studio sound

AND BROADCAST ENGINEERING

April 1979 60p

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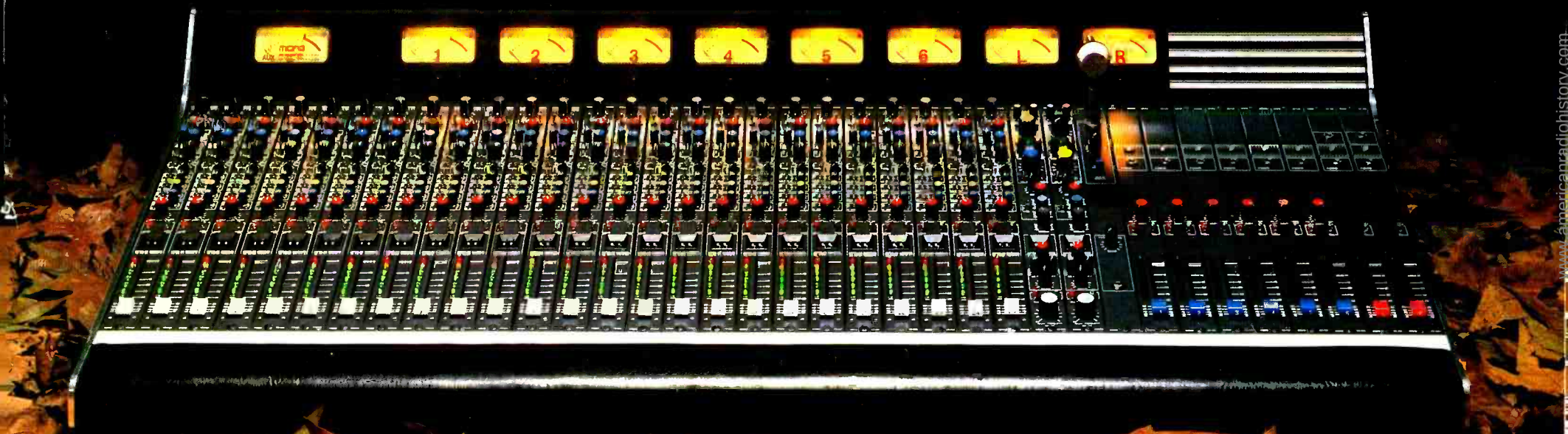

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THE LINK HOUSE GROUP

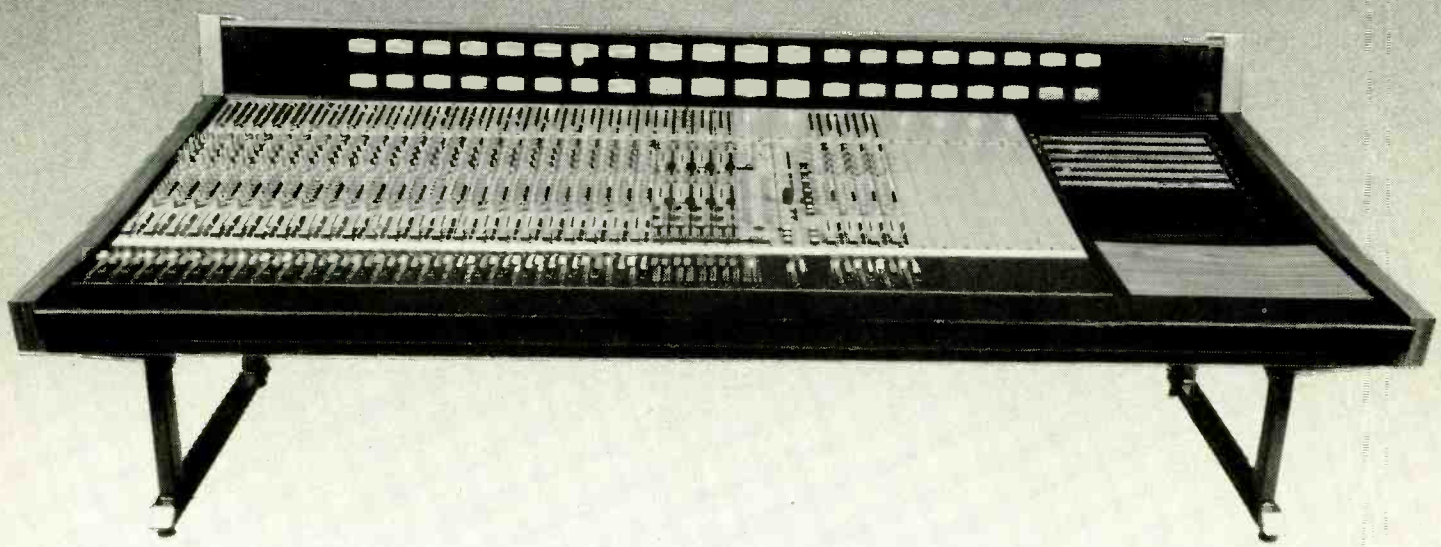
studio sound

AND BROADCAST ENGINEERING

The future of audio is digits . . . that is digital audio? True or not, there is nevertheless considerable interest from audio equipment manufacturers, particularly the larger corporations, into digital developments. Although digital audio has only recently come evident in recording studios, it has been around in Britain since 1971 when the BBC introduced 'sound-in-syncs' a technique where digitised audio is inserted into the parts of a television signal not used for transmitting picture information, enabling a separate audio distribution circuit to be eliminated with resultant cost savings and simplification in routing. Digitisation first showed itself in recording studios with digital delay lines and effects based on delayed audio such as flanging. Currently, digital audio has not yet found any other regular application in professional recording studios although Ampex, 3M and Sony are all currently doing their utmost to develop digital audio multitrack tape recorders, with 3M the only company actually delivering equipment, albeit in somewhat restricted quantities. The AES New York report in February *Studio Sound* attempted to consolidate digital recording developments from the 'big three' manufacturers. Over the coming months *Studio Sound* will be examining various aspects of 'digits', and particularly their application to the professional sound recording business. The first such article is published this month, and begins a 2-part consideration of the 'integrated digital studio' approach, that is the studio that operates virtually totally in the 'digital domain', that is using digital mixing, effects and recording within the studio. While Jeff Bloom's articles cover the practical aspect of digital studios, next month Hugh Ford will be providing an introduction into the world of digits, starting at the beginning with binary.

One recent development from Philips is a 'diode laser recorder' which enables 5 x 10^9 (5,000,000,000) digital bits to be optically recorded on each side of a 12in diameter disc. This packing density represents a 10 times increase over the most advanced magnetic disc pack at a fraction of the cost, and providing 250ms random access (not unlike a semiconductor RAM). This capacity can potentially (depending upon the digital coding technique) provide up to 70 hours digital sound recording recorded and replayed in real time (but presently non erasable). The disc recorder uses a diode laser of the AlGaAs DH type mounted in a transistor size encapsulation providing 12mW output sufficient to 'burn' micron sized holes in the tellurium based recording material. Although the present writing speed is only 300kbits/s, data has been recorded at the rather higher speed of 6Mbits/s for short periods (that is until the laser burnt out). But laser developments should make this a reliable reality. Although Philips foresee applications in data and television recording (the technology is directly based upon the VLP video disc player), it could possibly find application in multitrack digital recording or in the programming capability required for a totally digital studio. It even conjures up the appropriate vision of multitrack recording on a disc, for eventual release also on a disc!

AMEK M3000



Favourably comparable with any console available today, the standard 36-input desk offers simultaneous quad, stereo and mono mixes from 32 tracks, with DC subgrouping of VCA-assisted channel and echo return faders.

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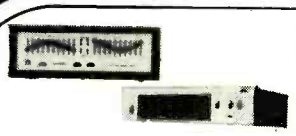

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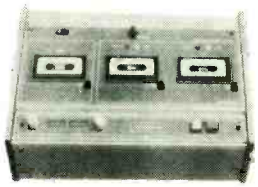

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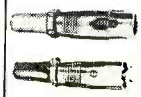

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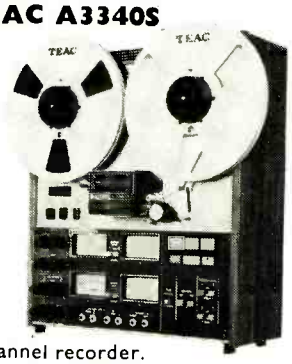

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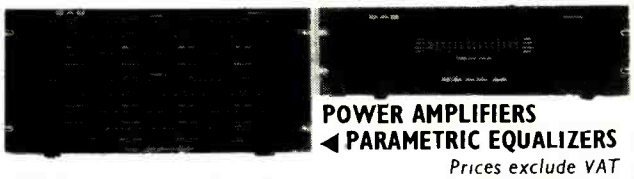

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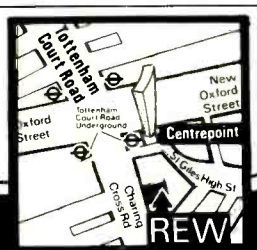

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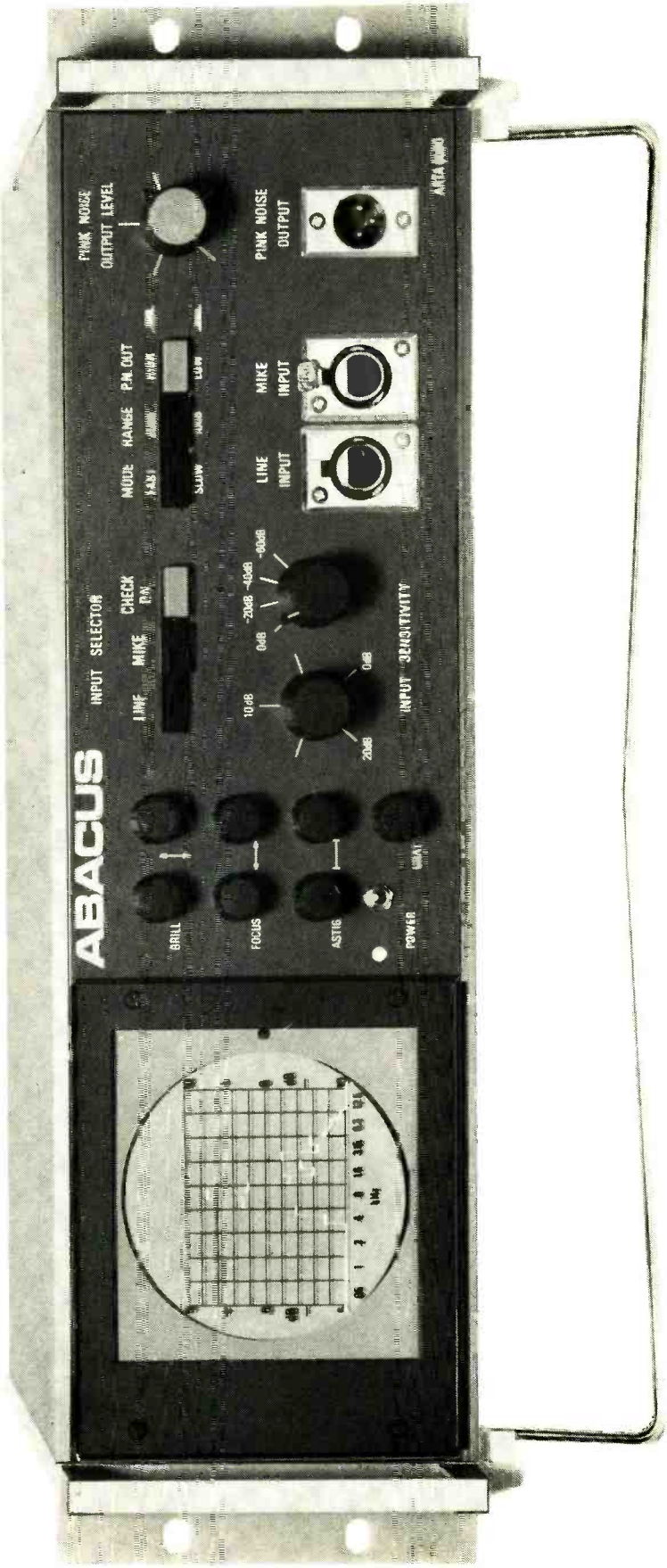

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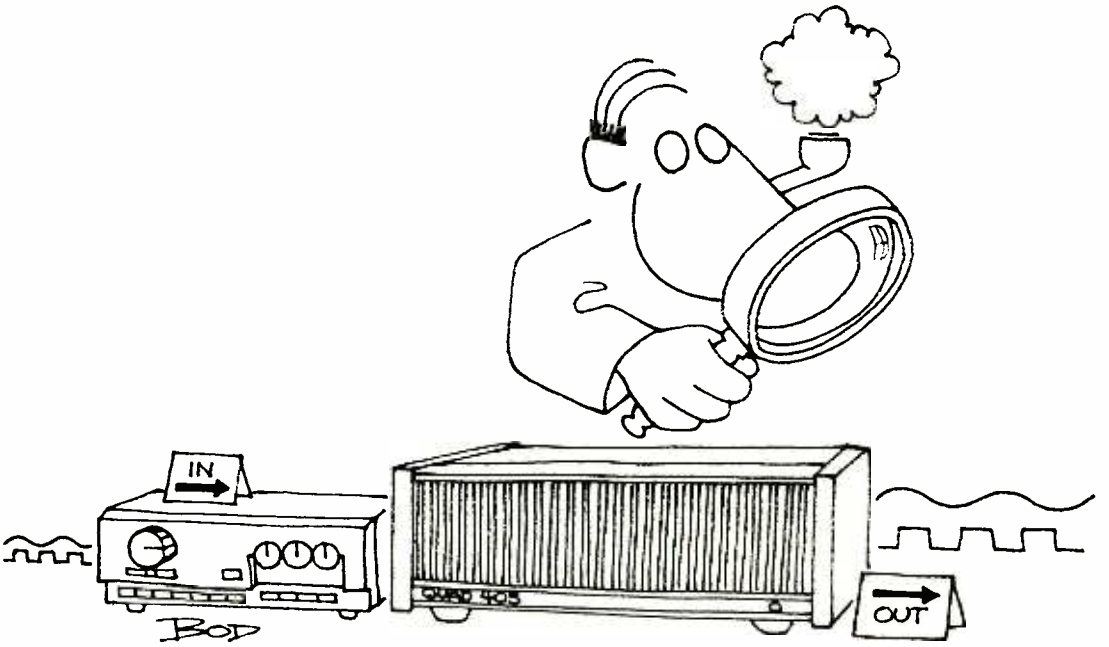

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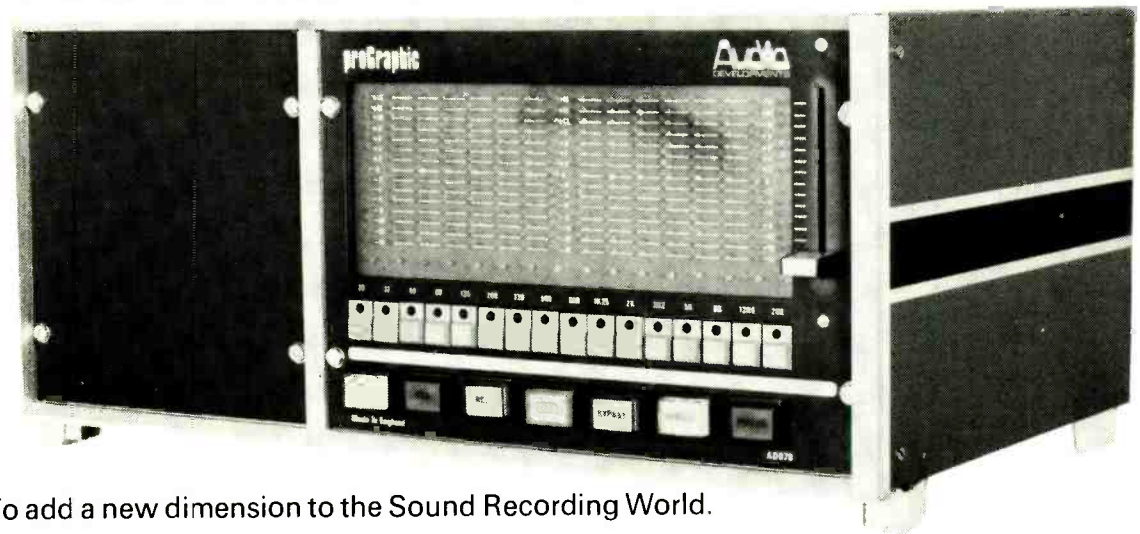

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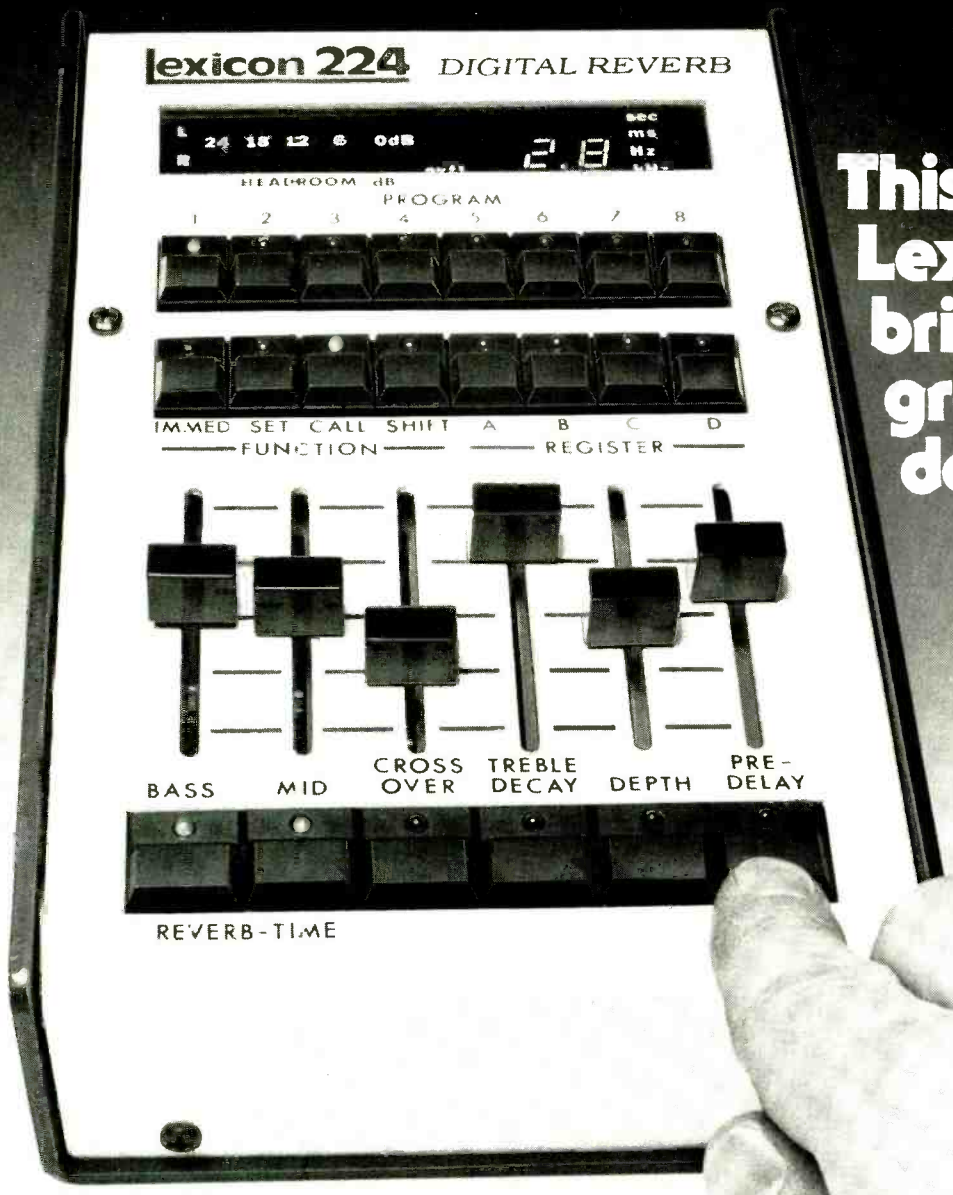

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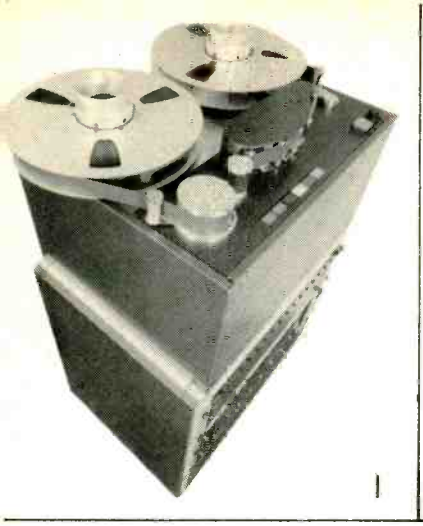
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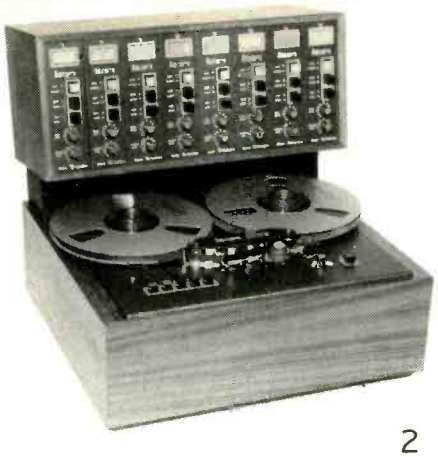
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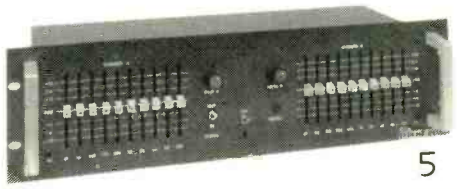
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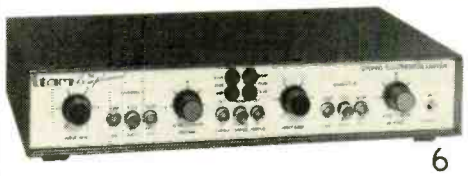
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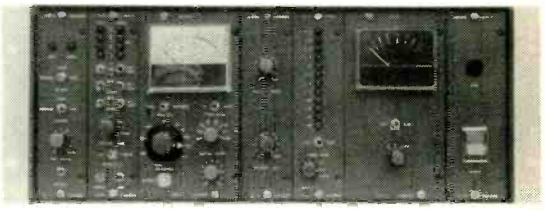
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THE EVENTIDE MODEL H910 HARMONIZER

The HARMONIZER employs digital circuitry and random access memories to actually transpose input signals by up to a full octave up or down. Any musical interval can be achieved by the continuously variable control and the optional monophonic or polyphonic keyboard allows real-time 'playing' of the HARMONIZER so that the musician can harmonize with himself. The HARMONIZER can be used to maintain constant pitch in direct ratio when the speed of pre-recorded tape is varied up or down.

DIGITAL DELAY

In addition the HARMONIZER is a low cost, very versatile delay line. The delay is variable in 7.5 ms steps up to 112.5 ms. A second output is optionally available that varies up to 82.5 ms

SPECIAL EFFECTS

Simultaneous use of feed back, delay and pitch change can be used to create previously unobtainable effects.

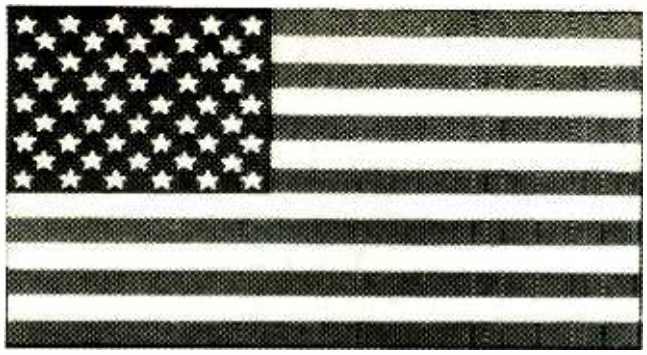
Other devices available in the Eventide range include the
1745M Digital Delay System
FLANGER
OMNIPRESSOR

U.K. Distributors

Feldon Audio Limited

126 Great Portland Street, London W1. Telephone: 01-580 4314. Telex: London 28668

Eventide, Instant Flanger, Omnipressor and Harmonizer are trade marks designating the products of Eventide Clockworks Inc.



American Newsletter

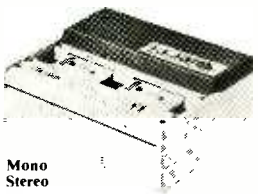
Ampex ATR 700

Now every studio can afford legendary Ampex performance and reliability. Fully professional specification including balanced inputs/outputs, Cannon connectors, variable tape speed, sel sync. The price will fit this year's budget, not next year's! Sole distribution by ITA.

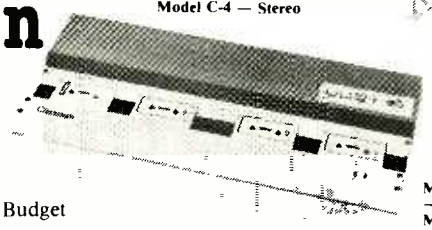
Auratone

The amazing 5C Super Sound Cube. Only 6"×6" — but it sounds enormous!
Only £38 per pair.

New! Cassette copiers from Pentagon



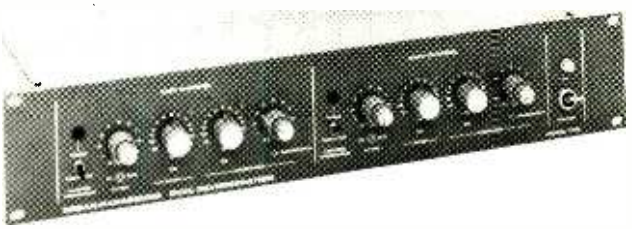
Model C-1 — Mono
Model C-4 — Stereo



Model C32S — Mono
Model C34S — Stereo

Simple operation — fully automatic 16 times speed. Choice of one or three copies. C32/34 — out-produces all other makes — 75 C60 per hour. Budget price from **£587 + VAT.**

Orban



Dual channel multispring reverb unit. Each channel features four springs — far smoother than single spring systems. "Twang" and "boing" are virtually eliminated by incorporating a floating threshold limiter. Bass, mid-range EQ and bandwidth controls. The best compact reverb unit available.

Sound Workshop

Model 1280 Mixer. At last — a cost effective mixer for the 8 track user. 12 input channels, 8 outputs, parametric EQ (optional), compact size. Send for our comprehensive leaflet. Price from around £1600.

Tangent

Model 3216. America's biggest selling multi-track mixer is now available in England. It is designed for 8, 16 or 24 track operation) upgradable). The very comprehensive facilities are remarkable for the price — around £6,000 for 16×16 configuration.

ITA

1-7 Harewood Avenue, Marylebone Road, London NW1.
Tel: 01-724 2497 Telex: 21879

FRANCE: Son Professionnel, 2 Rue des Tennerolles
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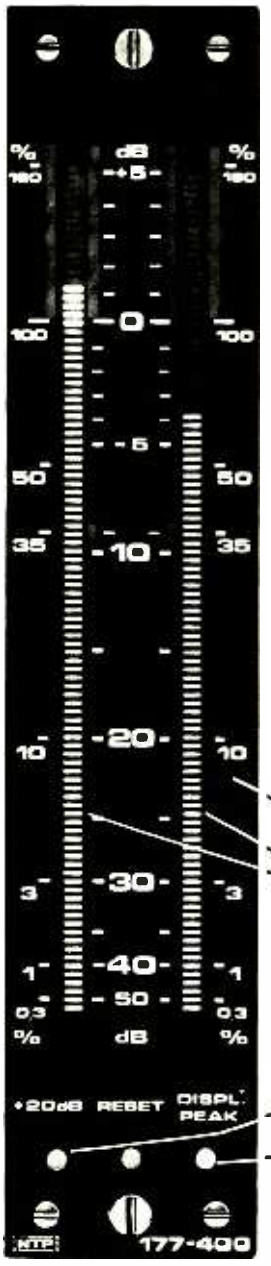
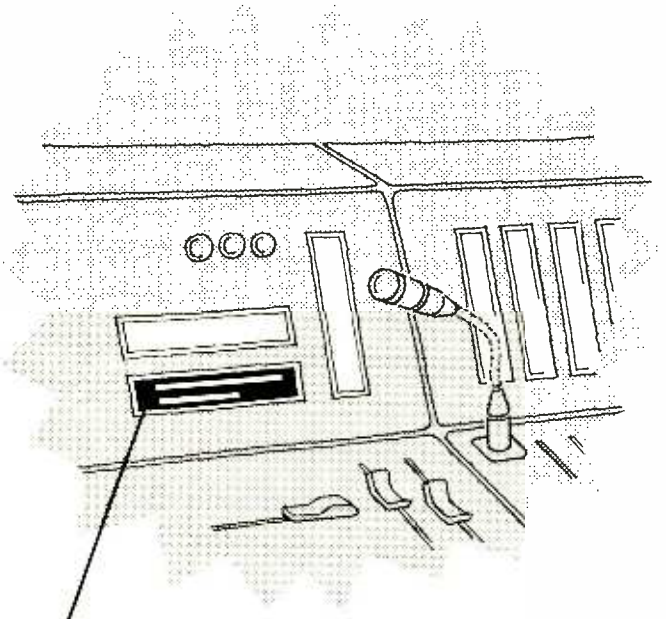
NTP - the specialist in PPM's.....

"peak" performance...

with the Peak Programme Meter type 177-400



original size 40×190 mm



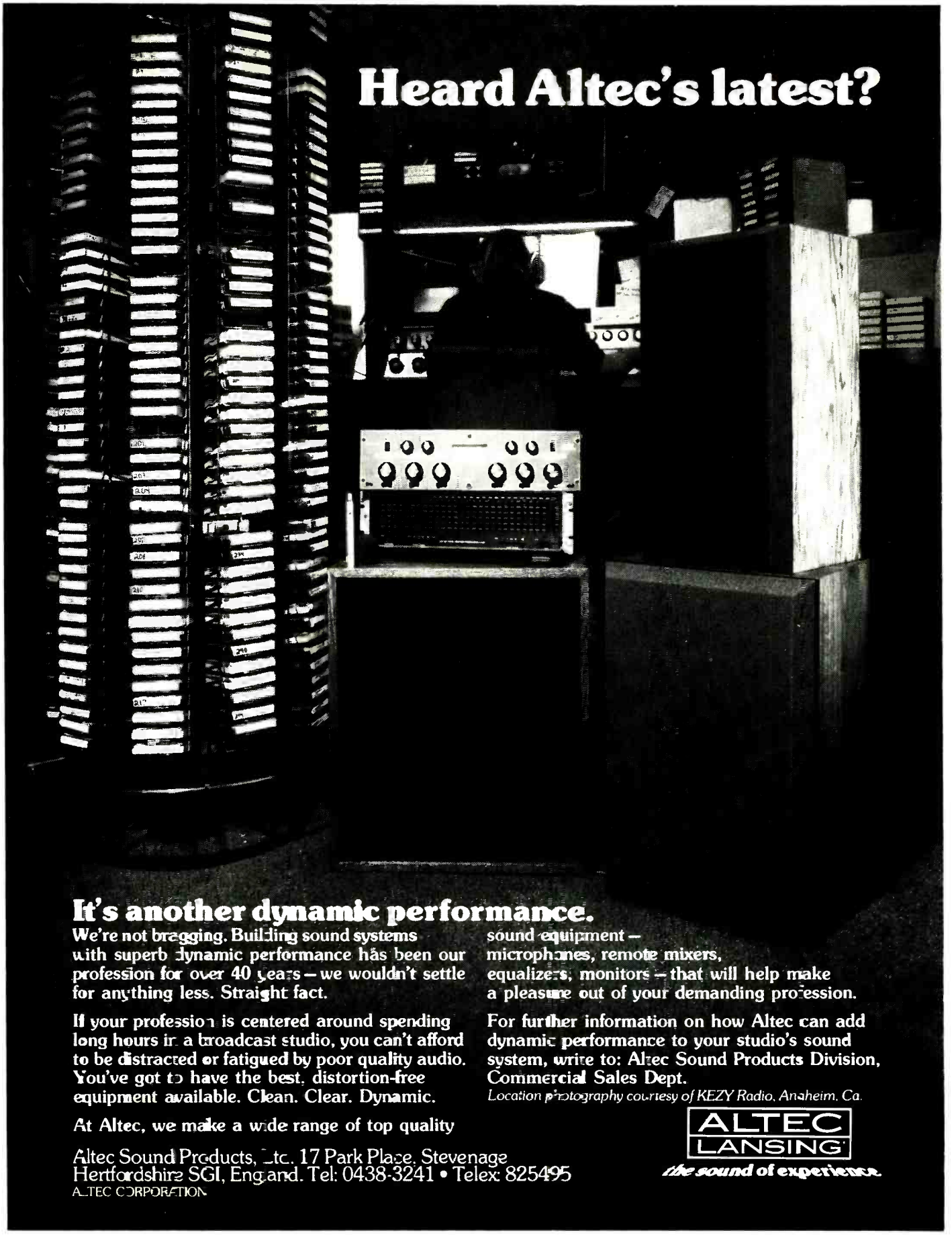
Type 177-400 features:

- Various scales - vertical or horizontal. Special scales on request.
- Bar-graph plasma display with 100 elements per column - clear overload indication by increase of light in overload area.
- Two independent channels with tracking better than ± 0,5 dB.
- Wide supply voltage range 22 to 32 Volts and very low current consumption.
- Additional gain switchable on the frontpanel.
- High impedance balanced floating transformer input.
- Digital Peak Memory.
- Motherboard/Daughterboard construction for easy service.
- Meets the international standards DIN 45406 and IEC 268-10.

For further information and full technical specifications:

NTP ELEKTRONIK A/S

Theklavej 44 · DK-2400 Copenhagen NV · Denmark · Telephone: +45-1 10 12 22
Telex: 16378 ntp dk · Telegramme: Electrolab



Here it is!

SAM 82

A small portable mixer for professional applications

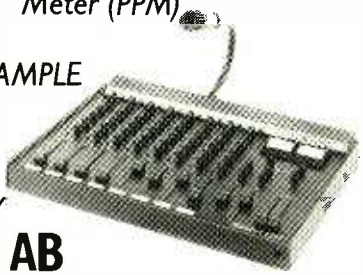
The mixer SAM 82 is designed for mobile and stationary applications in broadcasting, television and recording studios. The mixer has an all-metal case (aluminium) with a plastic cover with slide-in application.

INPUTS
8 Mic/line Channels
2 Echo Returns
2 Monitoring

OUTPUTS
2 Master Channels
2 Auxiliary
1 Talk-back

FEATURES
RF-filters
AC or Battery Supply
Phantom Supply
Test Tone Generator
Inputs/Outputs
Transformers
Peak Programme Meter (PPM)

ACCESSORIES FOR EXAMPLE
Battery Unit BU 4020
Carrying Case



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Adart

I am interested in the SAM 82.

☐ Please get in touch with me right away for a demonstration.

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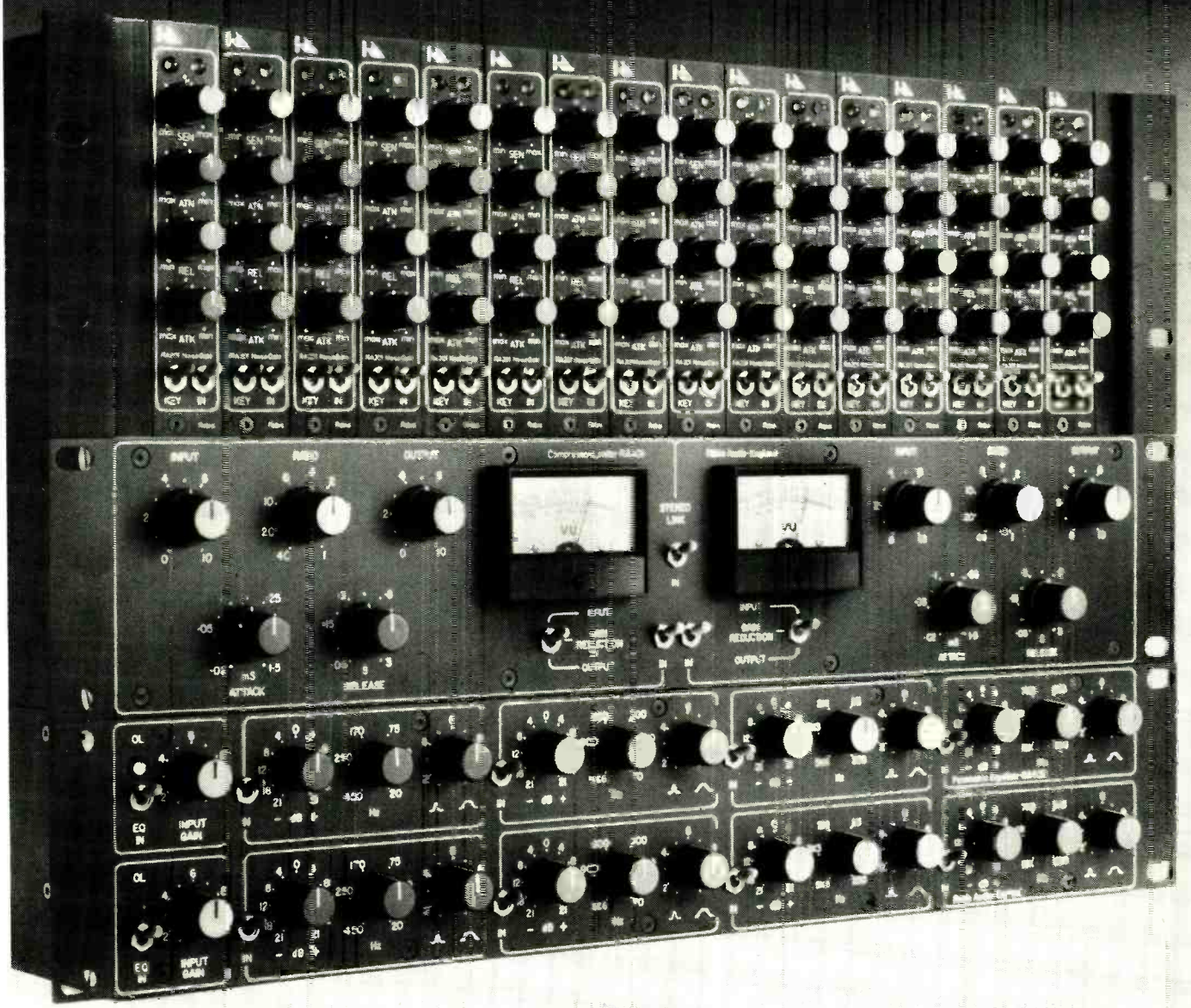
Rebis

Three Sound Reasons



RA201 Noise Gate. Indispensable in both studio recording and live PA work for elimination of unwanted low level signals.
RA301 Compressor-Limiter. A flexible and effective stereo/dual-mono unit for dynamic control and musical effect.
RA402 Parametric Equaliser. A versatile tool for comprehensive musical shaping and restoration of degraded programme.

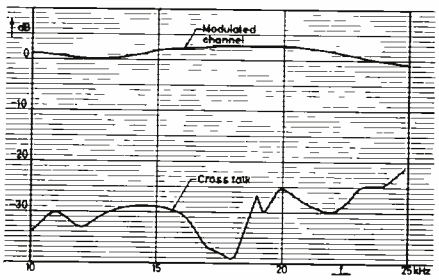
For further information contact,
Rebis Audio, Kinver Street, Stourbridge, W. Midlands DY8 5AB, England. Tel. Brierley Hill (0384) 71865

We made the man with the triangle in the Boston Pops extremely happy.

He wasn't cut off this time.

Arthur Fiedler's Boston Pops and Crystal Clear production made this new direct-cut record.

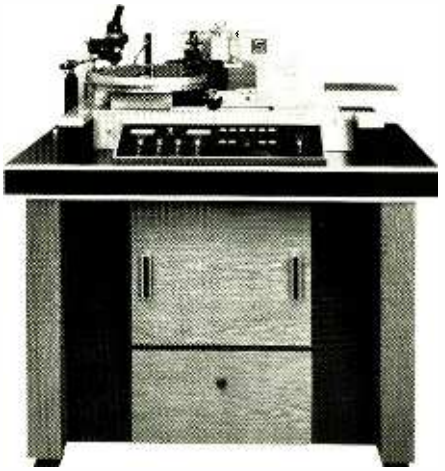
To be sure, they used three different combinations of cutting equipment. And the result, the Scully cutting machine with Ortofon cutterhead, was chosen by Arthur Fiedler and the sound experts. Not only to please the triangle player in the famous orchestra - but the depth in the music responded to the name "Crystal Clear".



Channel separation measured on cut lacquer disc by interferometric methods. DSS 731/GO 741.

The explanation:
The special construction of the Ortofon cutterhead

Every cutting engineer knows the difficulty of cutting frequencies in the supersonic area because of problems with the resonances in the cutterhead. These problems can be solved in several ways. The high frequencies can be cut off. Or an equalizer can be used to compensate for the resonances. Excellent when producing "middle-of-the-road". But for more sophisticated music you'll need the Ortofon equipment because we have solved these resonance problems. The Ortofon cutterheads DSS 731 and DSS 732 have the lowest secondary resonance above 30 kHz and 24 kHz respectively. This ensures a flat frequency response and high channel separation in the lacquer.



"The Lathe" by L. J. Scully. The Perfect Partner.

We looked for a cutting machine designed to meet the most stringent requirements of the master record industry. And found it.

Which means that Ortofon now represents this unique mastering unit in Europe. Just as L. J. Scully Manufacturing Corporation represents Ortofon in America.

We believe Ortofon and Scully to be a perfect combination. And so do others. Just ask Arthur Fiedler . . .

Please send brochures covering the Ortofon cutting equipment and The Lathe from L. J. Scully.

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Address: _____

Zipcode, town and country: _____

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fact: this condenser microphone sets a new standard of technical excellence.

The Shure SM81 cardioid condenser is a new breed of microphone. It is a truly high-performance studio instrument exceptionally well-suited to the critical requirements of professional recording, broadcast, motion picture recording, and highest quality sound reinforcement—and, in addition, is highly reliable for field use.

Shure engineers sought—and found—ingenious new solutions to common problems which, up to now, have restricted the use of condenser microphones. Years of operational tests were conducted in an exceptionally broad range of studio applications and under a wide variety of field conditions.

As the following specifications indicate, the new SM81 offers unprecedented performance capability—making it a new standard in high quality professional condenser microphones.

SM81 puts it all together!

- WIDE RANGE, 20 Hz to 20 kHz FLAT FREQUENCY RESPONSE.
- PRECISE CARDIOID polar pattern, uniform with frequency and symmetrical about axis, to provide maximum rejection and minimum colouration of off-axis sounds.
- EXCEPTIONALLY LOW (16 dBA) NOISE LEVEL.
- 120 dB DYNAMIC RANGE.
- ULTRA-LOW DISTORTION (right up to the clipping point!) over the entire audio spectrum for a wide range of load impedances. MAXIMUM SPL BEFORE CLIPPING: 135 dB; 145 dB with attenuator.
- WIDE RANGE SIMPLEX POWERING includes DIN 45 596 voltages of 12 and 48 Vdc.
- EXTREMELY LOW RF SUSCEPTIBILITY.
- SELECTABLE LOW FREQUENCY RESPONSE: Flat, 6 or 18 dB/octave rolloff.
- 10 dB CAPACITIVE ATTENUATOR accessible without disassembly and lockable.

Outstanding Ruggedness

Conventional condenser microphones have gained the reputation of being high quality, but often at the expense of mechanical and environmental ruggedness. This no longer need be the case. The SM81 transducer and electronics housing is of heavy-wall steel construction, and all internal components are rigidly supported. (Production line SM81's must be capable of withstanding at least six random drops from six feet onto a hardwood floor without significant performance degradation or structural damage.) It is reliable over a temperature range of —20° F to 165° F at relative humidities of 0 to 95%!

Send for a complete brochure on this remarkable new condenser microphone!

SM81 Cardioid Condenser Microphone

®SHURE®

Shure Electronics Limited, Eccleston Road, Maidstone ME15 6AU—Telephone: Maidstone (0622) 59881

IVIE
IS A NATURAL

A state-of-the-art real-time analyzer

The IE-30A RTA from IVIE is the most advanced audio analysis system in the world, yet it weighs a mere 3 pounds. It's so small that you can place your complete acoustics laboratory under an airline seat.

To assure the ultimate in measurement accuracy, IVIE uses 6-pole (Class III) 1/3-octave filters, and built in a low noise, precision (Type 1) sound level meter. These features combine to provide unmatched measurement capabilities for sound system equalization and evaluation. Having a calibrated voltage input range of 180 dB (0.5 μV - 500 VAC) allows for accurate measurements from the noise floors of preamplifiers to line level voltages (selectable true rms, average or peak detectors).

New microprocessor accessory With the new IE-17A accessory the IE-30A has microprocessor calculating power, and an X-Y recorder interface for data output. Now you can automatically analyze RT60, time delay events, reflections, articulation losses, tone burst and absorption characteristics – all under computer control. Don't settle for bulky test gear that does only half the job. Get the IE-30A System.

The IE-30A is shipped fully calibrated in a rugged flight case with a precision Type 1 microphone, RTA test probe and rechargeable batteries.

For the professional, it's a natural.
Call or write for a brochure and a demonstration.

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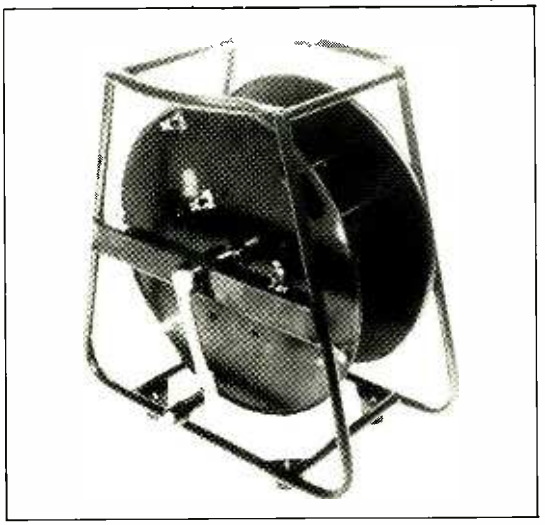
HEY, CABLE DRUMS ARE TECHNOLOGY, TOO.



WHY NOT BUY THE BEST

Every Keith Monks Cable Drum is a multi purpose carrier – for microphone, speaker or power cables. They're built of tough reinforced steel, with firm standing rubber feet – and there are four different models to suit every application.

Weight range 10 lbs. (4.54 kg.) to 120 lbs. (54.55 kg.), and if there isn't a cable drum to suit your requirements modifications and special designs can be made to order.

Find out more about Keith Monks Cable Drums – just get in touch at the address below – we'll be pleased to send you more information without obligation.

* Each one has a nylon-dipped black paint finish – hard wearing and rust resistant, for indoor and outdoor use.
* They all stack with other frames of the same size – make rigid, stable space savers.
* Each one has a removable centre drum – use one frame, several reels, to save time, cost and space.

Check this table to find the cable drum to suit you.

Model No.	*Capacity Standard Twin Screened Cable*	*Multi-Core Cable*
CD1	100 m.	50 m. $\frac{1}{2}$" (10 mm.)
CD2	200 m.	50 m. $\frac{3}{4}$" (20 mm.)
CD3	400 m.	100 m. $\frac{3}{4}$" (20 mm.)
*CD4		200 m. $\frac{3}{4}$" (20 mm.)

* To Special Order.

KEITH MONKS AUDIO

26-28 Reading Road South, Fleet, Aldershot, Hants., U.K. Telephone: Fleet (02514) 20568/9. Telex: 858606.
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SYNTOVOX 221

The Intelligible Machine

- 20-channel analysis and synthesis
- 54 dB/octave filters
- real time analysis LED read-out
- matrix patching
- fill-in facility
- built-in audio pulse generator
- random vlf and step modulation
- lfo modulation
- 56-way multiconnector for external control and computer applications
- 19" case
- £ 3,000

Syntovox 221 is one of the latest developments in sound effects equipment by Synton Electronics, also the creator of the famous 903 Phaser/Band Filter.

Syntovox 221 is a 20-channel electronic effects vocoder which features a range of fascinating new sound effects for everyone who is involved with music, film, television, radio or theatre.

One of the most distinghuishing qualities of Syntovox 221 is its intelligibility which can be considered as a standard for technical quality in a vocoder.

More than one year of research resulted in a highly accurate analyzing and synthesizing system which is the heart of Syntovox 221.
An extensive control system was designed to make Syntovox 221 sound more natural than any other vocoder.

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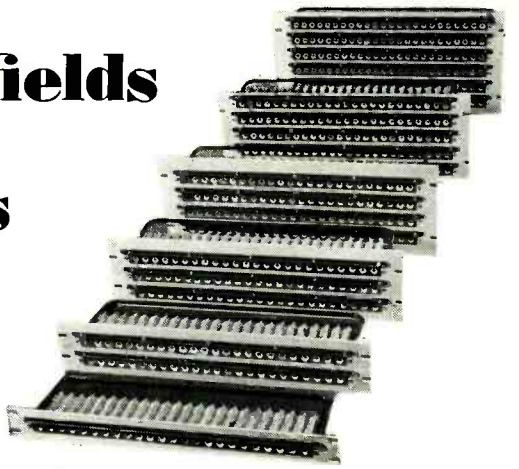

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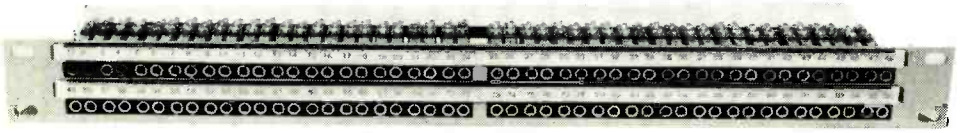

A member of Plasmec

The most versatile digital reverb ever made...

for one-third the cost of its rivals.

Ursa Major's new SPACE STATION is a true breakthrough in audio technology—a digital reverb so versatile that it can create virtually any pattern of direct sound, early reflections and reverberation, yet costs only a third of what you would pay for a single-function reverb system. This easy-to-use unit will take your dry tracks and put them into an endless variety of reverberant spaces, from tiny rooms to concert halls to parking garages to sci-fi locales. And the SPACE STATION can do even more. Multi-Tap Delay and built-in mixer give you totally new pure delay effects, while feedback of a single tap provides **simultaneous** echo or resonance effects.

KEY SPECS: Delay Mode: 80dB dynamic range, 0.1% T(N+D), 7kHz, 256ms delay, 16 programs of delay times for 8 Audition Taps: **Reverb Mode:** decay time 0 to 3.5s, EQ +0/-10dB at 20 Hz and 7kHz, two programs of reverb taps; **Echo Mode:** delay time 1 to 255ms, decay time 0 to 13s. Mono In/Stereo Out. LED Peak Level Indicator at 0,-6,-15 and -30dB. Manufactured in USA. **URSA MAJOR, SPACE STATION** and Multi-Tap Delay are trademarks of Ursa Major, Inc.

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SR20 and SR28

MIXING BUSINESS WITH PLEASURE

AHB
ALLEN AND HEATH BRENELL LTD

The New Allen and Heath SR Series has an impressive pedigree with its origins in custom mixers for Pink Floyd and King Crimson. The SR mixer is equally at home in theatres, clubs or studios and features a unique routing system enabling the engineer to assign channels to any one of eleven outputs! At under £2000 for a 20 into 4 or 6 group model the SR Series enables any professional Sound Company or Theatre to provide studio quality performance with no sacrifice of reliability or ruggedness.

Agents

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- —Fully modular construction allows any format up to 28 inputs per frame.
- —8 routing busses to groups and masters.
- —3 auxiliary busses for foldback and effects.
- —10 echo returns for multiple effects mixing.
- —Integral stage communications system.
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- —Sweep frequency equalization as standard.
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- —Comprehensive headphone monitoring system.
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- —+18dBm output head room.
- —P&G fader option.
- —Solo (PFL) of all desk functions.
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- —Heavy duty flight case (as shown).

ALLEN AND HEATH BRENELL LTD. PEMBROKE HOUSE, CAMPSBOURNE ROAD, LONDON, N.8

PROLINE PROFESSIONAL

2000TC recorders

In action with the professionals– at Radio Clyde

Proline 2000TC recorders are now in action at Radio Clyde. Fitted with a control panel which was designed in collaboration with John Lumsden, Chief Engineer of Radio Clyde these machines suit the particular requirement of independant local radio.

The Proline 2000TC is a state of the art 6.25mm professional recorder designed for heavy duty operation.

Electronics have replaced mechanics wherever possible. All board switching is via solid state analogue switches. Together with modular construction which is used throughout the Proline 2000TC is an extremely reliable recorder which is easy to maintain.

The comprehensive specification also includes servo controlled DC spooling motors using a digital open loop servo (patent pending) to provide constant tape tension for all reel sizes. Twin servo controlled DC capstans with built in varispeed. TTL logic for fast foolproof operation with the facility to programme the logic and select various editing facilities depending upon the users requirements. Velocity controlled spooling for easy editing and position location. L.E.D tape timer providing real time readout in minutes and seconds at both fixed speeds.

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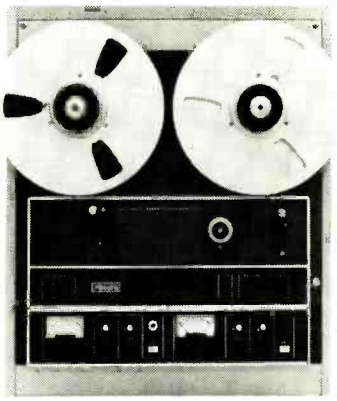
NEW PROFESSIONAL SCULLY 250



£1650 Stereo Rec/Rep

For Studio and Broadcast use.

Features:

2-track, quarter track, full track, half track, ¼" (6.35mm)

Tape Speeds	7.5 and 15 in/s or 3.75 and 7.5 in/s		
Signal-to-Noise Ratio:	**Full Track**	**Stereo Two Track**	**Half Track**
15 in/s	70 dB	66 dB	66 dB
7.5 in/s	70 dB	66 dB	66 dB
Distortion	(250 nWb/m): less than 0.7%		
Erase Efficiency	Greater than 70 dB at 1 kHz.		
Control Logic	TTL with motion sensing protection		

Models available up to one inch 8 track

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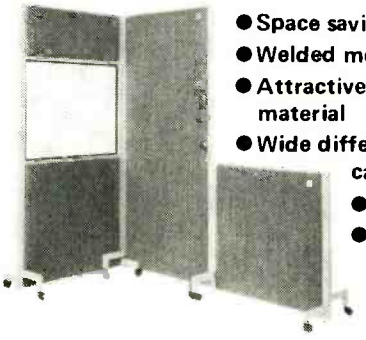
We have a lot to live up to ... and we do.

THE ACOUSTIC SCREENS from AK



- Space saving corner interlock system
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- Attractive 'cigarette proof' covering material
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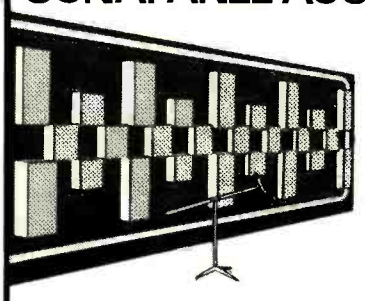
- Custom size option
- Roof sections to match

SONAPANEL ACOUSTIC SYSTEM



- Economic and flexible
- Individual layout scope
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- Detachable fixture allows relocation or resale

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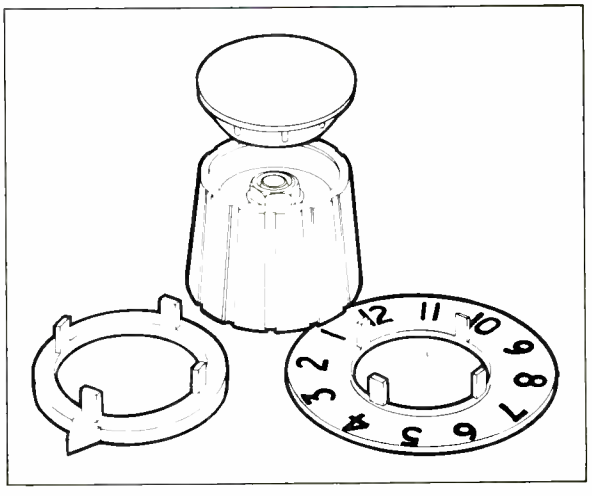
SIFAM KNOBS

aesthetically pleasing –ergonomically sound

A knob is a knob is a knob? Not to Sifam. It took us quite some time to combine the best features of styling, function, handling and easy assembly. Once it was evident that our efforts were appreciated by knob twiddlers who care about such things, we kept extending the range. Now there are three knob colours, six different sizes from 10mm to 38mm, short knobs, long knobs, short knobs with two wings, short and long knobs with three wings, all with or without line or lines, all in matt-finish Nylon with brass fixings. Then there are plug-in caps in eight colours, with or without spot or line, pointers in six colours, eleven figure dials (or to your spec.) and stators.

Considering how complex we can make all this seem, the Sifam Collet Knobs and Accessories catalogue is a masterpiece of clarity. It covers all the technical considerations too. Send for your copy and see.

In addition to this range of Collet Knobs, Sifam make Push-on-Knobs in 15mm and 21mm sizes.



SIFAM LTD
Woodland Road, Torquay, Devon, England, TQ2 7AY
Telephone: Torquay (0803) 63822 Telex: 42864
Agents throughout Europe, Africa, North America and Australasia.

SIFAM

news

APRS 79

As expected, all the sites of the Association of Professional Recording Studios APRS 79 exhibition being held from June 20 to 22 at the usual Connaught Room location, have been taken up. Total occupied space by the 95 exhibitors will be 19,300 square feet, 1,500 square feet up on 1978. Information from APRS, 23 Chestnut Avenue, Chorleywood, Herts WD3 4HA.

Reslo to distribute Primo

Reslosound has been appointed sole UK distributor for Primo of Tokyo. Primo are one of the world's leading manufacturers of mic capsules. The Primo range includes capsules, dynamic mics and accessories, desk mics, and a versatile radio mic system.
Reslosound Limited, Eagle Road, Rye, East Sussex TN31 7NB, UK. Phone: 07973 3959.

Canary consoles

One company erroneously omitted from the recent mixing console survey was Canary Mixing Desks Ltd, Wandsworth. A wide range of PA and recording consoles are manufactured including a 10-channel stereo mixer with submixer for an additional 10 inputs, both mounted in carrying cases with removable lids, 12/2 and 16/2 consoles are similar to 10/2, the 16/2 i has an additional aux send (making total three) and each channel has an illuminated VU meter. Canary also manufactures 10/4 main and submixers, a 15-channel live PA stereo mixer, and provides a custom service, in addition to a 400W amplifier and electronic crossovers.
Canary Mixing Desks Ltd, 17 West Hill, Wandsworth, London SW18 1RB. Phone: 01-870 7722.

Lynwood timer

An electronic timer for mains driven equipment has been introduced by Lynwood Electronics, Bournemouth. The *Leisure Series* provides a 24-hour LED display and enables a single time period to be set within this 24-hour period, output being mains switched on a 13A socket. Price is £38.50.
Lynwood Electronics, 20 Stourcliffe Avenue, Bournemouth BH6 3PT. Phone: 0202 426299.

Sonifex Q-PAC-R

Recent addition to Sonifex's range of NAB cartridge recorders is the compact *Q-PAC-R* which accepts the *A* size cartridge, and features simple operational controls — merely stop, record and play— with full remote facilities, a quick start solenoid operated transport mechanism, and easy cartridge loading. Switched PPM input/output metering is provided by five LEDs, and the recorder unit produces auto cue stop pulses, provides a professional specification within a small frame size, and is suitable for all broadcasting and film dubbing applications.
Sonifex Sound Equipment, 15 College Street, Irthlingborough, Northants NN9 5TU. Phone: 0933 650700.

Accessit signal processors

A range of Accessit signal processors intended for small audio systems has been introduced by Bandive Ltd, otherwise known as Andrew Stirling, Ivor Taylor and Andy Bereza. The first products include a spring *Reverberation Unit* with eq (£27), comp/limiter with 30dB dynamic range, FET gain control element and variable attack and decay (£26), *Parametric Equaliser* providing low and high tuning bands, with boost and cut for each (£26), and a *Booster* which includes four separate amplifiers switchable for bal or unbal output using electronic balancing and providing 0dB or 10dB gain with hi-Z inputs on single pole jacks, and outputs on 3-pole jacks (£25). A 24V power supply for driving four Accessit units costs £23, and a variety of leads are also available. A file of information and application notes can be obtained from Bandive Ltd, 8 East Barnet Road, New Barnet, Herts EN4 8RW. Phone: 01-440 9221. Telex: 25769.

Sifam low cost VU meters

Sifam Limited has introduced a new range of audio level meters available in two styles, both with a scale length of 56mm, the *Type AL22* and *Type AL22F*. The new VU meters meet all the technical requirements of ANS C16.5-1954 with the exception of the clause relating to dynamic characteristics. This is because the new meters are more heavily damped and have a greater rise time than traditional VU meters. However, as the extra rise time is of the order of only 0.1s it is not a critical factor in most applications. *Type AL22* is in Sifam's *Clarity* style (a clear one-piece acrylic moulding incorporating a black mask and sized 75mm x 61mm) whilst the *Type AL22F* is in the *Clarity Focus* style (designed for back panel mounting and sized 81mm x 44mm). Optional dial illumination is available on both types and the meters can be mounted at any angle. The meters are calibrated to produce 0VU from a signal 4VU above 1mW into 600Ω (1.228V). Price of the meters is less than £5 for any quantity with a minimum order level of 50.
Sifam Limited, Woodland Road, Torquay TQ2 7AY, UK. Phone: 0803 63822.

HM Electronics cordless mic

HM Electronics Inc of San Diego has introduced a new handheld cordless mic for the TV and professional entertainment field. Termed the *System 25*, the system includes a Shure *SM58* unidirectional dynamic element and has a soft compressor giving a dynamic range capability of 80dB from 100Hz to 12kHz. The system's receiver allows line-of-sight pickup at distances up to 500 feet with a minimum range of 100 feet under adverse conditions. HME claims that in combination with its new *AD* series of antenna triple adversity systems the *System 25* is virtually free of radio signal dropouts. The system uses a standard 9V battery and the VHF-FM *System 25* is non-drift crystal controlled. Price of the system is $1,570 including fitted road case.
HM Electronics Inc, 6151 Fairmount Avenue, San Diego, California 92120, USA. Phone: (714) 280-6050.

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Noise Gates from Roger Mayer Electronics

- 150 nano second Attack Time
- -96 Dbm Output Noise
- ·05% Distortion
- -56 Dbm Maximum Input Sensitivity
- Keying Input
- LED Indication of Non-Gating/ Gating Operation

Sole UK Distributors:

SSE

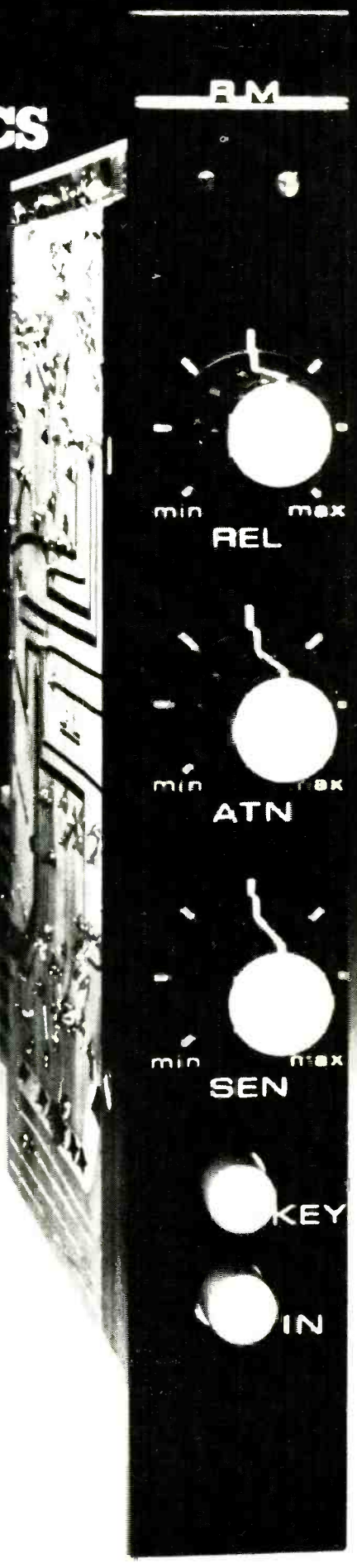
Scenic Sounds Equipment,
97–99 Dean Street
London W1V 5RA
Telephone: 01-734 2812

Lake Audio APS,
Artillerivej 10,
DK-2300 Copenhagen S
Denmark
Telephone: 570 600

3M France Minicom Div.,
Boulevard de l'Oise,
95000 Cergy
Telephone: 774 0275

Mike Llewelyn-Jones,
[illegible]

Model RM68



Model RM58X
(Retrofits into Kepex Rack)

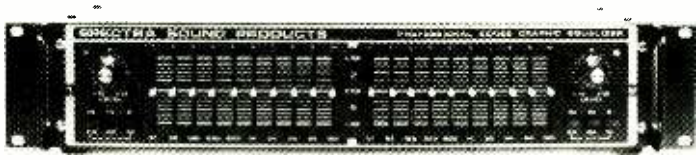
Jade Sound portable consoles

Jade Sound has been providing a high class mobile recording, public address and equipment hire service, based in the Cambridge area, for many years. Two years ago, being dissatisfied with 12/2 and 16/2 mixers on the market, Jade Sound decided to build its own. The result is the Jade Sound Series *2*, whatever happened to Series *1*(?) which comprises channel amplifier *2201* and monitor/output module 2301. The channel amplifier module is of heavy gauge steel construction providing a fully balanced input with phantom powering option on XLR connector, 0-70dB gain control, 3-band eq, two pre-fade/one post-fade aux output groups, stereo panning to two main output groups, automatic pre-fade listen facility, high quality in-channel limiter with bypass switch, and 67mm travel linear fader. The monitor/output module is of similar construction with two output slider faders, three rotary aux output faders, twin buffered VU meters, stereo monitoring, dual 3W monitor amplifiers, console LS with mute switch, talkback system with internal microphone, two way intercom and many other facilities. Three versions of the chassis are available for eight, 12 and 16 channels, and the chassis also includes the mains power supply, and multiway D type connector designed for an optional stage box (type *2405*). Equivalent input noise is better than - 121dBm with 600Ω source.

Jade Sound, 21 Enniskillen Road, Cambridge, England. Phone: 0223 60449 and 022023 4124.

Top quality tape copying from A&M

Glyn Johns in association with A&M Records has introduced what is believed to be the most modern and technically proficient tape copying facility in the UK. Operating on the principle that high speed duplication of cassettes does not fulfil the need for high quality stereo tape copies, the new facility aims to produce high quality, individually made cassette copies. The new facilities are equipped with three Studer *A80* stereo recorders and Tandberg three head cassette machines. Full details are available by phoning Anna on 01-385 6338, or by calling at The Old Manticore Cinema, 396-400 North End Road, London SW6.

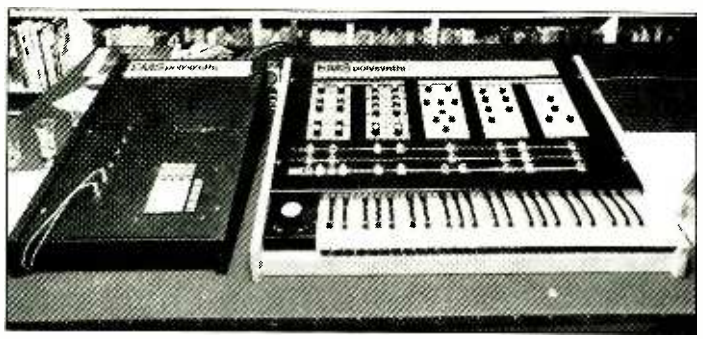


Spectra Sound 1000B

Spectra Sound graphic

Incorporating the latest in Bi-FET circuit technology, the Spectra Sound *1000B* graphic equaliser provides wide bandwidth, low noise (−100dBm), high slew (13V/μs) and low distortion (1M and THD less than 0.008%), and is "an intelligent addition to any recording facility, road system, or application where accurate signal processing is desired".

Spectra Sound Products Inc, 2245 South West Temple, Salt Lake City, Utah 84115, USA. Phone: (801) 467-2842.



EMS Polysynthi

EMS has introduced a new live performance synthesiser, the *Polysynthi*, with an optional add-on polyphonic sequencer which allows even greater flexibility.

The *Polysynthi* has a large range of special effects with instant patch switching. Features of the *Polysynthi* include equally tempered, fully polyphonic oscillator bank covering nine octaves in six overlapping ranges; 4-octave standard keyboard with three simultaneous outputs (polyphonic, position dependent control voltage, and pressure dependent control voltage); two comprehensive voltage controlled low frequency oscillators with variable waveforms; two ADSR envelope generators with LED displays; analogue delay line for echo, chorus, flanging and reverberation effects; and colour coded panel ergonomics for ease of operation.

The *Polysynthi* is played by means of a 4-octave, pressure sensitive, mechanical keyboard which supplies polyphonic information to the oscillator bank and two control voltages which correspond to the highest note played and the pressure applied. Above the keyboard is a 6-buss, centre-off, LED indicated switching system which allows the performer to choose between two low frequency oscillators, two envelope generators and the two keyboard control outputs. The main panel is divided into five coloured sections: two red *Control* sections, comprising two VCLFOs and two ADSRs; a central blue *Sound Source* section, with three oscillator bank waveforms, noise generator output and external input; and two yellow *Treatment* sections with a voltage controlled switchable two-pole or four-pole filter, a voltage controlled amplifier and an analogue delay line with voltage control of delay and with variable feedback and mix. The optional *Sequencer* is able to store up to 10 minutes of polyphonic music in its memory. A microprocessor controls the fully polyphonic sequencer which is capable of many simple and complex effects such as octave additions, transpositions and complex harmonic voicings. Editing is possible with the *Sequencer* and its programming is based on research carried out at the EMS computer studio.

Electronic Music Studios (London) Limited, c/o Peter Zinovieff, The Priory, Great Milton, Oxford, UK. Phone: 08446 729.

People

● David Pickett has been appointed lecturer in recording techniques at the University of Surrey in Guildford, the position previously held by John Borwick. Prior to coming to the University, Mr Pickett spent nine years at EMI's Abbey Road Studios.

● Michael Samuelson has assumed the position of managing director of Samfreight Ltd, the London based specialist freighting company for the film and television industries. Shirley Lavis is manager of the Cricklewood office, while Norman Brett manages Samfreight's Heathrow operation.

● Elliot Schwartz has been appointed director of sales for KLH Research and Development Corp in Westwood, Mass. He was formerly national sales manager for Bose Corp, and director of sales for Teledyne Acoustic Research.

● Jeff Davies has been appointed chief engineer (connectors) of Lee Green Precision Industries Ltd, a member of the Unitech Group.

● Neve has appointed Mike Blackburn European sales manager, and Tom Belshaw as sales executive in their Royston offices.

US patent office allows Aphex patent

The patent application for the principle behind the controversial Aphex *Aural Exciter* has been allowed by the US patent office, and will be issued shortly. The *Aural Exciter* was developed by Curt Knoppel, and the patent is owned by Inter-Technology Exchange, with Aphex Systems Ltd having exclusive worldwide representation. The patent office approved all 35 submitted claims which cover the basic idea of Aphex, that is generating a low level enhancement signal, which when added to the source signal, greatly improves clarity and intelligibility.

Genesis studio systems

Allen and Heath Brenell has recently supplied three *Studio Package Systems* to Phil Collins, Mike Rutherford and Tony Banks —Genesis. Each package comprises A & H *Modular 16/8* console, Brenell *Mini 8* 1in tape recorder and such peripherals as remote control, varispeed and limiter/compressors. Other well known musicians having recently acquired the package include Alan Price who has also constructed an acoustically treated studio.

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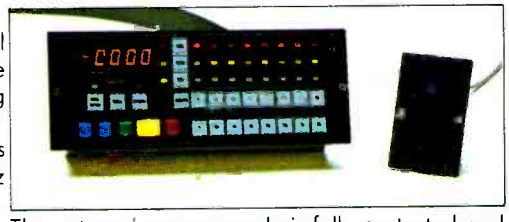
The Soundcraft 1"8-track.

Produced after two years of development, it's sophisticated, easy to use, reliable, and its specifications are superb.
The deck plate is a rigid aluminium casting of extreme dimensional accuracy, ensuring the absolute stability of the tape path.
Tape tension is servo controlled, as is the capstan (which has +15, −50% varispeed control), and wow and flutter is only 0.03%.
Control and monitoring facilities are comprehensive. A simple push-button matrix permits selection of line-in, sync and replay for any of the tracks and led's indicate the selected status.
The tape counter has a plasma display reading in minutes and seconds. There is also a highly accurate search-to-zero facility.



A special feature of the machine is that the whole of this control panel, and the varispeed control, can be used remotely. So once the machine is prepared, a single engineer can work a recording session without leaving the mixing console.
Replay S/N is 76dB (reference 510nWb IEC curve A); erasure is 70dB and record/replay frequency response is +1, −2dB (30Hz to 20kHz).
All signal levels can be adjusted by presets on each channel. The external power supply is fully protected and 19" rack mounting.
The Soundcraft SCM 381-8 is built to the highest professional standards throughout for the production of master quality recordings.
The UK professional price is £5,250 (excluding VAT). It includes all the above features as standard.
Contact Soundcraft for a brochure giving more details and a full technical specification.
Soundcraft Magnetics Ltd, 9-10 Gt Sutton Street, London EC1V 0BX, England. Telephone 01-251 3631 or 01-253 9878.
Telex 21198.

SOUNDCRAFT MAGNETICS LIMITED

New Shure mic and speaker

Shure Electronics has introduced a new miniature dynamic mic and a new stage monitor loudspeaker with high frequency variable dispersion control. The new *SM17* miniature dynamic lavalier mic is a high quality acoustic pickup mic with excellent isolation and feedback properties. The mic is supplied with 10 feet of cable and three alternative mic mounts—an expansion mount for fitting to the tailpiece of instruments of the violin family, an edge mounting clip for guitar soundhole or brass instruments, and a complete Lavalier assembly. Price of the *SM17* is £45.60. The *Model 703* stage monitor loudspeaker is a two-way unit with a high frequency driver and two eight inch heavy duty drivers. Control of the high frequency dispersion is accomplished through the use of removable acoustic wedges which in conjunction with the capability of two tilt angles provides the user with four alternative coverage selections. Power handling capacity of the unit is 100W (continuous programme into 8Ω) and the unit can produce 97dB SPL (1W input at four feet). Size of the unit is 283mm x 587mm x 438mm and the price of the *Model 703* is £209.40. Shure Electronics Limited, Eccleston Road, Tovil, Maidstone, Kent ME15 6AU, UK. Phone: 0622 59881.

Mustang amplifier

To be introduced at the Sound 79 exhibition (Cunard Hotel, March 20 to 22) is a new amplifier from Mustang Communications, the *DA 50*. Principle features are 40W output at low impedance or 100V line, three inputs, priority control, bass and treble controls, recording facilities, aux outputs and a choice of 11 input modules. Applications include schools, churches, paging, and background music systems, small stage productions and alarm systems, etc.

Mustang Communications, Nelson Street, Scarborough, North Yorkshire YO12 7SZ. Phone: 0723 63298.

Mustang DA50

Contracts

● BBC Scotland has purchased a Lyrec 16-track tape recorder for television dubbing. Other users include Roundhouse, Goodearth and Amazon.

● RTS Systems, North Hollywood, has sold a $35,000 custom intercommunication system to NBC-TV Burbank, for use in a new KNBC mobile truck.

● Radio Clyde has just installed the first of the new MCI JH-600 series consoles in its Glasgow music studio. Having now completed construction of its first mobile with twin MCI 24-tracks, Radio Clyde is now building a second, this time for its own use in Scotland—equipment will again be from MCI.

Lexicon Delta-T delay

A new lost cost professional audio digital delay has been introduced by Lexicon. The *Delta-T 91* has all the performance specifications and features of the more expensive *92* including muting of audio outputs during power up/down sequences, auto bypass, transformer inputs and outputs—the only difference is a single output, rather than two previously. Delay adjustment from 0 to 120ms is provided, and the *Delta-T 91* costs $985.

Lexicon Inc, 60 Turner Street, Waltham, Mass 02154, USA. Phone: (617) 891-6790. UK: FWO Bauch Ltd, 49 Theobalds St, Boreham Wood, Herts.

Lexicon Delta-T 91

JBL cut UK prices

The continuing strength of the pound sterling against the US dollar, has enabled Harman (Audio) UK Ltd to offer reduced prices on a range of JBL products. Full details from Harman (Audio) UK Ltd, St John's Road, Tylers Green, High Wycombe, Bucks HP10 8HR.

Metrosound to distribute Steeplechase

Metrosound Audio Products of North London, UK distributor for several American direct-cut record labels (including Crystal Clear, Nautilus and Sound 80), has now also been appointed distributors for the series of direct-cuts being produced by a specialist jazz company, Steeple Chase Records of Copenhagen. The initial three recordings are *Goin' On* The Frank Strozier Quintet, *Shades of Love* solo vibraphone from Walt Dickerson (both recorded in New York), and *Hi Fly* from the Horace Parlan Trio, recorded in Oslo. Each disc costs £8.98 and is available from record stores or direct from Metrosound, 4/10 North Road, London N7.

Donald Chave sets up audio consultancy

The well known engineer who founded the Lowther Manufacturing Co, Donald Chave, has set up a full time audio consultancy called Chave Innovations. Based in Kent, Chave Innovations will operate in the audio field and provide a service to manufacturers of speakers, amplifiers, tuners and pick-ups. Chave Innovations, The Grannary, Jackass Lane, Keston, Kent BR2 6AN. Phone: 0689 52051.

Millbank orders

Over 70 amplifiers manufactured by Millbank, have been installed by Golding Audio, in Europe's largest leisure complex, Blackpool Pleasure Beach. A variety of amusement rides utilise audio visual displays with Millbank sound systems, while the entire complex is fed with background music from a Millbank 10-cassette autochange mechanism. Millbank has also supplied over 120 sound systems to EMI Pathe Equipment Ltd for ABC and other cinemas, both in the UK and overseas and are fully automated. ■

studio diary

Stones Mobile behind the Iron Curtain

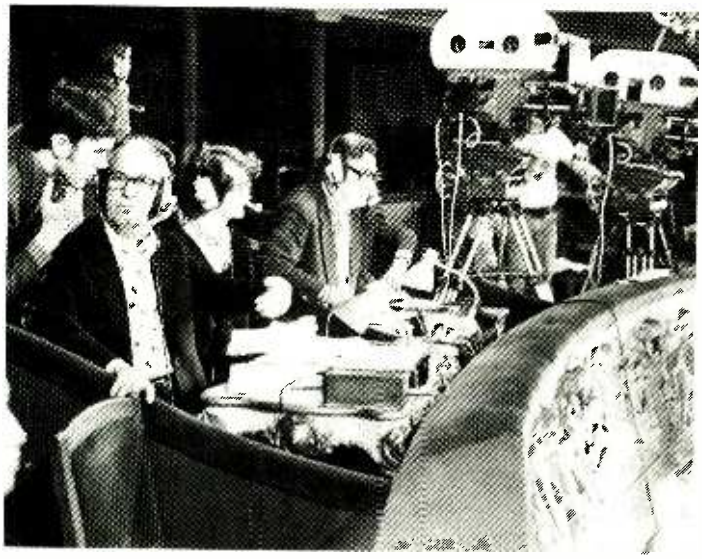
The Rolling Stones Mobile has seen much active service all over Western Europe since it was first commissioned in 1971, but until June this year it had never been required to operate behind the 'iron curtain' (unless you include a previous dash to West Berlin through East Germany.)

The event which brought about this unusual assignment was a performance of the Khatchaturian ballet *Gayaneh* by the Latvian company, Ballet Riga. Although this in itself was no remarkable occurrence, the reason for the involvement of the Mobile was to provide sound recording facilities for Special Event Entertainments, an LA based company who had been given permission to film a complete performance for 'big screen' presentation. The reason for filming the ballet in this particular location was that of all the different productions of this particular work, the Ballet Riga interpretation was the one which Khatchaturian considered the closest to his ideal.

Consequently, on June 5, the Stones Mobile was shipped out of Purfleet docks in the charge of its regular driver Pete Stevens. On June 10 Dave Hawkins, truck service manager and co-driver on this trip, flew out to Finland to join Pete who had by now found his way to a place called Kotka, about 30km from the Soviet border.

The intention was to rendezvous with two Soviet interpreters from the Russian television service at a place called Vyborg. At this stage of the game, Pete and Dave had assumed that Vyborg was at the frontier since the letter which confirmed the arrangements told them that the two interpreters would assist them through Soviet customs procedures. When they eventually reached the frontier both they and the camera truck (carrying all the film equipment) were quickly helped on their way with an equivocal 'good luck' and a wry smile from the Finnish customs men. The casual attitude and dress of the Finnish officials was starkly contrasted by their greeting at the other end of the 15 metre journey through no-man's land. After running the gauntlet of a succession of signs displaying cameras with red lines through them, multi-lingual placards proclaiming a variety of items which were '... Forbidden/Verboten ... etc', and, as if they weren't already aware 'You are now entering CCCP', they pulled up at the Russian frontier post confronted by a couple of uniformed guards with guns over their shoulders.

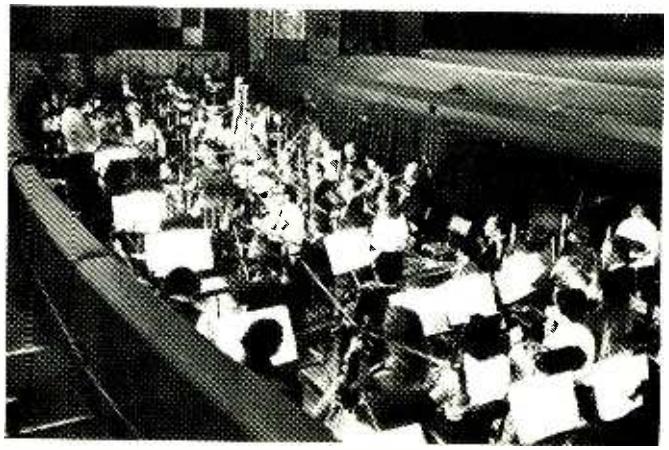
The first thing they found out on arrival at the customs was that Vyborg was situated about 60km inside Soviet territory, and therefore they had to clear Russian immigration under their own steam. John Lake, their colleague who was driving the camera truck, was immediately challenged about a 2-way radio set installed in the cab of his truck. It was hastily removed. A group of inspectors in boiler suits armed with torches and screwdrivers, clambered all over the trucks, and apart from numerous other things, asked the crew if they were carrying any guns. In the course of the next 5½ hours, all the various forms were filled, currency exchanged, declarations made, personal luggage searched, and the trucks were even driven onto ramps for inspection from underneath. Eventually, the trucks were sealed up by officials and the con-



Left, *production team for Special Event Entertainments in position on the Opera House balcony*

Below, *five of the six Panavision 35mm film cameras in the Opera House*

Below, *the rather cramped orchestra pit festooned with microphone stands*



Above left, *L to R Robbie Hambling, Dave Hawkins, Pete Stevens and Ray Pricket in front of the Stones Mobile*
Above right, *Stones Mobile parked in front of Riga Opera House, with lighting generator truck behind*

voy was told to proceed to Vyborg.

The roads were awful. By 15.30 they drew into Vyborg to the appointed meeting place, to be met by two agitated inspectors who had been waiting around since 8.00 am. The plan now was to push on to Tallin in Estonia, via Leningrad, which meant covering a further 400km that evening. By 3.30 on the Monday morning, they had made it to the Intourist hotel in Tallin. Their first impression of a Russian hotel was interesting as, according to Pete the first thing the hotel officials do on arrival is to a) relieve you of your passport and b) ask you to pay the bill in advance. However, this particular hotel, was pleasant enough and the food was quite good.

In the morning it was discovered that both trucks had had their GB plates ripped off for souvenirs. This was not surprising, as everywhere the two-tone camouflaged Stones Mobile went in the USSR it drew crowds of awe-struck spectators.

The journey from there to Riga was uneventful and the destination was duly reached as planned on June 12.

Meanwhile, earlier that day, Mick McKenna the Stones Mobile operations manager and fellow crew member Rob Hambling, left on a flight to Moscow along with freelance balance engineer Ray Pricket and the rest of the film crew.

Everyone involved in the operation had somehow managed to make it to Riga for June 12, and the process of finding a place to sleep now began. It had been arranged that the crew would be lodged in the Hotel Riga, literally just across the road from the Opera House where the ballet was to be performed.

The next day it was time to start the real work with a planning meeting. The sound truck was parked at the back of the hall conveniently close to an exit and more customs officials supervised the breaking of the customs seals. Soon the camera truck was being unloaded, and the sound gear being rigged. The first problem encountered ironically, was to do with communications. Riga is in Latvia, which, although a member of the Union of Soviet Socialist Republics, is a nation with its own distinct language and culture. However, the two Russian chaps, who had been sent along as interpreters didn't speak a word of Latvian, so alternative means of communication via Latvians who could speak either Russian or English had to be found before liaison with the theatre technicians could be established.

The next problem that faced both Ray Pricket and Mick McKenna was the size of the orchestra pit. It was approximately 45ft long by 9-10ft wide—not a lot of room for a 72-piece orchestra, and because the layout was thin and stretched compared with a normal orchestral layout, Ray decided that a multi-mic technique would be the safest approach under the circumstances. Other factors to be taken into account were an upright piano (again because of restricted space) and a large variety of percussion instruments, which play a very important part in the scoring of Khatchaturian's music.

Ray can't remember with accuracy which mics were employed, only that there were many Neumann *U47s*, *U67s* and *U87s* on the orchestra, along with a selection of Shure microphones (mainly *SM58s*). Apart from the close mics, there was a row of ambience mics about 10-12ft from the orchestra, and the audience effects were covered by a Neumann *SM69* and a couple of *U87s*.

Mick encountered great difficulty in placing the stage-box inside the orchestra pit as there was barely enough room for the musicians, never mind the forest of mics, stands and cables that had now sprouted up. Another rigging complication transpired when they discovered that at certain points in the ballet percussive effects are created by the dancers when they bang various props together on stage. The *Sabre Dance* is probably the best known piece from this work which uses such effects, and as these sounds are an important part of the score, it was necessary for Rob to rig three mics—one stage right, one stage left, and the other at the back of the stage to pick up any sound effects coming from these areas.

Having rigged all the film and sound equipment on the Tuesday, the Wednesday was used mainly for a camera rehearsal so that the camera crew, using six *Panavision* film cameras, could work out their shots and the camera reloading schedule. There were to be no retakes or edits, so in order to allow the optimum choice of shots at the cutting and editing stage, the camera reloading timetable involved meticulous planning and a comprehensive communications system. The Mobile had therefore provided a network of 2-way headsets for all the cameramen and focus-pullers, and talkback mics and loudspeakers for the director, his secretary, and also for the Mobile itself. This system made it possible for virtually everyone involved to be able to speak to everyone else. The director's secretary performed a running commentary on the timing and cueing of the film operation, and all that was said on the communications system was to be recorded on one track of the 24-track tapes, for subsequent reference during the cutting and dubbing processes. A 50Hz sync pulse was also recorded on a separate track, which, as the speed of the film cameras is controlled by a 50Hz crystal oscillator, would allow the final optical and audio media to be run in sync, once a common sync point had been found.

After the camera rehearsal, which was of no use to Ray in terms of getting a balance, there was a full-dress rehearsal on the Wednesday evening. This was immediately preceded by a 20 minute orchestral rehearsal, so that by the time the full-dress rehearsal started, Ray was more or less in a position to record this performance as a safety copy, despite the fact that there was no film in the cameras The only concession which the ballet company had made with regard to the filming was to extend the intervals between acts, and so allow a certain amount of regrouping of the camera operation, and also a reel change inside the Mobile. In anticipation of the need for continuous recording of each act, Mick had loaded one of his 24-track machines with 14in reels of standard play Ampex *406*, and the other with 10½in reels of Ampex *407* long play tape. In the event, both methods proved satisfactory.

The camera team were not so happy. The *Panavision* cameras were specifically designed for the intermittent operation of shortish 'takes' which are usual in the making of a feature film. On this occasion they were being asked to perform a continuous run, apart from reloads, during the entire ballet, and therefore there was a certain amount of concern, first of all about overheating, and secondly with regard to the capacity of their batteries, which were their only source of power. About the former problem, they could only keep their fingers crossed, but about the latter, Mick and his team managed to rustle up some car bat-

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teries and connect them up to act as a reserve supply.

After the full-dress rehearsal, the conductor came back to the truck to listen to a playback and, having made a few constructive comments, said that he was in general very happy. There was nothing more to be done now except to wait for Thursday night.

On the night, everything in the Mobile went without a hitch. The only potential black spot on the horizon was that one of the camera power-packs was running dangerously low. However, the car battery reserve supply obviated that problem. After it was all 'in the can' there was a celebration involving the cast, the film and sound crew, and a lot of the local 'bigwigs'. This gave the crew a chance to meet the locals and have the occasional waltz with the ballerinas, who incidentally were all very young and very beautiful, and, while they kept everyone at a suitably respectable distance, were obviously pleased that anyone from the West should be interested enough to come and film them.

There were other more informal celebrations including a drinking session in the 'House' recording studio. This studio was apparently quite modest by Western standards; it had very limited facilities, and was built 'like a battleship', but it served as a convenient location to exchange glasses of Latvian brandy and Scotch. One of the Latvians was very interested in rock music, particularly Manfred Mann's Earth Band and ELO, and although he didn't speak English, had about a 50% success rate in singing along with a few records he possessed. He was also over the moon when the sound crew presented him with a pile of Stones albums.

The next day it was time to go home. Most of the crew flew back to the UK, and after customs had once more sealed the vehicles, Pete and Dave, along with John in the camera truck started on the return journey back to Finland.

Coming through the frontier post back into Finland was like "stepping back into a new world", according to Pete. He had had a slight problem with the Soviet customs authority because, as he had been paid subsistence money for the trip in roubles, he had ended up with more roubles to convert back into Western currency than he had initially been given on the way in. His apparent profit took a bit of explaining, and in the end the officials would only give him the same amount of Western currency which he had originally exchanged into roubles. The balance, they told him, would be available on application if he returned to the USSR within the next three years. I don't think he's rushing to get back.

The latest news is that Glen Glenn Sound have remixed the tapes to a surround-sound format in the States using a theatre Dolby system. Carl Hanseman, the vice president of Special Event Entertainments, is reported to have described the sound as 'impressive' and has recently flown to the USSR to arrange a special showing in the Sports Palace in Riga, including stereo playback facilities. There is even some talk of a USA/USSR simulcast via satellite!

Bill Aitken

Blue Rock Studio, New York

New York's Blue Rock Studio has added an auxiliary recording room for live and overdub sessions to its 24-track facilities. The room, which is approximately 18 by 23ft, has brick and wood surfaces giving the room a 'live' quality. This quality makes it ideal for horn and string sessions and specialised drum, acoustic and guitar and vocal sounds, and in addition makes it suitable for use as a natural echo chamber. The new room is linked for both audio and video to Blue Rock's main studio and control room.

Blue Rock Studio Inc, 29 Greene Street, 10013 New York, USA. Phone: (212) 925-2155.

Aspen Audio-Recording Institute

Summer 1978 saw the inauguration at the Aspen Music Institute of a new training course, the Aspen Audio-Recording Institute, created to fill the vacuum caused by the shortage of well trained audio technicians in the USA. The course run by director Harold Boxer (music director for Voice of America) was conceived as an intensive 2-week workshop for students wishing to learn basic recording techniques. Four 2-week sessions were run with students recording some of the world's leading musicians on professional recording equipment. The tie-up with the Aspen Music Institute consisting of the Aspen Music School and Aspen Music Festival enabled students to record live performances ranging in complexity from solo instruments up to a 100-voice choir. Such was the glut of available material that during the 8-week run of the courses students received the opportunity to plan, record and critique a total of 108 live performances.

Training received by the students consisted of training in the theory and practice of acoustics, use of microphones, operation and maintenance of recorders, function and operation of mixers, use of audio tape, and experience of mixdown to stereo. All hands-on recording was done on three Ampex *ATR-100* recorders and an Ampex *ATR-700*, all of the equipment being loaned to the institute by Ampex. Practical experience was supplemented by a series of lectures by leading American recording industry personalities including Thomas Frost, director of CBS Masterworks, and John Pfeiffer, executive producer for RCA Red Seal artists and repertoire.

Bank of Ampex ATR-100s being used to tape a performance at the Aspen Music Festival

Regent Sound Studios, New York

Despite the name, Regent Sound Studios operate not only in straight sound recording, but also specialise in sound for video recordings and commercials, these activities now accounting for up to half of Regent's business in certain months of the year. President Bob Liftin is sound consultant for NBC-TV's *Saturday Night Live* programme and Regent produces the audio for many major network and cable television programmes. The design of Regent's two studios reflects Liftin's commitment to audio and video. Studio A has two Ampex *MM-1200* 24-tracks, 2 and 4-track *AG-400C* and *ATR-100* tape recorders which all interface with an EECO *MQS-100* synchroniser also interfaced to a *U-Matic* format video cassette recorder for video playback locked to the audio recorders. The *MM-1200*s are also equipped with 16-track head stacks and a *Quadruplex* video layback head.

Quadruplex video tape recorders also use 2in wide tape and the layback head allows sound to be either played or recorded using the *MM-1200*s onto video tape, thus allowing sound dubbing of pre-recorded video tapes without the expense of a Quadruplex video recorder. Studio B is equipped similarly to Studio A, but only has a single 24-track and EECO *B-450* reader/synchroniser also interfaced to a *U-Matic* video cassette recorder. Regent has also ordered an Ampex *VPR-2* Type C helical video recorder using 1in tape which is being increasingly used by broad-

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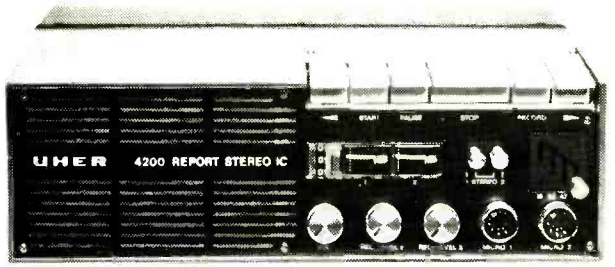

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casters around the world. Regent's layback facilities are designed for mono and stereo which is being regularly used in television, and unlike normal audio heads on video tape recorders, the stereo layback head has separate play and record sections enabling optimum response and S/N from each job. Obviously an excellent Ampex customer, Regent also uses an *AD-15* audio tape duplication system with two slaves.
Regent Sound Studios, 25W 56St, New York, NY 10019. Phone: (212) 245-2630.

Kaye Smith Studios, Seattle

The Pacific Northwest of the United States can be defined as the States of Oregon, Washington, Montana and Idaho—while some would include British Columbia (Canada), still further north. Admittedly there is little music recording happening in Montana or Idaho (though rumour has it that a fully 'state of the art' 24-track studio is under construction at present in Montana), however a lot is happening in Oregon (centred around Portland) and Steve Miller has just opened a 24-track studio for his own productions.

In Washington State, however, it all seems to be happening. Centred around Seattle, the industry here is thriving through local, national and international music production plus local and national radio and television production—several 24-track facilities already exist with one under construction and several more planned—Sea-West Studios having recently upgraded to 32-track.

Apart from the outstanding natural beauty of the area, the industry also has a rapidly expanding pool of talent (both local and imported) with which to attract new business. One such facility is Kaye Smith Studios located in a quiet area of downtown Seattle. Owned jointly by Lester Smith and Danny Kaye, the studios were built to a Westlake design and began life in 1973 as a full multi-purpose production house with a staff of about 30—writing, producing and recording music, film, television and radio—the latter being mostly commercials . . . quite a grandiose start. It appears, however, that Messrs Kaye and Smith, while they had seen the potential of Seattle and the Northwest, had seen it too soon or had acted prematurely and for a long time there was not enough demand to justify a staff or facility of this size. The result was what is known locally as "The great Christmas massacre" resulting from the decision to axe over half the existing staff . . . presumably a financial necessity.

From then on the studio became a straight rental facility including two staff engineers, Win Kutz and Buzz Richmond, who remain to this day, while the film side carries on with a skeleton staff.

Studio A is the larger of the two sound studios measuring 48 by 32ft excluding the traps which in fact take up a significant amount of working space. These traps are in fact about to be removed as part of a major redesign the studio is going through—more on this later. As A stands, it is a relatively live room with the familiar Redwood dressing of many Westlake rooms, a section of the floor is cork, and the large control room window provides another reflective surface. An iso-booth to the right of the control room also provides access to the studio. Interesting to see the boxed-in piano in A—a debatable practice. Studio B on the other hand is very dead with absorbent surfaces everywhere; measuring 22 by 20ft, it appears smaller due to the iso-booth at the far end. Evidently with the existing design it is Studio B that most clients prefer. Control room A is the larger of the two at around 22 x 20ft and both studios are similarly equipped. Consoles are API 32/24, both having been recently rebuilt and debugged, and now give extremely satisfactory service. An Allison *65K Programmer* has just been installed in B with similar automation due soon for A.

Twenty-four channels of Dolby A, 3M *79* 24-track, *ATR100* 2-track machines and an assortment of *Kepex*, *Gainbrains*, UREI *1176* and *LA3A* comp/limiters, Pultech equalisers, ITI and Trident parametric equalisers are common to both studios. EMT stereo plates and a live stereo chamber handle the echo while Eventide, Pandora and MXR digital delay lines shuffle from studio to studio. A choice of monitors is available—the standard being the Westlake monitors with Hidley Horns but also ADS *810*s, JBL *4333A*s and *Auratones*.

On the future of Kaye Smith Studios, Leslie Rood (office manager) had this to say: "Right now Kaye Smith is the biggest and best facility in town but we know full well that the industry in this area is about to take off and that any minute somebody is going to come in and build a facility to compete with us and so we aim to stay ahead of them. So far the studio has been riding on its laurels because for a long time we were the only sizable studio in town that had everything—two 'state of the art' 24-track rooms. The whole area is growing, the competition has already started and more is on its way. Hence the redesign of the studios in keeping with current trends and thinking. Kent Duncan of Sierra Audio has been consulting on the new rooms with Mike Flicker—probably the area's top producer currently and best known for his association with Heart. Basically the new design involves removing the asymmetry of the present rooms and returning to a basically rectangular room. The walls will have louvred areas which will lie flat or can be opened up to vary the acoustic character. In 'A' the Console and window will be moved back to allow more room and a larger reflective surface. The result will be a more active room very well suited to rock 'n' roll which, let's face it, accounts for most of the business, although we have seen a lot more jazz going through the studio recently. Kaye Smith, apart from working with national and international clients, is actively promoting local artistes and producers Win Kutz and Buzz Richmond are our staff engineers but do a fair amount of production work for outside companies—Win exclusively for Maverick Productions in New York and Buzz has done a lot for Epic Records and other freelance productions—and they bring work to Kaye Smith. Mike Flicker, Heart's producer, does a lot of work here (including the platinum *Little Queen* album) Tom Bell is a local producer and promoter who has written and produced a good portion of the Spinners albums and also frequently works for Philadelphia International Records. It was Tom Bell who brought Elton John to Kaye Smith for an album —unfortunately Elton was ultimately unhappy with the project and the album was never released."

Over the years, in addition to Steve Miller, the Spinners and Heart, many great names have worked at Kaye Smith — Bette Midler, Dionne Warwick, Johnny Mathis, Tower of Power, Bachman Turner Overdrive, Striker—a local band who made the national charts with their first album, are tentatively returning soon to Kaye Smith to record their second album on Arista Records. Local band Gabriel are regular clients along with top Hawaiian rock duo Cecilio and Kapono. At present, Win Kutz is working on an album project for CBS Records and Bob Johnstone is booked for the near future to record an album with Joe Ely for MCA Records. Steve Miller is provisionally booked in to mix his forthcoming album.

A brief word with Dave Matthew, Kaye Smith's chief engineer, on the subject of new equipment purchases is of interest. Apart from generally keeping an eye on all new products entering the market place, his particular interest is in the new Lexicon DDL and noise gates. Mike Flicker rarely, if ever, uses Dolby or dbx noise reduction with his productions but will use a noise gate wherever he can. With this in mind the Kaye Smith engineers are taking a close look at the ADR *Scamp* system and comparing the *Scamp* gates with Roger Mayer gates. It will be interesting to know who scores most points!
Kaye Smith Studios, 2212 Fourth Avenue, 98121 Seattle, USA. Phone: (206) 624-8651. **Enbee**

A V - Elektronik, Stockholm

A V-Elektronik is certainly not a typical Swedish studio. It is situated in the centre of Stockholm within walking distance of the concert house and is on the sixth floor of a block close to a busy shopping centre. The studio, which in 1955 housed an International Radio Station IBRA, was bought by the present owner, Goesta Konnebaeck, in 1966 and divided into two sections.

The first section, dealing with music, comprises a 16-track studio, a control room and mixing room. The studio, designed by Sten Walstroem, a Swedish professor of acoustics, is 750 square feet and based around a system of inclining walls giving different acoustical effects. One of the most noticeable features of the studio are the microphones which are Neumann *U47*s and now almost unobtainable in Sweden, and therefore much sought after. Goesta tells me that several offers for them have already been turned down! The control room is 320 square feet with a custom-built desk by Centroson and Ampex 16-track machines, amplification is by Quad and speakers by JBL.

The second section is the larger of the two and specialises in material for schools and companies, such as language tapes, still films and in addition certain programmes for Swedish radio are recorded from time to time. This section comprises two small talk studios, two control rooms and three mixing rooms, complete with 20 Revox copy machines for open reel

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tapes to enable direct sales to schools and companies.

Goesta, owner, studio manager and chief engineer, is assisted by two engineers. The three work together, even carrying out all studio repairs in a specially equipped laboratory close by. Improvements are continually in the air and Goesta tells me that at the moment plans are being drawn up for a new mixing room which will make five in all.

A V-Elektronik AB, Sveavaegen 34, S-111 34 Stockholm, Sweden. Phone: (08) 24-01-30. **Sarah Pink**

Red Bus Recording Studios, London

Amongst the current glut of new studios and the rebuilding and re-equipping of older studios currently taking place in London, a recent addition to the fold has been Red Bus Recording Studios. Situated in North West London not far off the Edgware Road, it is rather surprising having wandered through the local stallholders wares to find that an unlikely looking terraced building, houses recording studios. Appearances belie the excellent facilities and decor which lie within. Passing through the wooden double doors at the entrance to Red Bus is like going from chalk to cheese. The reception area and indeed the whole of the studios, plus Red Bus Records (who are housed in the same building), are extremely tastefully decorated. The use of earthy colours and finishes such as natural wood gives a very relaxed atmosphere which isn't tiring to the eye. It is interesting to note that with the increasing similarity of equipment facilities in many London studios these much more attention is n to decor and more ies as a means o The present 's make ple ve

fatigue. This forethought in the initial planning for the studios has been carried through in many ways including items such as the provision of an underfloor technical earth (three special copper pipes sunk into the ground) rather than the use of a mains earth with its attendant possible hum loop problems and mains bore interference problems.

The design of Red Bus' two studios by the Eastlake design team, but with several additional customised features specified by Geoff Calver, reflects Geoff's studio experience. Geoff started at Pye as a disc cutting engineer, then joined the Pye Mobile as an assistant sound engineer, and was the chief engineer at Marquee prior to moving to Red Bus. His experience has obviously been put to good use, as unusual features which the studios exhibit, such as individual

Red Bus Studio One in the control room. Left: Tony Swain, right Geoff Calver

foldback control and built-in direct injection on the transformers on the mic lines, are examples of this experience being put into operation.

As already stated, studio design by Eastlake using the usual ues and decor style. Studio 700 square feet and will up to 40 musicians, th, two isolation , and a live tudio. The modate is

However, Geoff said that the measurable acoustic difference is only of the order of a few milliseconds. Despite this, brass and string players and singers have found the live area very useful and brass players appreciated the facility as it meant that they didn't have to play too hard to achieve the required sound. This is important as the live area helps solve pitch and tonal difficulties with brass instruments caused by overplaying.

The control room for Studio One like the studio itself is spacious and well laid out and offers excellent vision to the studio. It is equipped with a 42/42 MCI *JH-542LM* fully automated mixing console with plasma display meters and spectrum analyser. The console has a number of customised features including custom equalisation and the I/O channel modules running from right to left so that the main 24 returns appear in front of the engineer for monitoring. Regarding the custom equalisation Geoff said this is to be converted to parametric eq in the near future. The available tape equipment comprised four MCI machines (a 24-track, two 2-tracks and a 2/4 track) with all machines being Dolbyed and remotely controlled from the console using an MCI *Autolocate II*. Monitoring loudspeakers are Eastlake designed using Gauss units driven by Amcron *DC300 A*s in conjunction with White ⅓-octave eq, with Auratone speakers for checking com- with normal domestic During my visit to Red Tony Swain was ession for Paul Blue produc- heard were pleasing

Ancillary equipment available in Studio One includes EMT plates and Master Room stereo echo units, Eventide digital delay and *Harmonizer*, MXR flangers and phasers, *Kepex* and Meyer noise gates, Marshall *Time Modulator*, APSI equalisers, Urei and dbx comp/limiters, Aphex *Aural Exciter*, Sony *TC229* cassette deck and Dual turntable. Mics in use include AKG, Beyer, Electro-Voice and Neumann models. Studio One also has available a Steinway *Model B* grand piano, Fender and Champ amplifiers, Roland synthesiser and Elka string synthesiser at no additional charge.

Red Bus' Studio Two is a modest sized studio of 400 square feet which is basically used for overdubs, voice-overs and percussion recording although it can also be used as an annexe to Studio One. The control room is equipped with a 28/24 MCI *JH-428B/LM* mixing console and an MCI 24-track machine together with three MCI 2 track machines, all with Dolby. Ancillary equipment includes Audio & Design and dbx comp/limiters, Eventide flanger, Delta Lab digital delay unit, Meyer noise gates, and a Master Room stereo echo unit. The control room can be used as a mixdown room and additionally the two control rooms can be linked together for 46-track recording. The tie-lines are already laid in and Red Bus are currently awaiting delivery of the MCI SMPTE synchroniser to link the two 24-track recorders.

The studio complex is fully air conditioned and has video lines connecting the studios and control rooms for video demonstration facilities, auditioning, etc. Building of the Red Bus studio complex began in May 1978 and took four months to complete—the first session taking place on October 1. Since opening, the studios have been very busy, user's having included arranger/producer Del Newman, French producer Bernard St Paul, the Three Degrees and Patti Boulaye.

As an example of current thinking and of studio design, Red Bus is certainly impressive. Geoffrey Calver and Eastlake have good reason to be proud of their achievement which owes much to the implementation of hard won experience and careful forethought and planning. Studio user's appear to be well pleased with the facilities and decor, which can't be bad. So it only remains to say well done chaps! Red Bus Recording Studios, 34 Salisbury Street, London NW8 8QE, UK. Phone: 01-402 9111.

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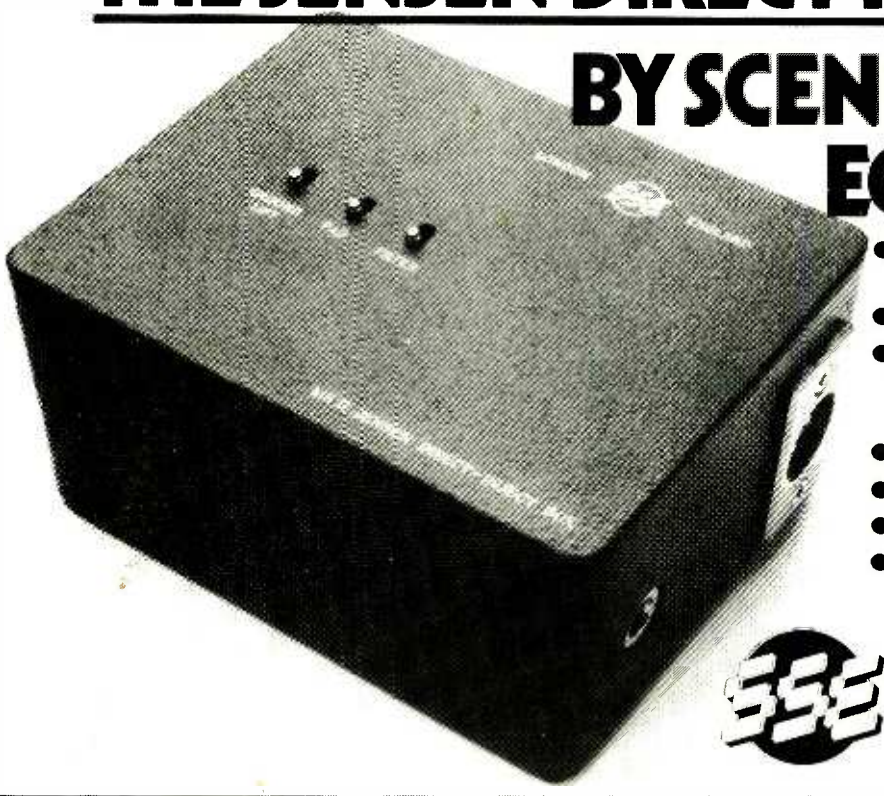

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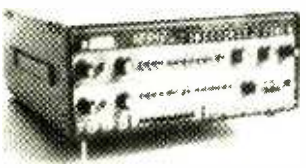

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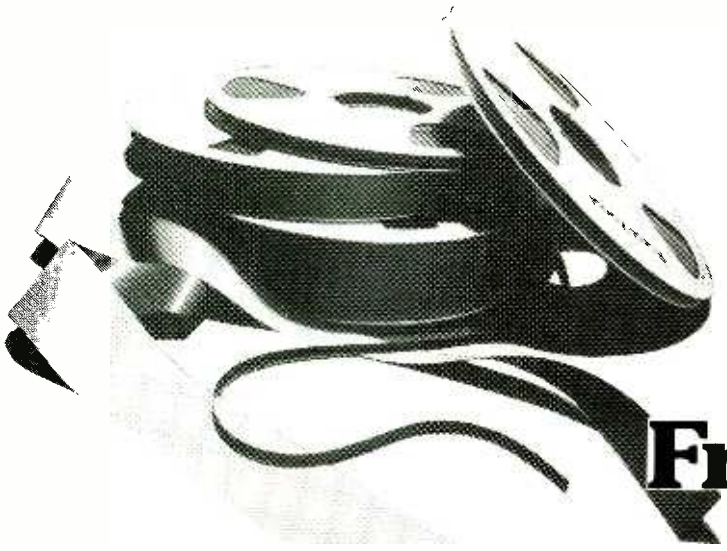


From Rust to Tape

Steve Billige (Racal-Zonal)

Magnetic tape is an essential ingredient of the recording process, but what actually are the ingredients of the tape itself? Steve Billige, technical services manager of Racal-Zonal, examines how different formulations and preparations can provide different recording and handling characteristics.

MAGNETIC TAPE is becoming more and more a part of our daily lives, being used for applications ranging from the highly critical requirements of aerospace research to recording the unique sounds of the latest 'pop' group. This article is essentially concerned with audio tapes produced for professional recording studios and broadcasting stations but also examines some of the ways in which research chemists make a serious contribution to the state-of-the-art in modern recording techniques.

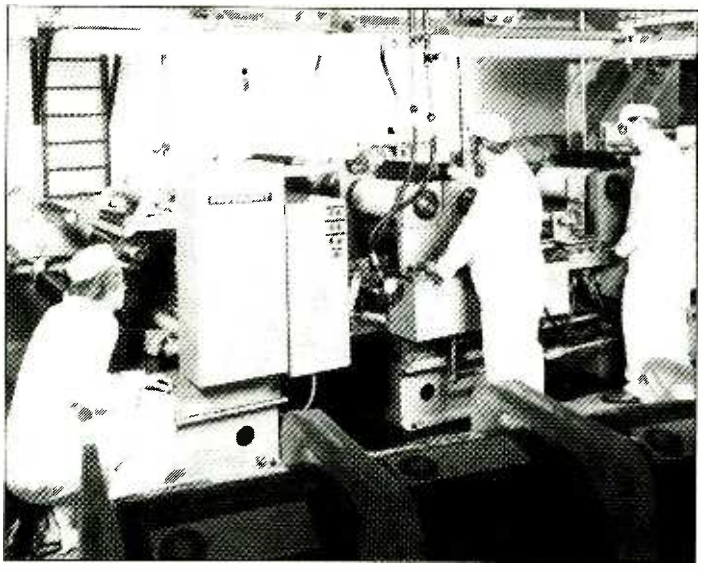
Essentially magnetic tape comprises a piece of plastic support coated with a layer of paint made from rust (yes—common rust) particles with a suitable binding agent. This is then wound on to spools, boxed, and another consignment of magnetic tape goes on its way. Simple isn't it? Let's start again . . .

The first principles of magnetic recording were defined by the physicist Obelin Smith around the year 1888, and the first practical applications of these theories were developed in 1898 by the Danish engineer Valdemar Poulsen who used piano wire wound around a drum and cranked by hand. Subsequently steel tape was used for the recording medium, but one practical disadvantage was that at high speeds it behaved more like a band saw (the tape edge can't have been too smooth) than a recording machine and a few finger tips were almost certainly lost! It is significant that even today, an operator can still get a nasty cut from the edge of a tape running at high speed. Magnetic recording has certainly come a long way since those early days, even if the principles used are still basically the same. But initially progress was marked by fits and starts of inventiveness and a slow acceleration of public interest. One of the very early inventions which hardly saw the light of day was a cotton thread impregnated with iron filings, but in hindsight this was remarkably close to our present modern day concepts.

Paper was reasonably successful as the base material for the iron filings, but suffered from harsh treatment. In 1944 the first modern plastic based tapes appeared, along with the first simple coating formulations. Early formulae were based on gamma iron oxide, modified polyvinyl chloride polymers as binders, and a carrier solvent. Quality was far from being high and deficiencies were only too apparent as the hardware developments imposed more stringent demands on the recording media. The base support, cellulose acetate, a material still well known in the motion picture industry, suffered largely from humidity instabilities and a lack of robustness as it snapped easily. PVC was stronger, but polyester is now the most popular with both manufacturers and users alike. Improvements were also made in the formulation, and the growth of additives such as lubricants, adhesion promoters and stabilisers have created a complex manufacturing process.

Techniques first experimented with in the late 19th century have been refined and improved, gaining acceptance in the fields of entertainment, industry, research and education. Surprisingly, the base material plays a major part in some of the final properties of the tape. Polyester (polyethylene terephthalate to give it the technical name) is immensely strong even when thin and resists stretch, shrinkage and reasonable punishment from heat and moisture. The thickness chosen is a complex function dependent upon the acceptable limits of print-through and the mechanical details of fitting a specific length of tape onto a certain reel size. Polyester base material is usually supplied to the user's specifications in base thickness, width and length. Professional audio tapes use a 35 micron base for standard play and between 19 and 23 microns for long play. The width of the 'jumbo' roll or web varies between 12in and 18in as the ideal size for practical use. Web width is of course a multiple of the end width to be cut, allowing for some edge wastage. Length is also in multiples of the end required lengths, so a 5,000ft reel will produce two 2,400ft reels with an allowance for wastage.

Coating machine with in line polishing rollers producing jumbo rolls

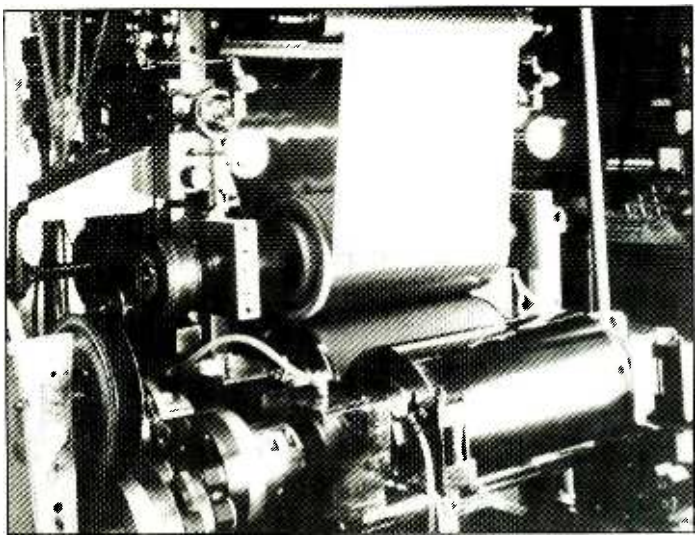


The magnetic lacquer or 'paint' coated onto the base support defines the majority of the electrical properties of a tape. The ingredients used in making this lacquer affect the electromagnetic properties. Other considerations are the thickness of the coating, the length of time and method in which the ingredients are mixed and the subsequent surface finishing. In modern tape technology there are four basic ingredients: ferric oxide, resin binders, carrier solvents, and additives. The most important single constituent in audio tape is ferric oxide and in defining the parameters of the tape, oxide coercivity, shape of oxide crystals, the amount of air trapped between the particles, and the amount of moisture in the oxide

must all be taken into consideration. The size and shape of the oxide crystals have an effect on both the signal-to-noise and signal transfer characteristics while coercivity affects noise, sensitivity and bias. In general a compromise is reached depending on the manufacturer's and user's specifications for the end product. Since a carefully controlled layer of these particles is applied to the polyester base material, some adhesive and dispersive properties are required and these are added to the oxide in the form of resin binders. These binders, primarily chosen for their adhesive properties, flexibility and durability, coat each particle and fuse them to the base.

The final magnetic lacquer must achieve the highest possible degree of purity and on the surface, its manufacture is simply a matter of grinding the oxide crystals with the binder until a regular dispersion is obtained—but this is probably the most difficult process in the whole cycle if the end result is to be top quality tape. A poor dispersion will lead to objectionable tape noise, bad signal stability, low high frequency response and excessive head wear. Several additives are included in modern formulations for specific purposes. For example, the tape must pass evenly across the heads without tape squeal or head wear. This can be overcome in the manufacturing process by adding lubricants such as silicone and tungsten disulphide whilst other additives include carbon which reduces the electrical resistance of the coating and thus reduces the static attraction of dust particles. The end result of additives is improved physical performance of the tape on the deck and fewer drop-outs. As many of the basic ingredients are dry in powder or particle form, it is necessary to use a liquid solvent or carrier agent. The solvent is chosen for its low boiling point and will evaporate during the coating process far easier than water.

The raw ingredients discussed are essentially simple and few in number, but the way in which they are mixed together is of paramount importance. This process is known as milling and the object is to break down and disperse all the ingredients into a lacquer. Considerations here relate mainly to milling time and temperature selection; also to the type of mill and to the milling medium. If the milling time for a given product is increased, a number of parameters will change. Bias noise will decrease, the bias requirement will decrease, high frequency sensitivity will increase, low frequency sensitivity will increase and there would be a degradation in print-through characteristics. Just to give two simple examples, a low print tape requires a short gentle mill whereas a high output tape will require a harsher, more vigorous and longer mill. So even at the start of the process, some compromises have to be made.



Close-ups polishing rollers

Although storage affects the lacquer and must be limited to a minimum, some short term storage of lacquer is necessary. The storage vessels contain more lacquer than required to produce any one batch of tape. In this way there are several lacquer batches blended together at the same time, thus smoothing out batch inconsistencies. Should the measurements, conducted on the final product, show trends away from the midpoint standard, then adjustments are made in following batch additions. Thus the amount by which the batch is likely to vary is very small indeed.

The highly refined magnetic lacquer must now be laid onto the support with a thickness accuracy within millionths of an inch. From large vats of the filtered lacquer, coatings are applied to the washed and surface treated support by one of two methods. The first is to meter lacquer on to the support which is then smoothed and excess lacquer removed. Another commonly adopted technique is similar to offset printing, where the lacquer is transferred under pressure by rollers.

While the coating is still in the wet state, it is necessary to align the oxide particles by using a high powered magnetic field. This is called orientation and achieves a far higher level of uniformity and sensitivity, and is extremely important for multitracking and recording masters. Sensitivity must be uniform in both forward and reverse directions and also in reel after reel of tape. The coated support is then dried in a tunnel oven, evaporating the solvent and fusing the resin binders and oxide particles to the base. Perhaps the single most important consideration at this stage is the coating thickness. Basically oxide thickness is determined by the product required. A high frequency product such as video or instrumentation tape requires a thin coating less than 7.5 micron whereas a low noise low print tape will require a coating thickness between 12.5 micron and 18 micron. Oxide thickness also determines the maximum output available from the tape the thicker the coating, the greater is the recording current required for saturation. Greater thickness also reduces distortion at normal recording levels but requires increased levels of bias. The absolute noise level of the tape is affected by oxide thickness since this is related to the bulk of active material in the replay head gap field at any one time. Modulation or DC noise is related to the density, evenness of dispersion and thickness and regularity of particle size.

Most modern audio tapes are subjected to a second coating process — back coating. Music mastering and stereo broadcasting tapes are required to be wound quickly without leafing in the wind. If a leaf occurs, the tape can easily be damaged when handled. This happens because air is unable to escape fast enough from between the smooth layers during a fast wind. If on the other hand the reverse surface is matt backed, the air will be trapped in the imperfections of the backing, resulting in an even wind. Again, a compromise is required, the back coating must be rough enough to trap the air but not too abrasive. In addition, a rough backing can cause print-through during storage of the tape due to the imprintation of the backing on the oxide surface, and any tendency of the backing to shed will result in drop-outs.

The manufacturer is left with his final variable—surface polishing. By glazing the oxide surface to a greater or lesser degree, the manufacturer can alter frequency response, bias requirements, sensitivity, noise, print-through, signal stability, head wear, tape wear, tape friction and winding properties. Extensive research has been devoted to surface finishing and this is one area where the effects on product performance have become more clearly defined during the past few years. This high degree of surface finish is obtained by calendering, the tape being compressed between two rollers, one chrome and one paper roller. In general, the higher the pressure the higher the surface finish. Over polishing, however, can result in oxide break-up. If the surface is correct, head contact will be good resulting in an excellent high frequency response. A compromise on surface finish must therefore be made in order to obtain the best high frequency response without causing drop-outs.

Until now, all operations have taken place on the 'jumbo' roll or web which now has to go through a slitting process to produce the required end product widths. This is an easy choice for the production controller since he knows the exact configuration that the user wants. It is not however such an easy task, for the engineer who has to prepare the slitting equipment, partly because of the precision required and partly because of the number of different widths that may be required- ¼in, ½in, 1in and 2in, to say nothing of metric cassette widths. To ensure straight edges without even microscopic debris or damage, is a precision task. With the addition of tension controls, microsteering, cleaning and inspection stations, modern slitting machines would hardly be recognised against earlier counterparts. The continuous movement towards more recording tracks of narrower size, slower speeds and higher frequencies, imposes new demands to raise the level of slitting technology, if skew and cyclic output variations are to be contained and edge track stability maintained.

Tape of required width, with or without coloured leaders and trailers is now wound onto the spool at precisely controlled tensions. Another variable here – the spool. Plastic spools tend to be light and cheap, but suffer from lack of rigidity. Normally any tape over ½in in width is wound on to a semiprecision, balanced metal spool. The spools must have cut-outs to show the tape, but too many cutouts can result again in a lack of rigidity and support. 54 ▶

From Rust to Tape

The final stage of manufacture is carried out in the test area where visual and electrical inspection ensures that the manufacturer has produced a tape conforming to his own and the industry's standards. Test equipment used is industry compatible and some of the finest available. Considering the many stages of production necessary to obtain a consistent product, the measurements which have to be carried out must be of a very close tolerance indeed. Due to the very specialised nature of the industry much equipment is manufactured in-house and there are BH loop (hysteresis curve) testers, infra-red spectrometers, humidity and temperature cycle cabinets, spectrum analysers, XY plotters and pen recorders. There are any number of high quality tape transports to check all the parameters which we have listed as variables. Small variations in the production process can cause large variations in the end product. A good example is coating thickness variation. Should the thickness vary from the optimum and become too thick, the product's bias requirement will be high, distortion will improve, noise will become worse, 1kHz sensitivity will improve and high frequency sensitivity will deteriorate.

In addition to the careful scrutiny given to the tape in the test area, additional checks are carried out by an end of line inspection team. The members of this team select random tapes from each finished production batch, covering the width and length of the 'jumbo' roll. These tests ensure that the production and quality control processes have all been carried out and that the finished product is of a consistent high quality. Only now can the tape be electrically erased, sealed in an airtight polythene bag, put into its box and sent to the warehouse for onward delivery. Going into the Racal-Zonal warehouse are a range of three professional audio tapes designed to meet the needs of a very discerning market. This is because we have identified each user and the compromises necessary in the 'trade-off' principles to produce a specific product. In common with other high output/low noise tapes, print-through is to some extent sacrificed while conversely high frequency sensitivity must be sacrificed to achieve a good low print tape. There are of course some parameters that are never traded off—these being the physical specifications.

The professional recording studio industry, if invited to write their own specifications would differ vastly in their requests from broadcasting organisations and duplicating houses. From the wide range of independent variables, we have combined and permutated to produce a range of tapes to suit all professional users. This range includes ¼in, ½in, 1in and 2in widths and covers all audio applications including music mastering, broadcasting, duplication and telecommunications logging. In addition, within the product range there are tapes designed with extremely low print-through characteristics for applications such as speech mastering and for location recording on portable recording equipment. Racal-Zonal also produces a range of low noise/high output audio cassettes.

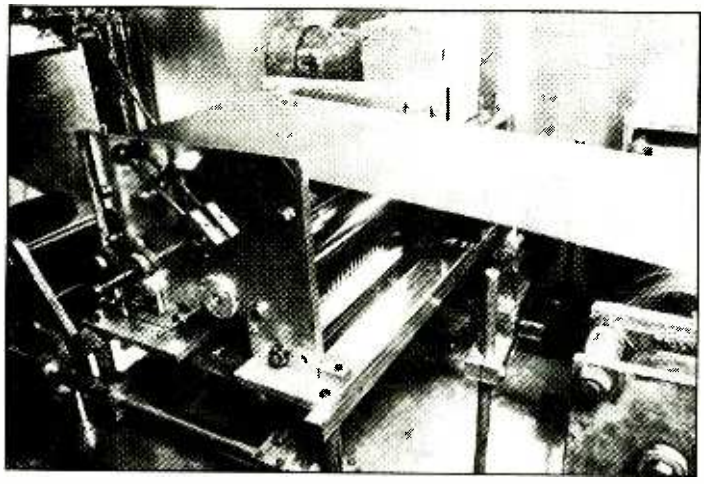
In the production of precision magnetic recording media for professional users, quality control is of paramount importance and the manufacturer takes this seriously at every stage of manufacture. From the intake of raw materials to a check on the seal of the polythene bag and the identification on the box, each vital stage of the process is subjected to the same critical appraisal. My company employs one quality control engineer for every five production workers, and quality control staff include chemists, physicists, and mechanical and electronic engineers.

Quality control starts with the basic raw materials, checking for impurities in the chemicals. Base rolls are subjected to checks of surface roughness, tensile strength, cleanliness and distortions. Spools are checked for accuracy, rigidity and balance. Constant samples are taken from each mixture of lacquer to check for the correct viscosity and even dispersion, before releasing the batch to the coating operators. Coating operations are carefully controlled to ensure complete adhesion of the lacquer to the base material and even coating thickness. Surface finishing is checked for under or over polishing and cosmetic defects. Samples are taken of the slit product to check for accuracy of slitting, cleanliness of the cut edge, and even the correct width. Any deterioration in the slit edge quality will result in the slitting blades being reground and realigned as poorly cut edges can cause drop-outs and skew. Even testing is subject to quality control to ensure that electronic equipment does not drift and that testing methods and bias requirements are correct, and standards are met.

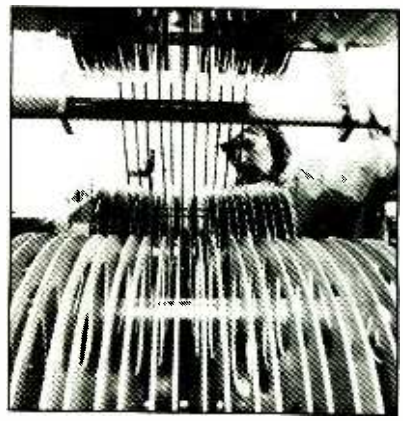
Although the basic processes appear straightforward, the setting of parameters and controls is a highly expensive, complex and challenging task. The enforcement of rigid control disciplines is obviously desirable in any industry, and this principle is an essential criterion in the manufacture of reliable magnetic media where there is the narrowest of thin lines differentiating between the compromises and optimisations of product specifications and process formulation. However, thanks to electronic and mechanical in-line process controls, manufacturers are no longer so dependent on the watchful but sometimes erring eye.

The foregoing is an indication of the complexity and sophistication of the magnetic tape manufacturing process. Visually, this process has changed little for over a decade and at first sight it is still an art rather than a science, and the results of countless hours of research and development are largely unseen. In the early years, the process itself was crude, and so required a considerable amount of development and improvement. The latest range of manufacturing equipment, process techniques and quality control has probably reached a stable point in its development.

Orientation of magnetic coating (while wet) over fixed magnet



Final tape spooling.

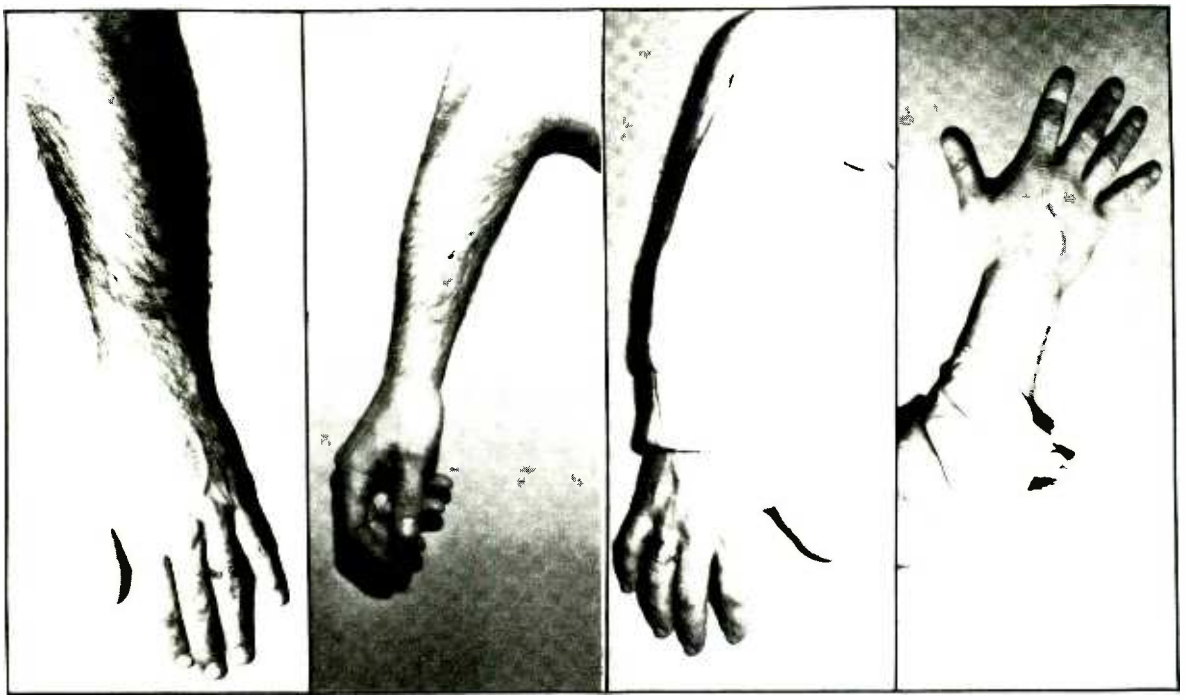


A major portion of Racal-Zonal's effort is now in the search for new and improved lacquers in order to provide optimum recording/playback characteristics whilst keeping head wear to a minimum. Inherent in these investigations is the study of emulsifying techniques and coating properties of new lacquers. Each product area requires a different formulation of lacquer in order to present the best magnetic properties relevant to individual applications, each of which is the subject of separate research programmes. All new formulations must be carefully tested and evaluated over a long period before being released for the manufacture of new products.

The audio tape industry is highly competitive and technologically innovative—so what of the future? The audio recording industry is rapidly changing towards digital recording techniques and Racal-Zonal already has a range of products suitable for digital applications—from cassettes and diskettes to open reel recording tape. This technology is constantly being updated and present ranges of products offer frequency responses far in excess of normal analogue recording (in excess of 1MHz). Digital recording does not suffer from the wow and flutter problems of normal audio tape transports and precise bit timing enables spot-on synchronisation of multiple recorders, if required. There are analogue/digital converters available and microprocessor chips are becoming far cheaper and more varied in their applications. Standard telephone cables can be used for the transmission of digital encoded information, with no subsequent loss of quality.

We have not yet reached the ultimate and so there are still many avenues open to magnetic tape and hardware manufacturers to improve standards. ■

Sound Workshop introduces its arms.



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digits

Into the Digital Studio Domain: Part One

P Jeffrey Bloom (Polytechnic of Central London)

In this, the first of a two part article providing an introduction to the totally digital recording studio of the future, P. Jeffrey Bloom, a research fellow in the Signal Processing Group at the Polytechnic of Central London, examines the advantages of digital signals and recording.

IT IS A unique period in the history of audio recording. In the last two years, multitrack digital audio tape recorders have become available which offer performance specifications far superior to those available from the best conventional (analogue) recorders. Digital signal processing technology, which is almost totally incompatible with the analogue processing and mixing systems in use throughout the recording industry, now offers widespread and almost unbelievable improvements over the analogue systems currently in use.

This article is an introduction to the fundamental principles involved in implementing an all-digital recording studio. By an all-digital studio we mean a studio in which not only are the audio signals recorded in a digital format, but are processed, edited, and mixed digitally as well. Efficient and intelligent deployment of digital signal processing technology in the studio environment can provide three major reasons for promoting a total transition because an all-digital studio offers 1) *subjective* (perceivable) improvements, 2) *practical* improvements, and 3) eventual (if not immediate) *economic* improvements, over current analogue studios.

Advantages common to all-digital signal handling devices, among which are these:

1) The process of digitising a signal makes the recorded signal much more immune to degrading effects inherent in various signal transmission, manipulation, and storage processes.

2) The entire range of digital signal processing techniques may be applied directly to such (digitised) signals.

3) The flexibility, overall control, and automation of a processing facility (such as a recording studio) may substantially be increased by the shrewd use of digital signal processing architecture.

Because the above points require discussion of such a vast range of topics, this article will appear in two parts, the first discussing the subjective and practical benefits which result from digitising audio signals and recording digitally; the second introducing the principles behind digital signal processing techniques.

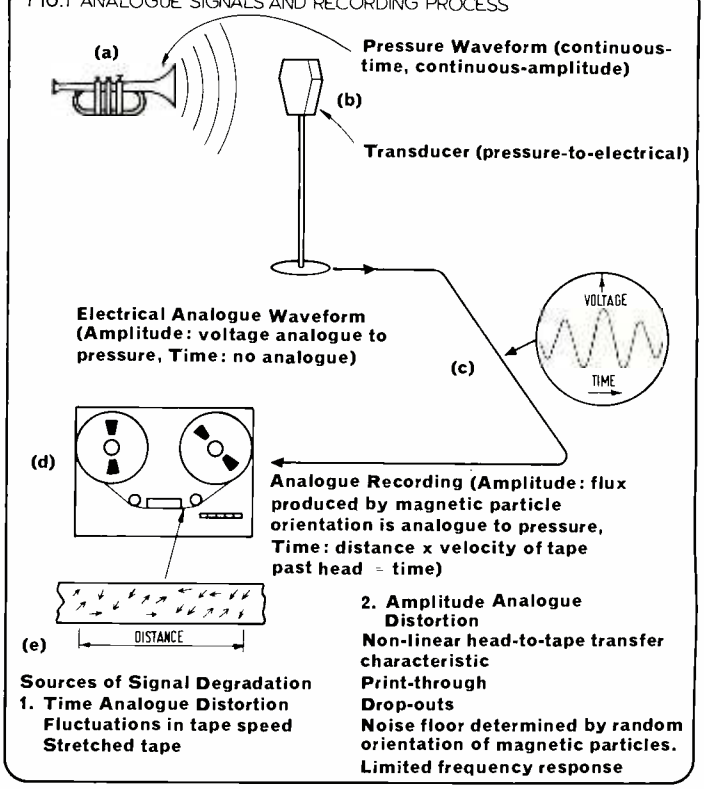
Naturally, in an introductory article such as this, a thorough discussion of any of these topics is impossible. But an enormous range of literature is readily available to the interested reader; in particular one should consult the latest convention literature and journals of the Audio Engineering Society, and the IEEE Transactions on Acoustic, Speech and Signal Processing.

Analogue signals and recording

In general, analogue signals are continuous time, continuous amplitude representations of other continuous time, continuous amplitude signals. In such signals, analogies are created between one or more of the physical characteristics of the original waveform and those of the new waveform. In audio we are primarily concerned with representing acoustic phenomena with analogue signals created in transducers, electrical networks and in recording media. For example, an ideal microphone creates a signal whereby a continuum of output voltages is an analogue to the continuum of pressure changes originally present at the microphone diaphragm (**fig 1a-c**). Note that in this case, as in the case of most transducers and electrical networks that only one analogy is created, and that is between the input and output signals' amplitudes. No analogy is needed for the characteristic of time. Consequently, most problems encountered with analogue transducers and networks are generally a result of deviations from a linear input/output amplitude relationship.

In conventional analogue recording processes, however, two analogies must be created—one for amplitude and one for time. It is equally important to recognise that in analogue recordings, both the continuous amplitude and time characteristics of the original signal

FIG.1 ANALOGUE SIGNALS AND RECORDING PROCESS



must be represented by physical characteristics of the new medium which are also continuous. For example in tape and disc analogue recording, time is represented by increasing linear distance along the recording tape and by a non-linear distance along the groove on the disc. In both cases, distance being a continuous quality, provides a convenient and continuous analogue to time. The amplitude of the original signal is impressed into a second continuously variable property of the recording medium. If this is done properly, all possible levels of the original signal's amplitude (within a restricted dynamic range) can be represented continuously and uniquely. Thus, an analogue recording can *ideally* provide a near perfect representation of the original signal.

Unfortunately, in practice, all analogue recording techniques become susceptible to two general classes of problem: those which affect the recording medium's analogy to the original signal's amplitude characteristic and those which affect the analogy to time (**fig 1d, e**). The classical terms which describe the measured performance of the complete recording and playback process (frequency response, signal-to-noise ratio, wow-and-flutter, etc) exist mainly to quantify different aspects of the recording chain's departure from preserving the exact time and amplitude relationships present in the original signal. Currently, these figures indicate that the analogue recording techniques are far from ideal.

Analogue recordings also suffer from localised and/or widespread degradation of the recording medium commonly termed drop-out. This is, once again, a result of the fact that time is inextricably associated with distance along the recording medium; consequently if the medium is damaged at some point, the signal's amplitude will be corrupted at the moment(s) in time represented by the damaged area. Moreover, very few (if any) analogue techniques exist to detect signal degradation resulting from medium-based defects or to recover the original signal waveform. It is not difficult to understand why analogue transducers and electrical networks can generally be made acceptable on a subjective, practical, and economic basis; but few analogue recording devices available are successful in all these categories simultaneously. However, in the last year or two, a radically different approach to the problem of improving audio recording has been developed to the point where it now appears to be vastly superior to any analogue technique. This new method has come to be known as digital audio recording.

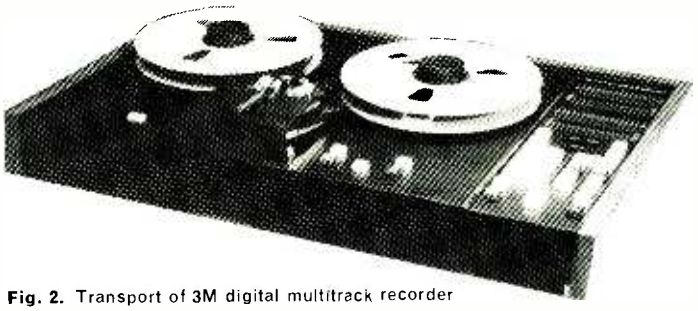


Fig. 2. Transport of 3M digital multitrack recorder

Digital signals and recording

Digital audio recording is actually just a form of digital data recording which the computer industry has been steadily developing for roughly 20 years. Recording audio digitally was not really a simple step to make namely because there were no satisfactory methods for converting analogue signals to high quality digital ones until the early 1970s. Other technical difficulties existed because the rate at which information had to be handled was extremely high; moreover, unlike typical computer data which can be neatly subdivided into 'blocks' of data, audio signals run continuously and require careful distribution in the recording media. Although these problems may not seem difficult to the layman, over five years passed between 1972—when the first digital audio recorders were publicised; and 1978—when half a dozen professional digital audio recorders clearly presented serious competition to the best analogue techniques.

Today a number of high quality digital audio recorders are on the market and are just beginning to make their way from the laboratory into the recording studio (**fig 2**). **Table 1** lists most of these and also presents the typical performance specifications that are quoted for most of these machines. Note that the large dynamic range is achieved *without* noise reduction. These impressive specifications often raise the question of how it is possible for a technology in its infancy to gain superiority over a technology that has been in development for over 100 years? The answer of course lies in the fact that in digital audio recording; the information describing the audio signal is converted or coded into (as the name implies) a *digital signal*. It is this digital signal which is then used to systematically modulate the recording media[2,5]. This is a significantly different approach from attempting to store a continuous time, continuous amplitude 'image' of the audio signal.

However, it is recommended that readers who are unfamiliar with these basics or who desire more details consult references[1,2,3] for a more thorough explanation.

Conversion basics

Analogue-to-digital conversion is based upon two critical and separate processes: *sampling* and *quantisation*. Sampling simply requires measuring the amplitude of the analogue waveform periodically and this generates a set of equally-spaced (in time) samples which are known as a discrete time series. Furthermore, between each instant when the samples are taken, the signal's fluctuations are ignored **fig 3**. Although one might intuitively feel that something is lost in this process, it is well known that virtually all frequencies from DC to one-half the sampling frequency can be preserved and resynthesised in this process.

In spite of the fact that sampling breaks the continuous dimension of time into discrete events, the sample still reflects the continuous nature of the signal's amplitude. Therefore, the process of quantisation is used to break a limited range of continuous amplitude values down into a finite set of numbers where each number represents a small and unique range of the possible amplitude values. The rules by which the numbers are assigned to the range of amplitude values are arbitrary, but the most common and useful ones (and the ones which will be referred to in this article) are those which associate equal increments (or steps) of amplitude with linearly increasing (or alternatively decreasing) binary numbers, **fig 4.** Binary numbers are used, of course, because they are constructed only from 1s and 0s and are thus compatible with the number system (and circuits) used in computers.

When a signal is quantised because amplitude fluctuations smaller than one-half the smallest step size are ignored, some information related to the signal's amplitude will necessarily be lost and this places a constraint on the maximum signal-to-noise ratio. When an N-bit binary work is used to represent any of the 2^N equal and linearly increasing possible amplitude steps, the resulting maximum signal-to-noise ratio is approximately (N x 6dB).

In the ideal digital-to-analogue conversion process, the stored series of binary numbers are fed into a device which creates an appropriately scaled series of analogue samples, **fig 5.** In practice, the original (quantised) input waveform can be reconstructed almost exactly (except for a slight high frequency roll-off owing to the amplitude characteristic of the reconstructed signal between the output sample values).

Also to ensure that frequency components exceeding one-half the sampling frequency are excluded from the input and output, the conversion chain must be preceded and followed by analogue low-pass filters, **fig 6.** However, since such filters are not ideal (lack perfectly sharp cut-off characteristics) unwanted frequency components and other sources of errors can arise. There are many other subtle sources of errors in the conversion processes — some of which are not yet clearly understood—that can cause significant and perceivable degradation to the input signal.

In spite of these technical difficulties, A/D and D/A converters are available which can re-

Table 1

Existing Digital Audio Tape Recorders

Manufacturer	Digital Audio Channels	Converter Quantisation	Sampling Frequency (kHz)
Mitsubishi	2	15-bit linear	44.05594
3M/BBC	32	16-bit linear	50.0
Nippon Columbia	8	14-bit linear	47.25
Sony	2 to 48	16-bit linear	44.056 / 50.350
Soundstream	4	16-bit linear	50.0
Technics	2	12-bit log	49.152
Toshiba	2	14-bit (floating point)	50.0
Ampex	4 to 48	16-bit linear	50.0

Typical Performance Specifications

Frequency response:	DC-20kHz (±1.0dB)
Dynamic range: (quantiser dependent)	90dB (max signal to noise) (16-bit systems)
Harmonic distortion:	<0.03%
Wow and flutter:	Unmeasurable
Cross talk:	<85dB
Audio print through:	Non-existent
Residual signal after erasure:	None

Into the Digital Studio Domain

spectively sample or reconstruct signals at greater than 50,000 times per second; and claims are being made that at this rate, 16-bit linear accuracy (theoretical maximum dynamic range of 96dB) is being (nearly) achieved. The measured figures for such systems generally indicate a flat (±0.75dB or so) frequency response from DC to 20kHz and a maximum dynamic range of about 90dB. These figures can be compared to those specifying the perceptual limits of the human ear, which typically has a frequency response of less than 20kHz and a dynamic range (from threshold to pain) of roughly 120dB. In doing so one could conclude that in normal living room listening conditions (where the ambient noise-level is around 40dB) the current performance of a high-quality A/D/A conversion system is nearly at a stage where a great deal of further improvement would normally be imperceptible. Nevertheless, there are no (published) figures to support this. In fact, there has not yet been enough subjective testing of digital conversion systems to be able to state clearly which objective measurements correlate with perceivable distortions. This situation should change in the near future as public interest grows.

Advantages of digital signal

We are now in a position to return to the main discussion and take up the question of what is gained by the digitisation of audio signals besides the high quality of the converted signal? The basic answer to this is fairly straightforward, yet the implications are profound and widespread.

First, the explicity association that each waveform sample has with the time at which it was taken has been severed; consequently samples can be processed, stored, duplicated, or clocked into an output (D/A) converter completely independently from one another. It is this latter possibility which allows digital tape recorders to have virtually no timing distortion (wow and flutter). Secondly, the period of time which exists between samples —as brief as it is—is long enough to permit high speed digital electronic circuitry to do a variety of rather astounding things, which we shall discuss next month.

Generally speaking, sampling an analogue waveform, and escaping from the continuous time nature of signals, is the real 'secret ingredient' in digital signal processing—time is now a parameter of the signal that can be 'manipulated' and used advantageously.

Similarly, converting amplitude measurement into a single, well-defined number of quantisation provides its own set of advantages. Since the numbers are predominantly coded in a binary format (ones and zeros) the data can be made portable and robust. This is because the 'one' bits making up the binary words are generally made clearly identifiable from 'zero' bits and any noise by using well separated voltage levels (such as +5V for 'one' and OV for 'zero') or some other sufficiently distinctive physical characteristic. Thus it is quantisation of the sampled signal's amplitude which permits transmission, storage, and repeated duplication of the original digitised signal with no degradation provided sufficient care is taken. Sufficient care means that in situations where the binary word is potentially altered, special measures (developed in the computer and telecommunications industries) must be adopted to detect and correct any errors.

Error detection and correction in digital audio is not a trivial problem as a typical example will illustrate. If say a 16-channel digital recording is desired where each channel is receiving 16-bit words at a minimum rate of 40kHz, the equipment would be handling over 10 million bits per second. Recording a 30 minute concert with this arrangement, means over 18×10^9 (18 thousand million) bits need handling, hopefully without errors!

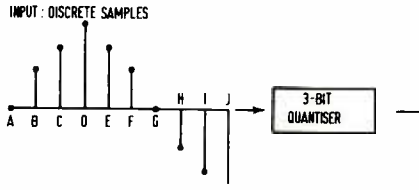
Because recording digital audio (at present) depends on techniques which are in part analogue and also on mechanical devices, errors will inevitably occur during record and/or playback. An error results if a bit (and consequently a digital word) is lost, received incorrectly, or decoded improperly. In digital tape recording where the bit density is very high, hundreds of consecutive bit errors can arise as a result of tape drop outs of particulate matter imbedded in the tape; and single errors can also be expected on a statistical basis from any of a number of causes.

A digital signal can be 'protected' from errors by first systematically re-ordering the incoming bit stream and dispensing consecutive samples (or bits) over a much larger region of the tape than can be affected by a typical drop out. (Note that a continuous signal could never be treated this way!) Furthermore, additional bits are added to the original signal data (according to a well defined set of rules based on the initial bit values).

During playback, these extra bits are examined by special digital circuits for local 'correctness', so that as the scattered data comes in bit-by-bit (so to speak) the signal can be reconstructed in moderately long segments. Each segment can be held back until the checking or correcting is complete. Then the segment of error free data can be clocked out, one word at a time, while the next segment is being checked and reconstructed.

60 ▶

FIG 4a **Quantisation of the discrete samples taken in fig 3. The quantiser's input/output rule (characteristic) is given in:**



INPUT SAMPLE	BINARY OUTPUT
A	100
B	101
C	110
D	111
E	110
F	101
G	100
H	010
I	001
J	000

FIG 4b **The output from the quantiser is the three-bit binary number shown in the table.**

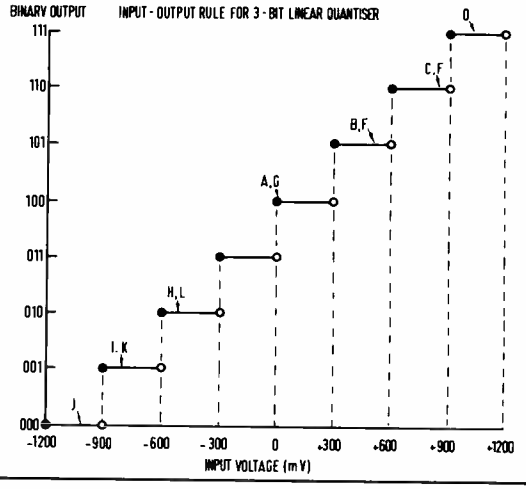
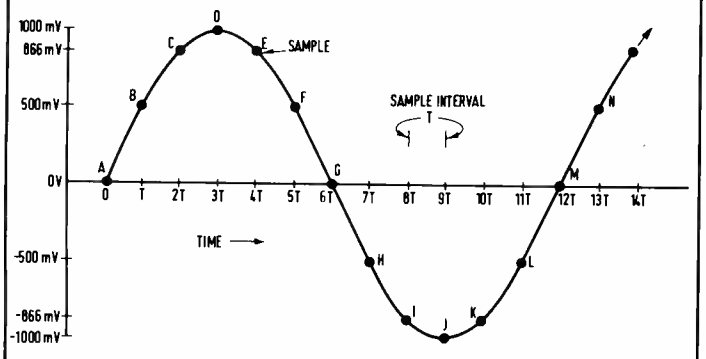


FIG. 3 **Sampling an analogue waveform: in sampling, the continuous waveform is measured periodically at intervals of T, as shown by the lettered dots. The sample's amplitudes are shown in the table.**



SAMPLE	TIME	SAMPLE AMPLITUDE	SAMPLE	TIME	SAMPLE AMPLITUDE
A	0	0mV	H	7T	-500mV
B	T	500mV	I	8T	-866mV
C	2T	866mV	J	9T	-1000mV
D	3T	1000mV	K	10T	-866mV
E	4T	866mV	L	11T	-500mV
F	5T	500mV	M	12T	0mV
G	6T	0mV	N	13T	+500mV

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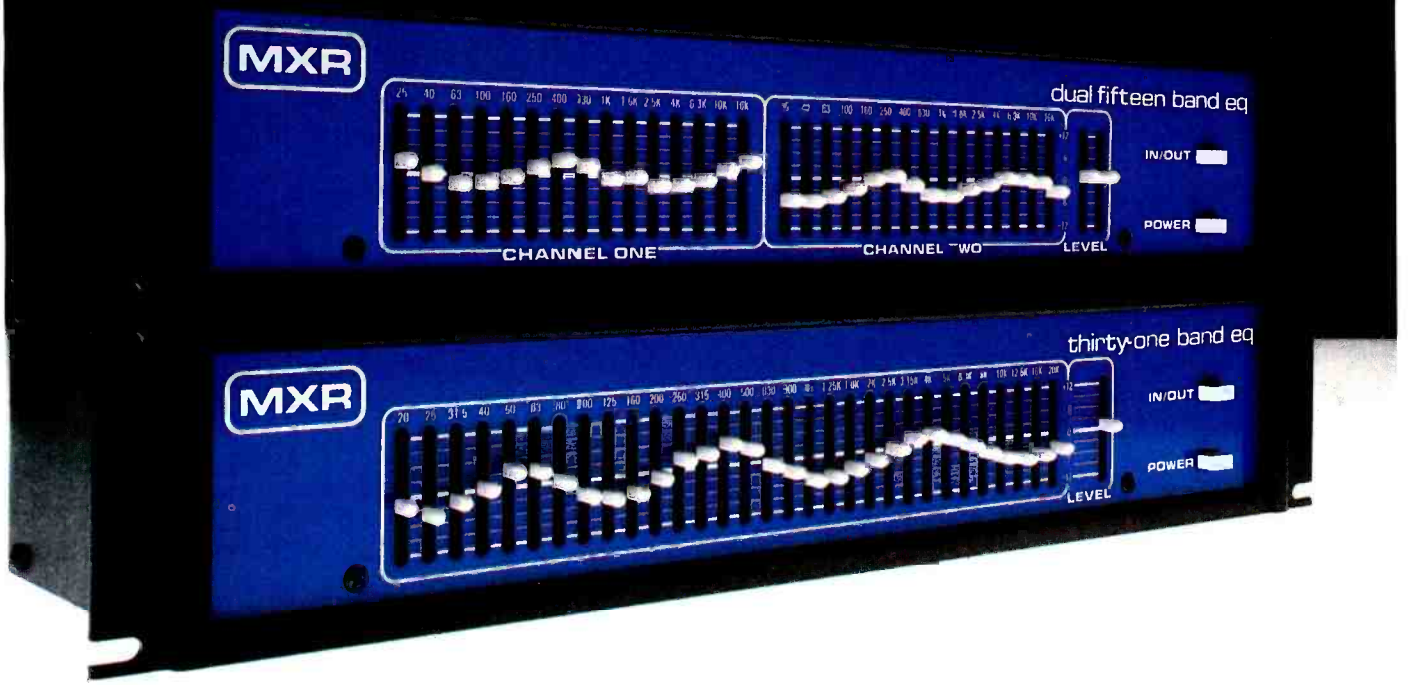


Into the Digital Studio Domain

The 'cost' of decreasing the error rate is having to handle even more data at faster rates either using more of the recording medium or packing the medium more densely with information. However, most users would accept this as a very small price to pay for having an output signal which is precisely the same as that which left the A/D converter.

The missing link

Thus far we have made a case for using digital audio signals by pointing out that this will dramatically improve the subjective quality of audio recording/playback systems, as well as provide practical improvements over analogue methods for transmitting, duplicating, and storing audio signals.

At this point, however, it is extremely instructive to divert our attention briefly to the consumer market, for there one also finds devices designed to play and record digital audio material. Especially exciting are devices using a laser scanning technique to read back (or record) digital audio signals which have been optically encoded on specially processed discs.

Currently, around a half dozen companies are involved in developing such laser played audio devices, as well as digital audio recorders and cassette machines for home use.

What is immediately lacking is a widely available means by which multitrack digital recording can be processed and mixed down digitally to generate digital master tapes, whose contents can then be transferred (digitally) onto a medium (such as the digital audio discs or digital cassettes) for mass distribution. Of course, if people were satisfied with merely recording audio in a digital format and reproducing it accurately, there would be little difficulty in doing exactly that now with the new equipment just mentioned. But the fact is, very few of today's artists are satisfied with (or are capable of) producing an entire record without some sort of editing or processing of the original recorded material. Consequently there is an increasing demand for a system capable of processing, mixing, and editing digitised audio signals to the satisfaction of the artists, producers and, ultimately, the public. Moreover, because current recording techniques generally employ so much 'close-miking' of instruments, it is only reasonable to expect that a great deal of control and manipulation of the raw sound from a microphone will be as necessary in future systems, as it is today.

One perhaps obvious (and commonly suggested) approach to filling this gap is to record multitrack audio digitally and then convert the digital signals back into analogue for processing devices. Then the mixed analogue output from the console would be reconverted back into a digital format for storage and copying. For reasons which will soon be more fully appreciated, this approach while possibly justifiable as a very temporary solution, is ultimately unnecessary, degrades the signal quality and wastes many of the advantages gained by the initial conversion. Moreover, the processing cannot be so extensively, precisely, and efficiently controlled (and automated) as with the digital processor which we will be describing in Part Two next month.

For these very practical reasons (which will be elaborated upon next month) it would seem very reasonable to encourage the development of all-digital recording studios. Of course, two more crucial factors must be considered —is all the necessary technology available, and if it is, will it be prohibitively expensive?

The first question can be dealt with more easily, and at the same time give information related to the question of economics. All digital devices, whether used for control or processing purposes, are constructed primarily from integrated circuit packages (chips). Several remarkable (and fortunate) trends seem to accompany the rapid development of digital integrated circuit technology. Especially noteworthy are the following: with successive generations of IC's, enormous increases in functional power are appearing in smaller and smaller packages that are faster in operation, consume less power, and are more reliable and cheaper than their predecessors. For example, the number of components that could be squeezed into a 0.01in square area increased by nearly 1,000 times between 1962 and 1973. This, along with other factors, has led to a halving of the cost per function every year. Similar trends are taking place in digital memory chips as well, which is crucial for signal processing as we shall see later[4].

Because digital audio involves such high quantities of data at very high data rates, digital audio processing requires some of the fastest most complex and consequently most expensive of the most recently developed IC's. Prominent among these is the digital hardware multiplier chip, which performs an absolutely essential function in signal processing. As its name implies, it multiplies two digital words together and outputs their digital product. Whereas such a device was not even available five years ago, there are now single chips capable of performing around six million 16 x 16 bit multiplications per second.

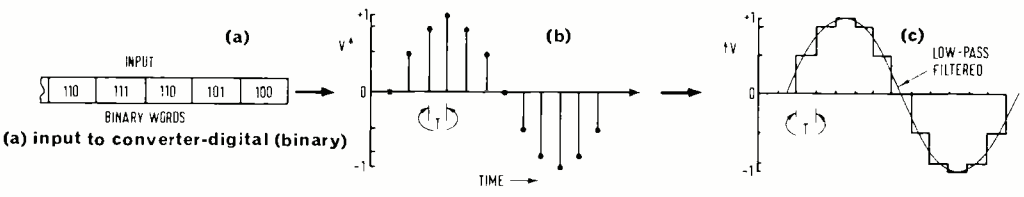
It is upon advances in hardware like this (as well as in converters) which has made it reasonable to wait to build the special purpose processing devices required in an all-digital studio. But now all the hardware components needed to build prototype systems exist, and the actual cost of the components will be only a small fraction of the total cost of development. The major costs will most likely be incurred in the initial design, construction, testing and programming of the required equipment.

In Britain for example, it is fairly well known that organisations like the BBC, EMI and Decca have been quite active in developing digital audio equipment. However, the actual evidence of such work is quite scarce (although this is fairly understandable considering the commercial potential of any successful research).

Nevertheless, it is very likely that in as little as two to three years, digital mixing, editing, and processing facilities will be available to the professional audio industry.

In the next part of this article, we will discuss the many practical advantages of using digital signal processing in the studio environment and also take a brief look even further into the bright future of digital audio. ■

FIG.5 **Digital to analogue conversion process:**

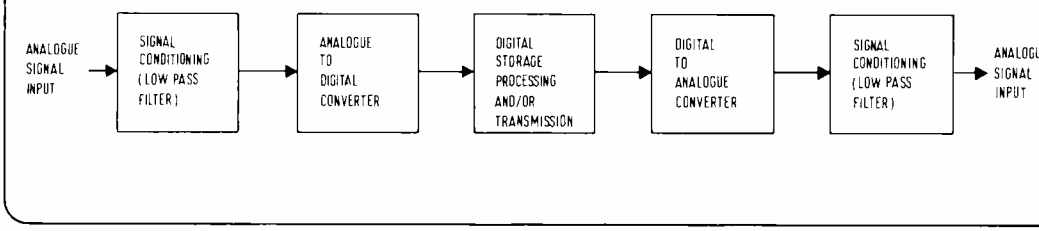


(a) input to converter-digital (binary)

(b) voltage samples created every T seconds. This waveform would result from an *ideal* D/A process

(c) typical output from read D/A converter (heavy lines). The converter creates a slight attenuation of high-frequencies. The lighter line indicates the output waveform after lowpass filtering.

FIG.6 **The complete analogue-to-digital-to-analogue chain**



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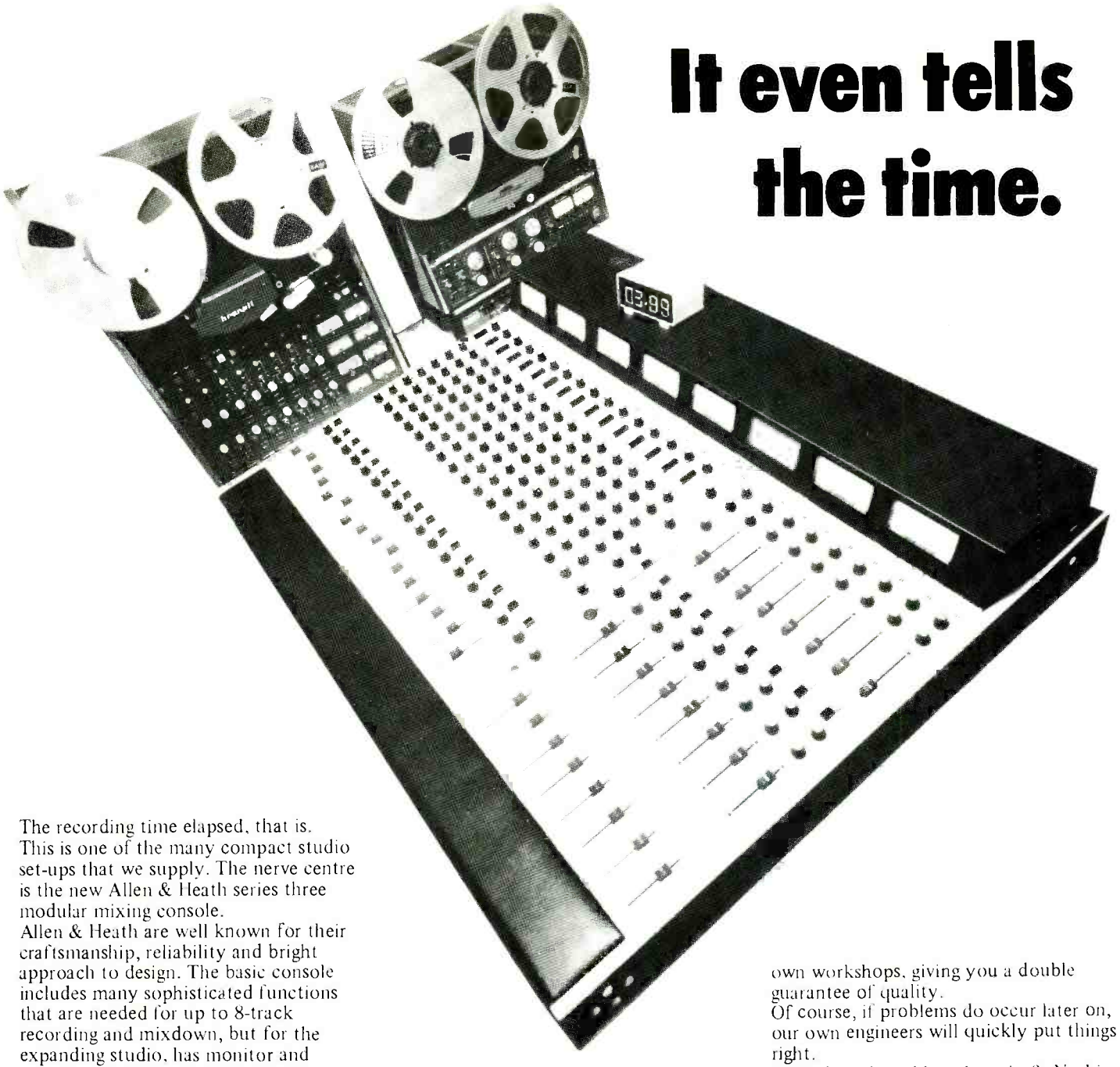
(2) B. A. Blesser and J. Kates, 'Digital Processing in Audio Signals', in *Applications of Digital Signal Processing*. A Oppenheim (Prentice - Hall, Englewood Cliffs, NJ, 1878), Chapter 2.

(3) T. G. Stockham, Jr, 'A-D and D-A converters: Their Effect on Digital Audio Fidelity' in *Digital Signal Processing*. L. Rabiner and C. Rader (IEEE Press, New York, 1972).

(4) T. R. Blakeslee, 'Digital Designs with Standard MSI and LSI' (John Wiley & Sons, New York, 1975) Chapter 1.

(5) R. B. Warnock, 'Longitudinal Digital Recording of Audio', *Audio Eng Soc 55th Convention*, Oct 29-Nov 7 (1976), preprint No 1169 (L-3).

It even tells the time.



The recording time elapsed, that is.
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ADRIAN HOPE

Spoof tapes

Here's a prophesy for Christmas 1979: no-one from the *Sunday People* newspaper will be invited to any private parties at the BBC or ITV. Why? For the 1978 get together, the BBC and London Weekend had put together some spoof video tapes which for instance had Princess Anne interviewed by sports commentator David Coleman. "Have you ever encountered sex?" asks Coleman. "I think I may have done. I think I have done, on one or two occasions, but I'm not quite sure", replies Princess Anne. It was of course a clever edit job. Coleman was originally asking a sportswoman if she had ever encountered sex discrimination and Princess Anne was replying to some equally innocuous question.

It was all good clean private fun until the *Sunday People* made it a front page story tagged by the inevitable moral cop out; a BBC spokesman was quoted as saying that she found "the whole idea distasteful". What a pity they don't make ENG cameras small enough for a BBC or ITV man to sneak one into the *Sunday People's* office party next Christmas.

Pioneering FM

JUST 25 years ago this month, on March 6 1954, the world's first FM station, call-signed W2XMN, went off the air after 16 years continuous broadcasting without any advertising subsidies. No that isn't a misprint. W2XMN, based at Alpine, New Jersey some 17 miles from New York, started regularly scheduled FM broadcasting on July 18 1939. The station only went off the air because its mentor Major Edwin Howard Armstrong, the inventor of FM, had committed suicide. On the night of January 31, 1954, Armstrong just walked out of the window of his 13th floor apartment at exclusive River House in Manhattan, bowed down with frustration over the legal problems centering round his master patents on FM. To cut what is a horrendously long and complex story short, at the time of his death Armstrong had no less than 21 legal suits running against RCA, Motorola and other radio and TV set manufacturers.

Armstrong had built the Alpine Heights FM transmitter with his own money, and some of it with his own bare hands, following an earlier squabble with RCA. He first made FM work in 1933 and the next year had been allowed to take over the NBC experimental TV station on the Empire State Building in New York. Using a 2kW FM transmitter on 44MHz, Armstrong disproved once and for all the folklore belief that VHF radio reception would stop abruptly at the horizon, which is 45 miles from the Empire State. He succeeded in transmitting static free radio to Haddonfield in New Jersey, a distance of 85 miles. In November of 1934 he even multiplexed four different programmes onto a single carrier—music on the main channel, a facsimile on a super audible subcarrier on a second channel, a synchronising signal for the facsimile on a third and a telegraph channel on a fourth subcarrier.

But even these successes could not compete with the lure of television, the nation's new toy. Armstrong and his equipment were ordered out of the Empire State Building. This is how the Alpine Heights transmitter was born. Armstrong, a millionaire shareholder in RCA (thanks to earlier inventions such as the superhet) sold a block of stock and spent $300,000 constructing the 400 foot tower at Alpine. The first programme went out at 4 o'clock on the afternoon of July 18, 1939. Apart from a brief silence that evening, caused when an insect crawled into a transformer, short circuited the power and caused a twenty second trip, all went smoothly. Gradually Armstrong achieved what he had set out to achieve. Albeit at his own expense, he gave a small cross section of the American public a chance to judge for themselves what FM radio had to offer. At the time that Alpine first went on the air, there were only 25 FM receivers in existence, all built by General Electric at a cost to Armstrong of around $10,000 and distributed free to his friends. But within a year there were 150 applications for new FM stations on file at the FCC. After the inevitable war hiatus, the FCC decided to shift the FM broadcasters from the original low frequency bands (around 40MHz) up to the bands between 88 and 108MHz, where of course FM radio still remains. Armstrong and his colleagues fought bitterly against this frequency shift arguing that the right place for FM was between 42 and 56MHz and the right place for television was upstairs in the higher VHF bands. Shortly before his death, Armstrong was still referring to the FCC frequency shift decision as "one of the colossal engineering blunders of the century". It's an interesting thought—was Armstrong or the FCC right? If FM were today downstairs at between 42 and 56MHz would we bless or curse Armstrong for it?

Even though the frequency shift, for better or worse, obsoleted the half million or so FM receivers already in use, FM became the craze. By 1948 there were 404 FM stations operating in the USA, 436 more had been authorised for construction and 178 conditional grants were out. Suitable receivers were being produced at a rate approaching two million a year. This set the scene for the legal attack by Armstrong which was to prove literally suicidal. He resented the fact that whereas most FM receiver manufacturers were paying royalties on his patents, a score of companies, notably RCA, were still holding out. He sued them all but cracked under the strain of the necessary pretrial work. Against the advice of friends and lawyers, Armstrong's widow Marion continued fighting the unfinished legal battles after his death. It took until 1967, a full 13 years later before the last court case had been decided in favour of the inventor. But with Armstrong gone there was no driving force to keep the station on the air. As one employee put it, "No matter if someone picks up the tab and puts it back on the air tomorrow, Alpine is dead. It died with the Major". In all Alpine had cost him $2 million of his own money.

Fortunately, some recordings of those pioneering days of FM still exist. But who knows for how long. I recently visited the Columbia University Library in New York which holds nearly a quarter of a million original documents relating to Armstrong and FM. Amongst all the paper work nestles a pile of inadequately labelled tape and disc transcriptions. Despite the inadequate labelling, it is clear that the tapes date back to 1947 and the discs to 1935, capturing comparative test transmissions of both AM and FM. But there's no facility at the library for playing the recordings and all the fragile discs, both originals *and* safety duplicates, are stored *together* in one fragile pile along with unspooled, *yes unspooled*, blocks of original 1947 Magnetofon tape. The tape is clearly decaying badly and cannot last much longer. It only needs one Columbia employee to drop the tapes and discs, for the unspooled blocks to spew into an irreparable tangle and the discs to shatter. Columbia has said it will try and do something about this sorry state of affairs. But as yet there is no firm word from the USA of any positive action. How sad that a University library ostensibly dedicated to the preservation of historical documents should show so little respect for such valuable audio records entrusted to them for safe keeping.

Back to mono

AND NOW it's own-up time. Who cut the recently released Brighouse and Rastrick brass band album, *Bandstand*, released by WEA on the PVK label (PVM 5)? More to the point who listened to the test pressings after cutting? Brian Matthew of the BBC was the first to spot what is presumably the undeliberate mistake. The first three and a half tracks on side one are in beautiful wide stereo. Then half-way through the fourth track, aptly entitled *Finale for Band*, there's an audible clonk and the whole sound image collapses into mono. It then stays in mono for the whole of side two. The transition is even more impressive if you listen on headphones, in surround-sound (because the rear channels suddenly cut out) or watch on a scope (because the fancy phase traces suddenly collapse into a straight line). Was it a fault in the cutting amp or did someone in the cutting room lean on the mono button? But whatever happened why did no one notice until the first batch of pressings had been out for review and were on sale in the shops? Can't anyone at WEA hear the difference between mono and stereo? Or does PVM perhaps stand for Perish all Vertical Modulation? ■

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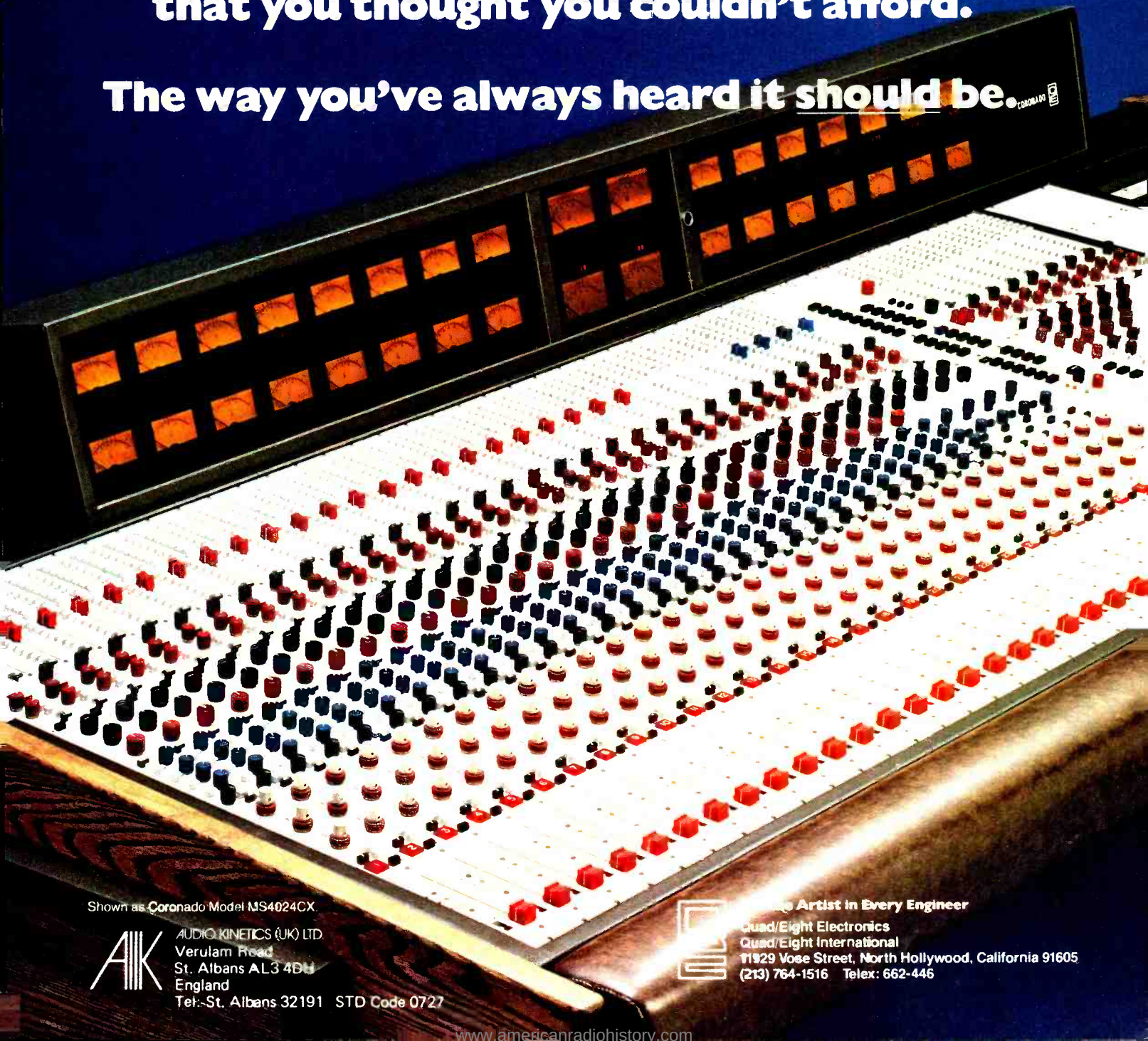

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AES 62nd Convention, Brussels a preview

The 62nd AES Convention will be held from March 13 to 16 at the Sheraton Hotel Manhattan Centre complex, Rogierplein Place Rogier, Brussels. This year's European convention has over 110 exhibitors showing a wide range of products, an increase on last year's representation at Hamburg. As usual a series of technical seminars will be run in conjunction with the exhibition. Opening hours are as follows:

Tues.	**March 13,**	**10am to 6pm**
Wed.	**March 14,**	**9am to 6pm**
Thurs.	**March 15,**	**9am to 5pm**
Fri.	**March 16,**	**9am to 1pm**

Measurement

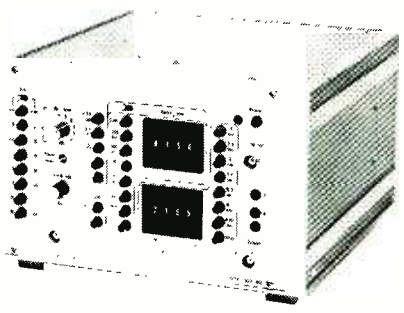
Following its introduction at AES New York **Ivie** will be showing the *IE-17A* microprocessor-controlled acoustics analyser for use with the *IE-30A* spectrum analyser. The *IE-17A* when attached to the *IE-30A* allows measurement of reverberation time in ⅓-octave or single octave bands; and measurement of room delays to tenths of milliseconds for the direct wave or any reflection. With the unit's built-in time gate the SPL of any reflection can be isolated, measured and compared to the direct wave. The unit can be programmed to control the pulse width of the source, the time that the *IE-30A* begins and stops analysis, and will also transfer any *IE-30A* screen pattern to an X-Y or strip chart recorder.

Neutrik are to show the *Audiotracer 3201* which measures and makes hard-copy recordings of the audio response of electronic and electro-acoustic systems. Also on display will be the *AD-4* analogue delay line with four discrete delayed outputs commonly adjustable over a 4:1 range and independently adjustable in level. Input sensitivity is continuously adjustable from 10mV to 10V for +18dB output.

NTP Elektronik will be exhibiting their series of peak programme meters including the type *377-100* multichannel PPM; bar graph meters; light diode meters including two new models — types *177-750* and *177-780*; light-beam meters; and video PPM type *377-500*. Also on display will be their compressor/limiters, equalisers, a ⅓-octave analyser a stereo monitor oscilloscope, a new compatibility meter type *177-590*, and a new universal gate/burst generator type *507-100*. It is hoped that a finished version of their controlled filter (the prototype of which was shown at AES Hamburg) will be available, plus a completely new compact electronic cross field system.

Ursa Major will be showing their *SST-282* digital reverberation system consisting of a digital delay line and digital reverberation synthesiser, with controls for all relevant parameters, including initial delay, decay time, room size, and high and low frequency equalisation. The system can be used as a straight audio delay unit with built-in mixer. Bandwidth is rated 5kHz, dynamic range 80dB, and noise and distortion is 0.2%.

NTP Universal gate/burst generator 507-100



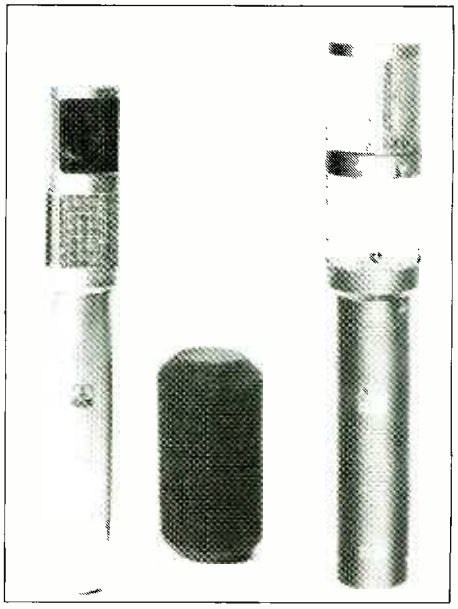
Microphones

AKG Acoustics are to exhibit their range of condenser mics models *C-424*, *C-422*, *C-34* and *CMS* pre-amplifier; their dynamic mics models *D-160* and *D-222*; their *TDU-7000* delay unit and *BX-15* reverberation unit, and their range of pick-up cartridges. Also on display will be their *C-535*, *C-567* and *C-568* mics, and their range of headphones and mic/headphone combinations.

Beyer will be showing the *LSE-1* headphone amplifier which simulates loudspeaker acoustics on headphones; the *MCM* modular condenser mic system with new preamplifier *CV-720*, available for 48V and 12V phantom power or variable from 8V to 52V; plus their range of dynamic mics, headphones, accessories, and their infrared sound system.

Calrec will be demonstrating their *Soundfield* mic, showing post-session steerable stereo, and in collaboration with the NRDC Ambisonics team will be demonstrating surround sound formats to show 2-channel, 2½-channel and 3-channel encoding/decoding as well as direct replay from the *B* format.

Electro-Voice will be introducing a new miniature electret condenser lavalier mic, *Model 1724*, which is a rugged, compact, lightweight battery powered omnidirectional tie-clip mic. It has a frequency response of 50Hz-15kHz, signal-to-noise ratio 50dB, an impedance of 1kΩ, and its output is unbalanced. Also on display will be the company's complete range of mics and studio monitors.

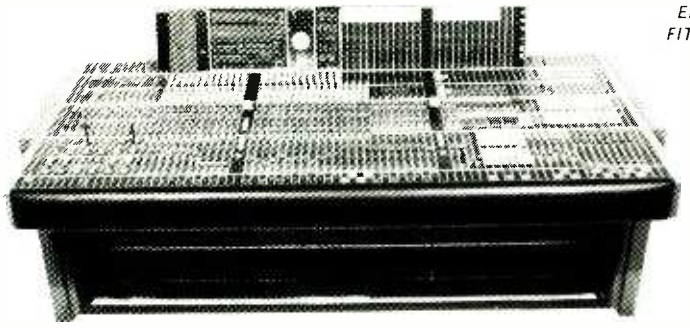


AKG C424 (left) and C422

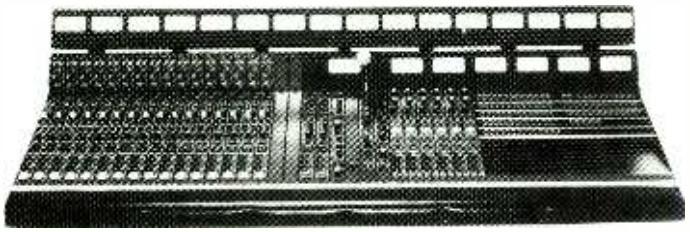
Neumann will be showing their new *KMR82* condenser shot gun mic, the *KMS84* condenser soloist mic, and the *K89* studio condenser mic. In addition they will also exhibit their mixing console components and their complete range of studio condenser mics.

Schoeps will be exhibiting their range of studio condenser mics and accessories. Included will be a new active 24dB-octave cut-off which can be introduced between the mic capsule and amplifier. In addition a pure figure-of-eight capsule with only one membrane will be shown.

Three new products are being introduced by **Sennheiser.** These are the *Model EM-1026* multichannel receiver system, the *Model SER-10* portable reportage transmitter, and the *Profipower* musicians mic. The *Model EM-1026* which utilises plug-in modules allows three channels to be used in full diversity mode, or six channels to be used as separate receivers in one housing. Another plug-in module supplies monitoring and antenna splitting. The *Model*



Elektroimpex FIT-IC mixing console



Midas mixing console

SER-10 is a portable transmitter for OB use and has switchable 10W or 1W output. The *Profi-power* musicians mic features high resistance to feedback, a built-in roll-off filter with three switchable curves, and a lockable click-free on/off switch. Also on display will be the *Model SK-1010* microport transmitter for frequencies around 200MHz, the audio level meter *Model UPM-550*, and the complete range of RF-condenser mics, dynamic mics and wireless mics.

Shure are to introduce the new *Model SM81* cardioid condenser mic, intended to be usable in a wide range of environments. It has a 3-position low frequency response switch, switchable 10dB attenuator and operates over a range of phantom powers from 12V up to 40V. Also on show will be the full range of mics and phono cartridges for professional applications.

Mixers

Allen and Heath will be displaying their complete range of mixing consoles with particular emphasis being given to their *Syncon* 16/24-track consoles available with up to 28 input/output modules, equipped with full quad subgrouping and mix-down. Also on display will be the *Series 3* modular mixer for 8-track facilities, the **Brenell** *Mini 8* 8-track tape recorder and the *SR 20* sound reinforcement console one of the *SR* series consoles available with up to 28 inputs, 8 groups, 3 auxiliaries, phantom power and stage talkback.

Amek will be showing an *M2000* 28/24/16-track mixing console, modules from the *M3000* series, and studio and control room plans and designs by **Everything Audio.** It is hoped that modules from the new *M1000* console will be available and that full technical drawings of the proposed *M2000A* console—a VCA fader version of the *M2000* with extended eq—will also be available.

Elektroimpex the supplier of studio equipment for the 1980 Moscow Olympics will be showing an *FIT-IC* system mixing console which features one inch channel modules, indirect control, soft switching, the possibility of forming control groups instead of AF groups, and a remote control facility for all functions. The console is automation ready, has programming and mixover facilities and is suitable for stereo, quad, and multichannel mixing. Also on show will be the fully modular, servo-controlled *STM 610* stereo studio tape recorder and the *SL-101* direct drive professional turntable. In addition the *PCP-101* commentators desk for simultaneous transmission by two commentators, a technicians monitoring desk, a power supply and a commentators table holding all the ancillary equipment will also be on show.

Electro-Voice are to exhibit several new products manufactured by its sister company **Tapco**. These will include their complete range of professional amplifiers and the *C-12* mixer all these products being shown for the first time in Europe. The *C-12* mixer is a 12 · 4 · 2 · 1 in out format mixer allowing routing of pannable inputs to any of the four subgroups together with simultaneous mono and stereo outputs. The mixer has regulated, foldback current limited phantom powering and three band per channel eq.

Enertec will be introducing a 24-track sound mixing console in their *UPS-4000* series with 24 inputs and four programme outputs and with VCA for adapting to automation control. Other consoles on display will be the *UPS-5000* series available with 12 to 20 inputs and four to eight outputs, and the *UPS-5100* series of OB consoles. Also being introduced is the *F-462* series of tape recorders in European or American Standards, available in stereo, dual-track and twin-track formats, or in a disc-cutting version with advance monitor for automatic pitch control. Other items on display include the *GCE-4000* series of solid state switching grids with automatic testing of commutation points; and a cassette broadcasting system available in both automatic and manual versions.

Harrison will be showing the new *Alive* live performance and sound reinforcement programmable console which was introduced at AES New York. Also being shown will be components from the new film rerecording console which will make its formal appearance at AES Los Angeles. In addition the latest version of the *3232C* master recording/remix console with *864* Auto Set console automation programmer will also be exhibited.

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MCI will be showing their range of recording/remixing consoles and tape recorders. The *JH-32* 3in 32-track recorder; the *JH-600* series of automated consoles; and the *Auto-Lock*, SMPTE/EBU generator/reader/synchroniser will be shown in Europe for the first time. Also on display will be the *JH-500C* console with *JH-50* Automation and Plasma Display meters, and the complete range of *JH-110 Series* of recorders will be shown with improved electronics. In addition the *JH-16* multitrack will be exhibited with the new microprocessor based *Autolocator III*.

Midas will display the new version of their *PR System* sound mixing consoles which has several new facilities available as standard, including in-place solo, bargraph metering to DIN and Nordic specifications and additional monitoring facilities for 16 and 24-track applications. The range of 20 standard modules and modular main frame concept provides many console format variations to cater for 4 and 8-track recording, audio visual productions, theatre and high quality sound reinforcement applications. A VCA controlled console system will be available for sophisticated stage productions.

Neve will be showing their *Model 5422* location suitcase mixer and will be providing a meeting and discussion area for visitors decked out with photographs and drawings of the company's equipment including details of the new *Model 8098* 46-track console and examples of their custom building capability.

French manufacturers **Plus 30** are introducing a new modular recording console *Model RS8036*. The new console has 36 input/output modules, 24 output busses for submaster assign, four-band parametric eq, VCA subgrouping, and logic status control. Also on display will be the *LC7600* stereo compressor/limiter.

Raindirk are to show their *Series III* mixing consoles available with inputs from 18 upwards and with features which can be adapted to need. They will also show the *Quantum* console which consists of an input section, and master-status and master-monitor sections with frames of 24/32/40-input channels. In addition the *Mini Mark II*, a low cost mixer in 10/4 to 24/4 format, with an eight monitor option, and available in portable desk or floor standing versions will also be shown.

SATT Elektronik will be exhibiting their small, portable *SAM82* mixer. The mixer has eight mic/line inputs and two main outputs, two auxiliary outputs (with transformer balanced line level) for cue and echo, echo returns, monitoring, talkback, test oscillator, power for condenser mics, and PPM meters with logarithmic scales. By means of a multipin connector two *SAM82* mixers may be connected together to give 16 inputs and two main outputs.

Siemens will be showing and demonstrating the **Sitral** *C-Mixing* desk technique with single component alternatives for the standard mixing operation in multitrack recording and mixdown. Also being shown is the *Crossmatic* audio distribution/control room system using the symmetrical electronic switching point *Model S-180*; and the *Novocord* magnetic film unit which can be coupled synchronously to any standard telecine, projector, or VTR, or other magnetic film units, and will follow at up to 30 times speed.

Neve 5422 'suitcase' mixer

Solid State Logic will be demonstrating their *SL4000* recording console with the *SSL* interactive studio computer. The *SL4000* has fully distributed logic control of all the major states; compressor-expander-noise gate and four band parametric eq on every channel; VCA and patch-free audio subgrouping; and full control of all tape machine functions. The *SSL* computer gives full mixdown automation with automatic status set up; automatic nulling and return to original; and display of DC levels and off-line editing. The computer also provides tape machine control (with location by time, cue point, or freely named section), drop-in timing and record keeping.

Soundcraft will be showing their new *Series 3B* 24-track console introduced at AES New York. Designed for 16/24/32-track studios. The console features up to 32-track monitoring, 4-band equalisation, high and low pass filters, eight auxiliary busses, two of which may be in stereo pairs, and a transformerless differential mic amplifier. The console may be automated. Also being shown will be the *Series 1S* range of portable stereo mixers, the *Series 2* 4-buss and 8-buss recording mixers and the *EX4S* stereo 4-way electronic crossover.

Televic are to show their semiprofessional mixing units for studios and theatres, together with their simultaneous translation equipment with microprocessor mic switching.

Trident will be exhibiting their *TSM Series* of consoles available with quad and stereo outputs, and in two frame sizes—32/24-track and 40/32-track, with four band parametric eq on each input. In addition the *Fleximix* expandable mixing desk; their parametric equaliser, stereo limiter/compressor, and low distortion oscillator/frequency counter will be shown.

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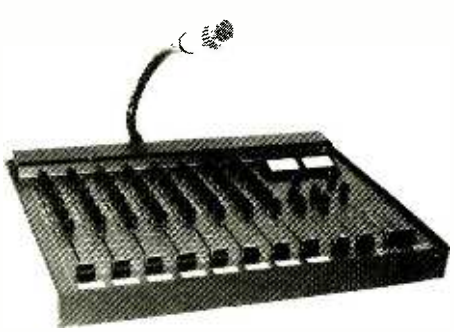
SATT Elektronik SAM82 console



Pity they didn't record Sgt. Pepper on it.

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Of course, what 4-track meant in those days was a machine that weighed half a ton, relied on 1" tape for its living, and could only go to three generations before tape hiss became intolerable.

As we say, a pity the new TEAC A-3440 wasn't around to do the job.

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There's an optional dbx unit available, the RX8, adding an astonishing 30dB to the overall S/N ratio.

And we've even built in a Pitch Control to alter tape speed by ± 5%. Which means you can add a piano solo weeks after your initial recording, and instead of tuning the piano, you you just tune the tape.

As you'd expect, the A-3440 is fully compatible with all modern studio systems, with a comprehensive range of TEAC back-up hardware available.

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Monitor Loudspeakers

On display from **Acoustic Transducer** will be their studio monitor loudspeaker systems, models *S50* and *S85*, with 3-inch voice coils and soft-dome midrange units. Also on show will be their high power loudspeaker units including the *PA 100-375*, 15in unit, the *PA 75-314*, 12in unit, and the *PA 75-234*, 9in unit; and a range of public address and recording studio electronics.

Barco will be introducing a new loudspeaker in their *MLS1 Series*, the *MLS 1/80*. The new loudspeaker has a continuous power capacity of 80W into 8Ω, sensitivity is 82dB at 1W and 1m, and frequency response on axis is 36Hz to 20kHz ± 2.5dB.

Electro-Voice are to introduce a new loudspeaker system the *Eliminator 5*. This has a single-folded *EVM15* horn, a 6½in vented midrange driver, and *ST 350A* tweeter. The system has a continuous power capacity of 100W into 8Ω, is capable of delivering sound pressure levels of up to 117dB at 100W and four feet, and its frequency response is 55Hz-18kHz.

Ferrofluidics will have their technical experts on hand to discuss the advantages of using ferrofluidics in voice coil gaps. Advantages claimed being increased power handling, voice coil centering, crossover design simplification, flattening of frequency response, and impedance peak reduction.

JBL will be introducing two new studio monitor loudspeakers the *Model 4313* and *Model 4301E*. The *4313* is a three-way control monitor featuring a 25mm aluminized dome high frequency radiator and a long throw 250mm low frequency driver. The *4301E* has a full complementary symmetry 10W amplifier built into the 4301 broadcast monitor.

Tannoy will be showing the recently introduced *Buckingham* monitor loudspeaker which is a three-way system with two 12in low frequency units and a 10in dual concentric unit. The loudspeaker will give an output of 94dB for 1W at 1m, longterm continuous power rating is 200W, and frequency response is 30Hz-20kHz ± 1.5dB. Other units on show will be the *Dual Monitor*, the *Monitor Red*, and a hybrid passive/active crossover with time compensated circuitry and parametric equalisers for the low frequency section.

Tape and Tape Duplicating

Agfa-Gevaert will be exhibiting their range of audio tapes for broadcasting and studio mastering applications, including their *PEM 468* studio mastering tape, their *PEM 526* mastering tape for bin loops, and their *PE 36* tape for high speed duplicating. A new addition to their range being shown for the first time will be the *PER 528* high output, low noise broadcast tape. Also on exhibition will be the company's range of bulk cassette tapes, magnetic film, open reel audio tapes, reference tapes and compact cassettes.

Auvis-Asona are to show their high speed (32:1) tape duplicating equipment and turnkey cassette production facilities. They will be introducing a new fully automated winder and cassette packaging system, plus a new ½in loop-bin.

BASF will be showing their range of professional tape products including studio tapes, calibration tapes (DIN and NAB), calibration cassettes, unisettes, duplicating tapes, and magnetic film. They will also be displaying their latest studio tapes type *SPR50LHL*; and type *SP54R* which is designed for broadcast applications.

W H Brady Co will exhibit their range of professional splicing and sensing tapes for use with cassettes, 8-track cartridges, master recorders, and video cassettes.

Cetec will be showing the *Series 1200* 64:1 cassette duplicating system together with the **Gauss** range of loudspeakers, including the latest modifications for the 1979 range.

Swiss company **Cross Music** will be demonstrating their automatic cassette labelling machine *Model CT-1800*, which has a capacity of 1,900 cassettes per hour.

EMI Tape will be showing their range of professional and duplicating audio tapes together with their ranges of domestic reel-to-reel tapes, cassettes, and accessories. Particular emphasis will be given to the new *862* high output, low noise mastering tape which is available in the full range of tape widths.

On show from **ICM Cassettes Merchandisers** will be their new C-Zero cassettes; two new cassette testing machines—the *DO-2000* drop-out checker and the *ICM 7804* wind tester which checks the mechanical functions of one to twelve cassettes automatically; and their *C-Box* cassette packing and storage system.

Heino Ilsemann will be exhibiting their *Type KZM3* loader which automatically loads cassettes and literature (single or folded) into plastic cassette cases at a rate of up to 4,800 cassettes per hour. Also on display will be their *ETK1* and *ETK1S* automatic cassette labellers, and their automatic cartoning machines types *MCB1K* and *MCB1KS* for use with flat blanks.

Infonics will be demonstrating tape duplication using various grades of ferric tape and the new **3M** *Metafine* metal particle tape.

Maglink will be showing their tape synchronising and control system, which has a new revised control unit adding new functions and simplifying operation. The control unit is opto-

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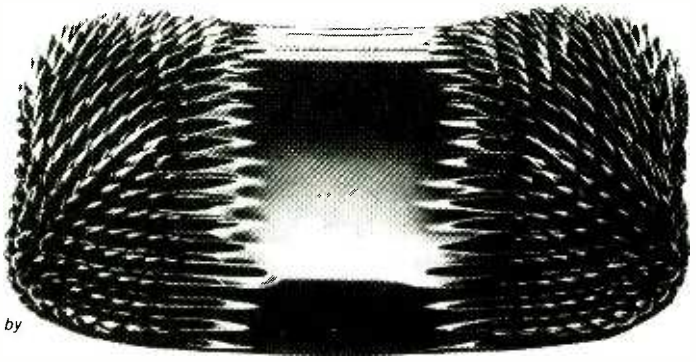

Ferrofluid 'falls up' as demonstrated by liquid burrs

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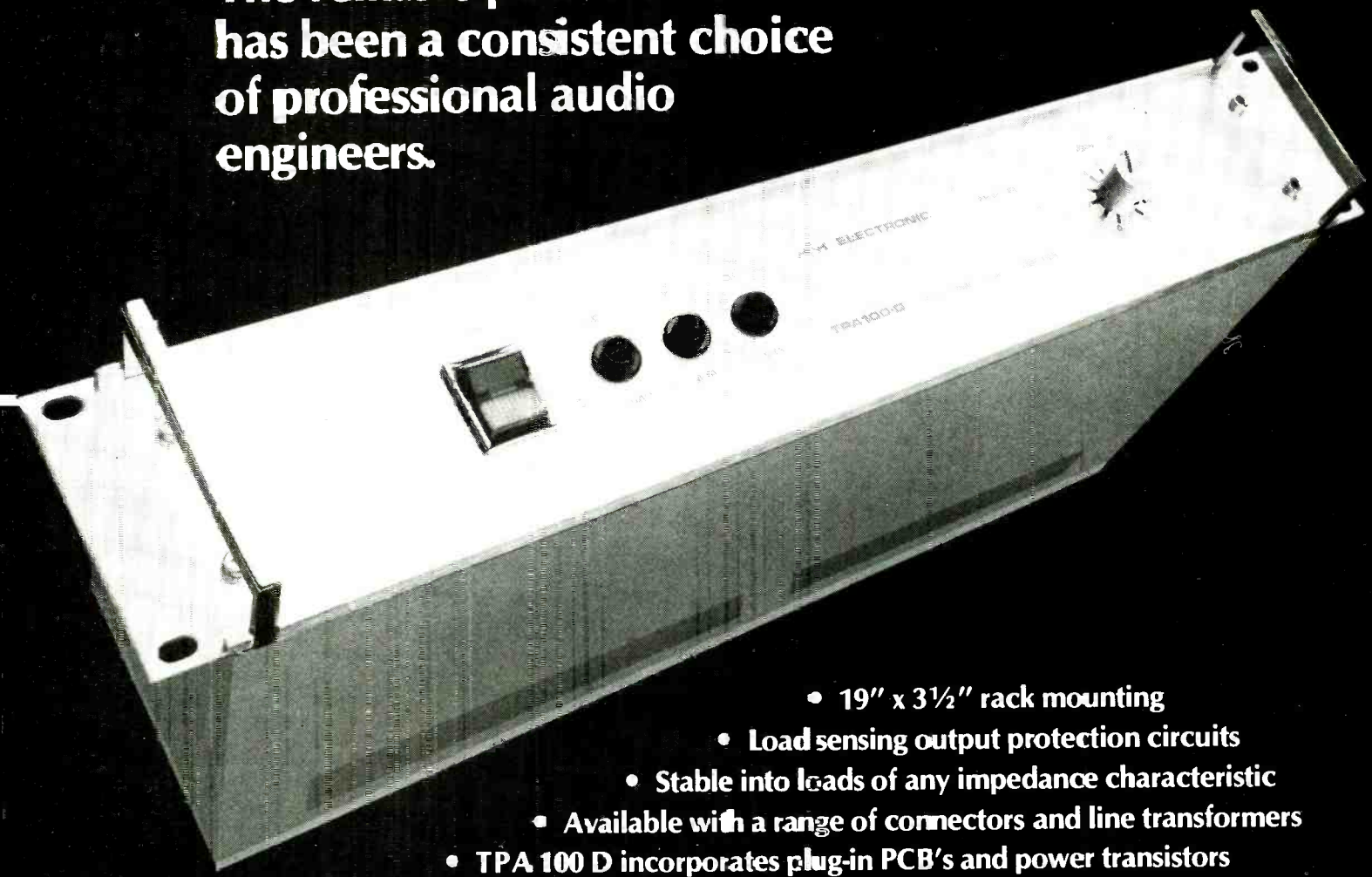

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isolated so it can be used remotely from the electronics. Also being shown will be their all-speed EBU/SMPTE-to-Maglink interface; the *Maglink* code reader which enables the *Maglink* time code to be displayed from any source without requiring their synchroniser; the *Maglink* code generator; the *Minimag* reader for use with the *Minimag* synchroniser; and their sprocket code generator.

Racal Zonal will be exhibiting their range of audio tapes and cassettes, including the low noise *Triple Eight* tape intended for music mastering and multitrack recording; the *Triple Six* tape designed for stereo broadcasting, speech mastering and archival use; and their range of super ferric oxide cassettes.

On exhibition from **Recortec** will be their automated cassette duplicator system with automatic cassette feeder. The system produces cassettes at a rate of either 32:1 or 64:1 and does not use a bin-loop, relying on unrecorded pancakes, C-Zero cassettes and a reel-to-reel master instead.

Steen Hauerback will be showing the TTL *Model 108* automatic cassette loader which has a capacity of between 80 and 70 cassettes per hour depending upon tape length. In addition they will show a range of C-Zero cassettes and pancake tapes in lengths up to 7,200ft from **Domain Magnetics.**

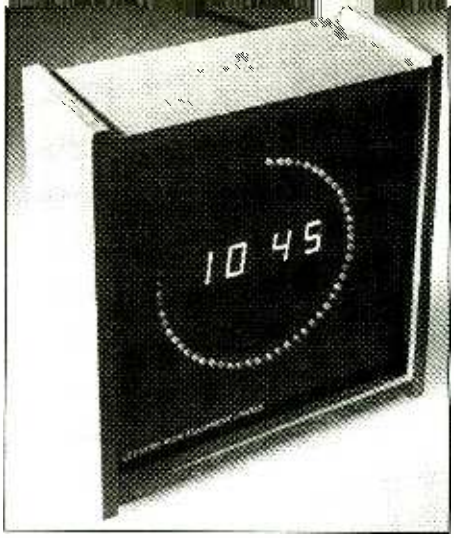
Tape Machines

On display from **Audio Kinetics** will be their *XT-24 Interlocator* for use with 3M, Ampex, Lyrec, MCI and Studer machines. The unit is capable of improving search action by computing and storing the ballistics of tape machines for high-speed location, and has an inches-per-second speedometer and programmable routines for automatic sequencing. Also on display will be **Quad-Eight** products, including the *CPR-16A* digital reverberation system and the *Corando* console with *Compumix III* automation.

ITAM will be exhibiting their *Model 1610*, 16-channel tape recorder using 1in tape. It has three speeds, varispeed, remotes for all functions, modular electronics including a separate equalisation plug-in card, is available in 8-track expandable to 16, and has an autolocator option. In addition as 12/4 mixer with 8-track monitoring, and an 8/2 mixer will be on display.

Leevers-Rich will be highlighting their *Proline 2000TC* range of ¼in professional tape recorders, available with standard or penthouse console housings, and different control arrangements for television, radio and recording. The range have dc servo-controlled capstans, electronically controlled tape tension, constant velocity spooling, and is switchable NAB/DIN. Also to be shown will be the *Proline 1000* series of tape recorders, available in rack mount, portable, or console versions, with either servo-controlled or direct-drive motors, tape-tension control, and modular construction. In addition, they will also be showing their demagnetising equipment for reels and heads, and the newly introduced *LR73* studio digital clock.

On display from **Lyrec** will be their *Model TR532* multitrack recorder with their new *TPC* microprocessor controlled tape position controller. The *TPC* can search to three different preset tape positions and recycle between two positions, and can store 16 different tape



Leevers-Rich LR73

positions which can be recalled and searched at the operator's convenience. The recorder has a comprehensive remote control unit offering search function, varispeed with four-digit readout, tape timer, and controls for all functions for all amplifiers. For each track selection can be made between ready, safe, line, sync, repro and solo. Also being displayed is the *System P-2000* cassette duplication system which has a new master/loop bin and twin slaves of compact design.

Nagra will be showing a number of units from their range of portable tape recorders including their *Model IV-SJ*, a 3-track, four speed instrumentation recorder designed primarily for scientific analysis applications. This model has speeds of 15/7½/3¾/1⅞in/s, signal-to-noise ratio at 15in/s is 64dB, CCIR 'A' weighted, third-harmonic distortion at 320 nWb/m is less than 1.5%, and frequency response at 15in/s is 25Hz-35kHz ± 1.5dB. Also being shown is the *Nagra E* designed especially for remote broadcast use.

NEAL-Ferrograph will be exhibiting their range of tape recorder models including the *Studio 8*, the *Logic 7*, the *Model 302* cassette recorder, and the *RTS2* and *ATU1* test sets for checking all tape recorder functions. In addition to these, three new units will be shown. These are the *Studio 7*, a reel-to-reel recorder developed from the *Logic 7* intended for general broadcast and studio use primarily as a support machine; the *Model 340* four channel cassette recorder; and the *Model 330* cassette recorder having two audio channels with a separate sync track for audio visual applications.

Nordisk Elektroakustik will be showing their range of tape recorders, including the endless-loop *LOOP-matic*; their documentation series *A700* and *A800*; and a new product the *UNI-matic* for the BASF unisette system, which is a plug-in studio recorder/playback system with crystal-controlled motor drive, and plug-in motor assemblies and printed circuits all running directly from 24V DC.

Otari will be exhibiting the *MX-5050* series of tape recorders which are available in 2-track and 4-track formats for ¼ inch tape and in an 8-track format for ½in tape. A new model in the series will be shown, the *MX-5050B*, ¼ in, two-channel unit which is an improved version of the *MX-5050*. Also on display will be a new one inch, 8-track machine, the *MX-7800*, which has a dc-capstan servo motor, varispeed playback, digital tape timer with LED readout, and remote control for the electronics and tape transport. In addition the new *MTR-*

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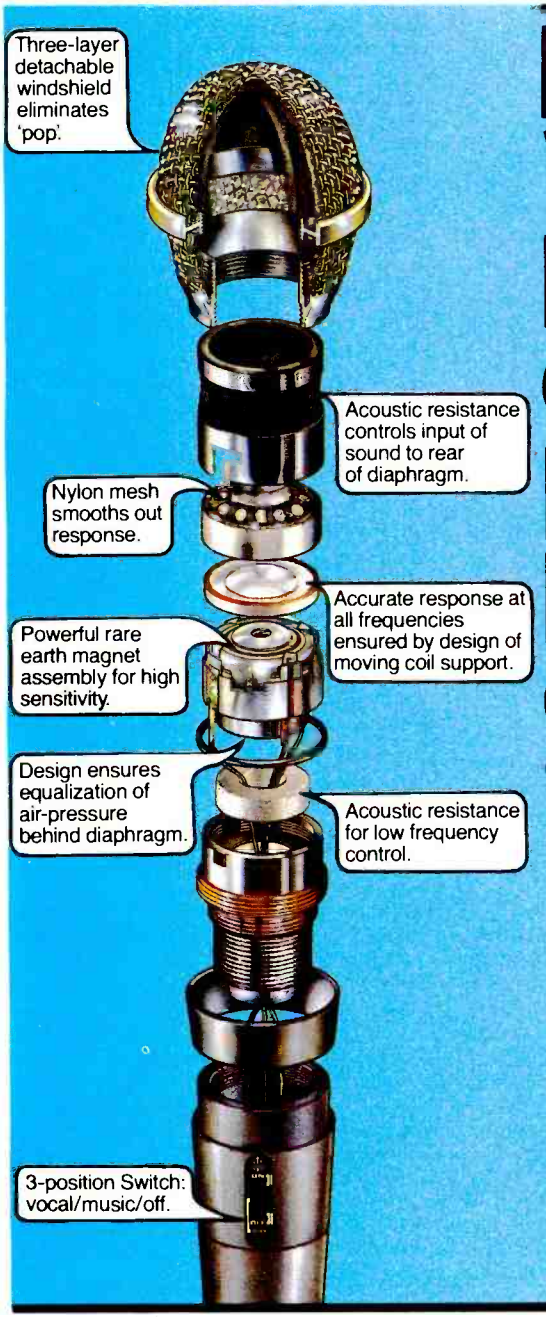

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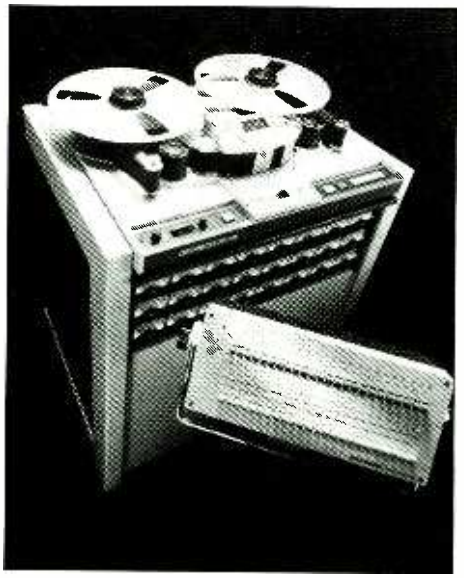


Otari MTR90-24 track

90, 24-track, 2in multitrack recorder with pinch roller free direct drive capstan with fully servoed dc reel motors, 20% stepless varispeed, and digital percentage readout will be shown. Otari's range of high speed tape duplication systems available in 8:1, 16:1, and 64:1 speed formats will also be shown.

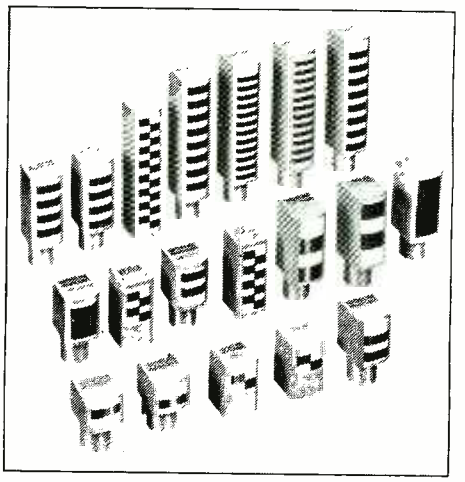
Soundcraft will be introducing a new 1in, 8-track fully modular tape recorder intended for studio or location use. The new unit has a precision engineered tape transport mounted on a rigid cast aluminium deck plate giving wow and flutter figures of 0.03%. The unit's control panel which carries all transport and audio controls including plasma tape counter display is a self contained module which may be removed from the machine for use as a remote control unit.

Belgian company **Staar** will be introducing a new device, the *Compucounter* which provides quick position finding on cassette tape without rewinding to the start. It includes a digital display showing exact tape position in minutes and seconds, following at any tape speed in recording/playback, fast forward or rewind modes. It will indicate the position within a few seconds after introduction of the cassette into the machine.

Studer will be showing a wide range of equipment including the *Revox* range. Main emphasis will be on their new *A800* 24-channel tape recorder, which has 14in reel capacity, microprocessor controlled transport electronics, crystal controlled tape speeds, wow and flutter 0.04% (peak value, weighted) at 15 and 30in/s, output 24dBm into 600Ω and signal-to-noise ratio (unweighted, NAB standard—8/16 channel model) 70dB at 15in/s and 74dB at 30in/s. Also being shown will be a new autolocator with microprocessor control, which has 20 memories to store addresses, separate displays for tape position and locate position, repetition programme for one repeat or continuous repeat, push-button return to beginning of tape, all entries executed by standard keyboard, and operational without modification to the tape transports of the *A800*, *A80/VU*, *A80/RC* and *A81*. In addition the *Model 269* portable audio mixer, a telephone hybrid unit, a Unisette cassette library system, and a *Revox* audio rack will be shown.

Woelke will be exhibiting a newly developed range of 16/24 channel 2in and 3in magnetic tape heads (record/playback/erase), designed to give low crosstalk even in sync mode and low contour effect at 38in/s. The erase heads can be used for full-track or channel-to-channel erasure. Also on show will be a new pilot tone head and the company's range of measuring equipment, including wow and flutter meters, wave analyser, and biasing meter.

Range of Woelke tape heads



Signal Processors

Aphex Systems will be showing their *Aural Exciter* and will also be exhibiting the *EQF-2* tunable peak/shelf equaliser with tunable high/low pass filter; and the *202*, a VCA which incorporates the *1537A* VCA chip.

On display from **Audio and Design** will be units from their range of signal processing systems, including the *F600* limiter for optical film, disc cutting and RF transmitters; the *F690* voice-over limiter; the *E900* parametric sweep equaliser; the *E500/560* band selectors; the *E950-RS* paragraphic equaliser switchable from six stereo to 12 mono bands, with variable frequency and Q, and fader amplitude controls; the *F760X* compex limiter; and the *F769X* Vocal Stresser.

Audio Developments will be demonstrating production models of their *AD070* programmable graphic equaliser for the first time in Europe. The *AD070* covers the audio range in 16 bands at approximately ⅓-octave steps with a Q factor of 2.2 at maximum and minimum. Control is in 2dB steps from −14dB to +14dB on each band. Control fader generates a binary code and a keyboard sets up various functions. Up to 16 preprogrammed response curves can be stored in the memory and the unit can be remote controlled from any signal source. In addition the company will be showing their range of portable mixers for film and broadcast use.

Two new compressor/limiters will be introduced by **dbx**, *Model 163* and *Model 165*. *Model 163* has continuously variable compression from 1:1 minimum at 0dB gain reduction to 0:1 maximum at approximately 30dB gain reduction. *Model 165* is continuously variable from 1:1 to infinity according to compression control and thrshold settings and signal level. Also being shown is the *Model 148* noise reduction decoder for broadcast playback, and

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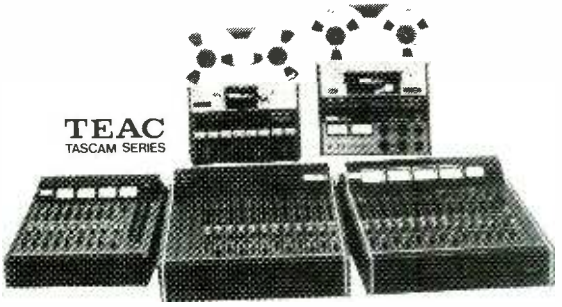

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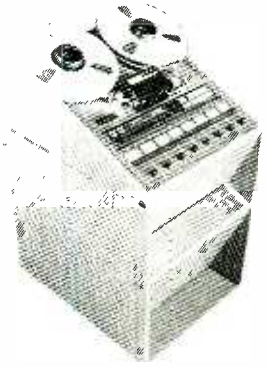
By popular demand we have produced a compact vari-speed unit that can be easily connected to any fixed speed recorder. The power oscillator is housed in a free standing case and connection is via two wires to the capstan motor.

The hand held remote switches between fixed speed operation and a plus or minus 15 percent pitch control



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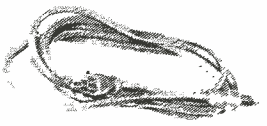

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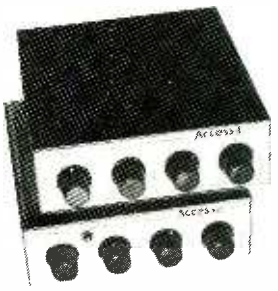

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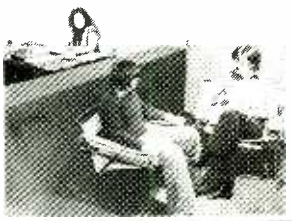

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AES 62nd CONVENTION, A PREVIEW

EMT 244 digital reverberator

the *Model 208* and *Model RM-155* 8-channel noise reduction systems.

Dolby will be showing their range of professional noise reduction systems including the *M Series* multitrack unit equipped with modules in standard units of 8, 16, 24, 32, 40 and 48 channels. Also being shown are the *Model 360* for use with film recorders; the *E2* equaliser for standardising the frequency response of loudspeakers; the *Series A* noise reduction systems for improving optical and magnetic sound-tracks in cinemas and broadcasting; and the Dolby FM system for radio and television sound transmission and reception.

EMT will be exhibiting a wide range of units. These include the *Model 244* digital reverberation unit; the *Model 250* electronic reverberation unit; the *Model 444* digital audio delay system; and a new unit, the *Model 446* digital line announcer. In addition the *Model 950* direct drive studio turntable will be shown, together with the *Model 258* noise filter, the *Model 260* filter limiter (de-esser), the *Model 261* compressor/limiter, and the *Model 259* mounting frame.

Future Film Developments will be showing their portable noise reduction unit for location recording. This has provision for two Dolby A-type modules with associated buffer amplifiers, automatic record/play and power switching, and battery supply.

On display from **Klark-Teknik** will be their *DN70* digital time processor, which has a clocking speed of 50kHz, frequency response to 15kHz, and delay options up to 652ms. With it will be shown the optional *DN71* digital controller which enables the *DN70* to generate many sound effects including harmonising and flanging. Also on display will be the *DN34* analogue time processor, which has two independently controllable delay sections; and their range of graphic equalisers including the *DN27* ⅓-octave equaliser, the *DN22* dual 11-way graphic equaliser, and the *DN15* graphic equaliser pre-amplifier.

Marshall Electronics will be showing their *Model 5001* time modulator; the *HP400* extended range 400ms time modulator; the *P500* analogue delay unit with 500ms delay, five delay output taps, and 94dB signal-to-noise ratio; and the *P250* delay unit with 250ms delay, single output tap, and 95dB signal-to-noise ratio.

Orange County will be highlighting their new *VS-1* stressor which now has a full parametric equaliser. This new *PEQ* equaliser is a four-band parametric, with adjustable Q, a signal-to-noise ratio of 110dB with all sections at 20dB boost, and tunable centre frequencies over the range 20Hz to 20kHz. Also on display will be the *CLX-S-FM* stereo processor, a complete self contained signal processing system which includes peak-limiter, compressor, and expander/noise gate.

Publison are to show their *DHM 89 B2* stereo digital audio computer with dual delay, dual echo, pitch shifting from 2 to 1 octave, automatic arpeggio, reversed sound, and a memory code. In addition they will be showing the *DHM 83B* quasi stereo option for the *DHM 81 B2*; the *ECL 20A* dual compressor/limiter/expander/noise gate; and the new *CL20C* dual compressor/limiter with variable threshold, attack time, release time, output gain and compression ratio.

Synton will be exhibiting their *Syntovox 221*, 20-channel vocoder, which has 54dB-per-octave filters, real-time analysis LED readout, matrix patching, built-in audio pulse generator, random VLF and step modulation, and 56-way multi-connector for external control and computer applications. Also on exhibition will be the *Syntovox 222* a new low-cost vocoder for small studio and stage applications. In addition the *Model 203* phaser and *Model 229* parametric equaliser will be shown.

Miscellaneous

On display from **BGW** will be a number of new products including the 750B, 750C, 250D and 100B amplifiers together with a new 1,000W amplifier.

Eastlake will be showing a video tape of their latest studio design projects and Tom Hidley and David Hawkins will be on hand to discuss the company's design philosophies.

EMS are to show their new *Polysynthi* equally tempered, fully polyphonic, twin VCO synthesiser with two ADSR envelope generators with LED displays, and analogue delay line for echo, chorus, flanging and reverberation effects. A new optional polyphonic *Sequencer* for use with the *Polysynthi* allowing up to 10 minutes of polyphony to be stored and edited will also be shown. In addition the *Vocoder* 2000 and a new modular *Vocoder* system will be shown together with the company's range of synthesisers and modules.

Gotham Export will be exhibiting the **Inovonics** *500* spectrum analyser, the **UREI** *567* public address processing unit, and the **Lexicon** *Model 93* prime time digital delay effects processor.

Keith Monks will be introducing their new

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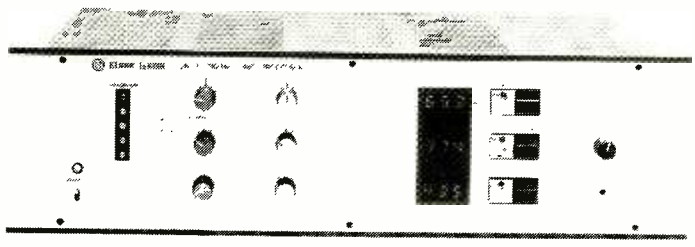
Klark-Teknik DN70



The 1980's are brought one step nearer by the introduction of the MTR-90. This new sophisticated design is based on accumulated technology and innovation which have been the hallmark of Otari for over 15 years.

The new-generation tape transport incorporates a pinch-roller-free direct drive capstan with phase-locked-loop dc-servo circuitry. Tape speeds are 15/30 ips with ±20% stepless varispeed and a digital percentage readout. Features include full dc-servo on supply and take-up motors for constant tape tension, automatic switching between input/sync/reproduce electronics with gapless punch-in/punch-out. And a sliding tape-speed controller, built-in digital timer, auto/manual motor-driven head shields plus 40-ohm balanced output, to name but a few. It comes with the latest electronics featuring a single plug-in card per channel.

The MTR-90 is also available in a 16-track frame, and a 16-track prewired for 24 which can be upgraded to a 24-track machine simply and economically. For the full story, get in contact with your nearest Otari distributor.

OTARI

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Announcing the new 24-track designed for 1980's. Otari MTR-90.

AES 62nd CONVENTION, A PREVIEW

semi-professional record cleaning machine which has a similar action to their professional machine but is less expensive. Also on show will be their range of mic stands, booms, arms, and cable drums; monitor loudspeakers; phase testers; impedance testers; and mic splitter boxes. In addition they will show the **EDC** range of mics and the **Davenport** range of public-address equipment.

On display from **Mosses & Mitchell** will be their range of jacks and jackfields with particular emphasis being placed on the new *440* range of miniature jack sockets which will accept the type *316* tip-ring-sleeve plug. They have palladium contacts and are available separately or assembled as jack-fields in two rows of 48 per row, paired at centres of 0.312 in, mounted on 19in by 1.75in panels. Special custom jackfields are also available to order.

Neumann will be demonstrating the new *VMS-80* automated disc mastering lathe. The lathe features dc servo turntable drive with crystal control; servo controlled pitch drive; automated pitch control based on phase detection and optimum adjacent groove space utilisation; and an automatic function control system which stores lathe commands and has push button recall. All roller components have been eliminated and the carriage rides on Teflon glide bearings.

Penny & Giles will be showing their range of faders and joystick quadraphonic controllers. Included will be the *Slimline 900* series of 65mm stroke units with control detent for mono; the *1100* series with 104mm stroke; the 1500 series with two micro switches and 104mm stroke; the *1400* long stroke (128mm) series; and the *2100* long stroke (128mm) series with two adjustable tracks in one housing. Also on show will be the *QP11* series of quadraphonic joystick controllers.

Philips will be exhibiting a sound reinforcement system, including their new *SQS* loudspeaker systems, and their range of mics, amplifiers and modules. They will also exhibit their *LDC15*, *LDC25* and *LDC35* audio mixing desks; and their new *Storemix* computerised mixing system.

Stanford stereo mixing panel

On show from **Sescom** will be their range of audio transformers and mic splitters; and their *SB-1* stereo balance box; *LS-1* line level splitter; *IB-1* input balancer; *OB-1* output balancer; and *MLD-1* mic-line driver.

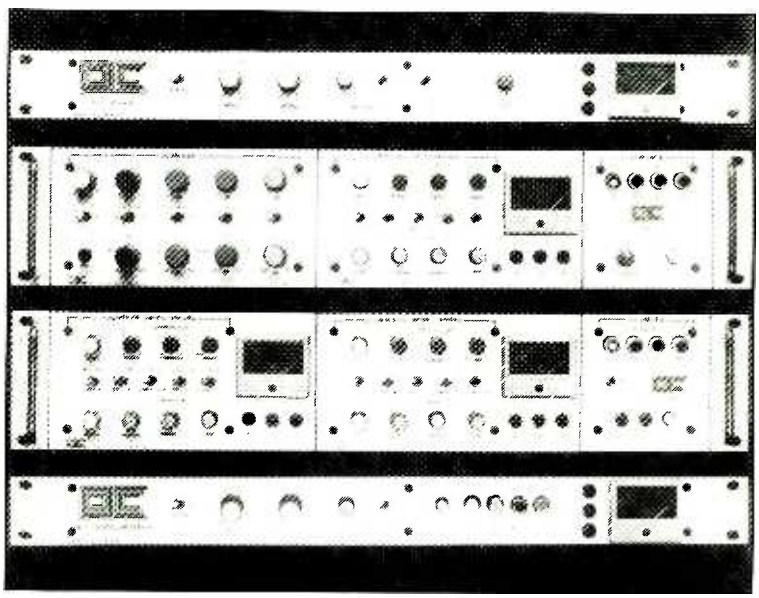
Silver Circle will be demonstrating a cordless foldback system which gives each musician the capability of receiving the balance of four or more discrete audio channels on either headphones or loudspeakers.

Stanford Audio Research will exhibit their complete range of audio mixers, models *M1773*, *M1774*, and new mixers models *M1771*, *M1775* and *M1776* together with the *B2211* and *B4272* power amplifiers, and the *UPL-100* universal power loudspeaker system. The units are designed primarily for discotheque and entertainment use: each mixer has two phono inputs, two tape inputs and a mic input, plus two master outputs. The power amplifiers have LED peak-level readout, input attenuators and on the *B4272* a quad/stereo switch.

Stanton will be introducing their *680SL* cartridge with stereohedron stylus tip for discotheque use. The stereohedron tip has a larger bearing radius giving the *680SL* increased record groove contact, making it suitable for rugged discotheque and professional applications. In addition their regular range of cartridges, styli and headphones will be shown.

Finally *Studio Sound* personnel will be making their yearly pilgrimage into Europe in the shape of editor Angus Robertson, assistant editor Noel Bell, and ad manager Mike Stormer. In addition to this intrepid trio, Richard Elen, editor of our sister magazine *Sound International* will also be in attendance. ■

Range of Orange County equipment



"The original A77 had set a standard by which I have judged other domestic and semi-professional recorders for many years. It is now clear that the new B77 sets a new standard not easily surpassed at its price"

Angus McKenzie (March 1978)

REVOX

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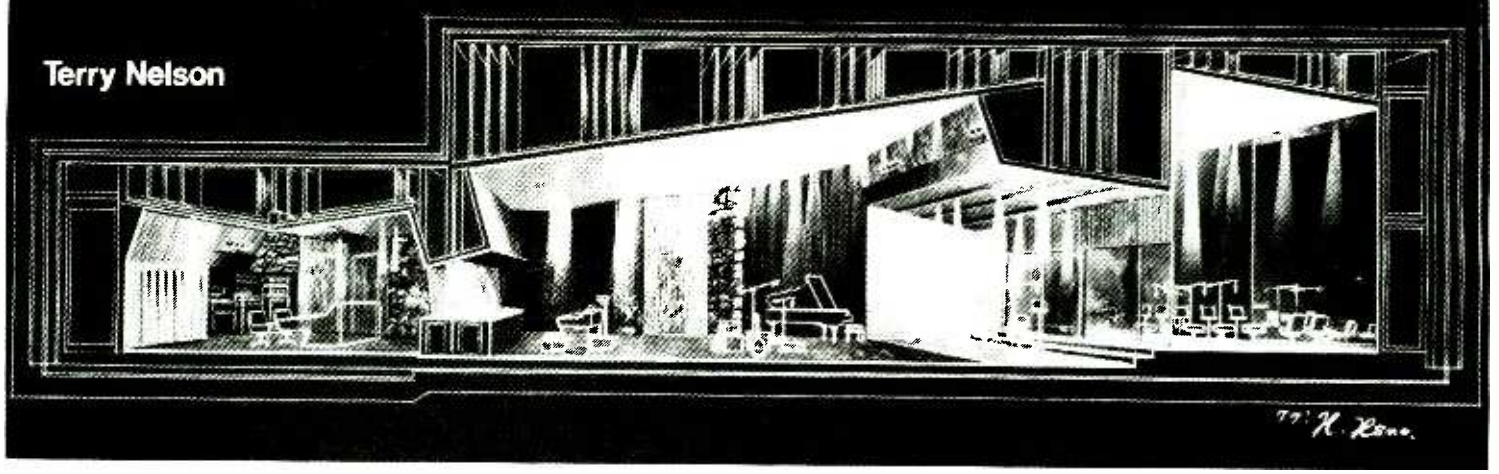
Tom Hidley on PA

Terry Nelson



Over 200 studios have now been acoustically designed and constructed by Tom Hidley of Eastlake Audio. Here, Terry Nelson interviews Tom Hidley and examines his attitudes toward live performance environments and PA

THE NAMES Tom Hidley and Eastlake are no strangers to the studio business, but with the new PA system at the London Palladium and the recent opening of the Virgin Venue Club in London, the Hidley / Eastlake reputation will no doubt start making inroads into the PA field! Being in Montreux last year for the Jazz Festival, I went to see Tom at his apartment overlooking the Casino in order to discuss his views on the present situation of sound reinforcement and how he felt the subject should be handled.

TN *Is your approach to PA similar to that of studios and control rooms, ie, an acoustic environment?*

TH Yes, though I don't have the wealth of experience and background in PA work that I have in recording studios and control rooms. To start with, let's briefly discuss the principles of a control room which is to, as accurately as possible, give a framework of reference to what is happening on the other side of the glass—good, bad or otherwise, you want to know. The only way you can know is that your control room frame of reference is one that is not going to lie to you, it's not going to colour it or have excessive reverberation times in any given point in the room to enhance the sound, and it's not going to have a monitor that plays tricks on you. Things should be as accurate and smooth as possible in the general listening area so that folks sitting on the left and right of the balance engineer really hear the same thing the engineer does, so again, the game and guesswork is taken out. Now, if you hear a pure sound in a recording studio and you walk back into the control room and you open a fader, well, our opinion is that without application of eq or any signal processing other than just running it through the console and up to the monitor, it really ought to sound pretty much the same as the microphone would hear it, at whatever distance that microphone is from the instrument that's generating the source. If that's the case, one can say that whatever is happening in the studio room acoustically is reflected to a degree in the sound that comes through the microphone, depending on how close-miked it is and certainly on the quality of the microphone; it's ability to handle transients, it's broadrange response, power handling, are all then reflected in what finally happens when it gets to the console. The fader is opened and the console's ability to handle the energy coming from the microphone without getting in trouble at the front end plus the characteristics of the monitor amp/speaker system to get the signal aurally into the room, decide what the original signal will sound. At this point it will be very desirable that the signal—after having passed from instrument to loudspeaker—be as accurate as possible. If it's accurate you can then intelligently work with signal processing to achieve whatever effect you might like. So, when you sit in the control room and listen to pretty much undoctored, unprocessed and unplayed with sound it should sound pretty natural—and pretty natural to the guy at the left, right, front or back of the room.

Now what difference really is there between that listening environment and that of an auditorium? Why should people that go to an auditorium to listen to professionals perform on stage not have the same reality, if you like, as what you hear in a control room? Can it be done?—of course it can be done. What is the criterion?—cost, budget. It is obviously a much larger area and so must be handled slightly differently. Now perhaps one might take exception to that and say that it has to be handled very differently! OK, that is possible depending on the auditorium but the end result and concept that you are after, I think, should be the same. The guy at the front or back of the hall, sides and middle, ought to have his money's worth. He ought to hear that act as it sounds in control room conditions. Obviously that is a broad statement! You could say the microphones that are used on stage are not the same as in the studio, you don't have the control acoustically onstage that you have in the studio. Granted. But why not design a stage as the backside of an open-faced studio? Here we are talking about a 2-dimensional studio that has walls and floor, but an infinite ceiling via trapping; you pretty much control the first and second order reflections at all frequencies and in some instances you can get a handle down on the 40Hz region that enables these frequencies to be dissipated once the microphone has seen them so that it doesn't become rumble and mud to the other microphones on the floor. Why can't the same principle be applied on a stage? After all, you have a ceiling, floor, back wall and two side walls but no front to it at all—no glass between it and the audience, and once you get into the cubic volume of the audience area; if you can dissipate the reflected energy coming back to stage you have then effectively got a 2-dimensional stage. So my gripe would be that if you are not in a situation where it is a classified historic building, and you are not allowed to touch one stick of wood or geometry that presently exists, then you can work with the stage and develop a studio environment with trapping and control reflected energy from the first and second order reflections. That stage can then be developed to present to the audience a good sound and providing that quality mics are used and that the stage has not been confined within three dimensions, then in fact that purity coming from the stage at the source should be—theoretically—able to be achieved with the same kind of quality that you would get in a recording studio. That's the first step; how to handle the source and how to get the source to be able to perform within a good environment. Next step, simulating con-

trol room characteristics for uniformity of sound left and right, front to back, top to bottom in the audience and broadband characteristics from the monitors so that you do not have all bottom, middle or top end depending upon where you sit in the auditorium. Now this implies some acoustic treatment in the auditorium and again, if it is not a classified historic building, this can be done within the confines of the limitations that the fire department may put upon you — safety regulations, safety exits, etc—and you can work the auditorium into an acoustic environment as you can the stage.

TN *So at the moment we are talking about a hall or theatre where the PA is a fixed permanent installation?*

TH Yes. So, if you have a fixed condition onstage and you design that stage to be a 2-dimensional recording studio with some variable acoustics in the mid band and high end, by virtue of movable finished materials, that will affect the first and second order reflections of mid and high end onstage. You then have a little control that will be flexible to different acts that come on—from a high sound pressure act to a low sound pressure act and various areas between; to an act that is oriented mainly to low end and rhythm to an act that would be, for example, the Nelson Riddle band and a lead singer. Your stage should have the ability to handle variable conditions. It should have the ability to change the reverberation times of floor, walls and ceiling, it should be geometrically developed so that first order reflections are not sprayed around the stage getting unwanted sound into open microphones and it should be a projection past the microphone to the audience. Then, when you have the sound motion from the stage in the auditorium, you need some control on how it's handled in that auditorium; you could have a situation where it is ground floor only or you could have one or two balconies, but you still want control of the throw and you want the people in the front row to hear essentially the same thing as the back row, balance between low end, mids and high frequency. If you go for this approach then you've really taken the stage and made it a partial studio with its variable acoustics, and you have fixed the acoustics in the auditorium as you would fix the acoustics in a control room as a frame of reference. The house system can then be installed feeding a monitor system that will handle low, mid and high end uniformly, from the first 10 rows to the last 10 rows. Now that is the ideal situation; you have a control room in the audience and a studio on the stage and the guy who pays £5 or £50 for his seat is not being shortchanged—he is able to hear what he came for, which is the purity of the act. He bought his ticket to hear John Doe; by God, he ought to be able to hear John Doe without hearing it through a loudspeaker or canned effect. He should not come away saying: "Wow, they sure sound better when they are playing out on the lawn," which is what can and does happen in many instances. For this reason I think an auditorium should be handled as we've described, with the stage treated properly and the auditorium able to present control room sound to the listeners. They have paid good money to hear an act perform and they not only want to see it, they want to hear it. By way of a personal comment, I feel that the auditorium sound industry has suffered in principle by sacrificing flexibility of move in move out PA systems for quality that can be designed, built-in and installed in an auditorium and its sound system. I think that this is an unfortunate thing. As soon as you take away the planned merge of a PA system to an auditorium listening environment (the acoustic plan) and you substitute a vacant hall, void of acoustic treatment, and install enormous portable road stacks on the front of the stage or suspend them up in the air, you have the situation of very uneven distribution of power and frequency through the auditorium. If you project to the audience brute force to the back row you're killing the man in the first 10-20 rows and the guy at the back says "turn it up!". So whatever situation you look at with the road system, you are generally looking at compromises because it cannot take into account every situation in every auditorium. You have a make-do situation and you try to accomplish your effectiveness of sound reinforcement with power, and loud is not necessarily beautiful! A screaming midrange, honking lower middle and a distorted bottom end —even though it's loud or apparently loud—isn't beautiful and does not help and is not fair to the artist or listener who has paid his money to hear it. So my contention is that these auditoriums should be planned, stages should be acoustically designed and built, auditoriums should be treated for acoustics and PA systems should be installed into that auditorium to be a part of and integrated with the acoustical characteristics of the hall, the end result being to present broadband uniform power distribution to all areas of the auditorium. That is where I differ in principle with what presently goes on in our industry today.

This naturally led onto a discussion about the Montreux casino just outside Tom's window as being a prime example of the attitudes that he is firmly against (see *Studio Sound*, Montreux Jazz). He went on to mention that among the various tenders that had been made for a fixed house PA he personally had made three—one Westlake and two Eastlake—to make some corrections in the hall and install a fixed PA and generally make the best of the bad geometry that had been put in. Needless to say, all proposals were vetoed for the same reason—budget. As he went on to say: "It's the concept, before the budget is even outlined, never mind stated, that the real problem lies with; that is the portable system—everybody brings their own. Not to worry, just throw it up on the stage, hook up these enormous amplifiers behind it, turn it on and make noise! Well, music is not noise. Music is delicacy, finesse and accuracy. It is the reproduction of what goes on, on that stage. My God, if the piano is just a fraction out of tune the artist will complain but the poor artist, had he sat out in the auditorium and heard what the PA system is doing to his piano, he'd walk off the stage, he'd be finished, not interested! He is very critical in a recording studio, he should have the ability to have that same control over what the audience hears."

This reminded me of when I worked for a small custom-built amplification firm some years ago. A swish restaurant in the West End of London had just spent some £25,000 on interior decoration and deciding that music, both live and recorded, was to be an attraction as well as the food, had installed about a £100 worth of 'hi-fi' for the PA. After about a month's high prices and complaints of broken ears from customers and musicians alike, we were called in to do the job properly (Oh yes, how many times have I heard that!), the only condition being that we could not touch the decor.

TH "No, of course not. That's much more important, you know, and I'm being facetious. Much more important to have it look pretty and have a good visual act than have good sound. To hell with the sound. They think they are not selling sound yet they are selling a musical act which is sound by definition. Never mind if they are in a barn or if they are in the Taj Mahal, never mind. What does it sound like, how real is it? That's my contention. I've heard night club owners say to me: 'I don't give a damn about what it sounds like. I don't give a damn, I just want to see it look right. Never mind there's all this sound crap, sound is sound.' That particular owner who said that to me went bust, by the way!" (Laughs)

TN *There's a moral in there somewhere.*

TH Maybe. However, I do think that in many instances when a budget is laid out for a club, disco or auditorium it is the cart before the horse. I think the concept of music accuracy has not got into the PA field as much as brute force power has and that is unfortunate. Stages are used with zero treatment and it is crucifying to just set enormous stacks in there, push 130spl out of the front of the auditorium and hope that you handle it with a full house at the back. There is no need for that kind of approach. All that it requires is that the concept be changed. Now I'm not saying that road groups should not carry their own PA system. After all, this is what is done by nearly everybody and consequently auditorium owners that feature acts are reluctant to expend enormous amounts of money to put in an audience sound system for fear that the road groups will walk in and, having had bad experiences with other sound systems—junkers as you've described—say: "No, no, we're not going to use that nonsense, we've got our own. It's enormous, it's the best system in the world, we paid £X for it, we're travelling with it, we use it." Well, rather than lose the booking the auditorium bends; they bow and say very well. Result? The auditorium owners are reluctant to take the first stand and say: "Fellas, this is it. We have paid a lot of money for this, we've had our hall treated for this, and this is what you will use."

TN *That is also what you are paying for when you hire the hall.*

TH That's it. A certain amount of control. Look at the studio business. You build an elaborate control room and you hire balance engineers trained to work within that environment and with that equipment. Now what does the studio owner really fear? Here comes a band that has a favourite engineer. Fine. But the band not always being really technically oriented from an electronics point of view, feels that their balance engineer can walk in and do the date completely. Don't need the house man there at all. The house man may be more competent or less competent but one thing is certain, he is more familiar with the setup. So the studio owner is fearful that the outside engineer will come in, sit down at his console and not understanding all of the gadgetry in the control room, attempt to do a mix or tracking

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Tom Hidley on PA

the first time through without a complete understanding of how the whole system works. Results are possibly somewhat substandard. Not in all cases. There are many folks that are familiar with that kind of desk in that kind of environment and they are perfectly capable within 30 minutes of pulling it off. Others are not. So the studio owner fears that the guy who is not capable will sit down at his desk, do the date, the product is substandard and the group goes away and says that bloody studio's not worth a damn! It's garbage. Right! Well, the studio gets bad rapped and it's not the studio's fault, it's the fault of the—well, where does the fault lie? In the studio owner saying OK you can bring your own balance engineer, or in the balance engineer's inadequacies not being able to handle it the first time round? Now perhaps the second or third night, after watching the house man handle it, he could sit down and do it, but frequently he goes in and pressures are applied and bad feelings come out of it. (Now, I don't know if all of that should be published but it's true—it's what happens. I've seen it repeatedly in Europe and in America.) In various music markets in the studio business, studios more often than not are the brunt of a complaint and take the blame for something they are not really responsible for. It's not fair. And the same analogy can be applied to an auditorium PA system that is brought in. The balance engineer may perfectly understand it but at the same time may possibly not understand the best way to get that house to work with that particular setup. It is not the system working with the house, it is the house working with the system. There is a difference and it is a difference that is not really understood.

So, you look at me; Eastlake is a studio design and building company. By the end of the year there will be over 200 rooms where we have been directly responsible for the design and probably 75% of them will have been built by ourselves rather than by outside contractors. It has developed a wealth of information. It has shown a lot of weaknesses in our own area of design; pointed out things that needed improvement, which we constantly work on, and the occasional time that we have a client directly involved or indirectly with an auditorium who asks us for help, well, you can't say to that client: "No!". You have got to do your best with the situation and this is how we have got thrown into it, little by little by little. We have had bad experiences and more recently very good experiences in auditorium work, and I have come to put these thoughts together in my mind that we have just discussed through observing what's going on in these concert situations and what happens on the stage and in the audience. What the complaints are. What are the non-musical aspects of what is going down? How is the customer being short-changed and how is the artist being

misrepresented. Those are really the two key cruxes of the musical side of the situation—the audience is being abused in many or in most instances and the artist is not being well represented by the systems that are put into these auditoriums on one-night stands.

TN *You and I have got a lot in common*!

TH Well, OK. Good. But I'm not here to say I've got all the answers. I sure don't, but I think the principles that we have talked about are nothing other than studio and control room principles and I feel in that category we damn well can speak from experience. Music is music. A performing environment, be it a studio or a stage, is a performing environment and a listening environment for accuracy, be it a control room or an audience in an auditorium, it is the same and in this context I feel that I can say something's wrong in the PA application in the world in general.

TN *Going on now to the situation where the venue is not a concert hall but a stadium, sports hall or even open air—do you have any thoughts on this?*

TH The principles we previously talked about are the same—the application has to be different due to the cubic volumes involved. Now what I have been discussing are auditoriums seating 4/5,000 people. I feel quite comfortable working in that size of auditorium such as the London Palladium where we did the house system. As the Palladium is an historic build-

ing, we were not allowed to touch the stage geometrically or the auditorium's acoustics, but we did put in a PA system of broadband frequency response with wide horizontal coverage. In order to get direct projection into the stalls and top and centre balconies, we had to go 27ft vertically up the columns on either side of the proscenium arch. The monitor for each audience section is broadband so you don't have one enormous low end array at the bottom on the stage, a mid-range further up and a tweeter section on top of that so the guy in the first row has no chance to hear anything but bottom end, the guy in the middle gets mid-range and bottom end and the chap at the back gets the direct throw of the tweeter with a little spray around the middle. Each of the Palladium monitors has a frequency response of 34Hz-16kHz. Now the curve is tailored for feedback reasons, but rests essentially a broadband curve. The power applied to the monitors for the front of the house is less than that supplied to the centre stack which are feeding a longer throw, the most power being applied to the top stacks which are feeding the longest throw. The result is that equal power energy within the auditorium is somewhat achieved plus equal distribution of sound both horizontally and vertically. Now that is a stage frontal

system with no second area reinforcement halfway back. The total distance of throw is about 120ft—not too long—and the building is also fairly wide, seating up to 3,000 people. The system has proved to be very satisfactory. Expensive—but satisfactory in its performance. I would have liked to have seen acoustic treatment in the auditorium plus certain things geometrically on the stage, but this was impossible due to the Palladium being an historic building.

At present we are looking at another project, the Virgin Club in London which will be for cabaret, new acts, established groups, etc. There will also be a sit-down dinner establishment as well as drinks licence and will essentially be on one level—no balcony operation. The request has been made by the clients that the front row not be killed with power and that the people at the back and in the middle will have equal energies. (We are talking about spl energies here, not the other kind!) Fine. They have also accepted that the stage will be built somewhat as a studio with walls and ceilings geometrically arranged for natural projection into the audience coupled with the reinforcement system. That again will be a stage frontal system but at various vertical heights so as to accomplish the uniform power distribution that they are looking for. Again, a fairly small environment, much like a discotheque. I'm not trying to equate the Virgin Club with a disco, but I'm saying that you could handle a discotheque with the same kind of approach as regards uniform power distribution. (Though the Virgin Club is now open at time of writing (see *Sound International*, p72, December 1978) there rests about six months of work to finish the hall acoustics, etc.)

You mention the stadium. This becomes a gigantic problem to

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Tom Hidley on PA

handle and you need to use the finesse that you would if it were a fixed auditorium for music only.

A stadium has basketball, car shows, cattle shows — and the occasional music show. Capacities of 15,000/25,000 are quite commonplace and in the States there are places that handle well beyond that. Cubic volumes are enormous—power is required. Again, this is a humble opinion but perhaps the same type of monitor is not in line for use in a 4/5,000-seat hall but the stage is still the performing area and the audience still the evaluating and listening area. The principles are the same but the approach must obviously be different because the volumes are larger.

We have built two road systems, one of them successful and the other, in my opinion, unsuccessful, even though they were identical. Without naming any names we'll talk about the successful system. This was put together, managed, run and operated by balance engineers from a recording studio that was directly involved with the group that bought the system. The balance engineers that did their record dates also did their concerts on the road. These engineers were clearly capable of defining precisely what they wanted as an end result to the audience, or at least to their mix position in the audience. The system worked from a musical point of view and after the first time it was used in Madison Square Garden I got a telephone call at the end of the concert from the chief engineer (unfortunately I wasn't there) whose comment was 'Magnificent'. OK, the system worked. It also had major drawbacks. Mechanically and logistically it was not an easy system to put together. It took a lot of interconnection, a lot of delicate grounding and there were a lot of things that were not practical for the final application of one-night stands. However, they were willing to live with this because of the results that they got. The system was later augmented, some things changed, and the crew relearned some things about what should and shouldn't be done. It was our first test case in this situation and again we have had much cause to learn. The next thing that came about in our history was another act that came to us and said: "We want a stage system, just a stage monitor setup for us to use". This was put together and again success; they loved it. The third proposition that came along was a client that wanted a very large elaborate road system. We went back to the pattern of what we had done on the first system which was of a similar nature. However, in this instance, the people that were running the system in the field were not the same as those doing the record dates and again that system was mechanically unwieldy for one-night stands but at least we were learning. This kind of connector doesn't hold up, that sort of situation won't stand the day-to-day travel. The whole thing just seemed to be too cumbersome, too awkward to handle; not enough time to set it up or debug it and it was just an impractical situation. At that point I passed; this is a field that I just don't feel confident in. The next venture was the Palladium system which, in my opinion, has turned out extremely well. However, it was a controlled environment to an extent and the one following that will be the Virgin Club. I look for enormous reaction from the industry on it because it is going to be a studio on stage with an audience that is a control room and I think the result of the thing when artists perform there is just going to be a revelation to what really can be done.

Coming back to your main big theatre or stadium, I think that the principles used in the smaller 4/5,000-seat hall can still be applied. The problems of trying to apply them is that the stage many times is struck, taken away, and hence your acoustic handling of that stage is finished so you have to pass on that. The second thing involved is that the cost of putting in a proper system for uniform distribution in a 25,000-seat auditorium would probably be so astronomical that you would never sell it to the owners. They would say this is not 100% of our income. We have motor shows, cattle shows, etc, so for one out of six or seven shows we're supposed to spend that much money? It wouldn't seem feasible to them. So the answer for the big auditorium, stadium, etc, although in principle we can say this is the way it should be done, in reality it probably can't, because of economics. However, the 4/5,000-seat hall is generally a music auditorium and as a result the owners and management are a little more prone to want to break the habit of the enormous stack that comes in with the roadshows and put in something with a little finesse.

TN *So the large road systems you don't want to give a definite opinion on—either by lack of what you consider to be adequate experience or whatever or feeling that they are out of your area for the moment?*

TH I think they are out of place in 3/4,000-seat halls.

TN *But if we talk about the average rock venue . . . .*

TH By the sheer economics of putting a system in a place of that nature where only one in six shows are music shows, by the fact that existing rock groups have invested enormous amounts of money into their own systems—and are not willing to give them up—by the pattern that has been established and by the economics on the negative side of what it would take to make an auditorium like that of an acoustical auditorium, I think you are fighting at this juncture too many existing conditions, ie venues for boat shows and concerts, present investments in existing PA equipment, etc — an immediate major change in the concept that has been started is in order.

TN *In the case of a rock group knocking at your door and saying they want a big road system but nothing already available satisfies, then they want you to build them one, would you be interested or not? Would there be some pointers you could give them?*

TH There would certainly be pointers that I would want to discuss and there would be a lot of conversation that I would want from them before I committed myself. If I felt I could not better the situation as it already stands I would tell them so, and vice versa It would have to be looked at as a one by one individual situation. I would want to know the technical expertise travelling with the group, size of venues and what they want to project—be it power or quality or both—and how much time they will have for setup (this last point often being out of their control). I would not approach it as I did the other two large systems I did in the States.

I went on to ask Tom whether there were many differences between the systems he had built and existing road setups.

TH Enormous differences. Folded or front/rear-loaded horns were not used. It was a studio system. The application was really not correct on a daily moving-it-around basis. It could have been used having been built-in to an auditorium that had been treated and in fact should have been in order to get uniform power to the front and back rows. The distribution factor is the costly thing because it implies nothing but a quantity of monitors and once you get into a long throw and areas where you cannot project far enough back broadband — you might be able to get 3kHz to the back row with a certain intensity, but if you are talking about a musical balance to the back row with the same power—and you are talking about a few hundred feet—well, at that point you are into multiple arrays staggered towards the back of your 25,000-seat auditorium which in turn implies DDL's and synchronisation of the sound which becomes really delicate and costly, as well as not being road movable. The expertise to set it up is generally not there, the time to set it up is certainly not there and the mechanics of setting up and installing such a system in the auditorium is often not available. It implies a permanent installation, which can be done, control room sound can be put into a 25,000-seat auditorium but who has got the money to do it and use it one out of six nights?

TN *There is always the Grateful Dead—$350,000 and 16 hours of installation.*

TH (Laughs) Yes, I know that setup. Comes a point where you say where do you draw the line, where do you stop?

We then went on to discuss the performance of the system put in for the London Palladium. As can be seen from the drawing this uses three pairs of vertical *TM-3* monitors, each pair being inverted in order to couple the bass, per side. Power is provided by H/H *500D* amplifiers in conjunction with White graphics and crossovers. One of the comments made when the PA was first used was: "I can't believe the clarity and bottom end", which must mean that the system works.

TH The stereo sum image on the ground floor is 4.5dB. Now there are a lot of control rooms in this world that are not even 3dB! The first balcony has 4.25dB stereo sum and the top 4dB. Now that is broadband and the clarity, the purity that results from that kind of planning of convergence on paper and plan and then installing per se means that you have a controlled condition.

Time and practical experience will tell if the experiment at the Virgin Club will have positive repercussions on the live music industry. Whether one likes or agrees with Hidley's ideas is largely a matter of personal preference but the main point is that someone is making an attempt to remedy a situation that has been left dormant for far too long. Perhaps this will encourage others in the industry to join in with some concrete propositions. After all, if somebody opened a recording studio in a garage without even putting up one sheet of fibreglass I doubt whether the business would be a going concern for very long, so the next time you see your favourite group at the Empire Arena think about that little analogy and whether artist and audience alike are not being conned by the present situation. Think about it. ■

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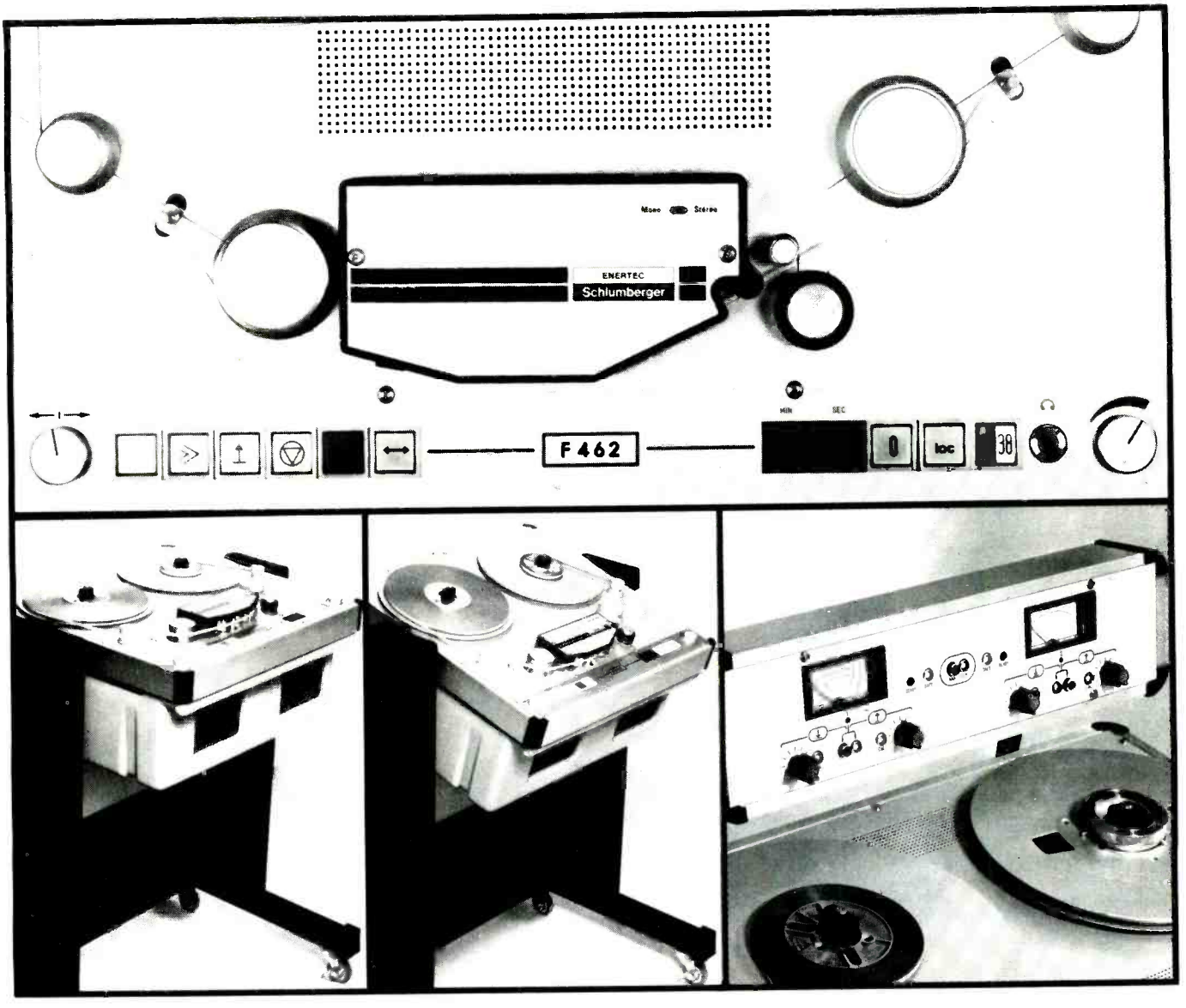

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letters

Uher CR240 review

Dear Sir, I am perplexed that you continue to publish reviews or 'operational assessments' such as the Uher CR240 *in your magazine.*

I recall an earlier review of a simplified Nagra IV *which was assessed by alleged professional journalists, same arguments, couldn't comprehend the controls, difficult and heavy to use.*

All new equipment is initially confusing, time is the ultimate reviewer. This Uher machine looks much lighter than a stereo Nagra, and would certainly fit into a flight case with 40 cassettes and batteries with more ease. But is the Dolbyed stereo cassette an alternative to a stereo Nagra yet. This is what I hope your magazine will tell me. Some doubts have been raised about the CR240*'s hum levels with the external power source, its ability to record music (mic overload, tape flutter) and the ease of head cleaning. A technical review plus a long term users report would be of much more advantage.*

Let's face it, most radio reporting standards have plumetted since the days when the BBC recorded discs in the back seat of large Humber cars. Relegate these 'off or loud' incompetents to the medium they deserve, the intergalactic phone in!

Yours faithfully, A peeved radio listener, Bristol.

Dear Sir, I have just read your review of the Uher CR240 *cassette tape recorder. Frankly I am astounded by the tone of the article.*

In 22 years as a reporter, correspondent and finally as Chief of Foreign Correspondents, I have never found a better quality tape machine.

The early editions of this model, the Uher 134 *and the Uher* 210 *have been used by myself and other correspondents in regions from Biafra to Bangladesh and from Sapporo to South Africa with great satisfaction.*

One of your reviewers reports that the batteries "fall out" . . . so doing a recording during the demonstration would be "foolhardy". I would respectfully point out that I personally have used this machine doing on-scene radio reports in war conditions and have never experienced any battery "fall-out".

If she finds the CR240 *complicated, perhaps one should seek understanding in the revelation that your reviewer works as the host of a children's programme. She should, as she suggests, stick to a "simpler recorder".*

I am, however, pleased to read that the reviewer concludes that "technically the recorder performed brilliantly and the quality was perfect". It makes all the article's previous criticisms seem what they are in fact: petty and inconsequential, in light of the professional journalist's search for the best available tools of his trade.

Yours Faithfully, FJ Kennedy, NBC News Worldwide Inc, 8 Bedford Avenue, London WC1B 3NQ.

Dear Sir, While I am becoming increasingly used to ill researched and damaging comment on many new products in the more 'light weight' hifi magazines, I was disappointed to see you follow the trend with Peter Sharp's review of the Uher CR240 *in January's issue.*

Obviously personal preferences and value judgements, albeit negative, can be accepted, however I would be grateful if you would allow me the opportunity to correct the several erroneous technical observations made by your selection of users.

Firstly, I can assure Jim Keltz that: it is impossible for the batteries to fall out when the machine is in the case; the machine cannot fall out of the case; the cassette loading mechanism is essential to the compact size of the machine and hence is not senseless; and his choice of microphone cannot be levied against the CR240.

Secondly, Therese Birch's honesty about not bothering with the instruction book goes a long way to explaining why she had difficulty in understanding the CR240, *particularly as controls simply labelled Dolby, Tape Selection, and Level were incomprehensible to her! Had she read the instructions, she may even have discovered the light which illuminates the cassette in low light conditions.*

Finally, Vince McGarry dismissed the CR240 *as being only justifiable in a home hifi set-up and then declared it as unusable since it only ran on batteries. The* CR240 *is equally applicable to home hifi, field or in-car use and runs from a mains unit, a 12V car supply, a 10 hour rechargeable accumulator or even dry batteries.*

In conclusion, please understand that the CR240 *was designed, not as a replacement for say the Sony* TC150, *but rather to offer the highest quality stereo recording in the smallest and most convenient form.*

Yours faithfully, Roy L Campbell, general manager, Uher Ltd, 24 Market Place, Falloden Way, London NW11.

Vocal-Stresser

Dear Sir, We refer to your review of AES New York last month: in your description of the Orange County display, reference was made to 'vocal-stressors' in their product range.

Orange County Electronics of Winnipeg, its subsidiary and agents, are bound by a Consent Decree dated 1976 September 24 before a US Federal Court, not to use the term 'vocal-stresser' and 33 other marks in connection with their products anywhere in the world. The Court found that this and other marks were valid trademarks of Audio & Design (Recording) Ltd. Vocal-Stresser *was never a common usage term and we must protect this mark from such use by drawing attention to these facts.*

We trust we will have your magazine's co-operation in correcting this error at the earliest possible date. A copy of the Consent Decree is being made available to you to substantiate our claims.

Yours faithfully, M. J. Beville, chairman, Audio & Design (Recording) Ltd, 84 Oxford Road, Reading RG1 7LJ.

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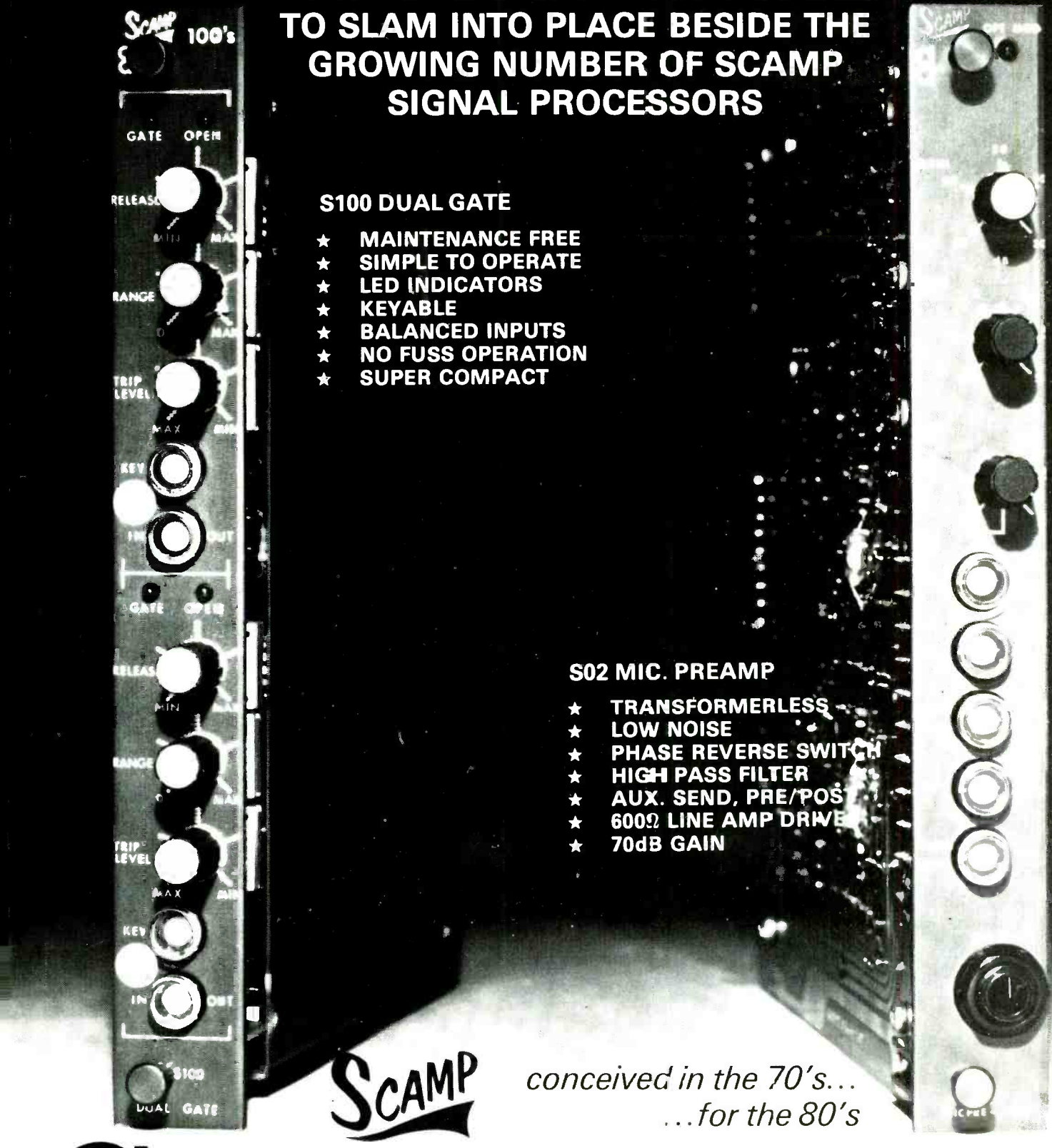

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Rock Festival's reply

Dear Sir, On reading Donald E. Person's interesting letter (February 1979) which, amongst other things, alleges 'inexperience, ineptness and bumbling' on my part, I find it difficult to plead one way or the other owing to the absence of any specific point of criticism in his letter which might justify the charges.

He does, however, raise one significant point which is worth further discussion, ie when he says that he 'would never admit to such inept technical blundering . . . ' etc.

It would have been very easy for me, in retrospect, to have presented the day's events in a more dignified and cosmetic manner.

This approach would have resulted in a predictable exposition of ordered theory and technique, tactfully ignoring any contentious practical and human problems.

Extending Donald's policy to its natural conclusion would in general terms, lead to a great deal of face being saved, and a great deal of information being lost.

Am I correct in inferring that, as this information would, in his opinion, only be of value to those whom he considers 'inexperienced and inept', he consequently justifies a more expedient attitude towards the reporting of such matters, in preference to the slightest risk of personal criticism.

Yours faithfully, Bill Aitken, BBC Radio.

AVAB Visu-Lizer

Dear Sir, Thank you for the article about the AVAB Visu-Lizer *in the January issue of* Studio Sound.

I hereby wish to underline what Hugh Ford mentioned in his summary, that the equipment is primarily intended to be an easy instrument to measure the frequency response curve—from source to the produced sound in the room.

I agree that the Visu-Lizer *is not easy to use as an instrument of its own as we have not included any character generator with it. The reason is that it would make the equipment a lot more expensive and that when the* Visu-Lizer is *used together with our equalisers which have the same octave bands, then the whole equipment* (Vizu-Lizer *and equaliser) will give the user a very quick and easy way to obtain a flat response curve in the listening room.*

This is also the reason for the calibration of the Visu-Lizer*—when all the bars are equalised the* Visu-Lizer *shows the spl-level in the room.*

Concerning the microphone, as you probably know from practical measuring with a spectrum analyser in a normal room, the response curve will be far from flat. A possibility of equalising the response within a few decibels will be a great improvement.

A better microphone, eg AKG C451E, which we have suggested in the leaflet enclosed with the Visu-Lizer, *will of course give a more precise measurement.*

Unfortunately such a microphone is very expensive and we think that the Beyer microphone is a good compromise, especially when you have the Visu-Lizer's *intended use in mind.*

Both these microphones are described in the leaflet where we have also explained how the bars on the TV screen should be set to compensate for the Beyer microphone (63Hz 3dB down, 31.5Hz 6dB down). Furthermore we supply each microphone with its own response curve where we also point out the peak response at 8kHz (normally the 8kHz bar should be set 3dB up).

In addition to this I wonder if you have received the leaflet mentioned above in its English translation.

There is a difference when the Visu-Lizer *is used together with an octave band equaliser, because each bar on the screen will then have its correspondent control on the equaliser. To adjust an equaliser without an analyser can be a very tiresome task, and the* Visu-Lizer *is in this case very easy to use and not the least, easy to read off even at a long distance and by many people at the same time.*

To summarise the idea behind the Visu-Lizer: *it is an instrument that people without a deep knowledge about acoustics can use, eg when they adjust their equalisers at home, construct their own loudspeakers and so on. Naturally an ordinary customer cannot afford his own* Visu-Lizer, *but in Sweden hifi retailers have them for hire which makes the equipment available for everyone.*

Yours faithfully, Dan Weinholt, export manager, Tommy Jenving AB, Karl Johansgat. 98, 41451 Goteborg, Sweden.

Quality control

Dear Sir, I appreciated the opportunity to meet members of your staff during the Audio Engineering Society Conference in New York City this past November, and to have received your magazine during 1978. The publication has been very useful in keeping me informed on the developments in equipment and procedures for the improvement of broadcast sound and audio reproduction quality.

Of particular interest to me was the article by Royer Slater in the April 1978 issue on the quality control in the manufacturing of metal stampers and pressed records. This article contained the most comprehensive description on the manufacturing of records I recall being published in the technical journals, texts of audio recording, or in the popular magazines directed to the audiophile. I believe that broadcasting station engineers and production staff having knowledge of the correct terminology for the various defects occuring in records and their causes will be particularly helpful in communicating with record manufacturers and distributors in obtaining pressings of the highest possible quality for broadcast use. Experience indicates that record firms will more readily respond in supplying select quality discs and replacements for defective pressings when the defects are correctly identified. I believe that additional articles on quality control in record and tape manufacturing will not only be of informal value, but also assist the performing artists, recording studios and broadcast station personnel in obtaining records of improved quality for broadcast and for use by the public.

Yours faithfully, John W. Reiser, Federal Communication Commission, Washington,DC 20554, USA.

Parametric Equaliser

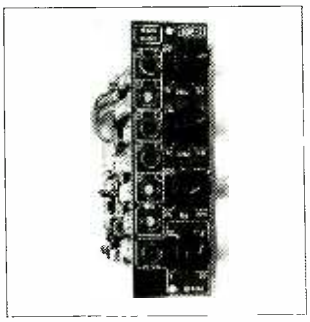
A very versatile instrument for getting sounds just right. It's modular and directly retrofits APSI 550.

EQ is peak or shelf.

Filter is high or low pass, tunable.

Bandwidth is 20Hz to 20kHz.

Reciprocal cut or boost on EQ.

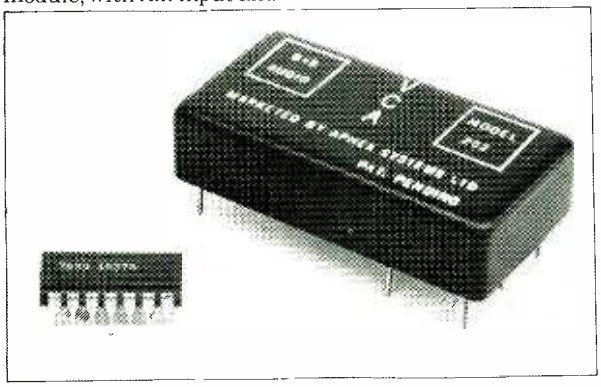


Input	High level	+ 30dBm (max) at 34KΩ
	Low level	+ 20dBm (max) at 11KΩ
Output	High level	+ 30dBm with − 93dBm noise
	Low level	+ 20dBm with − 103dBm noise
Frequency response	EQ & filters out	10Hz to 20kHz, ± 0.1dB
	EQ & filters in	20Hz to 20kHz, − 1dB
Distortion	Harmonic & IM	< 0.1%
Transient response	Slew rate	> 10V/sec.
Power		± 12V to ± 18V at 75mA

Voltage Controlled Attenuator

The first high quality VCA in the professional audio market.

It's available in chip form for OEM, or in a complete module, with full input and output facilities for direct fitting to any automated console with existing VCA's. However, we can design a VCA package to fit any other manufacture.



Band width	Module	DC to 200kHz; ± 0.1dB
	Chip	DC to 50MHz; ± 0.1dB
THD	+ 10dBm input	0.004% (20Hz to 20kHz)
IMD	− 14dBm input	0.03%
Noise	Unity gain	− 90dBV; ± 1dB
Modulation noise		6.5dB
Overshoot & ringing		None
Slew rate		> 10V/μ sec.
Input impedance		20KΩ
Input level		+ 20dBV
Gain		0dB (+ 15dB available on special order in module form)
Attenuation	Module	> 94dB; 20Hz to 20kHz
	Chip	> 100dB; 20Hz to 20kHz
Control voltage		Can be scaled as needed
DC shift	Vs Attenuation	≤ 5mV
Power		Regulated ± 15V at + 25, −33mA

Grouping and Automation System

With this system, you can now add semi-automation to your console at a fraction of the cost of a new one. Adaptable logic and extensive matrix grouping make up to ten 24-channel presets available.

And since the unit is portable, it can be moved from one studio to another in minutes, for the most efficient use of studio time.

It's expandable from 8 channels and it's just as useful for PA grouping as studio mixdown.

For MCI equipment, a compatible automation package is available.

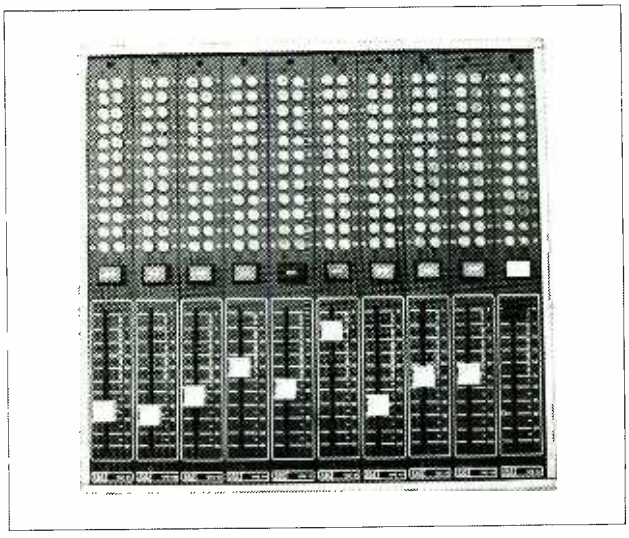
Our own Voltage Controlled Attenuators (VCA) are used throughout, whose high quality assure minimal sound degradation.

Maximum output is + 24dBm.

The system comes in two parts–control console and VCA case.

The control console has group control modules, each containing grouping switches, mute switch and fader, and a master control module with master fader.

The VCA case is self powered and houses the appropriate number of VCA cards and all the input/output XLR connectors.



Aphex

The Aphex Aural Exciter

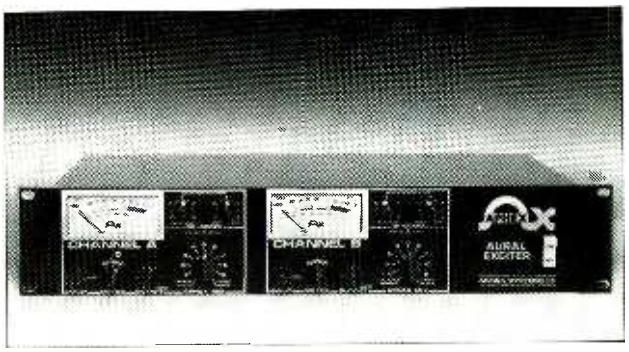
One of the most exciting signal processors to have been invented.

It brings sound to life and makes it louder, without any actual change in level.

It does it by introducing phase information in the form of a series of minute delays whose magnitude depends on frequency.

The formula by which the Aphex device selectively processes the audio signal has been arrived at after considerable research into the mechanisms of the ear. In particular as to how it receives complex phase information relating to the actual location of a sound source.

Aphex sounds amazing on most instruments, including the human voice.

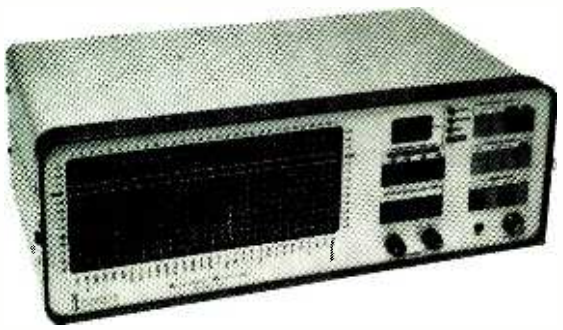


Aphex
Audio Systems (UK) Ltd
35 Britannia Row
London N1 8QH
Telephone: 01-359 5275
Telex: 268279 Britro G.

APHEX

reviews

Inovonics Model 500 Acoustic Analyser



MANUFACTURER'S SPECIFICATION

Analyser sensitivity: (for 0dB reference level) 40 to 139dB SPL or dBA weighted for microphone input, —60 to +39dBm for line input. Maximum display sensitivity range extends measurement limits to +9 and —27dB re reference level.

Display range/accuracy: 0.5dB, 1dB or 2dB per step with relative reference level, and indicated display error less than ±0.25dB; 3dB with step error less than ±0.5dB.

Filter characteristics: 2-pole pair filters on ISO ⅓-octave centres, 25Hz to 20kHz. Response exceeds ANSI S1.11/Class II/1971 standard, relative filter accuracy ±0.5dB.

Rectifier characteristics: peak or 0.25, 1 or 4s log averaging response, crest factor greater than 20dB above indicated reference level.

Reverberation analysis: RT_{60} readout internally extrapolated from 30dB or 15dB initial decay. Measurements to 9.99s with 10ms resolution; an exclusive averaging system increases low frequency measurement accuracy. Accuracy ±3%, ±2 counts for decays greater than 0.1s. Decay plot has vertical resolution of 0.5dB, 1.0dB, 2.0dB or 3dB per step.

Microphone input: 200Ω balanced with XLR connector. MIC CALIB adjustment accommodates microphone sensitivities between —60dB and —48dB reference 10μbar.

Line input: 100kΩ unbalanced; calibrated ±0.5dB.

Pink noise source: digitally synthesised pseudo random ±0.5dB spectral accuracy, selectable wideband or octave band output with 2-pole filters on ISO centre frequencies 63Hz to 8kHz. Manually gated unbalanced output is variable to +5dBm.

External oscilloscope output: BNC connectors for scope vertical and sweep trigger; external scope display has 7.5, 15, 30 or 45dB dynamic range.

Interface connector: permits external control of memory storage, pink noise gating and decay plot scan; provides display data output and internal clocking signals for interfacing with digital peripherals.

Power requirements: 100/120/220/240V AC ±10%.

Internal battery: 3 hour typical operating life; recharges in 8 hours.

Operating environment: 0°C to 50°C; 0 to 90% relative humidity at 40°C.

Size and weight: 135 x 394 x 292mm hwd, 7.7kg.

Price: $2,750

Manufacturer: Inovonics Inc, 503-B Vandell Way, Campbell, Cal 95008, USA.

THE INOVONICS ANALYSER is not only a ⅓-octave spectrum analyser but also a reverberation time measuring device including a pink noise source which may be filtered into octave bands. A LED matrix having 31 vertical lines and 13 horizontal lines is used as a display of either the spectrum analysis or the reverberation decay. In the spectrum analysis mode, each vertical array of LED's represents a ⅓-octave band in the standardised sequence 25, 31.5, 40, 50, 63, 125Hz from the lower limit of the 25Hz ⅓-octave up to the 20kHz ⅓-octave in 30 bands, the 31st LED being a wideband level indicator.

The vertical scaling of the display is controlled by four interlocked pushbutton switches each with a red LED indicator to show which switch is operated. These switches permit display scaling from 0.5dB per step, 1dB, 2dB to 3dB per step with the actual display being calibrated from +3dB to −9dB in one decibel steps.

A further four interlocked switches, also equipped with red LED indicators, serve two purposes. In the spectrum analysis mode, the switches select the display averaging time between 0.25s, 1s and 4s when using an average law rectifier or select peak indication using a genuine peak rectifier. In the reverberation time mode, these switches select the horizontal timebase speed of the display for plotting the decay curve, the available speeds being 7.5, 15, 30 or 60ms per horizontal step. Thus the time for a full scan of the display can be varied from 232.5ms up to 1.86s.

This reverberation display operates in conjunction with one of the two inbuilt memories which in the spectrum analysis mode can be used to store displays indefinitely for subsequent comparison, four buttons being used to enter or clear either of the two memories. A further feature is that by means of two rear panel BNC connectors the display can be shown on an oscilloscope in the form of a vertical bar display; one connection being the signal to the oscilloscope and the other the trigger to the oscilloscope for maintaining synchronisation.

A further four pushbuttons select the display mode, input source and weighting. Buttons identified as MEMORY A and MEMORY B display the contents of the memories whilst the button RT_{60} displays the reverberation time and curve. The fourth button REAL TIME selects a real time display, but, repeated pushing of this button selects a line level input displayed in dBm, a low level microphone input displayed in either dB sound pressure level or dBA weighted sound pressure level. The mode selected is indicated by a LED adjacent to a three digit decimal display which indicates either the 0dB level of the spectrum display in the range 40 to 139dB SPL, −60 to +39dBm for the line input or reverberation time in seconds, tenths and hundredths.

During any overload or out of range conditions, this digital display is extinguished as it is if reverberation time measurement fails due to lack of available signal-to-noise ratio. The desired zero level of the spectrum display is selected by two pushbuttons, one of which raises the level and the other of which lowers the level, both in 1dB steps. Cleverly a single push of a button alters the zero level by 1dB, whilst holding either button continuously alters the level at a rate of 10dB/s. There are two further pushbutton controls, associated with the display and pink noise source. The former serves two purposes such, that in the normal display modes, it allows the analyser to automatically set its zero level in accordance with the signal input level (only in 1 or 2dB per step displays with either 0.25s or 1s averaging time) whilst in the reverberation time mode, it allows the instrument to assess reverberation time from the decay time to −15dB instead of the normal −30dB used by the instrument (normally reverberation time is the time for a signal to decrease to −60dB but assuming exponential decay, this time may be found by doubling the time to the −30dB point or quadrupling the time to the −15dB point).

The other switch mentioned above is the pink noise gate switch and switches off the pink noise at the same time as starting the reverberation time counter when depressed. The time display and curve display then disappear with the curve then being plotted in real time and the reverberation time display remaining extinguished until the −30dB (or −15dB) point has been reached.

A rear panel ¼in jack allows an external signal to be fed to the gate and through the octave filters to the signal output; the gate is however not arranged to operate at zero crossing points and therefore has restricted applications. Two front panel controls affect the noise output, one a level potentiometer giving an output up to +5dBm and the other a nine position rotary switch which selects either a wideband output or an octave filtered output with centre frequencies of 63Hz, 125Hz, 250Hz, 500Hz, 1kHz, 2kHz, 4kHz or 8kHz.

The remaining front panel features are the power on/off switch and a nearby red LED indicator. During mains operation this LED is illuminated whilst the internal battery is being charged to 80% of its capacity and during battery operation remains extinguished until about half an hour of battery life is left, when it begins to flash. According to the manufacturer, the instrument may be battery operated for 2/3 hours with a recharge time of 8 hours mains operation.

To the rear of the instrument, a pushbutton switch selects mains or battery power operation with the mains being applied via a standard IEC connector in combination with the fuse and voltage selector. The microphone input is a XLR socket providing a balanced input with an associated screwdriver operated calibration potentiometer being accessible

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Series III De Lux Mixing Console available for 16, 24 or 32 track monitoring. This re-styled version of our very popular standard console features Indian Laurel wood finish, leather armrest, illuminated meters and comes complete with power supply, Penny & Giles faders, XLR connectors and stand. For further details of this low cost, high quality system, contact our agent in your country or direct to the factory.

28 inputs, 24 track monitoring console supplied recently to Olympic Studios (Chelsea).

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Hillbrow, Johannesburg 2001,
South Africa. Tel. 642-8721/1209

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through a hole in the rear panel.

The unbalanced line input and the external gated signal input together with the gated signal output, are all unbalanced ¼in jack sockets—a type of connector more compatible with a studio environment rather than a laboratory?

The final rear panel connector is a 10-pin digital interface which permits external control of the gate, initiation of the reverberation decay plot, memory entry and finally a 4-bit serial output of the displayed levels together with the necessary timing pulses to use this data.

Internally, the standard of construction was very good with the glass fibre printed circuit boards being easy to remove for servicing through the use of ribbon cables and connectors joining the boards to each other and the fixed components on the chassis. Whilst there is not widespread use of components identifications, the excellent instruction book includes clear layout diagrams and circuits together with a full description of the instrument and of course operating instructions.

Spectrum analysis of the pink noise output at an effectively constant bandwidth should produce a plot falling with increasing frequency at 6dB per octave (10dB per decade) and **fig 1** shows that the output is flat to within 0.5dB from 100Hz to virtually 20kHz, but that at 20Hz the output is 1.5dB below its desirable level. As will be seen later, this does not matter if the pink noise source is used with the spectrum display which reads slightly high at low frequencies.

Like the pink noise source, the external gated input passes not only through the gate but also through the octave filters, the frequency response of which is shown in **fig 2.** These filters are common 12dB per octave filters as opposed to bandpass filters specified by ANSI or other standards. In the wideband position of the filter selector switch the frequency response from the external gated input to the output is shown in **fig 3** which is reasonably flat to 20kHz.

The manually operated gate which is not designed to operate only at zero crossings of the waveform gave 67dB isolation which is more than adequate with the maximum pink noise output level being +5dBm from a very low source impedance at maximum output level, increasing to a maximum of 260Ω with variation of the level control. The input for external signals to be gated could handle +2dBm in the wideband mode or −4.5dBm with the filters in circuit into an impedance of between 13kΩ and 9.8kΩ depending upon the filter selection.

The level accuracy of the display was checked for overall error relative to maximum deflection and also for errors between increments on the four ranges. As can be seen from **Table 1** these errors were always well within one display division and the accuracy of the increments was excellent.

The fact that this instrument has an accurate 0.5dB per division resolution means that, unlike so many analysers, it can be used for the accurate alignment of tape recorders and transmission systems when using pink noise and this is much quicker than using sinewaves and plotters.

Another potentially useful feature is the ability to use an oscilloscope as a remote display, but as can be seen from a photograph of such a display (**fig 4**) it is not all that easy to interpret the frequencies and levels in the display. However, if one is aiming at a flat response, this problem may not be too critical.

Checking the centre frequency of the display filters showed that worst case errors were about 1% with the majority of filters being tuned to within ±0.5% of their nominal frequencies whilst investigations into the filter shape revealed that the characteristics were

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TABLE 1
MAXIMUM ERROR IN DISPLAY

Range	0.5dB	1.0dB	2.0dB	3.0dB
Incremental Error	0.09dB	0.13dB	0.42dB	0.9dB
Cumulative Error	0.34dB	0.45dB	1.5dB	2.5dB

FIG.1 INOVONICS PINK NOISE OUTPUT

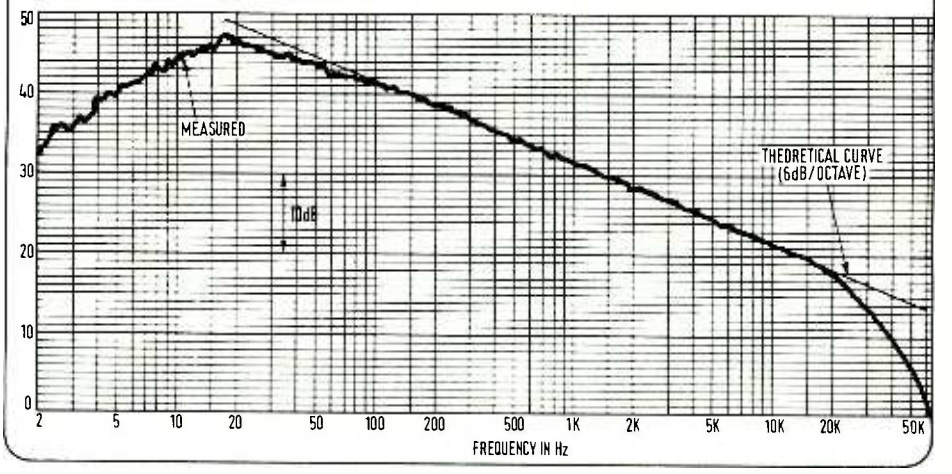
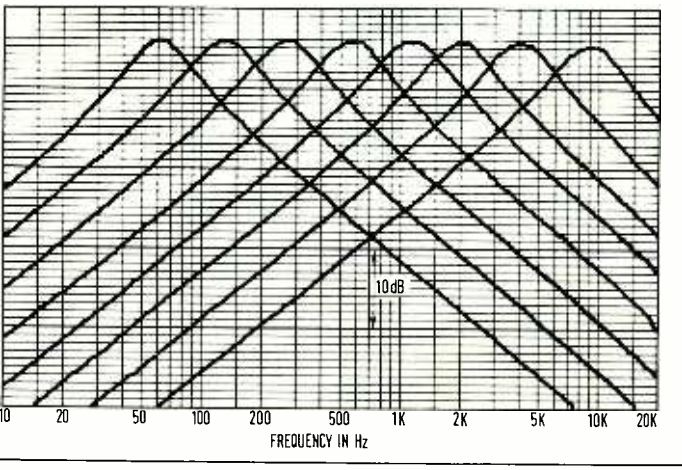


FIG.2
INOVONICS 500
OCTAVE FILTER
FREQUENCY
RESPONSE



"OUR GAUSS EQUIPMENT IS BETTER TODAY THAN THE DAY WE BOUGHT IT."

George R. Jones, Vice President
MCA Records Inc.

"Thirty years in the recording business is a little like thirty one-year experiences. That's how fast this business changes. And with the requirements of quality in our product, the quality of the consumer's equipment and the technology of our industry, we've continually upgraded our Gauss high speed tape duplicating equipment. We don't exchange the system, we improve the existing system. And Gauss is there to help us. That's important to us. Ten years from today, we'll probably still be using our same Gauss equipment. With modifications."

At Cetec Gauss, we think we ought to grow with you. Just as we've grown with MCA. That means we offer you our equipment in modules. Not just master, tape bins, and slaves; but, electronic and reproduction modules. That means you can upgrade your equipment as we upgrade the technology. You remain state-of-the-art because we're state-of-the-art.

But don't take our word for it. Ask anyone who owns Gauss equipment why they own Gauss equipment... instead of something else. The answer will probably be that they can't afford to own anything cheaper. Beccuse Gauss delivers.

Where do we go from here? Straight ahead. With better sound reproduction, even greater reliability and state-of-the-art technology. Modularly. Which means you can plan to own your Gauss high speed tape duplicating system for a long, long time. Ask anyone who owns Gauss equipment.

Write for our Tech Sheet. 32:1 or 64:1. Gauss is a better system.

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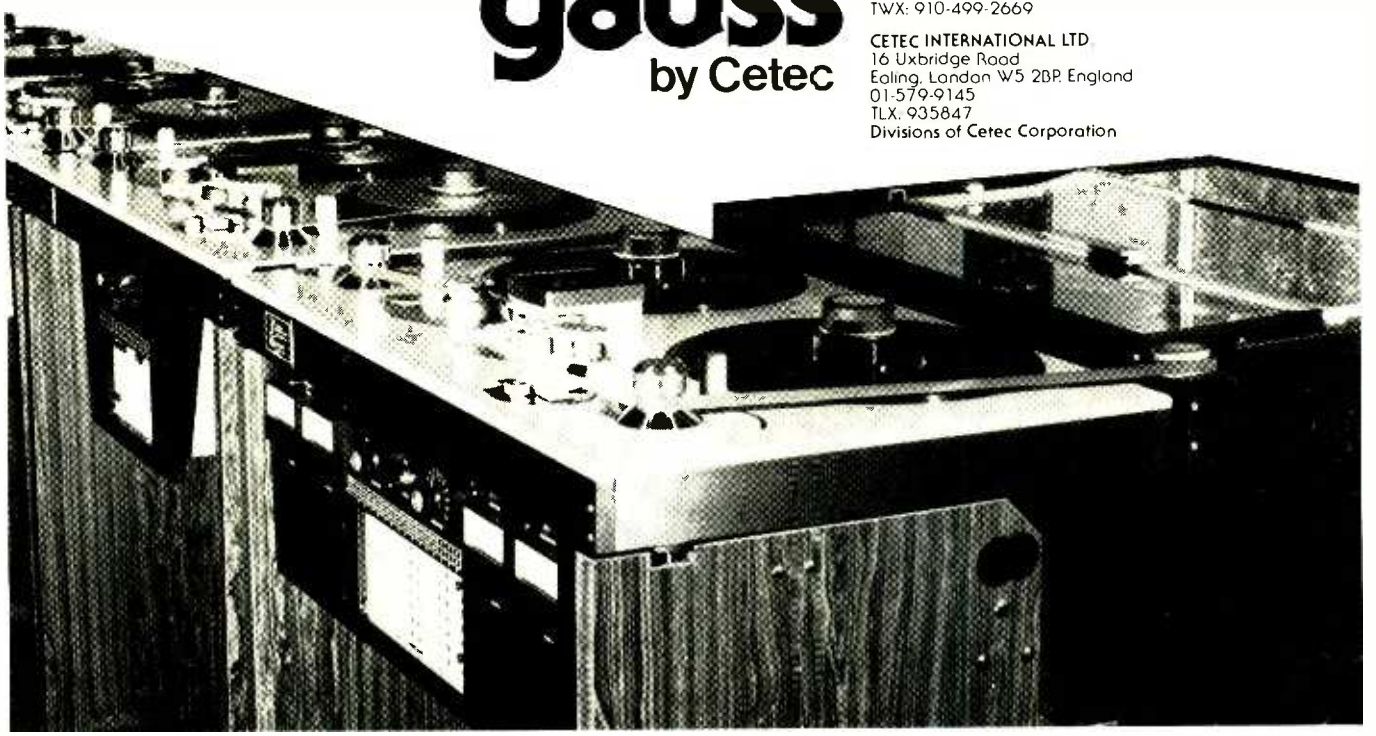
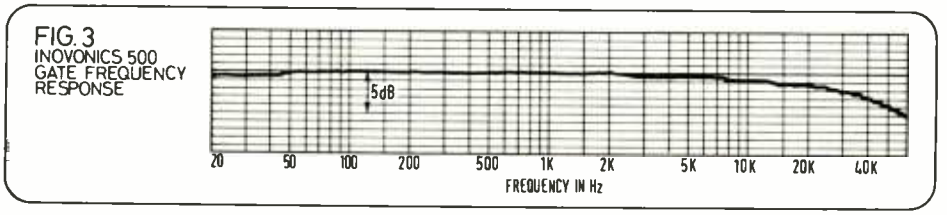




very well within the ANSI class II requirements claimed in the manufacturer's specification.

The rectifier characteristic in the normal modes of operation with the choice of averaging times, was found to correspond accurately to an average rectifier law, whilst in the peak mode, the rectifier characteristic indicated the true waveform peak with a fast attack such that −1dB relative to the steady state equivalent signal was reached in 800μs.

Whilst the analyser is not supplied with a measuring microphone, its balanced input is adjustable over a wide range in sensitivity from 1.4mV down to 130μV for an indication of 74dB SPL (1μBar or 0.1Pa). This range will handle most dynamic microphones, but the single turn adjustment potentiometer was difficult to accurately adjust and could to advantage be replaced with a multiturn potentiometer.

Measurement of the microphone input impedance showed that this was too low for many microphones at 442Ω and was likely to modify the high frequency performance. Surprisingly no provision is made for powering condenser microphones which tend to have a better frequency response than dynamic types.

Checking the A weighting curve showed that this was just within the IEC specification, but it must be remembered that the IEC specification for sound level meters requires a true rms as opposed to the average rectifier in this instrument.

Inherent noise in the analyser limited the SPL range according to the microphone sensitivity and the rectifier characteristic used, the A weighting making little difference to the overall SPL indication. Using the peak rectifier the residual noise varied from 38dB SPL to 42dB SPL whilst with the average rectifier the residual dropped to 23 to 26dBA SPL permitting accurate measurements below 40dB SPL.

As with SPL measurement, the dBm measurement can use either the peak or average rectifier characteristics, but unfortunately it is not possible to use the A weighting on the dBm ranges. Noise on the dBm ranges was below indication using the average rectifier, and −81dBm using the peak rectifier thus limiting the peak range to about −70dBm for accurate readings.

The line input for dBm measurement had a satisfactorily high input impedance at 98.4kΩ in parallel with only 16pF, and the accuracy of the dBm ranges was at all times within maximum error of 0.18dB cumulative or step error —an excellent performance above 40Hz but with a slight boost in indication below becoming +1.5dB at 20Hz which happens to compensate for the performance of the pink noise source.

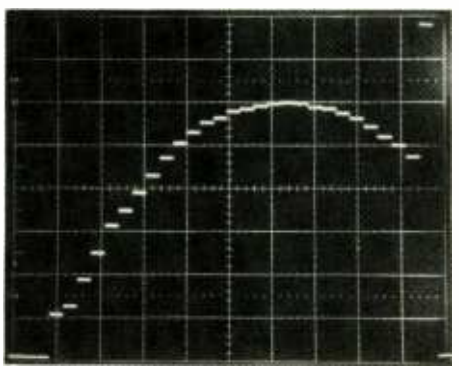
Reverberation time is measured as the time between the pushing of the gate switch and the time for the signal at the microphone to fall to −30dB × 2 or −15dB × 4, thus giving the time to −60dB assuming exponential decay of the sound level.

The two levels −15dB and −30dB were found to be set accurately, so all that was necessary to check the reverberation time accuracy was to determine the accuracy of the timer. This was done by extending tone bursts for an accurately known time beyond the operation of the gate switch and the results showed that the measured reverberation time was amazingly accurate to within ±2% or better above 3s. The available number of digits in the counter becomes significant below 1s where the manufacturer's specification is ±3% ±2 counts, equivalent to ±5% which was readily met by the analyser.

The instrument ran happily on its internal batteries for over four hours, but the batteries suddenly died without the LED indicator on the front panel flashing as it should before disaster strikes.

As far as the autoranging function is concerned, this was a particularly useful feature for reverberation time measurement, but was rather slow in action for other purposes. However it was not prone to jitter or sudden dramatic range changes as are some instruments.

Fig. 4



Summary

This Inovonics Acoustic Analyser was a pleasure to use and has a great deal more to offer than many competitive devices.

With the exception of the frequency response errors in both the pink noise source and the bar display at very low frequencies this is a very accurate instrument which will find numerous applications. In particular the accuracy of reverberation time was impressive, and the fact that the decay curve is displayed gives confidence in the validity of the measurement.

Other than the rather too low microphone input impedance and the lack of phantom powering for condenser microphones, the instrument is extremely versatile and will find many applications both on-site for acoustic measurements and in the studio for maintenance work.

Hugh Ford

A JBL MONITOR KNOWS ITS PLACE.

A studio monitor is only a tool. It is not supposed to enhance, add to, subtract from, or in any way modify sound.

That's your job.

What a studio monitor is supposed to do is tell you precisely what's on tape. Because you have to know everything that's there. And everything that isn't. Before it's too late.

That's why JBL monitors are in thousands of recording and broadcast studios around the world. In fact, according to a national survey by Billboard Magazine, JBL's are in more recording studios than any other brand.

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The 4301: Our newest 2-way monitor. Compact and efficient, for small broadcast control rooms and home studios.

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The 4315: An ultra-shallow 4-way, for maximum sound in minimum space.

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JBL

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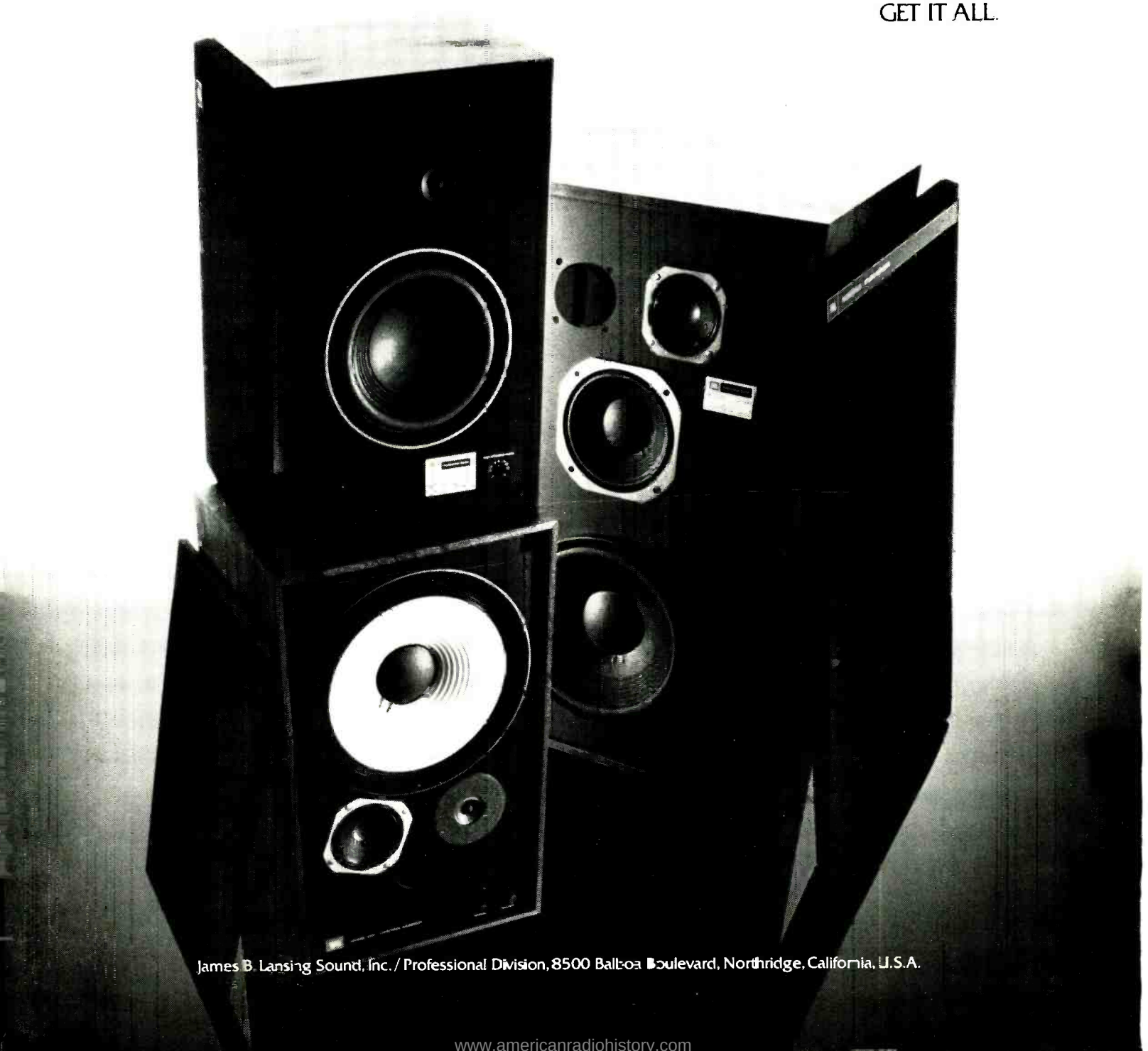


James B. Lansing Sound, Inc. / Professional Division, 8500 Balboa Boulevard, Northridge, California, U.S.A.

AS IN previous tape reviews, the major manufacturers of professional recording tapes were invited to submit two NAB reels of each of their products which they wished to be included. All manufacturers except EMI included long play material which finds applications in the semi-professional field as well as with portable interview recording, and in addition Agfa submitted two samples of double play tape.

Whilst Pyral were invited to submit samples they declined because they are about to launch a new product, samples of which were not available. This new tape type *CJ87* is said to be a competitor for the high output materials such as 3M type *250* and BASF *SPR50*. In the past, the Japanese manufacturers have not offered standard play materials and have generally restricted their activities to the domestic market place, but it is interesting to note that Maxell submitted two versions of standard play tape both of which offer a highly competitive performance.

Upon arrival all sample tapes were inspected for their mechanical condition and quality of winding. As will be seen later in this review, the tapes of European manufacture were generally in better condition than those from the United States and Japan. Maybe this can be accounted for by temperature changes and vibration in transit, but no tape was found to be physically damaged and each one seemed to be improved upon with regard to cleanliness of tape.

The physical performance of all tapes was considered to be very important because poor winding readily leads to inadvertent damage in handling, and also shedding of debris not only causes dropouts, but any accumulation of debris on tape guides can also damage the tape. Therefore all tapes were wound from end to end on two types of recorder, one typical of high quality professional machines and the other typical of the cheaper semi-professional machine as used by small studios. An Ampex type *ATR-100* was used to wind the tapes at constant tension of 70g at a tape speed of 120in/s and subsequently at its very fast winding speed averaging over 480in/s and the condition of the tape noted after this treatment. The tape was then wound from end to end in the fast wind mode again but on a Teac *A-3340* which winds at a low tension typical of semi-professional machines. The tape's condition was again noted. Very large differences were found between tape types with the back coated tapes generally exhibiting a better winding performance than those without a back coat; however more shedding of debris was found with back coated tapes.

Most manufacturers now use the type of NAB spool with little window area which affords better protection to the tape in handling as well as being less prone to being bent in use; however, 3M still use the old tinny type open spool as do BASF with their *SPR 50* tape. Some manufacturers fit leader tapes and some don't, but this is generally of little consequence except I didn't like the leader on the EMI tapes because it was particularly fiddly to handle—being thin and prone to static charges which make it cling to everything except the spool hub where it's wanted.

The measurements

All tapes were measured at a tape speed of 15in/s on an Ampex type *ATR-100* professional recorder equipped with stereophonic heads to the CCIR recommendations with a 2.79mm replay track width as opposed to the NAB track width of 1.91mm. The use of this European track width offers a 3.3dB noise advantage and affects the apparent tape performance as does the gap width of the record and replay heads which are typical of many machines at 12.5μm and 2.5μm. In view of the time-consuming nature of testing tapes, only the one tape speed of 15in/s was used with equalisation to the NAB standard of 50μs and 3180μs which gives a noise advantage over the IEC standard of 35μs for this tape speed. However it must be remembered that the equalisation also affects the apparent distortion performance and in this respect the use of the NAB standard is a disadvantage.

In all cases the performance of the Ampex *ATR-100* was such that it had no significant affect on the measured performance of the tapes so far as distortion and noise were concerned, there being at least 10dB between the tape noise and the replay noise from the machine.

The recording bias was set to the point where a 10kHz tone has dropped 4dB with increase of bias—a typically satisfactory point for most tapes, but not necessarily the absolute optimum for minimum modulation noise and harmonic distortion. Unfortunately some recorder manufacturers still recommend bias adjustment at 1kHz, or even worse, suggest that bias should be adjusted for optimum frequency response. The setting of bias accurately at 1kHz is not easy due to the flatness of the bias/sensitivity curve at low frequencies and therefore unsatisfactory for comparing the performance of tapes. Whilst at 10kHz the bias/sensitivity curve is steep and the bias can be set with good accuracy and repeatability.

In lieu of any other standard reference tape, the bias and the sensitivity of the samples was compared with that of the DIN 38 reference tape, which is becoming rather 'long in the tooth', and the tabulated results relate the 4dB over bias point of this tape to that of the review samples. In addition the sensitivity at 1kHz, 10kHz, 15kHz and 18kHz is related to the DIN tape at the respective 4dB over bias points at 10kHz which was used for all measurements.

Bias, sensitivity, maximum output level for 3% third harmonic distortion and third harmonic distortion with a fluxivity of 320nWb/m at 1kHz were measured for all of the 58 tape samples. This daunting task was done semi-automatically using a Tektronix *31* programmable calculator which was interfaced to drive the B&K *2010 Heterodyne Analyser*, measure bias and also measure third harmonic distortion via a B&K *2606* measuring amplifier connected to a ⅓-octave filter. By twiddling only two knobs, this system provided a print-out of relative bias, sensitivity at all four frequencies, maximum output level and also third harmonic distortion at a fluxivity of 320nWb/m. Not only did this effect a considerable saving in time, but also the repeatability of measurements was far better than manual methods—generally being within 0.1dB.

With the exception of three tape types, Agfa *PEM468*, 3M *250* and *256*, which require a bias about 2dB above the run of the mill tapes, the bias requirements of all samples are within a small range which should be readily met by all recorders. Similarly there is little difference in long wavelength (1kHz) sensitivity but a very significant difference in the short wavelength sensitivities ranging from −1dB to +8.2dB at 18kHz. Reference to machine reviews in previous issues of *Studio Sound* shows that a number of recorders cannot cope with this range of record equalisation.

The tabulated maximum output level for 3% third harmonic distortion is referenced to a fluxivity of 320nWb/m at 1kHz which is 4dB above the common 'operating level' which is used by many people to set zero VU. Almost all tapes have more than 10dB 'headroom' above 'operating level' as recommended by the NAB standard and now there are more high output tapes which allow the recording level to be increased by 4dB or more Outstanding among these are Ampex *456* and BASF *SPR 50* which also exhibit very low third harmonic distortion when recording a 1kHz tone at a fluxivity of 320nWb/m.

In many ways more important than harmonic distortion is intermodulation distortion, and this was measured by the CCIF method using two tones of equal amplitude separated in frequency by 100Hz (f_1 and f_2), the distortion product ($2f_1$-f_2) being related to the amplitude of a single tone. The tabulated figures relate the 1% and the 10% intermodulation levels around 1kHz and 10kHz to a fluxivity of 320nWb/m when only one tone is recorded which is just short of 320nWb/m when the twin tones are recorded. Examination of these figures shows the shortcoming of some of the

high output tapes when noting the 10% intermodulation points at the two frequencies where all is well around 1kHz, but the 10kHz 10% intermodulation falls well below the 1kHz 10% point. Comparing Ampex *456* with BASF *SPR 50* illustrates this with 1.5dB difference in intermodulation around 1kHz but 6dB difference at 10kHz.

Turning now to tape noise, this was measured using the Sennheiser *UPM550* meter incorporating the CCIR recommendation 468 weighting network with unity gain at 1kHz and employing both quasi-peak and true rms metering. The tabulated figures relate tape noise at the 10kHz 4dB over bias point to a fluxivity of 320nWb/m and show that the spread of noise performance ranges over about 3dB. As a general pattern, the low noise and high output tapes exhibit poor print-through performance and this is a vicious circle as the lower the noise, the more objectionable the print-through. There are however a few tapes which have the best of both worlds and the EMI *861/862*, 3M *262* and Maxell *UDXL50* are welcome newcomers. The print-through figures relate the pre-echo of a tone recorded at 200nWb/m after storage at 20°C for 24 hours, the tape being wound in for 5 minutes, recorded with a series of tone bursts, rewound and stored and then measured on the first replay. The frequency used for the measurement corresponded to the IEC proposals, being 1.2kHz for standard play tape, 1.6kHz for long play and 2.5kHz for double play.

Another important and not so well understood tape parameter is modulation noise, that is noise which varies with the amplitude and spectrum of the recorded signal. In the past this has been measured by applying a direct current to the record head and then measuring noise in the conventional manner, but it has been shown that this measurement does not give good correlation with the subjective effects of the noise. The method used for this review is similar to that proposed by IEC (following the method described by Trendell in the *Journal of the Audio Engineering Society* Volume 17 No 6) and is the same as that used for my previous tape review in *Studio Sound* (August 1977). Briefly a 1kHz tone is recorded onto tape and the replayed signal passed through a 500Hz to 1.5kHz bandpass filter to define a noise bandwidth. This signal is then passed through a 1kHz notch filter such that the fundamental is removed leaving a defined band of noise with the harmonics having been removed by the bandpass filter. This noise is related to the amplitude of the original 1kHz tone with a true rms meter.

Although the use of noise reduction systems reduces the effects of modulation noise and of print-through, the defects still exist and in practice the difference between tapes becomes greater due to expansion in the replay processing of noise reduction systems. Similarly, noise reduction systems expand uniformity defects and whilst the conventional pen recordings of uniformity of reproduction show the more obvious differences between tapes there are more subtle differences.

The uniformity plots in this review were made using a pen speed of 20dB/s with a 10dB potentiometer giving a resolution of 0.1dB, the time plotted for each tape being one minute for each of the three frequencies 100Hz, 1kHz and 15kHz. It is to be noted that particularly in the case of the long play and thin coated tapes, the 100Hz uniformity may be worse than the short wavelength uniformity due to coating thickness variations.

These plots and the measurement of apparent intermodulation to the SMPTE method were measured at a level 10dB below 200nWb/m at which there is not true intermodulation distortion; however using the Amcron intermodulation analyser gives a good indication of the uniformity of the high frequency tone because it operates in the conventional manner of measuring intermodulation by filtering out the low frequency tone and rectifying the high frequency to determine the degree of intermodulation, as opposed to the measurement of true intermodulation using a wave analyser.

So much for the testing methods; there are many ways of evaluating the results, but the last line in the tables gives a good idea of the available dynamic range by relating the average of the two 10% IM distortion levels to weighted rms tape noise and showing a 6dB difference between tape types.

Notes on individual manufacturers

AGFA. All the tapes arrived in good condition with well wound reels. The *PEM 268* and *PEM 368* had excellent winding characteristics on both the *ATR-100* and the Teac with no sign of debris. The *PEM 468* also had first class winding but there was very slight shedding of debris. The *PEM 526* did not wind well at high speed on either machine, throwing individual turns onto the flanges as did the *PE 36* to a far worse extent being very poor on the Teac. The uniformity of reproduction of the *PEM 526* and *PE 36* was not particularly good but *PEM 368* and *PEM 468* had both good performance and print-through.

AMPEX. All samples arrived with blocks of turns on the spool flanges but otherwise in good condition. Types *406* and *407* wound all right at 120in/s on the *ATR-100* but were poor at high speed on both machines, the *407* being particularly bad on the Teac. Similarly the *456* was not a good performer at high winding speeds but no tapes showed signs of shedding. All three types had a poor print-through performance but the *456* in other respects is one of the best available tapes.

BASF. All samples arrived in good condition and behaved well at high and low speeds on the *ATR-100*. The *LPR35* wound well on the Teac but the *SPR50* had a loose pack—no shedding was noted. The 15kHz uniformity of the *SPR50* was not good but in other respects it was one of the best tapes with outstanding print performance. Similarly the *LPR35* ranks among the best long play tapes.

EMI. Over half the EMI samples arrived with an imperfect wind, being wound on the spool flange or blocks of turns being on the flange. All samples wound reasonably well with the back coated *862* being first class and for some reason better than its back coated companion *852* which showed a degree of throwing individual turns onto the flange on the Teac. All samples shed some debris with the *852* shedding an undesirable amount of back coating. For all tapes, examination of the uniformity plots and the apparent SMPTE intermodulation distortion and modulation noise shows that not all is well, but print-through is to a high standard.

3M. All samples arrived in excellent condition. *206* and *207* were particularly poor at winding on either machine, even the *ATR-100* at 120in/s was not particularly good, but the type *250* was a little better and none shed debris. Types *256* and *262* gave a first class wind on the *ATR-100* and behaved well on the Teac with *256* being outstanding, but both types exhibited slight shedding of the back coating. *206* and *207* showed poor uniformity and print-through but good modulation noise. With the exception of the poor print-through, type *250* showed an excellent performance with very low noise. The later tapes *256* and *262* on the other hand have excellent print-through but higher noise and a rather low 10% intermodulation performance at 10kHz.

MAXELL. As received the condition of most samples was not impressive with many tapes having blocks of turns contacting the spool flanges and one tape having a loose wind. The booby prize goes to Maxell for submitting a NAB reel of tape which was cut in half 18 minutes in! The *UD50* wound well on the *ATR-100* at 120in/s and quite well at high speed on both machines but a little loose on the Teac. The *UDXL50* was very poor at high speed on the *ATR-100* but not bad on the Teac; *UD35* behaved reasonably on both machines whilst the *UDXL35* was poor on both with all tapes shedding slight dust and not showing good uniformity of reproduction. In other respects all tapes showed a good performance with the *UDXL50* being one of the best tapes in this review.

RACAL ZONAL. More than half the tapes arrived wound onto the spool flange but otherwise in good condition. Types *666* and *888* wound exceptionally well on the *ATR-100* and far better than average on the Teac with the *889* long play being marginally less good on both machines. Types *666* and *888* showed slight shedding of the back coating. All types showed rather poor modulation noise with *666* being one of the tapes best for print-through but worst for basic noise.

SONY. Both types of Sony tape arrived with the tapes having sections in contact with the spool flanges and both types were far and away the worst at winding on the *ATR-100* at any speed or on the Teac; however no shedding was observed. While in most ways the performance of the FeCr was very good the print-through was exceptionally poor as was the uniformity of reproduction. The *SLH11* on the other hand had exceptionally good print-through coupled with a well balanced performance.

Conclusions

The 28 varieties of recording tape covered in this review include all the major manufacturers except Pyral who unfortunately could not produce a sample of their new product in time, so we have to look forward to this. Several new tape types are included with the Maxell *UDXL* being of particular interest.

It must be emphasised however that the measurements are based on only two samples of each type which may not be typical of production. Manufacturers were asked to provide samples from different batches, but many ignored this request.

For some time the theme has been 'high output, low noise' but this design has been bugged by very poor print-through and the trend now appears to be reaching a compromise with slightly less output, low noise and low print like the EMI *851* and 3M *262*.

Unfortunately there is no perfect tape and it remains up to you, the user, to choose your compromise but sadly the better tapes are still more expensive.

Hugh Ford 96 ▶

STANDARD PLAY TAPES

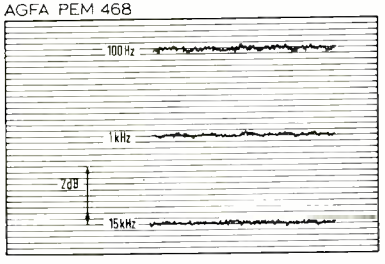
	Agfa PEM468	Agfa PEM526	Ampex 406	Ampex 456	BASF SPR50 LH	EMI 851	EMI 852	EMI 861	EMI 862	3M 206	3M 250	3M 256	3M 262	Maxell UDXL50 120B	Maxell UD50 120B	Racal Zonal 666	Racal Zonal 888
Bias at 10kHz (dB)	+2·0	0	—0·2	—0·3	+1·2	0	—0·1	—0·3	—0·4	+0·7	+2·1	+2·4	+0·5	0	0	—0·2	+0·4
Sensitivity at 1kHz (dB)	—0·3	0	+0·5	+1·5	—0·5	—0·5	—0·5	+1·2	+1·2	—1·5	+0·4	—0·6	—0·4	+1·1	—0·9	—1·1	+1·1
Sensitivity at 10kHz (dB)	+1·5	+1·7	+3·3	+4·8	—0·2	+1·5	+1·0	+1·6	+1·5	+0·5	+2·3	+0·6	+0·7	+5·5	+2·7	—0·5	+2·1
Sensitivity at 15kHz (dB)	+2·1	+1·4	+4·3	+6·3	—0·2	+2·1	+1·7	+1·7	+1·5	+0·7	+2·7	+0·9	+0·8	+7·3	+4·1	—0·9	+3·1
Sensitivity at 18kHz (dB)	+2·2	+2·6	+4·7	+6·6	—0·3	+2·4	+1·8	+1·8	+1·6	+0·7	+2·6	+0·8	+0·8	+8·2	+4·6	—1·0	+3·2
Maximum output level for 3% third harmonic distortion (dB)	+10·3	+7·3	+8·1	+12·8	+11·3	+6·1	+6·3	+9·8	+9·6	+6·4	+10·9	+10·2	+7·7	+9·6	+6·8	+5·3	+10·2
Third harmonic distortion at 1kHz and 320nWb/m (%)	0·4	0·7	0·6	0·3	0·3	0·9	0·9	0·4	0·4	1·1	0·4	0·4	0·7	0·4	0·8	1·0	0·4
Intermodulation distortion:																	
1% IM (1kHz + 1.1kHz) (dB)	0	—2·5	—0·5	+4·4	0	—4·0	—4·5	0	—1·0	—4·0	+4·0	0	—3·5	0	—3·0	—5·0	+1·0
1% IM (10kHz + 10.1kHz) (dB)	—7·5	—9·0	—10·0	—5·0	—5·5	—8·0	—11·0	—7·5	—12·0	—8·0	—2·0	—9·5	—8·0	—2·0	—4·0	—10·0	—9·0
10% IM (1kHz + 1.1kHz) (dB)	+11·0	+9·0	+10·5	+14·0	+12·5	+8·5	+8·5	+13·5	+11·0	+9·0	+12·0	+11·0	+10·0	+11·5	+8·5	+7·5	+11·5
10% IM (10kHz + 10.1kHz) (dB)	+7·0	+5·0	+7·0	+12·0	+6·0	+6·5	+5·5	+4·0	+4·5	+5·0	+8·0	+5·5	+4·0	+9·0	+7·5	+4·0	+6·0
CCIR weighted noise rms (dB)	—54·5	—54·3	—54·0	—54·5	—55·5	—54·5	—55·0	—53·5	—54·0	—56·0	—56·7	—54·0	—53·0	—54·5	—55·5	—53·0	—54·0
CCIR weighted noise quasi-peak (dB)	—50·5	—49·5	—49·5	—50·5	—51·5	—50·0	—48·8	—49·5	—49·5	—52·0	—52·5	—49·5	—49·5	—50·5	—51·5	—49·0	—49·8
Modulation noise ref 320nWb/m (dB)	—58·5	—60·5	—60·0	—61·0	—59·0	—58·0	—58·0	—58·0	—56·0	—62·0	—62·0	—60·0	—58·0	—61·0	—58·0	—52·0	—53·8
Apparent SMPTE intermodulation (%)	2·0	2·5	1·6	0·7	0·3	2·8	3·2	2·1	3·0	3·0	1·5	2·0	3·5	1·0	1·7	1·7	1·8
Print-through (dB)	—56·5	—56·0	—52·0	—53·0	—57·5	—56·0	—55·0	—54·0	—54·5	—51·5	—51·0	—59·5	—57·0	—56·5	—55·5	—58·5	—52·0
Dynamic range (in terms of average of 10% IM level to rms noise) (dB)	63·5	61·3	62·8	67·0	64·8	62·0	62·0	62·3	61·8	63·0	66·7	61·8	60·0	64·8	63·5	58·8	62·8

STANDARD PLAY TAPES

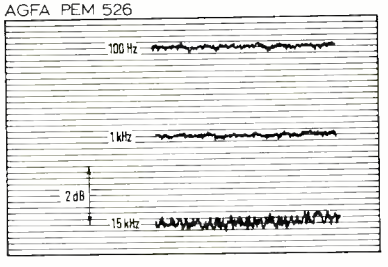
Uniformity of reproduction over 1 minute at 100Hz 1kHz and 10kHz

(SEE TEXT)

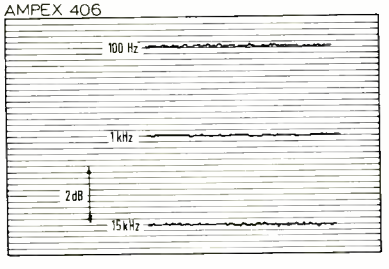
AGFA PEM 468



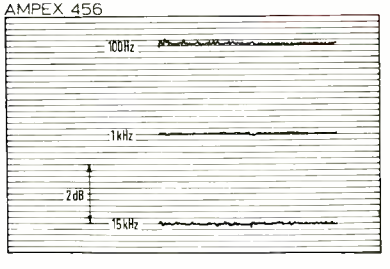
AGFA PEM 526



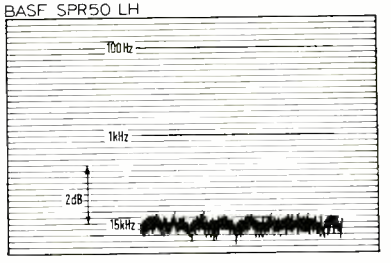
AMPEX 406



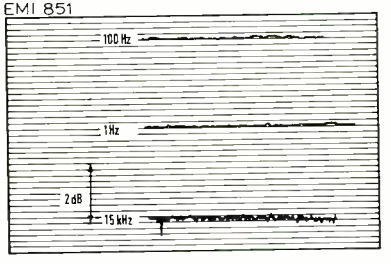
AMPEX 456



BASF SPR50 LH



EMI 851



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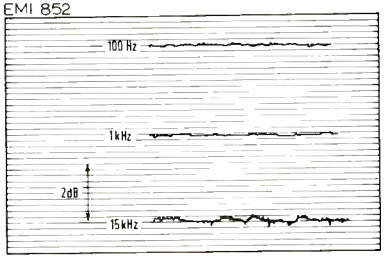

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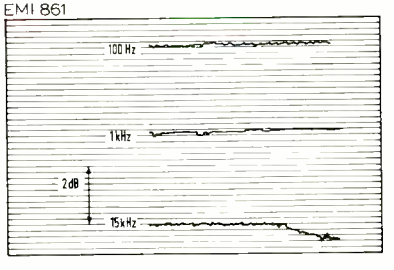
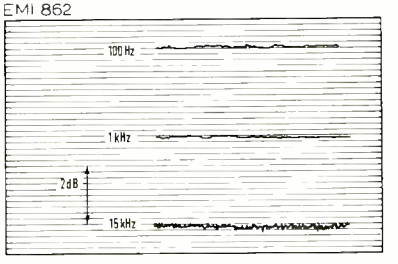
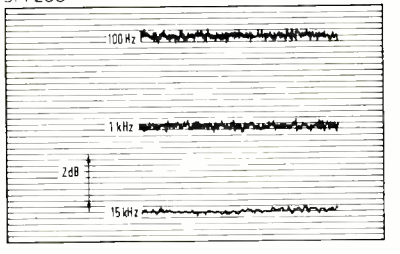


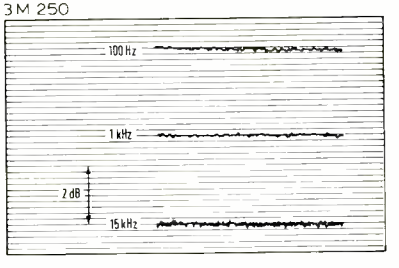
EMI 862



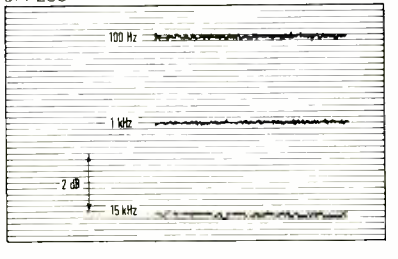
3M 206



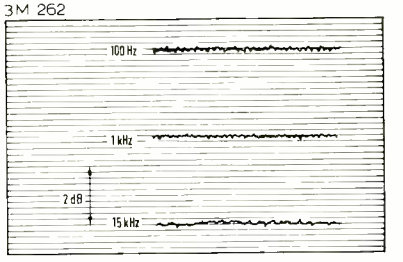
3M 250



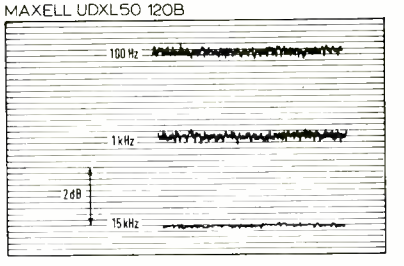
3M 256



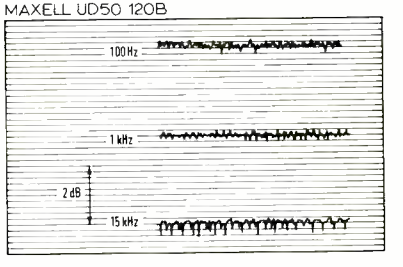
3M 262



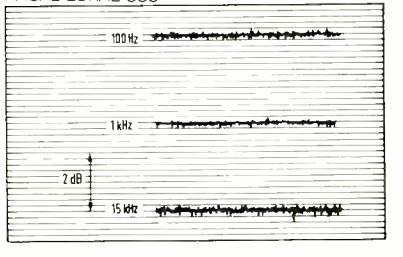
MAXELL UDXL50 120B



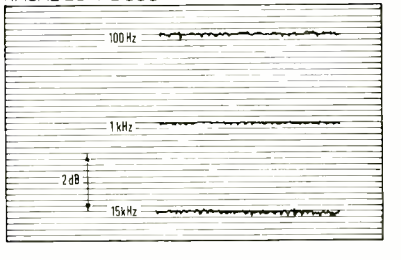
MAXELL UD50 120B



RACAL ZONAL 666



RACAL ZONAL 888



	LONG PLAY TAPES								DOUBLE PLAY	
	Agfa PEM368	Ampex 407	BASF LPR35 LH	3M 207	Maxell UDXL35 180B	Maxell UD35 180B	Racal Zonal 889	Sony SLH11	Sony Fe Cr	Agfa PEM268	Agfa PE36
Bias at 10kHz (dB)	+0·3	—0·4	—0·3	+0·3	+0·2	+0·1	+0·4	0	+0·6	+0·5	—1·8
Sensitivity at 1kHz (dB)	—1·4	+0·7	—0·7	—1·0	+1·2	—1·2	—0·7	—0·9	+0·1	—1·3	—2·6
Sensitivity at 10kHz (dB)	+2·4	+3·4	+3·6	+0·4	+4·7	+1·5	+1·2	+3·6	+3·2	+1·9	+3·7
Sensitivity at 15kHz (dB)	+3·5	+4·2	+5·0	+0·4	+6·2	+2·7	+1·8	+5·2	+3·7	+2·8	+5·8
Sensitivity at 18kHz (dB)	+4·0	+4·6	+5·7	+0·4	+7·0	+3·2	+2·0	+5·9	+3·8	+3·3	+6·7
Maximum output level for 3% third harmonic distortion (dB)	+6·5	+8·2	+8·5	+6·6	+10·4	+6·8	+6·6	+6·9	+9·5	+8·8	+3·4
Third harmonic distortion at 1kHz and 320nWb/m (%)	1·0	0·5	0·6	0·9	0·2	0·8	0·8	0·8	0·7	0·9	1·6
Intermodulation distortion:											
1% IM (1kHz + 1.1kHz) (dB)	—0·5	—2·5	—2·0	—4·0	+2·0	—3·0	—3·5	—3·0	—2·0	—3·0	—6·4
1% IM (10kHz + 10.1kHz) (dB)	—5·5	—6·5	—3·0	—6·5	—5·5	—5·5	—4·0	—2·5	—3·5	—4·0	—8·0
10% IM (1kHz + 1.1kHz) (dB)	+9·0	+10·0	+10·0	+9·0	+14·5	+9·0	+9·0	+8·5	+10·5	+8·5	+5·0
10% IM (10kHz + 10.1kHz) (dB)	+8·0	+7·0	+8·0	+5·0	+9·0	+6·5	+6·0	+8·0	+8·0	+7·0	+8·5
CCIR weighted noise rms (dB)	—56·0	—54·0	—55·0	—56·0	—55·0	—54·7	—54·0	—55·0	—55·3	—54·5	—54·1
CCIR weighted noise quasi-peak (dB)	—50·5	—49·0	—51·0	—51·8	—51·0	—51·5	—49·7	—50·5	—51·2	—50·5	—50·0
Modulation noise ref 320nWb/m (dB)	—54·5	—61·0	—58·0	—61·0	—60·0	—60·0	—56·5	—58·5	—58·0	—54·0	—58·0
Apparent SMPTE intermodulation (%)	3·0	1·7	0·6	3·2	1·0	2·8	3·0	1·8	2·7	3·0	3·3
Print-through (dB)	—54·5	—49·5	—54·0	—51·0	—50·0	—51·0	—51·0	—55·5	—49·5	—54·0	—57·5
Dynamic range (in terms of average of 10% IM level to rms noise) (dB)	64·5	62·5	64·0	63·0	66·8	62·5	61·5	63·3	64·6	62·3	60·9

LONG PLAY TAPES

Uniformity of reproduction over 1 minute at 100Hz 1kHz and 10kHz

(SEE TEXT)

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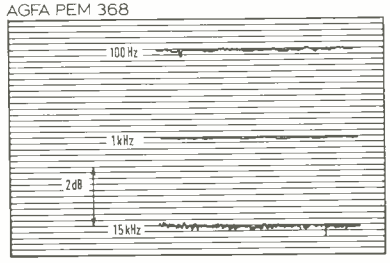
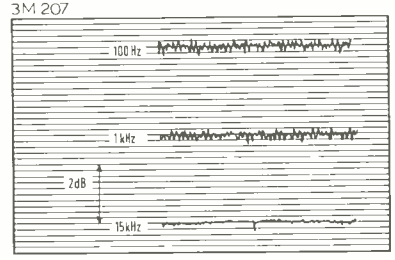


3M 207



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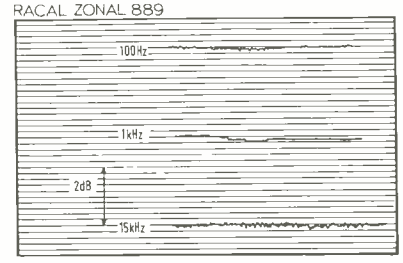
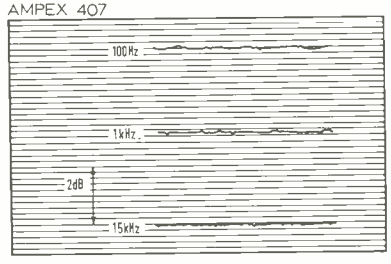
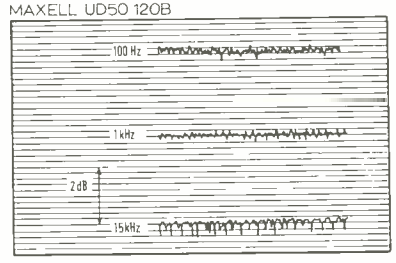


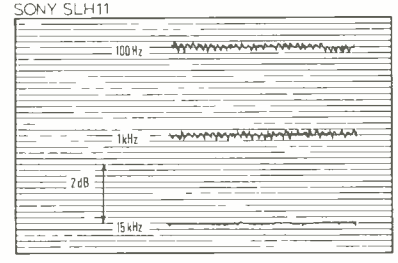
AMPEX 407



MAXELL UD50 120B



SONY SLH11



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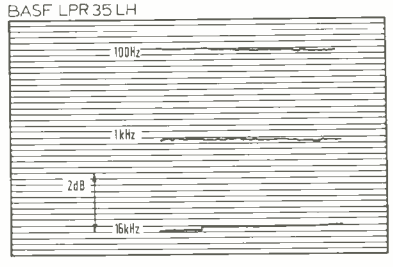

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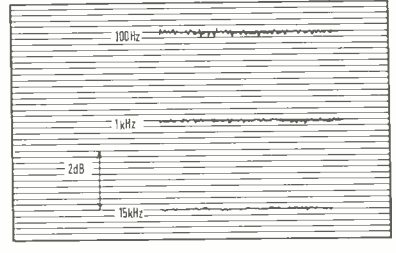

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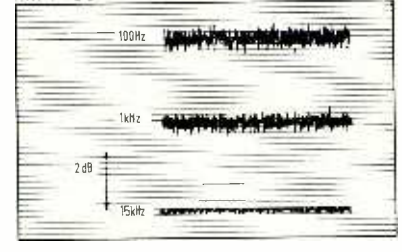
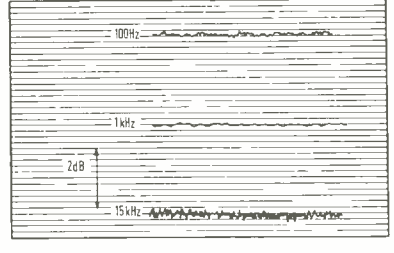


DOUBLE PLAY TAPES

AGFA PEM 268



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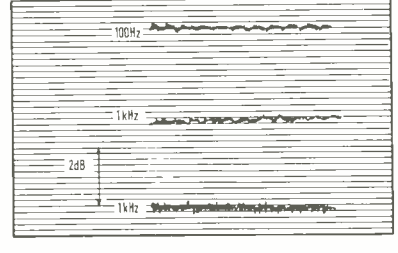

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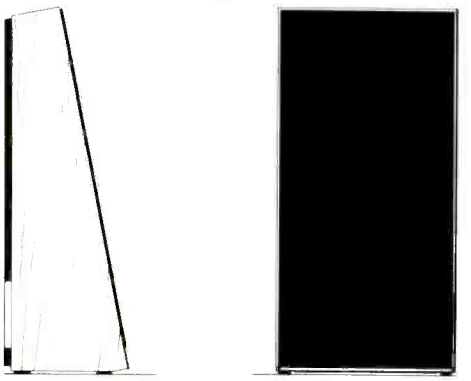

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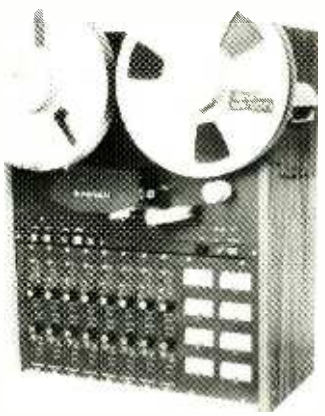

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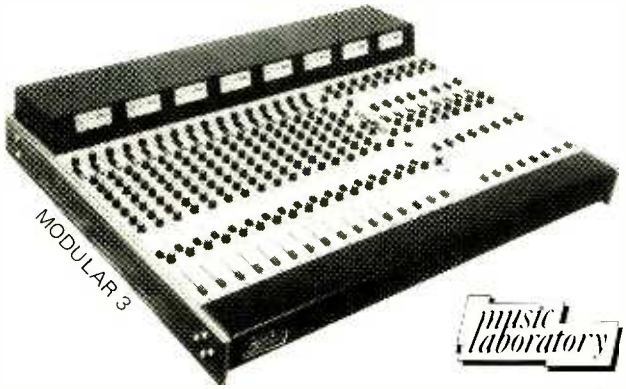

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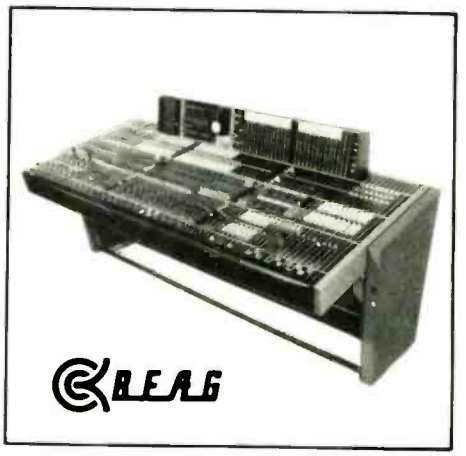

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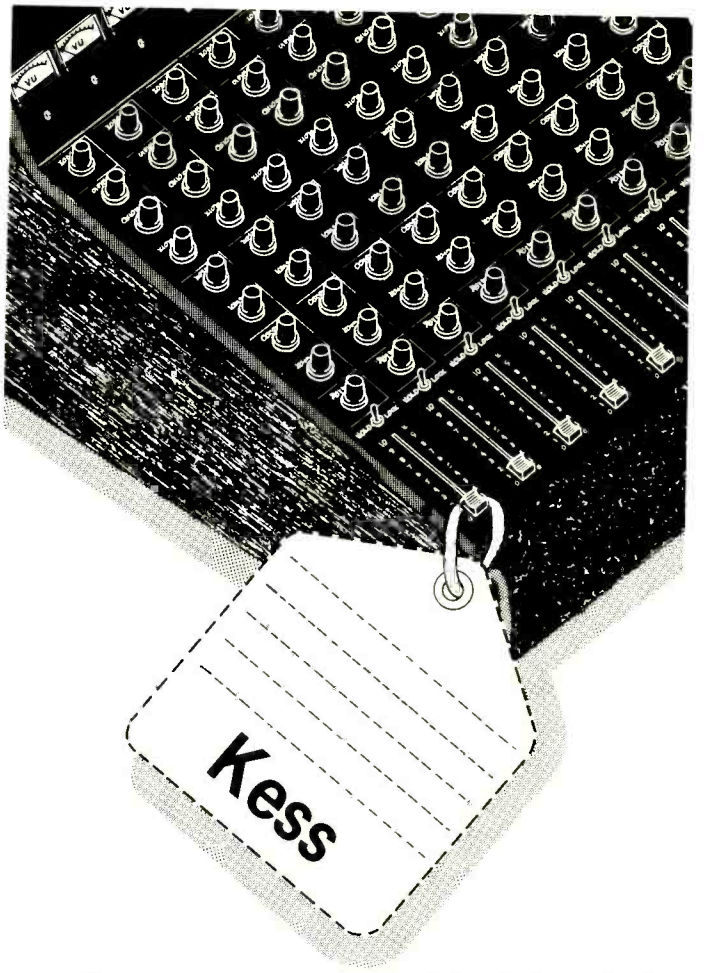

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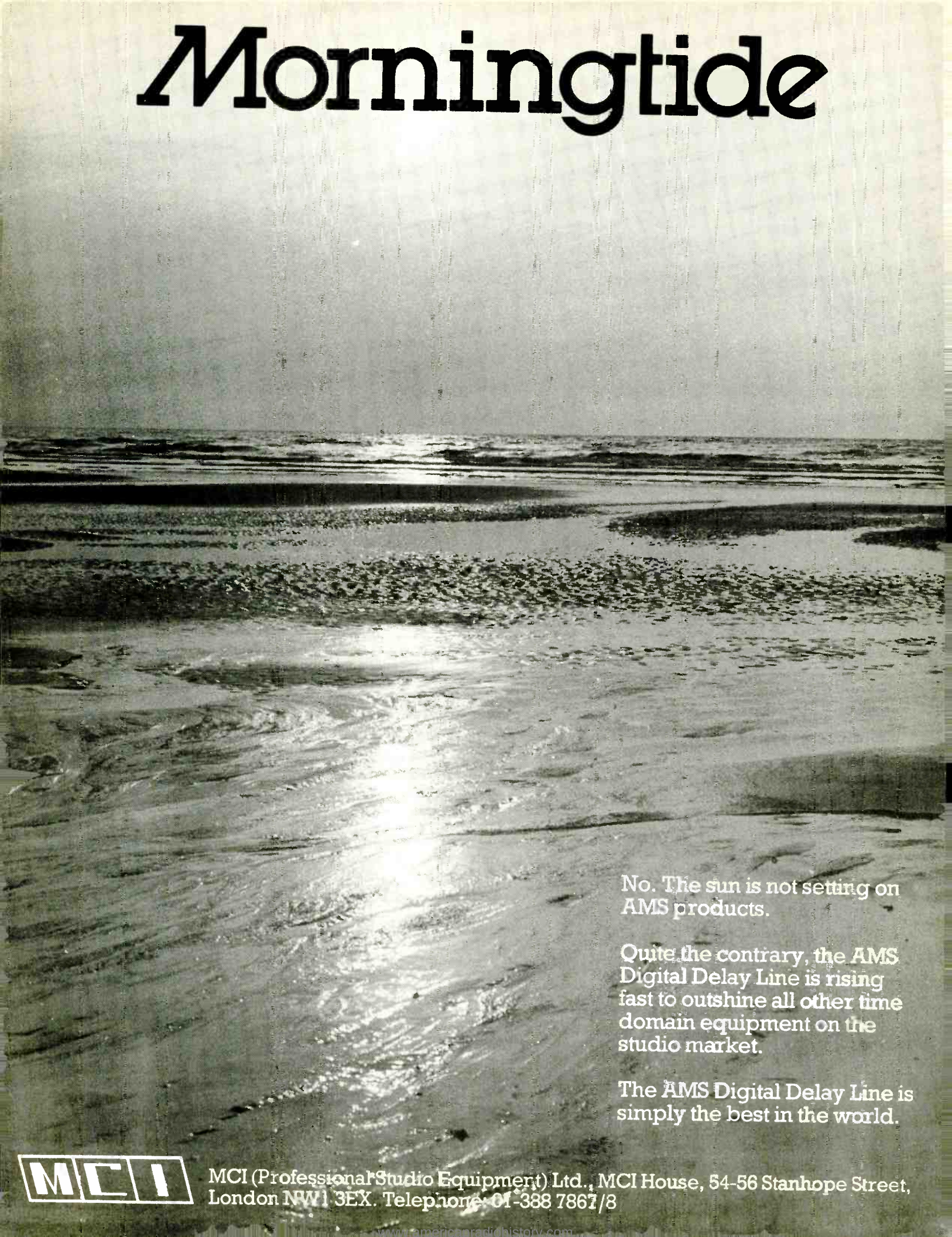

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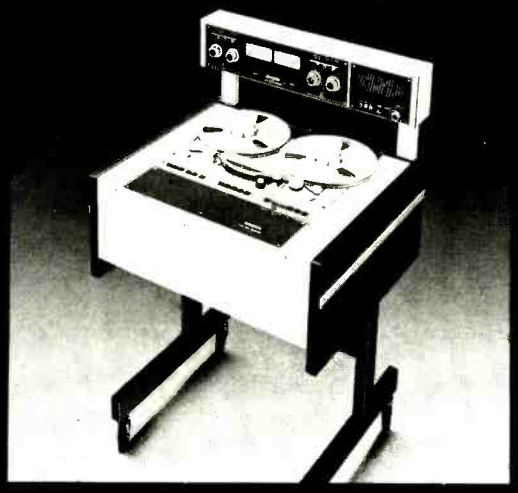

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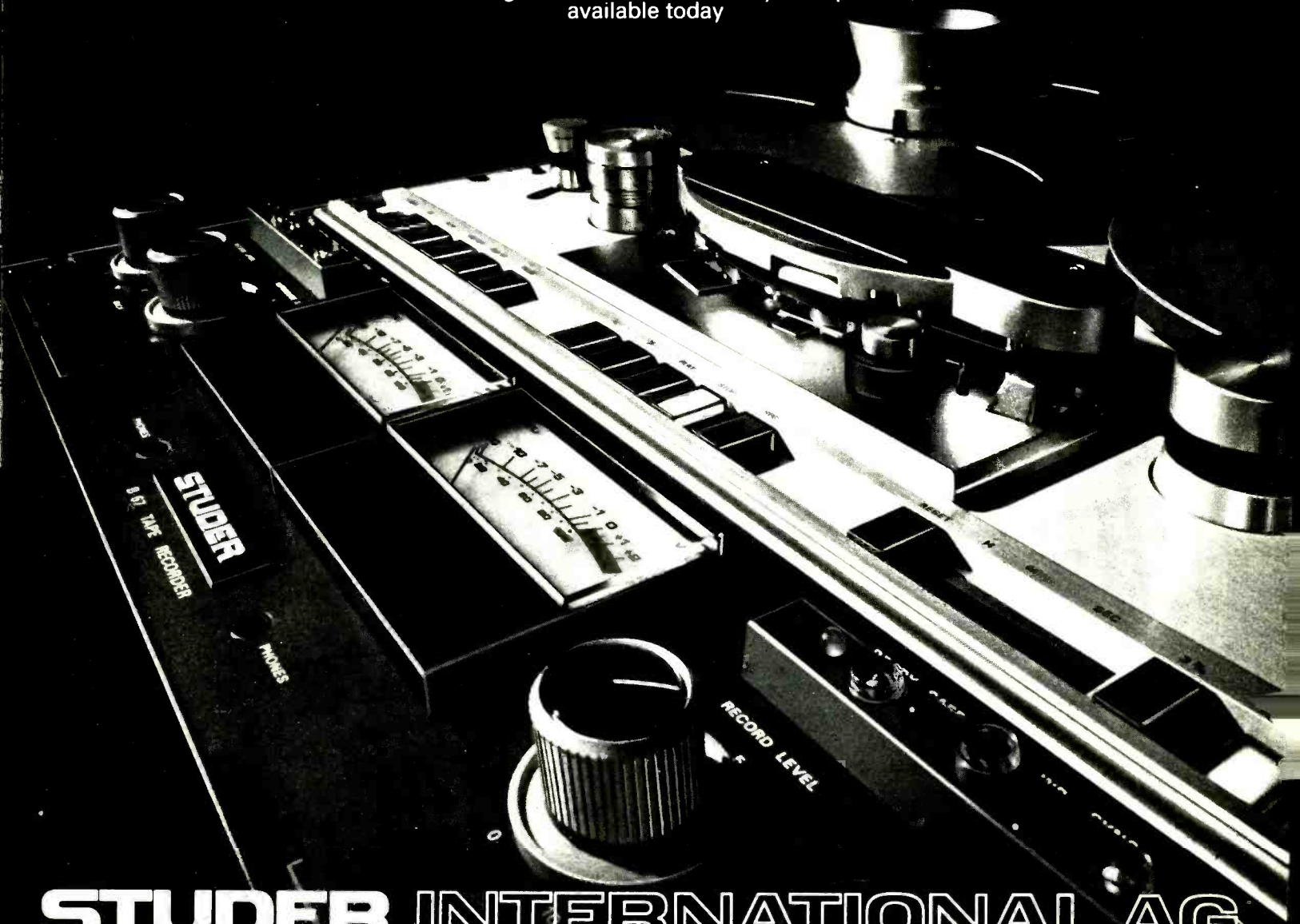

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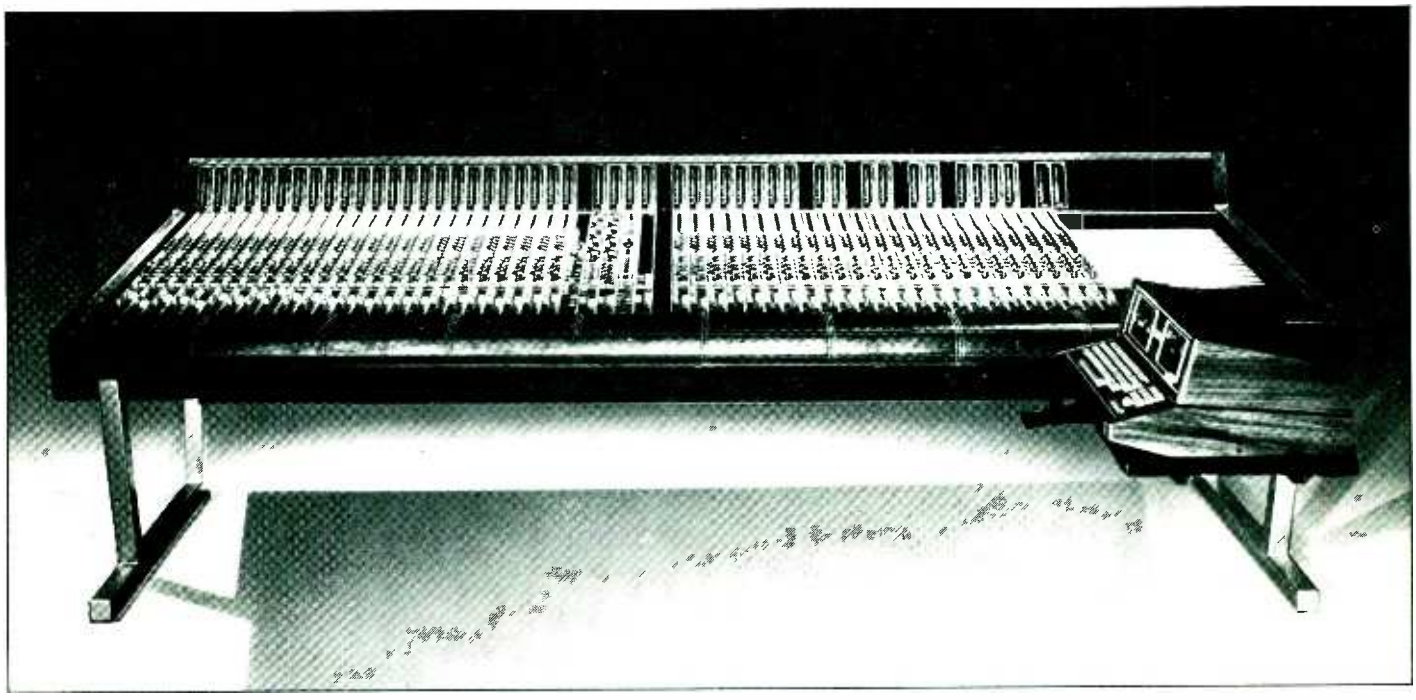

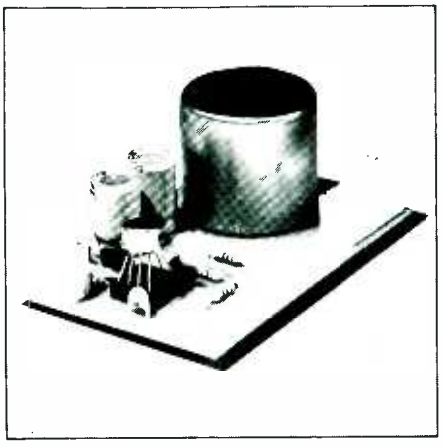

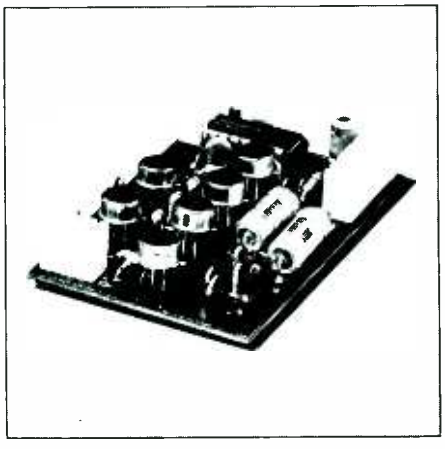

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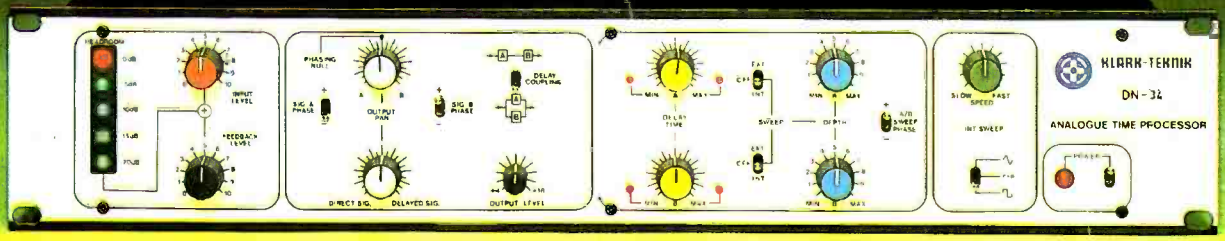
The new DN34 analogue time processor.



Think of the effect you'll have.

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Like other Klark-Teknik products, the DN34 is the result of intensive research and development - the best there is in state-of-the-art analogue delay technology.

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