

FULL STEREO OPERATION
2 in, 2 out.

PROGRAM SOFTWARE SUBSCRIPTION SERVICE
The SP2016's digital circuitry is so powerful, we've yet barely tapped the ultimate capabilities inherant in the Programmable Effects Processor. EVENTIDE continues to develop new and exclusive effects for the SP2016. Not just updated and refined reverb programs (although we will offer these, too) but totally new and unique effects. Because the SP2016 is a fully programmable system, we can supply these new effects (as well as revisions) as they are developed via convenient plug-in modules. They will be available individually or through our program software subscription service. The SP2016 is obsolescence proof.

SELF-TEST FEATURE
The most extensive self-test capabilities of any pro-audio product ever! Should a problem develop, the SP2016 will spot it and even pinpoint the part number of the suspect I.C.

U.K. Distributors

FELDON AUDIO

126 Great Portland Street, London W1N 5PH Tel: 01-580 4314. Telex: London 28668.

product Mixing consoles guide

Modular system console with modules available for separate functions and separate updating without console replacement. Full automation and memory of knob positions.

KAJAANI (Finland)
Kajaani OY Electronics, Nuaskatu 11, SF-87400 Kajaani. Phone: (86) 37.311. Telex: 33148.

10EA Series of compact consoles with six to 24 inputs and two to four outputs and the *KAJAC Series* of in-line multitrack recording consoles with up to 36 output busses.

MCI/SONY (USA)
MCI (a Division of Sony Corp of America), 1400 W Commercial Blvd, Fort Lauderdale, Florida 33309. Phone: (305) 491-0825. Telex: 514362.
UK: MCI (Professional Studio Equipment) Ltd, MCI House, 54-56 Stanhope Street, London NW1 3EX. Phone: 01-388 7867. Telex: 261116.

JH-500D Series of 28 to 56 inputs multitrack automatable consoles, *JH-600 Series* in 18 to 36 input sizes and wide number of options including split consoles and modifications for mobile uses, and *JH-800* general purpose console with up to eight input channels.

MIDAS (UK)
Midas Audio Systems Ltd, 54-56 Stanhope Street, London NW1 3EX. Phone: 01-388 7060.
Canada: Gerr Electro-Acoustics Ltd, 363 Adelaide Street East, Toronto, Ontario M5A 1N3. Phone: (416) 868-0528. Telex: 06524385.

PR range of multifunction consoles that are constructed from a range of 20 *PR system* modules to provide simple or complex consoles as required.

M-JAY (UK)
M-Jay Electronics Ltd, Albion Mills, Church Street, Morley, Leeds LS27 8LY. Phone: 0532 524956.

Range of *Airdale* studio consoles from 16/8/8 to 32/24/24 with stereo outputs.

MM (UK)
MM Electronics, PA:CE Musical Equipment Ltd, 63 Kneesworth Street, Royston, Herts. Phone: 0763 45214.

Range of PA/recording consoles with input channels up to 20 channels and outputs for 4-track or stereo use.

NEOTEK (USA)
Neotek, PO Box 11127, Chicago, Illinois 60611. Phone: (312) 929-6699.

Several ranges of multitrack consoles with maximum console sizes of 32-channel with automation and other options.

NEPTUNE (USA)
Neptune Electronics Inc, 934 NE 25th Avenue, Portland, Oregon 97232. Phone: (503) 232-4445.
UK: Court Acoustics Ltd, 35/39 Britannia Row, London N1 8QH. Phone: 01-359 0956. Telex: 268279.

Ranges of small consoles with maximum sizes of 24-channel, that have both PA and stereo/4-track applications.

NEUMANN (West Germany)
Georg Neumann GmbH, Charlottenstrasse 3, D-1000, Berlin 61. Phone: 030 251-4091. Telex: 184595.
UK: FWO Bauch Ltd, 49 Theobald Street, Boreham Wood, Herts WD6 4RZ. Phone: 01-953 0091. Telex: 27502.
USA: Gotham Audio Corp, 741 Washington Street, New York, NY 10014. Phone: (212) 741-7411. Telex: 129269.

Range of modules that can be assembled into consoles to meet precise requirements in a variety of sizes.

NEVE (UK)
Neve Electronics International Ltd, Cambridge House, Melbourn, Royston SG8 6AU. Phone: 0763 60776. Telex: 81381.
USA: Rupert Neve Inc, Berkshire Industrial Park, Bethel, Connecticut 06801. Phone: (203) 744-6230. Telex: 969638.

Wide range of consoles from the *8108*, 56-input console with 48-track capability and the option of *Necam* automation system, to the compact 8/2 portable suitcase console *542*.

PARTRIDGE (UK)
Partridge Electronics Ltd, 56 Fleet Road, Benfleet, Essex SS7 5JN.

Range of mixers for recording use between 5/1 and 24/8 formats.

PLUS 30 (France)
Plus 30, 37 Rue des Annelets, F-75019, Paris. Phone: (1) 202.21.02.

Modular in-line mixing console system.

PRIMROSE (UK)
Primrose Electronics Ltd, Reddings, Kirkby on Bain, Woodhall Spa, Lincs. Phone: 0526 52950.

Custom console designers and manufacturers.

PROGRESSIVE (UK)
Progressive Electronic Products Ltd, 83 Leonard Street, London EC2A 4RB. Phone: 01-729 5411.

Manufacturers of console modules available in various forms. Also a range of small to medium sized multitrack consoles.

PROTECH (USA)
ProTech Audio Corp, Flowerfield Building 1, St James, NY 11780. Phone: (516) 584-5855.

Integra 3 range of PC card modules for assembly into a wide variety of mixing consoles; *FPC Series* of portable consoles from 8/4 to 16/8.

PYE (UK)
Pye TVT Ltd, PO Box 41, Coldhams Lane, Cambridge CB1 3JU. Phone: 0223 245115. Telex: 81103.
USA: Central Dynamics Corp, 331 W Northwest Highway, Palatine, Illinois 60067. Phone: (312) 991-4720.

SM12 compact 12/4 modular portable console.

QUAD/EIGHT (USA)
Quad/Eight Electronics, 11929 Vose Street, North Hollywood, California 91605. Phone: (213) 764-1516. Telex: 662446.
UK: Feldon Audio, 126 Great Portland Street, London W1N 5PH. Phone: 01-580 4314. Telex: 28668.

Pacifica and *Brentwood/Coronado* multitrack consoles with maximum mainframe sizes of 36 channels; *248 Series* of console components and *Compumix III* automation system.

QUANTUM (USA)
Quantum Audio Labs Inc, 1909 Riverside Drive, Glendale, California 91201. Phone: (213) 841-0970.

Ranges of compact consoles of up to 16 channels and larger consoles of up to 32 inputs.

RAC (UK)
Rugby Automation Consultants, 220 Alwyn Road, Rugby, Warwicks CB22 7RA. Phone: 0788 810367.

Specialist in the manufacture of smaller custom consoles.

RAINDIRK (UK)
Raindirk Ltd, 33A Bridge Street, Downham Market, Norfolk. Phone: 03663 82165. Telex: 817737.

Wide range of recording consoles from portable 8/2 to full-featured 40-channel consoles. Raindirk also custom manufacture.

REBIS (UK)
Rebis Audio, Kinver Street, Stourbridge, West Midlands DY8 6A. Phone: 0384 71865.
USA: Klark-Teknik Electronics Inc, 262A Eastern Parkway, Farmingdale, NY 11735. Phone: (516) 249-3660.

Custom-built mixing consoles but also offer a standard mainframe of 28/16 with up to 32-track monitoring.

RSD (UK)
Recording Studio Design, Chaul End Lane, Leag, Luton, Beds. Phone: 0525 570621. Telex: 825612.
USA: Studiomaster Inc, 1365C Dynamics, Anaheim, California 92806. Phone: (714) 528-4930. Telex: 678407.

60 ▶

HARNESSING SOUND AT THE SPEED OF LIGHT

With the rapidly expanding video market comes the increasing demand for better sound quality. Simple extension of existing audio facilities through the addition of a video cassette machine, a colour monitor and a Q-LOCK Synchroniser offers a new dimension to your market.

Q-LOCK enables you for the first time to have precise synchronised control over an audio, video or film machine matrix in any combination.

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- Integral multi-standard SMPTE jam sync code generator with NEW GEN-LOCK option for regenerating code.
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- User orientated design by graduates of post production.
- Supplied complete with generator, readers, machine interfaces and all necessary cabling and connectors.

Effectively combining any three machines, be it video, audio or film, the Q-LOCK System controls the whole machine matrix as a single piece of equipment, giving you greater flexibility, easier sound editing and improved accuracy. More machines can be added on a chase basis.

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Tel: St. Albans 32191. Telex 299951

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Telephone no .....
Type of business Audio Video Film Broadcasting

product Mixing consoles guide

Ranges of mixers for live and recording use up to four-track with 16 input channels.

RSD (Canada)
Richmond Sound Design Ltd, 1234 W 6th Avenue, Vancouver, British Columbia V6H 1A5. Phone: (604) 734-1217. Telex: 0454667.
USA: Listec Television Equipment Corp, 30 Cain Drive, Plainview, NY 11803. Phone: (516) 694-8963. Telex: 640470.

Ranges of portable recording consoles with facilities for up to 8-track use with 24 inputs.

SAIT (Belgium)
Sait Electronics SA, 66 Chaussee de Ruisbroek, B-1190 Bruxelles. Phone: 02 376.20.30. Telex: 61130.
UK: Sait Electronics UK, Wireless House, 31 River Road, Barking, Essex IG11 0BX. Phone: 01-594 5642. Telex: 897576.
USA: Sait Inc, 33 Rector Street, New York, NY 10006. Phone: (212) 422-6690. Telex: 222411.

Manufacturer of consoles of most sizes and for a wide range of applications. Custom building also available.

SAJE (France)
SAJE SA., 5 Rue Solferino, 92100 Boulogne, Billancourt. Phone: 609.15.54.

CSM 6 console is a multipurpose modular console in sizes from four to 40 inputs with a choice of three input modules.

SATT (Sweden)
SATT Electronics AB, Tellusborgsvagen 90-94, PO Box 32006, S-12611 Stockholm. Phone: 08 81.01.00. Telex: 10884.
UK: AEG-Telefunken (UK) Ltd, Market Street, Maidenhead, Berks SL6 8AE. Phone: 0682 39171.

Two compact portable consoles of 4/2 and 8/2 sizes with full facilities.

SECK (UK)
Bandive Ltd, 10 East Barnet Road, New Barnet, Herts EN4 8RW. Phone: 01-440 9221. Telex: 25769.

Range of low cost mixers with sizes from small basic models to the *1682* with 16 channels.

SIEMENS (West Germany)
Siemens AG, D-7500 Karlsruhe 21. Phone: 0721 595-2428. Telex: 782851.
UK: Siemens Ltd, Siemens House, Windmill Road, Sunbury-on-Thames, Middlesex TW16 7HS. Phone: 09327 85691. Telex: 8951091.

Ranges of modular mixing consoles that can be used in many applications. Top of the range is the *Sitral C* console system offering up to 48 channels.

SOLID STATE LOGIC (UK)
Solid State Logic Ltd, Stonesfield, Oxford. Phone: 099389 8282. Telex: 837400.
USA: Musicworks International, 2352 Wisconsin Avenue NW, Washington, DC 20007. Phone: (202) 342-1501. Telex: 23440519.

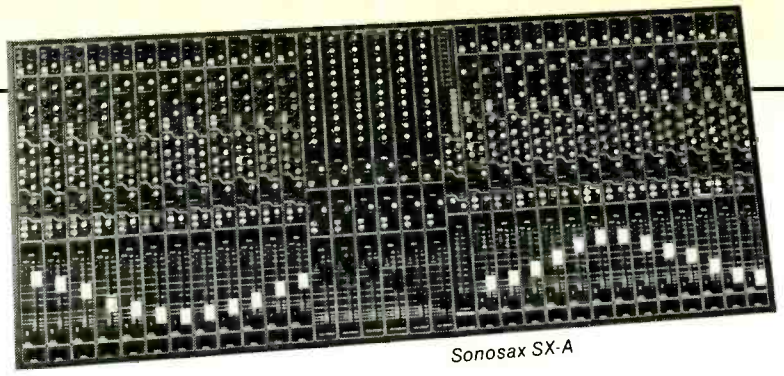
Automated computer controlled consoles with a maximum mainframe size of 56 channels. *Total Recall* option allows storage of console knob positions.

SOLIDYNE (Argentina)
Solidyne Srl, Tres de Febrero 3254, 1429 Buenos Aires. Phone: 701-8622.
USA: Intectra, 2349 Charlston Road, Mountain View, California 94043. Phone: (415) 967-8818. Telex: 345545.

Wide variety of consoles from 4-channel portables to full studio modular multitrack consoles with over 32 input channels.

SONETEC (France)
Sonetec, 21 Avenue du Fort, F-92120 Montrouge. Phone: 654.07.07. Telex: 202347.

Range of modular recording/PA consoles with up to 32 input channels, smaller modular range with VCA control features and a compact 8/4 console for portable use.



Sonosax SX-A

SONIFEX (UK)
Sonifex Sound Equipment, 15 College Street, Irthlingborough, Wellingborough, Northants NN9 5TU. Phone: 0933 650700.

Ranges of consoles with models from 6/1 to 16/6 in intended for broadcast applications but also capable of smaller recording use.

SONOSAX (Switzerland)
Sonosax, Route d'Yverdon 27, CH-1028 Preverenges/Lausanne. Phone: 021. 71 13 13.

Light and compact modular mixing system for multitrack use with wide choice of modules with standard features including VCA sub-grouping and a compressor on each channel.

SONY (Japan)
Sony Corporation, 7-35 Kitashinagawa, 6-chome, Shinagawa-ku, Tokyo 141. Phone: 03 448 2111. Telex: 22262.
USA: Sony Corp of America, 9 West 57th Street, New York 10019. Phone: (212) 371 5800.
UK: Sony (UK) Ltd, Pyrene House, Sunbury-on-Thames, Middlesex. Phone: 09327 89581. Telex: 266371.

Range of small basic mixers for portable use, The *MX-20* 8-channel unit can be ganged with another to form a 16-channel console.

SOUNDCRAFT (UK)
Soundcraft Electronics Ltd, 5 Great Sutton Street, London EC1V 0BX. Phone: 01-251 3831. Telex: 21198.
USA: Soundcraft Inc, 20610 Manhattan Place, Torrance, California 90501. Phone: (213) 328-2595. Telex: 182499.

Various ranges of consoles from PA/recording models whose functions are determined by the choice by modules, to several models of studio multitrack consoles with separate output groups and monitoring, some being automation ready.

SOUNDOUT (UK)
Soundout Laboratories Ltd, 91 Ewell Road, Surbiton, Surrey KT6 6AH. Phone: 01-399 3392. Telex: 8951073.
USA: Soundtracs Inc, 262a Eastern Parkway, Farmingdale, NY 11735.

Semi-portable mixing consoles for recording applications with sizes up to 24/4/2.

SOUND WORKSHOP (USA)
Sound Workshop Professional Audio Products Inc, 1324 Motor Parkway, Hauppauge, New York 11787. Phone: (516) 582 6210.
UK: Trad Electronic Sales ltd, 149b St Albans Road, Watford, Hertfordshire WD2 5BB. Phone: 0923 47988. Telex: 262741.

Several ranges of in-line consoles for multitrack recording with up to 36-channel mainframes. Automation option.

SPECTRA SONICS (USA)
Spectra Sonics, 770 Wall Avenue, Ogden, Utah 844041. Phone: (801) 392-7531.
UK: (modules and components) Sun Recording Services, 34-36 Crown Street, Reading, Berkshire. Phone: 0734 595647.

62 ▶

CHECKING PHASE . . . A new approach from BSS

The BSS AR130 is a unique PHASE CHECK system that departs from the conventional unidirectional pulse method, with all its inherent inconsistencies. The AR130 utilises a continuous encoded-tone test system, that gives outstandingly consistent results in applications such as multiple driver speaker arrays, amplifier racks, multiways, etc.

If you use, design or build, any form of active or passive electrically connected equipment, call for your spec sheet on this invaluable piece of test equipment.

AGENTS:
France: Regiscene, Paris 374 58 36. **Belgium:** T.E.M. Brussels 569 18 23. **Holland:** Ampco BV Utrecht 433 134. **Germany:** Audio Vertrieb. GmbH Hamburg 524 51 51. **Spain:** Lexon Distribuciones, Barcelona 203 48 04. **Italy:** Ivo Cabrini, Parma 698 144. **Australia:** Audio Mix Systems, Roe Bay, Sydney. **South Africa:** Colosseum Acoustics, Johannesburg 23 4541. **Austria:** Bourke & Dissertori GmbH Wels 52242 7147. **Canada:** Gerr Electro Acoustics, Toronto 868 05 28. **America:** Klark Teknik Inc, N.Y. 249 3660. **Japan:** Matsuda Trading Co, Tokyo 255 3047.
UK AGENTS:
HHB Hire and Sales, London 961 3295; Scenic Sounds, 01 734 2812; Music Laboratory 01 388 5392; Turnkey 01 440 9221; Wigwam Acoustics 0706 68766; Autograph Sales 01 267 6677.

Brooke Siren Systems, 92 Colney Hatch Lane, London N10. Tel: 01-444 7892. Telex: 912881 BSSAUDIO

STL

PRECISION

MAGNETIC

TEST TAPES

UK Distributors:
PRECISION AUDIO MARKETING
Bimini House,
Christchurch Road,
Virginia Water,
Surrey

Tel. Wentworth 4416

Manufactured in the USA by Standard Tape Laboratories Inc.

product Mixing consoles guide

Custom and standard consoles for recording and broadcast purposes. There is a wide number of configurations depending on the choice of modules.

SPHERE (USA)
Sphere Electronics, 20201-A Prairie Ave, Chatsworth, California 91311. Phone: (213) 349-4747.

Standard and custom consoles for a wide variety of applications. Standard range includes *Eclipse C* console with interchangeable equalisers, VCA subgroups and automation.

STELLAVOX (Switzerland)
Stellavox, CH-2068 Hauterive, Neuchatel. Phone: 038.33.42.33. Telex: 35380.
UK: Future Film Developments, 36/38 Lexington Street, London W1V 3LE. Phone: 01-437 1892. Telex: 21624.
USA: ADB Alanco, 6630 Tailor Road, Box 108, Blacklick (Columbus), Ohio.

5/2 portable mixer with phantom and AB powering, built-in limiters etc.

STRAND SOUND (UK)
Rank Audio Visual Ltd, PO Box 51, Great West Road, Brentford, Middlesex TW8 9HR. Phone: 01-568 9222. Telex: 27976.
North America: Strand Century Ltd, 6334 Viscount Road, Malton, Ontario, Canada.

Two ranges of modular recording mixers with maximum size of 32/4.

STUDER (Switzerland)
Studer International AG, CH-5430 Wettingen. Phone: 056 2687 35. Telex: 53682.
UK: FWO Bauch Ltd, 49 Theobald Street, Boreham Wood, Herts WD6 4RZ. Phone: 01-953 0091. Telex: 27502.
USA: Studer Revox America Inc, 1819 Broadway, Nashville, Tennessee 37203. Phone: (615) 329 9576.

Several ranges of recording consoles in modular form with sizes up to 32 channel and some models with automation.

TAB (West Germany)
Tonographie Apparatebau V Willisen GmbH Co, PO Box 130534, Kleine Klotzbahn 27, D-5600 Wuppertal 1. Phone: 0202 447452. Telex: 8591742.

T30 Series of modular mixers that are constructed around differing mainframe sizes from a wide selection of modules to form consoles for the intended application.

TANGENT (USA)
Tangent Systems Inc, 2810 South 24th Street, Phoenix, Arizona 85034. Phone: (602) 267-0653.

Several ranges of multitrack consoles with input channel sizes up to 32 channels and full studio facilities.

TAPCO (USA)
EV-TAPCO, Division of Gulton Industries, 3810 148th Avenue NE, Redmond, Washington 98052. Phone: (206) 883-3510. Telex: 4492594.
UK: Electro-Voice (Gulton Europe) Ltd, Maple Works, Old Shoreham Road, Hove, Sussex BN3 7EY. Phone: 0273 778401. Telex: 87680.
Range of smaller consoles with stereo recording facilities and input sizes up to 36 channel.

TEAC/TASCAM (Japan)
USA: Teac Corporation of America, 7733 Telegraph Road, Montebello, California 90640. Phone: (213) 726-0303. Telex: 677014.
UK: Harman (Audio) UK Ltd, Mill Street, Slough, SL2 5DD. Phone: 0753 76911. Telex: 849069.

Wide range of consoles from basic 8/2 to the *M-16* 16- or 24-channel console with 16- or dual 8-channel monitoring.

TECHNICAL PROJECTS (UK)
Technical Projects, Electrosound House, 11 Marshalsea Road, London SE1 1EP. Phone: 01-403 3838. Telex: 885659.

The new name for the special projects division of Theatre Projects. They undertake custom console design include large post production models.

TECNICOBEL (France)
Tecnicobel, 8 rue de la Croix-Matre, BP26, F-91122 Palaiseau Cedex. Phone: (1) 920.80.39. Telex: 692543.

RB60 and *RS50 Series* of modular consoles with the *RB60* console expandable to 42-channel.

TOA (Japan)
UK: Toa Electric Co Ltd, PO Box 82, Castle Street, Ongar, Essex. Phone: 0277 364333. Telex: 995554.
USA: Toa Electronics Inc, 1023 Grandview Drive, San Fransisco, California 94080. Phone: (415) 588-2583. Telex: 331332.

Range of small mixers of up to 16 channel for stereo use.

TORE SEEM (Norway)
Tore Seem A/S, PO Box 10, N-1344 Haslum. Phone: 02.53.39.75. Telex: 19121.

SEESAM series of consoles from 24 to over 40 channels with automation. Also the *SEEMIX* series, a simplified version of *SEESAM* system and ranges of smaller consoles.

TOTAL AUDIO CONCEPTS (UK)
Total Audio Concepts Ltd, Islington Mill, James Street, Salford M3 5HW. Phone: 061 8346747. Telex: 668127.

Three ranges of mixers, two of which have recording applications; the *TAC 1682* System for multitrack consoles up to 40/8/2 with 24-track monitor, and the *TAC 1042*, a 10/4/2 with 8-track monitor mix.

TRACKTECH (UK)
Tracktech, 159 Park Road, Kingston-upon-Thames, Surrey, KT2 6BX. Phone: 01-549 9130.

Compact in-line consoles in four sizes up to 24/24/16.

TRIDENT (UK)
Trident Audio Developments Ltd, Post No 38, Studios Road, Shepperton, Middlesex TW17 0QD. Phone: 09328 60241. Telex: 8813982.
USA: Trident (USA) Inc, 652 Glenbrook Road, Stamford, Connecticut 06906. Phone: (023) 357-8337. Telex: 643678.

TSM series of comprehensive multitrack consoles, *Series 80* simpler multitrack consoles, Trimix expandable compact mixing system and from the Consumer division, the *VFM series* of budget consoles.

TWEED (UK)
Tweed Audio Electronics, Pinnaclehill Industrial Estate, Kelso, Roxburghshire, Scotland TD5 8DW. Phone: 0573 2377. Telex: 727633.
USA: Tweed Audio (USA) Inc, 12 Ilex Drive, Newbury Park, California 91320. Phone: (805) 499-4764. Telex: 652337.

Offer a custom console building service as well as standard range of consoles including models from small portable units to larger consoles with 24 track monitoring.

WARD-BECK (Canada)
Ward-Beck Systems Ltd, 841 Progress Avenue, Scarborough, Ontario M1H 2X4. Phone: (416) 438-6550. Telex: 06525399.
USA: Ward-Beck Systems Inc, 6900 E Camelback Road, Suite 1010, Scottsdale, Arizona 85251.

Range of consoles for multitrack use but in connection with TV audio and broadcasting requirements.

WESTREX (USA)
Westrex, 2629 West Olive Avenue, Burbank, California 91505. Phone: (213) 846-3394. Telex: 698254.

ST3000 modular consoles with input/output combinations according to requirements. Also compact mixer for location work.

YAMAHA (Japan)
USA: Yamaha International Corp, PO Box 6600, Buena Park, California 90620. Phone: (714) 522-9105.
UK: Yamaha Musical Instruments, Mount Avenue, Bletchley, Milton Keynes, Bucks. Phone: 0908 71771.

Modular console ranges of up to 32 channels with dual PA and recording applications.

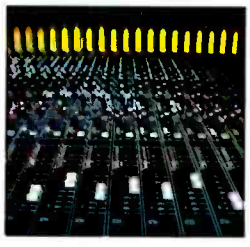
ZOOT HORN (UK)
Zoot Horn Equipment, 31 Station Road, London SE25 5AH.

Modular and expandable console systems with applications for PA and recording in various forms set by choice of modules. ■

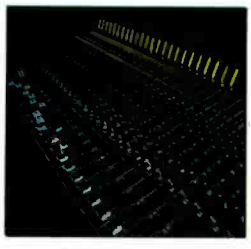
Facilities:

The MR-3 is supplied complete with integral patchbay and varying frame sizes to accommodate up to 56 input channels.

Each input module has a full 24-track output-assign matrix and three bands of parametric E/q, with a high pass filter and optional variable 'Q' on each band.

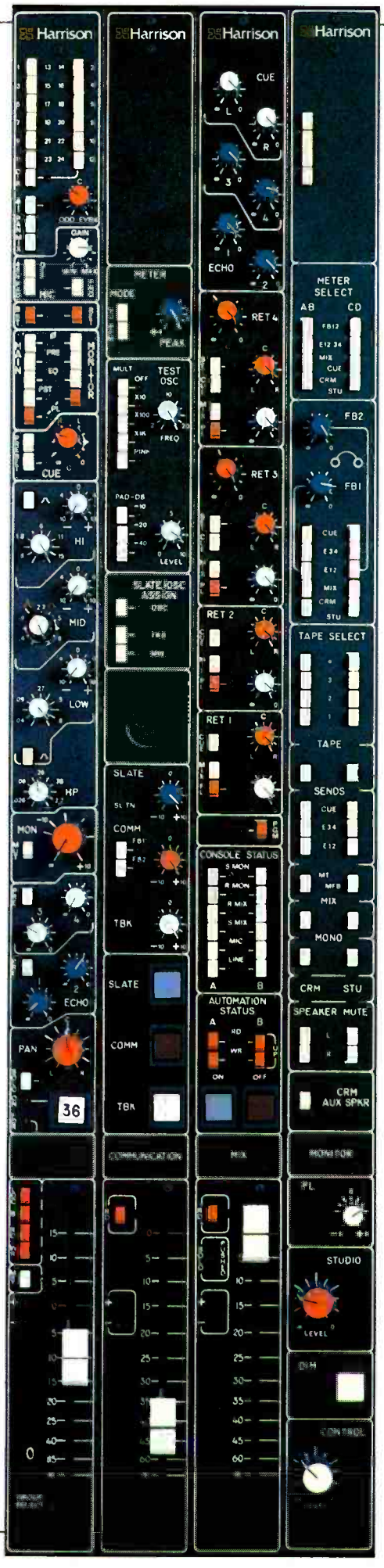


In addition, each module offers six auxiliary sends and a direct assign button for multitrack recording.



Major console status changes are effected with one-button ease. Six modes of operation are available including two new statuses for broadcast and video post production.

The standard VCA faders enable the operator to establish VCA groups when recording and mixing. The console is prepared for rapid installation of three proven automation systems: Melkuist, Allison and Harrison's own Auto-set.



The Harrison MR-3. High on Features, Low on Price.

You can never afford to buy cheaply. What you must do these days is buy economically.

Recognising this, Harrison has developed the MR-3 music desk. High on impressive features, but not on cost, the MR-3 represents excellent value and a unique opportunity to invest in Harrison performance.

In other words the MR-3 guarantees maximum efficiency in 24-track recording.

The Harrison MR-3. Underpriced it may be, undermade it's not.

To find out more about the Harrison MR-3 contact F.W.O. BAUCH at the address below.

Harrison

F.W.O. Bauch Limited

49 Theobald Street, Boreham Wood, Hertfordshire WD6 4RZ
Telephone 01-953 0091, Telex 27502

Post production at Disney

Bob Anthony

Walt Disney Studios in Burbank, California, have long been known for their successful film and television projects. One of the contributing factors in the overall quest for excellence has been the quality and care that goes into each magnificent soundtrack. As a means of upholding that fine tradition, Disney's audio department ordered a mammoth, state-of-the-art, re-recording board from Harrison Systems, Nashville.

THE layout of the console system at Disney comprises four separate mixing panels – one each for dialogue and music, and two for sound effects – arranged symmetrically around a central producer's desk. Each mixing section houses 12 channels, and all of the desks are basically interchangeable. The features per channel are parametric equalisation (one high, two mids, and one low) plus high- and lowpass filters, panpot, four echo sends, and switches to compare tape-recorded signal to that coming off the fader. Grouped together near the top of every section are eight submaster selector switches which are all assignable, and eight reassigns. (The reassigns allow the engineers to electronically move outboard equipment to various channels of the board.) Although the number varies, there are usually at least two 7-band graphic EQ's per desk. One of the sound effects stations and the dialogue desk contain remote switching apparatus (forward, reverse, and stop) for operating the projector, replay machines, and the recorder.

The board also features a 'B' side, which doubles the number of inputs to 96 with a flick of a switch (assuming that sufficient replay machines are available) either all at once, or one channel at a time.

Sound effects mixer Frank Regula explains the advantage: "I have only 12 faders, but sometimes I need another loop for wind, traffic, etc. At one point in the reel where I don't need the cut track that's there, I'll have the crew-chief put the loop on the 'B' side. When I get to the point where I need it, I'll just punch it up, and in essence, I have an additional track."

Since the board was installed two years ago, the re-recording engineers – John Van Frey, dialogue; Nick Alphin, music; and Frank Regula, effects – have developed a strategy by which every project methodically acquires unique aural dimensions.

Dialogue

Of the three parts of any soundtrack, the dialogue is probably, in some ways, the least intricate, yet also the most important. When the dialogue tracks can't be understood, the film is severely crippled, if not completely worthless.

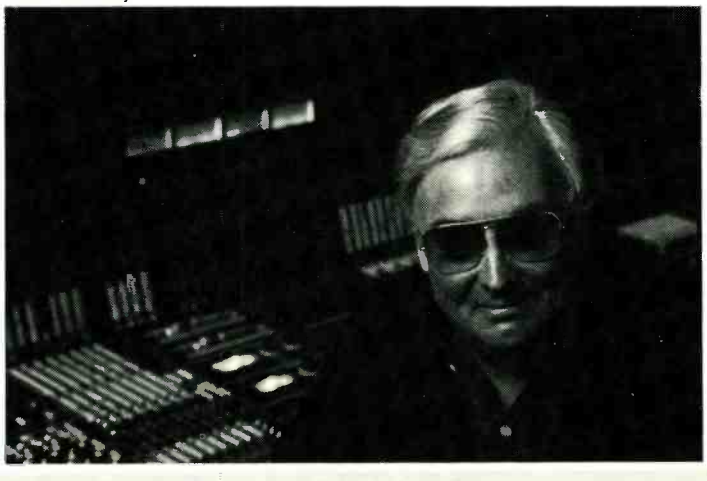
The dialogue is usually recorded on location with a ¼ in Nagra. However, some directors, like Robert Altman, prefer an 8-track recorder for specific applications. For example: given eight actors, eight radio mikes may be fed to individual tracks, which are later mixed and transferred to 35 mm magnetic film. From this point on, all the tracks are treated the same. After being cut by the editor, the tracks are brought to re-recording where John Van Frey, the editor, producer and other interested parties, scrutinise the entire show for dialogue quality. The decisions are made as to what needs to be looped, or lived with.

If the original tracks are not usable, the actors must be brought into the studio to re-do their audio parts. However, the two alternatives for recording them are either individually, or in a group, neither of which is totally sufficient. Recording all the parts at one time around a single mike very seldom produces an aural perspective that matches the visual perspective caught by the camera on the set. The better alternative, from the engineer's point of view, is to record the actors separately. But this means the actor must try to recreate his dialogue with no other stimulus. This, also, generally yields a less than satisfactory track, because it lacks the proper level of emotion.

"One of the biggest problems I have," says Van Frey, "is matching dialogue done on location with dialogue recorded on a sound stage. Hopefully I can find out from production what mike they used on the live stage and match it. Overall, the best tracks for me to work with are ones that are clean with no reverberation or ambience of any kind. If that ambience effect is necessary, I can add it electronically with digital delays, echo units, etc, but if the original track has a lot of ambience, it can't really be removed to match a drier scene."

Once these discrepancies are ironed out, the tracks are mixed with what few outboard effects are necessary, and the dialogue is finished.

John Van Frey



Music

Nick Alphin oversees the music tracks from studio recording through re-recording. "We do everything right here on the lot, all live with 40, sometimes 60, people in the orchestra, depending on what the conductor wants. We mix down to the specific format on 4-track, 35 mm mag sprocketed film. The mixing process is tricky, because we must make sure that the mix in the studio control room will translate to the 500-seat re-recording theatre. The studio booth has JBL *4333* placed about 10 ft away from the mixing position, with live end/dead end acoustic treatment on the walls. The re-recording room, although designed to simulate the equivalent of three-quarters full, is still pretty live. Luckily, it's fairly representative of a standard theatre. What we hope for is that when we get to the dubbing stage, the mix doesn't need a lot of EQ."

If the project is headed for viewing via a mono medium, like television, Alphin will mix down the strings to one track, the wood and brass on another track, and all the rhythm section and keyboard player on the last so there are just three 'stripes' (tracks) to work with. That affords him at least some control over the separate orchestra sections, when he gets to the re-recording stage.

"For TV, a lot of composers, and I agree with them," says Nick Alphin, "will dub the tracks down on a teeny *Auratone*, because we know that the mix will eventually play on something similar to that. In fact, I've had composers dub down to just a mono track, and mix on a small speaker right in the studio."

The size of the theatre does introduce a slight inconvenience when working on television projects. "We really can't do a perfect mix for television in here," Alphin points out, "because we're mixing in such a big room. If we do it correctly on the big monitors to sound right on a small speaker, the producers don't usually like the balance. They don't realise that people listen to TV in their homes at a much lower level than what's considered normal in a dubbing studio. At low volumes, the voice still pops out, but the music and effects are lost. Instead we'll crowd the music and effects a little tighter to the voice for a television mix than we would for a project headed for theatre distribution. Fortunately, we'll be building a smaller room for television mixing."

Stereo film projects are not 2-track mixes, but 4-track left, centre, right and surround. Because some cues, such as those accompanying an intimate love scene, might not be necessary in the surround location, only the left, centre and right are mixed in the studio. The surround track, when needed, is derived during the dubbing process by combining the left and right channels, and feeding the composite to the back speakers through a time delay. Unfortunately, mixing flexibility, as it pertains to sections of the orchestra, is sacrificed for the true, 3-channel stereo required by this track configuration.

Effects

The complexity of most contemporary shows, necessitates a large

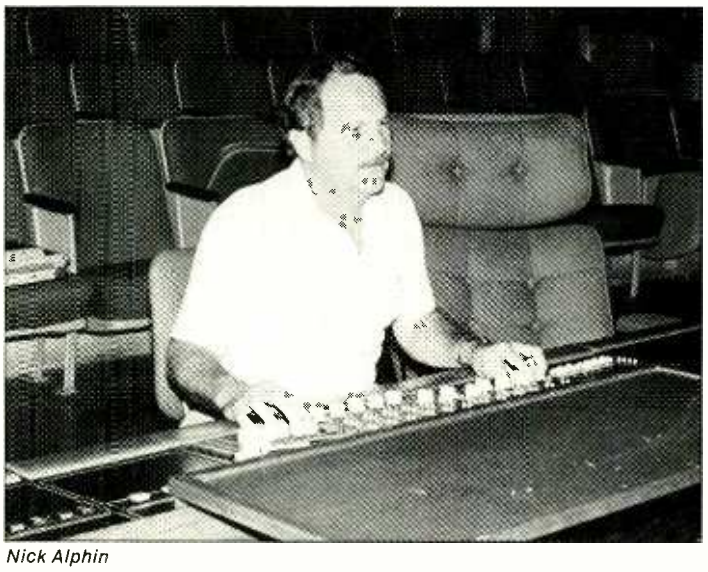
number of sound effects tracks per project. "At one time, some of the features done here would have only 10 or 12 effects tracks," remembers Frank Regula, effects mixer. "Now, particularly with stereo, there are up to 100 or 120 tracks. *The Black Hole* had 130 effects tracks on one reel, and a lot of those were stereo. The cue sheets go on forever. On those projects, where we have to keep predubbing down, we'll be doing effects up and down the entire board. The more hands there are, the faster it goes."

Whenever dialogue has to be replaced and looped, the background effects on those tracks, like footsteps, clothing movement, etc, are also lost, and need to be replaced. Regula may be called upon to record those on the separate Foley stage. He may also be required to go out in the field, and make effects tracks, like stereo backgrounds. Even though Disney Studios has a colossal sound effects library, new live elements may work better. Because the effects library goes back so many years, many of the elements are on noisy, optical tracks, and are not of acceptable quality for contemporary stereo pictures.

Any experimentation with 'magic sounds' (sounds requiring outboard equipment) or synthesiser work is done in the theatre, too, before the final dubbing takes place. This saves money during the re-recording process, because all the special sounds are worked out ahead of time.

During the cutting and editing, Frank Regula makes pre-dubs, and runs pieces of film in the theatre for review by the production staff. This is the time for decisions concerning noise levels, clarity, accuracy of sound, and so forth. For dubbing, all the elements are laid out in the most convenient order, depending on the particular project requirements. Regula determines the optimum layout available from the cue sheets, all the while trying to retain enough room for all of the tracks.

The effects tracks may be broken down into sections. For example all background parts will be kept together on a certain group of tracks and a pre-dub made of that. "I always want to keep backgrounds away from any moving effects like car chases, sirens, and whatever else will be fluctuating in level," stresses Frank Regula. "If the project calls for a chase scene with cars, those may be broken down into two sets of elements – the good guys' car sounds, and the ones that belongs to the bad guys. From those tracks, the squeals are pulled out, and laid on separate tracks. Likewise, each of the automobile engines get their own tracks. The object is to give ourselves as much flexibility as possible, and still get all the elements on the tape machines. That way, if the producer asks for more screech, hopefully, I won't find it tied up on the same track as the car engine.



Nick Alphin

Balance

The primary focus of any mix is to ensure that the dialogue, the music and the effects are balanced with one another. The projectionist at any playing theatre will set the audio at a comfortable level that's determined by the volume at the beginning of that show. If marginally-low dialogue is accompanied by loud effects and/or music at the beginning of the first reel, most theatre owners will turn down the overall volume. The result is that for the whole show, no one will understand the dialogue.

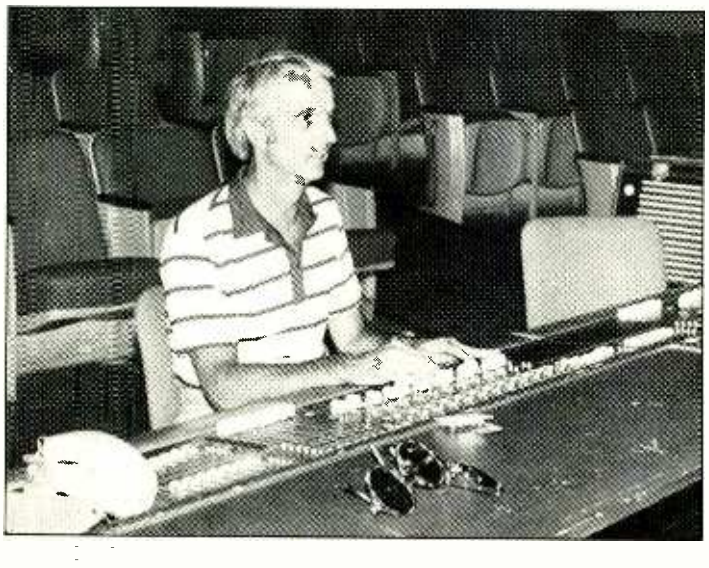
"You have to fool the operators in the theatres," says Nick Alphin. "They'll walk into the theatre during the first 100 ft of film, and arbitrarily set a level that will remain for a month. We have to give them something that we know they'll set at a resonably normal level. If we confuse them with some odd mix, they'll hurt us out in the field."

Frank Regula offers an example: "If the film starts with a huge loud explosion, the theatre owner will set the level of those explosions so he feels his speakers aren't going to be destroyed. What that means is that any dialogue that accompanies loud effects near the beginning, has to remain approximately the same level throughout the picture. If the mix volume is brought down, the audience will lose the dialogue at that point in the film."

The general rule of thumb is to do the dub at a pre-determined dubbing room sound pressure level, and keep everything in balance. The determination of the soundtrack's overall volume in a playing theatre is left up to the owner; he can crank up his system to whatever makes him happy. "You can always go up in volume," adds Nick Alphin, "but you can't always go down in the theatre, because you lose that delicate balance between the parts. The delicate background sounds, like breeze effects, get lost.

Interestingly enough, one of the most difficult situations that all of the engineers encounter is not of a technical nature. Obstacles occasionally arise when dealing with the backfield – the editor, producer, and all the other people who have input on any given project. One person is always easier to deal with than a committee, but even the solitary producer or director can generate a number of disagreements.

Frank Regula



The playback levels demanded by the production staff during dubbing is a case in point. "If the producer or director tells us they want the tracks louder to their ears," mentions Alphin, "the only way to accomplish that is to turn up the monitor to some extreme. But that fools everybody. Then we're changing the parameter of our ears in the room. We try to get our balance first, then turn up the level in the room when we play back the whole reel. Printed on mag, we peak at zero VU on the desk meter, but electronically, that translates to about +4 dB. That's 1% distortion. If the element is an explosion, we can sometimes go over that, because we don't care if the signal breaks up."

Another consideration along the same lines, is the producers who "like to hear a little scenario taking place off screen all the time in order to keep the action alive," says Frank Regula. "For instance: in a suburban setting, he may want to paint a picture with the sound of a lawn mower, kids, a bicycle, because he doesn't like the film to get too quiet. Well, that can present a problem sometimes. There's only so much sound you can put into a scene that the viewers are going to recognise without setting up the presence of those object ahead of time. He may want to hear sprinklers and birds off-camera, but unless you show a character watering a lawn somewhere prior to that, the sound is just going to be in the way. At difficult times like that, we try to persuade them that that's not the way to go. But they're the boss. We end up doing many things that are not our own ideas."

That's the one barrier that no amount of technology will ever be able to overcome. But that's good. Audio engineering shouldn't get too easy. ■

Biographies

John Van Frey started his career with Ryder Sound Services in Los Angeles, and worked for MGM and Warner Brothers before settling at Disney, where he's been for more than 20 years.

Nick Alphin started 'inside' on the lot doing loading, recording and various other jobs. He took a 'one day call' and has been with Disney just about 17 years.

Frank Regula spent a number of years in production doing mixing for shows. The following 12 years were spent at Warner Brothers as a boom man and mixer. Like Alphin, a one day call at Disney's led to what now amounts to almost 15 years of work.

Studiofile:1

Gerim Recording Studio, Chicago

Back in the '50s and '60s, Chicago was famous as the home of blues and R&B artists who would later prove to be the starting point for the rock revolution in the US and England. At the heart of the scene was Chess Records, through whose 3-track facilities passed such luminaries as Chuck Berry, Muddy Waters, Bo Diddley, and a group of studio musicians who would go on to form Earth, Wind & Fire. When Leonard, the last of the Chess brothers, died in 1969, the label moved its offices to New York, and within two years had lost almost all of its artist roster.

Gerald Sims, an imposing but soft-spoken black man, started working for Chess as a studio guitarist in 1962. Over the next several years, he moved around to Okeh and Brunswick Records, finally returning to Chess as a producer, with his own label for local musicians, called Gerim.

After the studio closed down, Sims spent his time teaching and selling musical instruments, although he did take brief forays back into the recording world, producing a gold record with Jerry Butler for Mercury, and a less successful solo album on Warner Bros.

In 1979, after it had been used as a dance studio for several years, the old Chess building was put up for sale. Sims thought the time would be ripe for him to get back into the business full time, and so he snapped it up. In February, 1981, Gerim Recording, at 2120 South Michigan Avenue (and if that rings a bell, check your old Rolling Stones albums—they were here, too), opened its doors.

Gerim Recording now has two studios. Studio A, the original Chess room, boasts an Amek 28/24 console and an MCI *JH-114* 24-track deck with *Autolocator III*. Monitors are *Time-aligned* UREI *838*s, powered by BGW amps. Mixdown is to a Studer *B67*, with an Otari *5050* serving as a second stereo deck. There are a pair of Ashly comp/limiters, a pair of UREI *1176*s, a Pultec *EQH-2*, and a Lexicon *Prime Time*. Reverb is provided by an *Ecoplate*. Two live chambers from the Chess days are still intact, but they are not hooked in. In the 40 × 24ft studio room, EV *Sentry III*s provide monitoring for up to 25 musicians. "The studio is set up for straight-ahead sessions and a live sound," says Sims. "I think that type of recording is coming back."

Sims and chief engineer Harry Brotman were in large part responsible for the control room design and the acoustic treatment in the studio. "I read all the books," recalls Sims, "and then collaborated with Pyramid Audio, who contracted it out." The treatment in Studio A is fairly simple, consisting of ceiling bass traps, recessed monitors, and large cloth panels along the long walls to break up standing waves.

Control room B

Studio B, which smells deliciously of fresh-cut wood, is, on the other hand, less than half the size of the 24-track room, and is clearly more oriented towards overdub sessions. The equipment is mainly Tascam: *90-16*, *80-8*, and *25-2* tape machines, and two *Model 5* mixers hooked up in tandem along with four *Model 1*s. Another Otari *5050* stereo machine is here, as are two more Ashly comp/limiters, an Orange County *Vocal Stressor*, and Tapco reverb and graphic eq. There is also a Master Room reverb unit. Monitors are JBL *4315*s and miniature Braun speakers, powered by Yahama, Tapco and Sansui amps. "We use this room mostly for in-house demos," explains Sims, "but it also provides our outside clients with a choice of what kind of recording they want to do and how much they want to spend." The 24-track studio goes for $100 per hour, and the 16-track is $50.

The two studios are connected by a 15 × 12ft "string room", lined entirely with wood tiles, in which resides a Knabe baby grand piano. Sims intends to acquire a Steinway grand shortly, and will then move the Knabe into Studio B permanently. Other house instruments include a Rhodes *88* and a Hammond *B3*.

The microphone complement is solid without being overly elaborate. It features the usual AKGs, Shures, Sennheisers, and Electro-Voices, as well as an impressive number of Neumann *U87*s. The house tape is Ampex *456*, which is almost always used at 30in/s with no noise reduction. "In my experience, noise reduction has a subduing effect on the sound," says Sims, "so I stay away from it. When I explain that to my clients, I find I have no trouble convincing them to spend the extra money on tape, particularly if they're going to be taking their tapes around to other studios."

The studios are up a flight of stairs, and Gerim's offices are on the ground floor. Leonard Chess's old office in the rear is now a large open concrete space, ornamented only by a set of disco lights in the ceiling. "They were part of the deal when we bought the wood tiles for the string room," explains Kathy Newman, studio manager and Sims's stepdaughter. "We don't use them for anything yet, but we do like the space as a rehearsal room."

"I'd like to do some in-house video production in there," says Sims, "and right now we're working on getting some ¾in equipment that we can eventually sync up with A control. Video's definitely the coming thing, but it's still a few years off. Once every home can afford a videodisc player, it'll be a must for every audio facility to have at least some video. We figure now is a good time to start in and get our feet wet."

In the few months that the studio has been open, business has been good, both for the rejuvenated Gerim label and independent projects. Sessions have included a gospel album with Mitty Collier, a Cleveland R&B group called 7 Miles High, and a new wave band called the Trouts. "When we opened, we didn't have any built-in clientele," says Sims. "We still need to find our business. Unlike the big rooms around town, we promote ourselves in the local papers." But, as Newman says, "it's not so bad building a studio up slowly. It gives us the chance to catch up with ourselves, and see how we can do things better."

About half of the studio's time is spent on Gerim Records projects, with most of the remainder taken up by independents. The studio has done a couple of commercials, a field that Sims would like to explore further, but, as he says, "We're really just set up right for music production.

"We have a very competitive room," he goes on, "so it's really just a matter of time before things start to really grow. We're not a big record company with PR men at every radio station coast to coast, so we have to tiptoe—promoting the studio and the label step by step."

Gerim has had its share of media coverage, however, including, while I was still in town, a segment on a local TV magazine called *On Cue*. The one item that seems to attract the most attention is not the string room, the mic collection, or the console. Rather, it is a door that leads to the back stairway, right behind the pay telephone and the Coke machine. On the door are scribbled many dozens of long-disconnected phone numbers of important people from the Chess days—session players, producers, and suppliers of various and sundry goods and services. There is even a number for Andrew Oldham.

The history of the building in which Gerim Recording is located is no doubt an attraction for those clients who would like to attach themselves to a legend, but, as Kathy Newman says, "We can't sell the studio on what it *used* to be." On the contrary, Gerald Sims and his staff are making a strong effort to provide a modern, quality facility for local music, black and white, in a town whose recording scene today is dominated by commercial clients. And that, in itself, might be of some historical significance.

Gerim Recording Studio, 2120 S Michigan Avenue, Chicago, Illinois 60616, USA. Phone: (312) 326-5450.

Paul D Lehrman

Tasco at Wembley Arena

Wembley Arena is no place for an inexperienced PA company, and in terms of sound engineers, it is well-known for sorting out the men from the boys. The usual approach is to have the stage positioned at one end with the PA flown above it, generally resulting in an acceptably good sound in the front seats but getting steadily worse as you move away from the stage. The direct to reverberant sound ratio decreases, until flutter echoes and discrete repeats, occurring somewhere in the rear sections of raked seating, make any plans of serious musical appreciation abortive. Other approaches have included going to the expense of rigging a number of individually driven systems, suspended from the roof at various points around the stadium, using a series of DDLs for time alignment, frequently with unsatisfactory results. Probably the most expensive, and certainly the most successful method to date is to suspend a system in a circle above a circular stage, and do the show in the round. There are only a small number of artists who can, or want to, afford such a rig, however Diana Ross is happily one of them, and it was this method that Tasco used for her series of concerts at Wembley in June.

Although Tasco are keen to point out that there is no such thing as a Tasco system, and that they will put

68 ▶

Studiofile:2

Tasco cont'd

together a rig to suit their client's needs and pocket, their number one system, and the type used at Wembley, is the Harwell, designed by Roger Harvey who has given Tasco an exclusive worldwide licence for its use. A basic system is made up of a number of stacks, with each stack comprising a bass unit, a low-mid unit and a combined high-mid and high unit. The bass cabinets measure approximately 1.3 × 1.0 × 0.8m, with the low-mid and the high-mid/high units having the same length and breadth, but half the height so that any number of any combination of units can be stacked or flown together, depending on the requirements of the venue, whilst still maintaining good visual appearance and stability.

Roger is understandably reticent to divulge the exact details of each unit's design, but the bass cabinets contain a pair of Gauss 15in drivers which are front and rear loaded with folded horns, taking the useful response down to around 30Hz. The low-mids come in at 200Hz, and use a design which Roger refers to as peripheral loading: two 12in drivers, usually JBL, are mounted diametrically facing each other, with a pair of saucer shaped, aluminium cast phase plates between them, so that the sound is dispersed out around the periphery of the units, feeding into a flared horn. Crossover point for the high-mids is 1.25kHz. They use a pair of JBL *2441*s both driving into an aluminium cast diffuser which looks like a larger version of a JBL bullet, feeding into a glass fibre flared horn, with anything over 6.3kHz being taken care of by four JBL *075*s. For heavier bands, sub-bass units are also available. These —normally driven by a dbx sub-harmonic synthesiser called a *Boom Box,* which produces at its output a signal one octave below that at its input—can make full use of the response of the sub-low units which can apparently function usefully at 15Hz. As these concerts were thought to be more or less cabaret shows, the response of the bass units was considered sufficient, and no sub-bass was used.

Roger quite openly states that there is nothing revolutionary about the design of the system, or the principles on which it is based. It is the exact dimensions of the various constructions such as the horn throats, and the relative path lengths of the front and rear loading on the bass units, together with the extremely high standard of materials and construction that make the system's performance special, not only aurally, but also in terms of durability on the road. Apart from the drivers, about 90% of the components that go to make up the system are designed by Roger and built in the workshops on site at Tasco's warehouse in Lambeth Road, or by local labour over which he can keep a close watch.

The system for Diana Ross consisted of 16 high-mid/high units, 16 low-mids and eight bass bins flown above the centrally placed stage, driven as four separate systems at right angles to each other, on axis with the arena. In addition to this there were also eight full range units, suspended under the main rig, pointing down towards the front rows of seating. Each of the four quadrants had its own crossover and Klark Teknik *DN27* graphic equaliser, and was aligned separately using a Klark Teknik *DN60* spectrum analyser together with the ears of engineer Barry Newman. The crossovers, also designed by Roger, were capable of driving a 6-way system, with switchable crossover points, using either 18dB/octave or 36dB/octave filtering; the latter slope being used in this case. The gear was brought in on Sunday to be rigged ready for the first show on Wednesday night, including a total of 38 electric winches which were suspended from the main supports of the roof by their main cables plus two sets of safety cables to comply with the GLC's safety regulations. The system was powered by a combination of BGW and Crown amplifiers.

All auxiliary equipment was mounted in custom-built rack units which Tasco call 'Satellite Racks', and can be filled with anything that the client desires, and connected via a multicore cable to a central patchbay. Via this, anything can be patched to anything; in this case a fairly standard array of compressors, gates and DDL/reverb units.

The sound was very good. The band was very laid back with Miss Ross' vocal well out in front. The Harwell system has met the general approval pretty well wherever it's been, and although it's substantially more expensive than its rivals, it is well booked up for the next few months.

James Francis

Tasco Sound Ltd, 113 Lambeth Road, London SE1. Phone: 01-582 3020.

Nimbus 9/Soundstage, Toronto

Somehow, I figured I was in for an interesting time when I decided to pay a visit to Nimbus 9/Soundstage. In reply to my initial inquiry, I received a 2-page computer-typed letter from chief engineer and studio manager Jim Frank, extolling the virtues and the history of the place, and describing the many, many activities that go on under the company's split-level roof.

My suspicions were confirmed when I arrived. On one side of the lobby lies the recording suite. On the other, a computer complex that would do justice to a medium-sized bank. Out back is another studio where David McLey was playing with the latest version of his digitally-controlled analogue synthesiser, and the lobby itself, with its exposed brick walls, butcher-block desks, plus couches, and track lighting, could have been a furniture showroom. I soon found out that it once was just that.

The story of how the furniture left and the recording gear and computer hardware found a home here goes something like this: "In the late '60s, Jack Richardson was an agency account executive for Coca-Cola," says Jim Frank, as he settles himself on a machine that dispenses that very beverage. "He produced a lot of commercials, both film and audio. One year the company decided to offer a record album as a prize for sending in bottle caps, and they asked Jack to produce it. One side was an unknown band out of Winnipeg called The Guess Who.

"He got the band a contract with RCA, but when their big single, *These Eyes,* started to fade, RCA wouldn't save them. So Jack quit his job, mortgaged his house, and took off to work with the band himself. He ended up doing so much producing, away from home, that his wife took out a full-page ad in *Billboard* that said, 'Jack — please come home! Shirley'. Of course, the record company had something to do with the ad, too."

The work included three albums for Poco, and Alice Cooper's first success after leaving Frank Zappa's fold. "Shep Gordon, Cooper's producer, left some of the band's early stuff on Richardson's desk one day," says Frank, "and the joke around the office was that whoever screwed something up had to produce these guys." Meanwhile, Al Macmillan, a local musician, found a furniture warehouse, set well back from a residential street, in the Yorkville section of Toronto, which at the time was in transition from hippie haven to ultrachic quarter, and joined Richardson as a partner, Macmillan hired Bob Ezrin who was a musical director for shows, to be Richardson's assistant. Ezrin was the one who recognised Alice Cooper's potential, and *I'm Eighteen, Billion Dollar Babies, Welcome to My Nightmare, Only Women Bleed* and other discs were the products of that collaboration. "It was an amazing match," says Frank.

Ezrin and Richardson were not happy with their constant travelling to New York and Los Angeles, or with the studios they had to work in in those cities. In 1972, they leased part of Macmillan's building and built their own 16-track studio, equipped with 3M and Ampex tape machines and an Auditronics console. A year or so later, Richardson and Ezrin invited some of the staff from the Mastering Lab in Los Angeles, where they had had many of their albums cut, to come to Toronto to re-do the control room, build a mastering room and modify the board.

"Bud Wyatt was one of the team," says Jim Frank, "and he took most of the transformers and a lot of the extra line amps out of the board. We ended up with the first transformerless console in Canada. Auditronics heard what we were doing and got a little curious. They sent a rep to check out what was going on, and Bud just handed him a box of parts."

By the mid-70s, with the cutting room in full operation, Nimbus 9/Soundstage began to experiment with audiophile-oriented direct-to-disc recording. They started with a punk group called Rough Trade, and then branched out into big band and experimental jazz and classical music, with such artists as Ruggiero Ricci, Boyde Neel's Toronto Chamber Orchestra and The Boss Brass. The records, mostly on the in-house Umbrella label, won several engineering awards, and one was even nominated for a Grammy.

By 1978, the studio had under its belt Peter Gabriel's premier solo album, a Bay City Rollers album,

70 ▶

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Nimbus cont'd

and the *Night Moves* single by Bob Seger as well as the Alice Cooper and Guess Who albums. Ezrin left the company to strike out on his own (although he still works often at the studio) and in early 1980, Richardson followed suit. David McLey, a prolific composer and synthesiser designer, whose own collection of computer hardware and 24-track recording equipment was taking over both his apartment and the warehouse space he had rented, joined the firm, along with several other investors. The infusion of capital, about $250,000 worth in the studio alone, allowed the company to take over the rest of the building and to set up a sophisticated computer research facility, dedicated to the problems of music and recording.

The studio is now a 46-track facility, with an MCI *JH-532* automated console sitting front and centre. (The old board is still around, as well. It was moved into what had been the cutting room and is now a separate 8-track studio, the property of a partially-jointly-owned radio production company called Skywave.) Tape machines are an MCI *JH-24* with Grady head stacks, an EECO synchroniser, and a Sony timecode generator. The studio does plenty of video scoring and overdubs for jingles and film, and there is a Sony ¾in cassette machine, and a 21in Sony monitor. This last is also used to display console automation data, in conjunction with a UREI *Vidigraf* system. Mix-downs and dubs are handled by a pair of stereo Ampex *ATR-100*s, a 3M *M79*, a ¼-track Revox, and an additional *ATR-100*, equipped with mono heads, four speeds, and VSO. There are 26 channels of Dolby. Digital recording is also available, on a special order basis.

Monitors were originally Audio-techniques *Super Reds*, but they have been replaced with custom built speakers designed, according to Frank, "to eliminate the existing problems without creating any new ones". UREI subwoofers and horns accompany Altec *604-E2* drivers, and they are tri-amped with Phase Linear power amplifiers through Audiotechniques *Time Sync* crossovers. The cabinets were designed with the help of the company's own computers and acoustic programs.

Other monitors available are JBL *4301*s and *4311*s, and *Auratones*.

There is a very wide range of outboard gear, including UREI, Teletronix, Pye, and Flickinger limiters; plus Pultec, Lang, API, and Flickinger equalisers, Eventide *Instant Phaser* and *Harmonizer*, Quad-Eight gates, an Orban de-esser, Burwen noise suppression, and a *Scamp* rack. Reverb is supplied by two EMT *140*s and a *240*, a Lexicon *224*, and an AKG *BX-20*. In addition, a small hallway is used as a live chamber. Microphones, which total over 35, include Neumanns, AKGs, Sonys, Shures, Crown *PZMs*, Sennheisers, Beyers, and Electro-Voices.

The studio room measures 24 x 48ft and features very flexible acoustics. It sits on an 'acoustic resin' concrete floor, and in the lower third of three of the walls are concealed honeycomb bass traps. Instruments on hand are a 1921, 7ft Steinway grand, a honky-tonk upright piano, a Rhodes, a *Clavinet*, a harmonium, a Hammond *C3* with Leslie, and assorted percussion.

The other side of the building belongs to Nimbus' sister company, Syntronics Music Corporation, and that is where the impressive *VAX* computer system made by Digital Equipment Corporation lives. The company boasts a large staff of programmers and engineers who spend their time researching and developing products, programs and systems for the needs of the music industry, present and future. The studio's automation system is not hooked into the large computer, but Frank says that some kind of interface is not far off. The computer is, however, in use for all sorts of office functions, including correspondence. Its primary centre of activity, at least at the time of our visit, seems to be David McLey's synthesiser.

The *McLeyvier*, as it is called, was presented to the world soon after our visit, at the New York meeting of the Audio Engineering Society. It is an extraordinarily clever and easy-to-use system geared towards the serious composer. It can simultaneously synthesise up to 128 voices (in its largest version), and it has an absolutely gorgeous and ingenious notation system, with a quick line-plotter attached to print out scores. Syntronics has hired a fancy New York public relations firm to get the word out on the *McLeyvier*. The exhibit at the AES was a tremendous success, and the *McLeyvier's* suite was one of the busiest in the hotel.

Although the Nimbus 9/Soundstage studio is not the largest recording facility in Toronto, it and the companies with which it is affiliated are no doubt at the forefront of all sorts of technological development. With a staff of three full-time engineers, it often finds itself operating around the clock. Despite the high-tech operation—or maybe because of it, and the confidence that the knowledge that the studio is so ready to face the future inspires—it is still the friendly, private place that Bob Ezrin and Jack Richardson designed it to be.

Paul D. Lehrman

Nimbus 9 Productions Limited/Soundstage Division, 39 Hazelton Avenue, Toronto, Ontario M5R 2E3, Canada. Phone: (416) 961-9688.

Aosis Recording Studio

Aosis finds itself on the third floor of what was, in 1829, the new Chappell's piano factory. If you want to find it you'll need fairly precise instructions as to where it is—when I went to see it, there were very few clues to give it away. The six flights of narrow stairs leading up to it will have all but the most stout-hearted reaching for the piece of paper with the address on. There is, however, a large ½-ton goods lift which is soon to be modified to take passengers as well, and access for equipment into the studio is quite good.

The studio is owned by the partnership of Jim Hawkins and Ken Capper, which was founded back in the autumn of '79 with the expressed intention of building a studio as the centre of a production company, as well as an independent commercial concern. At the beginning of 1981 they finally found the Belmont Street premises and finished the basic construction work around October of that year.

Jim takes care of most of the administration, pulling on his experience in owning, running or working for, various equipment/instrument hire companies around town, and his resultant involvement with recording studios. Ken, who was a balance engineer on the Manor Mobile for a couple of years, is the house engineer, and is responsible for designing the basic structure of the studio and offices. He was around when Eastlake built The Townhouse, and having seen the construction, on and off, from start to finish, used many of the same techniques in the building of Aosis. The third floor had previously been used as a warehouse and as such it was one big, open space without a single wall or partition. Ken did a set of drawings showing the basic layout he wanted and suggested methods of construction. These he took to Andy Munro of Turnkey Two, who after doing the necessary calculations, made a few alterations and drew up a set of working plans. Jim and Ken took it upon themselves to do all the physical construction of the place, only bringing in a carpenter for the final fixings.

There is a small reception which leads through into a modest kitchen/lounge area of about 10 by 17ft, equipped with a pinball machine and a Space Invaders-type video game, together with the basic kitchenware necessary for the preparation of simple snacks. Out of here and across a corridor brings you into the studio floor area of about 480 ft^2 which includes an 8 by 8ft drum riser. The whole thing is floated on two inches of rockwool, and the floor has been split into two across its width to give two mechanically isolated areas. On top of the rockwool is a layer of high density chipboard, two layers of thick felt carpet underlay plus a layer of carpet. The walls, which are also floated, are built around a 4 by 2in timber frame containing two inches of rockwool sandwiched between two half-inch fibre boards, finished on the outside with chipboard and on the inside with plasterboard. The ceiling is of a similar construction but has an extra layer of rockwool. On completion, standing waves were found to be noticeable between the two parallel side walls; these were eradicated by replacing the plasterboard with pegboard in certain areas to provide extra broadband absorption. The drum riser has also been isolated by means of concrete, rockwool and chipboard. The double solid fire doors leading to and from all the main areas of the studio were fitted with standard domestic handles, but the fits were so tight that Ken actually had to remove the seals on a couple of them because people were having difficulty in shutting them, due to the air pressure between them. The acoustic separation between the control room and the floor area was good.

An 8 by 4ft, triple-glazed window allows a good view of a fairly large control room, the construction of which is similar to the playing area, except that an extra 4 by 2in structure was added to form the now almost classic V-shaped ceiling, together with a couple of active bass traps in the rear of the side walls. The desk is a Soundcraft *1624*, with a 3M *M79* 24-track, a Studer *B67*, a Revox *PR99*, and a pair of Lockwoods with Altec dual-concentric drivers, which replaced the original Tannoy drivers, after listening tests showed them to suit the room's 'over enthusiastic' bass response. The Altecs are driven by a Quad *405* as are the pair of *Auratones*. The auxiliary equipment includes an Eventide *949 Harmonizer*, a Roland *SDE2000* DDL, a Roland phaser, an MXR flanger, a pair of Roland stereo 15-band graphics, an ADR *Scamp* rack with two gates and two compressors, an old Altec valve compressor and a pair of ADR *FX760N Compex* limiters.

A good selection of microphones include a number of Neumann, Calrec, AKG, Beyer and Shure models, with a vast selection of instruments and other equipment available from the sister hire company, free of charge when it isn't out on hire. Permanently in the studio is a Yamaha 7ft 6in grand, a Fender *Rhodes 88*, a Hammond *C3* and a Pearl kit fitted with roto-tom-type heads, with a choice of a Gretsch or Sonor snare.

The overall finish of Aosis is rough, but I was assured that plans for cosmetic improvements were in the pipeline. Its appearance, together with the price of £20 per hour, belies the amount of knowledge and understanding that has gone into the studio's construction. **James Francis**

Aosis Recording Studio, 10a Belmont Street, NW1. Phone: 01-267 4680. ■

Sony have just made the world's most advanced 24-track analogue recorder...

AES Convention Anaheim preview

Due to the unavailability of a full list of exhibitors until very shortly before going to press, we are unable to offer our usual preview format. Instead, we have collated two sections: a preview of UK-based exhibitors including their products on show, and a full list of exhibitors. We apologise for this lack of information, which was due to matters beyond our control.

UK-based exhibitors

● **Advanced Music Systems:** range of digital delay and reverb units including the new *A/V-Sync* audio delay for video applications. ● **Allen & Heath Brenell:** two new mixer ranges, *21 Series* budget stereo range; *System 8* range of 8-buss mixers. ● **Amek:** new *Angela* multitrack console series; *M2500* system with new *L40A* LED display; *BC01* portable broadcast mixer; sample of new *M1000* multi-purpose system; plus revised *M3000* multitrack and *M4000* post-production system modules and range of TAC products. ● **Audio & Design Recording:** full range of signal processors plus new ambisonic *Transcoder* for surround-sound mixing. ● **Audio Developments:** *AD-062* Minimixer, *AD145* Picomixer and *AD160* ENG mixer will be featured. ● **Audio Kinetics:** *Q-Lock* range of synchroniser/machine control systems plus new *Q-Link* computer-controlled interface linking two *Q-Locks* via RS-232 serial line.

● **Brooke Siren Systems:** new *AR130* phase-checking system plus full range including *MCS-200* modular and *FDS-300* fixed-format 'frequency dividers'; *AR116* active DI unit and *AR-125* lead and fuse tester.

● **Connectronics (Canford Audio):** wide range of screeened cables in a selection of colours including *Musiflex* and *Studiflex* lines.

● **H/H Electronics:** range of professional audio equipment including *MOSFET* power amps and the new *M-900* addition to the range. ● **Malcolm Hill Associates:** new *K-Series* studio consoles, plus 24/8/2 *J-Series* PA console and new *M-Series 2* monitor mixer; wide range of power amps.

● **International Musician & Recording World:** range of musicians' and consumer magazines.

● **Jackson Music Group:** first stop in a world tour introducing a wide range of British audio products and services to overseas markets. The range includes **Alice (Stancoil), Bel, Lockwood, Mobile One, Accessit, Drawmer, Radford, Maglink** and **Audan**. List complete at time of going to press and subject to alteration.

● **Keith Monks:** wide range of microphone stands, booms, record cleaning equipment and accessories. ● **Klark-Teknik:** new *DN30/30* dual ⅓-octave graphic, matches bands of *DN 60* analyser; *DN27A* and *DN22* graphics plus preview of forthcoming *DN-700* DDL and new 30-band cut-only room equaliser.

● **Melkuist:** *GT-800* console automation system plus colour graphics display; new software offering mix-edit facilities; *Events Selector* on demonstration ● **Midas:** *PR System* consoles including 24/6/2 PA unit and 24/8 stage monitor types; *TR System* 24/8/8 theatre console; new *Auditorium* 30/12/2 console system.

● **Neve:** *8128* music recording console plus two *51 Series* models (24 and 16 out) and the *542* range of portable consoles.

● **Penny & Giles:** wide range of conductive plastic audio control elements including linear faders of various types and potentiometers, etc.

● **Sifam:** wide range of meters including four styles of true VU meters and two styles of low-cost VU-type meters, plus PPMs. Full range of collet and push-on knobs ● **Soundcraft:** new *2400* series with automation; new *800B* and *400B* consoles; new 40/8 PA console and 40/16 stage monitor console; plus *Series 1600* unit and *SCM 762* multitrack ● **Solid State Logic:** new *SL6000E* video post-production console and complete package, plus novel *EQ-P* retrofit EQ card which sounds remarkably like a parametric *Pultec*. ● **Soundtracs (Soundout Laboratories):** complete range of PA and 4-, 8- and 16-track recording consoles including 16/4, 16/4/2, 24/4/2, 16/6 monitor, *Omni 16* and *Omni 24* configurations plus modified units aimed specifically at the US market.

● **Tannoy:** the company will be showing the *SRM* series of monitors and a new range of products for the broadcast market ● **Technical Projects:** revamped *MJS 401D* test set; *Series 5000* stereo production console; *Multi-pan* programmable multichannel memory panner; modules for *4000 Series* post-production console; telephone FX generator; distribution amplifiers and LED meter displays ● **Trident:** *Series 80, Trimix* and two versions of the new *VFM* budget console system (both versions 16/8/2: one PA model and one studio version) plus *TSR* mulit-track.

● **Studio Sound and Broadcast Sound:** copies of *Studio Sound* will be available, along with the latest issue of *Broadcast Sound* the new bi-monthly aimed at audio people in broadcasting, video, A/V and related fields. Editor **Richard Elen** and executive advertisement manager **Phil Guy** will be on hand at booth B408 and will be visiting exhibitors during the course of the convention. We look forward to meeting both visitors and exhibitors. ■

Exhibitor's list

A

ABX Company
Accurate Sound Corporation
ACO Pacific Inc
Acoustic Design by Jeff Cooper
Acoustilog Inc
Adaptive Systems Inc
Advanced Music Systems
Agfa-Gevaert Inc
AKG Acoustics
Allen & Heath Brenell
Alpha Audio
Altec Lansing
Amek Systems & Controls Ltd
Ampex Corporation
Anvil Cases
Aphex Corporation
Association of Sound and Communications Engineers
Auburn Sound Manufacturing
Audico Inc
Audioarts Engineering
Audio & Design Recording
Audio Developments
Audio Engineering Associates
Audioforce Inc
Audio Kinetics
Audio Processing Systems Inc
Audio Services Corporation
Audio-Technica US Inc
Audio/Tek Inc
Audio Video Automation Inc

B

BASF
Beyer Dynamic
BGW Systems
Big Briar Inc
Bose Corporation
Brooke Siren Systems Ltd
Bruel & Kjaer Instruments Inc
Bryston Manufacturing Ltd

C

California Switch and Signal
Canford Audio/Connectronics
Cerwin-Vega Inc
Cetec-Gauss
Chet Dunn Associates
Clearcom Intercoms
Community Light & Sound
Countryman Associates Inc
Crest
Crown International
Cybersonics Inc

D

Datatronix Inc
David Hafler Company
David Lind Associates
dbx Inc
Deltalab Research Inc
Design Direct Sound Inc
Dod Electronics
Dorrough Electronics
Duncan Electronics Corporation

E

Educational Electronics Corporation
Electro Sound Inc
Electro-Voice Inc
El Mar Plastics Inc
Emilar Corporation
Eventide Clockworks Inc
Everything Audio
Excalibur Industries
EXR Corporation

F

Fender/Rogers/Rhodes (CBS Musical Instruments)
Fostex Corporation

G

Goldline Connector
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If you'd like to know more, contact Keith Smith or Mike Jopp at Sony (UK) Ltd, Pyrene House, Sunbury Cross, Sunbury-on-Thames, Middlesex, or telephone Sunbury (09327) 81211.

And find out how Sony are making even the newest analogue recorder out of date.

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AES preview

H

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HH Electronics
Hill Audio Ltd
HM Electronics Inc

I

Infonics Inc
Inovonics Inc
Interlake Audio Inc
Interface Electronics Inc
International Audio
International Musician & Recording World
IQS Inc
Ivie Electronics

J

Jackson Music Group
JBL
JRF Co Inc
JVC Company of America
JVC Cutting Center

K

Keith Monks Audio Ltd
King Instrument Corporation
Klark-Teknik Research Ltd

L

Lakeside Associates
Lexicon Inc
Long/Wickersham Associates

M

Magnefax Inc
Marshall Electronics Inc
Martin Audio
Melkuist Ltd
Meyer Sound Laboratories
MicMix Audio Products
Midas Audio Systems Ltd
Mitsubishi Electric Corporation
Modular Sound Systems
Motorola Inc Ceramic Products
MTI Corporation
Music Technology
MXR Innovations

N

Nady Systems
Nagra Magnetic Recorders Inc
Neutrik Products
Neotek
Nippon Columbia Co Ltd
Nortronics Company Inc/ Restoration

O

Omnimount Systems
Orban Associates
Ortofon Instruments
Otari Corporation

P

Panasonic Company PAD
Passport Designs
Peavey Electronics
Penny & Giles Ltd
Pentagon Industries
Phoenix Audio
Professional Audio Services & Supply Company
Professional Audio Systems
Publison Audio Professional

Q

Quantec GmbH
QSC Audio Labs

R

Rauland-Borg Products Co Inc
R-Columbia Products Co Inc
Recortec Inc
Renkus-Heinz Inc
Roland Corporation
RTS Systems
Rupert Neve Inc

S

Sagamore Publishing Company (db Magazine)
Saki Electronics
Schell Electronics
Sennheiser Electronic Corporation
Sequential Circuits
Sescom Inc
Shino Musical Instruments Corporation
Shure Brothers Inc
Sierra Audio Corporation
Sifam
Solid State Logic
Sony Corporation/MCI
Soundcraft Electronics Ltd
Soundstream Inc
Sound Technology Inc
Soundtracs International
Sound Workshop Professional Audio Products Inc
Spectra Sonics
Stanton Magnetics Inc
Stephens Electronics
Studer Revox America Inc
Studio Sound & Broadcast Sound
Studio Technologies
Swintek Enterprises
Symetrix
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Syntauri Corporation
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T

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Technical Audio Devices
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Tentel Corporation
3M Company
TOA Electronics Inc
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V

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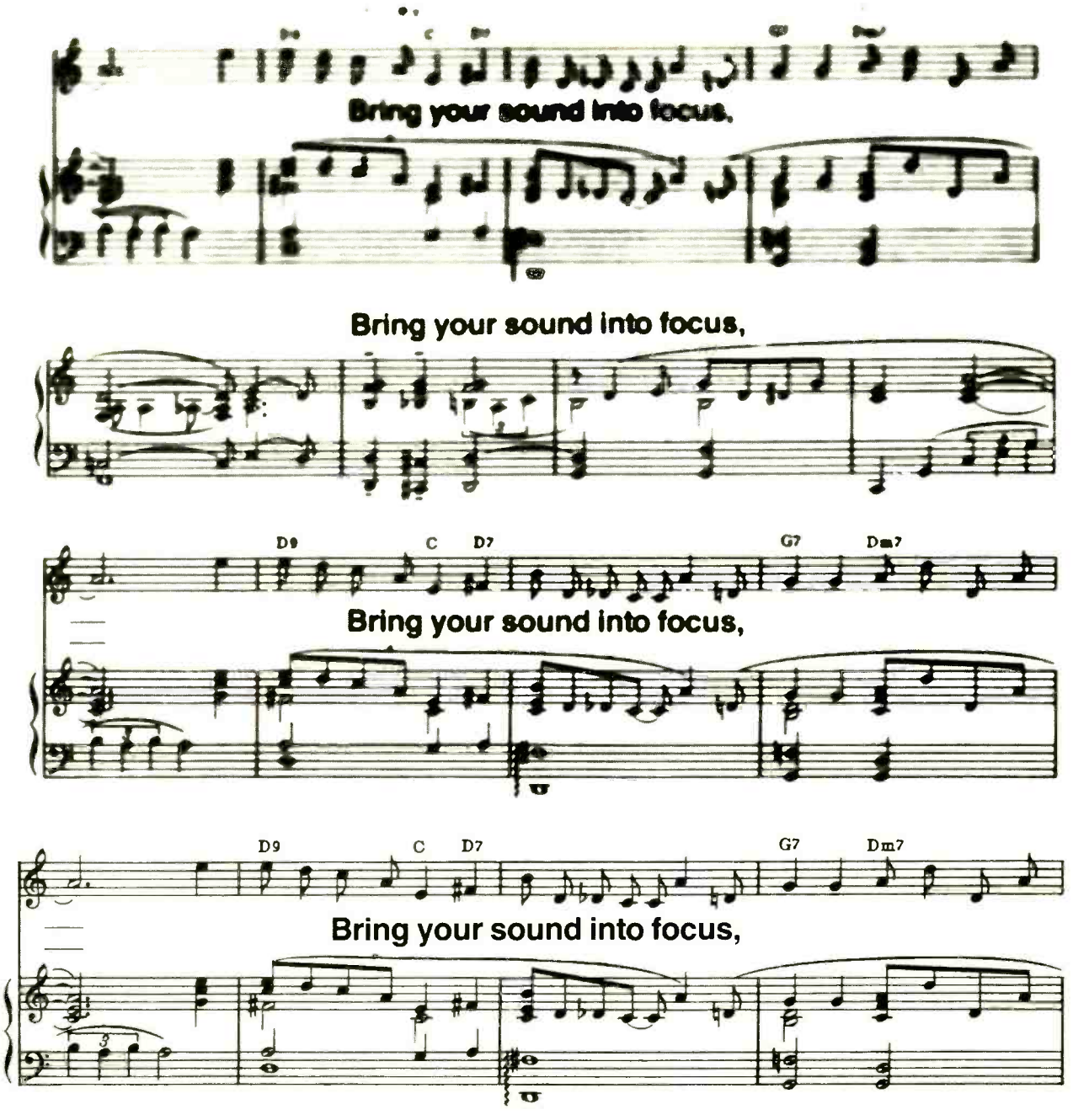
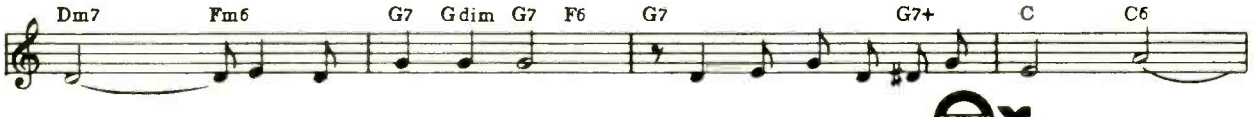


Aphex II



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Aphex Systems, Ltd.
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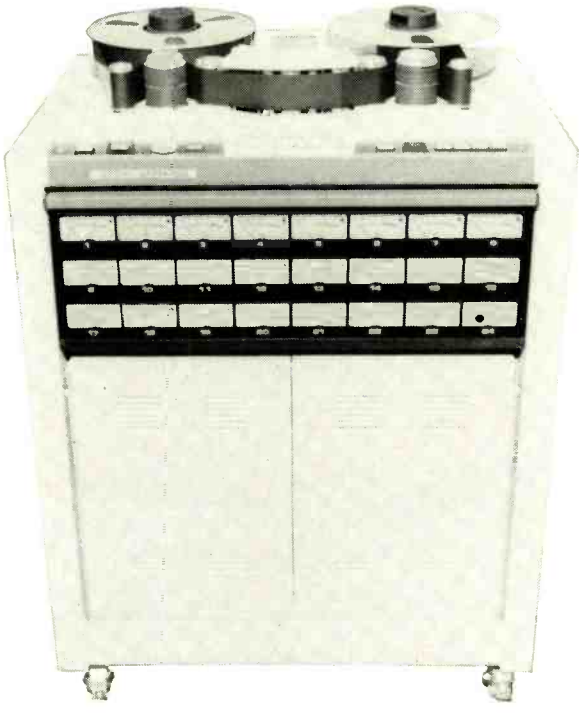

Otari MTR-90-II

MANUFACTURER'S SPECIFICATION

General
Tape width and tracks: 1 in eight tracks; 2 in 16 tracks; 2 in 16 tracks prewired for 24 tracks; 2 in 24 tracks.
Reel size: up to 14 in NAB (356 mm).
Head shield plate: motor driven automatic or manual operation.
Heads: plug-in head blocks with easy access to independent head azimuth adjustment.
Drive system: pinch roller-less direct drive capstan system with ±20% speed control. Constant tension servo-controlled reel motors.
Motors: one DC capstan motor; two fully servo-controlled DC reel motors.
Tape speed deviation: less than ±0.05% from beginning to end of reel.
Fast forward/rewind time: 120 s maximum for 2400 ft (760 m).
Wow and flutter: (peak weighted per DIN 45507) 30 in/s less than 0.04%; 15 in/s less than 0.05%.
Pitch control: ±20% continuous variable control, digital percentage readout with 0.1% precision.
Start time: less than 1.0 s.
Cue control: cue function by rotary cueing knob, bi-directional.
Electronic tape timer: 6-digit display indicating hours, minutes, seconds and tenths of seconds.
Tape speeds: 30 in/s (762 mm/s) and 15 in/s (381 mm/s).
Weight: 440 lb (200 kg).
Dimensions: 770 x 1100 x 620 mm (whd).
Power: 100/117/220/240 V single phase AC, 50 or 60 Hz. 720 VA operating, 2000 VA starting.

Electronics (measured with 3 M 226 tape)
Line input: + 4 dBm level and 10 kΩ active balance.
Line output: + 4 dBm active balance (maximum source impedance 5 Ω).
Amplifier clipping: + 28 dBm.
Headroom: + 24 dB.
Equalisation: NAB or IEC; reproduce equaliser switchable.
Bias frequency: 257 kHz record; 85.7 kHz erase.
Punch-In/punch-out: gapless and noiseless inserts with automatic monitor switching.
Standard record level: 320 nWb/m.
Overall frequency response: (at 250 nWb/m) record/reproduce 30 in/s 50 Hz to 25 kHz ±2 dB; 15 in/s 30 Hz to 18 kHz ±2 dB.
Synchronous reproduce: 30 in/s 50 Hz to 18 kHz ±2 dB; 15 in/s 30 Hz to 18 kHz ±2 dB.
Signal to noise ratio: (record/reproduce) 24-track: 30 in/s > 66 dB; 15 in/s > 64 dB. 16-track: 30 in/s > 66 dB; 15 in/s > 66 dB. Unweighted S/N at 520 nWb/m measured with a 30 Hz to 18 kHz audio filter.
Distortion: 0.5% at 1 kHz at 320 nWb/m.
Crosstalk: 24-track: at 1 kHz better than 53 dB. 8/16-track: at 1 kHz better than 58 dB. 8/16/24-track: from 220 Hz to 16 kHz better than 45 dB.
Erase effect: > 75 dB.

Accessories
Standard: remote control with selective reproduce on all channels; LED status indicators and transport operating controls; manual.
Optional: autolocator with full shuttle search-to-cue capabilities and 10 memory capacity; 16/24-track conversion kit.
Manufacturer: Otari Electric Co Ltd, 4-29-18 Minami-Ogikubo, Suginami-ku, Tokyo 167, Japan.
UK: Industrial Tape Applications, 1-7 Harwood Avenue, Marylebone Road, London NW1 6LE.
USA: Otari Corp, 2 Davis Drive, Belmont, Cal 94002.

THE basis of the *MTR-90* is a fairly thick flanged alloy casting which is machined on its upper flanges to provide a reference face. Further machining on the lower face provides references for most of the transport components which secure to the bottom of the casting.

The two reel motors which are DC-servo-controlled via potentiometers on the tension arms, are equipped with solenoid-operated band brakes on their bottom ends and very nice reel hold-downs with a capability for 14 in reels. The hold-downs have a plastic grommet within the upper half of the reel hub. Operating a small lever on top of the hold-down expands the grommet section and provides a very quick and positive lock.

From the reels, the tape passes over large diameter tension sensing rollers mounted on alloy arms which are both spring-loaded and solenoid-controlled. The arms mount on to a rather short support bearing, on the bottom end of which is the position sensing potentiometer. On the pay-off side the tape passes over a plastic-covered roller of approximately 60 mm diameter and equipped with a tachometer disc for the tape timer, before passing to the headblock.

The latter comprises a 10 mm thick machined casting which secures on to the main casting by four screws. Either side of the headblock are large

78 ▶

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diameter roller guides followed by guide posts in the form of bottom tape-edge guides.

The tape continues past the staggered ferrite erase head to the metal record head, a flutter roller then the metal replay head. Connections to the heads are by means of four 'D' connectors on the main casting with solenoid-operated tape lifter pins passing through the casting. An unusual feature is the motorised headshields which are operated via a leadscrew. From the exit guide roller in the headblock the back of the tape feeds over the 60 mm diameter plastic-covered capstan and thence to the take-up tension sensing arm. No pinch roller is used as the DC-servo-controlled capstan drives the tape by friction alone with the servo reel motors providing precise control of tape tension in a similar manner to the Ampex *ATR-100*. All tape movement functions are microprocessor-controlled giving excellent tape handling.

Within the top of the casting which protects the headlblock is a tape timer which gives readings in hours, minutes, seconds and tenths with a reset switch and the tape speed selector providing 30 or 15 in/s. To the front of the headblock a splicing block is provided, with a choice of 90° or 60° cutting angles.

To the front are the normal tape movement controls in the form of illuminated pushbuttons. In addition a 'cue' button activates a 360° potentiometer which acts as a tape speed control allowing any speed in either direction. At low speeds a nearby yellow LED indicator blinks with the tape direction being shown by green illuminated arrows. Alternatively the capstan may be rotated by hand to locate edit points; it would, however, be easier if the capstan shaft was extended for this purpose. An additional function of the cue button is to lower the tape lifters in the fast wind modes. The motorised headshield can be lowered or raised at any time by pressing a headshield button with a further pushbutton unloading the tape for editing.

The final control on the tape transport is a spot erase button which only operates in the stop condition. Pressing this button (which is protected by a hinged cover) energises the erase head on any selected tracks and allows 'hand erasure' of clicks, etc by pressing the button and at the same time moving the tape by hand.

At the front of the machine below the tape transport a hinged panel supports the 24 VU meters and gives access to the tape transport components, the complete transport being hinged at the rear so that it can be tilted up on two stays. Located behind doors at the front are two racks of printed circuit boards and the power supply which has the main on/off switch and miniature circuit breakers and indicator lights for all supply rails.

The top rack of electronics houses the 24 signal electronics boards, one for each channel, each board being beautifully laid out with full component identifications. Holes in the front panel of each board give access to 15 multiturn potentiometers which are clearly identified on the front panels. The replay and sync preamplifiers each have their own gain, HF equalisation for high and low speeds and LF equalisation controls. The record section also has high and low speed HF equalisers with a single gain control and a phase optimisation control plus a single bias control. On the board itself there is a single potentiometer and a slide switch which selects a balanced or unbalanced output.

Master control of bias is on one of the seven boards in the lower rack which has three spare slots. At the front of the bias board a 3-position slide switch selects one of three preset bias levels which are adjusted with multiturn potentiometers at the front of the board. In addition a further front panel switch turns the LF compensation on/off and a ¼ in jack socket allows a test signal to be applied simultaneously to all channels.

On the board, three miniature slide switches control the replay equalisation of all channels giving a choice of 17.5 μs or 35 μs at 30 in/s, 35 μs or 50 μs at 15 in/s and 3180 μs or infinity at 15 in/s. A further switch offers automatic replay attenuation as a option in the fast wind modes.

The only control on the adjacent tape counter board is a lamp test switch with the next board being the digital input/output interface. This offers both RS232 and 20 mA current loop interfacing at baud rates which can be selected from 110, 1200, 2400 or 4800. At the time of writing little is known about the functions available at the interface.

The following board has the *8080* microprocessor which controls the tape transport functions with socketed ROMs allowing future modifications in the programs to be readily incorporated. A 4-way DIL switch on the transport control board provides a number of user options. One option is to inhibit the replay outputs until the capstan is up to speed whilst the other switches are concerned with monitoring in the standby mode and fast modes.

The remaining two boards are concerned with the capstan and reel servos and have only a few simple-to-set front panel controls.

Turning to the rear of the machine, the top section has a rather noisy fan which cools the transport motor control transistors which are mounted in sockets in this section of the back panel which hinges down for access. The centre section has the audio inputs and outputs in the form of *XLR* connectors with two 'D' connectors feeding the remote control unit. A further 'D' connector provides noise reduction switching.

Within the bottom section a further, but quiet, fan cools the power supplies which are fed via a detachable line cord. Five multiway connectors feed the remote control unit and the optional autolocator, provide the serial and BCD digital interfaces and permit the use of an external clock for synchronisation.

With the exception of a few boards on the tape transport, the transport motor drive transistors and the VU meter drive amplifiers, all the electronics are in the card frames. All parts are interconnected by sockets to ease servicing and access to all parts is very good.

The complete unit is mounted into a strong fabricated steel frame with four wheels and four good strong handles in the sides. At the rear the connectors and fans are well-protected.

Remote control unit

The normal fast, play, stop and record buttons are duplicated on the remote control unit, plus the cue button for listening in fast wind. A 3-position slide switch selects the speed mode from fixed, external control and variable. When the latter is selected the speed is controlled by a multiturn potentiometer.

A 4-digit display – which may be switched on or off – shows the speed in either in/s or as a percentage of nominal, a pushbutton selecting the function and LEDs within the display showing the nominal speed and whether the display is in in/s or percentage.

The audio switching functions of the remote control unit were extremely clearly laid out and quick to set. At the top in horizontal array are the 24 record/safe paddle switches each with an associated red 'record' LED with a master record/safe switch covering all channels.

Proceeding down the panel are three rows each of 24 LEDs showing the condition of each channel, yellow LEDs indicating input monitoring, green indicating sync mode and orange replay. Below this display 24 3-position paddle switches select the status for each channel from input, sync or replay. However, associated with each status is a master pushbutton such that a single push of a button can set all channels to input, sync or replay. In the case of the individual channel paddle switches the central position is the less-used sync mode, such that passing a finger across the switches can set all channels to input or replay.

Optional autolocator

Like the remote unit, and of the same size, the autolocator has a very good layout and is simple to use whilst providing most functions of other autolocators. At the top are two 5-digit displays of time in hours, minutes and seconds, one being the locate time and the other the tape time which is not necessarily the same as that on the recorder itself. Each display has its own reset button.

Below are two horizontal rows of ten pushbuttons and a row of ten LEDs associated with ten stores. Pressing one of the ten 'store' buttons stores the current tape time and illuminates the associated LED to show that the store is in use. The second row of pushbuttons are search buttons and pressing them, fast-winds the tape to the stored time. Also associated with the stores is an 'all clear' button. To avoid accidental operation of this button a single press has no effect, it being necessary to press the button twice in rapid succession to clear the stores.

A 4 × 4 keypad incorporating the numerals 0 to 9 allows tape times to be entered into the locate display. Further buttons transfer the locate display to the time display or vice versa, transfer the transport time to the tape time display, load and recall stores and change the sign of the locate display. The unit tested was completely tolerant of negative times and did not even take exception to entering 1 min 99 sec (negative or positive).

The normal fast, stop, record and play controls are duplicated with the following autolocate functions available. Firstly a 'zero set' button illuminates when pressed and then plays the tape until the start of a 1 kHz tone is found on track 1. The tape is then stopped and the machine and the tape time counter reset – the idea of this being to locate a positive zero location on tape.

The next function, 'search zero', when pressed transfers the machine tape timer to the autolocator's tape time display and then proceeds to search for zero time. Pressing the 'search' button fast winds the tape to the displayed position in the locate display relative to the tape time display, ignoring the display on the recorder.

Pressing 'shuttle' plays or records from the current tape position to the time in the locate display, drops out of record (if recording) and fast winds to the original tape position before again entering play and continuing to shuttle until stopped. The final function, 'auto rewind', allows the record or play mode to be entered whilst remembering the time when the button was pressed. The machine continues to record/play until the locate time is reached when it fast-winds to the time the 'auto rewind' button was pressed and stops.

A last feature of the autolocator is a 4-digit stop watch counting in seconds to 99 min 59 sec. This has associated reset and start switches with a third switch functioning as a start/lap time switch. In the lap state the display stops at the current time with

80 ▶

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FIG 1. OTARI MTR-90-II RECORD/REPLAY FREQUENCY RESPONSE

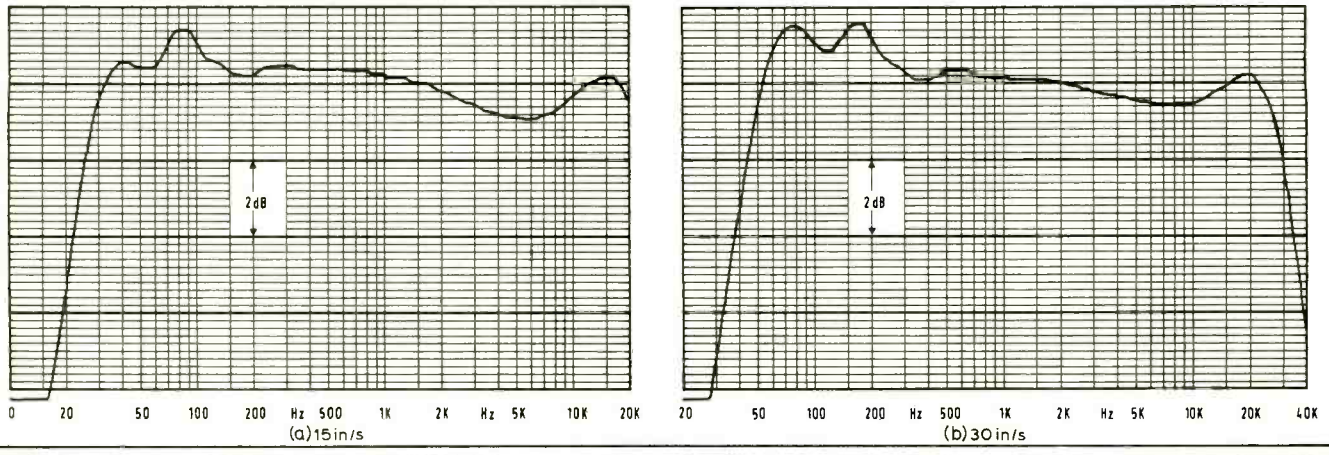
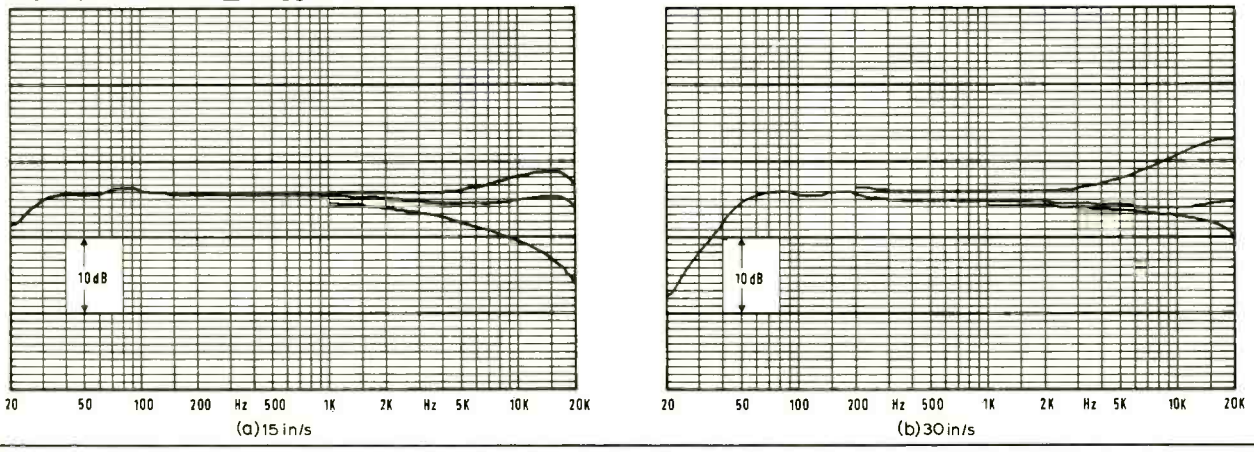


FIG 2. OTARI MTR-90-II RECORD EQ



the decimal point flashing whilst the count continues.

In operation the autolocator was very accurate with negligible tape slip and positive location without hunting. In practice the tape fast-winds and as it approaches the required point decreases speed until it comes to a gentle stop at the locate point.

Inputs and outputs

As supplied, the input sensitivity was such that +4 dBm indicated zero VU and recorded 320 nWb/m on the new 3M type *226* tape. The input could accept +33 dBm before the onset of clipping with the sensitivity range being such that anything over −5 dBm would record 320 nWb/m.

The input impedance remained constant at 9.5 kΩ with gain as did the common mode rejection in excess of 60 dB from 20 Hz to 20 kHz.

On the output end, the machine could deliver +24 dB.7 V or +24 dBm loaded into 600 Ω. Adjustment of the replay level control gave between 0 and +14 dBm for a recorded fluxivity of 320 nWb/m from a source impedance of 0.5 Ω at 1 kHz at the electronically-balanced outputs which may be individually switched to unbalanced.

Frequency response

Typical record/replay frequency response curves using 3M type *226* tape are shown for 15 in/s and 30 in/s in **Fig 1.** Of particular interest is the lack of ripples in the LF response which is commonly so troublesome when using noise reduction. The actual −3 dB points were at 35 Hz and 27 kHz at 30 in/s or 20 Hz and 21 kHz at 15 in/s – a most satisfactory performance. Furthermore, the frequency response in the sync mode was excellent, extending ±1 dB from 50 Hz to 20 kHz at 30 in/s or 30 Hz to 20 kHz at 15 in/s.

Again using 3M type *226* tape, the range of the record equalisers at 15 in/s and 30 in/s is shown in **Fig 2** respectively, the range being more than adequate and easy to adjust in view of the use of multiturn potentiometers. There was, however, an undesirable degree of overall level shifting at extreme adjustments.

Fig 3 is typical of the replay equalisers at 15 in/s for CCIR 35 μs equalisation with the LF equaliser having an unnecessarily large range and the HF equaliser a good range. At 30 in/s the situation was similar, but the HF equaliser extended to −9 dB at 20 kHz.

Switching the replay master equaliser switches produced the correct change within 0.1 dB at 30 in/s for the 17.5 μs and 35 μs standards, however at 15 in/s the accuracy was within 0.4 dB over several channels.

Distortion

Checking the 1 kHz maximum output level for 3% third harmonic distortion showed this to be 9.5 dB above the reference fluxivity of 320 nWb/m. Headroom in the record amplifiers was such that 28 dB above the level required to record 320 nWb/m could be driven. Similarly the replay electronics could handle in excess of 20 dB above 320 nWb/m at the standard gain settings.

Third harmonic distortion at 320 nWb/m was

82 ▶

FIG 3.
OTARI MTR-90-II
15in/s REPLAY EQUALISER

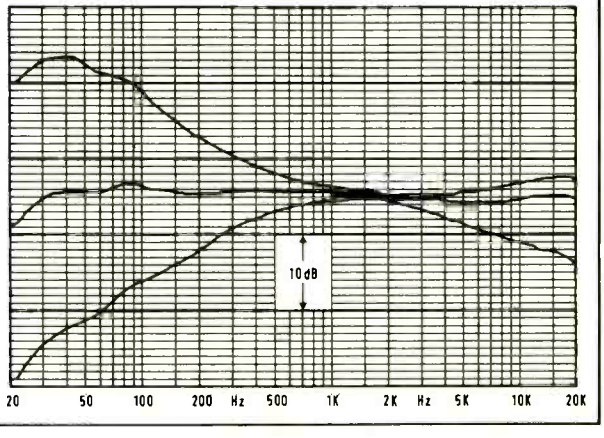


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TABLE 1

Measurement method	Noise referred to 320 nWb/m			
	30 in/s		15 in/s	
	Machine	Tape	Machine	Tape
22 Hz to 22 kHz RMS	– 69.5 dB	– 61.0 dB	– 68.0 dB	– 60.5 dB
A-weighted RMS	– 78.0 dB	– 65.0 dB	– 75.0 dB	– 63.5 dB
CCIR-weighted RMS	– 72.0 dB	– 56.5 dB	– 69.0 db	– 55.0 dB
CCIR-weighted quasi-peak	– 67.5 dB	– 53.0 dB	– 65.5 dB	– 51.0 dB
CCIR-weighted ARM	– 78.5 dB	– 63.0 dB	– 75.5 dB	– 62.0 dB

TABLE 2

Measurement Method	Noise referred to 320 nWb/m			
	30 in/s		15 in/s	
	Machine	Tape	Machine	Tape
22 Hz to 22 kHz RMS	– 64.5 dB	– 61.0 dB	– 64.0 dB	– 60.0 dB
A-weighted RMS	– 75.0 dB	– 66.0 dB	– 73.0 dB	– 63.5 dB
CCIR-weighted RMS	– 70.0 dB	– 58.0 dB	– 67.5 dB	– 55.5 dB
CCIR-weighted quasi-peak	– 66.0 dB	– 54.5 dB	– 63.5 dB	– 51.5 dB
CCIR-weighted ARM	– 76.0 dB	– 65.0 dB	– 74.0 dB	– 62.0 dB

FIG 4

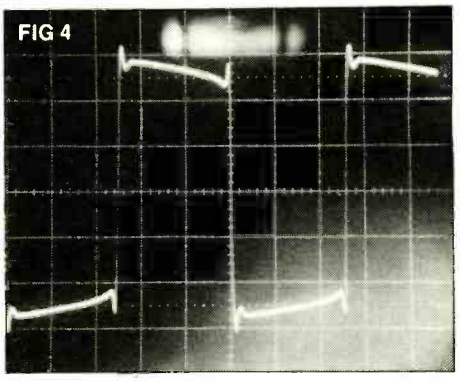


TABLE 3 Weighted Wow and flutter

Tape speed	Beginning	Middle	End
30 in/s	0.022%	0.023%	0.026%
15 in/s	0.025%	0.025%	0.027%

very low at less than 0.2% at either tape speed with other harmonics being below 0.03%.

The recording and replay of a 1 kHz squarewave gave similar results at both speeds, the performance at 30 in/s being shown in **Fig 4** which is an excellent result. The phase compensators had a wide range and were easy to adjust.

Noise

Noise was measured in several channels for the machine alone and with 3M type *226* tape which had been recorded with bias only on the machine, replay being done in both the normal replay mode and the sync mode. In the replay mode without tape, power line frequency hum was significant on the outer tracks but random noise showed little variation between tracks.

On the outer tracks the 50 Hz component averaged 59 dB below 320 nWb/m with the 150 Hz hum harmonic being only 2 dB lower. Hum on the inner tracks was greater than 74 dB below 320 nWb/m.

The replay noise performance in the hum-free tracks is shown in **Table 1** and whilst these results are excellent, the sync mode also gave a very good noise performance as can be seen from **Table 2**.

Crosstalk

Investigating the 'bleed' from the erase head on to adjacent tracks by recording a 15 kHz tone on one track and then recording the adjacent tracks with bias showed a 0.5 dB loss of the 15 kHz at 30 in/s or a 0.7 dB loss at 15 in/s.

Fig 5 shows the result at 30 in/s of recording on tracks 9 and 11 whilst replaying the interleaved track 10 – a worst-case condition – the results were entirely satisfactory. At 15 in/s the results were similar except that the frequency scale is shifted down one octave.

Crosstalk between adjacent tracks in the sync mode (a very unwise condition) is shown for both speeds in **Fig 6** where track 10 is replayed in sync whilst track 11 is being recorded. Having regard to the excellent sync bandwidth a potential gain at high frequencies is not surprising.

Fig 7 repeats this at 30 in/s and shows the conditions for recording 2, 3, and 4 tracks away from the track being replayed, the results being quite acceptable.

Wow, flutter and speed

Wow and flutter to the IEC quasi-peak weighted standard was measured at the beginning, middle and end of a 10½ in reel of tape with the excellent results given in **Table 3**.

Fig 8 is a spectrum analysis of a 10 kHz tone recorded and replayed at 30 in/s, which shows a good performance as far as sideband noise is

84 ▶

FIG 5.
OTARI MTR-90-II
30in/s CROSSTALK WITH
TRACKS 9 AND 11 IN RECORD
AND TRACK 10 IN PLAY.

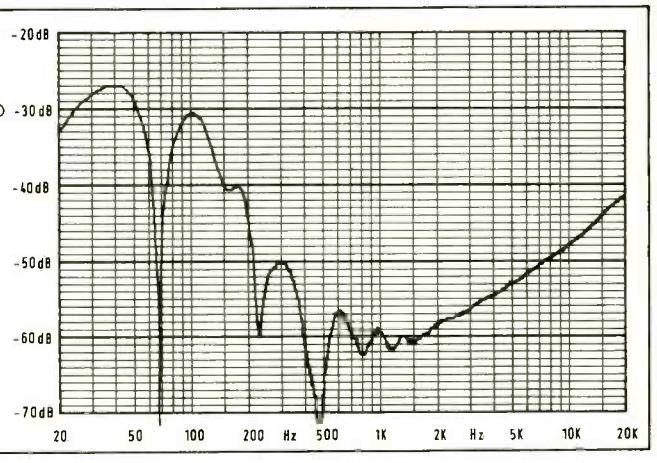


FIG 6.
OTARI MTR-90-II
CROSSTALK BETWEEN
ADJACENT TRACKS-TRACK 10
IN SYNC AND TRACK 11
IN RECORD.

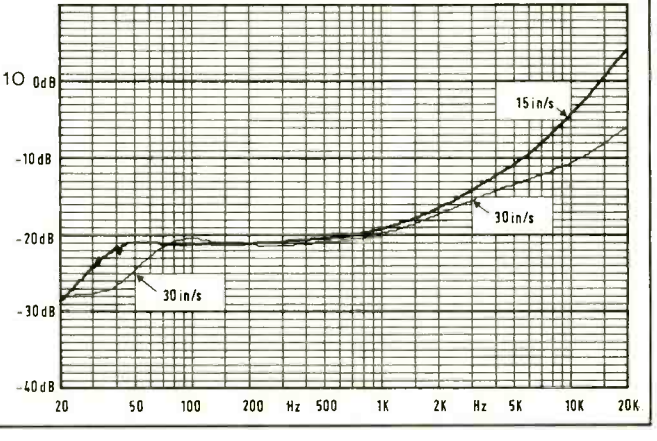
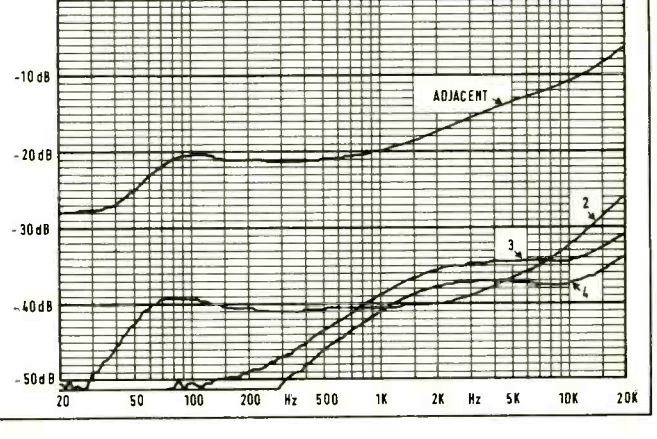


FIG 7.
OTARI MTR-90-II
SYNC CROSSTALK 30in/s
SEE TEXT



concerned. Checking the drift in speed from one end to the other of a 10½ in reel of tape showed the drift to be less than 0.01%. Checking the varispeed accuracy shows this to be within the readability of the display with the available range being 75% to 123.5% of nominal speed.

Other matters

The phase-jitter between tracks 1 and 24 at 10 kHz with a tape speed of 30 in/s is shown in **Fig 9**, showing a peak-to-peak jitter of about ±10° with a cyclic nature which may well come from the tape itself, as the period is about 2.5 s corresponding to 75 in of tape.

Erasure of a 1 kHz tone was measured at both tape speeds on a number of tracks and found to show quite large variations, however the erasure was always satisfactory at greater than 80 dB.

The VU meters were found to be genuine instruments to the American Standard C16.5 with correct rise and fall time and the correct rectifier characteristics.

In all modes the tape handling was first class with a constant tension of 400 g except when accelerating in the fast wind modes where the maximum speed was such that the machine produced a very good wind.

Bias ramping and erase timing were such that no gaps or clicks were recorded with the bias timing automatically compensating for the staggered erase head.

Summary

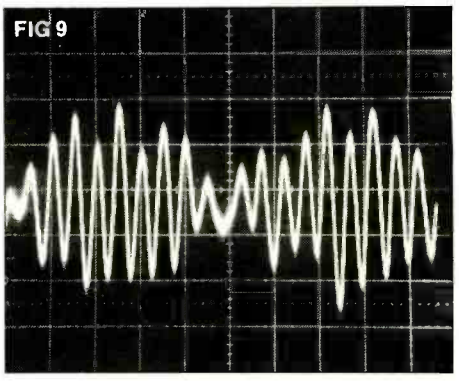
The Otari *MTR-90* is a very well-built machine with the tape transport having many of the features of the premier recorders of European manufacture. Maybe the overall finish and cosmetics are not quite to the best standard, but they are certainly not far off.

All the electronics are very well made and, with the exception of a degree of hum pickup in the outer tracks, offer a first-class performance. All adjustments are well controlled and the overall concept of the electronics well conceived.

Both the remote control unit and the autolocator are highly practical with excellent layouts. Full and foolproof interlocking is provided for all functions with clear displays of the machine's status.

This machine is to be thoroughly recommended, particularly when comparing its price with competition.

Hugh Ford



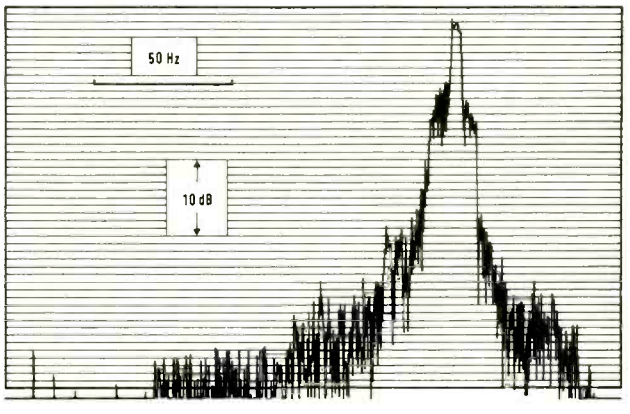
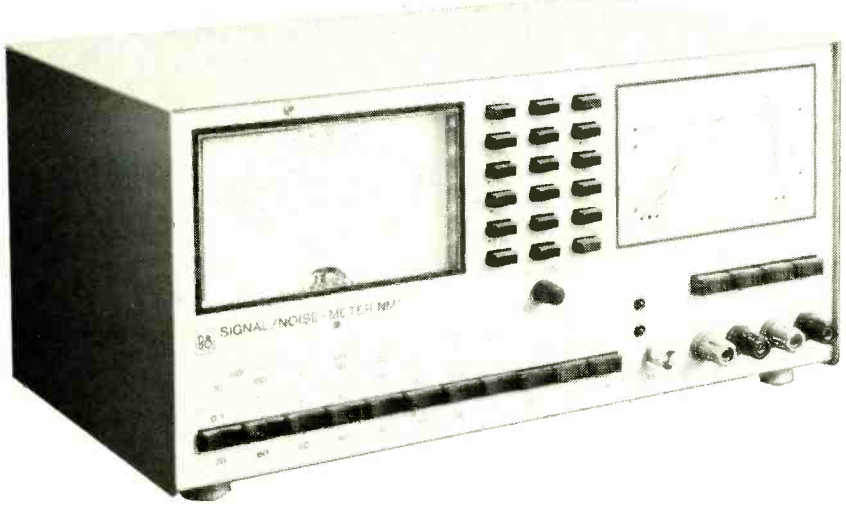


FIG 8.
OTARI MTR-90-II
SPECTRUM ANALYSIS OF
10kHz TONE RECORDED
AND REPLAYED AT 30in/s

Bang & Olufsen NM1 S/N meter



THE Bang and Olufsen noise meter type *NM1* is an instrument designed for voltage and noise measurement using unweighted or weighted measurements using the standard A-weighting or the more recent and popular CCIR-weighting in addition to other useful filters. These consist of 20Hz or 200Hz highpass filters which work in conjunction with a lowpass filter intended for excluding stereo pilot tones, tape recorder bias frequencies or the like.

Furthermore the instrument includes a wide band measurement plus characteristics to meet the DIN or CCIR-unweighted frequency response, plus the ability to use external filters.

In addition to these capabilities three rectifier characteristics are available — a true rms rectifier with the IEC recommended 'fast' and 'slow' characteristics, plus a 'normal' characteristic — an average rectifier for noise measurements to the Dolby recommended CCIR/ARM method using the CCIR-weighting curve — finally a quasi-peak rectifier characteristic meeting the requirement of CCIR recommendation 468-2 (1978 version — other manufacturers please note!) and the requirements of DIN 45405.

A useful 'plus feature' of the Bang and Olufsen meter is that it includes stereo inputs which may be switched left/right and also switchable 4Ω and 8Ω load resistors each rated at 100W continuous or 140W for 5 min and also an internal loudspeaker for monitoring the inputs.

To the front of the instrument a 110mm wide moving coil meter, without mirror scale, is calibrated in volts, dB, dBm and watts (into 4Ω or 8Ω) with 11 interlocked pushbutton switches along the base of the instrument providing range switching. These buttons allow full scale deflections from 37V to 370μV corresponding to 140W to 14nW or +33.5dBm to −68.5dBm. A further button provides x10 range extension on

86 ▶

Sony Digital Audio is anything but a new idea. As far back as 1974 Sony introduced their original working digital audio recorder.

Even at that stage its wider dynamic range, flat frequency response, lower distortion and lack of deterioration in repeated copying put analogue equipment in the shade.

But now, having put much time and effort into research and development, Sony have produced a range of digital audio equipment which produces results even better than their original machine. Giving sound recordings which are virtually indistinguishable from the original performance.

An achievement made possible not only by improving on the original design but also by Sony extending the digital audio range to include a 24 track recorder, reverberator, 2-channel audio processor, preview unit and electronic editor. The widest range of digital audio equipment on the market.

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the least sensitive ranges.

At the centre of the front panel three vertical rows of six pushbuttons control the function of the instrument. The left hand row includes a power on/off button with the remaining buttons selecting the rectifier characteristic from average, rms — normal — fast or slow — or peak characteristic. Similarly the right hand row of interlocking buttons select the frequency characteristic with the selected characteristics being displayed by means of green LED indicators on a frequency response plot of the characteristics to the right of the instrument.

The six selectable characteristics include linear (wide band), IEC recommendation 179 (Precision Sound Level Meters) A-weighting, unweighted to CCIR recommendation 468 or DIN 45405, weighted to CCIR recommendation 468, 20Hz highpass with pilot filter or 200Hz highpass with pilot filter.

Where the CCIR-weighted characteristic has been selected the unity gain point of the weighting curve is shifted from the normal 1kHz to 2kHz when the average rectifier characteristic is selected to comply with the Dolby suggested measurement method called CCIR/ARM (CCIR weighted with Average Reading Meter).

Turning to the centre row of switches the bottom button selects the external filter connections at the rear of the instrument, the next two buttons select the x1 or x10 voltmeter ranges with the x1 button being interlocked with the above two buttons which select either 8Ω or 4Ω loads on the external inputs. Finally the top button switches the internal monitor loudspeaker on/off with its volume control below the pushbutton matrix.

The final front panel features are the input connections consisting of a BNC socket and two pairs of terminals/binding posts on the standard ¾in spacing with 3mm sockets. The BNC socket serves as the input for normal voltage measurement with the binding posts being selected when the load resistor buttons are depressed. However, four interlocked pushbuttons above the binding posts select left or right inputs with either the internal 4/8Ω loads or external loads connected to a DIN socket at the rear of the instrument. When such a load is not connected the binding post inputs become high impedance inputs.

Other features at the rear of the instrument include four BNC sockets which provide external filter input and output plus AC and DC outputs from the metering circuits suitable for feeding chart recorders etc.

A further BNC socket allows external instrumentation to be connected to the left and right inputs according to the front panel left/right selection. There is also provision for feeding an external loudspeaker from the monitoring amplifier via a 2-pin DIN socket and a slide switch for isolating the instrument's ground and connecting it to a single 3mm socket nearby. Finally there is the fixed 2m long power lead and the metric power fuse which was properly identified for 110V or 220V operation.

Generally all user functions were clearly identified and the instrument was easy to use with good control layouts, however the lack of a tilting foot can be irritating when the meter is used on a flat bench.

Removal of the top cover revealed that the construction was based on a mother pcb occupying most of the base of the instrument and containing a few components. The majority of the components were mounted on two further boards which plug into pin connectors on the mother board and feed other parts by plug-in ribbon cables, the power supplies being a separate board in the base of the unit and various other smaller printed circuits mounting other components.

Access for servicing was reasonable and all components were clearly identified by screen printing on the glass fibre pcbs.

Whilst the standard of electrical construction was entirely satisfactory the mechanical construction was not particularly substantial and it is felt that this is strictly a laboratory instrument as opposed to a portable instrument as it could be easily damaged in transit.

MANUFACTURER'S SPECIFICATIONS

Wattmeter
Measuring range: 0.01nW to 140W in 11 ranges. fsd (0dB) at: 10nW to 100W.
dB range (0dB = 100mW): −90dB to +30dB, −90dBm to +30dBm in 11 ranges.
Range extension: +1.5dB and +3.5dBm.
Dial: 0 to 140W and −20dB to +1.5dB.
Accuracy (1kHz sine), LIN (±10% mains voltage variation): ±0.3dB fsd.
Frequency range: depending on the filter and detector type.
Input resistance: 2×4Ω, 2×8Ω, 1×2Ω, 1×16Ω ±1.5%.
Load: 2×100W continuous, 2×140W max 5min.
Inductance: typically 1.8μH (4Ω), typically 2.7μH (8Ω).
Noise power (LIN and AVG): typically 0.01nW in 10nW to 10mW ranges, typically 100μW in 100mW to 100W ranges.
Crosstalk (1kHz sine): left to right channel >100dB.

Voltmeter
Voltage range: 10μV to 370V in 13 ranges fsd (0dB) at 0.316mV to 316V.
dB ranges (0dB = 1V): −90dB to +50dB in 13 ranges.
dBm ranges: −90dBm to +50dBm in 13 ranges.
Range extension: +1.5dB and +3.5dBm.
Dials: 0 to 12, 0 to 37, −20dB to +1.5dB, −20dBm to +3.5dBm.
Accuracy (1kHz sine) LIN (±10% mains voltage variation): ±0.3dB fsd.
Frequency range: depending on the filter and detector type.
Input impedance: 1MΩ/40pF in the mV ranges. 1MΩ/27pF in the V ranges.
Inherent noise (LIN and AVG): input shorted typically 6μV in the 3mV range, typically 5mV in the 1V range. Input shorted with 10kΩ typically 15μV in the 0.3mV range, typically 5mV in the 1V range.
Overload protection: max 400Vdc or max 400 Vac (f≤100Hz).

Measuring amplifier
Amplification: −30dB to +70dB in 11 steps.
Accuracy (1kHz sine LIN): ±0.3dB.
Frequency range (LIN) RL>10kΩ: 7Hz to 1MHz ±1dB, 4Hz to 1.5MHz ±3dB.
Input impedance: 1MΩ/27pF (−30dB to 0dB), 1MΩ/40pF (+10dB to +70dB).
Output voltage: max 3V effective (4.2V peak) 1kHz.
Output impedance: 1kΩ ±5%.
Inherent noise (LIN and 0.3mV): typically −34dB at shorted input, typically −26dB at 10kΩ load.
Harmonic distortion at 1kHz: <0.2% 2nd harmonic, <0.1% 3rd harmonic.

Monitor amplifier
Output power: 0 to 450mW, 8Ω
Frequency range, built-in loudspeaker: 120Hz to 10kHz max 1.5W.

Detector types
Frequency range: with mean value (AVG) rectifier 10Hz to 1MHz ±0.3dB. With effective value (rms) rectifier 20Hz to 200kHz ±0.3dB. To DIN 45633, IEC 179 slow or fast 20Hz to 200kHz.
Overload margin: +10dB (0dB).
Peak detector (PEAK): DIN 45405, CCIR 468, frequency range 30Hz to 200kHz ±0.3dB, overload margin +20dB (0dB), DIN 45405.

Filters
Linear: 4Hz to 1.5MHz +0.5dB −3dB.
A-Weighted: to DIN 45633 and IEC 179.
Unweighted: to DIN 45405 and CCIR 468.
Weighted: to DIN 45405 and CCIR 468 with unity gain at 1kHz.
Weighted: to DIN 45405 and CCIR 468 with unity gain at 2kHz. Only available with an 'average' dector.
Pilot tone filter (20Hz): to DIN 45500-2 with 19kHz and 38kHz attenuation >36dB.
Pilot tone filter (200Hz): to IEC 315-6 with 19kHz and 38kHz attenuation >36dB.
Filter accuracy: ±0.2dB at unity gain point.
External filter output: 0dB typically 26mV from 1kΩ ±1%.
External filter input: 0dB typically 26mV into 1kΩ ±1%.
External filter frequency range: 10Hz to 200kHz ±0.3dB.

Signal outputs
Left/right: galvanically connected to L/R input via L/R switch.
Output impedance (L/R): 1kΩ ±5%
Analogue output (AC): 1V sine (0dB), 1kΩ ±5%.
Analogue output (DC): 1V (0dB), 1kΩ 1%.
Loudspeaker connection: 450mW, 8Ω.
Mains connection: 110V/220VAC ±10%.
Consumption: approx 16W.
Temperature range: 10°C to 40°C.
Dimensions: (whd) 12¾ × 8¼ × 6¼ in/323 × 210 × 160mm.
Weight: 14.4lb (6.5kg).
Manufacturer: Bang and Olufsen A/S, DK-7600 Struer, Denmark.
UK: Bang and Olufsen (UK) Limited, Eastbrook Road, Gloucester.

Inputs and outputs

The normal BNC high impedance input was found to offer an input impedance of 909kΩ in parallel with 23pF on the volts ranges with the shunt capacity rising by about 10pF in the mV ranges — quite high enough for normal applications.

When using the binding post inputs the value of the load resistors was adequately accurate when

88 ▶

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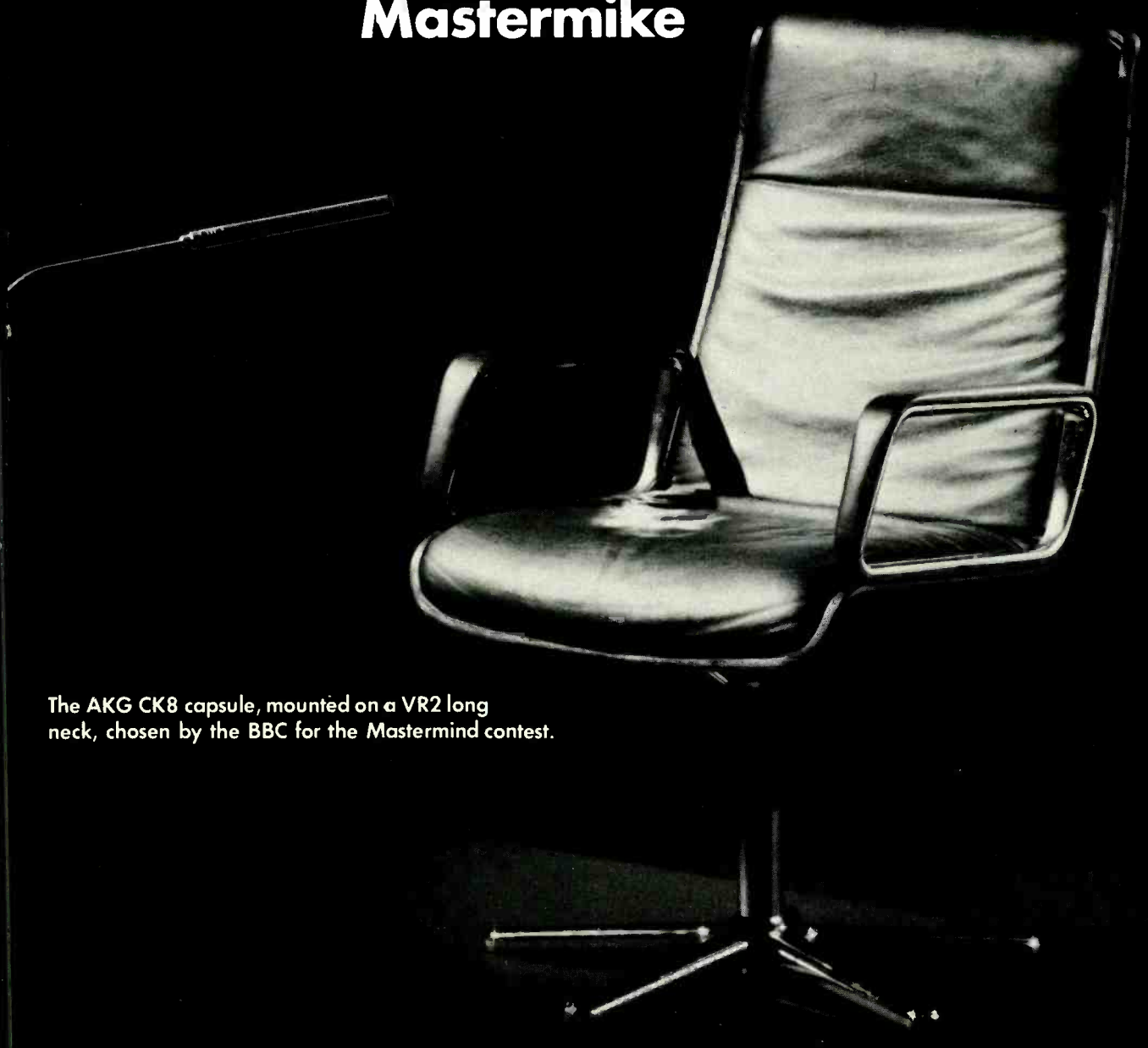
Mastermike



The AKG CK8 capsule, mounted on a VR2 long neck, chosen by the BBC for the Mastermind contest.

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London W3.
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cold, but continuous dissipation of 100W produced excessive drift which I regard as unacceptable for accurate power measurements (see **Table 1**).

TABLE 1

Nominal resistance	Cold resistance L/R	Hot resistance
4Ω	4.049/4.043Ω	4.150Ω
8Ω	8.068/8.070Ω	8.213Ω

The inductance of the load resistors, being 1.2μH for the 4Ω resistors or 2.2μH for the 8Ω resistors was entirely satisfactory. A minor irritation was that the wire holes in the input binding posts were not all aligned vertically.

Turning to the external filter connections the voltage level for unity meter indication (as opposed to full scale of 1.2) was found to be 27.5mV with the output impedance being 1.002kΩ and the input impedance 999Ω — personally I would have preferred a lower output impedance and higher input impedance and the connections will not be compatible with some external filter arrangements.

Similarly the meter outputs have nominal impedances of 1kΩ with actual impedances of 1.009kΩ and 1.019kΩ for the DC and AC outputs respectively with the voltages being very close to the nominal 1V for unity meter indication at 0.991V DC and 1.010V AC.

Metering accuracy

Checking the calibration accuracy at 10Vrms input at 1kHz showed this indication to correspond to 0.996V with the meter being effectively flat from 30Hz to above 200kHz in the 'flat' and rms conditions on any sensitivity range.

Accuracy of the input attenuator was found to be within ±0.05dB within the frequency range to above 200kHz and the accuracy of alignment of the weighting networks at 1kHz was found also to be within ±0.05dB — a creditable performance.

Noise was always at a low level relative to the measurement capability, being at worst 30μV when measuring linear wideband with the peak rectifier and the input shunted with 600Ω. In all other conditions noise was below 10μV, but it must be remembered that the sensitivity of the unit is such that reliable measurements cannot be made below say 50μV.

Weightings and filters

The frequency response of the meter for the weighted conditions is shown in **Fig 1** which demonstrates the A-weighting, CCIR Recommendation 468 weighting and the CCIR/ARM-weighting versus the 'flat' response. It can be seen that the accuracy of the curves is excellent and they remain well within the permitted tolerances.

Similarly **Fig 2** shows the frequency characteristics of the filters and the 'unweighted' curve to CCIR recommendation 468 and DIN 45405 plus the lowpass filters which attenuate the 19kHz pilot tone frequency by 38dB and 38kHz by 37dB. Again these curves are well within accepted tolerances.

Rectifiers

The characteristics of the rms rectifier was checked to the IEC Recommendation 179 (Precision Sound Level Meters) and found to be within the tolerances, twin tone testing showing that also the average and peak characteristics were correct.

Meter ballistics

Again using IEC Recommendation 179 the 'fast' and 'slow' meter characteristics were checked for their response to tonebursts and overswing and found to be well within the recommended tolerances.

More difficult to meet are the peak meter requirements to meet the CCIR Recommendation 468: 2 of 1978. In relation to this recommendation the meter was checked for its response to tonebursts of various durations at 1kHz and found to be very close to specification as shown in **Table 2.**

A further test is to apply 5ms bursts of tone at various repetition frequencies and here the meter fell just short of the requirements on one measurement as shown in **Table 3.**

In addition to the above tests the meter was checked for various other parameters such as overload and reverse error on pulses and found to be well within the requirements.

Summary

The Bang and Olufsen *NM1* meter is very well conceived for routine maintenance work on stereo equipment and is another welcome contender in the limited range of meters which meet the CCIR 468 requirements.

In addition to this the B and O meter has other useful weightings. It is unusual as it has a true rms and also average rectifier and has the very valuable feature of a low power monitor amplifier and loudspeaker.

Overall the performance was found to be very good, with a couple of minor hiccups, in spite of which this unit can be well recommended for general maintenance work. **Hugh Ford**

TABLE 2

Toneburst time	1ms	2ms	5ms	10ms	20ms	50ms	100ms	200ms
Meter's % steady state indication	18	29	42	48	52	59	71	87
Standard	13.5	22.4	34	41	44	50	58	68
Tolerance	21.4	31.6	46	55	60	68	78	92

TABLE 3

Burst rate	2Hz	10Hz	100Hz
Meter's % steady state indication	41	72	94
Standard tolerance	43/53	72/82	94/100

FIG.1 B&O NM1 FREQUENCY RESPONSE FOR WEIGHTED CONDITIONS

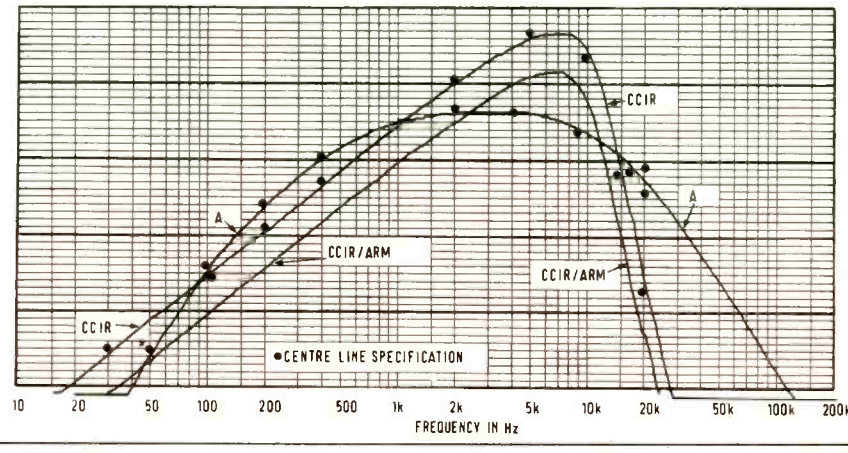
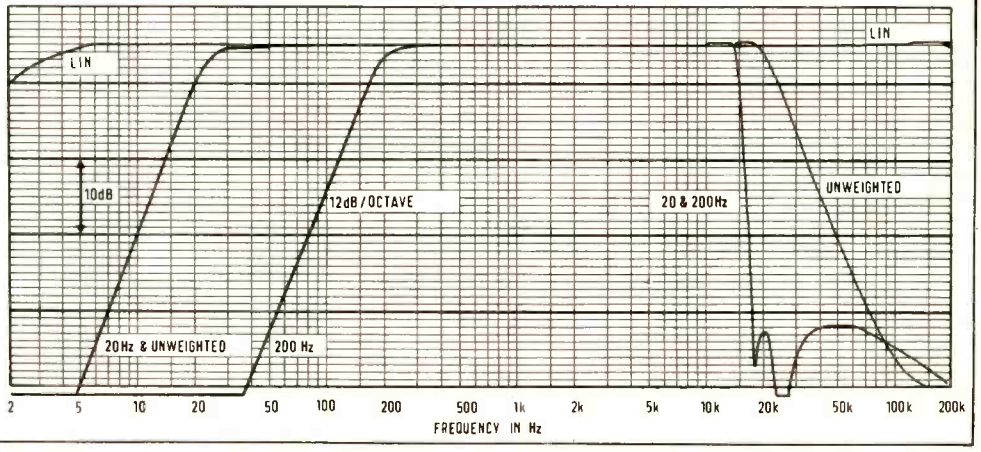


FIG.2
B&O NM1
FREQUENCY CHARACTERISTICS
OF FILTERS



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Bridging the gap between the new technology and old reliability, it's the logical extension of the innovative technology built into our multichannel MTR-90. The new MTR-10 gives the professional unprecedented control:

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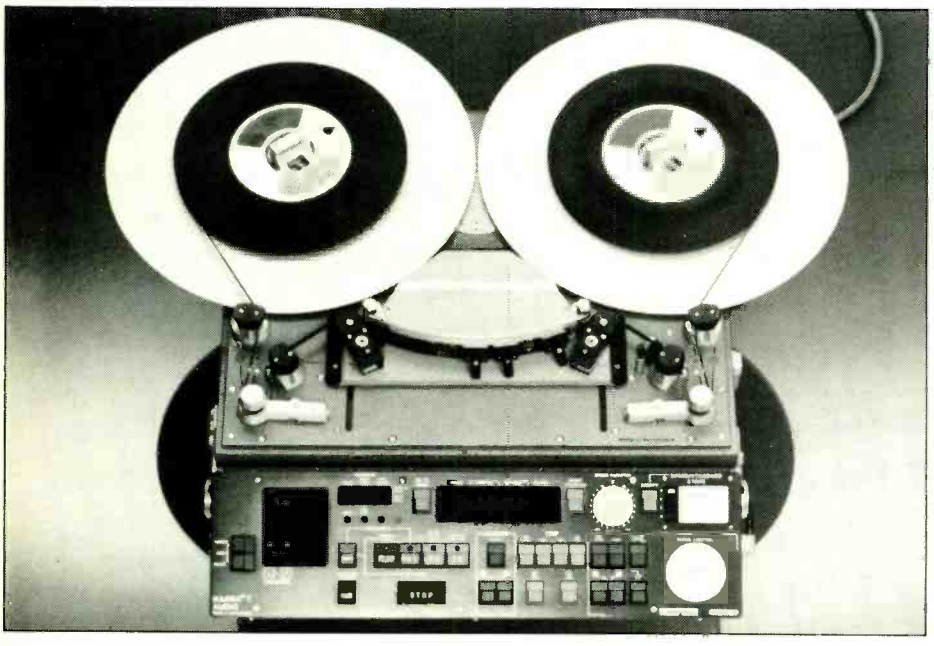
- Full servo, D.C.PLL transport governed by an on-board microprocessor — an industry first.
- Unmatched production features — exclusive multiple edit modes, reverse play, standard alignment level presets, and dual-mode varispeed. Other features include controlled wind, preset master bias switching, three speeds and IEC, AES and NAB selectable. Also it includes return-to-zero and offers an optional tape locator with ten position memory and tape shuttle.
- Comprehensive servicing and support. Fully modular power supply, audio and transport electronics card frame. A highly dedicated distributor service network with factory trained and supported technicians.
- Available in full-track 1/4", 2-track 1/4" and 4-track 1/2". Comes with optional DIN-head and overbridge versions.

Nagra T-Audio



THE Nagra *TA* studio recorder is a new and innovative machine completely different from the famous portable Nagras and for that matter from any other audio recorder. These comments apply not only to the tape transport, but also to the electronics and the whole concept of the machine. Designed originally as an instrumentation transport the tape is driven by twin capstans, one either side of the head block —a well proven instrumentation transport feature. However a completely novel feature is that the tape tension is detected within the headblock and the offset between the capstans is arranged to achieve constant tape tension across the heads.

The tape transport is based on a 4 mm thick alloy plate mounted within a cast frame. This hinges on the fabricated alloy body of the recorder which is supported by a cast alloy spider. Within the main body there are twin, small, monitoring loudspeakers driven by a monitor amplifier on a PCB fixed to the right-hand side of the recorder. The level control and a channel selector switch for the amplifier protrude through the side together with a loudspeaker/headphones toggle switch and a stereo headphone ¼ in jack.

Located beneath a screen are the main electronics comprising five large PCBs which plug into a mother board at the rear of the unit. To the bottom right side is the mains power supply which has an on/off toggle switch and incandescent power indicator which protrude through the front cover. Also on the power supply is a rotary voltage selector covering European and American voltages and twin power fuses the identity of which is confusing as it implies one fuse is for 110 V operation and the other for 220 V operation.

Audio inputs and outputs take the form of recessed *XLR* connectors on the rear panel which also includes twin 25-way 'D' connectors, one for remote control via an IEEE-488 buss and the other for comprehensive audio monitoring. Also at the rear are two locking Tuchel connectors for

MANUFACTURER'S SPECIFICATION

Tape transport: twin capstan open loop system ensuring very low wow and flutter and modulation noise.
Preset calibrations: direct access to four preadjusted recording calibrations in respect of speed, type of tape (bias) and standard.
Playback speed: selection of four playback speeds with respect to standard (CCIR, NAB, Nagramaster).
Fast copying: facilities at 30 in/s.
Editing: standard – manual with free spools, bi-directional hand pull, dump and built-in cutter. Optional – servo controlled with automatic displacement of edit point to built-in cutter.
Remote control: detachable, individual control unit with full remote capabilities and access to all functions including counter by means of a 25-pin 'D' connector.
Power supply: AC/DC operation with very low power consumption.
Warning display: two levels of alarm (close to limits and out of limits) for power (internal DC voltage supply) and interhead tape tension.
Matrix display: for record and output modes.
Tape counter: time display, five digits (h.mm.ss) bidirectional, 7-segment LED (eight digits for optional time code: hh.mm.ss frames). Time indication corresponding to selected speed. Accuracy better than 0.1% at all speeds including spooling mode. Zero locator and reset pushbutton.
End of tape sensor: optical clear tape.
Speed variator: variable playback speed ±6% and variable spooling speed 0 to 10 m/s in both directions.
Skip: three speeds in both directions by non-latching switches – nominal speed and 2x nominal speed with listen facilities, fast winding speed without listen.

Tape transport

Tape drive: twin capstan open loop system with two servo-controlled capstan motors and interhead tape tension sensor.
Tape tension: two independent tape tension servo control loops, one between the two capstans and the other between spools and capstans. Between capstan 75 g (internally adjustable). Between spool and capstan – normally 75 g. Maximum tape tension 180 g when starting or stopping at fastest spooling speed.
Tape speeds: 30 in/s = 76.2 cm/s, 15 in/s = 38.1 cm/s, 7½ in/s = 19.05 cm/s, 3¾ in/s = 9.525 cm/s.
Tape width: 6.35 mm (¼ in).
Tape thickness: from 25 μm to 50 μm (0.7 mil to 1.5 mil without adjustment).
Maximum spool diameter: up to 180 mm (7 in) with lid. Up to 300 mm (11.8 in) without lid.
Spool hub type: NAB, AEG, cinema.
Speed accuracy: $< \pm 0.05\%$ (0.1%) from $-20°$ to $+70°C$.
Wow and flutter: weighted peak flutter recording/playback system. IEE 193 – 1971 ANSI S 4.3 1972 standards. 30 in/s – $\leq \pm 0.015\%$ ($\pm 0.025\%$), 15 in/s – $\leq \pm 0.02\%$ ($\pm 0.027\%$), 7½ in/s – $\leq \pm 0.025\%$ ($\pm 0.035\%$), 3¾ in/s – $\leq \pm 0.03\%$ ($\pm 0.05\%$).
Start time: 30 in/s – 500 ms, 15 in/s – 300 ms, 7½ in/s – 250 ms, 3¾ in/s – 200 ms.
Stop time: measured with 300 mm (11.8 in) full spool, IEC standard – from fastest speed to tape stationary 1.5 s. from 30 in/s to tape stationary 0.5 s.
Fast winding speed: up to 10 m/s (730 m or 2400 ft: 100 s).

Head unit

Interchangeable head unit with erase, reference (optional), record and playback heads.
Stereo head unit: record/playback two tracks per head. Track width 2.75 mm (0.108 in). Inter-track distance 0.75 mm (0.029 in). Erase full track.
Two track head unit: record/playback two tracks per head. Track width 2 mm (0.095 in). Inter-track distance 2.4 mm (0.095 in). Erase two tracks.
Mono head unit (IEC standard): record/playback one track per head. Track width 6.35 mm (0.25 in). Erase full track.

Record-reproduce

Inputs: symmetrical floating (isolated from chassis); impedance > 10 kΩ; nominal level 0 dB 390 mV to 4.4 V (internally switchable); clipping level > + 14 dB; record calibration mounted on plug-in cards (maximum four per channel), operator adjustable and interchangeable.
Outputs: symmetrical floating (isolated from chassis); load > 200 Ω; nominal level 0 dB 755 mV to 4.4 V (internally adjustable). Maximum output level > + 24 dBm; output impedance < 30 Ω.
Erase: frequency 256 kHz crystal-controlled; efficiency > 82 dB standard head, > 90 dB special head; at maximum peak level 1250 Hz – 1020 nWb/m.
Bias: frequency 256 kHz crystal-controlled.

Performance (measured on NTA-S09012 model): 6.35 mm (0.25 in) stereo version
Crosstalk: > 50 dB at 1 kHz, > 40 dB at 10 kHz.
Frequency response: typical; specified values in brackets. Test tapes 3M *250* for NAB standard, 3M *256* for CCIR standard); 15 in/s CCIR/ NAB 30 Hz to 20 kHz ±1 dB (±1.5 dB). 7½ in/s CCIR/NAB 30 Hz to 15 kHz ±1.5 dB (±2 dB). Fast copying: 30 in/s 50 Hz to 60 kHz ±1 dB (±2 dB).
Signal to noise ratio: RMS, ASA A-weighted, reference signal at maximum peak level (1020 nWb/m, *810 nWb/m) NAB 3M *250*—15 in/s 73.5 dB, 7½ in/s 73.5 dB. CCIR 3M *256*—15 in/s 75 dB, 7½ in/s 71 dB*. SPR50LH—15 in/s 76 dB, 7½ in/s 70 dB*. *PEM 468*—15 in/s 74.5 dB, 7½ in/s 69.5 dB*. AES —30 in/s 77.5 dB. *Nagramaster* —15 in/s 77.5 dB*.
Distortion: (measured at 160 Hz and 1.6 kHz 1020 nWb/m*, 810 nWb/m 15 in/s—NAB, H2 0.3%, H3 0.7%. CCIR, H2 0.3%, H3 0.7%; 7½ in/s—NAB, H2 0.3%, H3 1.0%. CCIR, H2 0.5%*, H3 1.0%*. (Tape used for test: NAB standard, 3M *250*; CCIR standard, 3M *256*, SPR *50 LH* and *PEM 468*.)

General

Dimensions: (wdh) with 180 mm (7 in) reels and without control unit 400 mm × 335 × 238 mm. With 300 mm (11.8 in) spools and without control unit 610 × 420 × 250 mm. Control unit 400 × 110 × 50 mm.
Power supply: mains adaptor or 11 to 14 V DC.
Power consumption: AC typically 65 VA maximum 85 VA. DC typically 40 W.
Operation positions: any position.
Operating temperature: (tape limited) – 20 to + 70°C (DC supply). – 20 to + 50°C (AC supply).
Manufacturer: Kudelski SA, CH-1033 Cheseaux-sur-Lausanne, Switzerland.
UK: Hayden Laboratories Ltd, Hayden House, Chiltern Hill, Chalfont St Peter, Bucks.

92 ▶

Nothing reproduces better than a Sony microphone.

If the microphone you're using gives anything less than completely faithful reproduction from studio to control room it certainly isn't a Sony. The C48 simply can't be bettered in that respect. Its performance is so outstanding, it won't leave so much as a whisper behind in the studio.

And the same level of sound quality applies throughout Sony's range of professional microphones.

The C35P and C36P uni-directional condenser types perform beautifully on stage and are particularly suitable for multiple-microphone recording.

In theatre and outside broadcast situations Sony C74 and C76 shot gun type microphones will accurately pick up frontal sound, with excellent indirect and ambient noise rejection.

Newer additions to the Sony microphone range include the ECM 969 and 989 single point stereo mikes with the option of remote control of directional axes, and the F560 and 660 uni-directional dynamic types, particularly suited to vocal performances.

In fact from the tiny ECM 50 PS tieclip mike to the F115 omni-directional dynamic microphone which will stand up to the harshest climatic conditions without any loss of sound quality, there's a Sony Microphone to suit just about any professional requirement.

Because after 30 years in the business there aren't many situations Sony haven't been called on to cope with.

If you'd like to hear more, contact Keith Smith at Sony (UK) Ltd, Pyrene House, Sunbury Cross, Sunbury on Thames, Middlesex or telephone Sunbury 81211.

SONY

PROFESSIONAL AUDIO

high speed copying with a bandwidth extending to 60 kHz at the copying speed of 30 in/s and the mains connector which for some reason takes the form of the high current version of the IEC connector.

At either side of the recorder there is a 9-way 'D' connector for connecting two control panels one of which normally fits to hinged brackets at the front of the machine, the other optional panel being a remote control. Also at the sides are two fixings for the very neat optional console which allows the recorder to be tilted to any convenient angle.

As is usual with Kudelski products the standard of construction is beyond reproach in both the mechanical and electronics departments and access to all parts for servicing is excellent. Furthermore most units can be easily removed as interconnections are via ribbon cables equipped with insulation displacement connectors.

Reverting to the tape transport each reel has a servo-controlled DC motor of remarkably small dimensions equipped with a gear wheel which drives a toothed belt. This in turn drives two separate spool hold-down positions at each side of the recorder which are flush with the top plate. The two inner positions accept spools up to 8 in diameter (7 in with the clear plastic lid in place). Using the two outer positions spools up to 11.8 in diameter can be accepted.

Three types of spool hold-down clip into the drive positions—NAB, cine or European AEG hubs. The cine adaptors use the common spring-loaded centre catch with the NAB adaptors having a central toggle which makes three leaves protrude through the sides of the adaptor and descend upon the spool to give positive location. Braking of the spools is at the outer locations and appears to take the form of internal drum brakes which are driven via a motorised cam which performs all mechanical movement functions within the recorder.

A screwdriver-operated switch beneath the transport plate allows oxide in or oxide out operation with this and all other features including the tape threading path being clearly identified on the transport plate.

From the pay-off spool the tape passes over a metal guide roller before passing to the spring-loaded roller guide tension sensing arm the position of which is sensed by a variable reluctance transformer. There follows a low inertia tape speed/position/direction sensor before entering the first capstan. Both capstans are directly driven by servo motors with the right-hand capstan controlling the tape speed which is referenced to a crystal, with the left-hand capstan being controlled by the tape tension within the headblock.

The capstans take the form of large diameter ceramic sleeves on metal shafts well protected with bearings at their outer ends. To my knowledge the pinch roller arrangement is unique. Both pinch roller assemblies and the replay head shield (with provision for two shields at other positions) are mounted on a carriage plate. In the loading or 'park' state the carriage, which is the width of the headblock, retracts about 2 in clear of the heads giving excellent access to the heads for cleaning and a straight tape path for loading.

Entering the stop mode activates the aforementioned motor-driven cam which places the carriage close to the headblock with the pinch rollers disengaged. The next action is entering a tape drive mode (other than fast modes when the carriage is retracted) when the motor-driven cam is again activated and the pinch rollers engaged.

The headblock is readily removable, being secured flush on to the top plate by three screws with the electrical connections being two 25-way 'D' connectors and the mechanical location by two pins which enter holes in the top plate. Within the headblock which comprises a machined alloy shell, the head and other components are suspended from the top of the shell. At the entrance to the headblock an optical clear tape sensor is fitted at a fixed edge guide, followed by a ferrite erase head and the tape tension sensor which is a variable reluctance transformer device with fixed edge guides at either side. This is before a position for an extra head which is followed by the metal record and replay heads in between which there is a flutter roller.

Whilst the review sample was fitted with European stereo heads, 2-track and monophonic headblocks are available with time code being an option.

From the fixed exit guide of the headblock the tape passes a manually operated set of editing scissors before the take-up tension arm with its two metal roller guides controlling the take-up spool.

Turning to the electronics each record/replay chain occupies a plug-in PCB which extends almost the complete width of the recorder, the two boards being similar but not identical. Each board has five subsidiary plug-in boards one of which has a bar-type LED level indicator with 3 dB steps from −18 dB to +6 dB. The remaining four boards each have record equalisation, level and pre-distortion controls allocated to a particular tape speed and type. Changes in record equalisation and tape speed combinations can therefore be achieved by interchanging these boards, but bias setting must be done separately.

The potentiometer controls available at the front of the audio channel boards are an overall replay level for all speeds, four head loss compensators for the four speeds from 30 in/s downwards and then five controls on each of the four plug-in equaliser boards. These controls are for record level, record equalisation, second harmonic pre-distortion and third harmonic pre-distortion at 160 Hz and at 1.6 kHz.

The remaining front control is a toggle switch on the level indicator board for switching between input and output. Seventeen further potentiometers require an extender board for adjustment with soldered links selecting the output level between 0.775 V, 1.55 V or 4.4 V. A movable pin connector selects the input sensitivity between these levels in addition to 0.390 V and 3.10 V. Finally two miniature PCB mounted slide switches select the 30 in/s high speed copy function.

Space is left to the right of the audio boards for a noise reduction board to be plugged in via a pin connector, but no details of this were available at the time of writing.

Below the audio boards and of the same size is the logic/control board which is largely a mass of logic integrated circuits.

To the left of the front a 3-position toggle switch selects monophonic, stereo or multitrack operation—a 4-track ½ in version of the recorder being intended. Adjacent to this a slide switch selects the record delay such that the record mode is entered either after a tape length being that between the erase and record heads or

94 ▶

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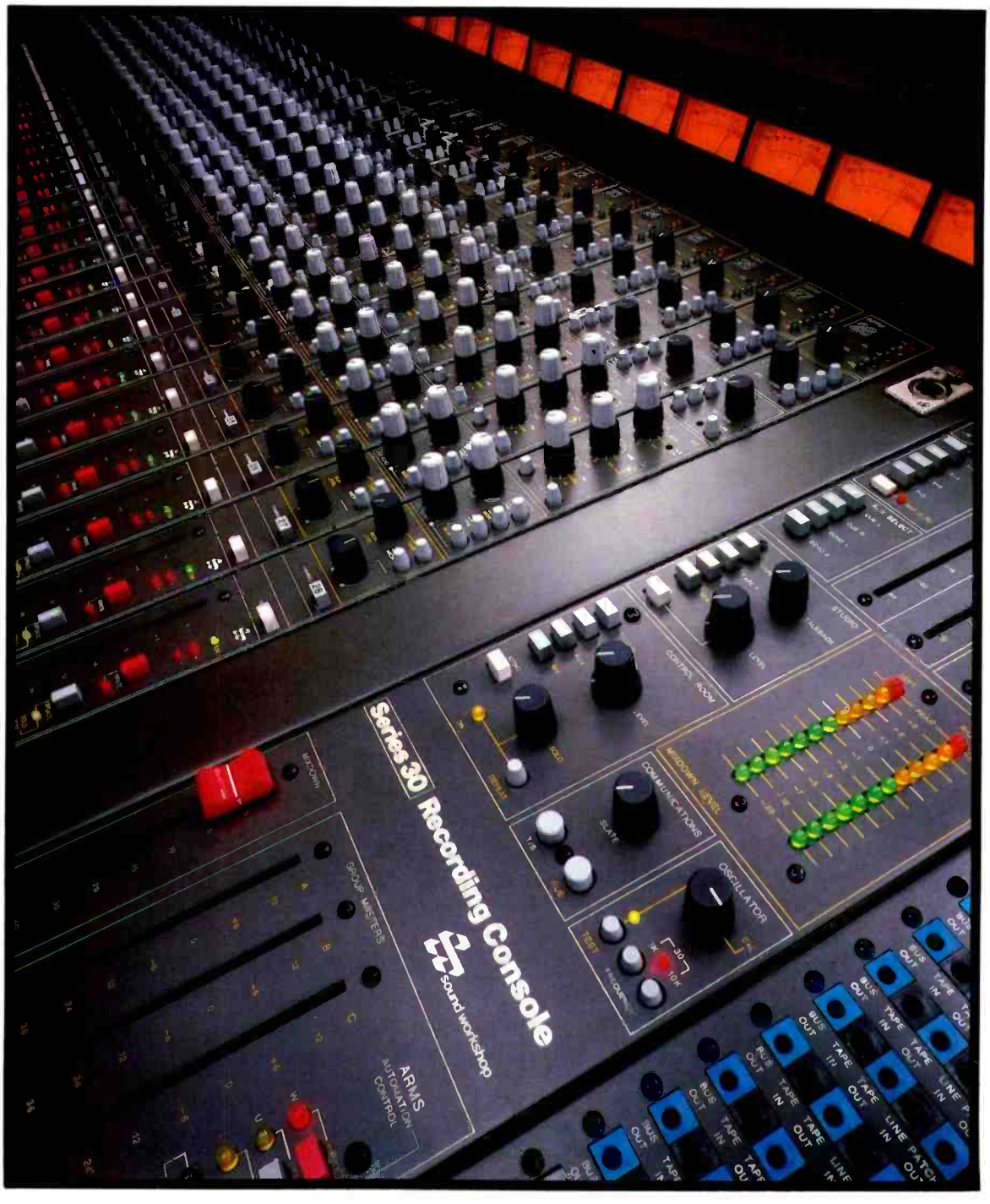

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when the proper tape speed has been achieved.

There are four rotary switches which select the replay equalisation for each of the four speed/record equalisation combinations selected. The available replay equalisations cover 3¾ in/s NAB/CCIR, 7½ in/s NAB or CCIR, 15 in/s NAB or CCIR or Nagramaster, 30 in/s CCIR or AES. Next there is a single bias level setting potentiometer for each of the four selected speed/equalisation combinations. Following these an 8-way DIL switch selects the initial conditions at switch-on dealing with such matters as the allocation of monitor outputs or ready/safe in multitrack. There follow three sensitivity controls for the clear tape sensor and the tape counter and a clear tape function switch which allows rewind, stop or no action at clear tape.

Below this is the speed stabiliser board with a large heatsink. Controls on this board affect such matters as tape tension and motor-driven cam operation, this board and the computer board below it being to the left of the power supply. Finally there is space below for the optional synchroniser board.

Two types of control panel are available, one being a simplified version of the other excluding the editing functions, skip functions and loading with spool motors on. The two types are interchangeable or may be operated in parallel with the remote control up to 60 m away from the recorder and being connected via a serial interface using a 6-way screened cable.

To the left of the control panel an annunciator panel shows the machine status with space for four channels, the review machine giving record indications and output source between input/replay or off—this selection being by means of two momentary pushbuttons. Nearby there is a smaller warning annunciator panel with six indicators: two each for power, phase lock and tape tension. These give warning of impending disaster as 'close to limits' indications and 'out of limits' indications. Below this there are three indicator lights, one for mono, one for timecode and a spare with a nearby light sensor automatically controlling the intensity of all indicators and displays.

The tape motion controls whilst being conventional at first sight take the form of momentary pushbuttons with integral LED indicators. However all the controls except record serve two functions depending if a 'shift' control is pressed at the same time. Entering the record mode by pressing shift and record inhibits all tape motion controls except stop, play which drops out into play and a pause control. Entering record immediately illuminates the record LED and after the appropriate delay illuminates the record indicators in the annunciator panel. Dropping into record from play is achieved by pressing record and shift.

The other functions associated with the shift control are: play (LED on) which becomes variable speed play in association with a speed variator control; rewind (LED on) which becomes go to leader; fast forward (LED on) which becomes variable speed spool with the speed variator control; pause which becomes listen when spooling; and finally, stop (LED on) which becomes park and withdraws the pinch roller carriage. At the centre of the panel tape time is indicated in hours, minutes, seconds and frames (when time code is fitted) up to 9 hr 59 min 59 s with clear seven-segment displays with proper negative and positive indication. In addition the tape timer automatically corrects when the tape speed is changed such that the indicated time always corresponds to the actual time from the original zero position on tape. Pushbuttons allow the time to be reset and also provide a zero locate facility.

Already mentioned is the speed variator control which is a dial calibrated to ± 6% in speed with additional arbitrary indications of ± 10 for spooling speed. A third annunciator panel has four indicators which line up with tape speed, equalisation and tape type legends, the change being made by a single 'modify' pushbutton which steps through the options.

In the simple control panel a single 'load' button is provided which withdraws the pinch roller carriage, releases both spool brakes and switches the spool motors off. The tape is then laced and pressing stop initiates the spool motors and inserts the pinch roller carriage. Two further load buttons are fitted to the more complex control unit, one starting the right spool motor once the tape has been laced and the other the

96 ▶

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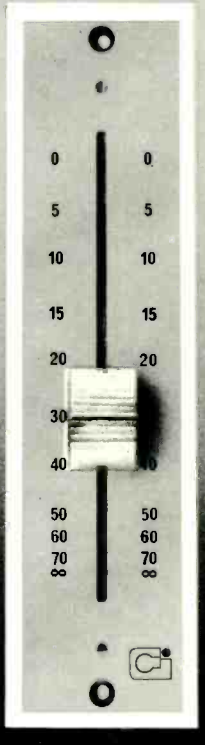

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TABLE 1

Tape speed	30 in/s	15 in/s	7½ in/s	3¾ in/s
Equalisation	17.5µs	35µs	70µs	90 + 3180µs
Frequency 31.5 Hz	−5.4 dB	−1.0 dB	−0.6 dB	−2.0 dB
100 Hz	−1.4 dB	−1.4 dB	−0.6 dB	−1.2 dB
500 Hz	−0.5 dB	−0.2 dB	−0.1 dB	−0.2 dB
1 kHz	o dB	0 dB	0 dB	0 dB
5 kHz	+ 0.4 dB	+ 0.2 dB	+ 0.5 dB	+ 1.0 dB
10 kHz	+ 1.0 dB	+ 0.6 dB	+ 1.1 dB	0 dB
12.5 kHz	+ 1.3 dB	+ 0.8 dB	+ 1.4 dB	−3.0 dB
16 kHz	+ 2.0 dB	+ 0.9 dB	+ 1.2 dB	−10 dB
18 kHz	—	+ 0.8 dB	+ 0.6 dB	—

TABLE 2a Machine replay noise without tape reference 320 nWb/m

Speed	30 in/s	15 in/s	7½ in/s	3¾ in/s
Equalisation	AES	CCIR	CCIR	NAB/CCIR
22 Hz to 22 kHz RMS	65.0 dB	65.0 dB	64.0 dB	65.5 dB
A-weighted RMS	79.0 dB	78.0 dB	72.0 dB	71.5 dB
CCIR-weighted RMS	73.5 dB	72.0 dB	67.0 dB	63.0 dB
CCIR-weighted quasi-peak	70.0 dB	68.0 dB	63.0 dB	59.0 dB
CCIR-weighted ARM ref 2 kHz	80.5 dB	78.5 dB	73.5 dB	69.5 dB

TABLE 2b Noise from Ampex *456* tape recorded with bias only

22 Hz to 22 kHz RMS	56.0 dB	59.5 dB	59.0 dB	61.0 dB
A-weighted RMS	67.0 dB	65.0 dB	62.0 dB	64.0 dB
CCIR-weighted RMS	59.0 dB	56.5 dB	53.0 dB	54.5 dB
CCIR-weighted quasi-peak	55.0 dB	52.0 dB	49.5 dB	51.0 dB
CCIR-weighted ARM ref 2 kHz	65.5 dB	65.0 dB	62.0 dB	61.0 dB

left motor. Whilst these functions can be useful care is required as the spools suddenly take off once tape tension is present!

A further feature of the comprehensive control panel is six skip buttons, three for each direction. Pressing skip with a single arrow by it initiates tape movement at the set speed in either direction whilst the button is still pressed with the tape in contact with the heads. Pressing a skip with two arrows does the same at 30 in/s with the audio output muted by 6 dB. Pressing a skip button with three arrows moves the tape at the fast wind speed out of contact with the heads and with the audio fully muted. These skip functions are excellent for editing as if they are operated when in the play mode the recorder returns to play after a skip function.

The final feature of the comprehensive control panel is the editing system with several unique features. Pressing a 'free spool' button releases the spool brakes and disconnects the motors allowing rock and roll editing, two other buttons allowing single-handed editing with one spool free and the motor on the other pulling the tape at low power.

A most ingenious facility is initiated by pressing a 'servo' button which engages the right-hand pinch roller, releases the brakes and applies power to the spool motors—turning a rotary control with inbuilt inertia then moves the tape in either direction via the capstan allowing precise edit point location. Whilst access to the replay head can be attained by removing the head shield this is normally unnecessary as pressing a button marked with scissors moves the tape so the edit point is located above the inbuilt editing scissors. There is finally a dump edit button which dumps tape at the set tape speed from the right-hand capstan.

All these features, which don't take long to understand, make the Nagra *T-Audio* a unique editing machine which is lightweight and easily transported by one person. When running, the machine was very quiet and kept remarkably cool being without any form of ventilation, thus excluding dust and dirt.

At the time of writing only a provisional instruction manual was available and even the UK agents did not have servicing information. However this will no doubt appear in due course and the machine will be very easy to service as all components are clearly identified and readily accessible.

Inputs and outputs

The input impedance of the balanced audio inputs was found to be constant with gain setting at 14 kΩ with a very good common mode rejection ratio of 70 dB at 1 kHz decreasing at 6 dB/octave with increasing frequency. With the input sensitivity link set for 1.55 V (+6 dBm) as supplied at 30 in/s and 15 in/s this input level recorded 510 nWb/m with the individual record level setting controls for each tape speed/type having a range of ± 4 dB which is quite adequate.

The main audio outputs at the *XLR* connectors were found to be floating outputs with an impedance of 50Ω. As supplied the output at 30 in/s and 15 in/s was +6 dBm for a recorded fluxivity of 510 nWb/m with an adjustment range of ±2.5 dB. At the lower tape speeds the output level was +4 dBm for a fluxivity of 320 nWb/m at 7½ in/s or 250 nWb/m at 3¾ in/s.

At the rear panel monitoring 'D' connector, low impedance unbalanced outputs are provided for monitoring after the input preamplifier, the input signal before recording on to tape, the replay from tape and the signal applied to the output transformers. All these signals had a level 6 dB below the input signal level. This connector also includes a signal to indicate that the recorder is in the record mode, this being a zero to +7 V level. In addition, amongst other signals, the connector includes the buss signal applied to the remote control unit—this signal having a period of 60 µs with a block length in the order of 15 ms.

Finally there is the remote control connector for connection to an IEEE buss. This connection is not however directly compatible with IEEE 488 controllers and requires a special interface. This connector also includes other remote control features including varispeed and remote servo editing control facilities.

Replay performance

The replay frequency response was checked using an Ampex calibration tape at 30 in/s and BASF calibration tapes at the three lower tape speeds. Both channels were found to be identical to all intents and purposes with the results being as shown in **Table 1.**

Allowing for tolerances between calibration tapes the above performance at the three higher tape speeds is very good; however as shown in **Fig 1a** and **Fig 1b** the range of the replay head loss equaliser is fairly restricted, particularly at the higher tape speeds. However the function of a number of on-board controls is not known and these may allow further changes in equalisation and levels which are not available at the front of the boards.

Noise in the main outputs was measured with tape which had been recorded with bias only and without tape referred to a fluxivity of 320 nWb/m as given in **Table 2.**

98 ▶

FIG.1 NAGRA T-AUDIO EQUALISERS

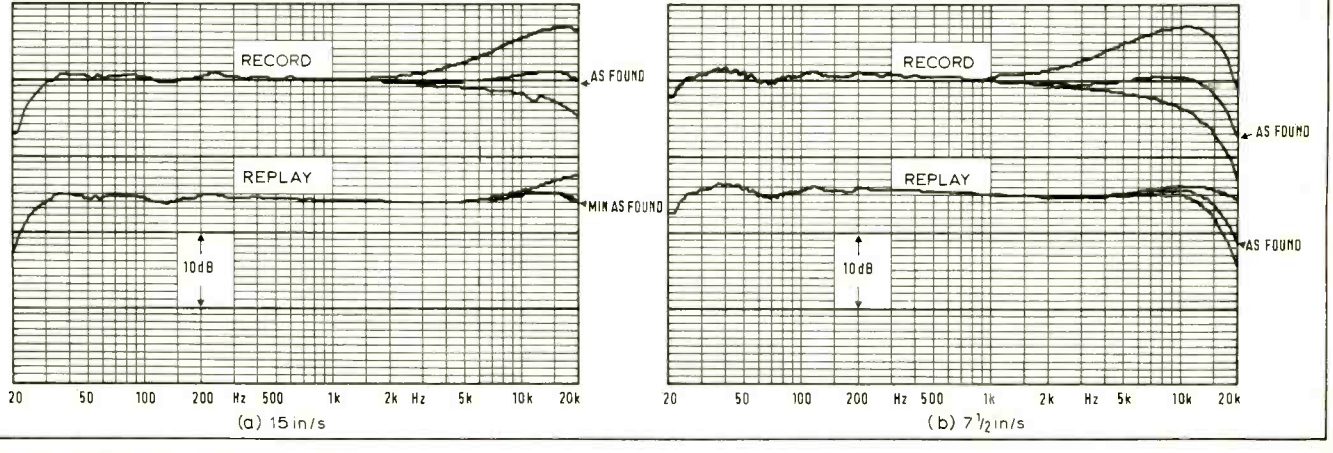

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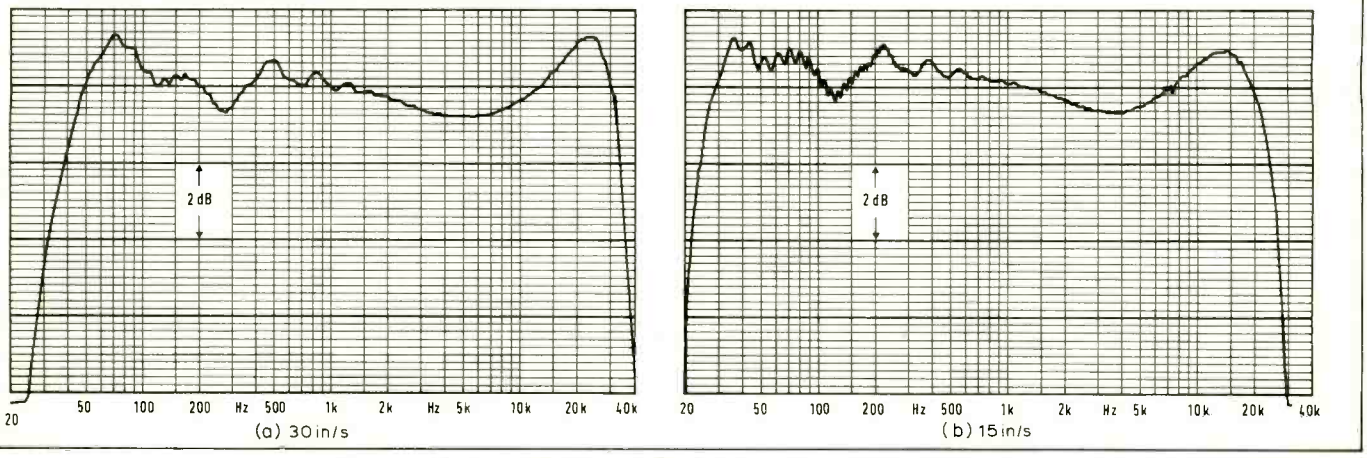
FIG.2 NAGRA T-AUDIO RECORD/ REPLAY (AMPEX 456)



All these figures give a very good margin between machine replay amplifier noise and tape noise for Ampex *456* which is one of the lower noise tapes available. It was however noted that the machine was rather prone to power line hum pick-up from nearby devices. In addition the low frequency noise performance of the two channels differed significantly with the quoted 22 Hz to 22 kHz band limited figures showing the best channel with up to 6 dB differences in this measurement and negligible differences in the weighted measurements.

The signal handling capability of the replay chain was more than adequate for any current tape types with the output level reaching +20 dBm before severe distortion occurred.

Record/replay performance

The record/replay frequency response as received for the tape speeds of 30, 15 and 7½ in/s are shown in **Fig 2a, Fig 2b** and **Fig 3** respectively which show a good performance which could be bettered by fine adjustment of the bias and equalisation. Of particular interest is the good control of the low frequencies at the higher tape speeds.

Reference to **Fig 1a** and **Fig1b** shows that the range of the record equalisers is adequate with the range of bias being such that the machine could overbias Ampex *456* tape by 5 dB at 10 kHz at 15 in/s. Similarly the record drive was adequate with a capability of driving a level 15 dB above 320 nWb/m.

Resulting from the pre-distortion technique used in the record amplifiers the second and third harmonic distortion when recording 320 nWb/m at 1 kHz at 7½ in/s was remarkably low at 0.1% for both harmonics with the 3% third harmonic point being at +11.3 dB reference 320 nWb/m. Dropping into record was found to leave approximately a 1 in erased gap on tape irrespective of the tape speed. It is therefore assumed that some adjustment of the bias timing ramp was required for gapless drop-ins.

Crosstalk between the two tracks using the stereo head supplied at 30 in/s and 7½ in/s was excellent as shown in **Fig 4** and **Fig 5.** However the latter is deceptive at very low frequencies due to breakthrough of a 20 Hz tone when running at 30 in/s. This breakthrough is probably associated with the right-hand capstan motor as it was found to be extremely sensitive to the presence of the replay headshield, being about —40 dBm at the output with the shield in place or —30 dBm

100 ▶

FIG.3
NAGRA T-AUDIO RECORD/REPLAY
7½ in/s BASF SPR50

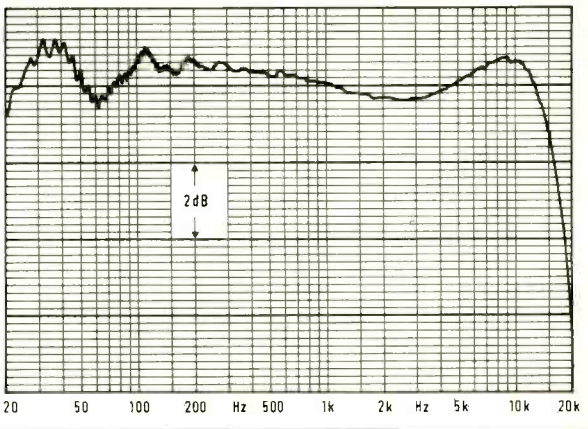


FIG.4
NAGRA T-AUDIO
30 in/s CROSSTALK

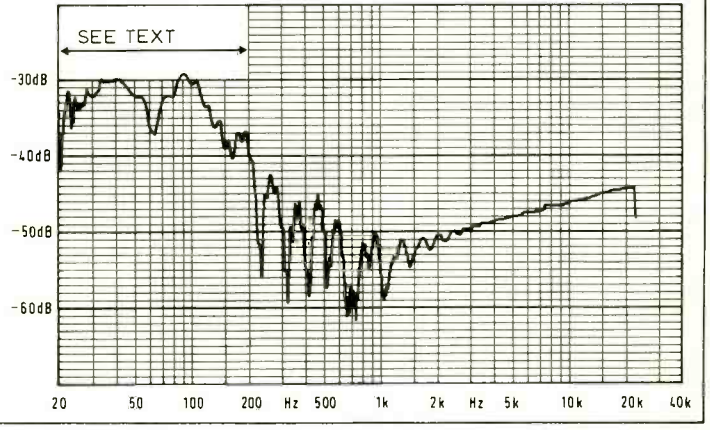
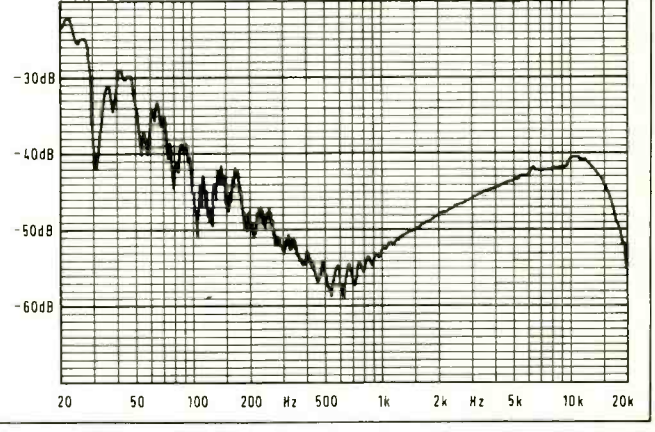


FIG.5
NAGRA T-AUDIO
7½ in/s CROSSTALK



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without the shield. In the latter case the harmonics of the 20Hz tone were audibly objectionable.

Erasure of a 1 kHz tone was found to be 85 dB at 30 in/s increasing to 90 dB at 7½ in/s with the standard full track erase head with a special head said to offer even better erasure.

Wow, flutter and speed

Wow and flutter was measured to the IEC quasi-peak weighted method at the beginning, middle and end of a NAB reel of tape. Whilst the wow and flutter did vary with location the performance was very good as **Table 3** shows.

TABLE 3

Tape speed	Beginning	Middle	End
30 in/s	0.015%	0.020%	0.017%
15 in/s	0.020%	0.025%	0.027%
7½ in/s	0.022%	0.025%	0.030%
3¾ in/s	0.030%	0.035%	0.040%

A 3.16 Hz bandwidth spectrum analysis of a 10 kHz tone recorder and replayed at 15 in/s is shown in **Fig 6** which shows a complete lack of any discrete sidebands and altogether a remarkably good performance for an analogue recorder.

The relation between the four tape speeds was found to be within 0.006% with the speed difference from the beginning to the end of a 2400 ft reel being less than a remarkably small 0.002%.

Checking the varispeed function showed this to have a range of +7.3% to —6.4% with the calibrations suffering an offset of +0.7% at the zero point such that negative values over the nominal ±6% range read too high and positive values too low. More accurate setting of the zero point would make the calibration usefully accurate.

The fast winding was such that 2400 ft of tape could be wound in one minute with the variable speed function giving a full range in both directions.

Other matters

Phase jitter between the two tracks was excellent as shown in **Fig 7** for a 10 kHz tone at 15 in/s with the peak to peak jitter being about ±5°.

A sample of the good square wave performance is shown in **Fig 8** for a 1 kHz square wave at 15 in/s. It was however noted that the output showed a mild overshoot even when monitoring the input signal irrespective of output loading.

The accuracy of the tape timer was such that positional errors were less than 1.5 in in 1500 ft of tape including use of the fast wind modes with naturally, the zero locate function having the same accuracy. Unlike some zero locators which hunt around the zero point, the Nagra approaches the zero point at the full wind speed and then slows down until the correct point is found.

With such a high fast winding speed unless the tape type is carefully selected the wind can be very poor—BASF *SPR50* wound very well, Ampex *456* wound poorly at full speed but well if the speed was lowered using the variable speed facility. In all modes the tape tension stabilised at 80 g, peaking 120 g under some transient conditions.

If power failed in any mode the machine came to a gentle halt, but when fast winding until the tape ran out the spool braking was insufficient and the end of the tape could readily be damaged.

Summary

Mechanically the Nagra *T-Audio* is a remarkable machine with the design of the tape transport giving a very clean audio performance. Whilst, at first sight, the controls appear to be rather complex, the operator soon gets used to the novel features and realises the versatility of the machine. As an editing machine the extra facilities not found on other recorders are of enormous value.

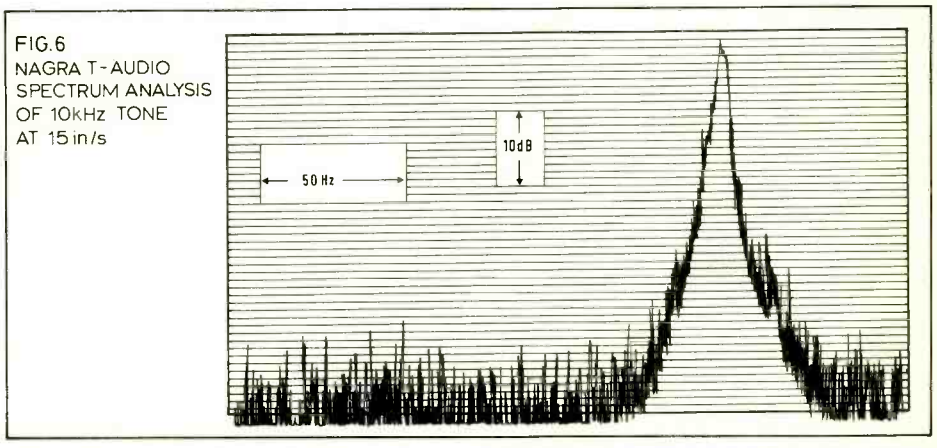
As with the mechanical department the audio electronics also offer a very good performance with an excellent margin between tape noise and machine noise at the four tape speeds.

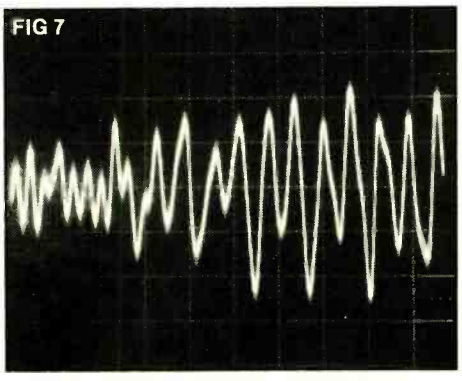
Bearing in mind that this is an early production machine it was not surprising to find a few minor criticisms, but I am confident that the factory will take due note of these. Overall an original recorder with many excellent features which make it particularly attractive for location recording and editing let alone as a studio machine.

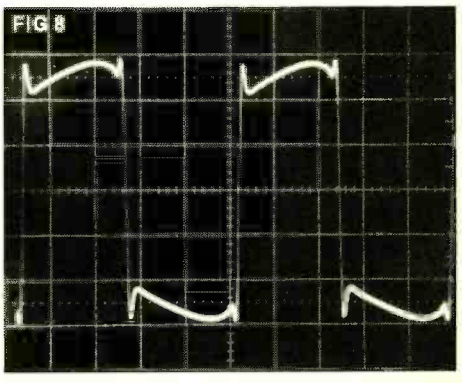
Hugh Ford

Manufacturer's comments

1) The space on the right of the audio boards is designed for a signal processor such as a sophisticated limiter, de-esser or Dolby or other type of noise reduction.
2) Work is being done to improve head shielding which will make the machine less prone to hum pick-up from external sources and also lower the pick-up from the motor at 30 in/s.
3) Currently the bias timing is designed to eliminate clicks when entering record. However the SMPTE time code version of the machine will include bias ramping and electronic editing.
4) The variable speed control is normally trimmed during manufacture and it is suspected that someone altered the trimming.
5) Half speed fast winding is easily accomplished and this will be a standard modification to future production when the circuits are next revised. **HF**

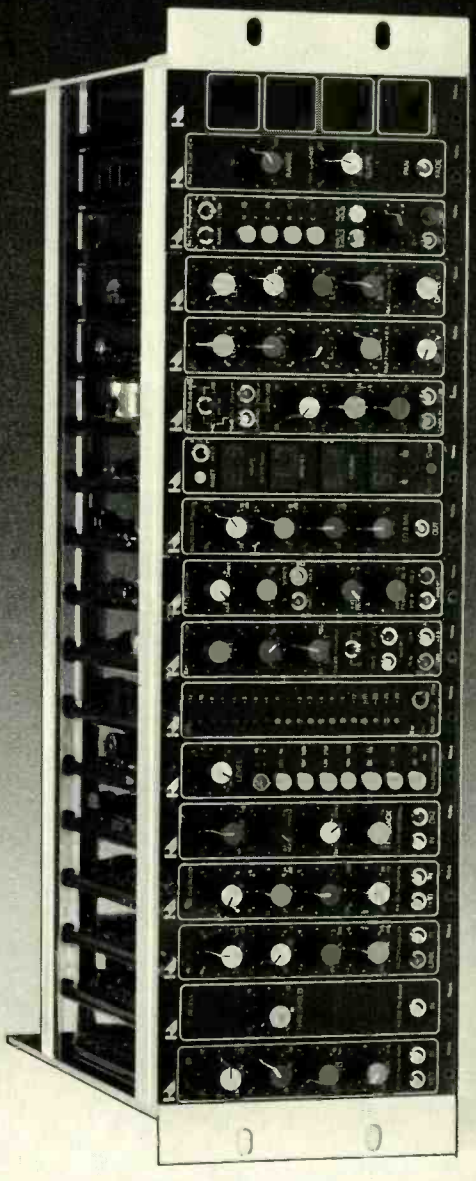






Rebis RA200 Series

The Nº1 Gate



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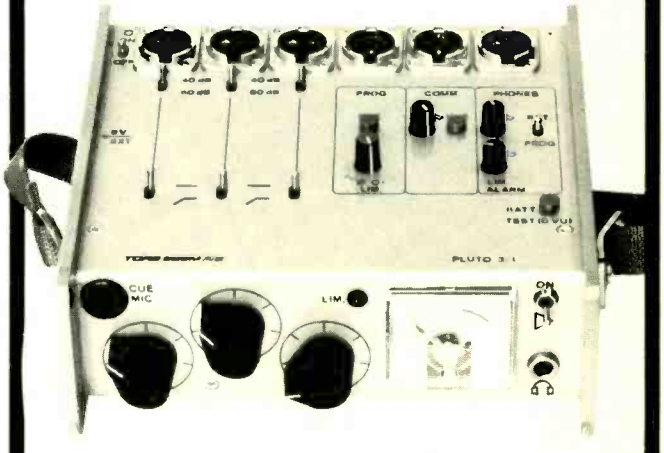

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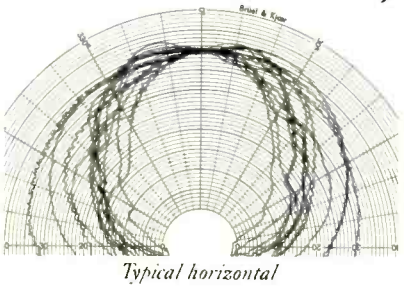
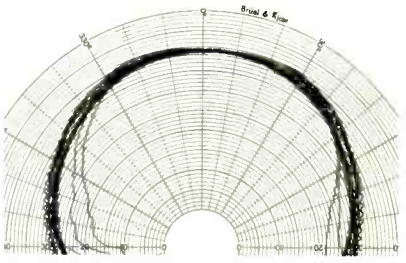
Before you invest in new studio monitors, consider all the angles.

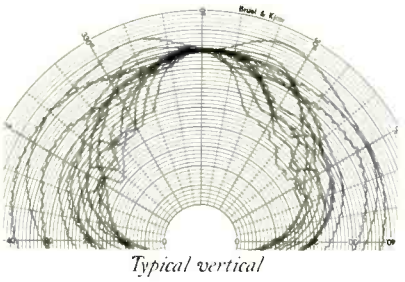
Polar response comparison of a typical two-way coaxial studio monitor and JBL's new 4430 Bi-Radial studio monitor from 1 kHz to 16 kHz.



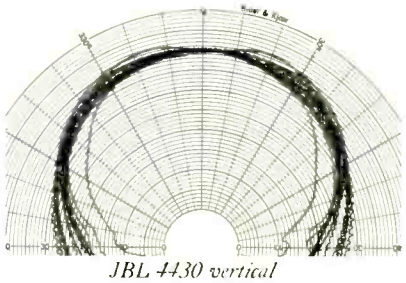
Typical horizontal



JBL 4430 horizontal



Typical vertical



JBL 4430 vertical

No one has to tell you how important flat frequency response is in a studio monitor. But if you judge a monitor's performance by its on-axis response curve, you're only getting part of the story.

Most conventional monitors tend to narrow their dispersion as frequency increases. So while their on-axis response may be flat, their off-axis response can roll off dramatically, literally locking you into the on-axis "sweet spot." Even worse, drastic changes in the horn's directivity contribute significantly to horn colorations.

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The key to this improved performance lies in the unique geometry of the monitors' Bi-Radial horn.[1] Developed with the aid of the latest computer design and analysis techniques, the horn provides constant coverage from its crossover point of 1000 Hz to beyond 16 kHz. The Bi-Radial compound flare configuration maintains precise control of the horn's wide 100° x 100° coverage angle.

1. Patent applied for.

And the Bi-Radial horn's performance advantages aren't limited to just beamwidth control. The horn's rapid flare rate, for instance, dramatically reduces second harmonic distortion and its shallow depth allows for optimal acoustic alignment of the drivers. This alignment lets the monitors fall well below the Blauert and Laws criteria for minimum audible time delay discrepancies.

But while the Bi-Radial horn offers outstanding performance, it's only part of the total package. The new monitors also incorporate JBL's most advanced high and low frequency transducers and dividing networks. Working together, these components provide exceptionally smooth response, high power capacity, extended bandwidth, and extremely low distortion.

Judge For Yourself

Of course, the only way to really judge a studio monitor is to listen for yourself. So before you invest in new monitors, ask your local JBL professional products dealer for a Bi-Radial monitor demonstration. And consider all the angles.

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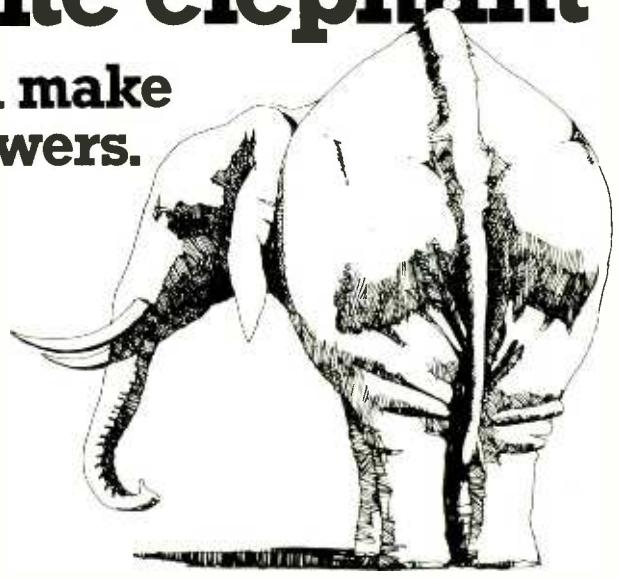
82111

Before your next monitors turn into a white elephant

...ask some questions, and make sure you get the right answers.



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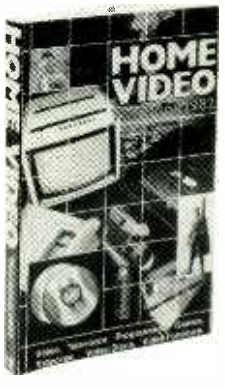

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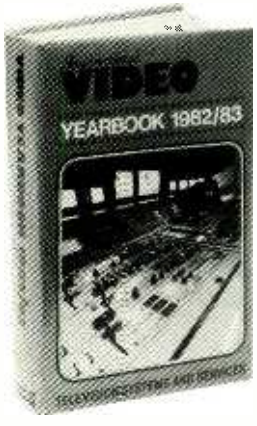

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