studio sound

AND BROADCAST ENGINEERING

October 1980 75p

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Studio designers

MIDAS the professionals' choice

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studio sound

AND BROADCAST ENGINEERING

Studio design has always been a personal affair, with there being many different schools of thought as to the 'perfect studio'. Many have tried, but possibly none quite as successfully as Tom Hidley—whether you personally like or dislike his designs is irrelevant, because at least they (and there are over 100 studios around the world bearing his trade marks) are all acoustically sufficiently similar to enable producers to work in different studios while being confident that their recorded product will always sound similar. Of course, whether it still sounds 'right' at home is another matter. But consultants do not come cheap, and many studio owners make use of less experienced designers—sometimes it works, sometimes it doesn't, and it is then often very expensive to correct, by a professional. One slightly peculiar aspect of consultants is that true architects are bound by their trade association rules which prevent them advertising their services—for instance the architect section of the *Yellow Pages* directories carries no advertising, only the free telephone numbers.

How to choose a consultant for a job is very difficult, but generally comes down to seeing previous examples of that firm's work. Thus in the survey this month, we have tried to indicate the names of the latest projects in different areas, which each firm was involved with. Unfortunately, the same studio names often appear more than once, from different companies, indicating that often several different consultants are used for various phases of the project—so do not assume that just because a consultant says he worked on a particular project, that he was necessarily responsible for it in entirety. Personal recommendation is really the most successful way to engage somebody that will shape (literally) your future.

This is the last issue for which I will bear blame, and from next month the task of writing this column will fall on Richard Elen, this magazine's new editor. Richard is already well known to the pro-audio business and can be found at most of our exhibitions (if you look in the right bar). He is currently editor of *Sound International*, our sister publication (on the other side of the office) and he can also often be found behind the consoles of local studios. I am not moving very far (two floors down), and now have responsibility for our new Special Projects department which is looking into new publication areas, and our Yearbooks in particular. The *Video Yearbook* is already well established, while the first new book will be the *Pro-Audio Yearbook*, to be published next March. Letters have already been sent out, but please check that your company has replied, or contact us immediately.

Other new Yearbooks planned for 1981 publication include one covering the theatre and live performance business and another for record companies including (amongst other sections), surveys of recording studios. So while Richard will be looking after *Studio Sound*, I shall still be very much in evidence, and will remain in contact with you.

Angus Robertson

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OCTOBER 1980 VOLUME 22 NUMBER 10

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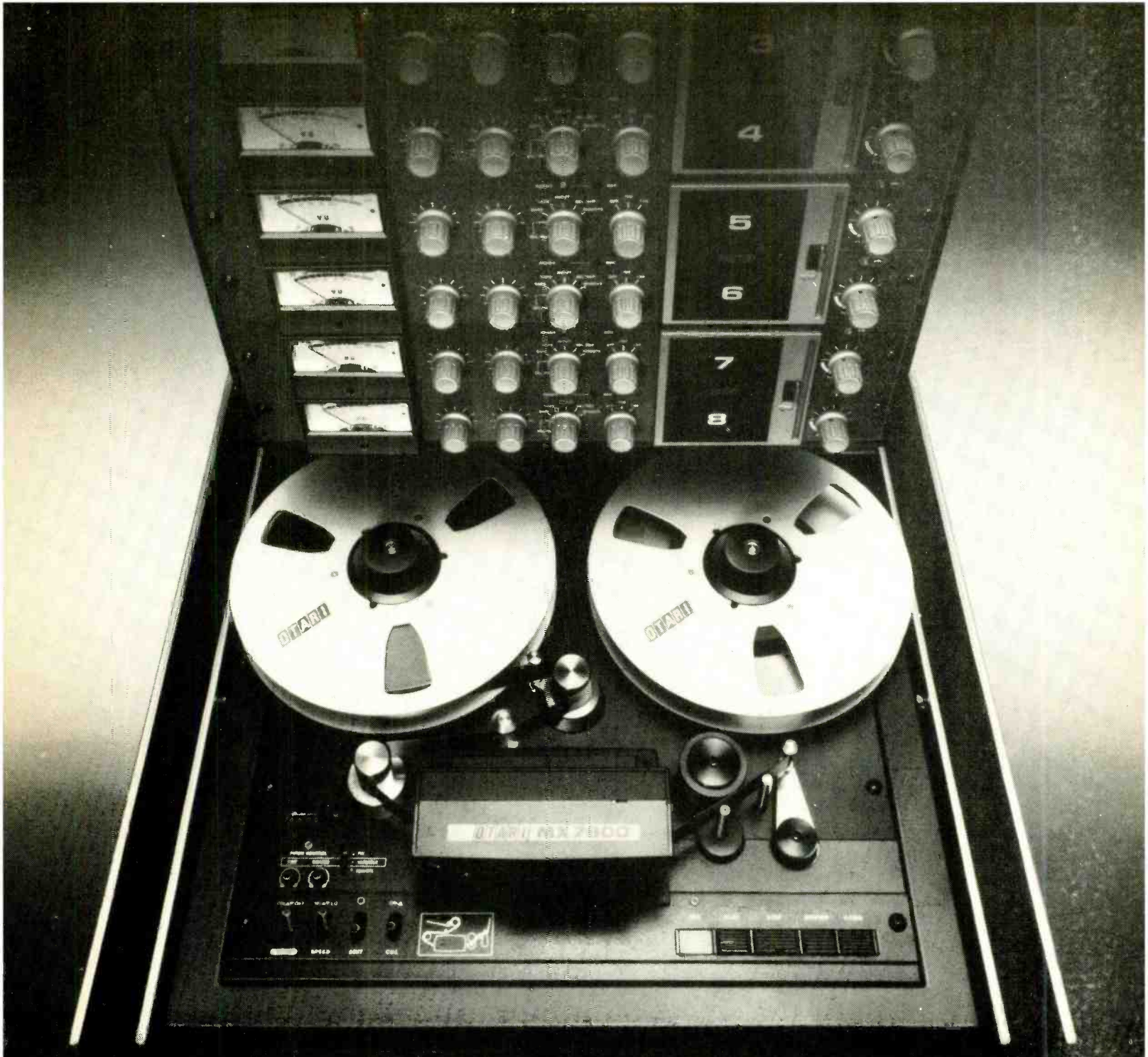

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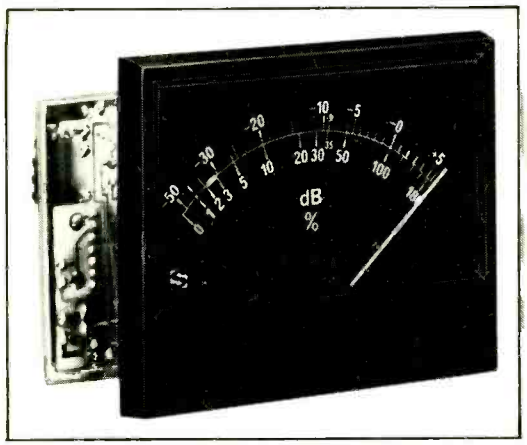

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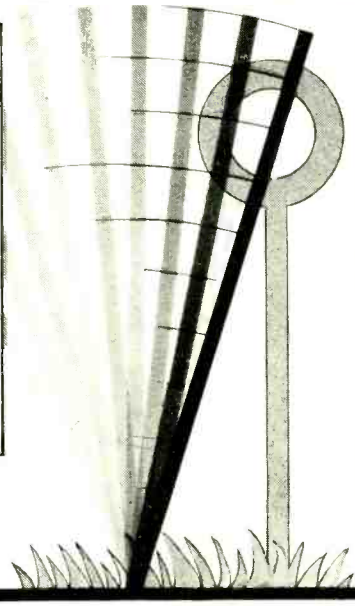

If you have had difficulty sourcing Peak Programme Meters to meet DIN 45406, the fast European PPM standard, then Relax! The Soundex PPM 302 amplifier card and *fast* meter movement make it look easy. The scale reads from, −50dB to +5db, 0% to 180% including the red part of the scale and it's amazingly accurate. Our amplifier card is surely the smallest at only 54 × 70 mm and the cost won't finish you.

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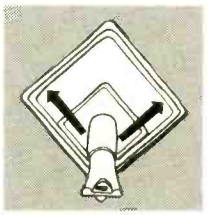

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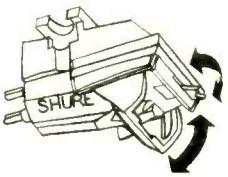

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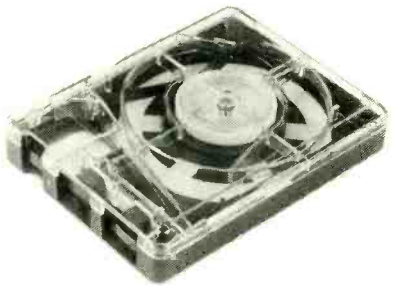

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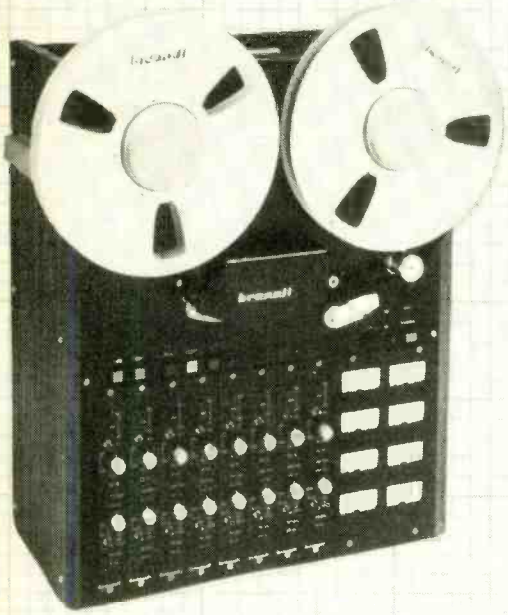

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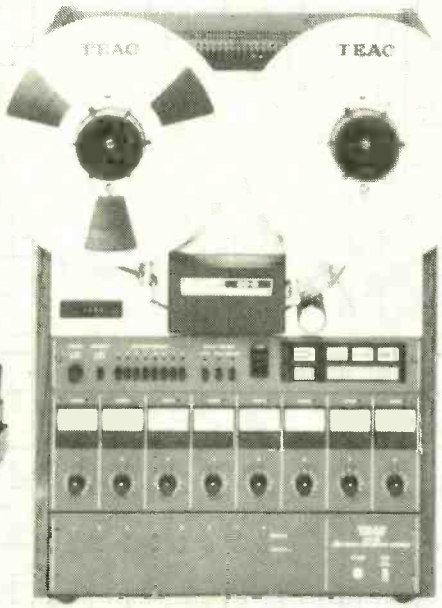

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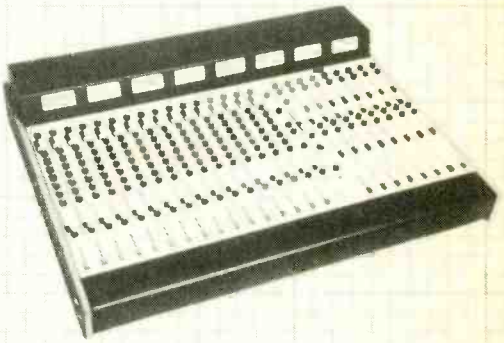

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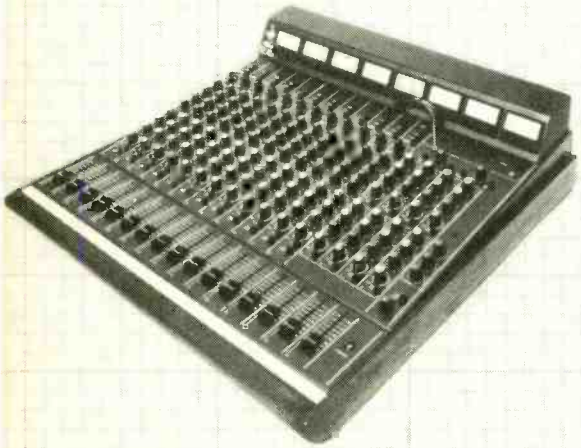

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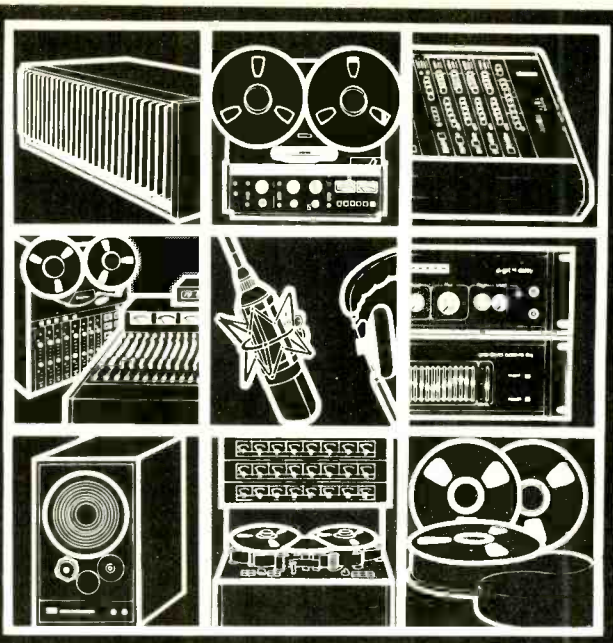

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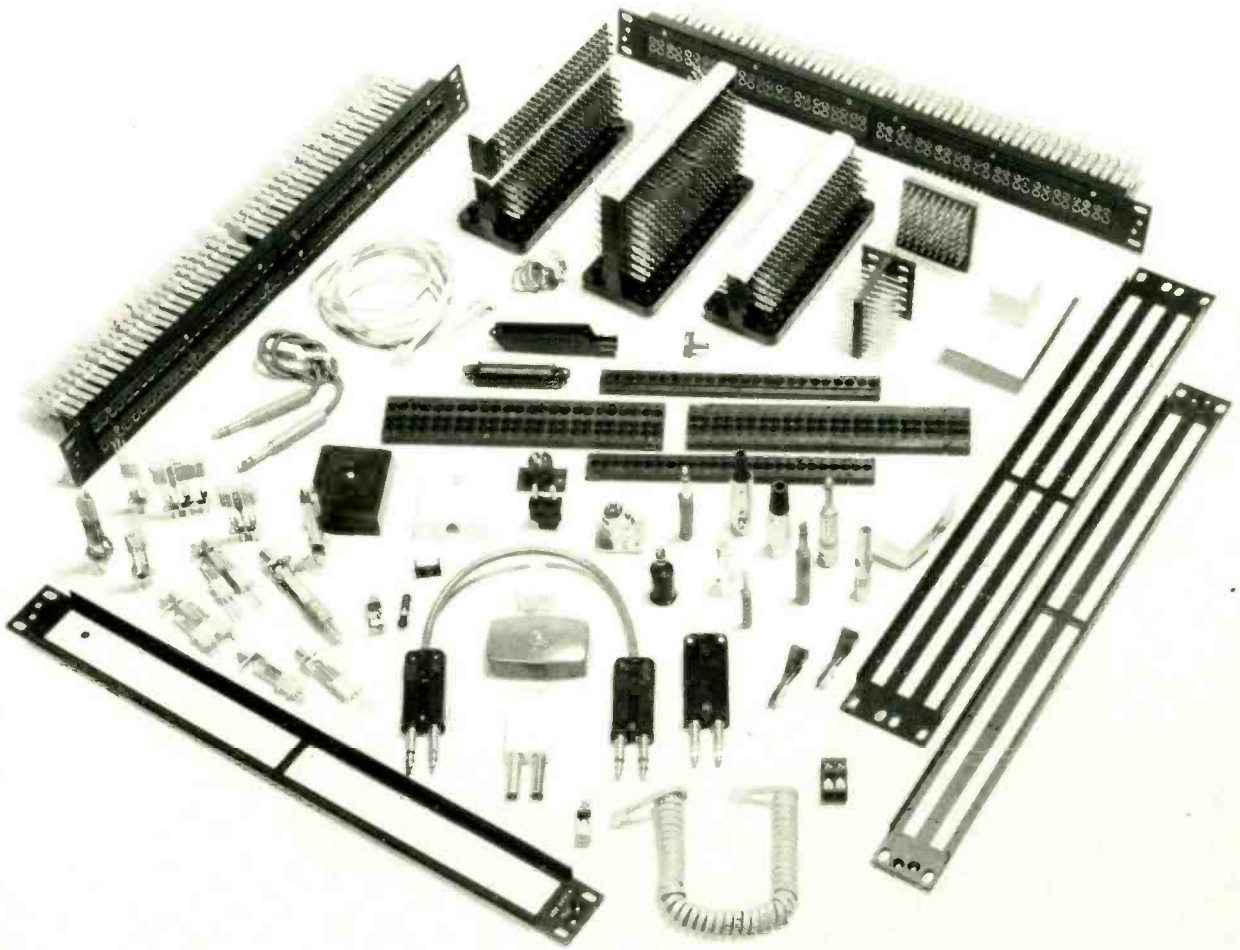

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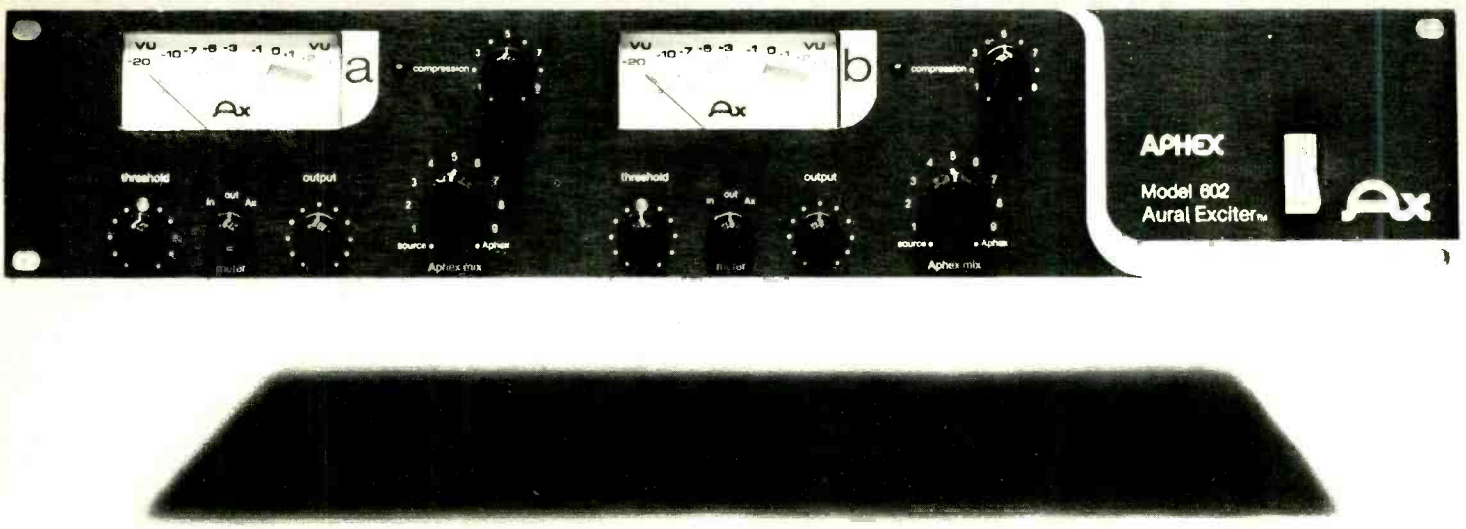

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(Tokyo) Tel: (03) 253-9022
TLX: (781) 222-7097 (APXIEH)
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Aphex New York, Ltd.
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Tel: 704-714
TLX: (722) 23071 (JMGPH)
Aphex South, Inc.
(Nashville)
Tel: (615) 327-3133
Aphex Spain
(Madrid) Tel: 267-5222
Aphex Systems (Suisse) SA
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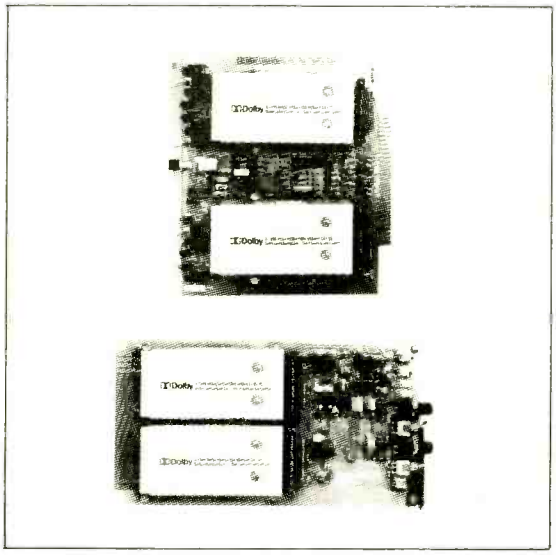
Tel: 021/33.33.55
TLX: (845) 24107
(VOGUE CH)
Aphex Texas, Ltd.
(Dallas) Tel: (214) 351-6772
Aphex South Africa
(Johannesburg)
TLX: (960) 8-2440 S.A.

With the Dolby system, the sound can match the picture.

A great deal is happening these days to improve the quality of television audio. New distribution methods such as diplexing, new post-production techniques for laying down sound-tracks without having to re-record them repeatedly on VTRs, the reality of stereo TV audio in some countries – these factors and more are combining with the growing audience sensitivity to good sound to put a new emphasis on television sound quality.



These modules are designed for incorporation into existing Ampex and Sony 1" Type C video tape recorders. Installation takes as little as 20 minutes utilizing a flexible printed circuit board interface provided with each module.

However, a major bottleneck remains: noise. The better the rest of the studio and distribution chain becomes, the more the noise from the audio tracks of VTRs limits the ultimate fidelity of television sound. The audio signal-to-noise ratio of 2" quad machines is typically worse than 50 dB, while the specs for the new generation 1" machines are typically 52-56 dB. That kind of performance is not as good as many consumer audio tape recorders, and unless improved, may always keep television sound in second place to the high fidelity color picture.

Dolby noise reduction is the proven way to break the noise bottleneck, here and now. It provides 10 dB of noise reduction (rising to 15 dB at higher frequencies), without audible degradation of the original signal. It reduces hiss, hum, rumble, the effects of multiple-generation re-recording – *all* noise not part of the original signal. It reduces print-through, even years later. It can reduce distortion by permitting the use of lower record levels. And Dolby noise reduction is the key to taking full advantage of the wider frequency range now increasingly being provided in the rest of the TV audio chain.

Since its introduction 15 years ago, Dolby noise reduction has become universally accepted for quality audio tape recording, both professional and consumer. It is also regularly used to improve the audio quality of VTRs in several European countries. Just ask any professional audio recording engineer about the benefits of the Dolby system, or contact us for full technical information. Let us help you in your efforts to provide television sound which matches the television picture.

Dolby®

Dolby Laboratories

'Dolby' and the double-D symbol are trademarks of Dolby Laboratories

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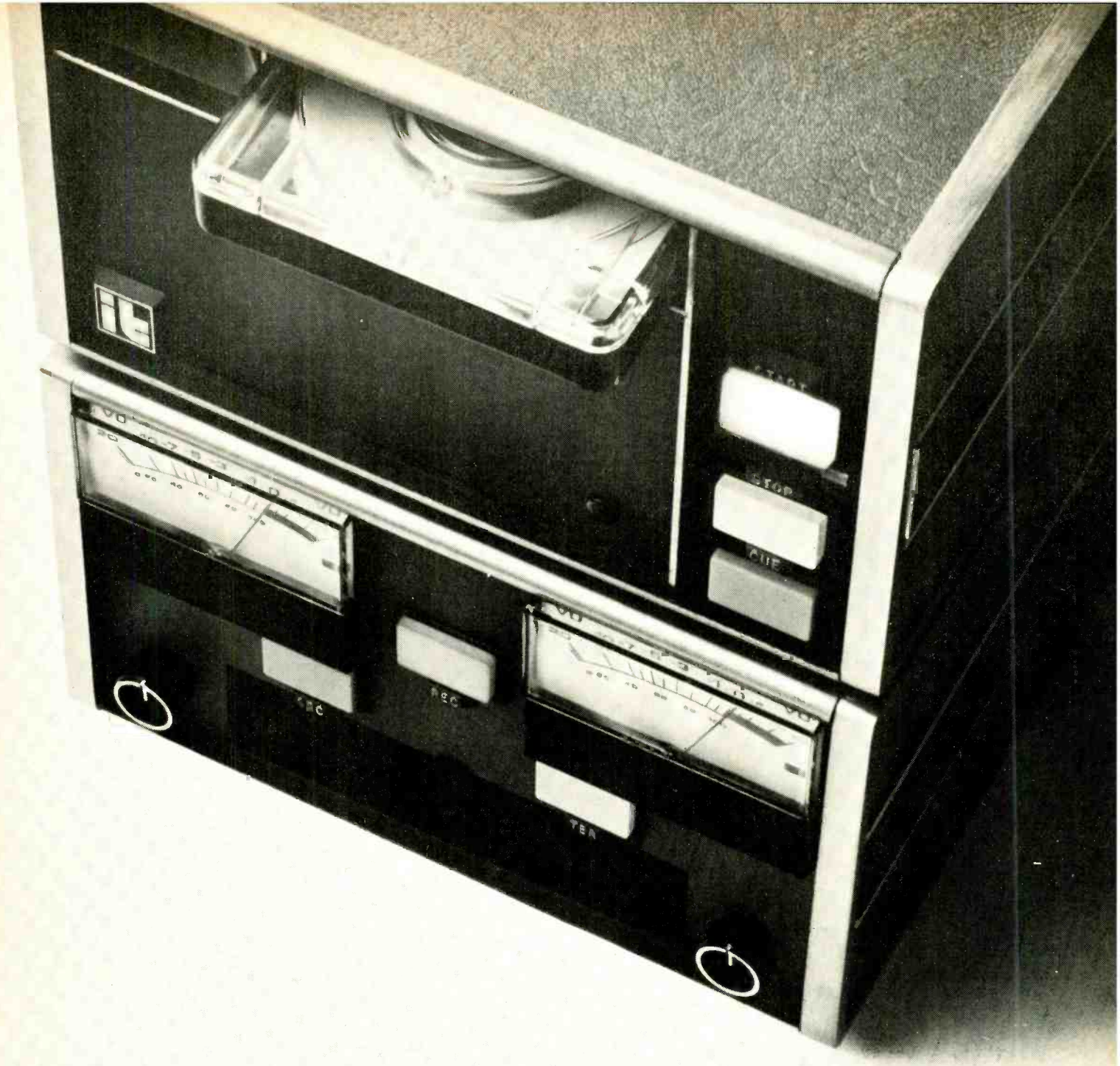
Telephone (415) 392-0300
Telex 34409

346 Clapham Road
London SW9
Telephone 01-720 1111
Telex 919109

S80/2361/2722



THIS NEW GENERATION CARTRIDGE MACHINE FROM ITC ALMOST SPEAKS FOR ITSELF.

There's been much talk about reel-to-reel quality from cartridge machines. Unfortunately, most of it turned out to be hot air.

But now it's a cold fact with Series 99 from ITC, the world's leader in cartridge machine technology.

With 19 patents pending for both electronic and mechanical innovations, it's no wonder that ITC's Series 99 sets new standards.

For sheer quality of sound. For greater operator convenience. And for simplified maintenance.

If you want to hear the cartridge machine that virtually speaks for itself, write now for a few words on the subject to F.W.O. Bauch Limited.

International Tapetronics Corporation
2425 South Main Street,
Bloomington, Illinois 61701, USA

F.W.O. Bauch Limited
49 Theobald Street, Boreham Wood, Hertfordshire WD6 4RZ
Telephone 01-953 0091, Telex 27502

turnkey mix

5 STUDER 24 TRACK'S DELIVERED

The Soundcraft 1624 is the most sophisticated mixer in its price range. The Studer A80 twenty four track is the most reputed, and now at revised prices offers the best value in the market. Put them together and you have a package set for the eighties. Our experience of both private and commercial installations enable us to tailor this package to your exact requirements. Prices start from around £30,000. Call Andrew Stirling on 01-440 9221 for full details.

SLUMP SALE

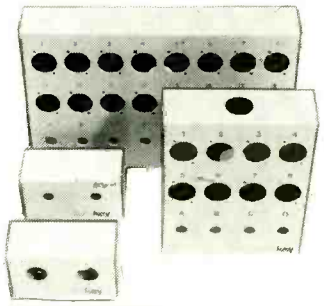
Some ex-demo, oddball and slightly damaged items available once only, on a first come, first served basis;

ASC 15ips 2/tk (again)	£299
DBX 163 Limiter	£93
TEAC CX210 Cassette	£90
2 Bose 802 Speakers	£473
Stands for above	£128
S500D transport case	£56
RSD 16x4 flight case	£48
Patchbay, 2x24 way	£68
KM Cable Drum	£26
KM Medium boom stand	£23
KM L/Weight boom stand	£18
TEAC Model 1 mixer	£35
Wollensak copier 2770	£1098
Wollensak copier 2772	£1055
Ashly stereo para. eq.	£276
Ashly mono comp/lim	£146
SHURE Promaster, from	£95

Prices are exclusive of VAT and delivery, please call for full details.

PORTASTUDIO

At last – TEAC'S long awaited PORTASTUDIO. No bigger than a normal casette machine, this remarkable unit is a four channel mixer and simul-sync recorder in one. Add a microphone and a pair of headphones and you can make four track demos immediately. Available now.



THREE WAY CUBE

Apart from supplying these mighty midgets for free standing use, we can also provide a swivel bracket for console or wall mounting, and a steel adaptor ring that fixes the speaker to a mike stand. These micro monitors are finding their way into every major studio. Spread the word!

MIKE BOX

We now have a range of exclusive wall or cable mounting connector boxes. The standard type takes 8 female XLR's and 4 jacks, the large version is exactly twice that, and the two smaller boxes accept 2 jacks or XLR's respectively. All types have back and side cable entries and fixing holes, and are available with or without connectors.

SHORT TAKES

IVIE Analyser now available for hire from T2 . . . . **Regal** Recorders in Hitchin opens for 24 track business . . . . we present the 'Best emergency programming' award at local radio luncheon . . . . **Dave** Whittaker previously of AHB joins us as Technical Coordinator . . . . **Major** Broadcasting company makes a blindfold test and chooses GBS reverb from all competition . . . . **free** demo record available now . . . . we install a state-of-the-art system at **Prosound** show . . . . **development** of Turnkey monitor nearing completion . . . . **bulk** tape scheme now operating . . . .

ADVANCED AUDIO DESIGNS DDL

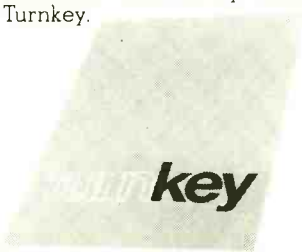
New from America, this processor makes full band delays up to 250mS available in 1mS steps. A front panel digital display shows the programmed delay and full footswitch remote functions are available. As well as normal delay effects, (enhanced by a feedback control) the circuitry allows effects such as flanging, pitch alterations, frequency modulation and infinite repeat hold. Exclusively from Turnkey.

CABLE BREAKTHROUGH

A conductive plastic sleeve replaces the normal wire braid in the remarkable 6527 range of cables. Not only is this wire lighter and more flexible but also screening properties are increased a hundredfold. Available in the ten resistor code colours, by the meter or the drum.

ANNIS MAGNET-OMETER

It works somewhat like a compass, but tells you when. Put it next to a tape head, guide or capstan, and you get an accurate reading of the residual magnetic field. The scale is accurately calibrated, 5-0-5 Gauss, and an extension probe for awkwardly positioned heads is available. Exclusively from Turnkey.

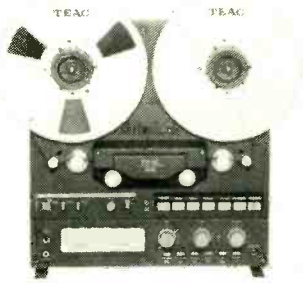


GREEN BOOK

Much more than a catalogue, the new "Turnkey by Mail", 28 page book includes hints on setting up a studio, choosing equipment, and other practical advice. Call or write for a copy or use the reply coupon in the September issue of Studio Sound.

12 by 2 SPECIAL

We have acquired a batch of quality branded stereo recording or PA mixers. Each channel has wide range mike or line inputs, insertion points, four band eq, and two auxilliaries. The output section features echo returns, VU metering and powerful headphone monitoring. A snip at £360.00 plus VAT.



TEAC 32-2

As predicted in the last Mix, Teac's new stereo mastering machine proves to be a winner. Switchable NAB/IEC equalisation, varispeed, big VU's, motion sensing and a closed loop type tape path all contribute to its success. What's more, it's priced well below the competition.

All the products that we sell can be bought using Access or Barclaycard/Visa. Order by phone for fast delivery. Call or write for a copy of our new "Turnkey by Mail" catalogue or visit our demonstration room in North London during normal office hours.
Our business is helping you with yours.

VISA Access

Turnkey.
8 East Barnet Road,
New Barnet, Herts., EN48RW.
Phone 01-440 9221
Telex 25769

The Neumann reputation for quality and reliability in condenser microphones has remained unsurpassed since the 1920's.
Half a century later, Neumann are still the first choice.
The extensive Neumann range now includes the KMR82 shotgun, the U89 and the USM69 stereo microphone.

Audio Export Georg Neumann & Co. GmbH
D - 7100 Heilbronn Fleinerstrasse 29 West Germany

F.W.O. Bauch Limited

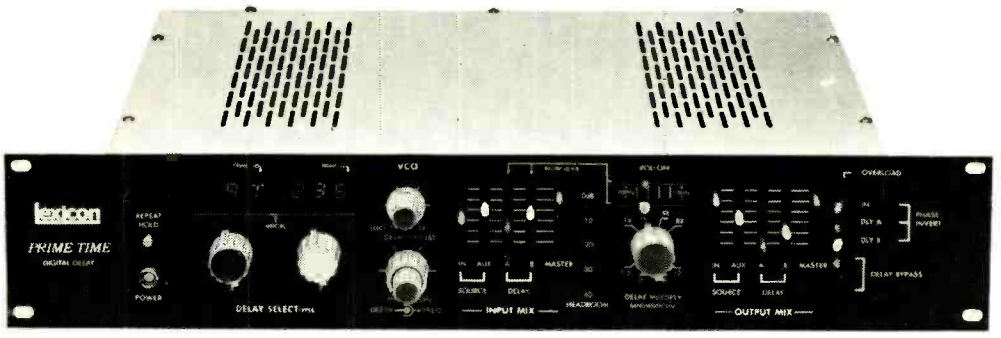
49 Theobald Street, Boreham Wood, Hertfordshire WD6 4RZ
Telephone 01-953 0091, Telex 27502

Studio or live- the effect's the same.

Lexicon Prime Time offers professional quality delay with special effects.

A completely self-contained unit, its features include:

- ☐ Two independently adjustable delay outputs.
- ☐ Up to 2-second delay for special effects.
- ☐ Flanging, doppler pitch shift, vibrato.
- ☐ Repeat hold functions.
- ☐ Remote control for all dynamic functions.
- ☐ Complete independent mixing for delay and reverb processing.



The Lexicon 93 Prime Time Digital Delay Processor provides unparalleled quality both live and in the studio.

It combines simplicity of use with versatility and flexibility, allowing creative innovation.

For more information on Lexicon Prime Time contact F.W.O. Bauch Limited.

lexicon

Lexicon, Inc., 60 Turner Street, Waltham, MA 02154 (617) 891-6790

F.W.O. Bauch Limited

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

STUDIO EQUIPMENT FOR TODAY-AND TOMORROW

AMS equipment is to be seen in the best studios in the World-studios who have had the foresight to reject today's gimmicks, recognising them as a source of tomorrow's spare parts. AMS equipment is designed to the high quality standards that will be required for studios of the mid 80's and beyond, and is fully expandable to allow the newest effects to be added to even the most basic system whilst retaining the exceptional specifications of 18 kHz bandwidth, 90 dB dynamic range and distortion of a miserly 0.025% on all functions. Figures that pull in the business far better than gimmicks.

AMS achieve this by harnessing the very latest technology to the traditional values of good, solid engineering design.

At this stage, we feel we ought to point out the catch-
you won't be able to buy a second-hand piece of AMS gear. And it is quite expensive new. Which means that not everyone can own one...
But then that's life.

CALL US TO-DAY FOR A DEMONSTRATION IN YOUR OWN STUDIO

THE PRODUCTS:
DMX 15-80 Digital Delay Line.
Options:
Up to 4 seconds delay at
18 kHz bandwidth.
Pitch Change Module.
Full Remote Interface.
Modular Reverberation Module
(available shortly).
DMX 15-80S Stereo Delay Line.
DM-DDS Disc Mastering
(preview) Delay Line.
16 Bit Sampling, 27 kHz Bandwidth.
DM2-20/28 Twin Channel
Analogue Flanger/Autopanner.

THE DISTRIBUTORS
U.K. : AMS, Head Office, Burnley.
U.S.A.:Quintek Distribution Inc.,
North Hollywood, L.A.
SPAIN: Singleton Productions,
Barcelona.
CANADA: Octopus Audio, Toronto.
NORWAY: PRO Technic A/S Oslo.
SWITZERLAND:ABQ, Zurich.
FRANCE: Studio Equipment, Paris.
HOLLAND: Delcon, The Hague.
BELGIUM: T.E.M./ A.S.C.,Brussels
DENMARK: Sweet Silence,
Copenhagen.
W. GERMANY: Elmus GmbH, Berlin

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Advanced Music Systems, Worsthorne Village, Burnley, England.
Telephone 36943 & Telex 63108

ams

"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

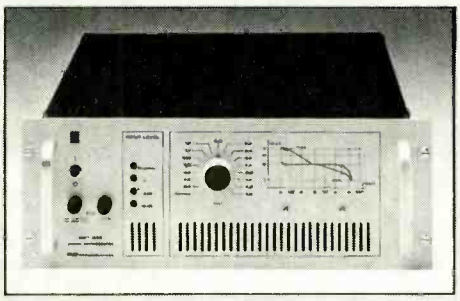
For the full story contact F.W.O. Bauch Ltd., 49 Theobald St., Boreham Wood, Herts. WD6 4RZ

IMAGINE A STUDIO WITHOUT AN EMT PLATE.

We can! EMT digital reverberators are judged by experts to be subjectively superior in sound quality, even to the renowned plate and famed foil.

The EMT 250 offers numerous facilities, including the first reflection delay selectable decay characteristics.

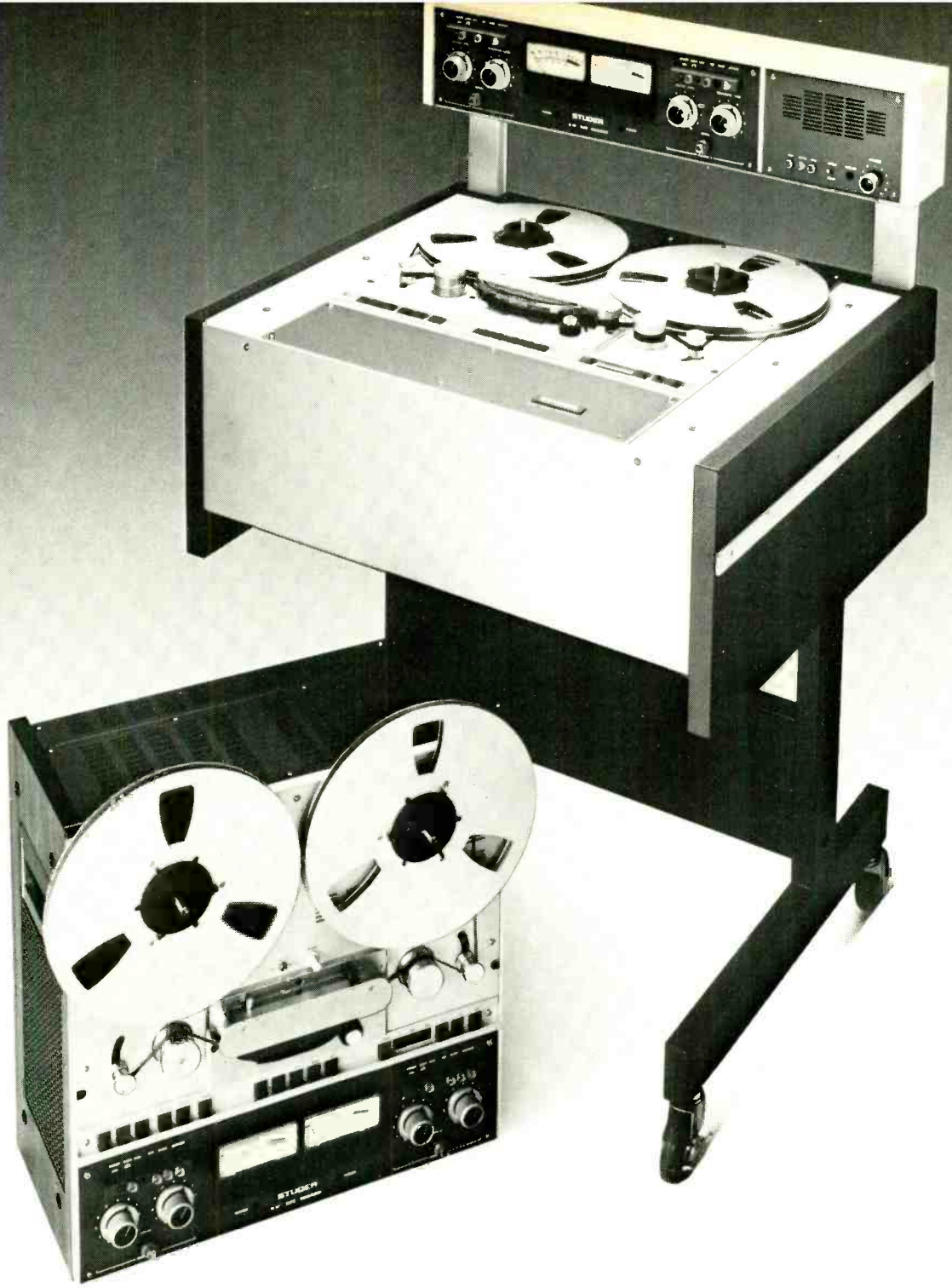
The EMT 244 is a compact microprocessor reverb-only system.



They can even be made to sound like a plate!

EMT FRANZ GmbH
Postfach 1520, D-7630 Lahr, Tel. 07825-512, Telex. 754319. Franz D

F.W.O. Bauch Limited
49 Theobald Street, Boreham Wood, Hertfordshire WD6 4RZ
Telephone 01-953 0091, Telex 27502



The Robust Movers.

When a Studer machine is needed as a rugged, reliable workhorse in the studio or mobile unit, the B67 is the natural choice.

The value-for-money B67 offers proven reliability and performance to justify its acceptance as the direct replacement to the renowned B62.

For more information contact F.W.O. Bauch Limited.

STUDER
INTERNATIONAL AG
CH-8105 Regensdorf Telephone (01) 840 29 60

F.W.O. Bauch Limited
49 Theobald Street, Boreham Wood, Hertfordshire WD6 4RZ
Telephone 01-953 0091, Telex 27502

STUDER REVOX AMERICA INC Nashville
Telephone (615) 329-9576

STUDER FRANCE S A R L Paris
Telephone 533 5858

STUDER REVOX CANADA LTD Toronto
Telephone (416) 423-2831

news

Neve Necam II

Neve has introduced a new version of its *Necam* computer assisted mix-down system. Termed *Necam II* (also known as *Necam D*) the system is tailored to the needs of film dubbing and TV post production studios. *Necam II* simplifies the laying down of master tapes on to edited video tape, incorporating sound effects, dialogue and music, while maintaining sync between audio and video using SMPTE code. Up to 999 mixes may be stored, with recall of any mix or part of a mix together with the appropriate servo-fader movements, from a simple keyboard. Each mix or crossfade may be built-up fader by fader with the computer automatically remembering each mix or part of a mix, and selected parts of different mixes can be combined to achieve the final mix. *Necam II* also allows wild effects to be cued into the mix at exact times, either by entering them on the 'fly' or via SMPTE timecode. Should an event not be exactly synchronised sync can be achieved by individual frame offsets. Up to 64 external machines may be controlled by the *Necam II* system, while other features include programmable roll back, a repeat facility and large display facility.

Neve Electronics International Ltd, Cambridge House, Melbourn, Royston, Herts SG8 6AU, UK. Phone: 0763 60776.

AKG America

The AKG Division of Philips Audio Video Systems has been renamed AKG Acoustics Inc and concurrent with the change of name the company is relocating to Stamford, Connecticut. The move will consolidate AKG's sales and marketing operation with its warehousing and service departments. AKG's new American address is: AKG Acoustics Inc, 77 Selleck Street, Stamford, Conn 06902. Phone: (203) 348-2121.

Bowmar panel meter

A new 5in solid state analogue panel meter called the *APM 500* has been produced by American manufacturer Bowmar/ALI. The panel meter is a 50 segment LED bargraph meter which can be lit from zero to full scale in 2.5ms with 2% accuracy. The meter has a 100kΩ input impedance; will accept ac or dc voltages and currents, and 7-bit binary inputs; and is available with various options including differential input, high input impedance, single/dual setpoints, and special ranges and scales. The meters are priced at $175 in quantities of 1—24. Bowmar/ALI Inc, 531 Main Street, Acton, Mass 01720, USA. Phone: (617) 263-8365.

Sound ideas

Canford Audio has made available a new comprehensive sound effects library in the UK. Called 'Sound Ideas' the library contains more than 2,000 effects (over 20 hours of material) and is supplied on 100 reels of master tape at either 7½ or 15in/s, mono or stereo, NAB or CCIR. The library has the advantage that once purchased there are no royalty payments. A demonstration tape is available on request.

Canford Audio, Stargate Works, Ryton, Tyne and Wear NE40 3EX, UK.

Phone: 089422 4515.

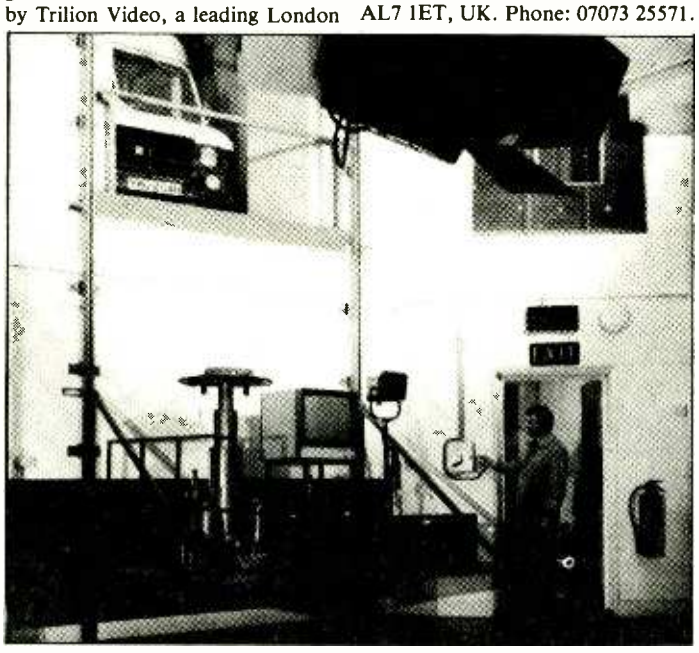
Ursa Major demo cassette

Ursa Major has produced a demonstration cassette highlighting the reverb and related effects available from its *SST-282 Space Station* effects unit. Available at a cost of $2 the cassette explains and illustrates the various effects and demonstrates the wide variety of uses the unit can be utilised for in the recording studio. Additionally, a further cassette illustrating broadcast applications is available at the same price.

Ursa Major Inc, Box 18, Belmont, Mass 02178, USA. Phone: (617) 489-0303.

Ratcliff wall lift

A problem which many studios have is equipment access from outside the studio. Where access from a higher or lower level would solve this problem a useful means is provided by a wall lift. Such a lift is available from a UK company called Ratcliff. The accompanying photograph illustrates a one ton capacity Ratcliff goods lift which has been installed by Trilion Video, a leading London television facility, and shows the basic concept. The particular model shown has a 102 x 72in timber-surfaced platform, however, Ratcliff produce a variety of lifts of various sizes and weight capacities. Ratcliff Tail Lifts Ltd, Bessemer Road, Welwyn Garden City, Herts AL7 1ET, UK. Phone: 07073 25571.



Sound Broadcast Equipment Show

The fifth Sound Broadcasting Equipment Show, organised by Audio & Design (Recording), will take place from 2pm to 9.30pm, on Tuesday September 30, in the Albany Suite, Albany Hotel, Birmingham. This show which has grown out of the ILR Chief Engineers Conference is an excellent opportunity to see broadcast orientated products in an informal and friendly atmosphere. This year's exhibition has over 45 companies attending and admission is by invitation only, limited to people directly connected with broadcasting. Companies exhibiting include: AKG, Alice, Ampex, Audio & Design, Audix, FWO Bauch, Beyer, Brabury Electronics, Bulgin Electronics Soundex, Buzz Music, CAE, Calrec. Canford Audio, Clive Green, Danbridge (UK), Philip Drake, Dolby, Electro-Voice, Elliott Bros, Feldon Audio, Future Film Developments, Harman UK, Hayden Laboratories, HHB, HH Electronic, Klark-Teknik, Lee Engineering, Leevers-Rich, Maldwyn Bowden International, MCI, Neal Ferrograph, Neve, Racal Zonal, Scenic Sounds Equipment, Shure, Sony, Soundcraft, Sound Video Techniques, Studio Equipment Services, Tandberg, Tannoy, Trident, Turnkey, Tweed Audio, and Wayne Kerr. *Studio Sound* will be attending, while outside the Radio Hallam mobile will be on display. Invitations are available from exhibitors or from Dave McVittie at Audio & Design (Recording) Ltd, North Street, Reading, UK. Phone: 0734 53411.

Moritex condenser mic

Symot Ltd is marketing the Moritex range of electret condenser mic units. These units are 6.5mm in diameter and 5.4mm high, and claimed to be non-directional. Sensitivity is −64dB ±3dB, output impedance 1kΩ, current consumption less than 1mA, and maximum sound pressure level 120dB.

Symot Ltd, 22A Reading Road, Henley-on-Thames, Oxon RG9 1AG, UK. Phone: 04912 2663.

Shure SM63-CN mic

Shure has introduced a light weight, small, dynamic, omnidirectional mic, the *SM63-CN*. Weighing only 2.8oz and less than 6in long, the mic features improved sensitivity over the *SM61* (6dB), a humbucking coil, an elastomer isolation shock mount, a built-in breath and pop filter, and a rugged Veraflex polyester grille. Accessories supplied with the mic include a swivel adaptor and a windscreen for outdoor use. Frequency response is 50Hz to 20kHz, impedance 150Ω, amd output level −76dB. Price of the *SM63-CN* is £57.

Shure Brothers Inc, 22 Hartrey Avenue, Evanston, Ill 60204, USA. Phone: (312) 866-2200.

UK: Shure Electronics Ltd, Eccleston Road, Maidstone ME15 6AU. Phone: 0622 59881.

Electro-Voice PL80 mic

Electro-Voice has introduced a new super cardioid dynamic mic, the *PL80*, designed for voice or instrument applications. First used at this year's Montreux jazz festival, the mic features variable bass response (proximity effect), built-in blast filter and shock mount, and rugged aluminium and zinc construction. Quoted specifications include: frequency response 60Hz to 17kHz; impedance 150Ω balanced; output level −56dB; and EIA sensitivity −150dB. The mic has a diameter varying between 2.5 and 5cm; is 19cm long; weighs 350gm; and is supplied with a stand adaptor and a carrying case.

Electro-Voice Inc, 600 Cecil Street, Buchanan, Michigan 49107, USA. Phone: (616) 695-6831.

UK: Electro-Voice Division, Gulton Europe Ltd, Maple Works, Old Shoreham Road, Hove BN3 7EY. Phone: 0273 778401.

30 ▶

Feldon Audio are proud to announce their appointment as exclusive U.K. distributors for the Synton range of products

Syntovox 221-The Intelligible Machine that set the standards in vocoder techniques. £2780·00*

The Syntovox 221 is a 20-channel vocoder system already in wide use in sound recording studios, radio stations, scientific institutions, and by leading composers, for its outstanding quality and unexcelled intelligibility. Included are 54dB/octave filters–a feature not to be found in any other vocoder on the market. It offers the versatility of a built-in pulse generator for direct speech synthesis, with several control units for pitch modulation.

Also available: the Syntovox 222 (Triple Two)

–a simplified vocoder system specifically created for performing musicians who need a flexible, easy-to-use machine for on-stage and session work. Triple Two is the trend setter for budget recorders–with a price to prove it: £468.00.*

synton HOLLAND

* Prices subject to variation, dependent on the rate of exchange.

UK Distributors

Feldon Audio Ltd.,

126 Great Portland Street, London W.1. Tel: 01-580 4314. Telex: London 28668.

New Lexicon DDLs

Lexicon has introduced two new digital delay units, the *Model 122 Series* designed to replace the older *102 Series* and the *PCM 41* a low cost digital delay processor designed specifically for on-stage and small studio usage. The *122 Series* comprises two units, the *Model 122* (mono) with up to five inputs, each individually adjustable, and up to 320ms of delay; and the *Model 122-S* (stereo) with two independent delay lines each with one or two outputs, a VCO module for time modulation, and up to 160ms per channel of delay. The *122 Series* features 14 bit floating point digital encoding with 6dB gain steps; 9-pole Butterworth filters on all inputs and outputs; input limiter stage; balanced transformer isolated inputs and outputs; LED headroom indication in 6dB steps; and modular delay memory capacity in 40ms modules. Delay selection on the mono model is in 5ms steps, while on the stereo model selection is in 2.5ms steps. The VCO module which is standard on the stereo model and optionally may be fitted to the mono model, allows flanging, automatic double and triple tracking, vibrato/tremolo effects, 'precedence' effect panning, and dynamic pitch modulation to be carried out. Other options include remote control and/or digital programming, and an extension chassis option for the mono unit. Quoted specifications include 95dB dynamic range; frequency response 20Hz to 15kHz +0.5dB, −1.0dB; and THD plus noise, typically less than 0.1%.

The *PCM 41* digital delay processor employs PCM encoding, has a bandwidth of 20Hz to 16kHz (or in a x 2 mode 20Hz to 6.5kHz), and has a VCO section. Basic bandwidth delay range is 0 to 200ms, but may be increased to 400ms via a delay multiply control. In the restricted bandwidth mode, delay capacity is available up to 800ms. Effects available include automatic double tracking, flanging, vibrato/tremolo, arpeggio, doppler pitch shift, slap echo, infinite repeat, etc, and via an envelope follower control, articulated sweep. Other features include LED headroom display; input, feedback and output mix controls; signal invert and output phase invert controls; high and low feedback filter controls; and a remote control facility.

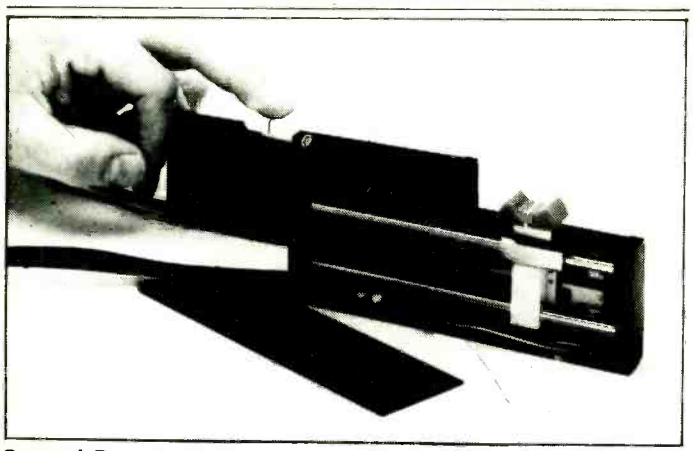
Lexicon Inc, 60 Turner Street, Waltham, Mass 02154, USA. Phone: (617) 891-6790.

UK: FWO Bauch Ltd, 49 Theobald Street, Boreham Wood, Herts WD6 4RZ. Phone: 01-953 0091.

Studer prices down

In order to meet increasing demand for its multitrack tape machines Studer has increased production of its *A80/VU Mk II* recorder. In addition, Studer informs us that because it has recovered its original development and tooling costs this has allowed the price of its multitracks to be reduced. FWO Bauch, the UK agent tells us that new lower prices will be effective for orders taken for delivery from June 1, 1980 and that these will apply to the complete *A80* range, from 4-track to 24-track. For example a 24-track now costs £18,072, and when ordered complete with the new 20-memory autolocator and remote control unit the price is still under £20,000.

FWO Bauch Ltd, 49 Theobald Street, Boreham Wood, Herts WD6 4RZ, UK.
Phone: 01-953 0091.



Sound Dog faders

Cetronic Ltd has made available a new range of studio quality faders, the *AT104* and *AT2104 Sound Dog* range, developed by MCB. The faders are standard 104mm faders available in single or double track versions, and employ conductive plastic resistance and collector tracks with a precious metal cursor. Housed in metal cases, the faders feature a spindle slot dust trap to protect the internal track. The fader specification includes infinity cut off at better than −85dB, and a working life of over one million operations.

Cetronic Ltd, Hoddesdon Road, Stanstead Abbotts, Ware, Herts SG12 8EJ, UK. Phone: 0920 871077.

Hire Association Europe

A new trade association for the communications industry has been formed. The new organisation, the Sound and Visual Division of the Hire Association Europe was inaugurated in January 1980 and membership is open to companies operating in the professional sound, public address, audio-visual, and video hire fields. According to Keith Instead, chairman of the division's steering committee, 'Hiring is very much a growth sector of the communications industry and we believe it is essential to establish an organisation with very high standards of membership to give added confidence to potential customers.' Interested companies requiring further details should contact: John Walker, Hire Association Europe, Idenden House, Medway Street, Maidstone, Kent ME14 1NY, UK. Phone: 0622 679645.

New PEP modules

To compliment its *CM1* 3-band eq, 8-group routing module, Progressive Electronic Products has introduced a new channel module *CM1 B* featuring eq defeat and facilities for 24V phantom powering. The module also has the added advantage of a 20dB mic-pad. The company has also introduced a PPM driver card and a group channel module utilising LED display VU meters.

Progressive Electronic Products, 593 High Road, Leyton, London E10 6PY, UK. Phone: 01-558 0678.

Forthcoming Exhibitions

September 12 to 18
Photokina, Cologne (Cologne 0221 8211).
September 20 to 23
International Broadcasting Convention, Brighton (London 01-240 1871).
September 30
Sound Broadcasting Equipment Show, Birmingham (0734 53411).
October 31 to November 3
AES 67th Convention, New York ((212) 661-2355).
January 8 to 11, 1981
CES (Winter), Las Vegas ((312) 861-1040).
January 23 to 29
Midem 1981, Cannes (Paris (1) 505.14.03).
March 17 to 20
AES 68th Convention, Hamburg ((212) 661-2355)
April 12 to 15
NAB Convention, Las Vegas (Washington (202) 293-3500).
Early May
AES 69th Convention, Los Angeles ((212) 661-2355).
May 30 to June 4
Montreux 12th Exhibition (Montreux 021 61.33.84).
Early June
CES, Chicago ((312) 861-1040).
Mid-June
APRS, London (09237 72907).
June 29 to July 3
Film 81, London (01-242 8400).
November 25 to 28
Tonmeistertagung Convention and Exhibition, Munich (Berlin 030 308 2234).

New American studio association

Following in the wake of the formation of SPARS, the Society of Professional Audio Recording Studios, another American studio association has been formed. Called the Organisation of American Recording Studios, the association under the acting directorship of founder Robert Lee, intends to create a national forum and information exchange among member studios. Membership of the association (unlike SPARS) is open to all studios, and its philosophy is that technique, marketing and management are as important as equipment. The organisation intends holding national and regional conventions and meetings for members, mounting educational seminars, and the publishing of a quarterly newsletter. Cost of membership of OARS is $125 for full membership, and $50 for associate membership, with an additional charge of $25 to first time applicants as a processing fee. Further details are obtainable from Robert Lee, Box 262, Manasquan, New Jersey 08736, USA.

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professional compressor/limiters - the first family of level control

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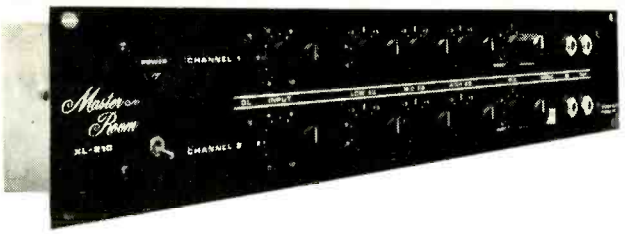
97-99 Dean Street,
London W1V 5RA
Telephone : 01-734 2812/3/4/5
Telex : 27 939 SCENIC G

France	**3M France SA, Mincom Div.**	Boulevard de l'Oise, 95000 Cergy Tel : Paris 749 0275
Germany	**Audiolive**	Kyffhauserstrasse 10A, 5 Koln 1 Tel : Koln 230910
Holland	**Pieter Bollen Geluidstechnik**	Hastelweg 6, Eindhoven Tel : Eindhoven 512 777
Sweden	**Tal & Ton Musik & Electronic AB**	Kungsgatan 5, 411-19 Gothenburg Tel : Gothenburg 130 216
Spain	**Mike Llewelyn-Jones**	AP Postal 8.178 Madrid Tel : Madrid 637 0752



Micmix XL-210

Based on the same technology utilised in the Micmix *XL-305* reverb, a new Micmix reverb unit, the *XL-210* has been recently introduced. The *XL-210* is a 19in rack mount unit featuring two independent stereo channels which are switchable to mono operation. Input and output connections are via front and rear panel ¼in jacks allowing front panel patching to be carried out without disturbing the rear panel connections. Inputs are active balanced circuits facilitating either balanced (20kΩ) or unbalanced (10kΩ) lines, while the outputs are 600Ω unbalanced. Features include a mix control to blend the direct and reverb signal; 3-way equalisation (± 12dB at 100Hz, 1kHz and 10kHz); and peak holding overload LED indication. Decay time is 3s; frequency response 20Hz to 20kHz (direct channel); harmonic distortion less than 0.1% (direct channel); crosstalk −45dBm (reverb channels); and output noise −78dBm (direct channel), −70dBm (reverb channel 'A' weighted). Price of the *XL-210* is $950.

Micmix Audio Products Inc, 2995 Ladybird Lane, Dallas, Texas 75220, USA. Phone: (214) 352-3811.

UK: Scenic Sounds Equipment, 97-99 Dean Street, London W1V 5RA. Phone: 01-734 2812.

Inovonics Model 500 plotter interface

Inovonics has introduced an x-y plotter interface for its *Model 500* acoustic analyser. With the new accessory the *Model 500* can be connected to an x-y plotter with 2V dc full-scale input sensitivity, and data from real- and reverberation-time analyses can be printed immediately when ac power is available for the plotter. For battery-powered operation data can be stored temporarily in either of the *Model 500*'s two memories for printout at a later time. The plotter interface is mounted in an existing recess on the back panel of the *Model 500*. Price of the interface is $290.

Invonics Inc, 503-B Vandell Way, Campbell, Cal 95008, USA. Phone: (408) 374-8300.

UK: Feldon Audio Ltd, 126 Great Portland Street, London W1. Phone: 01-580 4314.

APRS digital harmonisation working party

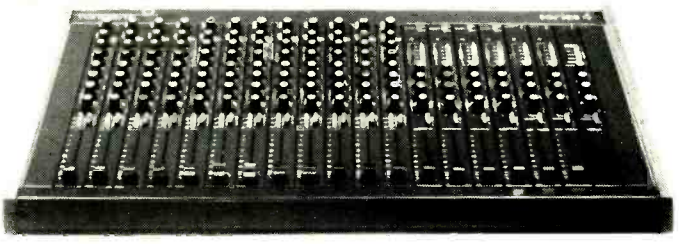
The APRS is to hold the first meeting of its special working party on the problems of digital harmonisation during the forthcoming International Broadcasting Convention in Brighton, on Monday, September 22 at 10.30am. Under the chairmanship of *Studio Sound* consultant Hugh Ford, the working party is expected to establish a formal framework in which it will work towards the eventual goal of establishing an International Digital Harmonisation for professional recording equipment. Anyone interested in attending the inaugural meeting, or being co-opted onto the working party should contact the APRS Secretary, Edward Masek, 23 Chestnut Avenue, Chorleywood, Herts WD3 4HA. Phone: 09237 72907.

Sale of the Century?

Studio One, EMI Abbey Road, will be the venue on October 15 and 16 for a once-in-a-lifetime sale of recording equipment including some unique items. In particular, there will be a couple of Beatles specials in the Studer *J37* 4-track recorder used on the Sergeant Pepper album and the *Mellotron* tape organ with many of the Beatles' original tapes still intact. Another item on offer is the limiter compressor used by Joe Meek—most notably on Telstar. The main sale will cover a wide and comprehensive range of professional recording and ancillary equipment. Further details are available from Martin Jackson, The Studios, Rickmansworth, Herts, UK. Phone: 09237 72351.

Tangent Series 4

Tangent Systems Inc has introduced a new range of small mixing consoles designed for sound reinforcement applications and 4 or 8-track recording. Termed the *Series 4*, the consoles are available in either 12 or 20 input fully modular mainframes with optional reverb and expander modules. The consoles have four output busses; transformerless inputs; 3-band eq on each channel; eight independent returns; PFL: six out buss assign through four submasters and L/R stereo busses; three independent foldback sends; full provision for multitrack monitoring and assign; muting; 100mm faders; and phantom mic power. Prices of the *Series 4* start from approximately $2,800. Tangent Systems Inc, 2810 South 24th Street, Phoenix, Arizona 85034, USA. Phone: (602) 267-0653.



Dominus moving coil preamp

UK manufacturer, Dominus, has introduced a moving coil preamplifier unit to accompany its range of stereo disc amplifiers. The m-c preamp is a self contained mains powered unit with two front panel controls for matching input load resistance (20-470Ω) and capacitance (2-1500nF) to that of the m-c cartridge in use. Input clipping level is 45mV. The unit's outputs are suitable for driving any high quality disc stage, output clipping level is 2V rms, crosstalk is greater than −50dB, while THD is greater than −82dB (0.008%). Features of the unit include full Mumetal shielding to ensure low hum induction and switch-on muting at the output to avoid transients. The m-c preamp

costs £194 and may be used with either the Dominus *Stereo Disc Amplifier 3*, or where balanced line outputs are required the Dominus *Stereo Disc Amplifier 2*.

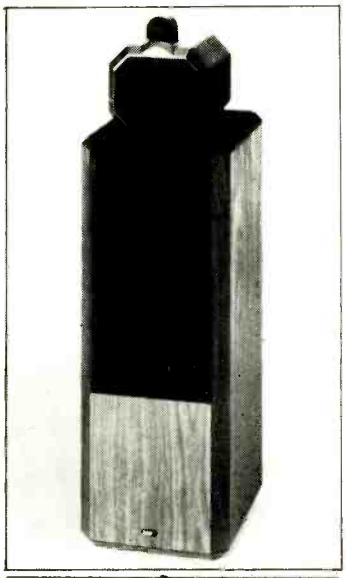
Dominus, PO Box 1, Cranleigh, Surrey GU6 7JF, UK. Phone: 04866 6477.

New B & W monitors

B & W Loudspeakers has introduced two new monitor loudspeakers, the *Model 802* and the *Model DM14*. The *Model 802* follows the concept of the *Model 801* which has found considerable favour as a classical music monitor, and is a 3-way system incorporating electronic overload protection. More compact than the *801*, the monitor features two bass drivers and vertically aligned mf and hf drivers. Quoted specifications are: frequency response, 55Hz to 20kHz ±2dB; sensitivity, 85dB into 8Ω at 1W at 1m; and power handling, 50W minimum. The *DM14* is a compact 2-way system with two lf/mf drivers and a separate hf unit, and as with the *802* incorporates electronic overload protection. Quoted specifications are: frequency response, 80Hz to 20kHz ±2dB; sensitivity, 86dB into 8Ω at 1W at 1m; and power handling, 15W minimum. Prices are *DM14*, £239 per pair, and *802*, £775 per pair.

B & W Loudspeakers Ltd, Meadow Road, Worthing, West Sussex BN11 2RX, UK. Phone: 0903 205303.

B&W 802



EMT 948 turntable

A new arrival at the AES 65th Convention in London was the *EMT 948* broadcast turntable. This is a direct drive turntable with reversible rotation facility and is a more compact unit than the *EMT 950* turntable introduced some three years ago. The *EMT 948* uses a high resolution tachometer generator and master quartz generator for speed lock and the turntable's speeds may be either fixed at 33⅓, 45 and 78 rpm, or continuously varied. The turntable has controls for fast cue, stop and reverse cue; uses the same pcb's as the *EMT 950* including the audio amplifiers; has a motor lifted tone arm; and may be remote controlled. Price of the *EMT 948* is £1,338.

EMT-Franz GmbH, Postfach 1520, D-7630 Lahr, West Germany. Phone: 07825 512.

UK: FWO Bauch Ltd, 49 Theobald Street, Boreham Wood, Herts WD6 4RZ. Phone: 01-953 0091.

USA: Gotham Audio Corp, 741 Washington Street, New York, NY10014. Phone: (212) 741-7411.

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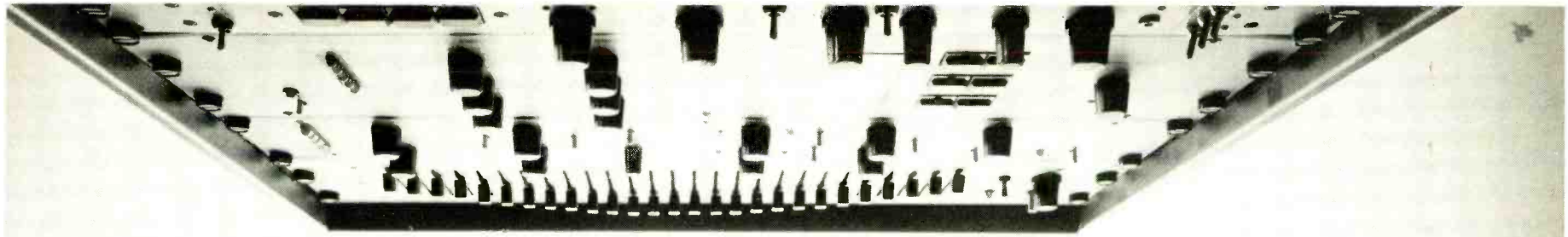
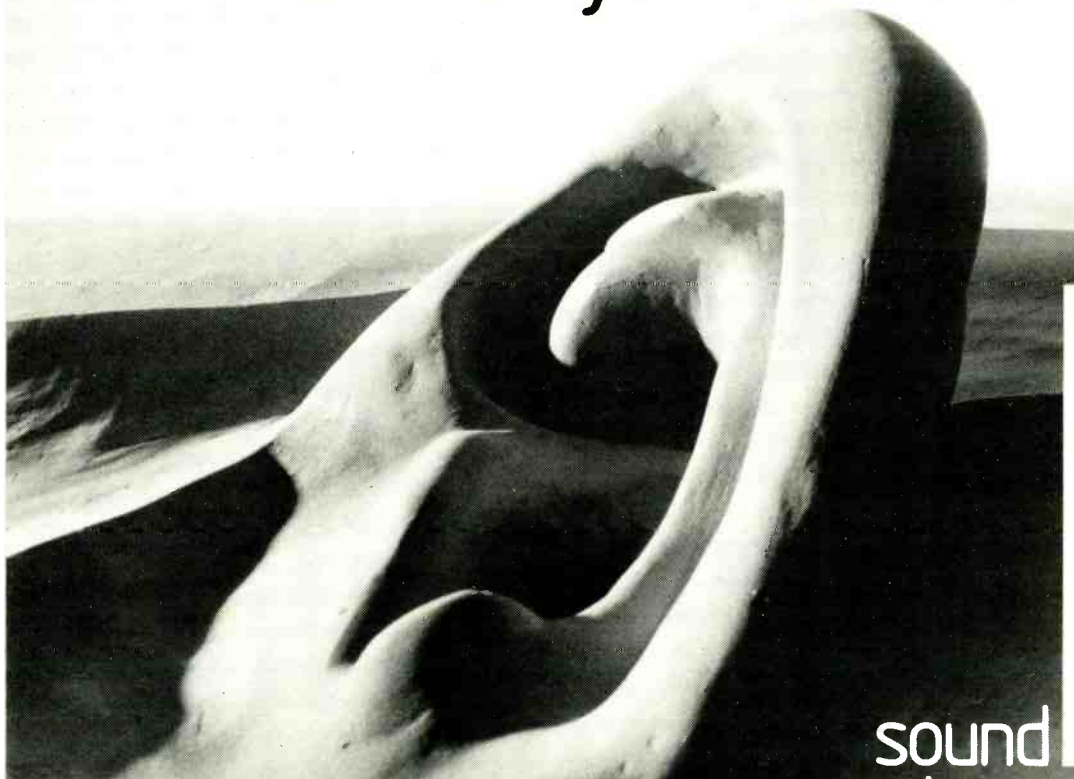


sound systems out of this world



DN34 Analogue Time Processor

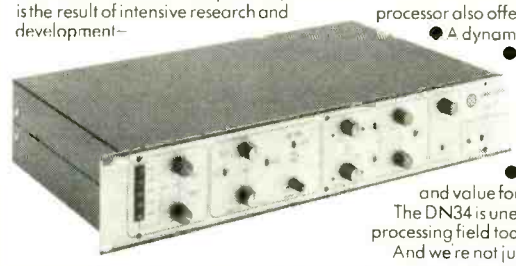
The Klark-Teknik DN34 analogue time processor is an exceptionally versatile signal processing and special effects unit, designed around two discrete, independently controllable delay sections.

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.

With a product of this stature you can achieve an incredible range of delay-based effects; cleanly and noiselessly.

The Klarke-Teknik DN34 analogue time processor also offers you:-

- A dynamic range better than 90dB.
- A time sweep range of 70:1.
- T.H.D. at less than 0.3%.
- Numerous exclusive features including full 'on board' mixing and phase reversal facilities.
- Amazing performance and value for money.



The DN34 is unequalled in the signol processing field today.

And we're not just saying that for effect.

sound is our science

WORLD WIDE DISTRIBUTORS

AUSTRALIA
Klarion Enterprises Pty. Ltd
Phone: (08) 61 3801
Telex: 34732

BELGIUM
S.E.D. Sprl,
Bruxelles
Phone: 02.522.70.64
Telex: 63210

DENMARK
S.C. Sound ApS,
Taastrup
Phone: 02.99.88.77

FRANCE
Studio Center,
Paris
Phone: 362.73.10

HOLLAND
Pieter Bollen, Geluidstechniek,
BV. Eindhoven.
Phone: 040.424455
Telex: 59281

ITALY
Roje Telecomunicazioni s.p.a.
Milano
Phone: 4154.141,
Telex: 332202 Roje 1

NEW ZEALAND
General Video Co. Ltd.,
Wellington.
Phone: 872-574
Telex: NZ 3859

SPAIN
Mabel Sdad,
Barcelona.
Phone: 3517011
Telex: 51526

SWITZERLAND
Dr W.A. Gunther,
Zurich
Phone: 0161 54 60 61

AUSTRIA
Peerless Production,
Wien.
Phone: 0222 83 22 24
Telex: 134072

CANADA
Omnimedia Corp.,
Montreal
Phone: (514) 636 9971

FINLAND
Nores Oy,
Helsinki
Phone: 90.520.311
Telex: 121676 norec sf

GERMANY
Hausmann Concert Electronic,
Berlin.
Phone: 433.60.97
Telex: 0181666

HONG KONG
Studer Revox Ltd.,
(Far East)
Phone: 5-459688
Telex: 60785

JAPAN
Hibino Electro Sound Inc.,
Tokyo.
Phone: 03.864 4961
Telex: 265.7314

SINGAPORE
Ultralinear International,
Singapore.
Phone: 2210387
Telex: 23860

SOUTH AFRICA
Colosseum Acoustics,
Johannesburg.
Phone: 23.4541

U.S.A.
Hammond Industries,
New York.
Phone: (516) 364-1900.
Telex: 96-1396

KLARK-TEKNIK RESEARCH LIMITED
Coppice Trading Estate,
Kidderminster, Worcestershire DY11 7HJ,
England. Telephone: (0562) 741515. 5 Lines.
Telex: 339821.

Quantum/Audio Logic

Quantum Audio Labs, the Los Angeles based console manufacturer, has acquired Audio Logic the signal processing and monitoring equipment manufacturer. Audio Logic is to operate as a wholly owned subsidiary of Quantum and it is being consolidated into Quantum's Glendale facility.

Coinciding with the acquisition, Andrew Thompson, formerly president of Audio Logic has become national sales manager for Quantum. Future plans for Audio Logic include expansion into advanced live music mixing systems.

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

North London Polytechnic course

Dr Roger Driscoll is once again offering his part-time *Sound Studios and Recording* course at the Polytechnic of North London which commences in late October. The course runs for two hours each Thursday afternoon, for three terms, leading to an examination in June 1981, and provides a knowledge of the fundamental principles and techniques of acoustics and recording. Course fee is £27 and application forms can be obtained from: Dept of Electronic and Communications Engineering, The Polytechnic of North London, Holloway Road, London N7 8DB.

Teac 144

An interesting new product from Teac is the *Model 144 Portastudio* integrated 4/2 mixer and 4-channel cassette recorder with Simul-Sync. Although primarily designed as a creative recorder for the musician, the unit is also useful for laying down demo material. The mixer section features four mic/line inputs with variable gain; aux send; 2-way ±10dB eq at 100Hz and 10kHz; pan; individual and master channel faders; headphone buss monitor; cue and remix buttons; record select switch matrix; aux receive control; tape cue controls; and VU metering. The recorder section is a 4-channel, 2-head, single direction cassette recorder operating at 3¾in/s. Features include a 2-motor transport with logic control; Dolby noise reduction; ±15% variable pitch control; a memory rewind stop function; and cobalt or CrO_2 cassette tape calibration. Quoted specifications include input impedance 60kΩ; output impedance 200Ω; recording time 15 minutes with a C-60 cassette; fast rewind 70s (C-60); frequency response 20Hz to 20kHz (mixer), 20Hz to 18kHz (recorder); wow and flutter ±0.06% peak weighted; and S/N ratio 68dB (mixer), 63dB ref 315Hz, 250nWbm (recorder). Price of the Teac *144* is £599.

Harman (Audio) UK Ltd, St. John's Road, Tylers Green, High Wycombe, Bucks HP10 8HR, UK. Phone: 049481 5331.

Teac Corporation of America, 7733 Telegraph Road, Montebello, Cal 90640, USA. Phone: (213) 726-0303.

Audio Developments PPMs

Audio Developments has introduced a new range of PPM meters available as OEM units. The range includes meters to both BBC and EBU standards, with a choice of meter size. Driver circuitry is on a compact card which mounts directly onto the meter terminals. The power supply may vary between 15 and 35V without requiring recalibration, while current consumption is only 6mA making the units suitable for battery operation or for applications where total supply consumption might be a problem. The input of the drive circuit is balanced at 400kΩ with built-in unbalanced input options of unity or +6dB gain. Sum and difference of two unbalanced signals is also possible without additional circuitry.

Audio Developments, Hall Lane, Walsall Wood, West Midland WS9 9AU, UK.
Phone: 05433 5351.

White pink noise generator

White Instruments has reintroduced its *Model 151* battery powered digital pink noise generator. The generator retails for £175 and is an ideal noise source for the testing and alignment of loudspeakers.

White Instruments Inc, PO Box 698, Austin, Texas 78767, USA. Phone: (512) 892-0752.

UK: Scenic Sounds Equipment, 97-99 Dean Street, London W1V 5RA. Phone: 01-734 2812.

Agencies

- Sony has appointed Feldon Audio as a dealer for its full range of professional audio products including digital equipment.
- AMS has appointed the following overseas agents: Holland—Delcon Holland BV, Frankenslag 9, Den Haag. Phone: 070 54.16.00. Japan—Continental Far East Inc, Sasaki Building, 3-18-9 Roppongi, Minato-ku, Tokyo 106. Switzerland—ABQ, Binzmühle-strasse 56, CH-8050 Zurich. Phone: 01 302. 77.03.
- Fostex the Japanese manufacturer of monitors, mics, headphones and power amplifiers has appointed Interlake Audio, Winnipeg and Parasound Inc, San Francisco as its North American agents.
- Parasound Inc has terminated its exclusive sales and marketing agreement with Orange County Electronics. Orange County will now market its products from its Winnipeg office.
- Future Film Developments has been appointed as the London distributor for the range of PA equipment manufactured by Millbank Electronics.

Address changes

- Westrex Co Ltd has moved to a modern custom-built factory at Bilton Fairway Estate, Long Drive, Greenford, Middx, UK. Phone: 01-578 0957/8/9.
- The sales and marketing department of Racal-Zonal Ltd has moved to Holmethorpe Avenue, Redhill, Surrey RH1 2NX, UK. Phone: 0737 67171. Telex: 946520.
- Devonair Radio Ltd, the new ILR station is now headquartered at The Studio Centre, 35/37 St. David's Hill, Exeter, EX4 4DA, UK. Phone: 0392 30703.
- Gulton Europe Ltd has transferred its Electro-Voice repair department to its Hove address: Gulton Europe Ltd, Electro-Voice Division, Maple Works, Old Shoreham Road, Hove, BN3 7EY, UK. Phone: 0273 23329. Telex: 87680.
- Studio Equipment Services Ltd has moved to larger premises at 100/102 Hamilton Road, London NW11, UK. Phone: 01-458 9133. Telex: 87515.
- The sales and marketing office of Tannoy Products Ltd has moved to 77/79 High Street, Watford, Herts WD1 2DJ, UK. Phone: 0923 48868.

People

- Neve has appointed Michael Harris as its regional sales manager for the Near, Middle and Far East markets.
- David Mills has been appointed marketing manager responsible for magnetic tape oxides by Pfizer Inc.
- Lou Lombardi has joined Altec Corporation as general manager of Altec Lansing of Canada Ltd.
- MXR Innovations has appointed Bob Wilson as export co-ordinator responsible for all overseas marketing and sales.
- Professional Sounds Inc has added Jonathan Kendall to its staff of audio consultants and engineers, with responsibility for systems design.
- Devonair Radio has appointed Jeff Winston as its programme controller. Jeff was previously programme controller at Pennine Radio.
- Millbank Electronics has appointed Barry Noyes as its marketing director.
- David Bissett-Powell has been promoted to sales and marketing director of Tannoy Products Ltd.

Contracts

- Ampex has received an order to supply 28 *ATR-102* tape machines to RTVE the Spanish national broadcasting authority. The machines will be used for music and drama productions at RTVE's 'Casa de la Radio' centre in Madrid.
- Neal-Ferrograph has won an order worth in excess of £150,000 from the Syrian Broadcasting Authority for *Studio 8* tape recorders and ancillary equipment.
- AMS (Advanced Music Systems) has supplied the BBC with 10 *DMX15-80SB* stereo DDLs, three *DMX15-80* systems and a special 12s version of the *DMX15-80* for 'live editing' of realtime programmes. Television companies who have recently received AMS delay systems include Thames, London Weekend, Granada, Yorkshire, and ABC TV, New York. Recent studio installations include Olympic, The Roundhouse, Maison Rouge, Freerange, Ridge Farm, and The Manor in the UK, and Davlen Studios and Kendun Recorders in the USA.
- The Finnish Broadcasting Company has purchased five *DN70* digital time processors and five *DN71* sound effects generators from Klark-Teknik.
- Dunlopillo UK has supplied the Swedish company EMAB with acoustic foam wedges for a large anechoic chamber.
- Capital Radio has ordered a customised Cadac *P Series* 24 + 4 console which is to be installed in the Duke of York's Theatre, London. ■

New realms of expression from MXR.

The Pitch Transposer is MXR's newest addition to our professional line. It is one of our most innovative products, and possibly the most revolutionary signal processor in the music industry today. It is a unique, high-quality unit which provides a cost effective and flexible package for today's creative artists.

The Pitch Transposer extends your musical boundaries by creating live instrumental and vocal harmonies. It has 4 presets which allow the artist to predetermine the intervals to be processed. Transposed intervals can be preset anywhere from an octave below to an octave above the original pitch. The chosen interval is activated by means of touch controls or a rugged footswitch. LED indicators display which of the four presets has been selected.

A mix control is provided, enabling the unit to be used in one input of a mixing console, or with musical instrument amplifiers. A regeneration control provides for the recirculation of processed signals, creating more and more notes, depending upon the selected interval. This results in multitudes of voices or instrumental chords. An entire new range of sound effects and musical textures, unattainable with any other type of signal processor, is suddenly at your fingertips.

With many other pitch transposition devices a splicing noise, or glitch, is present. The MXR Pitch Transposer renders these often offensive noises into a subtle vibrato which blends with the music, and is, in some cases, virtually inaudible. The result is a processed signal which is musical and usable.

We have been able to maintain a high level of sonic integrity in this most versatile signal processor. The frequency response of the processed signal is beyond 10 kHz, with a dynamic range exceeding 80 dB.

A micro computer based display option allows the user to read the created harmonic interval in terms of a pitch ratio, or as a musical interval (in half steps). This unique feature allows the pitch to be expressed in a language meaningful to both musicians and engineers.

We designed our Pitch Transposer as a practical musical tool for those actively involved in creative audio. It reflects our commitment to provide the highest quality signal processors with the features and performance that will satisfy the creative demands of today's musical artist. See your MXR dealer.

Atlantex Music, Ltd., 34 Bancroft Hitchin, Herts. SG51LA, Eng., Phone 0462 31513, Tlx 826967

MXR Professional Products Group

studio diary

Cliff Richard and producer Alan Tarney with Ruth Low and Nick Glennie-Smith

Riverside Recording Studios, London

An unlikely site for a recording studio is behind a grocer's shop in an off the beaten track location in Acton, but this is precisely where Riverside Recording Studios can be found. The studio has been in existence at its present location since the mid-Seventies and has recently had its facilities upgraded while the opportunity was also taken to reconstruct the studio.

Prior to detailing the facilities it is worthwhile briefly covering the history of the studio which has been an organic growth from small beginnings. The studio takes its name from its early days when surprise, surprise it was located by the Thames. At that time the then studio owner Adam Skeaping was mainly involved in basic 2-track classical music recording. By 1976, however, the studio had moved to its present location and it had become a 16-track studio with a Soundcraft *Series 2* console and 3M *M56* recorder mainly used for jingles and demos. 1976 was an auspicious year for the studio since it was then that the present owner, Ruth Low, arrived as assistant to the studio manager. The following year Ruth became studio manager and decided that the time had come to prune the somewhat large staff of engineers, and for the studio to expand its clientele. Accordingly, freelance engineers became the norm and 'new wave' bands such as the Sex Pistols and the Stranglers increased the studio's field of operation. Adam Skeaping had by this time largely divorced himself from the day to day activities of the studio and in late 1978 he decided to sell the studio. After considerable soul-searching and with the aid of a helpful bank manager, Ruth Low then purchased the studio in 1979. Almost immediately Ruth decided to upgrade and reconstruct the studio and in December 1979 the studio closed for three months to enable the work to be carried out.

Having decided to reconstruct the studio, first priority was to convert a disused garage adjacent to the studio into a reception area and lounge. Originally though, Ruth had also wanted to use this area to extend the studio itself. However, this idea was rapidly shelved when a number of regular studio users indicated that they felt this would destroy the 'special' acoustic quality of the studio. Nobody it seems can explain quite why the studio should be regarded as having a 'special' sound, but as Alan Tarney a regular user puts it "there is something between 'live' and 'dead' that works, particularly with vocals and drums".

The studio isn't a particularly large room. At approximately 300sq ft there isn't an awful lot of room by the time a drum kit, Bechstein grand, and various keyboards have taken up their allotted floor space. However, the finish which includes heavy wall drapes does give the room an unusual presence which is particularly striking on vocal sounds. Should the particular acoustic quality of the studio not be suitable for some recordings, an adjacent passageway can (and has been) used as a vocal/drum booth, while the reception/rest area behind the studio which is a very live area with bare brick walls may also be utilised.

The studio control room is basically the same size as the studio and has been reconstructed to a design by AM Acoustics following Hidley Westlake practice. Although not an actual Westlake design the basic precepts and pebble-and-glass finish, along with bass trapping and heavy wall drapes, give the room similar advantages to a Westlake room. The upgrading of the reconstructed room has entailed re-equipment to 24-track, and interestingly Ruth and Ray Gillon, maintenance engineer and Ruth's assistant, have decided to stay with the equipment manufacturers the studio previously purchased from. Thus the console is now a Soundcraft *1624* while the multitrack tape machine is a 3M *M79* 24-track with Audio Kinetics *XT24* autolocate, which is operated at 30in/s without Dolby. Monitoring is over JBL *4343s* flush mounted either side of the control room window, and driven by HH *500s*, with White room equalisation, or alternatively via ADS *200* mini-monitors mounted on the console meter panel. As usual a wide variety of ancillary equipment is available including Lexicon *244* digital reverb and *Prime Time, Scamp* rack with compressors and noise gates, Eventide *Harmonizer* and *Instant Flanger*, Roland *Space Echo* and stereo phaser, and UREI *1176* comp /limiter. Tape mastering machines include Studer *B67* and Revoxs and a NEAL *302* for cassettes. Finally, there is a wide selection of microphones including mics from Neumann, AKG, Calrec, Beyer, and an elderly Lustrephone stereo ribbon mic.

In the short period since reopening, Riverside has built up an impressive roster of clients, current users including Barbara Dickson, Cliff Richard and Leo Sayer. All seem particularly pleased with the reconstruction and upgrading and at the time of my visit Leo Sayer and engineer Nick Glennie-Smith spent a considerable amount of time enthusing over the quality of the studio, Leo in particular loving the vocal sounds. While the reconstruction of the studio is complete, further work remains to be done above the studio and control room where a maintenance area and tape copy facility has still to be completed. Ruth Low must be congratulated on being one of the few ladies in the recording business who has made it to the very top, and shows every sign of remaining there. Already with a successful studio in being, she isn't content merely to let things drift, and her next ambition is to start her own production company specialising in radio and television jingles.

The facilities at Riverside may be on the small side, but the pedigree of the studio and its results are of the highest quality. In its revamped form the studio retains the best of its former features, but with additional facilities which make it an attractive recording venue. While it will never be able to accommodate the larger bands, in its own field the studio has much to offer. In this case being off the beaten track and small has definite advantages!

Riverside Recording Studios, 78 Church Path, Fletcher Road, London W4 5BJ, UK. Phone: 01-994 3142.

Noel Bell

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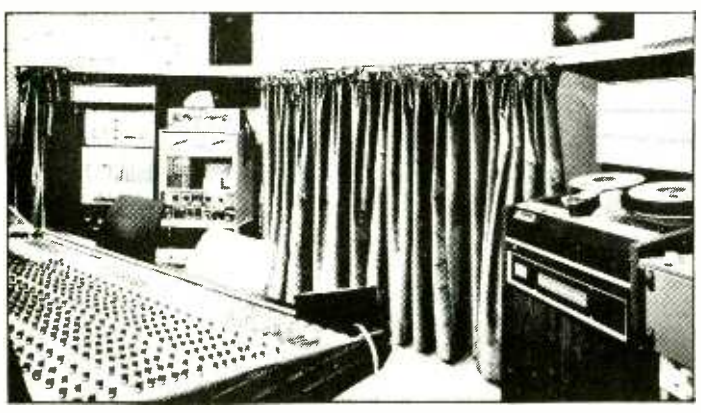
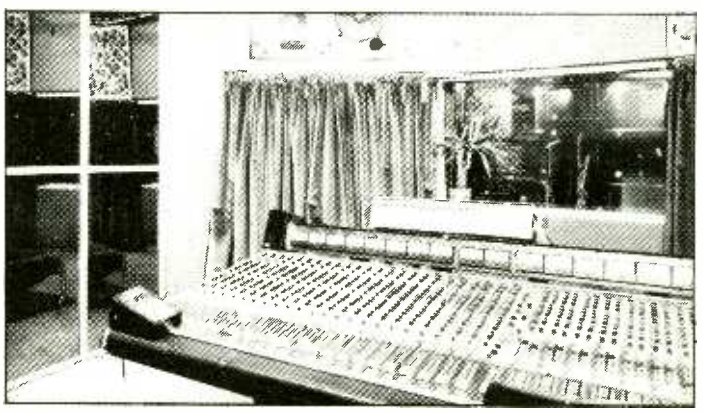
Control room with Soundcraft console and various goodies



Westlake styled control room with studio beyond



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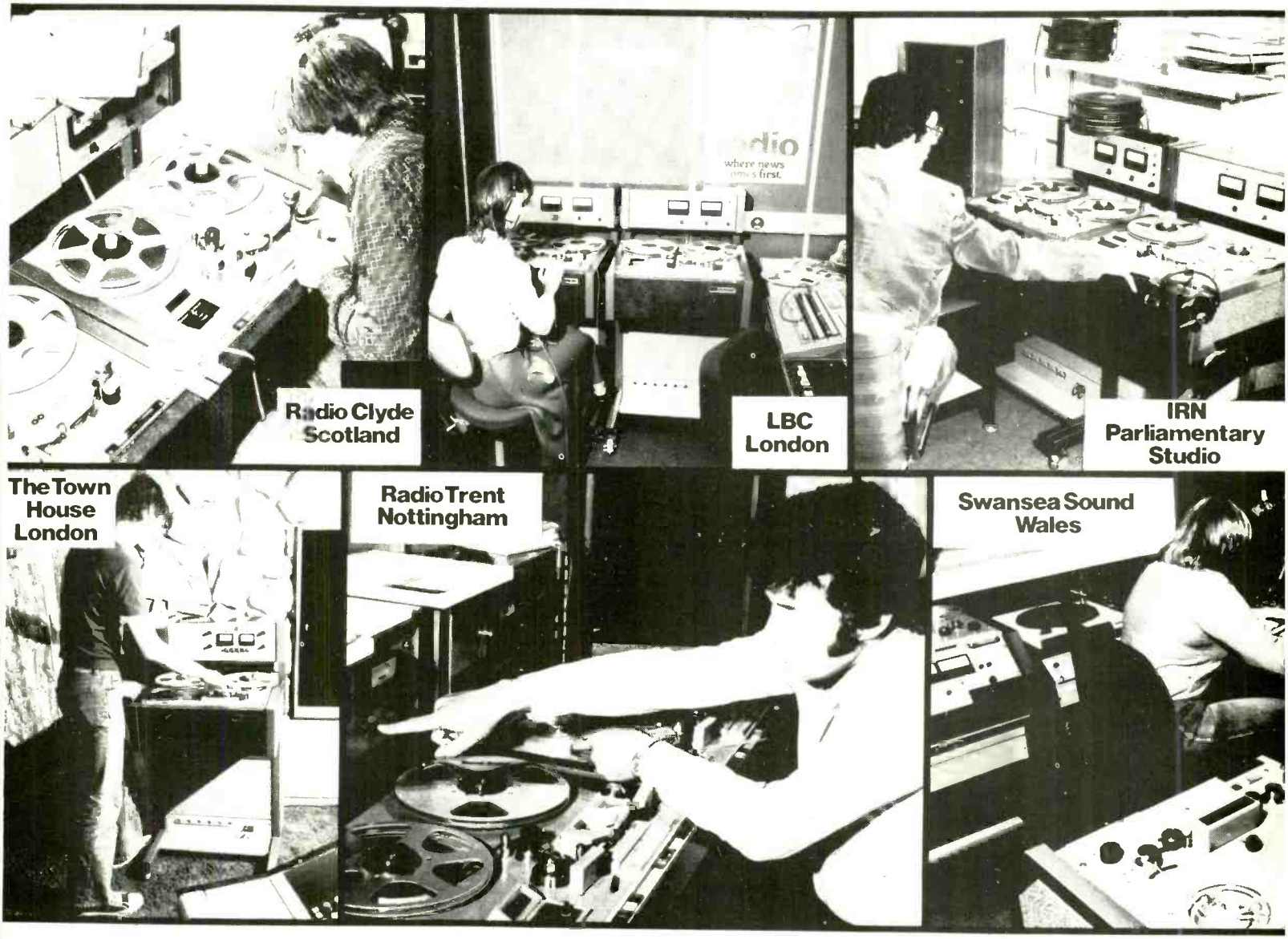

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Munich — Sound in the Theatre

The importance of sound reproduction and reinforcement has long been recognised in the German theatre and is an area where they have often been in advance of their European counterparts. The necessity of a quality sound system for music and sound effects reproduction in the theatre is as apparent as the need for a first class lighting rig but to see some theatres it would appear that as long as what one sees is all right, then the rest can go by the board. (By way of an example, the PA for *Jesus Christ Superstar* when I saw it was very good but when I went to see *Evita* during the London AES the sound was on a par with local rep.) In Germany it is now quite common—and has been for some time—for theatres to have their own studio facilities to enable production of in-house sound effects, music, etc, for playback during performances. Whilst doing the rounds of the Munich recording studios I was able to poke my nose into two of Munich's theatres and see what they had to offer in the way of live sound and recording facilities.

Kammerspiele Theatre — control room

Kammerspiele Theatre

This is a fairly small theatre owned by the City Council which puts on a variety of productions including avant garde and experimental works. Though not perhaps exactly an Arts theatre owing to the wide range of presentations, it is there as well to present the out of the ordinary. With all this in mind the theatre has a small studio of its own which has recently been updated to handle more elaborate realisations. Situated in the same building as the theatre, the studio can handle up to about 20 musicians and was previously an old rehearsal room. The control room sports a brand new Neve *5315* console, 24/4/2 plus direct outputs on each input channel and two echo returns, complete with GTC custom built 16-track monitor section featuring four auxiliaries and pan on each channel. At the time of my visit the new Lyrec 16-track recorder was in the process of being installed. Mixdown is on a Telefunken *M15A*. The studio is for the sole use of the theatre in order to produce music and effects tapes for playback on stage.

Bayerische Staatsoper - Nationaltheatre

This could be said to be the Munich equivalent of Covent Garden and as such enjoys considerable artistic prestige. As well as presenting the classic opera and ballet works the Nationaltheatre also includes music and choral recitals in its programme. Modern arts are not forgotten either, both instrumental music, choral and dance, and it would not be considered abnormal to have a group such as Tangerine Dream playing on stage for a modern ballet group! 'The arts are the arts whatever the style as long as it is well presented,' seems to be the attitude here and it is a frame of mind that can only be applauded heartily. The theatre itself is of the well known horseshoe style of configuration with stalls and five balconies or tiers. Total seated capacity is 2,098. The total stage area must be one of the largest in the world with its 2,452sq m—26,000sq ft—more than the Metropolitan in New York—and the effect of going backstage for the first time is quite staggering. Some of the Altec *A7s* that were there looked completely diminutive, poor things. In charge of the sound at the Nationaltheatre is tonmeister Dieter Behne who also was my guide for the afternoon of my visit.

The control room looks out from the back row of the stalls and is on the centre line. Placing is such that with a full house vision to the stage is not obstructed by heads or hats. The mixing centres round a Siemens console with 11 input channels, five subgroups and stereo master plus two echo returns. However, things are not quite so simple as they may seem to be as there is a routing matrix for the various possible sound sources that are to be routed into the mixer at any one time. This consists of 60 microphone lines, all cassette and reel-to-reel machines, turntable, etc, the pre-recorded sound sources also having the option of going directly into the subgroups or main outputs so everything is quite flexible. Metering is by a stereo pair of Siemens light beam meters with switchable characteristics. Audio & Design have managed again to get into the act with their *F760X-RS Compex* limiter, which must be a standard for German studios! In addition to the channel equalisation, the desk has several eq modules for patching into subgroups or main output should any tweaking be required in the course of a performance without altering the different inputs. Monitoring is by Klein & Hummel—both speakers and amplifiers—as well as by headphones and very good it is, too.

One aspect of the method of monitoring that is of interest is the use of a Neumann *KU80* dummy head. This is placed in front of the control room window at the top and gives an extremely good idea of what the audience is actually listening to in the auditorium. Herr Behne is the first to point out that in front of a glass pane is not the ideal place for a dummy head but for practical purposes it works well enough, as I was able to hear for myself. You really do feel as though you are in the hall. This additional information makes it easy for corrections to be made to the sound in the house that would not normally be possible in an isolated control room.

Recording equipment in the studio consists of two Telefunken *M15As* with Dolby *361s*, one Studer *B67* and an elderly Ampex 8-track that keeps soldiering on. Cassette recorders consist of one Tandberg *TCD330* and three Toshiba *PC6030*. Record playing facilities are by an EMT *930* and I should also mention that reverb is also by an EMT plate. The amplifiers for the house are all Klein & Hummel and consist of 4 x 240W, 10 x 120W and 6 x 60W. Distribution to the house loudspeakers is via a 42-channel matrix which allows for the creation of a multitude of aural effects.

Twenty-four main loudspeaker systems are available for reproduction in the auditorium and the 'odds and sods' cellar can always be raided should a production really require over the maximum. As can be imagined, about half of these are permanent fixtures while the rest are mobile and can be arranged in the hall to suit the effects required. The largest speakers in use are four Altec *A7s* and two Siemens of similar design. As well as for front of house use, these larger cabinets are often used as stage monitors (side fills) for large productions where it is difficult to hear the orchestra properly backstage. Microphones used are mainly Sennheiser and Schoeps with some Telefunken, Neumann, AKG and Beyer. In addition to the Sennheiser rifle microphones, some of the new Neumanns have also been brought into the armoury. Use of microphones varies with the job in hand but when I asked if mics were used for on stage solo vocal use I was told that this was rarely, if ever, the case. Use for off stage singing is quite usual, there always being a suitable pause between the end of the off stage lines and on stage singing. However, Herr Behne did add that in the case of large choral ensembles who were by necessity to the rear of the stage, "We use a couple of shotguns on the choir!" Wishful thinking, perhaps, or just echoing the thoughts of some music lovers. As you will have gathered the reference was to rifle mics and not the real thing though when I explained my source of amusement he thought that in certain cases it wouldn't be such a bad idea!

The recording facilities are used for the production of sound effects—such as thunder in the gallery and explosions in the front stalls—and backing tapes. These latter are sometimes made for use when there is no orchestra but the more usual procedure is to record sections to reinforce the existing musicians. This is done for a variety of reasons ranging from the fact that you cannot get 140 musicians into the pit at the same time or six virtuoso trumpeters on the same night. Where the score demands it, the extra parts are pre-recorded and played back with the orchestra. Other advantages of this system are that original score directions can be kept without, for example, the trumpet and horn section scrambling backstage to play a voluntary and then rushing back to join the main orchestra as in some of Wagner's operas. Though the theatre has a large library of these excerpts, depending upon the conductor, another recording will be made under his supervision so that he can be sure to have the orchestra at the correct tempo once the passage is reached.

In the main the two Telefunkens are used for performance playback and Dieter Behne demonstrated the ease with which these machines handle this sort of work bang on cue. Each section is normally cued up to the cue mark on the machine so that pressing the play button one

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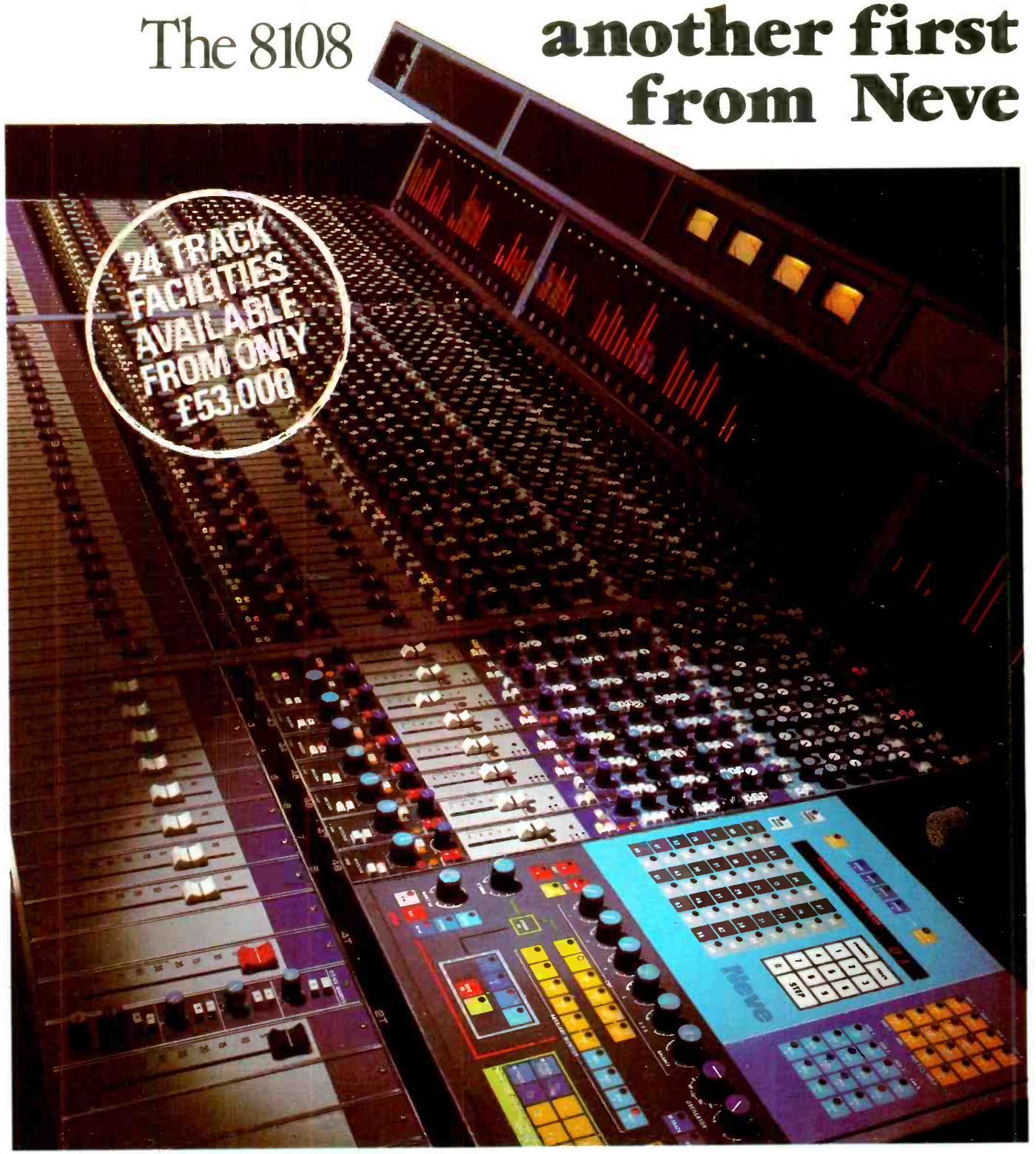
The 8108 another first from Neve



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Sundragon Productions, Manhattan

Tucked away on a sidestreet just off Fifth Avenue in Manhattan, Sundragon Productions is a 24-track studio that has skilfully blended streamlined recording design with a casual—one might even say cosy—recording environment. Entrance to the eighth floor studio is through a wide hall reminiscent of a suburban carport—full of lumber, power tools and a parked motorcycle. A kitchen serves as a reception area and meeting room, with studio and control room adjacent. A liveable space, and appropriately so as co-owners Michael Ewing and Ned Liben did live there originally.

"The studio was really built for the development of our artistic ability," Ewing explained, "for the purpose of doing our own production work and cutting our own albums." Like many in the city, Sundragon Productions was conceived as a private studio, and founded upon the varied backgrounds of the two principals. Ewing's career as a recording engineer was punctuated by stints as a commercial announcer and a broadcast technician with NBC Radio. Liben, a musician and composer, has played guitar and bass booking and administrative duties, in addition to his experience as a producer and engineer of radio jingles and demo recordings.

The pair worked on a number of recording projects together before forming Sundragon Productions in 1972 with the addition of Tom Duffy as chief engineer.

Initially 16-track, Sundragon was New York. Roger Meyer custom designed the mixing console, which has been expanded to 24-track yet retains class A British-style wiring.

"One of the nicest things about this board is it doesn't have a lot of transformers," Duffy said.

"It's pretty much known that the response is a cleaner, much more transparent recording. In addition, it's economical and very simple in approach—very European."

The mixing room is indeed quite beautifully designed. The actual space, which cannot be more than 100 sq ft has ample breathing room for two operators while the rack-mounted recording decks are conveniently at arm's length.

On the right is the Studer *A-80VU* 24-track and 16-track recorder. On the left is the vertical array of Studer 2-tracks for mixing, an *A-80VU*, a *B-62*, and an *A-67*. The console is 28/28 with five mixing busses and a Studer *A-800* autolocator. There are UREI and Teletronics limiters and Pultec equalisers as well as an Orban Parametric equaliser. dbx noise reduction for 24 channels complement Meyer-designed noise gates; Dolby *361s* are available for mix-down.

Things you won't find in this tidy control room are exposed wiring, indicator lights for this and that, and assorted bells and whistles of that ilk. The design philosophy here has kept switching down to the minimum; patching in accordance with the specific requirements of each booking is preferred.

Contemporary music is all that is done at Sundragon, particularly rock. Two early American new wave albums cut her are Talking Heads' *Talking Heads '77* and the Ramones' second album, *The Ramones Leave Home*. Ned Liben, whose own musical projects can be termed 'heavy metal', handles most of the booking and administrative duties. He believes that with rock bands the important thing is to capture the essence of a live performance.

"It's all part of the trend towards getting away from the plastic sound of disco," said Liben. "We're moving towards creating a natural, breathing sound rock 'n' roll really needs."

As for miking equipment, the facility has all the standards. Sennheiser, Neumann, Electrovoice and AKG represent a small sample of the collection. In addition, there is an abundant supply of JBL and other monitors in all shapes and sizes. Besides the Ludwig drum kit, instruments available include a Steinway grand piano, Hammond *B-3* organ, Mellotron, bass and guitar amplifiers and a stereo Fender Rhodes *88*.

Michael Ewing cited the recording of the Plasmatic's latest album as one example of the type of acoustic challenge new wave bands can provide. This extremist stage act cuts a guitar in half with a power saw during a number called *Butcher Baby* and the band wanted to capture that sound on their record.

Ewing recalled, "They brought their own chain saw but it didn't sound right. So we went out and got another chain saw and we put it down the back steps. We miked the top of the stairs, we miked the bottom of the stairs, and we miked the chain saw, and that's how we got what they wanted."

Equipment purchases also reflect the type of work that is done here. For example, a Dolby noise reduction system was deemed superfluous ("We do 90% of our work 30 in/s, we do rock music—there's not much of a demand for Dolby") but the firm is eagerly awaiting delivery of a Lexicon digital reverb unit to augment their existing EMT and AKG echo systems.

At present the facilities are booked slightly more than half the time. Mindy Glasberg is in charge of scheduling. Hours not used by outside clients are taken up with the Sundragon's own production work, mostly demos and some mastering for local and regional artists. Most of the engineering is done by Ewing and Duffy and two assistant engineers.

Recent projects completed at Sundragon are *Multiplay* an album by the Rivits for Island Records; a debut album by Sire recording artists Alda Reserve; an album by French film star Carol Laure collaborating with Lewis Furay for RCA; Richard Cotter's debut album; and the soundtrack for the film by The National Lampoon, a comedy group whose last project was the box-office smash film *Animal House*.

The Rivits recording employed extensive use of synthesisers, which is an area of development the company is keenly interested in. A separate synthesiser room is wired directly to the master control room. An ARP Avatar guitar synthesiser and a *Prophet* keyboard synthesiser are permanent fixtures and may be hired with or without an operator.

In the meantime, this small but pleasant recording studio is building up a clientele. Those booking this 24-track facility are likely to find the only obstacle to a smooth-running session is getting around that motorcycle in the hallway. **Mia Amato**

Sundragon Productions Inc, 9 West 20th Street, New York, NY 10011, USA. Phone: (212) 243-9000.

Munich Theatre cont'd

beat before the entry of the passage brings the tape in on time. It also follows that the engineer has to know how to read a score! It also says something for the conductors who launch into sequences with tape and orchestra without a click track!

Dieter Behne at the National Theatre's Siemens console — loudspeaker matrix at the rear

In case of problems there is of course a communication link between the rostrum and the studio. Further information about 'goings on' on stage is relayed via video cameras and the control room is equipped with video reel and cassette recorders as well as the monitors. Not that the performance is often recorded as such but the rehearsals, enabling sequences to be analysed. Incidentally, the control room is also fully equipped for plugging up into outside broadcast vans.

Though the installation as it stands works well, it is now pretty old and due for a change. To this end a budget of around DM2 million has been voted by the administration, a sum that reflects the importance of the sound system in the eyes—or should I say ears—of those concerned. As it is early days yet no news of what is going to happen is available so as they say "Watch this space!" However, two of the names cropping up so far for the new console are Siemens and Neve. Needless to say, Dieter Behne will be there to see it all happen and I look forward to being able to take him up on his offer to "come and see the show in the best seat in the house!"

The Nationaltheatre was about the last port of call during my tour of Munich (I did go and finish up at Country Lane but as they have been rebuilding they will be the subject of a new visit) and I feel some thanks are due to Herr Gerhard Picklapp, the director of the audio side of GTC who, as well as installers of audio systems and studios, are also distributors for such names as Neve, Tannoy, JBL and Teac-Tascam! Gerhard was able to fix up appointments for me at very short notice with the various studios and thus make everything possible in the little time available—thanks once again. **Terry Nelson**

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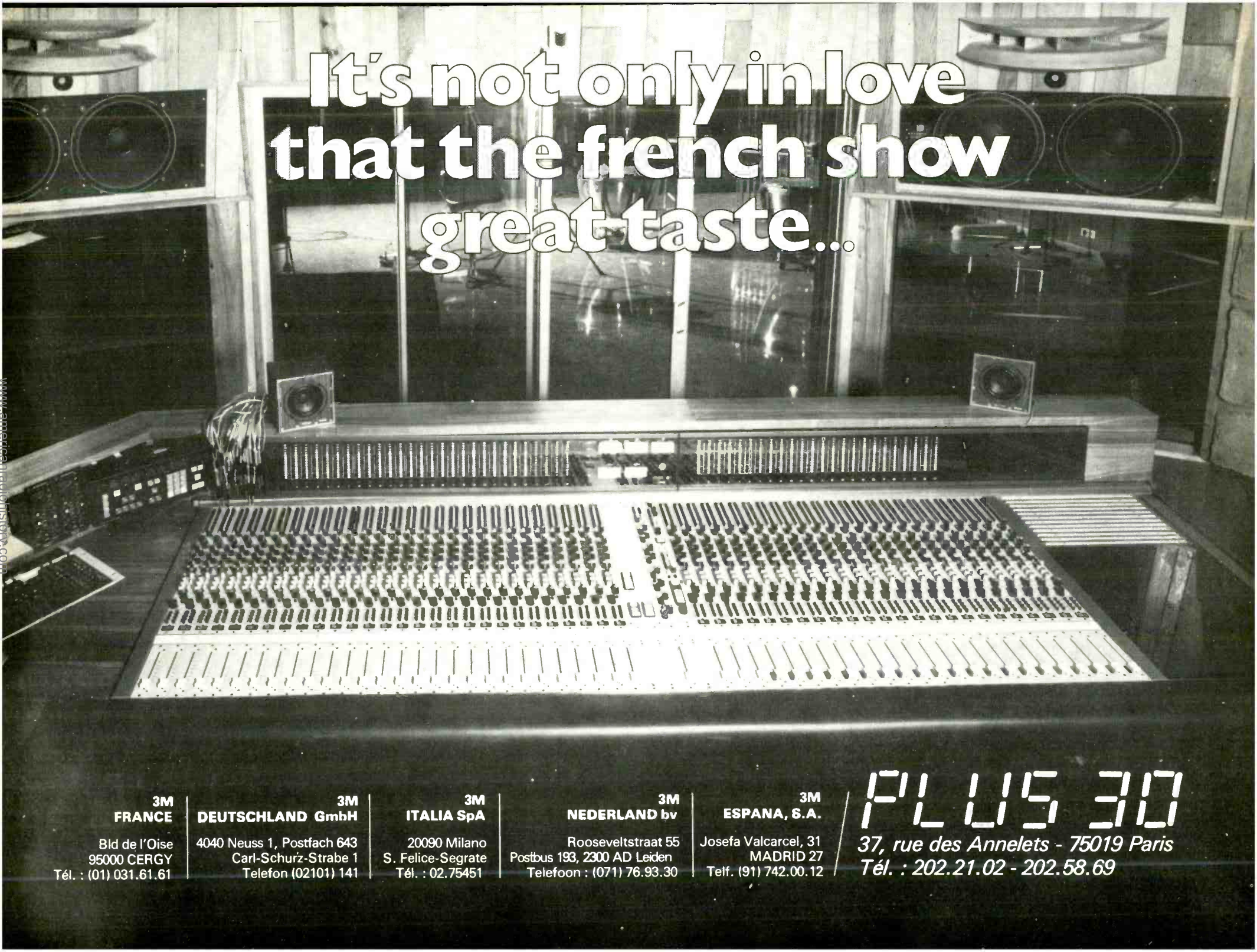

Zeus Recording Studio, Naples

Zeus, as everyone knows, was the king of the Greek gods and lived in the clouds that crown the top of Mt Olympus. However, with transport costs, etc, in this modern age the studio of the same name is underneath a Piazzetta near the seafront at Naples. For those of you who have been to Italy, you will remember that Piazzetta's are those enormous covered arcades with shops, restaurants and cafés, that have the appearance of being the cathedrals of the industrial age. When in doubt ask a policeman, which I did—four in fact—and was directed to a wide circular staircase disappearing down into the depths. The first basement level houses the offices of Industria Discografica, the record/music company that owns Zeus where I was able to meet studio manager/owner Ciro Barrucci. We were soon joined by Gianni Ruggiero, resident engineer, and it was time to visit the studio.

The studio is down on the second basement level but in case this implies poky to you, let me reassure you that in this case the word is spacious. The first impression coming into the control room is of a large room into which someone has slapped some recording gear. Once in the room, you realise that it is the asymmetrical shape, narrow towards the door and opening out towards the other side, that implies a slight disorder. The impression of space is very apparent and here is one control room where you can stroll about happily and not be worried about banging your head or knees and tripping over cables! The desk is squarely placed in front of the studio window with the effects rack to its left and the main multitrack to its right with the mastering and copy machines neatly lined up along the left wall facing the studio. There is very much a 'down home' atmosphere that I found rather cheery and not at all detracting. Some latter day acoustic treatment has been done, mainly in the bass and low mid regions, and though it may be a little too lively for some, the sound is good enough for most monitoring purposes. For the type of music recorded here, the sound in the control room resembles quite well the conditions under which the records will be replayed, which is quite a positive factor.

The action centres round a Trident *B series* desk in a 24/8/16 format and including four Trident compressor modules. The eight subgroups are also switchable for 24-track routing giving 1-8, 9-16, 17-24. The console has given a lot of satisfaction though the eq is now felt to be a bit limited and that some modification could be in order. Recording is on a Studer *A80* 16-track that is prewired 24-track ready, though there are no plans currently to update the machine. Mastering is on one of two completely refurbished Studer *C37s* with an *A67* in attendance for general duties. Monitoring is at present on JBL *4333As* and Altec *9849-8As* (and don't forget the Auratones) powered by a Marantz *300DC*.

During the year that he has been at Zeus, Gianni has been concentrating on getting some goodies into the effects rack and now has quite a useful selection with an Eventide *Harmonizer* plus keyboard, *Instant Flanger,* Lexicon *Prime Time,* UREI *1176LN* and *LA-3A* compressors and limiters plus *545* parametric, Orban dynamic sibilance controller and four *Kepex IIs.* Two Dolby *361* units are also available for mastering as is a large Teac cassette recorder for cassette copies. The control room also has several keyboards for customers to play around with, viz ARP *Odyssey* and *Omni-2* with a Yamaha pre-set synthesiser.

The studio is very roomy and even though the ceiling has been lowered by three feet there is still a good 5m left so the atmosphere is not at all oppressive. Insulation has been added to the ceiling to cut out rumble and noise from 'up top' and it is very effective as I did have a good listen to see if any untoward noises were filtering down. The acoustics have been updated by Gianni and imaginative use of pastel shades in the fabric covering the various treatments helps along the low-key ambience. The room is divided down the middle by large supporting pillars, that have been treated against reflections, leaving one half open for large formations or what have you and the other half taken up with rhythm instruments and the isolation room. Equipment in the studio includes resident drum kit, grand piano, Rhodes and various guitar amplifiers such as Ampeg and Fender. The drums are now recorded in the studio most of the time as the drum booth was found to be too dead giving them a rather small, lifeless sound. In the open part of the studio a much bigger sound is obtained as well as having a better communication with the other musicians. Also noteworthy is the novel bass drum anchor which consists of an anvil, which just goes to show that you don't always need a six inch nail!

Microphones are principally Neumann, the selection consisting of *U87s* and *U89s, KM84* and *KM85* (mainly for drums) and *U47* FETs that tend to be used for trumpets and other brass. For vocal work the *U89* has been used with a lot of success and Zeus now prefer it over the *U87.* Though multi-mic techniques are sometimes used on the drums, Gianni's preferred method is to have one bass drum mic with compressor, snare mic and compressor with two overheads completing the overall picture. These four drum channels are then fed into the four *Kepexs,* making for a punchy sound. The former drum booth makes a very good isolation room and is often used for acoustic guitar, vocals or percussion when a dry sound is needed. Foldback to the studio is by headphones and/or custom built monitor speakers mounted on castors.

For the moment, most of the music recorded at Zeus is Neapolitan folk. However, this does not mean that the music is without some punch as I heard in a single that had been recorded and mixed in a day. The sound was very modern with an extremely driving drum sound and tight brass arrangements, even though the song formwas traditional.

In order to attract a wider clientele, Zeus are in the process of finalising plans for an update of the studio, including 24-track, and in this age of miniaturisation they want the new equipment to be large in order to keep the space filled up! The philosophy is also large monitors for a large room and these will probably be JBL *4350s* with McIntosh amplifiers. A second small studio is also under construction in the adjoining rooms and this will use the existing equipment to provide a 16-track facility especially angled towards rock and small groups. Certainly, Zeus are not short of ideas and ambition and reflect a general attitude in Naples to make the city an important national recording centre.

You can try out your thunderbolts at Zeus (Industria Discografica), Piazzetta Matilde Serao 15, I-80132 Naples, Italy. Phone: (081) 406.791 or 415.997. **Terry Nelson**

New Neve console in Air's Studio 2

Studio News

● Gooseberry Studios, London has installed an Allen & Heath *Syncon* console, and taken delivery of an Otari *MTR-90* 24-track.

● Turnkey Two has been commissioned to design a 24-track studio for Rick Parfitt of Status Quo. The new studio will be equipped with Studer *A80* tape machines, JBL monitors, and a Soundcraft *3B* 24/24 console.

● The Automatt, San Francisco has been recording Carlos Santana utilising the 3M digital mastering system rented from Audio-Video Rents.

● A new UK studio, Regal Recording, Hitchin, has been commissioned by Turnkey. The new facility is ultimately intended to consist of three studios and a film dubbing suite. Present equipment comprises a Soundcraft *3B* automated console, Studer tape machines and Eastlake monitors.

● Sound Ideas, New York has installed a 3M digital mastering system, comprising 4-track and 32-track recorders.

● ICC Studios, Eastbourne, Sussex has reconstructed its Studio 1 and upgraded to 24-track. Acoustic design was carried out by Acoustic Technology and the control room has been re-equipped with a Trident *Series 80* 32/24 automation ready console and a Lyrec 24-track recorder with *ATC* remote. Other equipment includes UREI *838* time aligned monitors driven by BGW *750,* UREI compressors, Eventide *Harmonizer,* Deltalab DDL, EMT and AKG reverb, and an MCI 2-track recorder. ICC's Studio 2 remains an 8-track demo studio and is equipped with an Allen and Heath—Brenell package.

● Walt Disney Productions is to purchase two complete 3M digital mastering systems for use in creating the soundtracks on its EPCOT (City of Tomorrow) project. The company has already utilised the 3M system which was used to record the soundtrack and album of its film *The Black Hole.*

● Air Recording Studios, London has installed a Neve 52+6 channel, 24 group console in its Studio 2. The console is to the same specification as that installed at Air Montserrat last year.

● Music Centre, Wembley has upgraded its facilities for film and television audio work with the installation of a Neve *Necam II* computer assisted mixdown system. ■

It's a reliable recorder with foresighted features. A new constant-tension transport has a full symmetric tape path, the most advanced electronic servo and a large diameter capstan without pinch roller. The latest electronics includes single-card-per-channel modules, full-fledged remote controller, auto-locator and interface access for external synchronizers.

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Basic studio acoustics and design

Rupert Neve (Broadcast Training and Services Ltd)

The purpose of this article is to give a brief outline of the principal acoustic requirements for recording and broadcast studios, together with some practical suggestions as to how such requirements may be achieved especially when converting an existing building. The emphasis is on the minimum standards, but these give useful guidelines for studio construction.

A STUDIO has to be an ideal environment enabling creative work to be carried out with a minimum of frustration or disturbance. The qualities which contribute to such an environment are:

(a) Isolation—the attenuation of *outside* sounds which would otherwise interrupt work, and attenuation of *inside* sounds, eg monitoring, music recording, etc, so that you don't offend your neighbours;

(b) Controlled acoustics—giving a much greater freedom especially in the production of music and drama.

Generally, one should aim for a working environment which gives a high degree of comfort and permanence to reduce fatigue and ensure repeatability.

A studio can mean anything from a small voice booth to a large complex of studios and control rooms with multitrack music recording, stage and lighting facilities. The cost can vary enormously and it is very important to define the type of work to be undertaken in order to meet the standards required. In addition to the studio itself, an adjacent control room is required with a soundproof window between. The control room will contain mixing and effects units and high quality sound monitoring equipment, plus recorders and various other electronic equipment. Additionally, voice communication must be provided between the control room and the studio.

In a busy situation it makes sense to have one or more additional rooms suitably equipped for mixing, programme assembly and editing so that these operations can proceed without tying up the main studio/control room.

Isolation

Studios and control rooms must be designed to have high isolation from the outside world and from each other. The reverberation time must be designed to suit the type of work to be undertaken and must be controlled over as wide a range of frequencies as possible. The acoustics of the control room are as important as those of the studio. Also noise in the studio due to ventilation or other services must be kept very low.

If top performance is required it will be necessary to employ an acoustics consultant capable of a full design and supervision service. He will ensure that the right materials and methods have been used and undertake proof of performance measurements. A compromise design is usually not advisable for a busy commercial studio where efficient utilization of facilities is important and where effective use of invested capital is a factor.

There are many kinds of studios. For example music recording, multitrack studios, mixdown studios, disc mastering, broadcast, film sound, and video. They all fulfil the primary purpose of providing the right working environment for the user. They vary only in specification details which are required to achieve the optimum for the specialist.

There are three fairly clearly defined classifications:

(a) Full broadcast or top quality recording standard where isolation is in excess of 55dB for both airborne and structure borne noise which usually requires a floating structure decoupled from the rest of the building. Reverberation time is maintained over a wide frequency spectrum.

(b) Intermediate standard where isolation may be of the order of 35 to 50dB. A floating structure would only be necessary in the presence of heavy city traffic or underground trains nearby. The acoustic treatment may be less effective and the reverberation time not so closely controlled especially at low frequencies.

(c) Practical production room standard where isolation is less than 35dB and acoustic treatment is limited to that which is necessary to achieve a pleasant sound.

There is a cost factor of about three times between each classification. For instance if (a) costs around £90/sq ft (b) costs around £30/sq ft and (c) may cost as little as £10/sq ft. These figures cannot be taken as indicators of actual cost as obviously location, country and inflation will vary greatly.

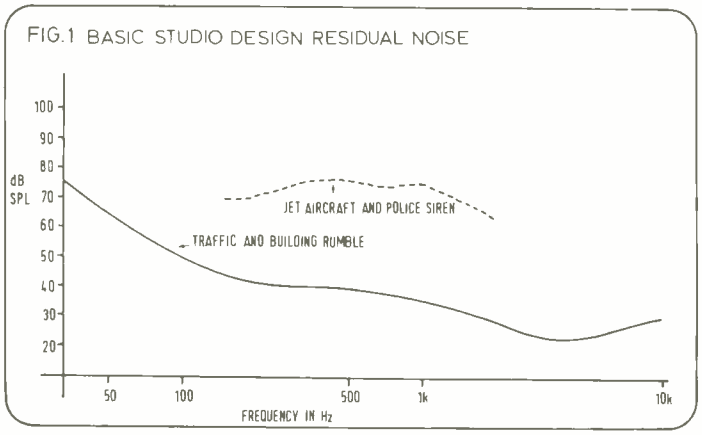
The ratios reflect the very large cost of achieving high standards where extensive structural work may be required but they also reveal the attractive possibilities of a relatively low cost studio which has been carefully sited.

Where does one start? The correct starting point is at the *concept* stage, so this is where we must ask some pointed questions. Firstly, what is the main use to which the studio is to be put? Is it music recording, drama, entertainment, documentary programmes, etc. The answer is frequently "a bit of everything". If so, then the cost will be higher or the results inadequate for some uses. Quite often a studio does get used for a wide variety of purposes, but this inevitably means a more comprehensive design so that several functions can be covered. Secondly, we need to ask how much usage will the studio get? If recordings are only made for two or three hours each day, but you have to stop once or twice because of a jet aircraft overhead, or because of a fire engine siren in the street, it would be arguable that you should not spend large amounts of money on expensive sound isolation. But if a busy main road nearby has heavy trucks passing every few minutes then a high degree of isolation is needed. Considering isolation, therefore, we must ask what is the environmental noise level like and how does it vary throughout the day?

The main sources of outdoor noise in towns are road and rail traffic, children playing, service deliveries, road repairs and building operations and, of course, aircraft are a potential hazard almost anywhere.

Sources of indoor noise, if the studio is in a shared building, are hi-fi equipment, radio and TV receivers, banging doors, heavy footsteps on wooden or concrete floors, lifts, air conditioning and other such machinery. These need to be measured and their probable effect assessed before trying to make decisions. **Fig 1** shows typical residual noise in a 'quiet' location, illustrating the need for adequate isolation. The best defence against any form of interfering noise is distance but one is not often in the happy position of being able to choose a truly remote location and an appropriate degree of isolation is always necessary, even if only to exclude birdsong!

A survey of the site before going ahead with a studio must be fairly thorough and must take account of seasonal activities (ie school holidays might lead you to forget that the next door building is a school!). Local planners need to be consulted about proposed new roads or other developments as well as the nearest airport, including details of present or projected aircraft flight paths. An alternative site would almost certainly be cheaper than trying to



exclude the sound of frequent low flying jets. Avoid busy main or trunk roads which carry continuous heavy traffic. Similarly avoid schools, railways (including underground) churches, convents or public clocks with bells or chimes. Beware of nearby factories with heavy machinery, high power transformers and high voltage electricity power lines. Watch out for high power radio and radar installations closer than a mile.

A third factor is the question of whether the studio you are planning is likely to cause any kind of nuisance to neighbours.

It is all very well to conclude that you have found a quiet residential area, which will enable you to convert a building for use as a studio, but what about the noise you will be making? Sound from the studio must not leak out sufficiently to be audible under quiet conditions, say late at night. It is also necessary to consider car parking and the noise created by groups of people arriving or departing.

It is usually necessary to provide a reception area, rest rooms, coffee and refreshment facilities and so on. Normally these factors would be taken care of by an architect and they will certainly be considered by the local planning authorities before granting permission. You can obviously save time and money by taking such factors into consideration yourself before making formal planning applications and incurring professional fees.

The next important question is whether to build from scratch or convert an existing building? A new building enables all the important parameters to be designed in at the start. It is only necessary to agree the specification and if you have the right professional advice, full facilities and acoustic performance will be achieved. An existing building may merely make use of existing rooms modestly adapted to classification (c) performance or it can be entirely remodelled inside retaining only the outer shell to achieve a studio complex to full classification (a) standards. In the latter case, an architect will do as much work as for a new building, but if you are adapting a building to provide a more modest standard you can save professional fees by assessing some of the features yourself.

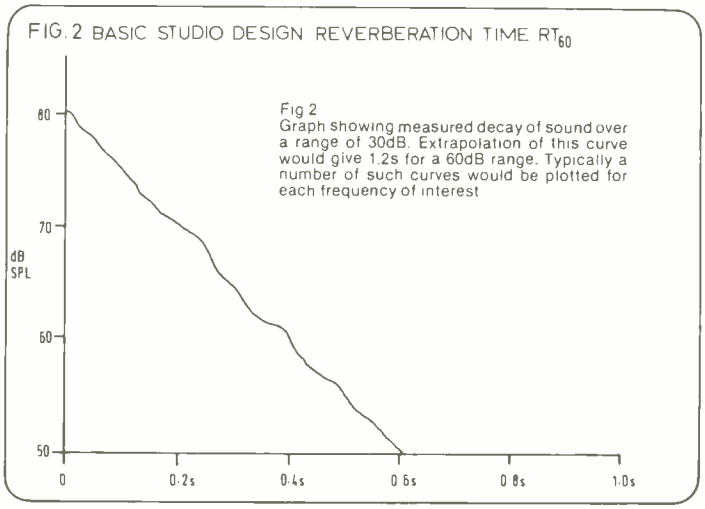


Fig 2
Graph showing measured decay of sound over a range of 30dB. Extrapolation of this curve would give 1.2s for a 60dB range. Typically a number of such curves would be plotted for each frequency of interest

A building must be well built and have a solid 'feel' about it. Unfortunately not many very modern buildings achieve this. However, in older buildings typically the lounge and dining room are ideal for conversion to a studio and control room. Depending on the layout of the rooms you will need sound resistant doors to an entrance hall. Alternatively the studio door can be bricked up and access made from the control room. You will also need to fit a window between the control room and studio. Doors and windows of advanced design are available from specialist suppliers complete with their frames to build in.

If the hall is likely to sustain noise of people coming and going, etc, during recording, then the doors and walls between hall and studio and control room have to be well insulated for sound and this could mean expensive double doors. It is probably cheaper to make a new entrance to the building and block off the hall, using it as a sound buffer area which can be used for storage of tapes, archives, books, etc. Watch out for toilets and water pipes which can be heard in these rooms when taps are opened.

You will find a second audition room very useful, where you can have semi-control room acoustics, for editing and listening. The amount of insulation from this audition room to the others must be fairly good, but is usually easy to achieve as it is likely to be the other side of the entrance hall. The audition room does not itself need very high isolation from the rest of the building.

It is very important to establish that the walls are heavy enough to give the isolation required. Single partitions of lath or plasterboard are not usually satisfactory. Either a double 4½in wall or a single wall of 9in thickness is required. Apart from visual inspection there are no really definitive tests possible at this stage because doors and windows are likely to be the weakest link.

Unless you are certain that isolation of less than 30dB is enough for your purpose, it will be necessary to fit fully designed acoustic doors and windows which typically have isolation around 35 to 40dB. Walls, floors and ceilings can be strengthened acoustically by additional construction which may take the form of standard building materials (wet work) or special isolation panels containing lead (dry work). Although the initial cost of dry materials is higher, their convenience may well outweigh their cost.

So much for lateral isolation. Now you need to check isolation from above and below. Get someone to walk around in ordinary shoes and speak in a good audible voice, as if on the telephone, in the rooms above. Hard noises such as leather heels, on bare floor boards are fairly easy to get rid of. Place a strip of a few yards of good foam rubber-backed carpet on the floor above and walk on it. The footstep noises should be greatly reduced but watch our for heavy low frequency thumps still audible when your tester walks on the carpet. If the floor shakes and transmits these thumps you may need a more expensive treatment either to the floor above or to the ceiling of the studio. This will mean that you need sufficient height in the studio to fit a suspended ceiling. However, this all depends upon what you use the upstairs rooms for. Noise from below is unlikely to affect you but check that conversations elsewhere can't be heard in the studio and that the floor does not thump or creak as you walk about. You should aim to find a building that requires only carpet on the floors. If a sound level meter is available having a flat response position noise level tests will be of great value to assessment.

Once the ground work has been done you will be likely to need measuring equipment and professional advice from an acoustic engineer who understands your objectives and who can, therefore, respond efficiently and can brief your architect. He will also estimate the weight of new or modified structures and at this stage your architect will say whether an existing building can take it.

The big lesson to be learned is that you must be clear in your own mind of your objectives.

An objectively prepared brief which provides answers to the questions is a remarkably helpful document which saves time and money in the long run.

Controlled acoustics

A studio must be free from objectionable reverberations, echoes and acoustic resonances. As with isolation, the degree of perfection necessary varies with the use to which the studio will be put.

Anyone who has viewed an empty building knows that echoes abound, footsteps and noises sound louder and sound is often hard. By contrast a well furnished room with heavy carpet, upholstered chairs and book-lined walls sounds quiet and gives an air of intimacy. This is because the higher frequencies are readily absorbed by such furnishing.

Sound is reflected off hard surfaces such as bricks and concrete. If walls are left bare, sounds will continue to be reflected from wall to wall after the original sound has ceased. The time taken for the sound pressure to fall by 1000 times its original value (or 60dB) is called the reverberation time (or RT_{60}). Reverberation time can be reduced by using absorbent materials in a room. Sound is not reflected equally well at all frequencies and a wall or floor covering which absorbs well at high frequencies is usually ineffective at low frequencies. This gives the room a characteristically tubby or even a boomy sound.

A large room or hall can be allowed to have a longer reverberation time than a small room, but whether the RT_{60} is long or short it is necessary that it should be the same value (or as near as practical considerations allow) at all the frequencies of interest. It is also necessary to ensure that the sound dies away at an even rate (see **fig 2**). Some buildings have naturally good acoustics either

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Studio design

because of careful design or due to a favourable disposition of dimensions and materials.

Small rooms ar often more difficult to deal with as the natural RT increases more quickly at middle and low frequencies.

A purpose built studio can be correctly designed from the outset and once the specification has been drawn up it is simply a matter of correct design and construction to ensure that the specification is met.

Adapting an existing building is obviously easier if isolation and reverberation are already good but even if this appears to be so it is essential to consult an experienced acoustics engineer at the start. Such measures as curtains (used on their own) egg boxes, peg board and even so called acoustic tiles are not effective — they may absorb the wrong frequencies and can actually worsen an otherwise useable room. Extensive use of fibreglass quilting produces too much absorption at high frequencies and needs to be balanced with other materials for even response.

Design values of reverberation time will vary quite considerably depending on the intended use of the studio, **fig 3**.

A small speech studio requires a short RT_{60} of about 0.2 to 0.5s. A multitrack studio is also given a short RT_{60} but for different reasons. Music groups, especially strings and choirs, need a somewhat longer RT_{60}, say around 0.5 to 1s. Large orchestras may need even longer RT_{60}.

It is very useful if the studio is large enough so that one end can be made dry (short RT_{60}) and the other end fairly live (long RT_{60}). This is of particular benefit for drama. If a studio is too dry musicians complain that they cannot hear themselves or each other. Careful use of directional microphones can produce a high definition sound even if the musicians are placed near the live end of the studio. As stated previously, RT_{60} should be reasonably even with frequency and, broadly speaking should be maintained over the range of frequencies being produced in the studio.

Design of the studio building

(a) Isolation

Sound travels through liquids and solids. Air is a liquid and very small apertures in a studio construction can completely wreck an otherwise good design. Doors and windows are the most obvious points of weakness.

Inadequate air seals will let sound through. Electrical fittings, ceiling and floor cavities, ducts and holes in walls which have been hidden but not filled are common offenders.

Sound travels through solids such as a wall or a door by causing it to vibrate and so creating a new sound wave on the other side. If the wall or door can't move then it can't create the new sound. So to prevent all transmission of sound, a wall or door must either be infinitely rigid or infinitely massive (see **table 1**). Therefore, a brick wall is very much better than a timber frame clad with building board and filled with fibreglass. This is often incorrectly specified. A door may have to be constructed with sheets of lead internally, alternatively it may be filled with sand or concrete. The weight makes it difficult to hang and to obtain a good seal, therefore, design is important. More than one door may be used with a space between, but the total weight must still be large. Similarly windows need to be double-glazed and of thick glass and framed in such a way as to prevent structure or airborne leaks around them.

Where walls, floors and ceilings are inadequate from an isolation point of view, special panels containing lead have to be used. Sometimes the required isolation can only be obtained by building a floating structure within the main room to isolate all structure-borne noise. The great weight often required for good studio design needs a very strong building and an architect must look carefully into the effect of adding such weights to the building structure.

The isolation provided by a door or window can be no better than that of the wall in which it is located and there is obviously no point in buying a 50dB door to hang in a timber frame and plasterboard wall with only 30dB of isolation — yet this is done all too often! Every aspect of the studio must be taken into account. Any weakness can spoil an otherwise good design.

(b) Ventilation

The result of good isolation is that you tend to have an airtight box and ventilation or air conditioning is necessary (see **fig 4**). An adequate ventilation system will take into account the amount of heat generated in the studio from equipment, lighting and people. The noise from air conditioning or ventilation must be kept low and to achieve this the air flow must be at low velocity from large ducts and blowers or compressors properly isolated. The ducts themselves must be acoustically baffled to prevent sound travelling through them from one area to another. Noise due to ventilation systems must not worsen the studio noise level by more than 5dB.

Attentuation of low frequencies in large ducts is very low so that long runs are an advantage. Separate ducts for different rooms and areas must be used, only meeting back at the plant to prevent loss of isolation acoustically to avoid picking up airborne noise outside the studio.

(c) Lighting

Studios need the right kind of lighting which must give both flexibility and repeatability. A studio can look and feel quite different under alternative lighting effects. Simple systems are available which enable lighting to be controlled from a desk mounted panel. More complex systems include memories which allow effects to be recalled either manually or in sequence. Drama productions benefit greatly from such possibilities and production time can be reduced considerably in video work by using the right kind of system.

Lighting should be suspended on a grid system which enables lighting units to be secured where they are wanted and readily moved, replaced or maintained. There are several proprietary systems ranging from very modest scaffold poles to the fully professional remote controlled TV and film studio systems.

Regardless of the complexity or simplicity of the system, light fittings and mountings must not introduce acoustic noise through ringing vibration or humming of chokes and control devices. Electrically there must be no interference. These factors are taken care of by proper attention at the planning stage and by good installation. An experienced

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FIG.3 BASIC STUDIO DESIGN
DESIGN VALUES OF REVERBERATION TIME

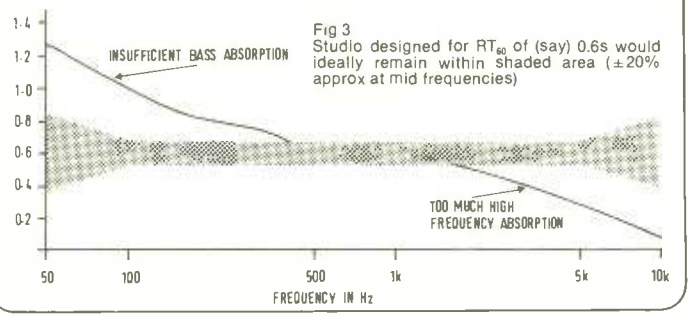


Fig 3
Studio designed for RT_{60} of (say) 0.6s would ideally remain within shaded area (±20% approx at mid frequencies)

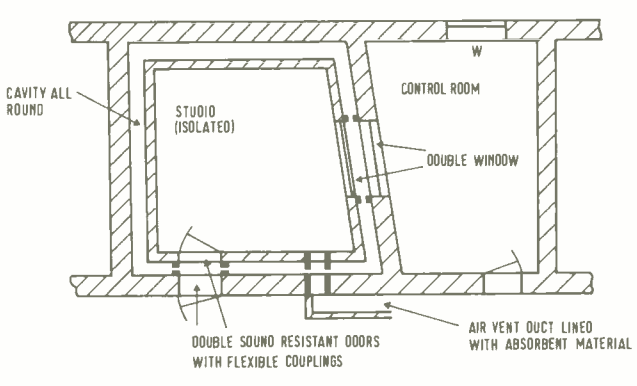
TABLE 1

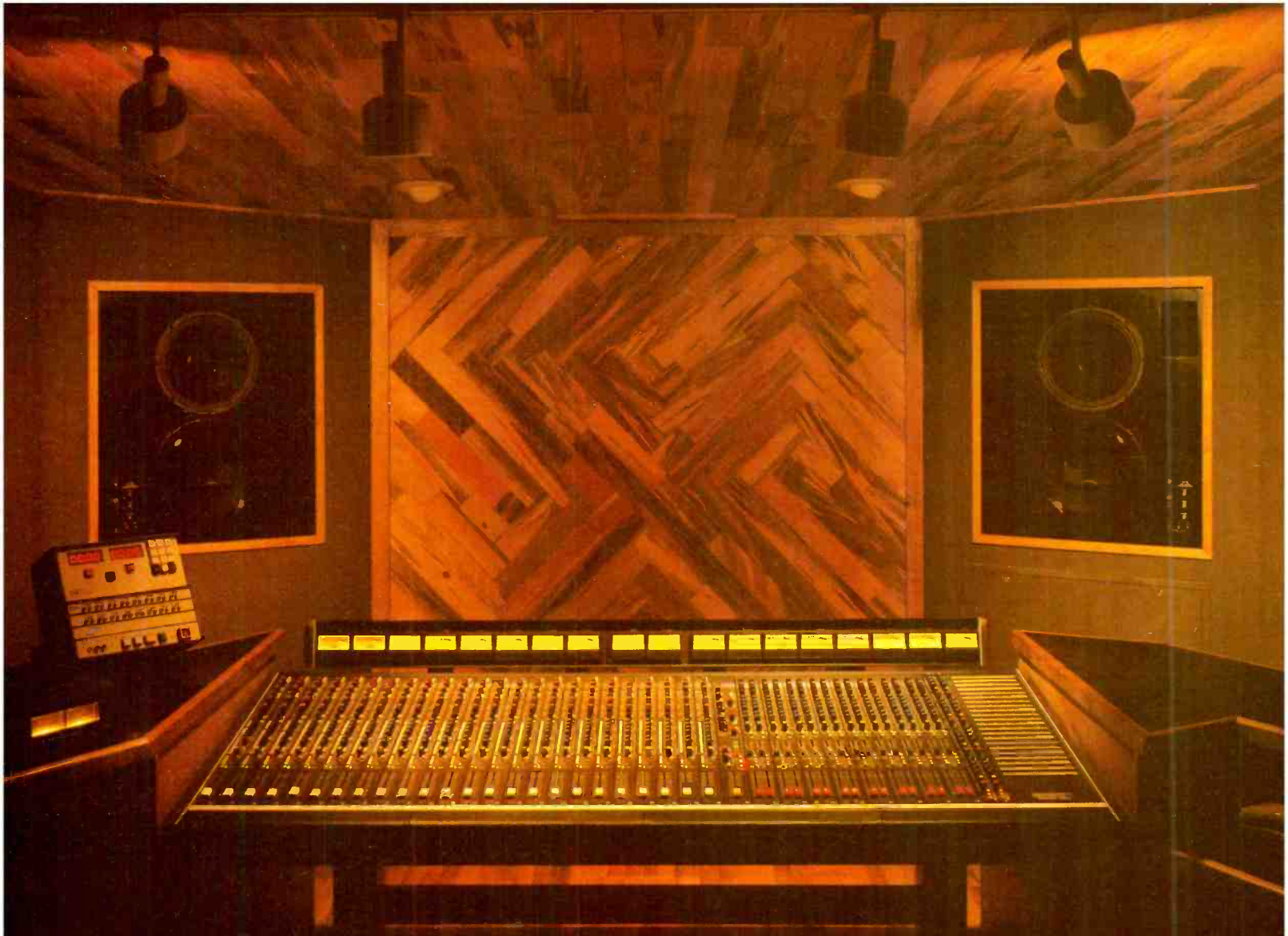
INSULATION OF TYPICAL WALL STRUCTURES

(Note that the mass approximately doubles for each 5dB increase in insulation. Values are approximate and assume walls are fully sealed.)

Isolation dB	Weight lb/sq ft	Weight kilos/m²	Construction
25	2	10	2in stud frame clad both sides with ¼in plywood
30	4	20	As above but clad with ½in plaster
35	10	50	2in compressed straw slab skimmed plaster both sides or 2in hollow clay block with ½in plaster both sides
40	25	120	3in clinker block with ½in plaster both sides or double 2in wood wool slab with 2in cavity and ½in plaster both sides
45	50	250	4½in solid brick with ½in plaster both sides
50	100	450	9in solid brick with ½in plaster both sides or double 4½in brick with 2in cavity and ½in plaster one side
55	200	1000	18in solid brick with ½in plaster both sides or 15in dense concrete with ½in plaster both sides or double 9in brick. 2in cavity and ½in plaster both sides

FIG.4 BASIC STUDIO DESIGN
PRINCIPLES OF A MECHANICALLY AND ACOUSTICALLY ISOLATED STUDIO





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engineer will design with these factors in mind and will know how to deal with any problems which may arise.

(d) Noise levels

Before attempting to specify the isolation and noise levels it is a good thing to be aware of some of the magnitudes involved and how they relate. **Table 2** gives a rough idea of levels of some familiar sounds.

Noise performance of a studio is usually defined by a noise rating or NR curve which takes account of the subjective effect of human hearing. Low frequencies can never be attenuated as effectively as mid and high frequencies but fortunately they don't need to be. See **fig 5**.

(e) Reverberation

Reverberation is controlled by using boxes or panels designed to absorb particular bands of frequencies. At the low frequencies special resonators may be required. The number of boxes and the extent of such treatment depends upon the desired reverberation time. Having the correct reverberation time makes the difference between success and failure of a studio. Treatment to secure the right results is expensive but far less expensive than adopting a compromise (which may look attractive) and then spending further money and loss of working time trying to correct deficiencies. Although this seems to be an obvious statement, a great many studio owners fall into the trap of false economy and many commissions of acoustic consultants are, in fact, rescue operations.

It was stated earlier that reverberation time should be reasonably constant over the frequency range of interest. Absorbing high frequencies is comparatively easy and is often accomplished by curtains, furnishings and book-lined walls. In fact it is often necesary to avoid too much absorption at higher frequencies. Furnishings are not very effective at low frequencies and there is no substitute for correctly designed acoustic absorber panels.

A short RT_{60} means that a greater surface area in the studio has to be acoustically treated which obviously means higher cost.

The technique of multitrack music recording requires very short RT_{60} to improve separation between instruments, vocalists and tracks. Straight stereo or mono recording of small music groups and choirs requires a *natural* balance and this is aided by a somewhat longer RT_{60} which the musicians themselves usually appreciate.

The final choice of reverberation time should be arrived at with the help of an acoustics consultant who will also specify the type and extent of the acoustic treatment.

It should be remembered that there are so many variables in the design and construction of a studio that it would be unusual if everything were to come right first time. It may be necessary to vary the number or type of absorbers.

TABLE 2

SOUND PRESSURE LEVEL

Pascals	Microbars (Dynes/sq cm)	dB above the threshold	Description
20.0	200	120	Pain. Close to aircraft engine or steam hammer
6.0	60	110	Monitor level in Pop studio
2.0	20	100	
1.0	10	94	Loud machinery in factory
0.6	6.0	90	Loud orchestra/choir
0.2	2.0	80	Average orchestra or chamber music
0.1	1.0	74	
0.06	0.6	70	Average speech
0.02	0.2	60	Ambient in quiet office
0.006	0.06	50	Quiet Church ambient
0.002	0.02	40	Countryside on a quiet night
0.0006	0.006	30	Good, well isolated studio
0.0002	0.002	20	
0.00006	0.0006	10	Virtually no audible sound
0.00002	0.0002	0	Pin drop on soft carpet 10ft away Threshold level

Proof of performance

However modest your studio, it is advisable to carry out some tests to ensure that design and construction have achieved the desired result.

Your acoustic consultant will normally carry out this service and the measurements he makes should reasonably agree with the design specification.

Isolation is measured by producing high sound levels outside the isolated area and measuring the sound level inside. This may be carried out wideband or at selected frequencies. Weighting curves may be used.

Noise level is measured in the studio to establish the residual noise from ventilation, lighting and other plant. In a good studio noise level will be much too low to give a reading on a sound level meter. Expensive low noise microphones are needed, preferably with a ⅓-octave analyser.

Reverberation time can be measured with band limited pink noise on discrete tones at a sufficient number of frequencies to establish the performance. The test signal is switched off and the decay plotted against time on a chart recorder.

Results may be supplied as figures or graphs. Sophisticated designs usually call for graphs showing variation or performance with frequency. Acoustic measurements are time consuming and sometimes require the use of very expensive equipment. Some consultants use specially prepared tapes and make recordings which are later analysed by a computer or in the laboratory.

The whole question of sound and noise is made complicated by the incredible design and range of the human hearing system. The ear responds to changes in air pressure at frequencies roughly between 20 and 20,000 times a second. It responds to frequencies in the middle of the range better than to those at the extremes, but the sensitivity to high and low frequencies alters as the sound level rises becoming more linear as the sound level increases. This is one of the reasons why hi-fi equipment is often played loudly. Loud sounds appear to have more bass and treble.

A healthy human ear can hear sound pressure levels as low as 0.00002 Pascals (Pa) and can tolerate without pain, sound pressures as high as 20Pa which is a linear range of one million times. However the sensation of loudness works on a logarithmic scale and the decibel (dB) is used as a unit which gives manageable numbers and reasonable correlation with subjective hearing. The dB is 20 times the common logarithm of the ratio of the sound pressures. It is a ratio and not an absolute. However, if 0dB is made equal to 0.00002Pa (threshold of hearing) then any other sound pressure can be expressed as a ratio to it.

Weighted curves (**fig 6**) are used to graph subjective sensation and are used to arrive at the actual isolation required for a studio. The noise level in a studio affects the signal to noise ratio of the resulting programme in a similar way to noise in the electronic part of the system. There is always some noise and it is necessary to ensure that the S/N ratio is good enough for your purpose.

The signal is the sound arriving at the microphone — say around 70dB sound pressure level. For an S/N ratio of 50dB the studio noise must not be higher than 20dB (70-50 for the mathematically minded). This would be satisfied subjectively by meeting the NR20 noise rating curve.

Fortunately low frequency noise is subjectively less important or studios would become even more expensive.

Remember that silence is expensive — don't over-specify. To keep costs within reasonable limits your studio must be designed so that it is appropriate to its intended use. ■

FIG. 5 BASIC STUDIO DESIGN
TYPICAL NOISE RATING CURVES FOR STUDIOS

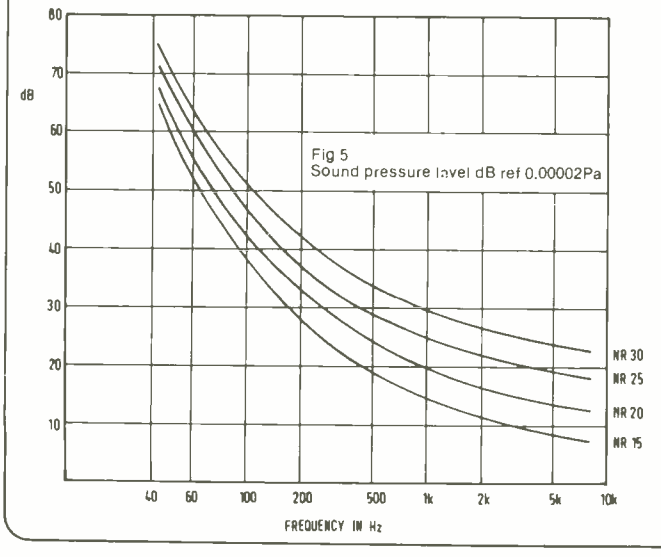
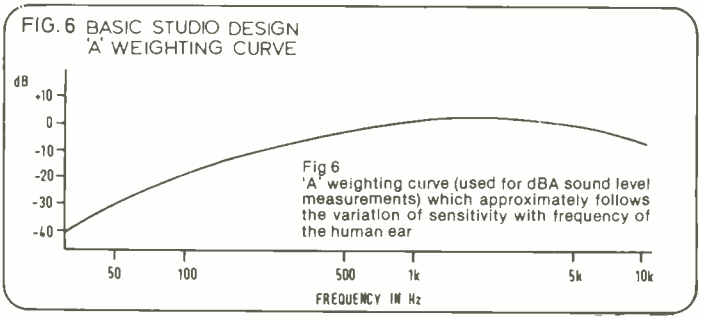
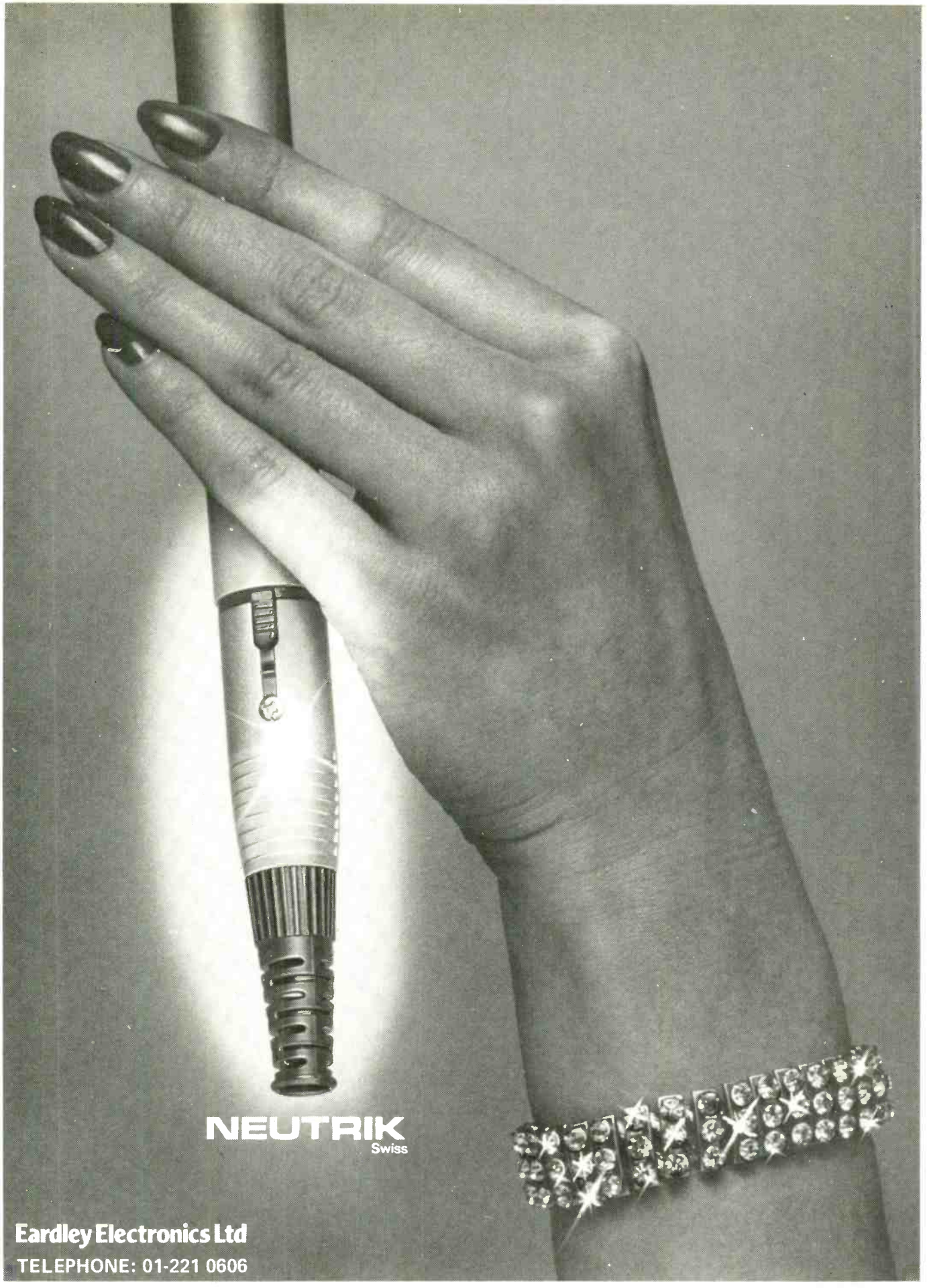


FIG. 6 BASIC STUDIO DESIGN
'A' WEIGHTING CURVE





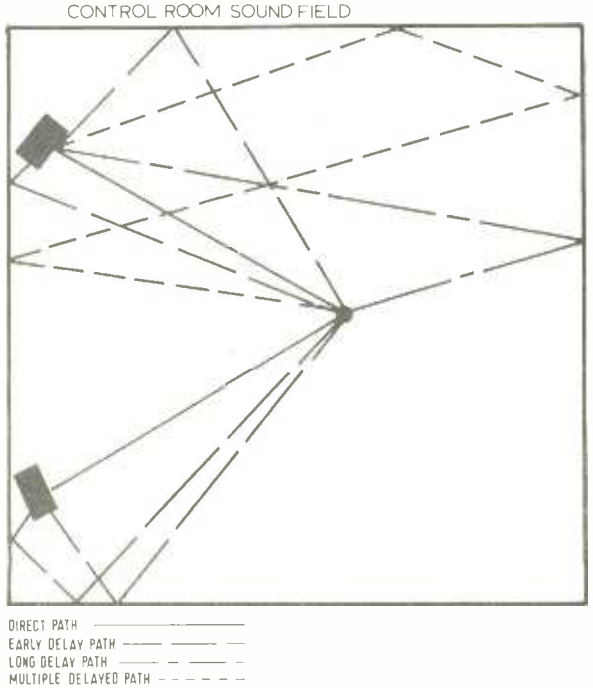
Developments in recording and monitoring acoustics

Andy Munro (Turnkey Two)

As the professional recording chain becomes less and less distorted, the performance of the acoustic environment has increased in significance to the point where many traditional design concepts can be shown to be inadequate. It is the purpose of this article to bring attention to some of the latest developments in acoustic technology.

THE FOCUS of attention in the modern recording studio is the control room, since it is here where the final sound is 'created', manipulating a multitrack master tape into the recorded product the discerning public has come to expect. In order to judge the quality of the sound originating in the studio, it is necessary that the monitor system maintains total neutrality and it is in the attainment of this that the greatest effort should be expended.

FIG 1 DEVELOPMENTS IN RECORDING AND MONITORING CONTROL ROOM SOUND FIELD



The monitor system itself consists of every element between the console output and the engineer/producer's ears which does not exist in the console/tape machine chain. The loudspeakers have always been considered the weak point in the hardware part of the chain, being the source of distortion and coloration far in excess of anything else. However, new developments in power handling and phase correction have eliminated many deficiencies to the point where the control room itself comes into question as a source of signal degradation.

Acoustic environment

Fig 1 shows a typical sound field development in a control room and it can be seen that many path lengths must occur between loudspeaker and listener. These path lengths may be defined as follows:

(a) direct path, effectively anechoic;
(b) early path lengths, arriving up to 10ms later than the direct sound;
(c) long path lengths, 10 to 20ms behind (a);
(d) reverberant sound field created by multiple path lengths and defined in terms of the RT_{60} of the room.

The reflections having the most disruptive effect are (b) which cause phase cancellation at frequencies defined as $F = \frac{500}{\Delta t}$ where Δt is the path difference in ms.

Path lengths in excess of 10ms can, of course, produce similar phase cancellations, but they have much less disruptive effect for the following reasons. Their amplitude is considerably lower as they approximate inverse square law decay, for at least some of their journey. Their intensity may be reduced by two or more reflections from absorbent surfaces, and they are also subject to the 'Haas effect' which is the ability of the ear to discriminate between direct sound and echoes. In the region of 15ms to 20ms of delay, human hearing is particularly aware of this effect which leads it to ignore such delayed information in the presence of the direct signal. This can be demonstrated by placing such a delay in one channel of an otherwise equally aligned stereo sound system. The listener will be aware only of the direct channel, almost totally ignoring the delayed sound. When the delayed channel is switched off, however, the ear detects a change in the ambient sound field and usually finds the sound less interesting.

It becomes apparent therefore,

that the ideal monitoring sound field consists of the direct sound path free of early interfering reflections followed with a highly diffuse ambient field consisting of multiple reflective paths with the first path difference greater than 10ms.

Time delay spectrometry

Much of the work involved in the measurement of the effects of room reflections has been made possible by time delay spectrometry (TDS), a technique developed by Richard Heyser of the California Institute Research Foundation. Basically the system consists of a swept filter which tracks the output of a synchronous swept sinewave generator with a specified lag time. By adjusting the lag time (hence TDS) it is possible to measure the direct signal or any successive reflection with no interference. The time window can be adjusted to measure direct and early reflections together and it is this analysis which shows severe phase cancellations in traditional monitor systems and rooms.

Another useful tool in this aspect of time related measurement especially where rapid analysis is required, is the Ivie *30/17A* microprocessor analyser. This extremely powerful device is well documented elsewhere, but mention of its time related measurement capability is warranted here.

An external signal generator provides a steady sinewave which can be gated to provide a tone burst. The analyser may be set to open a measurement window which corresponds to either the direct or reflected pulse. This enables successive delay paths to be studied and corrective acoustic treatment provided as required. Alternatively an internally generated snare pulse allows wideband spectrum analysis at specific time intervals allowing the measurement of both frequency response and delay time simultaneously. **Fig 2** shows a typical setting Ivie *17A* in the gated time mode in order to determine the amplitude of the finest discrete reflection arriving at the measuring microphone. Care must be taken to allow for the initial response of the speaker system to the snare pulse especially with large bass drivers.

Successive reflections can be measured at different frequencies to construct a time v energy curve for the monitoring environment.

Such techniques would not be viable in a commercial sense were it not for the speed with which such measurements can be obtained. In terms of the construction time of the average commercial studio, time related analysis more than justifies itself as the acoustic environment can be pieced together bit by bit, eliminating the need for costly alterations when the final decorations are in place.

Live end-Dead end

In America such techniques have been employed for several years and a new generation of control rooms are emerging. Hardly a month goes by without news of the latest 'Live end-Dead end' (LEDE) studio opening in LA or New York. **Fig 3** illustrates the basic layout of a typical LEDE control room.

The concept of the LEDE room was evolved by Don Davis of Synergetic Audio Concepts and is the registered trade mark of this organisation. In order to qualify as an LEDE room a monitoring environment must satisfy the following criteria. There should be a solid non-resonant outer shell which is asymmetrical and large enough to develop extended bass frequencies. This should contain a symmetrical inner shell with a crossover frequency between the shells of $fx = \frac{3v}{l}$ where v is velocity of sound and l is smallest room dimension. There should be a direct monitor path free of early reflections for between 2 to 5ms (early reflections 15dB or less than the direct sound level). A highly diffused sound field should exist generated by the rear of the room with time delay gaps ranging from 10 to 20ms. A comb effect must be produced by careful spacing and narrow band interference with constant RT_{60} frequency. Also the monitor speakers should be mechanically isolated to eliminate structure-borne transmission which can result in sound arriving before the direct path as sound travels at greater speed through solid material. The speakers must be flush mounted and time aligned to the wall plane to avoid any diffractional effects.

By correct geometric design it is possible to eliminate early reflections simply by the exclusion of particular surface angles—it is true that a wall area cannot be truly dead if a window exists as is the case in most control room designs.

The essential theory of LEDE, however, stands all argument and there is no doubt that time delay spectrometry is capable of providing more than sufficient proof. The most obvious subjective effect of LEDE room design is the awareness of what is happening to sound in the studio itself. By removing the coloration of the monitor system, every aspect of the recorded sound is enhanced making microphone placement and instrument screening far easier. Phase cancellations and anomalies in the recording chain become painfully obvious in the absence of 'masking effects'. It is logical therefore, that time compensated monitor speakers should find greater acceptance and enthusiasm in such control rooms and this has proved to be very much the case.

Time alignment

The concept of time alignment or linear phase compensation is not new, but it has long been argued that phase shift between discrete frequencies in a musical spectrum is not detectable to human hearing. There is now an opposing argument that transient response at high frequencies is very dependent on phase, but the most important aspect of phase (time) differences between drivers in a 2- or 3-way monitor speaker is the response anomalies that occur near the crossover points. Here, if two drivers are radiating equal energy, but are displaced by a small physical distance then phase cancellations of up to 15dB can occur. This can be proved very simply using time delay spectrometry and many demonstrations have taken place to indicate just how dramatic the effect can be on the overall system response.

The first investigations into time alignment which produced meaningful results were made by Ed Long in 1977. He experimented with a well proven and accepted monitor driver, the Altec *604*, which by virtue of its dual concentric construction has spatial differences between low and high frequency drivers. The effect of correct phase alignment of the two units produced remarkable results. Certainly any A/B comparison of musical material shows interesting effects depending on the phase integrity of the recording and playback system (including the rooms involved). One fact emerges —certain pieces of music sound truly miserable in such conditions,

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FIG. 2 DEVELOPMENTS IN RECORDING AND MONITORING
GTM SETTING FOR IVIE 30/17A

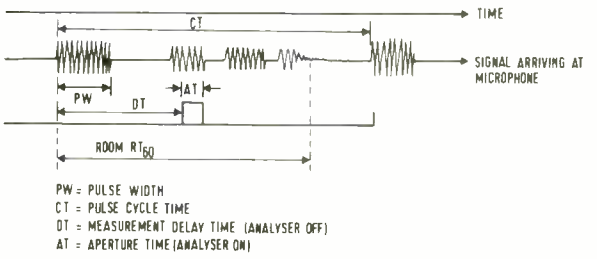
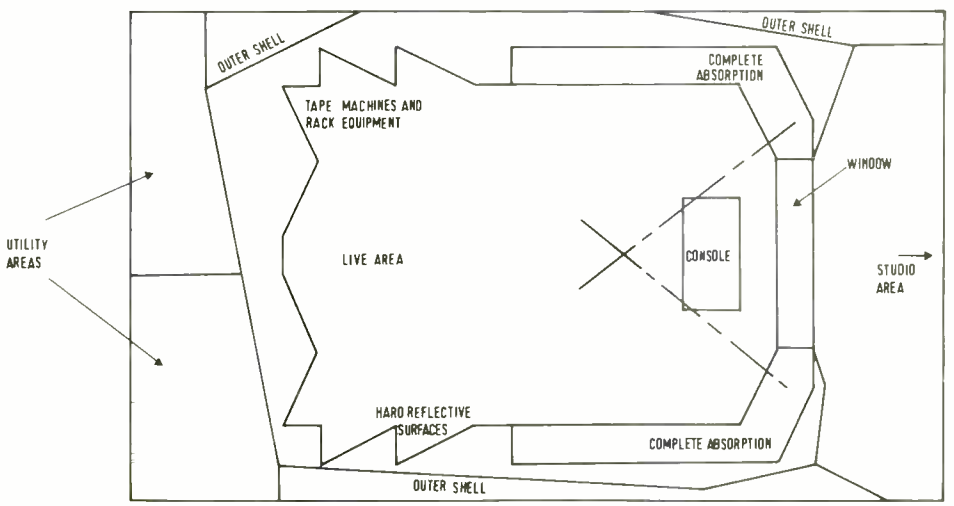


FIG. 3 DEVELOPMENTS IN RECORDING AND MONITORING
BASIC LAYOUT OF LE DE CONTROL ROOM



Developments in recording

therefore it is inevitable that an ever widening quality gap will develop in the commercial recording world which will be immediately apparent when time aligned speakers are available to the domestic hi-fi market.

Having attained the most accurate monitor source one should consider exactly what is the optimum acoustic environment for monitoring. By definition the purpose of a monitor system is to: (a) allow the engineer to assess both technical and musical quality as material is recorded; and (b) provide the producer with an artistic image which correlates not only to the control room but also to the outside world of domestic hi-fi and car radios.

A control room, which is virtually anechoic, may satisfy requirement (a) but with two disadvantages which preclude their use. Music has no natural timbre under such conditions and therefore must have artificial reverberation added which later under normal listening conditions, will appear excessive. The absence of a reverberant sound field with the high listening levels demanded by today's producers would require speakers and power levels on the limit of available technology in a room large enough to be anechoic at low frequencies, especially if boost equalisation is used.

The desired reverberation time for rooms of given volume has been assessed emperically over almost a century and within the limits of personal preference figures of around 0.25 to 0.4s for control rooms have been judged to be ideal. (The Fitzroy RT_{60} equation should be used for small control rooms.).

What has not been considered so much in the past is the development of the sound field, which is equally important and provides the ear and brain with the information it requires to assess the acoustic environment. For example a bathroom and a medium sized concert hall may show the same RT_{60} at mid range frequencies, but it is perfectly obvious that their acoustic characteristics are fundamentally different. The critical elements in room ambience are the time gaps between early reflections and more importantly the time and amplitude of the initial delay path in relation to the direct signal.

Berenak states that in a concert hall initial delays in the region of 20ms and 10dB below the direct level produce the most desirable ambience with near perfect articulation of the original sound. It is no coincidence that the Haas effect appears at its greatest in these conditions.

Control room of Regal Sound, Hitchin, a recent project undertaken by Turnkey.

In the control room, initial time delays of 10ms or more with highly diffused 'comb effect' reflections following, create the psychoacoustic effect of a much larger room without any increase of the reverb time.

In the design of the rear of such a control room, great thought must be given to the development of the reverberant sound field. Again, time related spectrometry is invaluable in measuring the density of reflective energy as it is the evenness of the 'time v energy' relationship which is important. The low frequency performance of the control room causes problems when the wavelength becomes greater than a third of the smallest room dimension (invariably the height). In order to maintain even sound field development at lower frequencies it becomes necessary to construct an outer shell which is hard, rigid and asymmetrical. Such a shell must often be constructed for isolation purposes anyway so the geometrical consideration is the only new parameter. The low frequency sound field can only be smooth to the limit of bass audibility if the shell is large enough to develop wavelengths of 30ft and angular enough to generate complex standing wave patterns. The low frequency reverb time can be controlled by the inner control room walls which, if constructed correctly, will provide wide band absorption free of undamped, high 'Q' resonances. The front of the control room must be considered very carefully in this respect as no early low frequency reflections must take place or, more correctly, their amplitude must not be significant in respect of the directly radiated energy.

Having considered the importance of time/energy relationships, the more conventional concept of frequency/energy curves—frequency response to the layman—seems almost insignificant. However, the ability of the ear is remarkable in detecting response anomalies so the monitor system must be flat to within a 3dB envelope to be considered acceptable.

The perfect LEDE room, in theory, would need no equalisation for the reasons previously stated—a time aligned monitor speaker listened to without early reflections would be perfectly flat regardless of the ambient spectral density which the brain would dismiss as almost insignificant in terms of the original data. This is why again when listening in a good concert hall one is blissfully unaware of the frequency response of the room—the brain is only interested in the direct information.

It is at this point where one of the most misused and misunderstood elements in the recording chain comes into question—equalisation.

To quote Richard Heyser, "A monitor speaker which has been equalised to a room should exhibit minimal phase shift. A minimum phase speaker is one which when equalised using standard RC or RLC networks has the minimum possible phase shift over the frequency spectrum."

It has since been established that minimum phase shift in a speaker is achieved by time alignment of the drivers to produce what is effectively point source radiation. It has further been established that a correctly designed equalising filter set will automatically balance the phase response of such a speaker.

Frequency response anomalies in non-time aligned speakers cannot be corrected simply by graphic equalisation because phase and time related effects cannot be compensated purely by a change in amplitude.

It can further be shown that phase shift in a filter is proportional to slope rate and that filter bandwidths of less than ⅓-octave can produce excessive transient distortion. This is further compounded by narrow band filters 'ringing' due to their long time constant.

The ideal graphic equaliser for studio use is a fully combining 30 or 31 band graphic giving up to 10dB boost or cut per filter. Fully combining filters are such that if two adjacent bands are cut by, for example 5dB the result will be a single ½-octave band cut of −6dB. If three adjacent filters are cut 2dB there will be a single ½-octave band cut of 6dB (See Fig 4). This property not only allows very smooth equalisation but also such filters are of the minimum phase type. Non-combining filters are not suitable for room equalisation.

To generalise, graphic equalisers are extremely useful for final system tuning and, set correctly, should result in identical energy/frequency curves from one room to the next.

However, they are not suitable for narrow band resonant effect corrections such as standing waves or cavity resonance. In a steady state measurement a graphic equaliser may appear to flatten such effects but the dynamic response of the room will remain poor at these frequencies. The only correct solution for such problems is treatment at source using real time analysis and preferably time delay spectrometry. By identifying the time domain of

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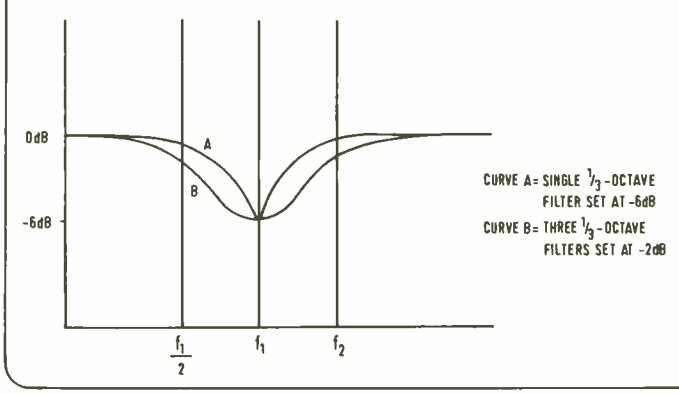
FIG. 4 DEVELOPMENTS IN RECORDING AND MONITORING
FULLY COMBINING FILTERS



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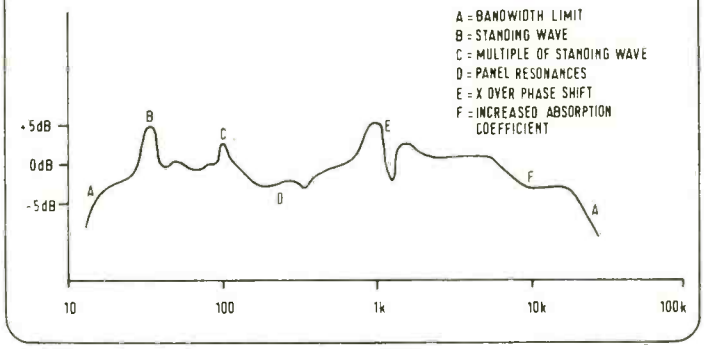
Developments in recording

each resonance, its cause and location can be determined and systematically tuned out by damping (see **Fig 5**). Equalisation can be extremely useful in reducing the monitor levels required by producers to accurately hear very low and high frequencies. Usually high monitoring levels are justified on the basis of the Fletcher Munsen equal loudness contours but the real problem is often that the monitor room is bass-light. The ultimate benefit of equalisation is that, used correctly, it enables tapes recorded in one room to be mixed elsewhere with little or no change in the quality of the mix.

One common problem is that monitor speakers which have been equalised to different settings on a stereo graphic, mainly because the room is not symmetrical, exhibit poor centre imaging. This is particularly noticeable on voice recordings and is a direct result of phase shift variations with different filter amplitude, emphasised probably by the asymmetrical waveform of the human voice. As would be expected these effects are less noticeable on correctly time aligned speakers and careful room design removes the problem completely.

FIG. 5 DEVELOPMENTS IN RECORDING AND MONITORING
TYPICAL CONTROL ROOM RESPONSE



Great care should be taken when applying excessive low frequency equalisation as it may result in severe amplifier clipping or at worst driver blow-out. A 3dB boost of the 50 to 100Hz octave band would warrant a 100W monitor system increasing to 200W to maintain the same operational headroom! The final comment on equalisation has to be: Two rings don't make a right!

Every element of this discussion has so far been concerned with the control room. It can be safely said that if the monitor system is accurate in terms of energy v frequency v time then what happens in the studio will be heard so acutely that many new recording techniques will evolve. In a minimum phase monitoring situation the smallest anomaly in phase becomes painfully obvious, new mic positions must be found, certain mic combinations will be stopped and a new method of recording will evolve.

It has long been understood that microphones exhibit severe response changes near reflecting surfaces. The reason has been well explained without the need for TDS but is of course due to time delay itself. Bob Shulein of Shure Bros produced an excellent paper on the correct placement of pressure gradient microphones and noted that pressure response microphones (omnidirectional of small dimensions) do not suffer nearly as badly. In fact when placed very close to a hard, large reflecting plane their response is perfectly flat. This is due to the fact that all sounds reflecting from the surface must be in phase with the direct sound. This ideal has been taken a stage further by Ed Long who has patented the Pressure Zone Microphone *PZM*. This microphone has caused much controversy and it is not the intention of this article to pass judgement, but merely to draw readers' attention to new developments in acoustic technology.

The concept of total phase integrity within the recording chain has now become a realisable objective. Digital recording and other advancements are pointless without further improvement in the understanding of sound field propagation and decay. There can be no doubt in the minds of anyone who has experienced recordings made in such LEDE studios that the next few years will see a total rework of sound recording as we know it.

It cannot be over-emphasised that the ideas discussed do work and are entirely provable, but totally unsuitable for studios unprepared to let the room dictate the final performance.

It only remains to acknowledge the work and writing of the following individuals and companies who have been the source of much of the material which has been used in this article. Don and Caroline Davis; Synergetic Audio Concepts; Richard Heyser; UREI; Ivie; FWO Bauch Ltd; Alex Garner, Tannoy Loudspeakers; and B & K Laboratories. ■

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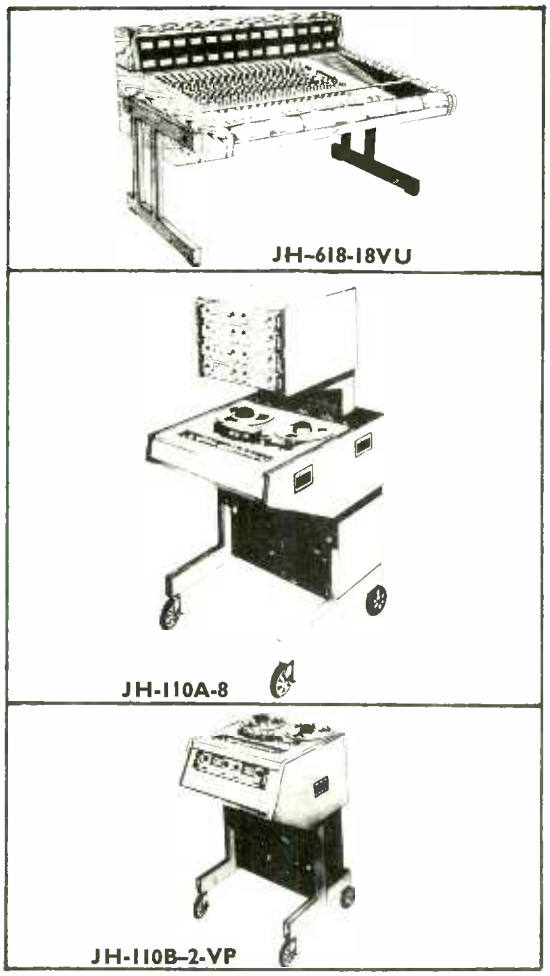

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Survey: studio designers and consultants

Information in this survey is based on questionnaires returned in July, and has not been further checked by *Studio Sound*. Questionnaires were sent to a large sample of architects and consultants known to operate in the acoustics field, although many chose not to reply. Possibly the most crucial question asked was 'Is the company's principal source of income pure consultancy on a project or hourly basis, or anything else?'. This should give some idea as to the 'morals' of the company, particularly when they are receiving hefty commissions for supplying particular brands of equipment—some companies do however manage to offer both services without conflict. In addition, each questionnaire requested the name of one recent project in each of eight areas, in order to indicate the company's scope. Thus the project names indicated in the following text are not necessarily a complete list of projects in any one area. Again, some companies chose not to give the names of recent recording and broadcast projects which might suggest that they are not active in those fields.

ABADON/SUN INC

PO Box 6520, San Antonio, Texas 78209, USA.
Phone: (512) 824-8781.
Principal staff: Galen Carol (pres), Woody Smith (VP).
Consultancy: not the company's principal source of income.
Facilities and personnel: includes drawing office, acoustic measurement facilities, carpenter on call, wiremen, electrical and electronic engineers. Recent projects have included Indian Creek recording studios, discos, Saltillo Mexico Cultural Center (theatre) and sound reinforcement systems. Abadon/Sun has a very limited clientele, with individual design and fitting to suit client's specific market area.
Fees: individual rates are established after consultation with client.

ACOUSTIC TECHNOLOGY LTD

58 The Avenue, Southampton SO1 2TA, UK.
Phone: 0703 37811. Telex 47156.
Principal staff: principal consultants Mr R J Davies and Mr R Crawford, there are six senior consulting engineers including Chris Manning and Bernard Postlethwaite, and nine consulting engineers including Bob Harris.
Consultancy: the company's principal source of income.
Facilities and personnel: includes drawing office, acoustic measurement facilities, mechanical and electronic engineers. Recent projects have included ICC and SAV recording studios, Prairie View, Texas A&M University, radio and TV studios, discos, theatres, auditoria, Doubletree Inns, convention centre Houston, churches, sports stadia, oil platforms, sound reinforcement, etc. The company recently celebrated its 10th year and completion of nearly 1,000 projects. The consultancy service is backed by comprehensive data analysis services including both main frame and desk top computers.
Fees: based on time.

ACOUSTILOG INC

19 Mercer Street, New York, NY 10013, USA.
Phone: (212) 925-1365.
Principal staff: Alan Fierstein.
Consultancy: the company's principal source of income.
Facilities and personnel: includes acoustic measurement facilities, architects (associates) and electronic engineers. Recent projects have included Atlantic Recording Studios, New York, Paradise Garden, New York (theatre), Radio City Music Hall, The Brick Church, New York. Acoustilog also manufactures equipment related to acoustic measurement of studios.
Fees: based on time.

ALICE (STANCOIL LTD)

38 Alexandra Road, Windsor, Berks, UK.
Phone: 07535 51056. Telex: 849323.
Principal Staff: Ted Fletcher, John A Andrews and Mike Bennett.
Consultancy: not the company's principal source of income.
Facilities and personnel: includes drawing office, acoustic measurement facilities, wiremen and electronic engineers. Recent projects have included BMS recording studios, Mercia Sound and Devonair Radio studios, Mandarin Hotel, Singapore conference centre, ICL Conference Centre, Windsor. Alice also manufactures mixing consoles and ancillary equipment for radio and television studios.
Fees: depends on whether consultancy is based on other equipment not supplied (typically provide turnkey projects).

ANGEVINE ACOUSTICAL CONSULTANTS INC

7349 Davis Road, West Falls, NY 14170, USA.
Phone: (716) 652-0282.
Principal staff: Oliver Angevine, Eric Neil Angevine.
Consultancy: the company's principal source of income.
Facilities and personnel: includes drawing office, acoustic measurement facilities, electrical, electronic and acoustical engineers. Recent projects have included WWOL Buffalo and WPXN Rochester (radio stations) and WHEC Rochester (TV), discos, Studio Arena Theatre, auditoria, churches, schools, hospitals, etc.
Fees: based on time.

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1516 Ferris Avenue, Royal Oak, Michigan 48067, USA.
Phone: (313) 544-1793.
Principal staff: Edward Wolfrum, Scott Randall, Charles Beach.
Consultancy: not the company's principal source of income.
Facilities and personnel: includes drawing office, acoustic measurement facilities, wiremen and electronic engineers, and associates for carpentry, architecture and mechanical engineering. Recent projects have included Tin Ear Records recording studio, Chicago, WEXL Royal Oak (radio), discos, film mixdown facilities, churches, etc. The company also provides a custom equipment design service.
Fees: based on time. Equipment is not supplied by Audio Graphics.

AUDIO INTERNATIONAL

424 Grant Avenue, Scotch Plains, New Jersey 07076, USA.
Phone: (201) 322-4466.
Principal staff: Warren Slaten (pres), Sybil White, Eric Slaten.
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Facilities and personnel: includes drawing office, wiremen, mechanical, electrical and electronic engineers, associates for acoustic measurement, carpentry, surveying and architecture. Recent projects have included Squires Productions, White Plains recording studio, WNOV Milwaukee (radio), auditoria, churches. Company also provides operational training and custom equipment.
Fees: based on project value, fees not payable if equipment supplied.

AUDIO VISUAL SYSTEMS

Unit 2, West Parade Industrial Estate, Halifax HX1 2TF, UK.
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Principal staff: Richard Lockyer.
Consultancy: not the company's principal source of income.
Facilities and personnel: includes acoustic measurement facilities, carpentry, wiremen, electrical and electronic engineers. Recent projects have included discos, Doncaster Civic Theatre, conference facilities and churches.
Fees: question not answered.

THE AUDIO WORKSHOP

7 The Grove, Harrogate HG1 5NN, UK.
Phone: 0423 57653/57751.
Principal staff: Mr M J Stockdale, Mr P Meakes.
Consultancy: not the company's principal source of income.
Facilities and personnel: includes wiremen, mechanical and electronic engineers, associates for drawing office, acoustic measurement, carpentry, building, architecture, surveying and electrical engineering. Recent projects include Crammer Studios, Celdon Jingle studio, discos.
Fees: based on time, payable even if equipment supplied by company.

BROADCAST CONSULTANTS INTERNATIONAL

PO Box 10, Twickenham TW1 1BQ, UK.
Phone and telex: not given.
Principal staff: Mr R Swain, associates Mr J Gibson, Mr M Bradbury, Mr J Coles.
Consultancy: the company's principal source of income.
Facilities and personnel: includes drawing office and electronic engineers. Recent projects have included Eel Pie recording studios, Capital Transkei (radio), Radio Jordan, Abu Dhabi TV, auditoria, conference facilities, mobile radio and TV vehicles.
Fees: based on either time or project value.

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16 Bentley Way, Whitehall Road, Woodford Wells, Essex IG8 0SE, UK.
Phone: 01-504 9796.
Principal staff: Mr P N Bone, Mr H S Bishop.
Consultancy: the company's principal source of income.
Facilities and personnel: includes drawing office, associates for acoustic measurement, architecture and surveying, others as specified by clients. Recent projects include Scorpio Sound Studio, Film Australia, various radio stations, and Churches Radio and Television Centre, Bushey. Associate company Shone Sound Ltd specialises in the supply of fittings and studio furniture including acoustic doors. The consultancy has over

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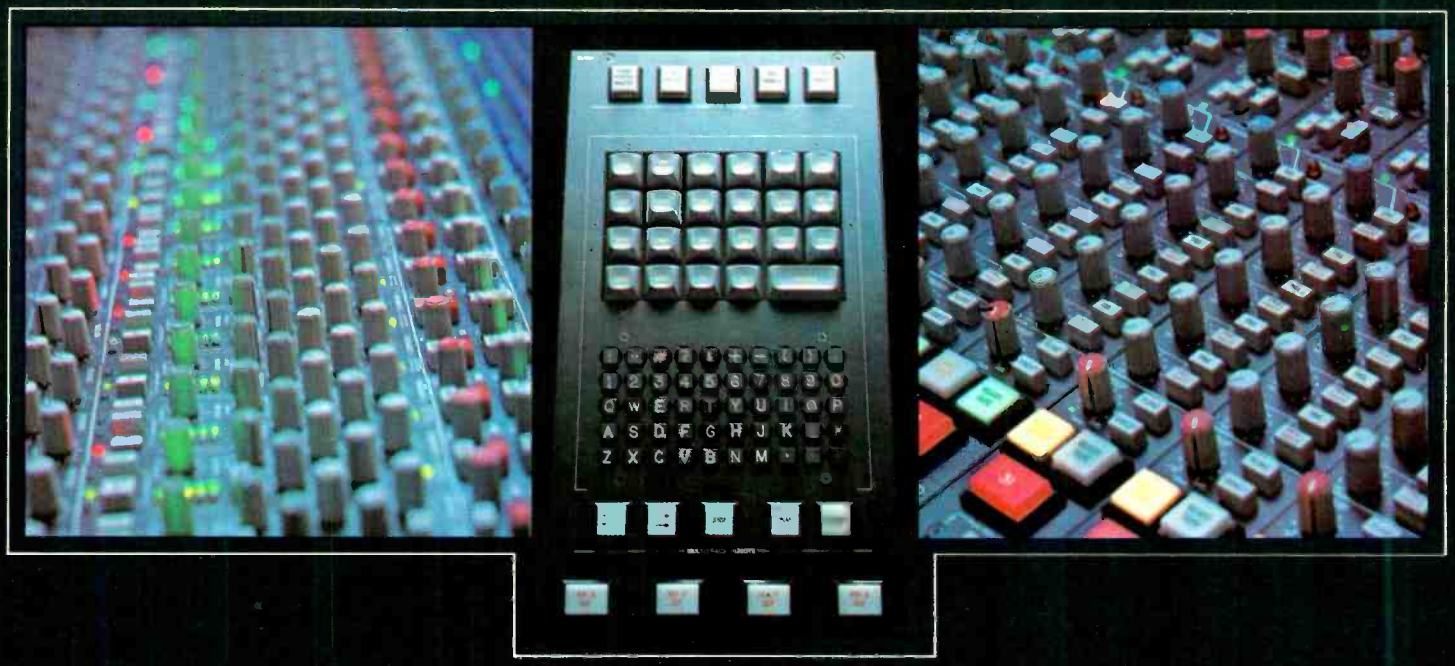

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Consultancy: not the company's principal source of income.
Facilities and personnel: includes drawing office, acoustic measurement facilities, wiremen, mechanical, electrical and electronic engineers, associates for architecture and surveying. Recent projects have included Film Australia (recording studio), ICI Brussels (TV), churches, budget AV studios for educational and charitable organisations. Also provide directional and monitor loudspeakers, custom designed audio equipment.
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6 Fareham Street, London W1V 3AH.
Phone: 01-439 8391. Telex: 28365.
Principal staff: David Binns, Dick Bowdler, Neil Spring, Alex Burd and David Lamberty.
Consultancy: the company's principal source of income.
Facilities and personnel: includes drawing office, acoustic measurement facilities, architects, mechanical, electrical and electronic engineers. Recent projects have included Audio International recording studio, Radio Jordan, RTZ Zagreb (TV), discos, The National Theatre, Doha, National Concert Hall of Wales, Jebal Ali Hotel, Dubai (conference facility), churches, noise and vibration consultancy for all building types and industry. In 1979, the firm acted as consultants for projects of value in excess of £280 million.
Fees: based on time and project value, equipment not supplied.

JEFF COOPER (consultant in acoustics)
22627 Cavalier Street, Woodland Hills, Cal 91364, USA.
Phone: (213) 887-9100.
Principal staff: Jeff Cooper.
Consultancy: the company's principal source of income.
Facilities and personnel: includes drawing office and acoustic design. Other details not supplied. Recent projects include Polygram Studios, Mexico and Singapore, Fantasy Films, Berkeley, and Russian Hill Recording, San Francisco.
Fees: question not answered.

COURT ACOUSTICS LTD
35/39 Britannia Row, London N1 8QH, UK.
Phone: 01-359 0956. Telex: 268279.
Consultancy: not the company's principal source of income.
Facilities and personnel: includes drawing office, acoustic measurement facility, electrical and electronic engineers, associates for carpentry, wiremen, architecture and surveying. Area of activity is principally in monitoring systems with such recent projects including Majestic Studios, Roger Cook (private), London Weekend TV, discos, theatres and auditoria. Also manufacture loudspeaker systems, graphic equalisers, electronic crossovers and spectrum analysers.
Fees: on time to two days, then project value. Fees still charged when equipment supplied, unless by prior arrangement with large contracts.

J H A CROCKETT & ASSOCIATE
83/87 Wallace Crescent, Carshalton, Sutton SM5 3SU, UK.
Phone: 01-647 1908. Telex: 884671.
Consultancy: the company's principal source of income.
Facilities and personnel: includes drawing office, acoustic measurement facilities and electronic engineers. Recent projects have included Mayfair Sound Studios, Halifax Building Society (TV studio), theatre, auditoria, conference facilities and churches, general acoustics and particularly noise interference between rooms and neighbouring properties.
Fees: based on time and/or project value, equipment never supplied.

CHIP DAVIS AND ASSOCIATES
3364 Clandara Avenue, Las Vegas, Nevada 89121, USA.
Phone: (702) 731-1917.
Principal staff: Chips Davis, Ed Bannon, Don Davis (outside consultant).
Consultancy: not the company's principal source of income.
Facilities and personnel: includes carpentry and wiremen, associates for drawing office, acoustic measurement, architecture, electrical and electronic engineering. Recent projects have included Syracuse University (audio archives).
Fees: question not answered.

DALY ENGINEERING COMPANY
11855 SW Ridgecrest Drive, Beaverton, Oregon 97005, USA.
Phone: (503) 646-4420.
Principal staff: Edward Daly, associates Russell Altermatt, John Ruscigno.
Consultancy: the company's principal source of income.
Facilities and personnel: include mechanical and electronic engineers. Recent projects include Audio Group recording studio, Portland General Electric TV Studio, theatres, auditoria, conference facilities, churches.
Fees: based on time, no equipment supplied.

EASTLAKE AUDIO (UK) LTD
97/99 Dean Street, London W1V 5RA, UK.
Phone: 01-734 2812. Telex: 27939.
Principal staff: David Hawkins, Stephen Russell, Julia Condor, Tom Hidley (acoustic consultant).
Consultancy: the company's principal source of income.
Facilities and personnel: includes drawing office, acoustic measurement facilities, carpentry, wiremen and electronic engineers, associates for architecture, surveying, mechanical and electrical engineering. Company undertakes projects for recording studios, radio and TV studios, and theatres, and has completed over 60 studios in Europe, offering separately design, studio construction and monitoring, often all three being supplied. The company has three field crews on construction installation projects. Also supply Eastlake monitoring systems and Eastlake proprietary studio doors.
Fees: based on time and project value. Typically a minimum of $500/sq m exclusive of air conditioning and electrical services.

ELLIOTT BROS (AUDIO SYSTEMS) LTD
114-115 Tottenham Court Road, London W1, UK.
Phone: 01-388 1833.
Principal staff: Bruce Elliott.
Consultancy: not the company's principal source of income.
Facilities and personnel include drawing office, acoustic measurement facility, associates for carpentry, surveyors, electrical and electronic engineers. Recent projects included Sain Recording Studios, North Wales. Also manfacture equipment.
Fees: based on both time and value.

EMPIRICAL AUDIO
3A Todd Place, Ossining, NY 10562, USA.
Phone: (914) 762-3089.
Principal staff: Sherra Schwartau, Wayne Schwartau, Ted Hammond, Mark Terry.
Consultancy: not the company's principal source of income.
Facilities and personnel: acoustic measurement facilities, wiremen, surveyors, mechanical, electrical and electronic engineers, others as associates. Recent projects include Greenstreet Recording, Soundmixers, Penny Lane, and Warehouse Studios, New York.
Fees: based on time and/or project value.

EVERYTHING AUDIO
16055 Ventura Blvd, Suite 1001, Encino, Cal 91436, USA.
Phone: (213) 995-4175. Telex: 651485.
Principal staff: Brian Cornfield (acoustic designer), associates Quinton Bradley (draftsman) and Joseph Nemic (architect).
Consultancy: the company's principal source of income.
Facilities and personnel: includes acoustic measurement facilities, electrical and electronic engineers, associates for drawing office, carpentry, wiremen, architecture, surveying and mechanical engineering. Recent projects have included David Gates and Discos de Centro America recording studios, Compact Video (TV), discos, Osmond Facility and Spectrum Studios (video post production). All required electronics are supplied to company's studio design clients.
Fees: based on project value, no fees payable if equipment supplied.

FLUTEL ASSOCIATES
2 Warren Road, Bexleyheath, Kent DA6 7LU, UK.
Phone: 01-303 4401/8177.
Principal staff: Peter Hamblin, A Barker, T Howard.
Consultancy: not the company's principal source of income.
Facilities and personnel: includes drawing office, acoustic measurement facility, carpentry, wiremen, mechanical and electrical engineers, Recent projects have included Wood Wharf studios, theatres, churches and lecture halls. Also manufacture acoustic panels, screens and absorbers.
Fees: based on time and project value.

W A HINES & PARTNERS
The Red House, 37 The Broadway, Stanmore, Middx HA7 4DJ, UK.
Phone: 01-954 2008/0995.
Principal staff: Mr P W Hines, Mr D J S Higgins, Mr William Hines (consultant).
Consultancy: the company's principal source of income.
Facilities and personnel: includes drawing office, acoustic measurement facilities. Recent projects have included preview theatres, small recording studios, conference rooms and cinemas.
Fees: based on time.

JOINER-PELTON-ROSE INC
10110 Monroe Drive, Dallas, Texas 75229, USA.
Phone: (214) 350-2384.
Principal staff: John Joiner, Tom Rose, David Joiner, Dave McCandless, Howard Burris.
Consultancy: the company's principal source of income.
Facilities and personnel: includes drawing office acoustic measurement facilities, architects, mechanical and electrical engineers. Recent projects have included Texas A&M University recording studio, WBEN Buffalo (radio), KERA and WFAA, Dallas (TV), discos, theatres, auditoria, conference facilities, churches, hospitals, hotels, etc. Acoustical consulting only.
Fees: based on time.

MIKE JONES (audio consulting engineer)
31 Parkfield Avenue, Eastbourne, East Sussex BN22 9SE, UK.
Phone: 0323 52300.
Principal staff: Mike Jones.
Consultancy: the company's principal source of income.
Facilities and personnel: includes acoustic measurement facilities and wiremen, associates for carpentry and mechanical engineering. Recent projects include cassette copying facility and survey at theatres.
Fees: based on time.

DAVID H KAYE (consultant in acoustics)
156 West Newton Street, Boston, Mass 02118, USA.
Phone: (617) 262-2428.
Principal staff: David H Kaye.
Facilities and personnel: includes drawing office and acoustic measurement facility, optical pattern projector for horn loudspeaker cluster design. Recent projects include auditoria, conference facilities, churches, arenas and concert halls.
Fees: based on time, no equipment supplied.

L&L AUDIO ENTERPRISES
4101 San Dominique, Montreal, Quebec, Canada.
Phone: (514) 843-6443.
Principal staff: David Jones, Toby Dubois, Jocelyn Guivremont.
Consultancy: the company's principal source of income.
Facilities and personnel: include drawing office, acoustic measurement, carpentry, wiremen,

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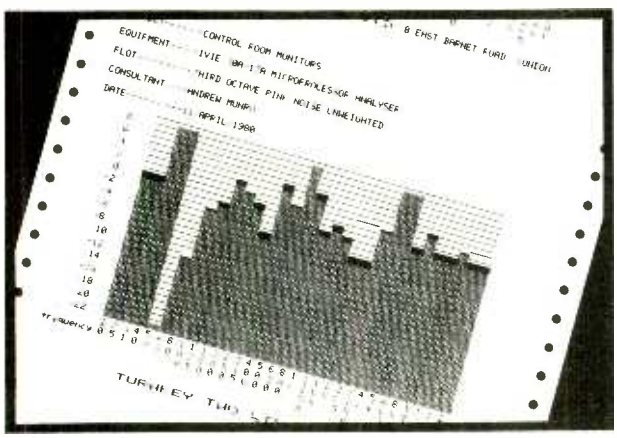
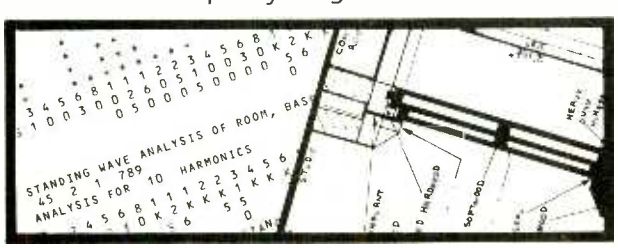
SOUND EXPERIENCE IN DESIGN

Accurate and neutral monitoring conditions are a vital link in the recording chain. Turnkey Two designs and updates studio acoustics using the most advanced technology available.



The Acoustics Jungle

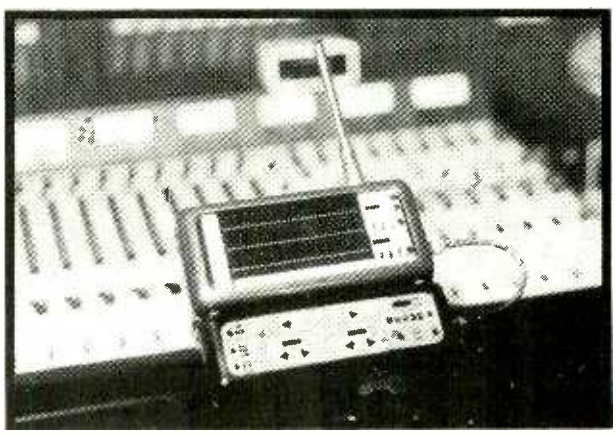
The studio is the most expensive element in the recording process. The complex reflections within its walls can distort an original sound more severely than any loudspeaker. Resonances and suck-outs of 20dB are not uncommon in poorly designed rooms.



Cost Effective

Our knowledge of construction techniques and building materials enables us to produce rapid results. Whether it's a question of corrective measures or building from the ground up, we guarantee our efforts and time schedules.

Through Turnkey we can also supply complete equipment packages – getting it right at the outset solves many future problems.



Systematic Analysis

The key to our operation. The use of computer analysis allows rapid meaningful data acquisition on site. Information is stored digitally and can be held for future reference. This also allows instant before and after comparisons when fine tuning.

Complete third octave analysis of both level and reverberation can be carried out in a few hours and time gated spectrometry even allows anechoic measurements to be made in a live room.

Your move

Turnkey Two can get involved in a project at any stage – its never too late to put your acoustics right.

For expert advice and more information on our services call Andy Munro on 01-440 9221.

Our business is helping you with yours

turnkey two

8 East Barnet Road
New Barnet
Herts. EN4 8RW
Telephone 01-440 9221
Telex 25769

Survey

surveyors, mechanical, electrical and electronic engineers. Recent projects include Omni-Son, Montreal, Moran Heights Studio, Studio St Charles. Le Mobile recording studio. Also television studios. Also manufacture monitor panels, DI boxes, phono pre-amps.
Fees: based on time.

LAKE AUDIO
33 Church Street, Rickmansworth, Herts. WD3 1DH, UK.
Phone: 09237 70488.
Principal staff: Cliff Lake, Clive Godsell.
Consultancy: not the company's principal source of income.
Facilities and personnel: includes drawing office, acoustic measurement facilities, carpentry, wiremen, mechanical, electrical and electronic engineers, associates for architecture and surveying. Recent projects include Decibel and Fast Buck studios, discos, theatres, auditoria, conference facilities.
Fees: question not answered, fees not payable if equipment supplied.

LEISUREPLAN
4 Great Pulteney Street, London W1, UK.
Phone: 01-434 3905.
Principal staff: Graham Walne, Geoffrey McNab.
Consultancy: the company's principal source of income.
Facilities: all services provided by associates. Recent projects include theatres.
Fees: dependent on project.

MALDWYN BOWDEN INTERNATIONAL LTD
PO Box 112, Brighton BN2 2RS, UK.
Phone: 0273 607384. Telex: 267727.
Principal staff: Maldwyn Bowden, Michael Fabricant, Christopher Humphrey.
Consultancy: the company's principal source of income.
Facilities and personnel: includes drawing office, acoustic measurement facilities, carpentry, wiremen, electrical and electronic engineers, associates for architecture, surveying and mechanical engineering. Projects include studios, theatres, discos, conference centres.
Fees: question not answered.

MODULAR PERFECTION
18917 NE 5th Avenue, North Miami Beach, Florida 33179, USA.
Phone: (305) 945-9774.
Principal staff: Seth Snyder, Peter Maletta, Ken Realander, Bruce Butcher, Henry Littles.
Consultancy: not the company's principal source of income.
Main activity is the manufacture of pre-fabricated wall, floor and ceiling sections for the construction of studios. Facilities include drawing office, architecture, carpentry, acoustic measurement facilities. Recent projects include Middle Ear; Right Track Recording, New York; International Sound, Miami; Sonotec Recording, Bogota.
Fees: based on project value, fees not payable if equipment supplied.

JAMES MOIR & ASSOCIATES
16 Wayfield, Chipperfield, Herts WD4 9JJ, UK.
Phone: 09277 62955.
Principal staff: James Moir, Mr R G Hibberd, Mr R L West, Mr D J Mynall.
Consultancy: the company's principal source of income.
Facilities and personnel: includes acoustic measurement facilities, electrical and electronic engineers. Recent projects include recording studios, discos, theatres (about 300), auditoria, conference facilities, churches. Also noise control, electro-acoustic problems.
Fees: based on time, no equipment supplied.

NEWMAN/LUSTIG & ASSOCIATES
1050 N State Street, Chicago, Illinois 60610, USA.
Phone: (312) 642-5364.
Consultancy: the company's principal source of income.
Facilities and personnel: includes drawing office, architects, surveyors, engineers. Projects include broadcast, production and post production facilities.
Fees: on a time or project basis.

PAOLETTI/LEWITZ ASSOCIATES INC
40 Gold Street, San Francisco, Cal 94133, USA.
Phone: (415) 391-7610.
Principal staff: Dennis Paoletti, Joel Lewitz.
Consultancy: the company's principal source of income.
Facilities and personnel: includes drawing office, acoustic measurement, architects, electrical engineers. Recent projects have included AT&T studios, K108FM Sacramento (radio), Bank of America TV studio, discos, theatres, auditoria, conference facilities (in China), churches, listening rooms.
Fees: on a time basis, no equipment supplied.

ANDRE PATROUILLIE/AUDIOTECHNIEK
Boereboomlaan 39, B-3072 Nossegem, Belgium.
Phone: 02 511.66.48.
Principal staff: Andre Patrouillie.
Consultancy: not the company's principal source of income.
Facilities: all services by freelance associates. Recent projects have included Promofilm recording studio.
Fees: based on time, not payable when equipment supplied.

PERCEPTION INC
Box 39536, Los Angeles, Cal 90039, USA.
Phone: (213) 660-9351.
Principal staff: Mr G L Augspurger.
Consultancy: the company's principal source of income. Recent projects have included several recording studios.
Fees: on a time basis.

PLAN AUDIO
9 South Street, Epsom, Surrey KT18 7PJ, UK.
Phone: 03727 41822.
Principal staff: Mr J G Cooper.
Consultancy: not the company's principal source of income.
Facilities and personnel: includes drawing office, associates for acoustic measurement, carpentry, structural engineering. Projects not specified.
Fees: not specified, but supply equipment.

PROJECT 2000
Flat 4, Windlemere House, Westwood Road, Windlesham, Surrey, UK.
Phone: 0990 26600.
Principal staff: Chris Lewis, Tommy Whelan, Nick Condron.
Consultancy: the company's principal source of income.
Facilities and personnel: includes drawing office, carpentry, wiremen and mechanical, electrical and electronic engineers, others available as associates. Recent projects include Satril Studio, Muppet Studio (TV).
Fees: based on time and/or project value.

RABIT LTD
2 Orchard Road, Kingston, Surrey, UK.
Phone: 01-642 0139.
Principal staff: David Wright, Bernard Spratt, Richard Slater, Andrew Mountford.
Consultancy: not the company's principal source of income.
Facilities and personnel: includes drawing office, carpentry, wiremen, architects, surveyors, engineers. Recent projects have included Sain Recording, Wales and Berwick Street Studio.
Fees: based on time.

RDW ASSOCIATES
23 Montgomery Road, Edgware, Middx. HA8 6NS, UK.
Phone: 01-952 1850.
Principal staff: Dr Roger Driscoll, Mr R A Walters, Mr J Betteridge (associate).
Consultancy: the company's principal source of income.
Facilities and personnel: includes acoustic measurement facilities, carpentry, electronic engineers, associates for drawing office, wiremen, mechanical engineering. Recent projects have

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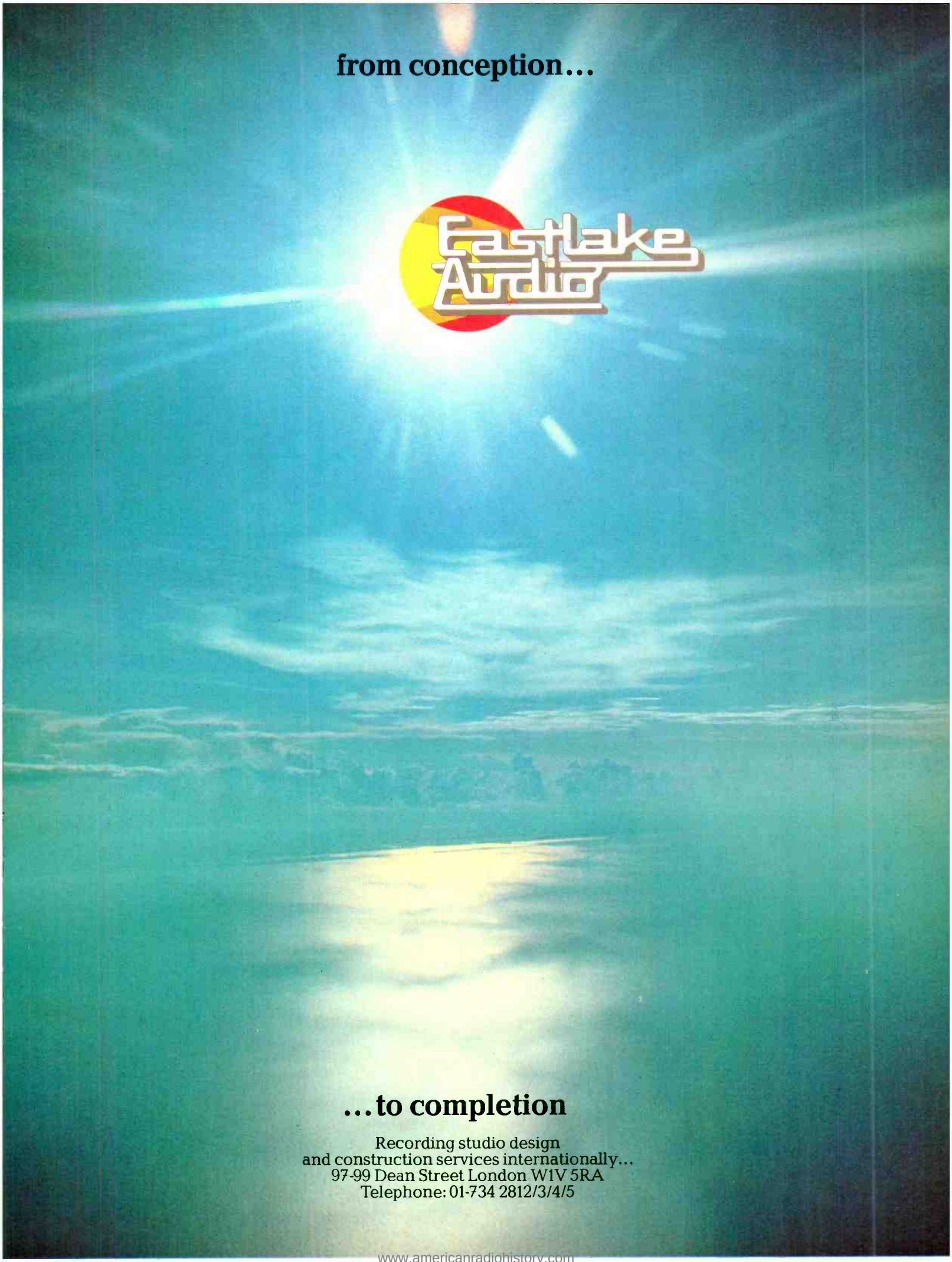
International Client List

Quayaquil, Ecuador	●	●	●	Fediscos S.A.
Caracas, Venezuela			●	Etcetera Productora Cinematographica
Lagos, Nigeria	●	●	●	Shanu-Olu Record Industries
	●	●	●	International Record Industries
	●		●	Rogers All-Stars Nigeria
Lome, Togo	●	●	●	Ministry of Information, Government of Togo (as sub-contractors to 3M France S.A.)
Oxford, England	●	●	●	Manor Recording Studios
London England	●	●	●	D.J.M. Recording Studios
	●	●		Britannia Row Studios
			●	London Palladium
	●	●	●	Maison Rouge
	●	●	●	Marquee studios
	●	●	●	Mobile One Recording Vehicle
	●			Music De Wolfe
	●	●	●	Phonogram Studios
	●	●	●	Pye Studios
			●	Roundhouse Studios
	●	●	●	Red Bus Studios
			●	Sarm Studios
	●		●	Strawberry Mastering
	●	●	●	Threshold Studios
	●	●	●	Townhouse Studios/Mastering Room
	●	●	●	Utopia Studios/Mastering Room
	●	●	●	Roger Waters
Dorking, England	●	●	●	Strawberry South Recording Studios
Manchester, England	●	●	●	Strawberry North Recording Studios
Republic of Ireland			●	Lombard Sound
Helsinki, Finland	●	●	●	Finlevy Studios
Trondheim, Norway	●	●	●	Arctic Studios
	●	●	●	Nidaros Studios
Oslo, Norway	●	●	●	Roger Arnhoff Studios
	●	●	●	S.E.S. Mastering
Stockholm, Sweden	●		●	Polar Music Studios
Kunglav, Sweden	●		●	Studio Bohus
Copenhagen, Denmark	●			Danmarks Radio Music Studio
	●	●	●	Danmarks Radio Recording Vehicle
Hoerve, Denmark	●	●	●	Tocano Studios
Berlin, Germany	●	●	●	Hansa Tonstudio
	●			Audio Tonstudio
Hamburg, Germany	●		●	Russl Tonstudio
Nüremberg, Germany	●			Studio Hilpolstein
Munich, Germany	●	●	●	Arco Tonstudios
	●	●	●	Musicland Studios
	●		●	Olympia Studios
	●	●	●	Union Studios
Eindhoven, Netherlands	●			Philips Research Laboratories
Hilversum, Netherlands	●			Wisseloord Recording Studios
			●	Dali-Press Studios
Kortrecht, Belgium	●	●	●	Studio Kritz
Paris, France	●			Jean-Michel Jarre
	●	●		Studio Barclay
	●	●	●	Le Chateau Studios
	●	●	●	Studio L'Imaginaire
	●	●	●	Studio De La Grand Armee
	●	●		Stars Music
	●	●	●	Studio Davout
Berre-Les-Alpes, France	●	●	●	Super-Bear Studios
Madrid, Spain	●	●		Eurosonic Studios
	●	●	●	Hispavox Studios
	●	●	●	Kirios Studios
Ibiza (Spanish Balearics)	●	●	●	Ibiza Sound Studios
Rome, Italy			●	L.D.C.-Mammouth Studios
Milan, Italy	●	●		Compagnia Generale Del Disco
	●	●	●	Il Mulino Studios
	●	●		Polygram Studios
	●	●	●	Stonecastle Studios
Zurich, Switzerland	●			Powerplay Studios
Montreux, Switzerland	●	●	●	Mountain Studios
Athens, Greece	●	●	●	Studio Era



included theatres, auditoria and conference facilities.
Fees: on time basis to 20 hours, project value above.

PETER SARONY & ASSOCIATES
30 Old Bond Street, London W1X 3AD, UK.
Phone: 01-493 2046.
Principal staff: Peter Sarony.
Consultancy: the company's principal source of income.
Facilities and personnel: includes drawing office, acoustic measurement facilities, architects, engineers. Recent projects include Konk and Chipping Norton Studios.
Fees: based on time or project value.

DAVID SCHWIND
557 Peralta Avenue, San Francisco, Cal 94110, USA.
Phone: (415) 768-4853/826-6529.
Principal staff: David Schwind.
Consultancy: the company's principal source of income.
Facilities and personnel: includes drawing office, acoustic measurement facilities, electronic engineers, vibration isolation, associates for carpentry, architecture, mechanical engineering. Recent projects include Aurora Studio, Bechtel Video Studio. Also design and manufacture to order omnidirectional tweeters.
Fees: based on time.

KENNETH SHEARER AND ASSOCIATES
Acorn House, 1 Bartel Close, Leverstock Green, Hemel Hempstead HP3 8LX.
Phone: 0442 54821.
Principal staff: Ken Shearer, Graham Anthony (associate).
Consultancy: the company's principal source of income.
Facilities and personnel: includes drawing office and acoustic measurement, associate architect. Recent projects have included Air, De Lane Lea, Eden recording studios, Forces Broadcasting, ATV, LWT, Granada, Thames TV studios, theatres, auditoria, conference facilities, churches, also experts in noise nuisance court cases (mostly discos!).
Fees: based on time, no equipment supplied.

CHRISTOPHER JOHN SHERMAN (Audio Consultant)
291 Lower Morden Lane, Morden, Surrey SM4 4NX, UK.
Phone: 01-337 8451.
Principal staff: Christopher Sherman.
Consultancy: the company's principal source of income.
Facilities: all services by associates. Recent projects include Peejay Music recording studio, Ewart TV studios, theatres.
Fees: based on time or project value.

SIERRA AUDIO CORP
721 South Glenwood Place, Burbank, Cal 91506, USA.
Phone: (213) 843-8115. Telex: 691138.
Principal staff: Kent Duncan (pres), Bill Rogers, Vencil Wells, Tom Hidley (acoustical engineer).
Consultancy: the company's principal source of income.
Facilities and personnel: includes drawing office, acoustic measurement facilities, carpentry, architects, electrical and electronic engineers, associates for wiremen, surveying and mechanical engineering. Recent projects incude Fantasy, Kendun, CBS/Sony recording studios, Australian Broadcasting Commission (radio), KTLA LA (TV), discos and theatres, video studios. Also manufacture monitors.
Fees: fixed price $15,000 to $75,000, no equipment supplied except own monitors.

SINGLETON PRODUCTIONS
Via Augusta, 59, desp 804 Edifico Mercurio, Barcelona 6, Spain.
Phone: (93) 228.38.00 Telex: 97700.
Principal staff: William Singleton, Ronald Burke, Raul Cilento.
Consultancy: not the company's principal source of income.
Facilities and personnel: include drawing office, acoustic measurement facility, acoustic engineer, associates for architecture, surveying, and mechanical/electrical/electronic engineering. Recent projects include Ibiza Sound, Ibiza; GEMA 1 and 2, Barcelona, discos, theatres, auditoria, conference facilities. Also import, distribute, install and service a wide range of professional audio equipment.
Fees: based on both time and value, fees still payable if equipment supplied.

S&P AUDIO LTD
41 Dorking Road, Tunbridge Wells, Kent TN1 2LN, UK.
Phone: 0892 38893.
Principal staff: Peter Smith, Elizabeth Edwards.
Consultancy: not the company's principal source of income.
Facilities and personnel: include wiremen, mechanical and electronic engineers, associates for drawing office and acoustic measurement. Recent projects include Berwick Street Recording Studios, Capital Radio, London, London Weekend Television.
Fees: based on project value, fees not payable if equipment supplied.

SOUND RESEARCH LABORATORIES LTD
Holbrook Hall, Little Waldingfield, Sudbury, Suffolk CO10 0TH, UK.
Phone: 0787 247595. Telex: 987248.
Principal staff: Mr N A Grundy, Mr J D Webb, Mr G J Cole.
Consultancy: the company's principal source of income.
Facilities and personnel: includes drawing office, acoustic measurement facilities, carpentry, wiremen and electronic engineers, associates for architecture, mechanical and electrical engineering. Recent projects include Kinks Studio, BBC Open University (radio), BBC Leeds, RTE Eire, RTB (TV), National Theatre (London), auditoria, conference centres, churches, etc.
Fees: based on time.

JOHN M STORYK ASSOCIATES INC
31 Union Street West, New York, NY 10003, USA.
Phone: (212) 675-1166.
Principal staff: John Storyk, associates Robert Wolsch, Marci Ramos, Ted Rothstein.
Consultancy: the company's principal source of income.
Facilities and personnel: includes drawing office, acoustic measurement facility, architects, associates for engineering. Recent projects include Atlantic Recording studios, Hit Factory, Chipping Norton Studios, Sigma Sound Studios, Criteria/West LA, National Recording Studios, NY. Also manufacture sound baffles, acoustic doors.
Fees: based on time, fixed fee.

STUDIO SOUND + MUSIC Gmbh
Schone Aussicht 16, D-6000 Frankfurt-Main I, West Germany.
Phone: 0611 284928. Telex: 4189420.
Consultancy: not the company's principal source of income.
Facilities and personnel: includes acoustic measurement facility, wiremen, electronic engineers, associates for drawing office, carpentry, architecture and engineering. Recent projects include MW Studios, Leonberg, Frank larian Productions, Berlin, recording studios, theatres.
Fees: based on project value.

RUPERT TAYLOR AND PARTNERS LTD
374 Edgware Road, London W2 1EB, UK.
Phone: 01-723 3659. Telex: 858740.
Principal staff: Mr R M Taylor, Mr D J Locke, Dr P F Chatterton, Prof S Gerges, Dr N G Leventhall, Mr B S Gowers.
Consultancy: the company's principal source of income.
Facilities and personnel: includes drawing office and acoustic measurement facilities. Recent projects include Rak Studios, auditoria and conference facilities, ventilation and air conditioning, noise control, sound insulation, expert evidence in court. Provide computer aided design services.
Fees: based on time, equipment not supplied.

THE CO (Total Hearing Environments)
28 Music Square East, Nashville, Tenn 32703, USA.
Phone: (615) 320-0807.
Principal staff: John Gardner (pres), John Brandon, Gordon Evans.
Consultancy: not the company's principal source of income.
Facilities and personnel: includes drawing office, acoustic measurement facilities, wiremen, electronic engineers, associates for carpentry, surveyors, mechanical and electrical engineering. Recent projects include Sound Stage, Nashville, recording studio, WWKX-FM, WHIN-AM, Gallatin (radio), Sistema Sandinista de Television, Nicaragua (TV), discos and theatres. Also supply equipment.
Fees: based on time and project value.

TURNKEY TWO
8 East Barnet Road, New Barnet, Herts EN4 8RW, UK.
Phone: 01-440 9221. Telex: 25769.
Principal staff: Andy Munro, Andrew Sterling, Ivor Taylor, Andy Bereza.
Consultancy: the company's principal source of income.
Facilities and personnel: includes drawing office, acoustic measurement facilities, carpentry, wiremen, mechanical and electronic engineers, associates for architects, surveyors and electrical engineers. Recent projects include Status Quo recording studio, Associated Press radio, Creative Studio (AV/CCTV), discos, theatres, auditoria, conference facilities, churches, noise and vibration control, time delay spectrometry, sound system design. Installation and servicing facilities from parent company (Turnkey).
Fees: based on time or project value.

VALLEY PEOPLE INC
PO Box 40306, 2820 Erica Place, Nashville, Tenn 37204, USA.
Phone: (615) 383-4737. Telex: 558610.
Principal staff: Bob Todrank.
Consultancy: not the company's principal source of income.
Facilities and personnel: includes drawing office, acoustic measurement facilities, engineers. Recent projects include Bee Jay Recording, Orlando, Groundstar Laboratory, recording studios, auditoria, mobiles.
Fees: based on time and project value.

EDWARD VEALE & ASSOCIATES
16 North Road, Stevenage, Herts, UK.
Phone: 0438 50023. Telex: 825211.
Principal staff: Eddie Veale, David Veale, Derek Buckingham.
Consultancy: the company's principal source of income.
Facilities and personnel: includes drawing office, acoustic measurement facility, wiremen, architects, electrical and mechanical engineers. Recent projects include RPM Music, Johannesburg (recording studios), Beacon Radio, M-TV, Helsinki, discos. Specialise in Town & Country Planning for recording studios, computer used for acoustic analysis.
Fees: based on time and project value.

WESTLAKE AUDIO
6311 Wiltshire Blvd, Los Angeles, Cal 90048, USA.
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Consultancy: not the company's principal source of income.
Facilities and personnel: drawing office, acoustic measurement, carpentry, wiremen, etc. Recent projects Electric Lady Studio, New York, and KCET (TV), Los Angeles. The company also produces monitoring systems and can supply equipment on a turnkey basis.
Fees: based on time and/or project value.

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Consultancy: the company's principal source of income.
Facilities and personnel: includes electrical and electronic engineers, associates for mechanical engineering. Projects include radio broadcast facilities in Sri Lanka, TV in Lusaka, several British ITV companies, Capital Radio London.
Fees: Based on time and project value, equipment not supplied. ■

Why Amcron is demanding protection money.

Over the years, Amcron has earned a peerless reputation as a pioneer in professional sound.

Amcron built the first solid-state four-channel tape recorder back in 1962. Then they developed the first stereo amplifier with direct coupled input and output.

In 1977, they introduced digital logic to the pre-amplifier and achieved another first.

But Amcron's latest first is probably the most significant of all.

The PSA-2 power amplifier is self-protecting.

A Self-Analysing circuit employs an analogue computer which constantly monitors the performance of the amplifier's critical stages.

Should the power transformer begin to overheat, an output transistor fail, or a short circuit occur, then the amplifier will automatically shut down to its 'stand-by' mode without damage to itself or to external equipment.

The protection circuitry also safeguards the PSA-2 against 'chain destruction' and damage caused by mis-matched loads.

As Dr. Mark Sawicki observed in his review of the PSA-2:

"When reading reports of systems used by The Who, McCartney and Genesis...the Amcron name appears frequently...Why?

Well, reliability and outstanding performance are the answers.

Overall, the performance of the PSA-2 amplifier...is excellent."

Now. Given that you're spending a lot of money on a power amplifier (arguably the most crucial piece of equipment in your system), doesn't it make sense to spend a little more on a unit which is virtually disaster-proof? We think so.

Which is why we went all out to win the sole British agency for the PSA-2. And, indeed, the whole range of Amcron audio equipment.

Drop in and see us anytime. We'll be delighted to give you an earfull.

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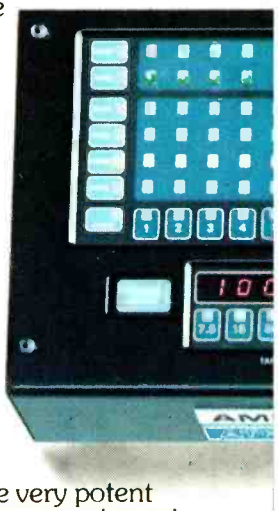
Introducing a present

Once you go through a recording session with the new ATR-124 24-channel recorder by Ampex, you'll want to go through another. Because with each new session you'll discover something new you can do. Things that you can only do with a recorder that's full of features of the future.

ATR-124 gives you the unheard of: Time on your hands.
Which means you can use that time to give clients more of what they're paying for—your creative skills. With the ATR-124 microprocessor-based control system, you can pre-program what you want to do ahead of time so you won't waste studio time setting things up. When their time starts, you're ready to record by touching a single recall button.

ATR-124 also lets you duplicate a technique you may have used earlier in the session without having to rethink what you did. Just touch the memory button and it'll all come back to you. ATR-124 lets you rehearse what you've got in mind, without recording it, to make sure what you've got in mind is right. Tape can be manipulated faster which means you'll get the sound you want sooner. And the chance to try something "a little different." All because of the speed and accuracy that ATR-124 puts at your fingertips.



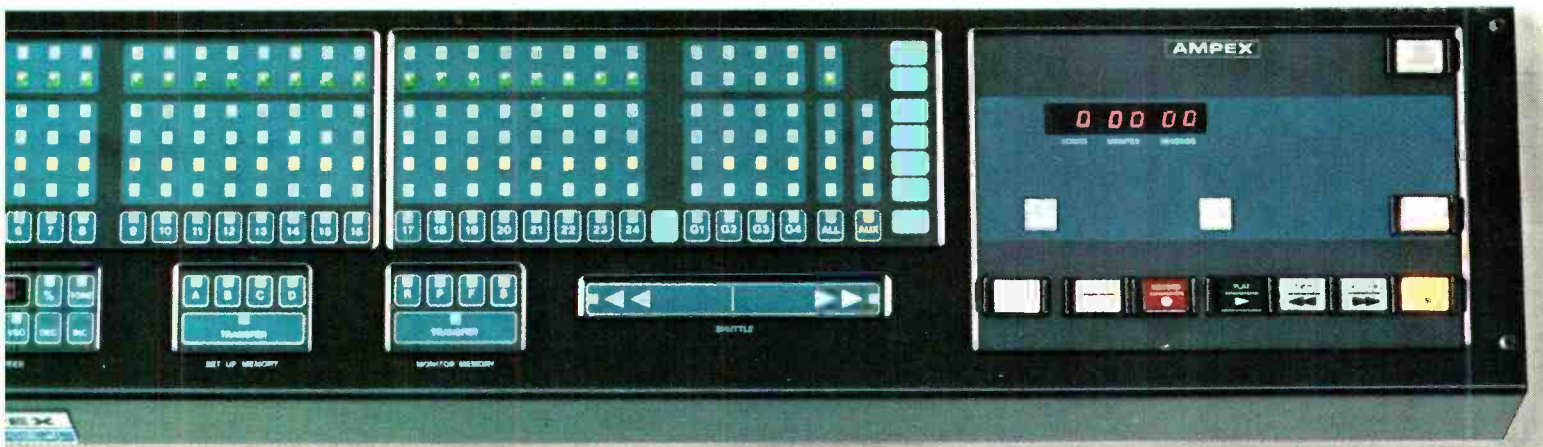
ATR-124 doesn't take away your creativity, it adds to it.
The less time spent setting up, correcting, and redoing, the more time spent creating. And when you add features that help you create to the ones that help you save time, you've got one very potent piece of audio machinery. Take the control panel for instance. It's like nothing you've ever seen. Pushpads linked to a microprocessor give you a new level of creative flexibility. Program a setup, then change it. Then change it back, all with a single fingertip.

A repeatable, variable speed oscillator for pitch correction and special effects is built in. In addition

from the future: ATR-124.

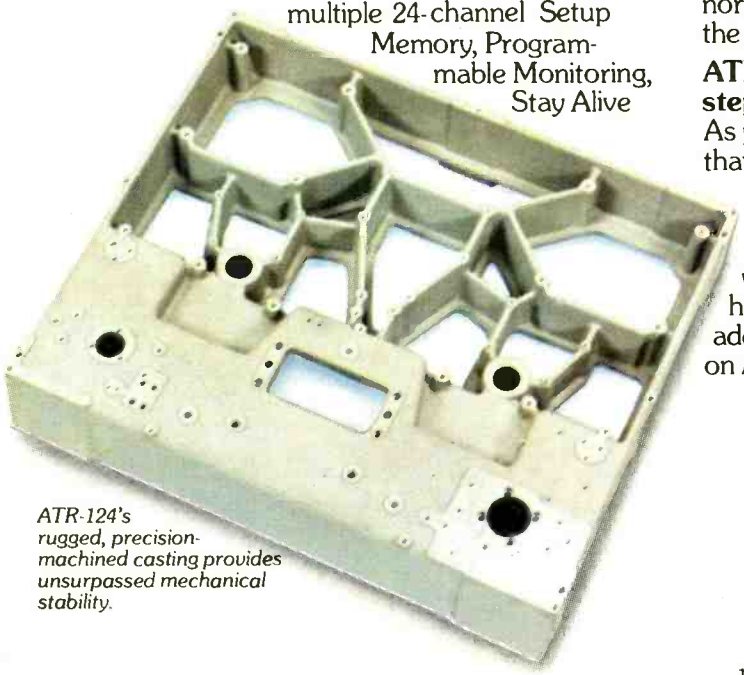
to the standard output, there is an optional auxiliary output with each channel that enhances flexibility. So don't think that ATR-124 is going to replace anything that you do. On the contrary, it's going to improve the skills you have, if not help you develop some new ones.

Memory, and Record Mode diagnostics. The point is this: If you like the ATR-100, you're going to love working with the ATR-124.



ATR-124's Control Panel. Speed and accuracy at your fingertips.

ATR-124 picks up where ATR-100 leaves off.
It's only natural that the people who brought you the ATR-100 should be the ones to bring you something better. ATR-124 offers you 24 channels instead of 4. You also get many new and exclusive features. The kind that have set Ampex apart from the crowd for the last 30 years. Features like balanced, transformerless inputs and outputs; a patented flux gate record head; 16" reel capability; input and output signal bus for setup alignment; membrane switch setup panel; fingertip-operated shuttle speed control; and microprocessor-based synthesized Varispeed -50% to +200% in .1% steps or in ¼ tone steps. ATR-124 also features microprocessor-based control of Channel Grouping, multiple 24-channel Setup Memory, Programmable Monitoring, Stay Alive



ATR-124's rugged, precision-machined casting provides unsurpassed mechanical stability.

ATR-124 options.
As impressive as the ATR-124 itself.
With the addition of a built-in Multi-Point Search-To-Cue (MPSTC), you can rehearse edits and control five tape-time actuated events and be compatible with SMPTE time code. Separately controlled auxiliary output amplifiers with each channel provide simultaneous monitoring of normal and sync playback as well as all other monitoring modes. A roll-around remote control unit can also be added to the ATR-124 which contains all control features normally found on the main unit.

ATR-124's Multi-Point Search-To-Cue (MPSTC). Provides 100 cue locations.

ATR-124. Your next step is to experience it firsthand.
As you scan the points we've covered, remember that you're scanning just a small portion of ATR-124's story. We haven't even begun to discuss the accessibility of key components for easy servicing and minimal downtime, or the features we've built in to give you greatly improved tape handling. To find out more, write to us at the address shown below. We'll send you a brochure on ATR-124, our latest audio effort.
ATR-124. Pure 24-Channel Gold From Ampex.

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IBC Exhibition, Brighton-a preview

The 8th International Broadcasting Convention will be held from Saturday September 20 to Tuesday September 23 at the Metropole Conference and Exhibition Centre, Brighton. Opening hours are 9.30am to 6pm and a series of technical sessions run concurrent with the Convention. 100 companies will be exhibiting their products. 'Studio Sound' here previews the audio aspects of the exhibition, while the September issue of our sister magazine 'Video' covers the video aspects.

● **Agfa-Gevaert:** complete range of audio tapes for broadcasting and studio mastering applications. ● **Ampex:** *ATR-116* and *ATR-124* multitrack recorders; *MM1200* multitrack; *ATR-100* recorder; *ATR-700* recorder; the **ECCO** *MQS-100* synchroniser; and Ampex audio tapes. ● **Audix:** ILR console package; recently introduced 8-group version of the *B100* broadcast console; improved version of the *MXT-1000* broadcast console; plus an extended range of broadcast modules and a new remotely controlled audio network switching system. ● **Aveley Electric:** new generation VHF receivers from West German manufacturer **Rohde & Schwarz**.

● **BASF:** wide range of professional tapes and magnetic film including test and calibration tapes. ● **BBC:** *NICAM* digital sound transmission system, plus a demonstration of the *COPAS* (Computer Processing of Audio Signals) system. ● **FWO Bauch:** wide range of products from **Albrecht, CMX Systems, EMT, Harrison, ITC, Ivie, Klein & Hummel, Lexicon, MRL, Neumann, Revox, Studer, Switchcraft,** and **UREI**. Highlighted will be the new Albrecht *MB51* capstan drive sprocketed film recorder; the CMX *340X* computer assisted editing system; EMT broadcast turntables, DDL's, and *266* transient limiter; a mobile broadcast version of the Harrison *Alive* console; ITC NAB cartridge machines; Lexicon *Model 1200* broadcast audio time processor; Studer *A800, A80* and *B67* recorders, *TLS2000* SMPTE tape controller, *269* broadcast console, *069* OB mixer, and automatic telephone hybrid system; and the Switchcraft range of miniature audio connectors. ● **Brabury Electronics:** details and examples of the company's OB mobile units; plus a wide range of ancillary equipment including jackfields, equipment racks, voltage stabiliser, audio distribution amplifiers, and talkback systems. ● **Broadcast Electronics:** new *FX-30* FM exiter; *Spotmaster* cart machines; and **QRK** turntables.

● **Delta Electronics:** range of radio frequency monitoring and measuring equipment. ● **Alan Dick & Co:** details of the company's masts, towers, transmitter antennas, and combining units. ● **Dolby Laboratories:** complete range of Dolby-A noise reduction units and modules; plus the Dolby-B *Model 334* unit for FM radio and stereo or 2-channel television sound transmission and reception. ● **Philip Drake Electronics:** *Commsbox* ring intercom system; *Mini Mobile* talkback system; *7000 Series* broadcast modular amplifying equipment; modular OB commentator equipment; and the company's modular talkback system.

● **Elektroimpex:** *FIT-IC* modular automation ready console; *STM 610* tape recorder; *SL-101* direct drive broadcast turntable; and *PCP-101* commentators desk. ● **Enertec:** *UPS-4000* series 24-track automation ready console; *UPS-5000* and *UPS-5100* consoles; *F-462* series of tape machines; *GCE-4000* series of solid state switching grids; and a cassette broadcasting system.

● **Future Film Developments:** comprehensive range of cables, cords, connectors, jackfields, wiring aids and associated components; plus a wide range of audio accessories and **Genelec** monitor loudspeakers.

● **Gowrings Engineering:** details of the company's OB vehicle design and construction service.

● **Lee Engineering:** wide range of products including **Audiopak** *A2* and *AA3* broadcast carts; details of the **Continental Electronics** broadcast transmitters; **Electro-Impulse** range of high and low power dummy loads, calorimeters and wattmeters; **IGM** comprehensive programme automation system, computer controlled with operator override access; **McKay Dymek** communications receivers; and the **Orban** *Optimod-AM* and *Optimod-FM* audio processors for broadcast usage. ● **Leevers-Rich:** *Proline 1000* tape recorders including the *1000L* slow speed logging recorder; *Proline 2000TC* recorder available with microprocessor controlled autolocate; plus the company's ancillary units including demagnetisers, bulk erasers, magnetometers and tape tension gauge.

● **3M:** 32-track digital mastering system comprising 32-track and 4-track recorders and digital editor with cross fade facility; *M79* analogue 24-track; **Audio Kinetics** *QLOCK 310* synchroniser, *QLOCK 210* synchroniser and *XT-24 Intelocator*; *Scotch* audio/video tapes and cassette and cartridge tape; plus various units including character generators, routing switchers and distribution amplifiers. ● **Marconi:** details of the company's sound broadcast transmitters including the new *B6038* 1kW solid state MW transmitter. ● **Martello Sound:** range of PA equipment plus the *Rello* radio mic system.

● **Neve:** *Model 5316* broadcast production console; *542* range of compact 8, 12 and 16-input consoles; the recently introduced *Necam II* automated post-production audio dubbing system; and details of the company's custom design and turnkey services. ● **Norsk Elektrisk Kabelfabrik:** wide range of audio cables for broadcast applications. ● **NTP Elektronik:** range of PPMs, comp/limiters, equalisers, and audio processing equipment, including the *582-100* programmable equaliser system. New products include the *277-500* stereo display unit, the *277-100* 8-channel PPM, and the *512* crosspoint system.

● **Optical & Textile:** range of products from **Swintek** including the *dB-S* radio mic system.

● **Pro-Bel:** new vision and audio routing switcher with microprocessor control from a variety of panels with alphanumeric displays. ● **Pye TVT:** details of a new FM radio transmitter, plus a new microprocessor based automatic transmitter controller.

● **Racal-Zonal:** wide range of audio tapes and magnetic film including the new *675* and *680* professional audio tapes.

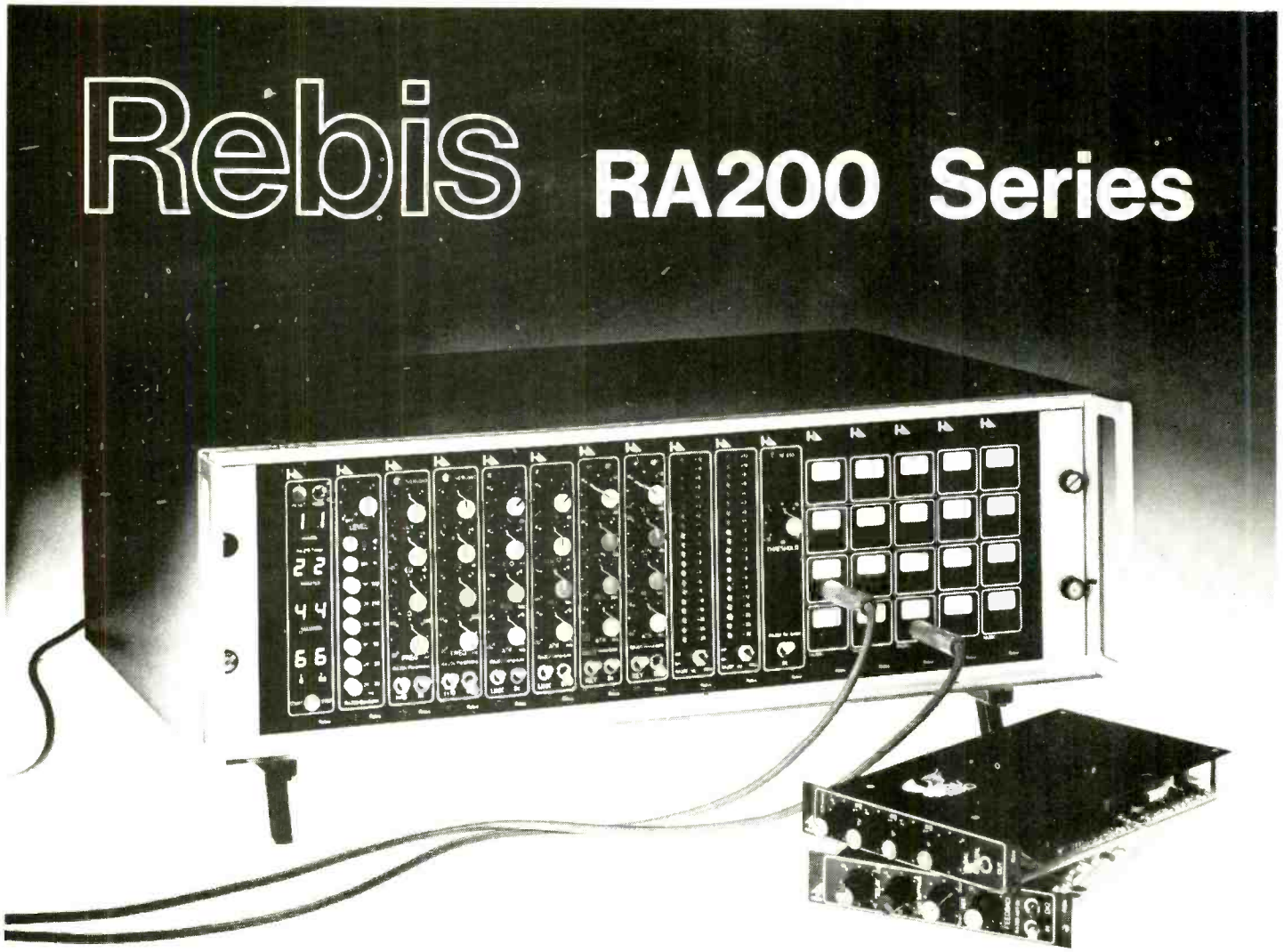
● **Sandar Electronics A/S:** wide range of routing, switching and distribution systems. ● **Seltech:** audio distribution amplifiers; microprocessor controlled intercom system; *Beaucart* cartridge machine; and a range of carts. ● **Shure:** new *SM77* and *SM78* cardioid mics; the recently introduced *SM63* omnidirectional mic; plus the company's established range. ● **Sony:** full range of studio and general purpose mics; studio and portable radio mics; range of cassette and portable open-reel tape machines; plus details of the company's PCM digital processors and editing controller. ● **SPC:** range of MW transmitters and antenna systems. ● **Spin Physics:** range of magnetic recording heads. ● **Surrey Electronics:** wide range of ancillary equipment including stereo disc amplifiers, moving coil preamplifier, PPMs, a distribution amplifier, and a transmitter monitoring peak deviation meter.

● **AEG-Telefunken:** details of the company's VHF broadcast transmitters, receiver and stereo encoder; plus the *M15* range of tape machines. ● **Tore Seem A/S:** *SEESAM* broadcast console with solid state input/output matrices, dc grouping, and microprocessor controlled fader operation and routing and signalling functions. Also wrap-around broadcast mixers; an OB mixer; a small single operator mixer; and centralised switching and routing systems.

● **Utah Scientific:** range of audio routing switchers.

● **Studio Sound:** editorial staff will be in attendance at the exhibition and in addition copies of the magazine will be available to visitors. ■

Rebis RA200 Series



The RA200 Series has established itself as the most versatile approach to sound processing. Now there's a new connector module and rear rack mounting power supply to make it even easier to put together a package that does the job you want, wherever you want it.

If you have a problem in O.B., stage, studio or mobile recording the RA200 Series is almost certainly your answer.

Like to know more? Ring us now on 0384-71865.

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NEW RA212 MIC-LINE INPUT MODULE AVAILABLE NOW

Anti-piracy, continued

A rude awakening is surely in store for those in the record companies who seem to believe that digital audio discs can somehow be made uncopyable, and thus put an end once and for all to home taping, and save the industry millions a year. Vague rumours to this effect have been bubbling under for some time now and they came firmly to the surface recently when John Fruin, WEA managing director, and new chairman of the British Phonographic Industry, spoke to a Merseyside dealers' meeting. Fruin was reported as saying that digital recording could provide a means of putting an effective signal on records to stop home taping. Although he has subsequently confirmed that what he said was not as positive as the article implied—and that the problem had not yet been solved, he has also confirmed that they are still pursuing the matter. **Oh dear.** It's been hard enough getting the record companies to face up to the fact that there isn't a cat in hell's chance of putting an inaudible spoiler signal on an ordinary disc to prevent home taping. In fact the BPI has again refused to release details of the unsuccessful research work which it commissioned from the Wolfson Unit of Southampton University 'until all worldwide efforts to try and develop a signal have been exhausted'. It seems that pathetic hope for an analogue spoiler springs eternal in the non-technical breasts of the BPI spokespersonage. Ironically, as if to prove the need for the BPI to release the Wolfson report, and so save others from expensively re-researching the same blind alleys as Wolfson, recent reports tell of the RIAA in the USA encouraging universities and research institutions to join the wild goose spoiler hunt. And after that report of John Fruin's comments, which will inevitably gain credence because of his exalted position in the industry, we are now to have a snowball of fresh hopes for a digital spoiler.

The great white digital hope, it seems, is that with a digital recording it will be possible to 'scramble and unscramble a signal'. Yes—of course, but scramble and unscramble as much as you like, at some stage in the domestic replay system the signal must be returned to conventional analogue form if it is to be audible to conventional human beings. Piracy will simply take place at the first analogue stage. Loss of quality will be minimal, the BPI should ask the BBC, who are currently transcoding from Sony *PCM 1600* 16-bit recording format to 13-bit landline format by briefly returning the signal to analogue, and losing virtually nothing in the process.

Digital discs

In April, Thorn-EMI, the joint company formed after Thorn's takeover of ailing EMI, announced the decision to back the JVC grooveless capacitance video and digital audio disc (VHD/AHD) rather than the Philips laser system. To put it mildly this came as a shock and to be euphemistic the decision could have very serious repercussions in the future.

Of course the Thorn-EMI adoption of VHD/AHD, makes some kind of commercial sense, because Thorn already sells VHS video tape recorders made by JVC in Japan. JVC has been looking for a software house like EMI to help make its capacitance disc system commercially viable and EMI has been looking for an outlet for its software. But the decision probably kills off all hope of video and digital audio disc standardisation in Europe, for ever. With video this may not matter too much, but for digital audio it could prove nothing short of disastrous for the record industry.

Many of the video software deals struck here in Europe and in the USA have been non-exclusive (at least in the long term) and thus hedge-betting for the programme producers and film studios. In other words in a couple of years' time it's likely that the same feature films or TV spectaculars will be co-released on two or three video disc formats in each country, ie optical format (courtesy Philips-Magnavox IBM-MCA-Pioneer, etc), grooveless capacitance (courtesy JVC and now Thorn-EMI) and grooved capacitance (courtesy RCA, CBS and Zenith in the USA). This will be confusing for customers, who will often probably end up buying the wrong disc format by mistake just as they bought the wrong quadraphonic discs, and it will be downright terrible for the shops who sell the discs and need to keep double or triple inventories. But worse is likely to happen with digital audio.

The Philips plan is still to keep video and digital audio formats separate, with video discs 12in in diameter and playable on video players but digital audio discs 4½in in diameter and playable on special *Compact* disc players. On the other hand JVC-Thorn-EMI still seems to be aiming for a single disc size, now 10in in diameter, with a single VHD/AHD player capable of reproducing either video or digital audio depending on what type of disc you put into the player and what kind of electronics are built in or added-on. So will EMI digital recordings appear only on grooveless capacitance format discs or will EMI licence its digital audio recordings for release on the rival Philips *Compact* disc laser format? And will Polygram licence the release of its own digital recordings, along with those of Decca which Polygram now owns, on capacitance format? Such cross-licensing will hardly help either format establish itself over the other. More likely, the two rival blocks will only allow the release of their own digital audio recordings on the disc system to which they are committed?

The result will be commercial death. Consumers can't be expected to purchase two different digital audio disc players. But they also can't be expected to opt for one system and thereby opt out of the chance of playing whole catalogues of recorded material. Although it is depressing to see a large European consortium backing a Japanese disc system, when there is a high technology European system available, it is possible to see some technical logic behind the Thorn-EMI decision. But only in the short term. The optical system still relies on a gas laser and until solid state lasers with long working life are available, optical players will inevitably be more expensive and complicated to make. What's more, Thorn-EMI seem to have been persuaded that they will find it easier to produce capacitance discs rather than optical discs. The proof of this pudding will be in the eating. The information packing density of any video or digital audio disc is very high and the tolerances around a hundred times tighter. Any company that believes pressing **any** disc of this type will be easy, is in for a rude awakening.

It would be reassuring to feel genuinely convinced that Thorn-EMI have thought of the long term as well as the short term. We're talking, remember, about a digital audio and video disc system which will hopefully take the industry through and into the next century. Any sacrifice now of long term commercial gains, will make for commercial grief in the future. It **may** be that Thorn-EMI really have taken a carefully considered, technically well-informed judgement with both the long and short term benefits in mind. But on the other hand it **may not**. And the wording of the Thorn-EMI 'fact sheet' on VHD/AHD does little to engender much confidence in the company's wisdom. The speed of the VHD/AHD disc was even wrongly quoted as 900 rpm (which is correct only for NTSC video) instead of 750rpm (for Europe PAL/SECAM). It was only after I'd phoned the company querying the point that a correcting press statement was released. Elsewhere the wording is curiously naive, or curiously assumes considerable naivety on the part of those who will be reading it. "A disc-caddy encloses the entire disc to protect it from dust, scratches and fingertips," boasts Thorn-EMI. An equally accurate comment would be that because the capacitance disc becomes unplayable if so much as touched by a human finger, the unfortunate consumer has to pay extra for an expensive rigid plastic caddy with each disc to protect it from fingermarks!

When in doubt, leave it out

Grundig has now issued a press release to 'supersede' the recent announcement that the company had sponsored a digital recording made by EMI. As previously reported this release described the digital coding system used by EMI, but got it hopelessly wrong.

Incidentally the audio press is still puzzling over another passage in the Grundig release—namely that the EMI digital recording system has a dynamic range of 90dB and an S/N ratio of 75dB. Surely dynamic range and signal to noise are one and the same thing, so how can there be 15dB difference between them?

Grundig has now solved the problem of correcting the previous technical errors and resolving confusions in the simplest possible way. The superseding press release makes no mention whatsoever of any technical data.

Choice of three

For anyone with £15 to spare and a good quality gramophone, there's an interesting golden ears test now available. Nimbus Records of Wyastone Leys, Monmouth have produced a boxed set of five discs all cut at 45rpm (except one side cut for interest at 78rpm) with the same piece of music (a Beethoven piano sonata) recorded simultaneously in three different ways.

Three sides were direct-cut, three were recorded digitally using a Sony *PCM1600* and *U-Matic* system, and three were recorded on an Ampex *ATR104* running at 30in/s with Dolby-A.

Nimbus, who will sell the boxed set for £14.95 all inclusive, aren't saying which sides were cut which way. No prizes are offered for guessing correctly, but Nimbus will satisfy buyers' own curiosity if they write in stating preferences. ■

Photograph courtesy of AIR Studios, London.

Whatever your budget, contact us now with your requirements.

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Rupert Neve Incorporated, Berkshire Industrial Park, Bethel, Connecticut 06801. Tel: (203) 744-6230. Telex: 969638.
Rupert Neve Incorporated, 7533 Sunset Boulevard, Hollywood, California 90046. Tel: (213) 874-8124. Telex: 194942.
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Neve

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Designing a professional mixing console

Steve Dove

Part Two - Broadcast Consoles

Broadcast control consoles are a different breed to the standard recording console. In Part Two of this series Steve Dove examines the background to their design and configuration, and describes an on-air broadcast control console.

WHILST the essence of broadcast mixers is simple enough—the combining of a few sources directly into a pair of outputs—it is all the rest of the system and monitoring necessary to make the mixer operational that is the complex part. As a rough guide, it's been said that recording consoles are 80% mixing, 20% system whilst broadcast is 20% mixing and 80% system.

Generally the audio signal paths are (at least in relation to recording) laughably straightforward but some signal paths are totally alien to any other requirements. Despite the simplicity of the audio chain, the performance constraints and specifications expected by the broadcast authorities are exceedingly demanding—to the extent that the author is convinced there has never been a console manufactured by anyone in Britain that, when first switched on, has met totally either the IBA Code of Practice or an appropriate BBC spec. It isn't the purpose of this article to deliver a blow-by-blow account of how to make a mixer that passes the Code, those who know would realise the futility of the attempt and those who don't are best off out of it for their own sanity's sake.

In the early days of UK commercial radio there were virtually no manufacturers (other than those already supplying the BBC and export) capable of delivering what the new programme companies thought they needed or actually needed. Suppliers were difficult to come by for either systems (dual-purpose continuity/production control areas were unheard of until then) or even basic hardware (who made a stereo channel?). Also equipment budgets were awesomely small—station owners were typically small-town businessmen whose conception of a radio station was 'a chappy with a record player'—chief engineers of the time had a very steep uphill struggle.

The upshot of all this was that no-one, engineers, owners, presenters or manufacturers, really had a clue what was going to be an optimum working system.

Manufacturers, pleased to be free of the BBC's free-system 'all inputs and outputs accessible', found it possible to make the dedicated function small broadcast desks from modules already designed for excellently performing recording desks. Who else would measure recording desks when delivered before acceptance for noise, left/right crosstalk, lf distortion, input and output transformer winding balance, etc?

It's taken the last seven years of British commercial radio for the console manufacturers specialising in broadcast consoles to 'get it right'. Many grey hairs, late nights and early mornings have been suffered by engineers in new stations with cutters in one hand, soldering iron in the other, bleary-eyed with crooked fags hanging out of their mouths whilst the nice IBA chappies look on wistfully, drumming fingers.

A salutary tale to those who think it's an easy game.

Although it is specifically only mixers intended for actual on-air broadcast that *have* to meet these specifications, they are meaningful determinations of path parameters before subjective apparence and as such realistically applicable to any audio-electronic signal path. It is illuminating, somewhat embarrassingly, to discover how few, especially recording systems, measure up.

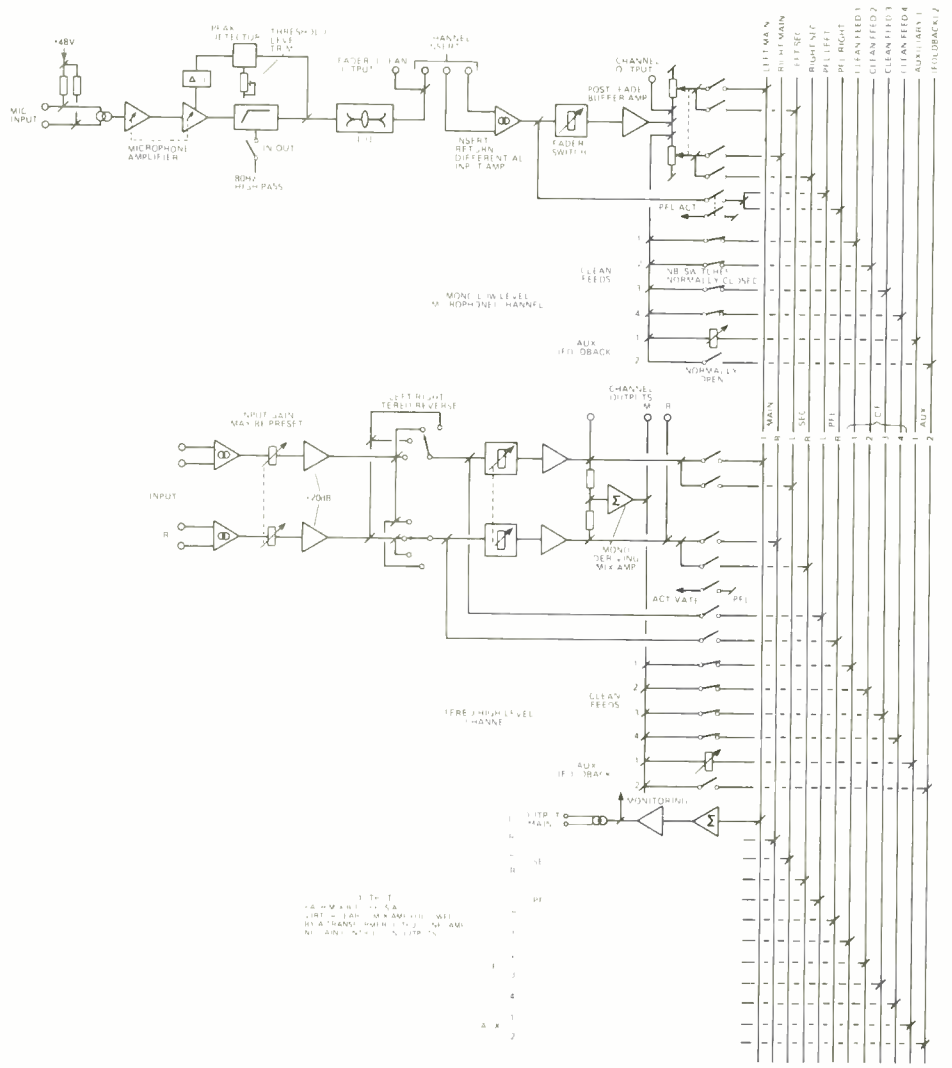
Rarely is a broadcast mixer the only item of consideration in an on-air environment as it is always concerned with other control areas such as master control or even the central racks area. It is impossible to design a 'stand-alone' mixer—there are innumerable ties in both system and signal path to be considered.

Bleary eyed engineers with crooked fags—cutters in one hand, soldering iron in the other—suffered late nights in many radio stations

Remotes

Remote control of machinery such as tape and turntables is of far higher importance than in a normal recording environment—the mixer is the true centre of operation particularly in the case of a DJ-style self-operated

FIG. 4 BASIC SCHEMATIC BROADCAST CONSOLE



desk. Machine starts at least have to be ergonomically available on the mixer so that the operator does not have to change his position relative to a fixed point microphone. Extending this even further, a choice of start modes will probably also be required—fader, back-stop or press-button? In this realm of operator preference, cartridge machines pose an interesting question or three. Most cartridge machines are fully equipped for versatile remote operation with all the start/stop/fastforward, etc, function lines accessible along with tally light feeds for the various status—for a triple-stack that's quite a collection of pretty flashing lights to cram onto a compact channel module (nearly always the three triple-stack outputs are submixed into one stereo channel). Perfect for chief engineers with a *Star Trek* complex but not so for the cute, but dumb, chick doing the late show.

This consideration, along with a common DJ/operator preference for 'feeling' the cart-slot they are about to fire as a tangible reassurance that there is actually something *in* there, rather detracts from full remoting simply because it is possible. Similar thinking follows for 'proper' tape machines—perhaps the only function other than 'play' that needs to appear on a self-op console is a 'return to zero' indexing from an autolocate, in order to simplify the cueing up of a tape after prefade level checking. It is, however, again deeply suspected that given the time, the operator will physically check the machine and set up the cue by eye.

It must not be forgotten that self-op DJ-ing is possibly one of the most personal interractions between people and audio hardware and as fun a technological toy it may be, it also has to be straight ahead and logical. The consequences of failure or confusion in the studio can be several thousand listeners banging transistor radios on kitchen tables with puzzled looks.

Production or On-air?

Two totally dissimilar approaches exist to broadcast control: (a) the console should have enough facilities to straighten out to broadcast standards any programme source that's thrown at it; (b) that all the programme material must be perfect before it hits the on-air desk regardless.

The first assumes that the technical competence of whoever is sitting behind the desk, combined with their conception of what sounds right is always adequate and reliable. The second, more realistically, assumes that this is not perhaps true, and benefits the DJ/operators by giving them less of a field of knobs to romp around in.

Naturally, provision has to be made somewhere on the station for rendering listenable less than adequate sources, but that control area doubles as a standby or alternate on-air control and cannot be greatly different in general layout and facilities to the original on-air desk. Fortunately, this seemingly unbridgable divergence in requirements is fairly simply resolved.

Fig 4 is a block system schematic of a barebones broadcast console with minimal operator controls but adequate signal path flexibility and access to cater for most encountered broadcast situations. No on-desk equalisation is normally necessary, but facility for simple hf, lf and a single sweep frequency mid section is provided on the mono microphone channels together with a second order highpass 'rumble' filter. This equalisation is given only a limited range of ± 6dB as if you have a microphone in a tightly controlled acoustic environment, such as a radio studio that needs tweaking more than that, it's time for a new one. It also prevents the DJ from doing horrible things to his own voice under the impression that it sounds wonderful, which it probably does to him with cans on and a bad cold.

A crash protection limiter is wrapped around the second section of the mic amp, catching an interviewee's lack of microphone technique, and usable (when the threshold is reduced into normal operating levels) as an effects limiter on the DJ's voice. He'll think that's wonderful too.

All in all, that should provide sufficient signal processing for any microphone source. Nevertheless a prefader breakpoint is provided, incidentally providing a fader-clean channel output feed, taken from the self-op microphone for talkback unless the channel is also used switched to an alternate source at any time.

The fader on the self-op mic position is seldom used as more than a soft switch and may be replaced by a conventional switch. This also solves the problem of what level to set the prefade monitoring feed from that channel. Ordinarily a mic channel fader is set to have calibrated gain at a certain amount of fader back-off, between 10 and 15dB, the PFL being set correspondingly. In the self-op position where the fader is wound right open, the PFL will be inaccurate in level by the amount of the back-off. A switch replacing the fader provides a defined amount of back-off, ie nil, to which the PFL may be set, thus avoiding the unfortunate situation of otherwise identical channels being non-interchangeable by virtue of differing internal level structures.

The amount of signal level headroom to be aimed for in a broadcast microphone channel provokes fairly interesting debate. With presenters well accustomed to reasonable microphone technique, virtually no headroom above the normal peak programme level is needed, but in an interview situation? The IBA code calls for headroom of at least 20dB above operating level with gain reduction to be made without incurring distortion by any level control accessible in the signal path. This, with supply rail voltages com-

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mon today, is reasonably simple to realise. They 'like to see' though, in the microphone channel, a headroom capability of 30dB above operating level (Daubney level). This implies running the mic channel at a level of about 10dB below standard line level, with the gain being made up either in the post fader buffer amp or actually directly on the mix buss. Naturally, if a desk output fader exists (and really there is no operational reason why one should), the desk will fail this stricter test since it would be impossible to eliminate clipping distortion in stages after the 10dB gain make-up has been introduced.

The stereo channel depicted on the main signal path schematic runs at unity gain throughout, headroom not being anything like the hassle it is on the microphone channel by virtue of the pre-processed nature of most line sources. A total of 20dB gain variation is made available at the front end to compensate for the widely varying levels from some pre-recorded sources—for instance on disc between K-Tel compilation albums and mid-sixties Motown singles.

No insert point is provided since this can be simply overcome by making the two channel inputs jack-field accessible. From a practical maintenance viewpoint, this access is a necessity—there is nothing worse than grovelling about under and behind a desk in order to unplug a source to perform measurements on either the desk or the source, whilst finding the right test lead connectors to do so.

Mono derivation is achieved by a dedicated mix-amp for all the clean-feed, auxiliary and channel outputs. Although it is entirely possible to derive most of the mono feeds via 'Y' resistor networks directly onto the mix busses, this has the drawback of worsening crosstalk, and in view of the number of feeds, makes an uncomfortably low impedance for the post-fader buffer amps to feed, unless they are beefed up to line-amps. The increased crosstalk is due partly to the greatly increased numbers of paths between the left and right channels, whilst to a large degree the increased ground currents resulting from the lower impedances will unearth (sorry) any further inadequacies in the grounding arrangements.

Crosstalk

Left to right crosstalk is possibly one of the more difficult specifications to better, particularly should conventional panpot arrangements be in use on the microphone channels. The two most common arrangements are shown in **fig 5**. The popular arrangement in **fig 5a** suffers from the fact that the wiper of the pot does not achieve total contact across the track, hence allowing a resistive path (ie a crosstalk path) to exist between the two ends of the pot and therefore the panned output. A less than perfect ground connection to the wiper will aggravate the situation. This is true also of the arrangement in **fig 5b**. Here, the effective ground resistance becomes added to the nearly inevitable end-stop resistance of the pot causing not only incomplete attenuation at full rotation, but again a resistive path between the two pan outputs. The latter is a more satisfactory panning system, but it does mean careful selection of the actual pots used in construction to avoid those with undue end-stop resistance. A 'bad news' pot can easily cause the channel to exceed the −50dB L to R, R to L crosstalk spec.

Fig 6 shows a fairly typical crosstalk characteristic. The flat portion at the lf end is 'resistive' crosstalk, caused chiefly by panpot inadequacies and generally a less than perfect internal grounding path system. The rising bit toward hf is 'reactive' crosstalk, the result mainly of proximity and capacitance between the two paths through the channel console, being directly proportional to relative level and proximity, and inversely proportional to impedance (the lower the path impedances, the lower the crosstalk). It may be inferred that minimising reactive crosstalk is both an electronic and mechanical design headache. Relatively high impedances are unavoidable at the wipers of attenuators and a few other points of the path, whilst physical containment of the two separate paths within the same modules and printed circuit layouts limit how far you can physically remove them from each other.

Producing broadcast consoles that now do not need individual attention to better the IBA's tight −50dB at 15kHz spec has taken many years' experience, many mixers and much thought.

An old dodge that was originally mooted as a joke in the pub but which to everyone's amazement and hilarity actually worked, involved deliberately introducing a known amount of crosstalk in the channels, then 'tuning out' by inverse capacitative cross-coupling of the appropriate mix amps—the capacitances needed being so small that short pieces of twisted wire or screened cable sufficed. It was amazing how many people stared in disbelief then walked away shaking their heads, muttering, at the sight of a giggling loon gazing intently at a meter whilst purposefully snipping ⅛in at a time of a bit of wire just dangling in mid air apparently going nowhere.

Stereo source channels are occasionally more prone to crosstalk than mono channels, since rather than the stereo being derived at the tail end of the channel by a panpot, it is stereo throughout. Care in card layout, together with an awareness of even passive component idiosyncracies is the only method, short of the rather wasteful one of using separate channels for the left and right. You would be surprised how much crosstalk can be introduced between two adjacent electrolytic capacitors, or even two mylar/polyester capacitors.

Despite how much care is taken over card design and buss systems, wiring to and from the card connectors to the external terminations is a major problem, especially if the wireman has an obsession about being neat and tidy, tying all the cabling into beautiful tightly bundled looms. Some you can, some you daren't.

Virtual-earth mixing busses are not entirely blameless for crosstalk, despite the fact that the impedance is, well, virtually earth. The signal is present as current, current generates a corresponding magnetic field where it is present (in this instance the buss) and the magnetic field induces a current into any adjacent, preferably parallel, bit of wire (in this instance the buss of the other stereo side); result—crosstalk. It's good practice for this reason to introduce a ground buss between each virtual earth buss, but this still doesn't help prevent an even sneakier path, present in mixers with ferrous chassis. A buss's magnetic field is capable, unlikely as it may seem, of introducing eddy currents into a steel chassis it may be in close proximity to, which can reintroduce currents into similarly located busses causing crosstalk and a designer to take up farming.

From the same root of inductive coupling comes the seemingly obvious advice not to mount output balancing transformers too closely to each other—this was the cause of many hours' fun trying to source a curiously vicious rise in lf crosstalk.

Microphone channel

Fig 7 shows a very useful channel subcircuit for use on microphone channels in on-air broadcast and broadcast production. It provides the usual channel facilities of PFL switching and channel mute via electronic switching, and also gives the person at the other end of the microphone some useful facilities.

All the activation lines are ground-

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FIG. 5 TYPICAL PANPOT ARRANGEMENTS

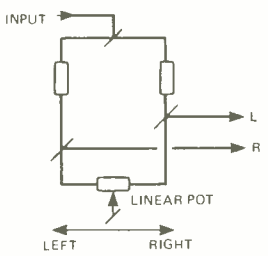


FIG. 5a

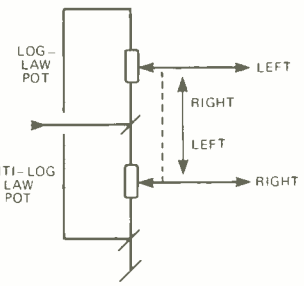
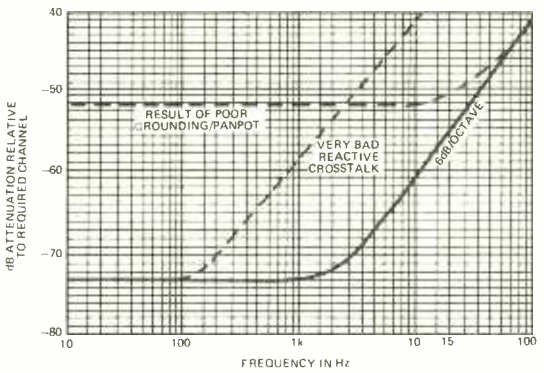


FIG. 5b

FIG. 6 TYPICAL MIXER LEFT/RIGHT CROSSTALK CHARACTERISTIC



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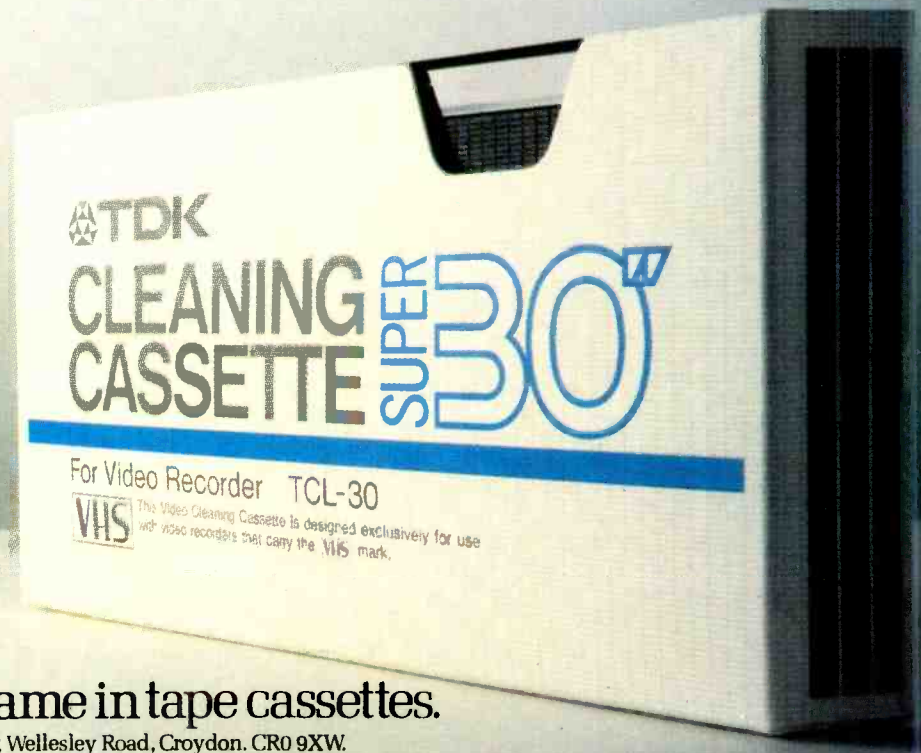

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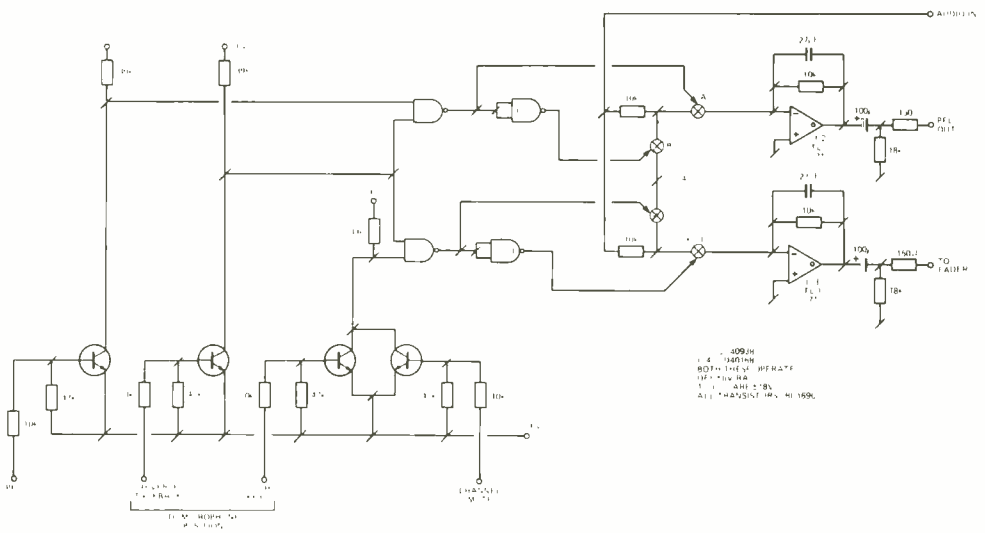
FIG.7 BROADCAST CHANNEL FUNCTION SUB CIRCUIT



ing contacts, obviating the need to run switching pairs everywhere. Two control lines need to be run up to the microphone position, and switches provided for the reverse talkback and cough-keys. In operation, the reverse talkback button mutes the channel from air but applies it instead to the PFL system (which normally is a monitor override function) so that the presenter can give cues to the operator without having to attract his attention first, even if his mic is live. Activation control for the PFL system should be simple since there is a wide variety of control voltages and senses available in this circuit.

The cough-key is simply a parallel activating channel mute.

Why cleanfeeds?

Best described as 'everything but' feeds, the need for them can be illustrated by three fairly common operational functions; studio foldback, telephone balancing and network contribution.

Ordinarily studio foldback is by cans or a loudspeaker muted by any live microphones in the same area, but for certain types of shows it is desirable to leave the loudspeakers on continuously but with the live microphones removed from the feed. This is primarily for the benefit of a non-technical studio audience who may otherwise be put off and act less naturally as a result of things not sounding as they expect them to. Similarly in a 'guess that tune' type of format a desk output minus the microphone feed is required whilst the mic is live to pick up audience remarks. In a foldback arrangement, the 'cleanfeed send' is the programme minus mic loudspeaker feed, whilst the 'cleanfeed return' is the microphone itself, being remixed back into the programme.

Telephone talk-ins are perhaps the most common example of programme material needing cleanfeed manipulation. The telephone line termination is by a hybrid, whether it be a transformer arrangement or an electronic system exemplified by the Alice *TBU3* or Studer units. The object of the hybrid is to provide the subscriber's signal relatively free of colouration and interference from the signal that is being fed to him. It would be nonsense to try to send his own voice back down the line to him, so it must be removed from the studio feed to the TBU. The cleanfeed send is the studio output minus the subscriber return from the TBU, whilst the cleanfeed return is that subscriber return, being brought up into a channel which is routed so as not to appear in the cleanfeed send.

An approach taken originally to create a cleanfeed on ILR desks for either telephone balancing or network provision was what can best be described as 'sequential cleanfeeding'. This entailed grouping all the channels appropriate to the first cleanfeed into a pair of mix amps, from which the cleanfeed output was taken, whilst the cleanfeed return together with the original mix were remixed into a second, sequential, pair of mix amps from which a second cleanfeed could be taken and so forth. The two main drawbacks to this method are the number of mix stages the original sources are subject to (degrading noise and crosstalk) and the inability to cross-cleanfeed (ie have cleanfeed returns crossmixed into other cleanfeed sends) other than in the rigidly defined sequential order. The number of cleanfeeds was also inflexibly specified at the construction of the desk, being that once it was built, it would entail a major system upheaval to change.

Needless to say, an alternative method, parallel cleanfeeding, has far fewer problems and is of considerably greater flexibility, resembling faintly free-grouping multitrack recording routing. In this method, a cleanfeed buss consists of a mix of all the sources, with the exception of any channel (pick a channel, any channel) which can have its feed deselected from that buss. Obviously, the appropriate cleanfeed return may then be brought up to that channel, since it can no longer be routed out to itself, also it is present on all the other cleanfeed busses. There is no limit (other than the predetermined size of the system) to the number of channels that can be allotted to separate cleanfeeds and since all the cleanfeed busses carry all the sources (other than the ones specifically deselected from their respective busses) crossmixing between cleanfeeds is implicit and automatic.

Really, the parallel cleanfeed system can be treated in design as merely an extension of the auxiliary feed system, the only difference being that the sources have to be deselected from the buss rather than selected to it. Most broadcast auxiliary feed requirements are for either a source (or a small group of sources) in isolation, or for 'everything but' feeds. Rarely is a 'recording type' separately mixed feed needed so anything more than one control variable foldback feed is a wasted luxury.

Broadcasting line amps

The thought of deliberately including high and low frequency roll-off filtering in any line output of a console must seem a total anathema to many studio engineers brought up in the 'broad is beautiful' era. In many circumstances, though, far from it. While not actually mattering whether filtering is present, the lack of it can occasionally have dire consequences —some occasionally potentially expensive. Immediately springing to mind are monitor loudspeaker and headphone feeds. Allowing possibly large amounts of energy through at frequencies the loudspeakers can't,

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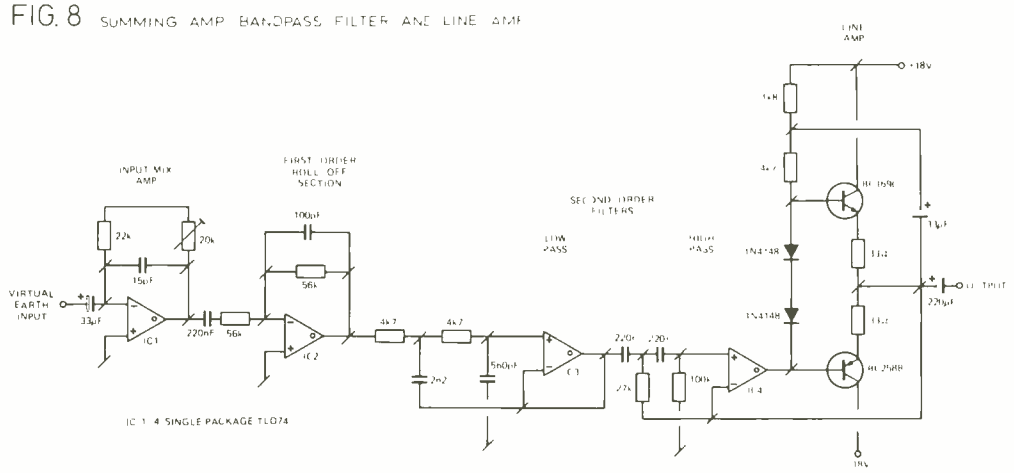
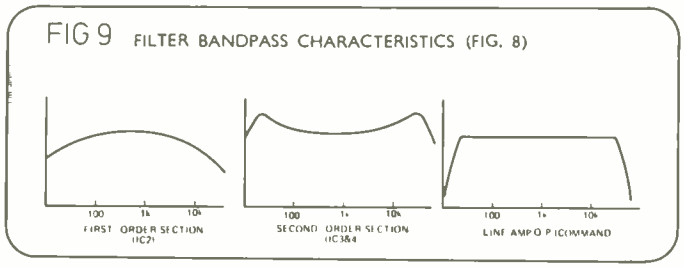
FIG. 8 SUMMING AMP BANDPASS FILTER AND LINE AMP





and your ears won't, do anything about seems a singularly silly pursuit, however 'purist'. Such transducers are designed to operate within certain power and frequency handling parameters and making sure you don't ask them to exceed those is a prerequisite of their longevity!

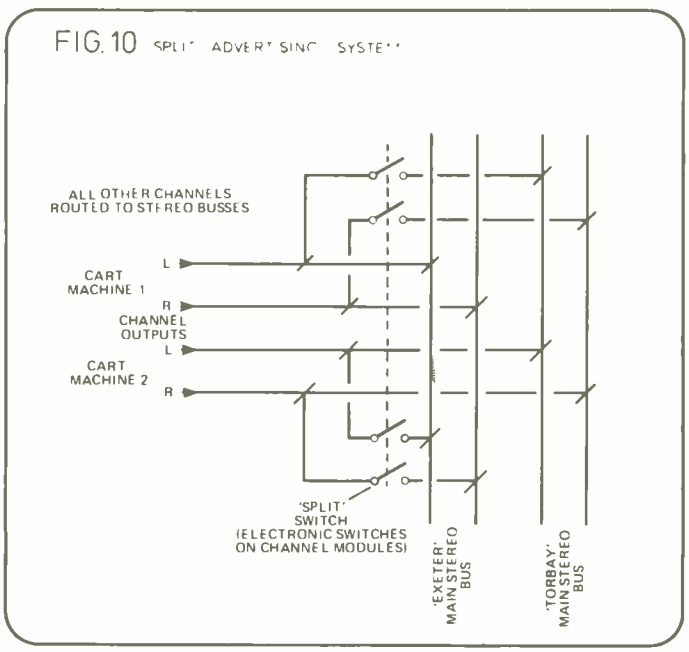
The summing amp, line amp and filter in **fig 8** was originally designed as the main desk output feed for a series of BBC radio continuity consoles—the main design criteria for the filter being that the lf response was down 10dB at 10Hz. The somewhat embarrassed, mumbled reason for this was that the significant quantities of subsonic rumble, naturally present from mics and turntables, was sufficient to interfere with and create sporadic responses from the subsonic data signalling system used extensively on the network's PCM programme links. Disc jockey drops pickup on record, transmitter switches off in the Outer Hebrides, get the idea?

It is a fairly straightforward third order highpass and lowpass filter, with a gain adjustable mix amp at the front and a line output complementary transistor pair tacked onto the last filter amplifier. All the gain and frequency determining elements are kept isolated and non-interreactive for versatility, and with the values shown the ½dB down frequencies are close to 20Hz and 20kHz, with passband ripple of who cares. In order to achieve a rapid out-of-band fall-off slope characteristic, the lowpass and highpass sallen and key filters (IC 3 and 4 respectively) were calculated for quite a high 'Q' and hence 'peak' approximately 1dB just inside their passbands, **fig 9**. To prevent the headroom margin at those frequencies being eroded by those 1dB peaks, the single-order roll-off and 'peak-smoothing' sections were placed ahead, around IC2.

ICs 1 and 4 are in fact all in a single 14 pin *TLO 74* quad op amp package, making possible a fairly high card component density and hence a compact system element.

All in all, it's quite amusing to watch a sweep frequency through the filter plummet as it passes out of band! Multiple passes of the same signal through this, or any, filter will have of course, a compounding effect. Subsequent generations will take on more and more exaggerated characteristics of the filters, but if they are present only at main outputs 'grand mastering', or monitor feeds, this is quite unlikely to become operationally problematic.

This filter was optimised for maximally flat in-band frequency response, phase response secondarily. Naturally, any roll-off filter will create in-band phase anomalies in particular approaching its turnover frequency. The question of the audibility of phase shifting will rage unabated and inconclusively for many years yet but for the purposes of justifying these particular filters, it is worth remembering that most frequency selective attenuation occurring in nature is interrelated with phase shifts, often of greater severity than those introduced by this filter. Maybe the same can't as easily be said about the vicious 12th order (and upwards) anti-aliasing filters commonly used in digital signal processing, but that is a separate argument altogether. A common finding by many authoriatative studies (including those by Ma Bell) is that until group delay is extended until there is an apparent *timing* disassociation, relative phase shift isn't noticable. This corresponds to many, many *cycles* of shift, never mind degrees.



Twin Stations

Coming into reality very shortly will be the new 'twin' stations in the British ILR network, the first of which being Devonair, operating in Exeter and Torbay. The system design for such a set-up is, shall we say, fraught, but an interesting problem was the requirement for split advertising between the two areas despite a fair proportion of the 'proper' programming being shared and operated from a single control area.

Each of the main on-air consoles was designed with two stereo mixing busses with separate groups designated for Exeter and Torbay respectively. Ordinarily with completely shared programming both stereo groups receive all the sources, but when a 'split' button is activated, the channel carrying a triple-stack cartridge machine is deselected from the Exeter buss, and another channel carrying yet another triple-stack deselected from Torbay. This enables the required function of separate advertising cartridge feeds to the two areas, **fig 10**.

In this somewhat extreme instance, the main desk output feeds are being treated as cleanfeeds, being to a specified degree clean of each other.

Master control

In the large ILR stations with large engineering staffs, master control of station output (always desirable) becomes practical.

Traditionally, master controlling has meant engineer-driven programming with nominal, or basic control, being given to the presenter. Working on the basis that the presenter's desk for redundancy's sake, or operational need, is to be air-capable in its own right, this has meant that in most current arrangements the MCR desk merely has sub-mix corrective control over the presenter's desk, with provision for the addition of commercial and taped feeds in addition to the 'nasty business' of phone-ins and outside sources. This leaves the things that need detailed attention to the engineer and more time to the presenter to be creative.

In order not to arrive at a second desk situation, where all the controls are duplicated, sub-mixes of the various source characters (grams, carts, tapes, mics, etc) are derived from the presenter's desk channel outputs and taken to the MCR as stereo line sources. An exception to this may be the main and interviewee microphones which would be split at microphone or mic-amp level and applied to separate mic channels in both desks, providing both a 'safe' and engineer control over interview situations. A major advantage to this system is that the MCR desk can be a 'normal' desk or even identical to the presenter's desk, with the sub-mixes and microphones appearing merely as an additional set of sources. Should it be required to use the MCR desk on-air, presto, a few switches and it's ready.

A differing approach, borrowing from recording automation technology, is to take the presenter's desk main stereo output direct to air but to provide each channel on each of the two desks with a VCA fader system. The presenter's desk will behave exactly as normal unless the engineer takes control of the VCA from the appropriate fader on the MCR desk, either completely or in an 'update' mode which increments or decrements the channel level around that set on the presenter's desk. Subgrouping, if required, is extremely simple being attained through tying the appropriate dc control voltages together, allowing the engineer the ideal operational circumstance where his desk, which may be in all respects identical to the presenter's, to appear to be just like a normal studio desk, with the sources appearing in the same place on both desks, regardless of whether he has taken control of them or not.

Since the MCR control is done via dc and may be subgrouped, it would be entirely possible for the engineer to leave the necessary faders clear and use the audio signal paths of the desk for other purposes—editing, dubbing, even pre-recording an interview—whilst still keeping an eye and having control over the other desk. Exactly how popular this capability would be with the engineers is, one feels, an altogether separate issue.

Perhaps an ideal arrangement, even in smaller stations would be for identical 'twin' control areas each VCA equipped and capable of controlling the other as and when required, obviously with a security system to avoid the delightfully forseeable disasters such a system could promote.

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Mixing console

Due to editorial space constrictions we were unable to publish the PA console description in Part One of this series. Below we detail the PA console format which should be read in conjunction with last month's article.

A PA desk format

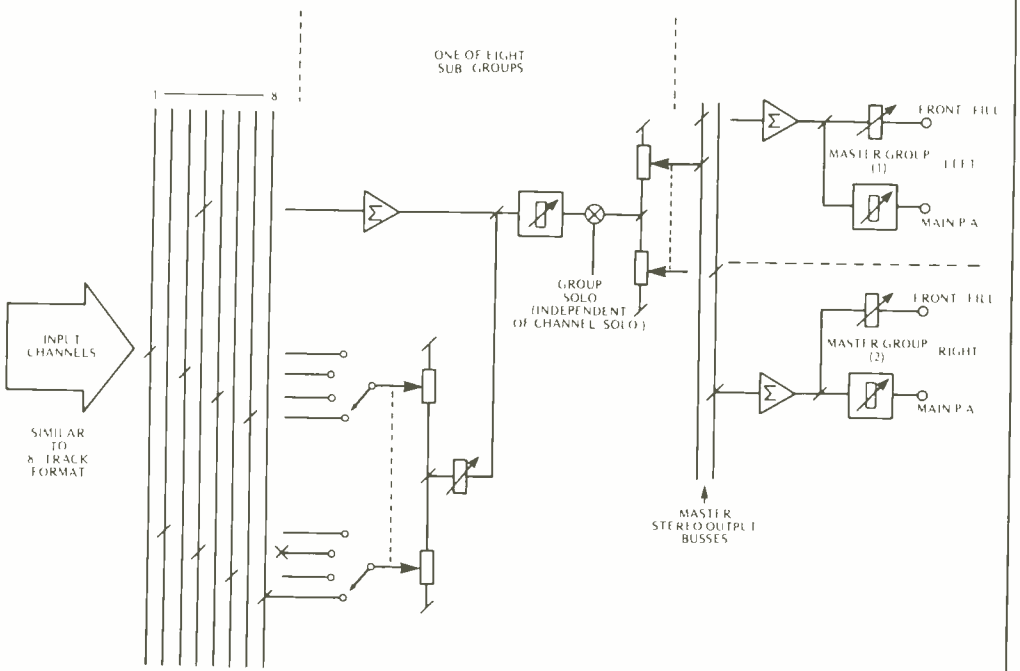
The PA desk format (outlined in **fig 11**) is fairly similar to the 12-8-8 format with the exception that no separate monitoring chain exists at all—the monitor loudspeaker system being very big, very loud and possibly 30ft above a stage 200ft away.

The channel is in fact identical to that discussed for the 12-8-8, including the separate solo system and 8-group routing. The groups, however, differ in that although there is still a group route-back facility, this now utilises the secondary gain control as well, whilst the main fader with its associated pan control feeds another pair of busses which constitute (together with another pair of group modules) the final desk output. The gain controls are again reversible at will.

No pan controls exist on the final group modules, but the two gain controls (non-reversible) remain in order to provide for control over two separate pairs of line-output feeds—nominally 'main PA' and 'front-fill'—often requiring individual setting.

Effect returns with this more than any other application tend to be problematic. All the channels inevitably end up used, so there is no possibility of bringing them back in that way and worse still, all the auxiliary feeds will probably be in use to effects, being that foldback is normally taken care of with a secondary stage console. For this reason, a separate module containing six 'bare-bones' effects returns, each with control of level and pan directly into the main desk output mixing busses is included as part of this mixer's 'backend' ■

FIG.11 SKETCH SCHEMATIC PA DESK BACK-END



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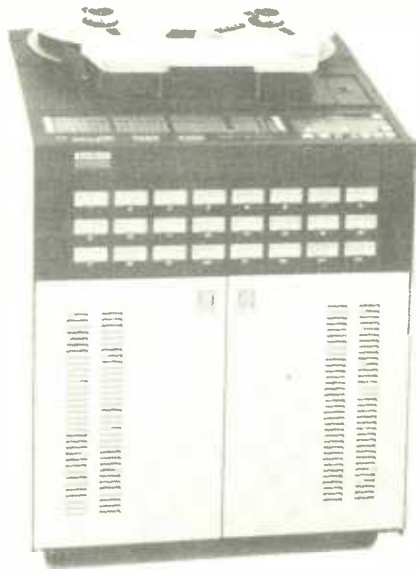
Ampex ATR-124 multitrack tape recorder

Ampex audio test pcb including the optional auto bias feature (not fitted to the review machine)



MANUFACTURER'S SPECIFICATION
Tape widths: 1in 8 channel, 2in 16 and 24 channel
Tape speeds: 7 5in/s (19 05cm/s), 15in/s (38 1cm/s), 30in/s (76 2cm/s)
Reel size: 5 to 16in (12 7 to 40 6cm) diameter.
Reel type: NAB.
Inputs: balanced, floating
Input impedance: 20kΩ, resistive +5.0%, 5Hz to 20kHz.
Input level: minimum 0dBm to produce operating level record flux level, maximum +16dBm. Input clip level, including record amplifier at mid-frequency, 26dB above system operating level.
Outputs: balanced, floating.
Output impedance: 50Ω, 5Hz to 20kHz.
Maximum output level (balanced): with 600Ω load +28dBm; with 200Ω load +25dBm
Preset output level: line output level is adjustable over a range of +12dBm to −2dBm.
Metering: VU meters.
Equalisation: any speed may be assigned to any of four selectable equalisations. These four equalisers are then automatically switched with transport speed switch. Each equaliser selected provides equalisation adjustable over the range AES/NAB/IEC/CCIR standards
Overall frequency response: reference 1kHz, at 30in/s (76 2cm/s) ±0 75dB 200Hz to 20kHz, ± 2 0dB 40Hz to 30kHz. At 15 in/s (38.1cm/s) ± 0.75dB 100Hz to 15kHz, ±2 0dB 25Hz to 20kHz At 7.5in/s (19 05cm/s) ±0 75dB 100Hz to 10kHz, ± 2.0dB 25Hz to 15kHz.
Signal-to-noise ratio: overall signal to noise ratio at 7.5 to 30in/s is measured with respect to a record level of 1040nWb/m (9dB above an operating level of 370nWb/m) when using Ampex *456* tape or direct equivalent At 1040nWb/m mid-frequency, third harmonic distortion is less than 3%.

Start time (10½in reel):

Speed	Time to attain flutter specification
7.5in/s (19.05cm/s)	200ms
15in/s (38.1cm/s)	300ms
30in/s (76.2cm/s)	500ms

Stop time: (10½in reel) 5.0s from fast wind modes; 0 7s maximum from play mode (30in/s, 76.2cm/s)
Rewind time: normal fast wind modes, 120s for 2400ft (731.52m) reel
Electronic tape timer: tape driven, reads in hours, minutes and seconds (option: minutes, seconds and tenths of seconds).

Tape speed and equalisation:	Track Format	30Hz-18kHz unweighted	ANSI 'A' weighted	IEC/CCIR Rec 468 weighted
30in/s (76.2cm/s) AES	8/16TK	72dB	76dB	67dB
	24TK	69dB	73dB	64dB
15in/s (38.1cm/s) IEC/CCIR	8/16TK	70dB	74dB	65dB
	24TK	67dB	71dB	62dB
15in/s (38.1cm/s) NAB	8/16TK	69dB	73dB	63dB
	24TK	66dB	70dB	60dB
7.5in/s (19.05cm/s) NAB	8/16TK	71dB	74dB	63dB
	24TK	68dB	71dB	60dB
7.5in/s (19.05cm/s) IEC/CCIR	8/16TK	68dB	71dB	62dB
	24TK	65dB	68dB	59dB

Wow and flutter:

Speed	ANSI S4.3/DIN 45507 Peak Weighted	ANSI/DIN Peak Unweighted	NAB RMS Unweighted
7.5in/s (19.05cm/s)	± 0.05%	± 0.12%	0.06%
15in/s (38.1cm/s)	± 0.03%	± 0.08%	0.04%
30in/s (76.2cm/s)	± 0.03%	± 0.08%	0.03%

System distortion: system electronics distortion, including record amplifier, reproduce amplifier and input/output system, at any operating level up to 20dB above operating level at mid-frequency is 0.03% total harmonic distortion and less than 0.05% intermodulation distortion.
Overall record/reproduce distortion: (using Ampex *456* tape or direct equivalent) at system operating level (0 VU = 370nWb/m, 6dB above 185nWb/m). Even order distortion of a 1kHz signal recorded at 370nWb/m is less than 0.1%. Third harmonic distortion at 1kHz 0.5% at a recorded flux level of 370nWb/m (0 VU), 3.0% at a recorded flux level of 1040nWb/m (+9 VU).
SMPTE intermodulation distortion: 1.0% at a recorded flux level of 370nWb/m (0 VU).
Crosstalk: crosstalk is measured by simultaneously placing the channel under test and an adjacent channel in record mode. The adjacent channel is fed with an operating level signal, the channel under test has its input shorted. The residual signal on the reproduced output of the channel under test relative to operating level, is less than 50dB, 100Hz to 15kHz at 15in/s.
Erase depth: using Ampex *456* tape or direct equivalent at any wavelength shorter than 75mils (200Hz at 15in/s) recorded 6dB above system operating level—85dB minimum.
Erase frequency: 144kHz.
Bias frequency: 324kHz (both bias and erase frequencies are derived from a master crystal oscillator).
Speed accuracy: (using 1.0 to 1.5mil base film thickness tape). Absolute speed accuracy ± 0.03%. Speed variation from beginning to end of reel 0.02% maximum.
Absolute accuracy: ±0.05% [1s in 2400ft (731.52m) reel at 15in/s (38 1cm/s)].
Heads: metal, adjustable azimuth and racking, 24-track 2in, 16-track 2in, 8-track 1in
Size: width 34 8in (884mm), depth 29 5in (749mm), height 49 5in (1257mm).
Weight: 800lbs (363kg) with accessories
Power line requirements: 90-115, 110-135, 180-230, 220-270V ac, 50/60Hz.
Power consumption: 1.5kVA.
Environmental operating specifications: temperature 10 to 40°C (50 to 104 F) humidity 20 to 80% non-condensing
Price: £32,000 as reviewed.
Manufacturer: Ampex Corporation, 401 Broadway, Redwood City, Cal. 94063, USA.
UK: Ampex Great Britain Ltd, Acre Road, Reading, Berks RG2 0QR.

THE AMPEX *ATR124* is a mammouth newcomer to the field of multitrack tape machines, being available as either 16- or 24-track. Changing between these two formats is a simple job which only takes a few minute's work.

Turning the scales at 800lb this is probably the heaviest machine to be had, however, its dimensions are such that it will fit any normal doorways and either 2in or 4in wheels can be fitted. As the machine is quite high, the use of 4in wheels could make operation difficult for the not so tall operators, particularly when 14in reels of tape are used.

The sloping top of the machine comprises the tape transport and control panel both of which are unusual in their design. Starting with the tape transport this is similar to the Ampex *ATR100* (2- and 4-track) in concept and surprisingly uses the same capstan motor and no pinch roller concept.

A heavy duty alloy casting forms the tape transport chassis with all the tape guides and critical components (with the exception of the capstan motor) being mounted onto machined reference faces on the top surface of the casting. It is consequently extremely quick and easy to replace any components. So that the main casting does not become strained it is mounted into the machine's chassis at only three points.

With a maximum capacity of 16in reels of 2in tape, the machine uses one horsepower servo controlled reel motors onto which the spools are mounted directly by an excellent type of spool

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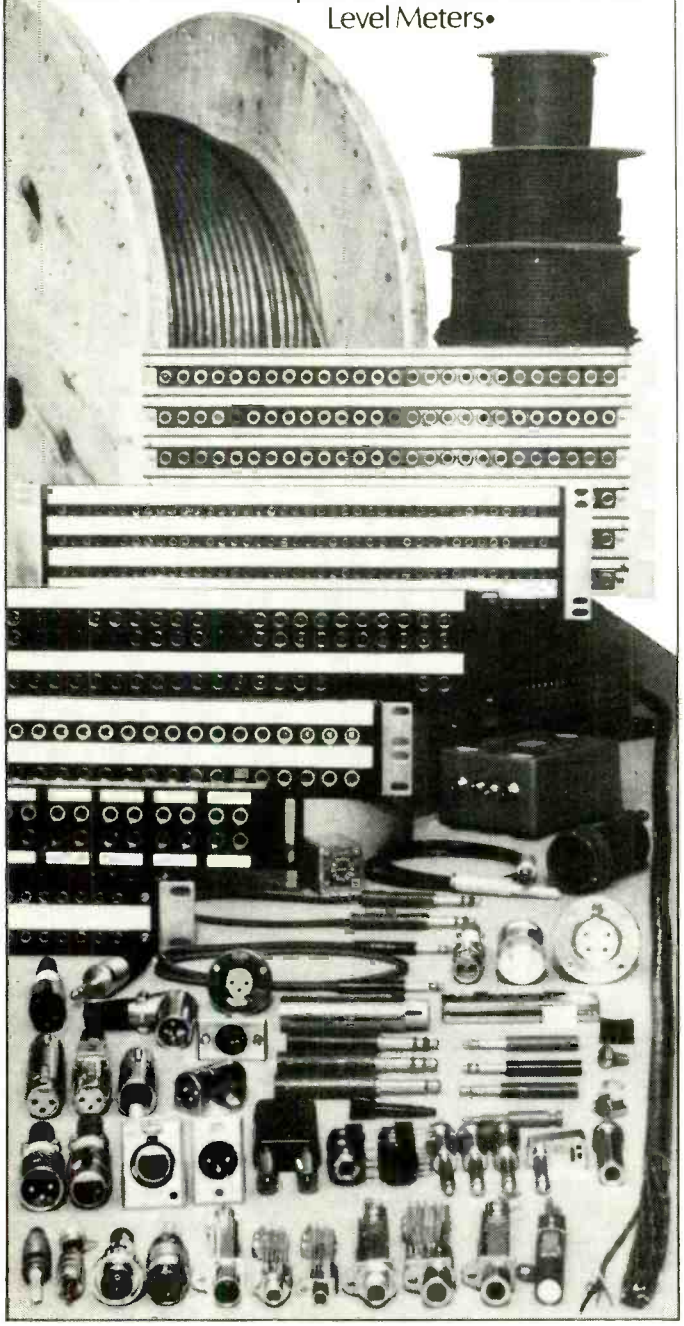

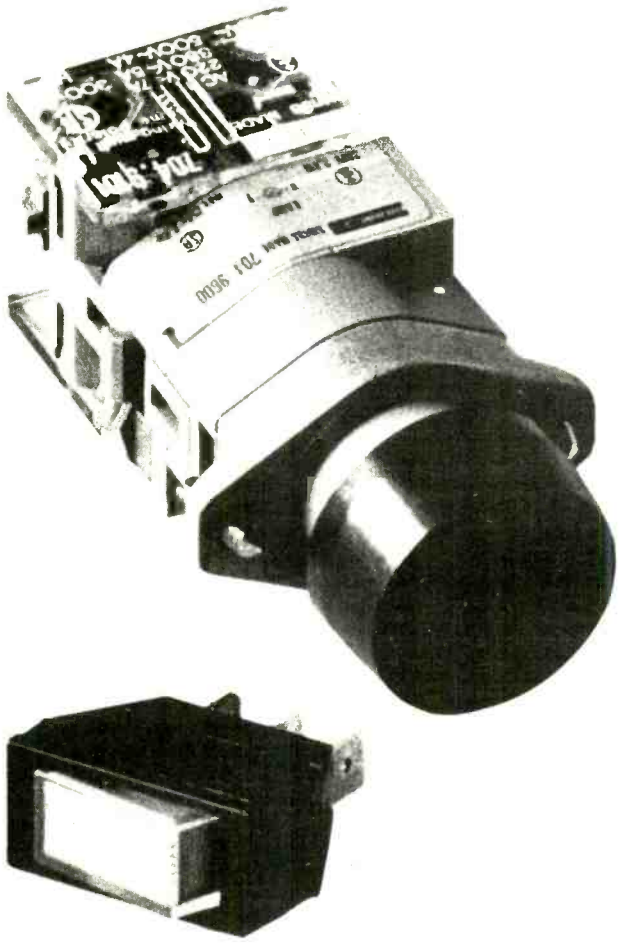

Two power switches. Both are rated at 16A/250V. The one on the left is specified for a minimum of 10 000 operations. The one on the right is specified for 100 000 operations. The one on the left is a good general purpose power switch. The one on the right is without doubt the best power switch at this rating. The one on the left is widely used in household applications, consumer and communication electronics and in well-known power amplifiers. The one on the right is widely used in air- and spacecraft, heavy-duty industrial applications and in the FM ACOUSTICS power amplifiers. In quantities of 100 pieces the one on the left costs about 30 Pence each, the one on the right about 3½ Pounds each. Just one of the reasons why the power amplifiers made by FM ACOUSTICS are more expensive and more reliable than all others.

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clamp. From here the tape passes to spring loaded tension sensing arms equipped with roller guides. Each arm has a dual rate spring system and has its position sensed by a variable transformer. The output from each of these transformers at the pay-off and take-up positions controls the reel motors to achieve remarkably constant tape tension.

From the tension sensing arms on both sides of the tape transport, the tape passes over roller guides and then on the left of the machine to a large diameter knurled roller equipped with a tachometer disc. This disc is used to drive the tape timer and acts as a damping roller, with the tape then entering the removable headblock.

At both the entry and exit from the headblock there are fixed guides with a flutter roller placed between the record and replay heads. The headblock is based on an alloy casting about half an inch thick supporting the ferrite erase head and metal record and replay heads. These are mounted on a wedged cog type of azimuth adjustment similar to that used on Nagra recorders. Solenoid operated tape lifting pins are located within the headblock, between the heads, with a substantial humshield hingeing from the bottom of the headblock and a splicing block with a choice of three cutting angles being mounted on the headblock top.

After the headblock the tape passes to the large diameter knurled capstan which is equipped with a tachometer disc to phase lock the capstan to a crystal. In view of the precise reel servo system, no pinch roller is required and editing is achieved by rotating the capstan by means of a knurled knob rather than rocking the spools which cannot be done on this machine.

Within the tape transport there are a limited amount of electronics mounted on several printed circuit boards, all of which are equipped with connectors and readily changed. In addition, at the left side of the tape transport there are two screening boxes containing the replay head amplifiers on plug-in printed circuit boards, each having four head amplifiers.

To the right of the tape transport the master controls are hidden beneath a hinged door. Firstly there are the power on and off buttons. If power is applied, when the machine is switched off, the red power off button is illuminated as an indication that the internal batteries (which maintain some of the internal memories) are being charged. Switching the power on starts the seven cooling fans (which are too noisy) and activates the tape transport. The transport can then be loaded by passing the tape through its simple tape path and then tensioning the tape—this activates the spooling motors at low power, full power being applied once any tape motion button is pressed.

Under the hinged lid there are then a set of eight pushbuttons which perform various functions. Firstly there are three spare buttons labelled A, B and C which feed the remote connector at the rear of the machine. Next there are buttons for inhibiting the record function, for switching on or off the bias and erase ramping, for noise reduction switching, and for controlling the VU meters at the front of the machine. The two buttons associated with these can switch the VU meters to read the auxiliary outputs and also increase their sensitivity by 10dB which is a very useful feature for aligning the machine.

Below these buttons are five buttons for each of the three tape speeds, and four buttons labelled one to four for switching in or out the record If boost required for NAB equalisation. Each of the tape speeds has buttons labelled one to four with the last button being an 'off' button. This complete arrangement allows the user to align four different equalisations within the electronics and to allocate these four selections to any of the three tape speeds. For instance the operator might align the machine for three different tape types at 30in/s and one at 15in/s, such that changing tape type only required pushing a button—a very useful feature of this machine.

So much for the tape transport section, now to the control panel which is very unusual. To start with, all switches dealing with signal routing and tape timing are membrane switches rear illuminated by LED indicators. The basic signal routing is accomplished by 24 track buttons in a horizontal line with the READY, SAFE, INPUT, SYNC, REPROduce and MUTE buttons in vertical array forming a matrix—the 24 track buttons being divided into three groups of eight tracks. This arrangement works in a fairly conventional manner by first pressing the button for the desired routing and then pressing the desired track buttons, whereupon LED indicators are illuminated within the matrix to indicate the current situation.

This is, however, only the start of the story as there are effectively five more track buttons in the matrix, one being labelled ALL and permitting all tracks to be set to the desired state and the four further buttons being group buttons labelled G1 to G4. The beauty of this system is that any combination of tracks may be put into a group by pressing a GROUP button followed by one of the buttons G1 to G4 and the desired track buttons. The only restriction is that one track cannot be allocated to more than one group.

Finally, within the signal routing matrix there is one further vertical array of switches associated with the optional auxiliary output for each track. This allows one to listen simultaneously to, for instance, sync and replay or input and replay. Thus this row of buttons allocates the auxiliary output of each track to input, sync, reproduce or mute.

As if these facilities were not enough there are two sets of four permanent memories in the machine for storing set-up information even when the machine is disconnected from power. The first set of memories controlled by membrane switches A, B, C and D plus TRANSFER allows four different settings of all functions in the signal routing matrix to be remembered and recalled at will by simply pressing A, B, C or D button. Loading is equally simple as all one does is set up the desired condition and then press TRANSFER followed by the memory button.

The second set of four memories is called the 'monitor memory' and remembers the monitoring conditions in the record, replay, fast wind and stop modes. Thus combinations of tracks can be automatically switched to different monitoring conditions in the different transport modes.

At the bottom left corner of this panel is a recessed MASTER RESET button for clearing all memories, next door to which is the tape speed control section. This comprises eight membrane switches and a four digit display. Three of the switches select the nominal tape speeds of 7½, 15 or 30 in/s with the remaining buttons being associated with the variable speed feature which is activated by a button labelled VSO. In the

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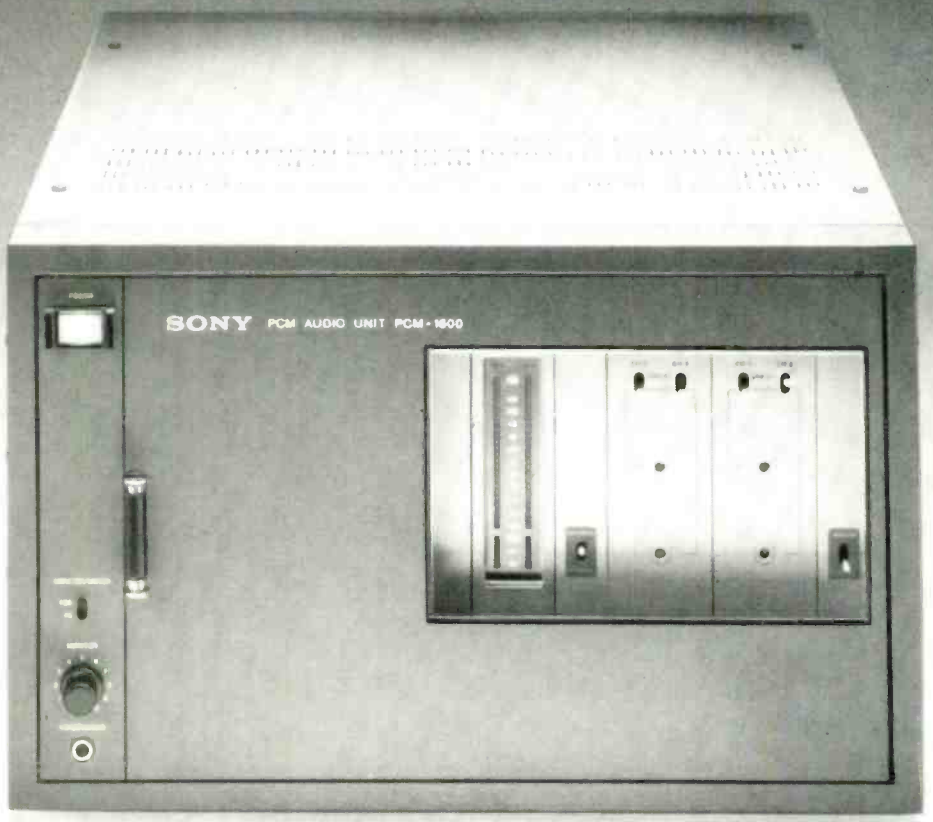

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variable speed mode the display shows the speed setting (not necessarily the actual speed) in either tones up to ±6 tones in quarter tone increments, or as a percentage of nominal speed over the range +200% to −50% with an indicator resolution of 0.1%. The setting is achieved by pressing either '%' or 'TONE' buttons and then either the 'DEC'rease or 'INC'rease buttons to alter the display. The speed change may be activated by pressing the VSO button, or the speed may be continuously changed with the INC or DEC buttons. It was found that setting a desired speed was undesirably slow and it is felt that the system could be modified to increase the rate of speed change if a change button was continuously depressed for a time.

Proceeding to the right there is yet another novel feature identified as SHUTTLE and taking the form of a horizontal strip of membrane switches. Running a finger along the strip shuttles the tape to the left or right at variable speed depending upon one's finger position.

The right hand section of the operator's panel can either be a standard search to cue section or, as in the case of the review machine, a multi-point search to cue. Both types have conventional pushbutton switches for the transport control functions: play, record, stop, fast forward and fast rewind. However, these controls have twin illumination with the top becoming illuminated when the button is pressed and the bottom becoming illuminated when the function is activated. Further conventional pushbutton switches allow the reel servos to be disarmed for editing, operate the tape lifters and initiate search. A further button called REHEARSE provides a very valuable feature in that it rehearses a drop-in to record without recording. It is thus possible to make the machine practice a drop-in at a cue without recording but whilst switching monitoring as if it had entered record.

The multi-point search to cue is a most complex facility operating with SMPTE time code. Briefly it has facilities for storing up to 99 cue points and has indicators in hours, minutes, seconds and frames for current tape time and for the timing of events. The latter can be a combination of dropping in or out of record, search and play, search and stop or just stop. In addition the timing can be modified by an automatic pre-roll button which works in conjunction with a pre-roll time setting in the electronics section with a range from 0 to 99s in 1s increments. A small digital keyboard is used to select the cue point stores and this keyboard may also be used to add or subtract any desired time from the time displays.

This multi-point search to cue offers endless possibilities far too complex to describe in this review. All the electronics for the control panel are housed beneath the panel on two layers of printed circuit boards which are very easily removed for servicing. Not surprisingly microprocessors are used in this part of the machine and servicing could be a very serious problem if it was not easy to exchange boards.

Turning now to the audio electronics, these occupy the section of the machine below the 24 VU meters at the front. The audio section is split into three sets of eight plug-in printed circuit boards each containing a complete audio channel with each section of eight channels being individually cooled by a fan.

Very sensibly the normal alignment controls all take the form of multi-turn potentiometers clearly labelled at the front of each board which has 39 controls plus various internal trimmers.

The design of the audio electronics is based on the design of the Ampex *ATR100* machine, but in the case of the *ATR124* no transformers are used with both the inputs and outputs being electronically balanced. As with the *ATR100*, the amplifiers are phase compensated and the extensive use of FET switches allows digital control of the signal routing via the internal microprocessor board, in conjunction with an audio control board in each section of eight audio boards.

Returning to the front of the audio board, at the top there is individual bias compensation adjustment with a master bias oscillator having the bias controls for the individual equalisation selections on the tape transport section (remember the buttons 1 to 4 for speed/tape/equalisation selection).

The remaining controls are arranged in three groups of 12 controls which in turn are arranged into three sets of four controls corresponding to the tape type/speed/equalisation selection on the tape transport (buttons 1 to 4).

Each of the three groups of controls (record, sync and reproduce) therefore has four gain adjustments and four hf equalisation adjustments with the sync and reproduce sections also having four lf adjustments and the record section four high frequency shelf adjustments.

Not only are the front panel controls clearly laid out and identified but also the various sections on the board and the individual components are clearly identified for easy servicing. Briefly the sections on the audio boards fall in the following categories: voltage regulator, erase amplifier, line input amplifier, record equalisation amplifier, record timing, record amplifier, reproduce equalisation, sync equalisation, line output amplifier, auxiliary (optional) line output amplifier, and VU meter amplifier. Both output amplifiers have their positive and negative rails protected by fuses on the audio boards.

Going now to the base of the machine at the front, the right hand corner is occupied by the master power supply which houses the reel servo printed circuit board and a regulator board. The latter has front panel testpoints for a number of voltage rails and provides the +5V for all the digital logic. This rail can be trimmed by a front panel control and the brightness of all lamps on the machine adjusted by a second front panel control. Whilst the latter is a nice feature, it was found that the LED indicators associated with the signal routing could not be made adequately bright for high ambient lighting conditions.

The remainder of the electronics are contained in a nine position card frame at the bottom left hand corner at the front of the machine, only five of the card spaces being occupied in the review machine. Of these five boards, the variable speed oscillator board contains the four master bias controls for the four tape type/speed/equalisation selections and LED indicators to show which selection is in use. In addition there is a variable speed oscillator test button which when activated tests the VSO section and when appropriate shows the word 'PASS' in the tape speed indicator.

Other than two digital thumbwheel switches for setting 1 to 99s preroll time and a reset button, the search to cue board has no user adjustments. The adjacent board, which is the main control computer, has a master record inhibit link as its main user control with the capstan servo and transport control board having a number of test features including three switches on the board which respectively reverse tape direction,

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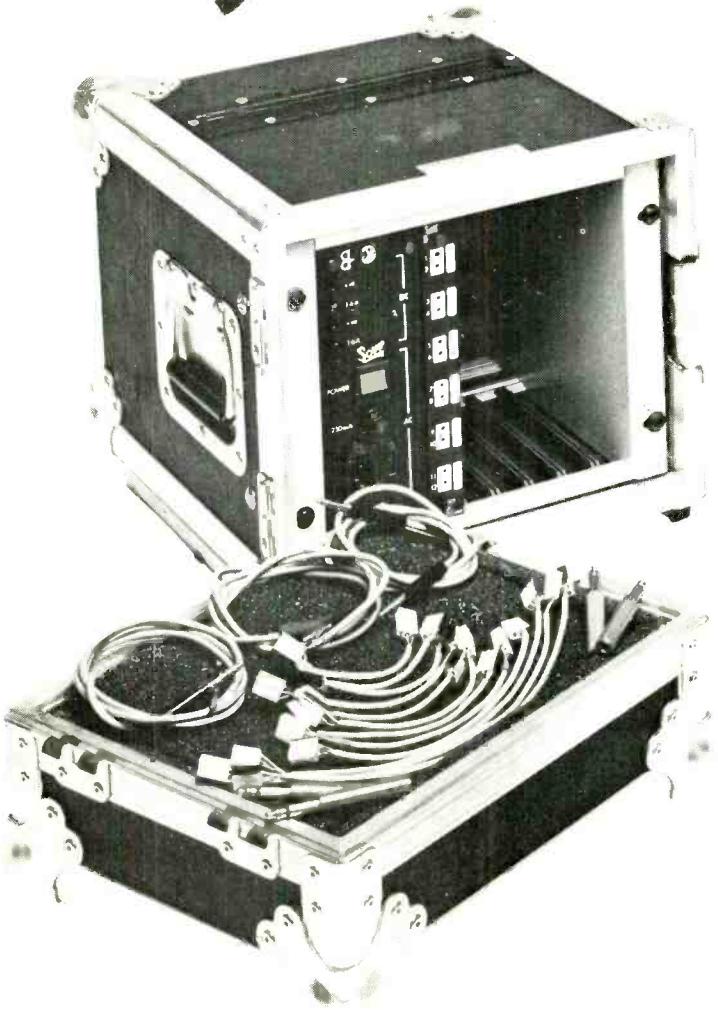

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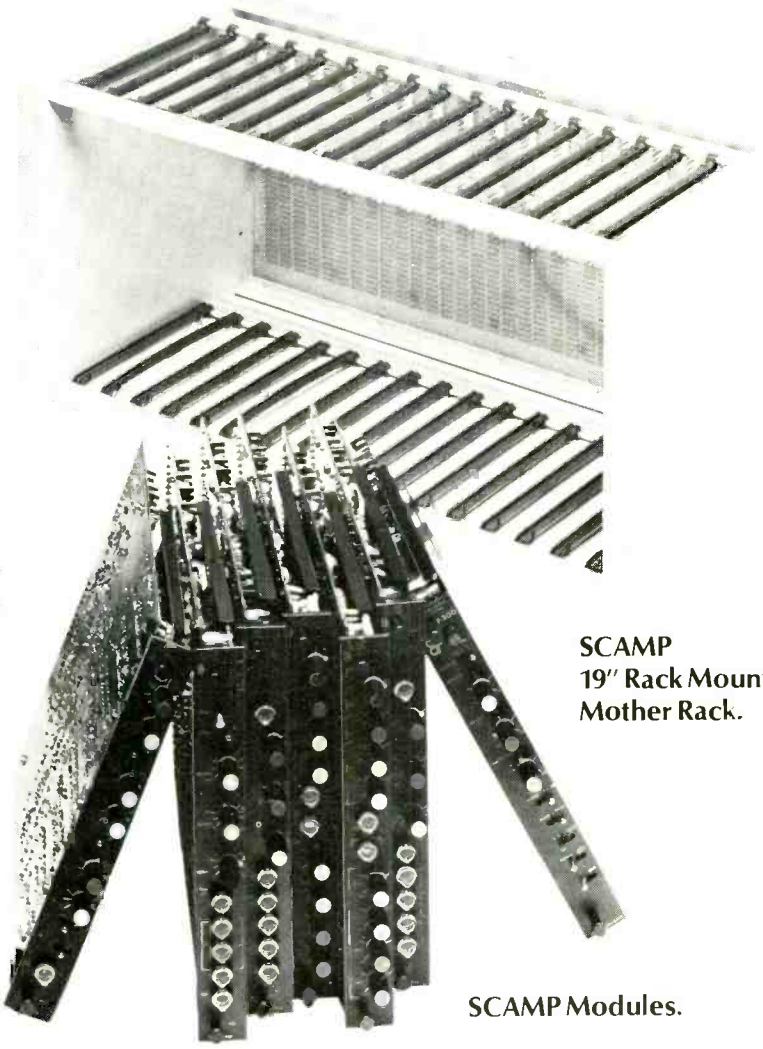

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select stop or play-off at the end of tape and maintain capstan servo operation in the absence of tape for servicing purposes. The front panel features on this board include a number of test points and potentiometers for controlling the fast wind speeds.

The final printed circuit board is the auto test board which provides a very valuable feature for rapid alignment of the machine. As an option, this board may also include an auto bias feature which was not fitted to the review machine. As it stands the board allows an input signal to a BNC connector to be applied to any input or to all inputs with the individual input being selected by two pushbuttons in conjunction with a digital display. In addition, three outputs are provided in the form of the main output at a headphone jack and the output buss and auxiliary outputs at BNC sockets. These can be connected to any channel by means of the digital display and selector buttons previously mentioned.

Turning to the rear of the recorder the only features are a gigantic power cable and connectors—72 XLR connectors for the audio input and the main and auxiliary outputs, two further XLR connectors for timecode in and out, a 104-way remote control connector and a 82-way accessory connector both providing a mass of logic interfaces and finally the 34-way 'D' connector for switching noise reduction.

So much for a lengthy description of a very complex recorder—how does it perform?

FIG. 1
AMPEX ATR-124 REPLAY EQ AT 15in/s

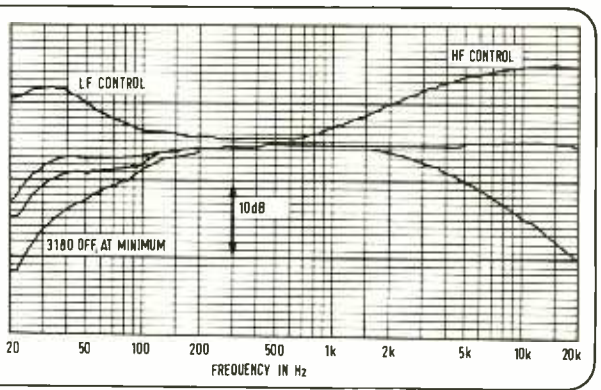
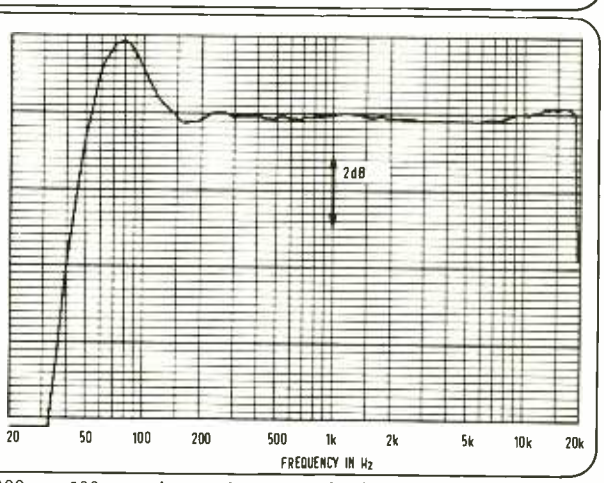


FIG. 2
AMPEX ATR-124 RECORD/REPLAY RESPONSE AT 30in/s AT O/P LEVEL



Performance

The quality of tape handling of this machine using Ampex *456* tape was beyond reproach even at the highest winding speeds of about 200in/s. Measurement of the tape tension showed that in all modes it remained in the range 300g to 500g, even at maximum acceleration and deceleration.

An additional feature was that the machine detects the approach of the end of tape in the fast wind modes and automatically reverts to the play speed as the end of tape approaches, thus playing the tape off instead of flaying the end about the place.

As with the Ampex *ATR100,* it takes some time to get used to editing by turning the capstan by hand instead of the reels, but once the new technique has been tried a little most people prefer this idea. Unlike many machines, no dump edit facility is provided. In operation the machine itself was very quiet, but the cooling fan noise was excessive. It is however understood that the fans may be run at low speed provided that the ambient temperature remains below 25°C.

The signal routing system was a delight to use and very easy to master, as was the storage system for signal routing, but as previously mentioned, the LED indicators could well be brighter. Random button punching could fool the logic system and make it run into loops, but this did not appear to be able to accidentally enter the record mode. Such actions as trying to enter record with no channels in ready resulted in the machine instructing the operator to check ready. This presenting itself in the form of LEDs in the matrix actually spelling out the instruction. It was noted that when in a slow reverse shuttle mode, the machine entered the play mode at locked speed.

The multi-point search and cue proved to be an exceptionally versatile system particularly in conjunction with the rehearse mode which should be a very valuable feature.

So far as the electronics are concerned, the use of multi-turn potentiometers for virtually all controls made accurate and stable alignment very easy with all controls being fine in operation and readily accessible. Whilst the mind may boggle at the thought of setting 892 controls, their iden-

88 ▶

FIG. 3
AMPEX ATR-124 RECORD/REPLAY RESPONSE AT 15in/s AT O/P LEVEL

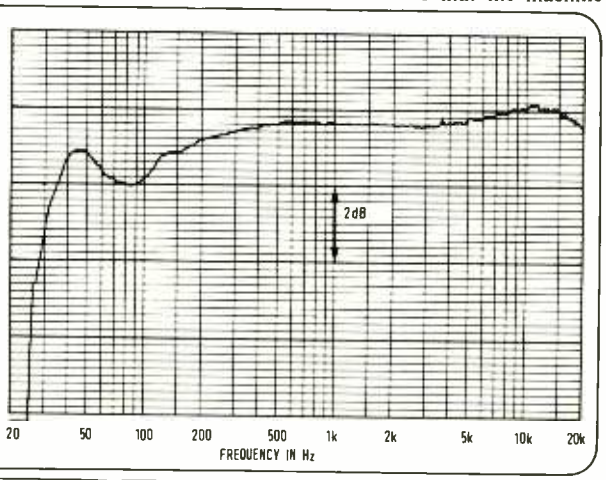


FIG. 4
AMPEX ATR-124 RECORD/REPLAY RESPONSE AT $7\frac{1}{2}$ in/s AT -10VU

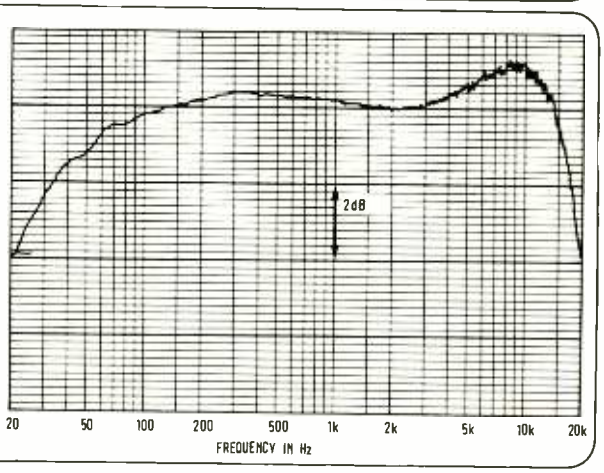


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TABLE 1

CONDITION	REFERENCE LEVEL (185nWb/m) TO NOISE RATIO		
Replay—no tape	**30in/s AES**	**15in/s NAB**	**7½in/s NAB**
22Hz to 22kHz rms	61dB	61dB	59dB
A weighted rms	70dB	68dB	67dB
CCIR weighted rms ref 1kHz	64.5dB	61dB	60dB
CCIR weighted quasi-peak	60.5dB	56.5dB	55.5dB
Replay Ampex 456 tape			
22Hz to 22kHz rms	57dB	54.5dB	55dB
A weighted rms	62dB	58dB	59dB
CCIR weighted rms ref 1kHz	54dB	49dB	50dB
CCIR weighted quasi-peak	46dB	45dB	46dB
Sync—no tape			
22Hz to 22kHz rms	52dB	54dB	52dB
A weighted rms	67dB	65dB	66dB
CCIR weighted rms ref 1kHz	61.5dB	57.5dB	59dB
CCIR weighted quasi-peak	57.5dB	53dB	54.5dB
Sync—Ampex 456 tape			
22Hz to 22kHz rms	50dB	51.5dB	50.5dB
A weighted rms	60dB	56dB	60dB
CCIR weighted rms ref 1kHz	53dB	46.5dB	51dB
CCIR weighted quasi-peak	48dB	42.5dB	47dB

tification and layout made this a simple task and not too long winded using the audio test board and VU meters.

Allowing for a few prototype modified printed circuit boards, the standard of construction of the machine was to the highest electronic and mechanical standards, but at the time of writing there is only a scanty provisional service manual. With such a complex machine servicing is a very serious matter and it is clear that Ampex had borne this in mind with the modular design approach and excellent accessibility to all electronic and mechanical parts.

Replay performance

The replay frequency response was checked at 30in/s and 15in/s using calibration tapes to the AES and NAB standards respectively and at 7½in/s using a flux loop, it being found that the machine could easily be aligned to within 0.5dB over the full frequency range. The wide range of available equalisation is shown in **fig 1** for a tape speed of 15in/s with NAB equalisation.

As supplied, the machine was aligned such that a recorded fluxivity of 185nWb/m (Ampex level) replayed at 0dBm with the replay level control

90 ▶

FIG. 5
AMPEX ATR-124 SYNC RESPONSE AT 30in/s

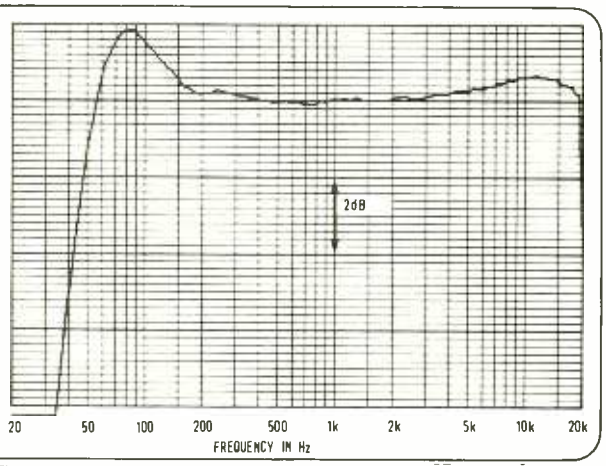
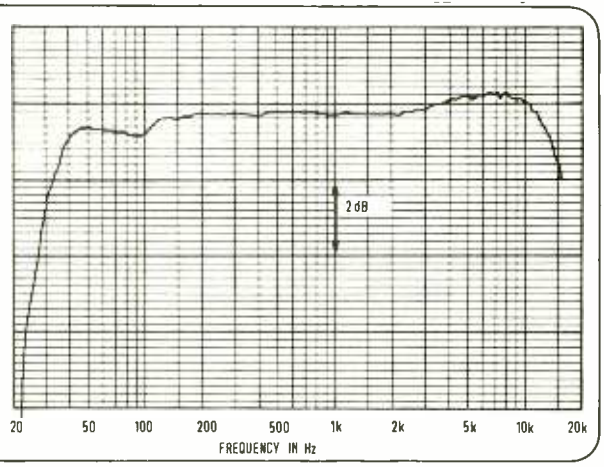


FIG. 6
AMPEX ATR-124 SYNC RESPONSE AT 15in/s



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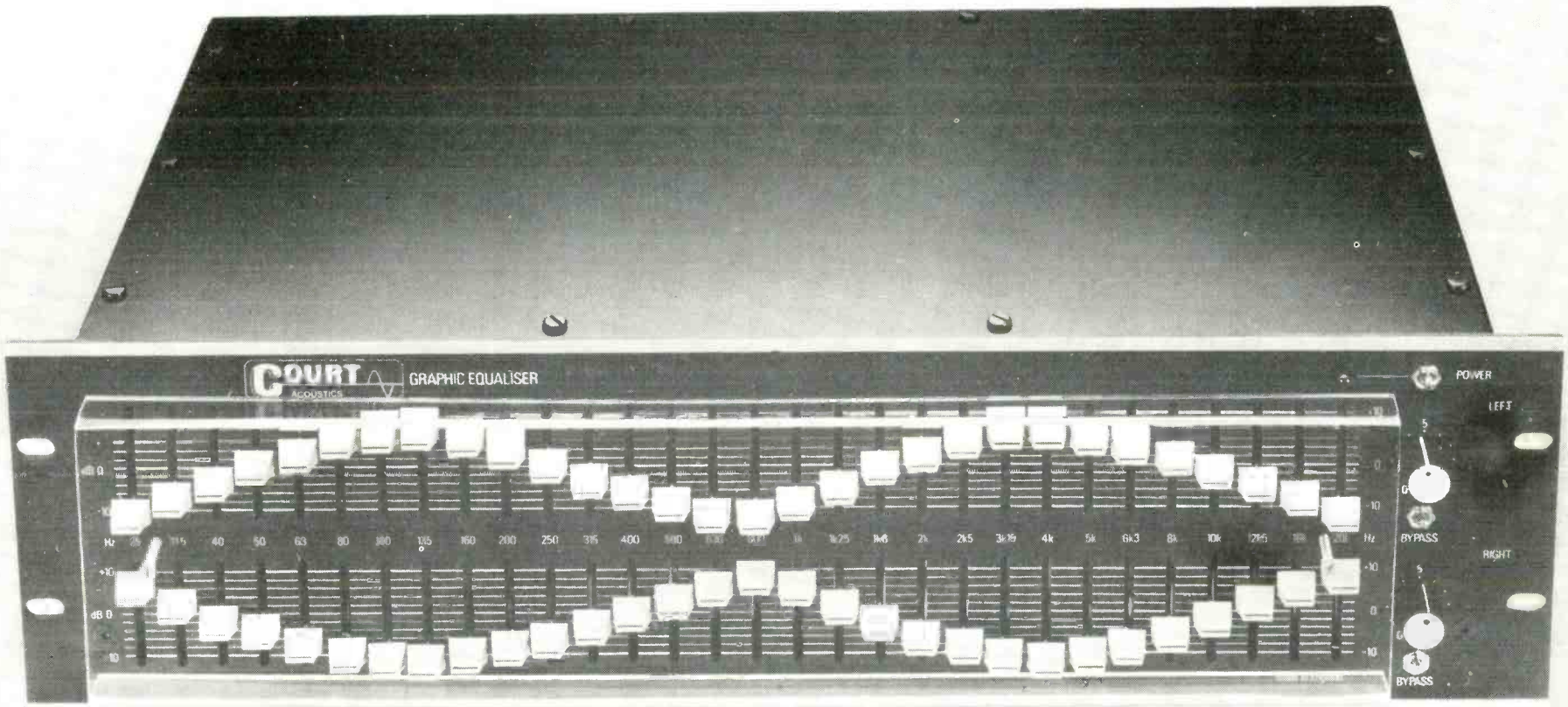

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TABLE 2

Tape speed equalisation	30in/s AES	15in/s NAB	7½in/s
3% MOL at 1kHz ref 185nWb/m	+ 13.5dB	+ 14.5dB	+ 15dB
Third harmonic at 320nWb/m	0.3%	0.15%	0.2%
Third harmonic at 185nWb/m	0.1%	0.08%	0.01%

TABLE 3

Speed	Beginning	Middle	End
7½in/s	0.06% (0.17%)	0.06% (0.15%)	0.065% (0.15%)
15in/s	0.04% (0.13%)	0.035% (0.11%)	0.028% (0.1%)
30in/s	0.028% (0.1%)	0.023% (0.07%)	0.02% (0.08%)

FIG 7
AMPEX ATR-124 SYNC RESPONSE AT 7½ in/s

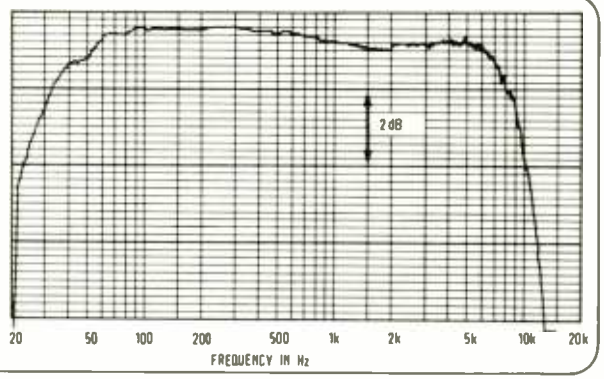


FIG.8
AMPEX ATR-124 RECORD EQ RANGE AT 15in/s

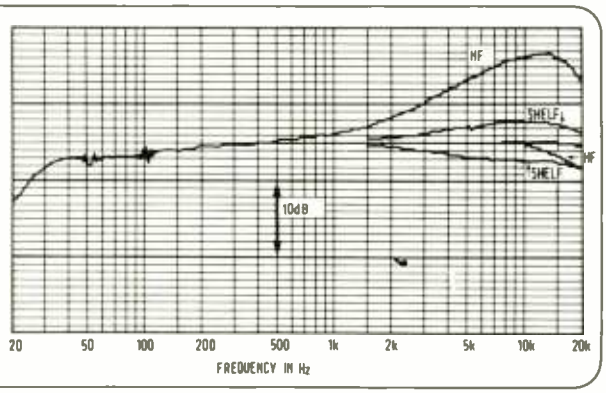


FIG.9
AMPEX ATR-124 CROSS-TALK REPLAYING 12, RECORDING 11 AND 13

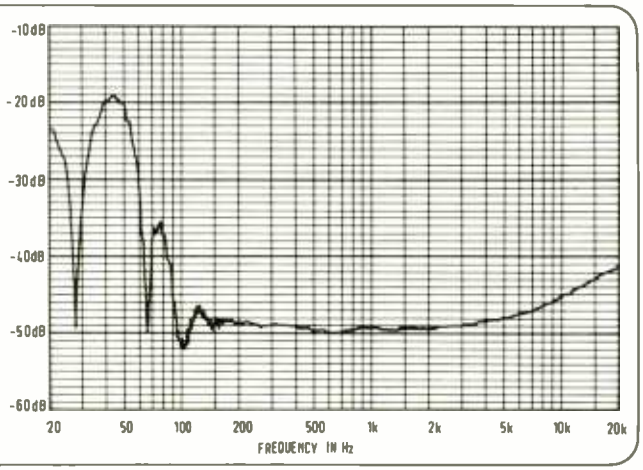
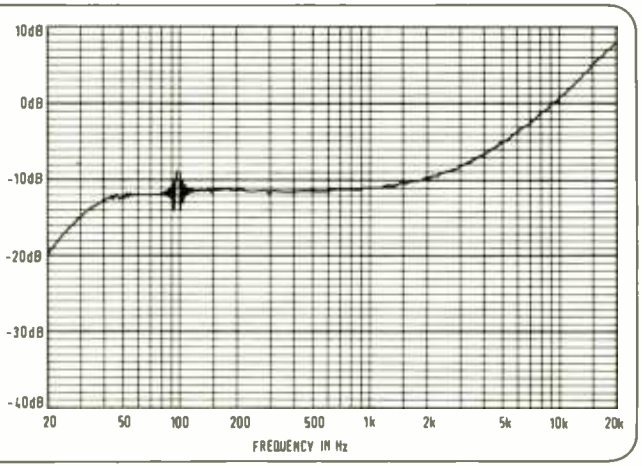


FIG.10
AMPEX ATR-124 SYNC CROSSTALK RECORDING 13, REPLAYING 12 IN SYNC MODE



capable of changing this level over the range −11.5dBm to +14dBm. At the supplied gain setting, the machine could replay a fluxivity 29dB above 185nWb/m before the onset of clipping—certainly a more than adequate margin!

Investigating the noise performance of the normal outputs and the sync outputs, both with Ampex *456* tape recorded with bias only, and without tape, gave the results in **Table 1** which were consistent for the 24 tracks with the exception of the unweighted figures.

The figures show a good performance with the sync track being unusually good. It was, however, noted that the unweighted noise performance of track one and adjacent tracks was inferior to a limited degree.

Record/replay performance

Having carefully aligned the machine for Ampex *456* tape, the record/replay frequency response was checked at all three tape speeds with the exceptionally flat response curves being shown in **figs 2, 3** and **4.** At 30 in/s the performance is quite outstanding with the response remaining within ±0.2dB from 130Hz to 20kHz with a relatively minor bass bump at 80Hz. Similarly the performance at the lower speeds is good and with a little patience might be improved.

Similarly the frequency response in the sync mode is sensible as shown in **figs 5, 6** and **7** for the three tape speeds, but in spite of the use of twin winding flux gate record heads the response at the lowest tape speed leaves something to be desired.

The range of the two record equalisers (hf and shelf) is shown in **fig 8** for a tape speed of 15in/s, it being seen that the shelf control operates with a mild range at mid-frequencies with the hf control having a wide range at high frequencies.

Checking the maximum output level for 3% third harmonic distortion and also the third harmonic distortion at 185nWb/m and 320nWb/m gave exceptionally good results **(Table 2)** with the record amplifier being capable of driving in excess of 30dB above the level required to record 185nWb/m at 15in/s. Also the range of available bias was more than adequate.

Checking the crosstalk between tracks by replaying track 12 whilst recording tracks 11 and 13 (a worst case) provided **fig 9** which shows a good performance above 100Hz with typical 'bumps' at lower frequencies. On the other hand the sync crosstalk as determined by recording track 13 whilst replaying track 12 in the sync mode proved to be very poor as shown in **fig 10** which demonstrates an impossible situation at all frequencies.

Recording and replaying a 1kHz squarewave produced exceptionally good results with virtually no overshoot as shown in **fig 11** thanks to the phase correction techniques in the amplifiers and complete lack of transformers.

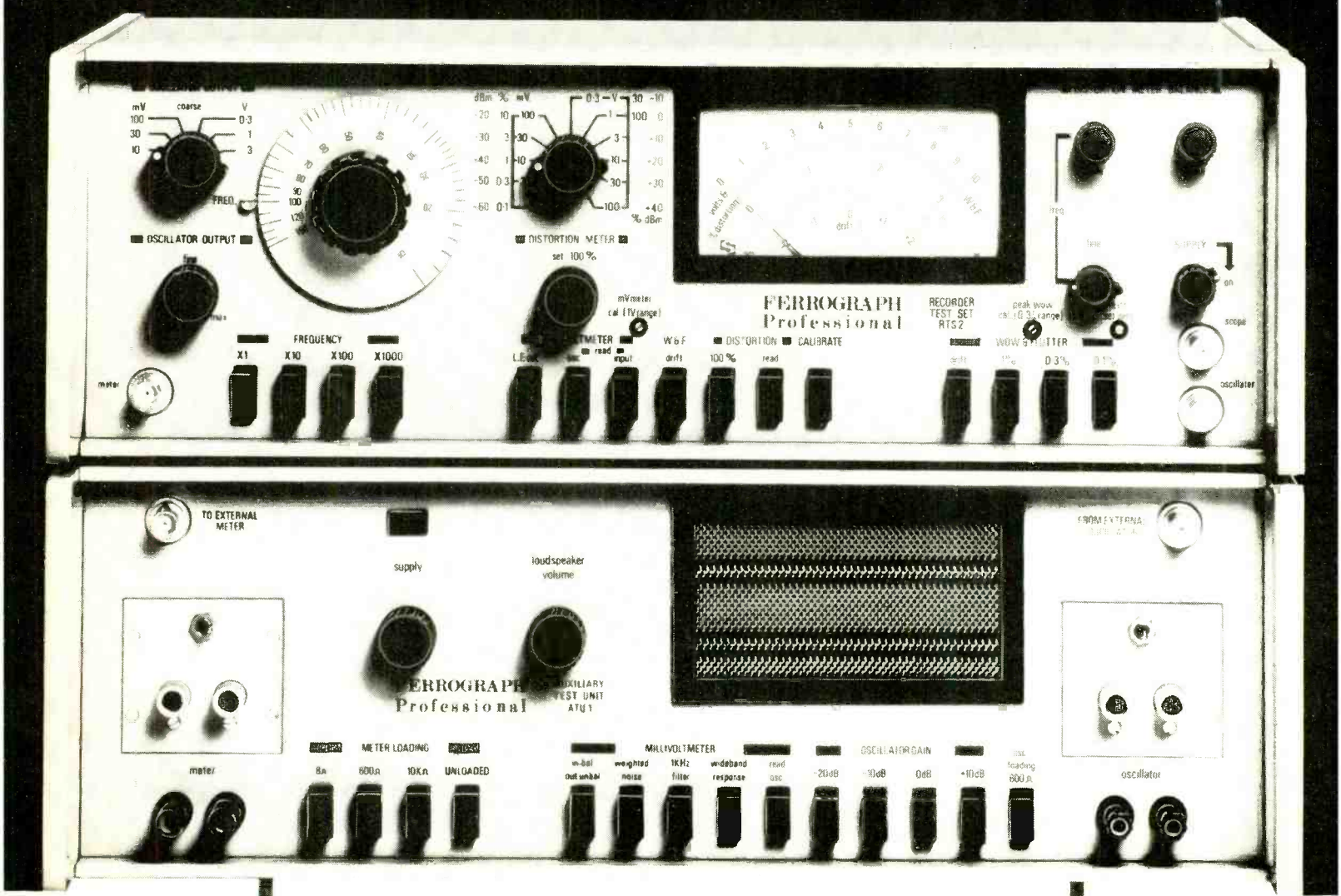
A final check in the record/replay performance was the erasure of a 1kHz tone recorded at 15in/s—here the 88dB erasure was excellent.

Wow, flutter and speed

Checking the wow and flutter to the IEC quasi-peak method, both weighted and unweighted at the beginning, middle and end of a 10½ inch reel of tape produced the results in **Table 3** which are on the margin of specification—I do however

92 ▶

Check 'em in
Check 'em out



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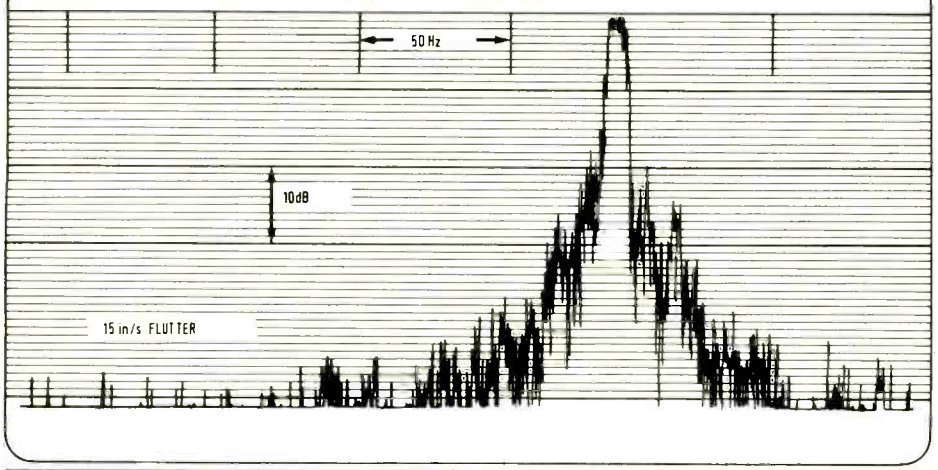
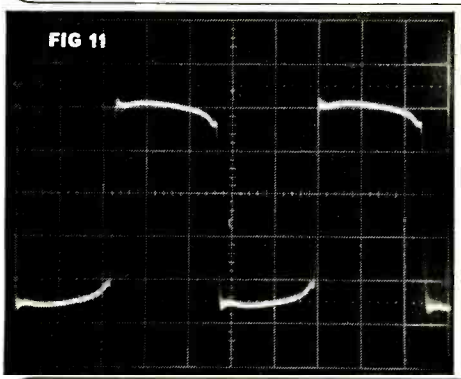
suspect that the performance can be improved by adjusting the servo system.

Undertaking a narrow band spectrum analysis of a 10kHz tone which had been recorded and replayed at 15in/s produced **fig 12** which shows a virtual absence of any defined sidebands and an unusually clean performance for an analogue machine.

FIG.12
AMPEX ATR-124 15in/s FLUTTER SPECTRUM ANALYSIS





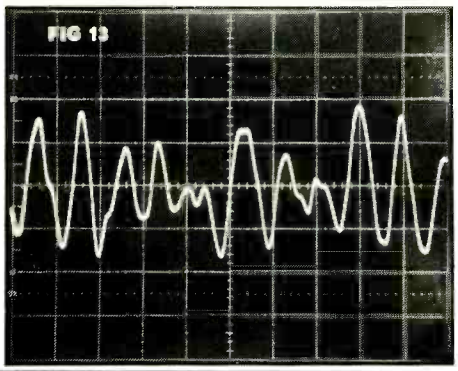
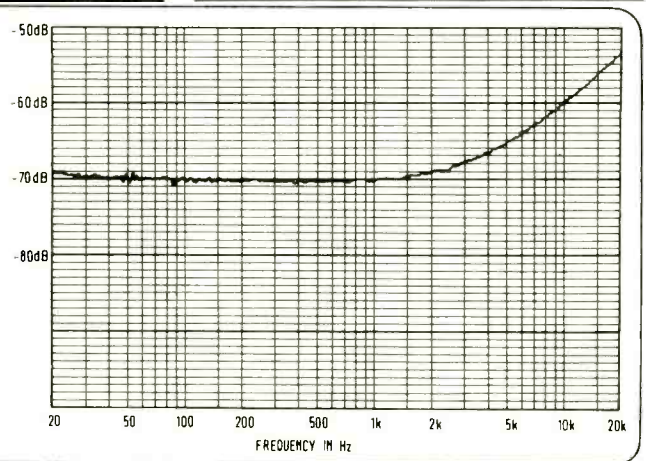


FIG. 14
AMPEX ATR-124 INPUT COMMON MODE REJECTION



So far as the relation between the speeds is concerned it should be precise because of the phase locking of the capstan to a crystal and was indeed measured to 0.0001% accuracy. In the varispeed mode it was found that the actual speed remained within the resolution of the speed indicator (0.1%), but it was noted that in the percentage mode not all 0.1% steps were available.

Other matters

Checking the phase deviation between the outer tracks using a 10kHz tone at a tape speed of 15in/s showed that the peak deviation was good in the order of ±20° with, as is shown in **fig 13**, a cyclic wobble with a period of about 0.5s which probably originates from the tape timer roller or the capstan.

It was found (for a change) that the VU meters had the genuine ballistics and rectifier characteristics required by the ASA standard, and the 10dB switched increase available in sensitivity proved useful for machine alignment.

The input impedance of 20kΩ with the excellent common mode rejection shown in **fig 14** was most satisfactory with the minimum input level required to record 185nWb/m being 8dBm with the inputs being capable of handling in excess of +22dBm.

On the output end, the main and auxiliary outputs were identical with an adequately low output impedance of 23Ω at 1kHz and capable of driving +28dBm.

Summary

There is no doubt in my mind that this is the most advanced audio recorder yet available. Virtually the complete concept of the machine is new, with a new type of tape transport, new techniques in the electronics and a revolutionary system of signal routing. In addition the multi-point search and cue provides outstanding facilities.

From the point of view of audio performance, handling and maintenance the word 'excellent' has cropped up an unusual number of times in this review.

The only area where I find this machine particularly disappointing is in the sync crosstalk situation and in this area great care is required in use. I also suspect a few bugs in the microprocessor systems, but this is hardly a surprise when the machine is so new on the market.

Overall, congratulations to Ampex—a great machine.

Hugh Ford

Manufacturer's comment:

The *ATR-124* record head design has been optimised for the signal parameters that were considered by Ampex and the key users in the industry to be of most importance. Two of these which influence record to sel-sync are:

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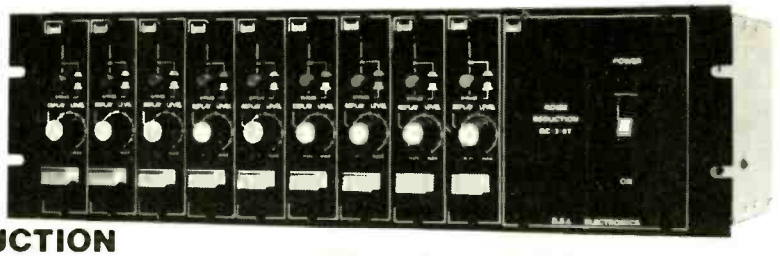

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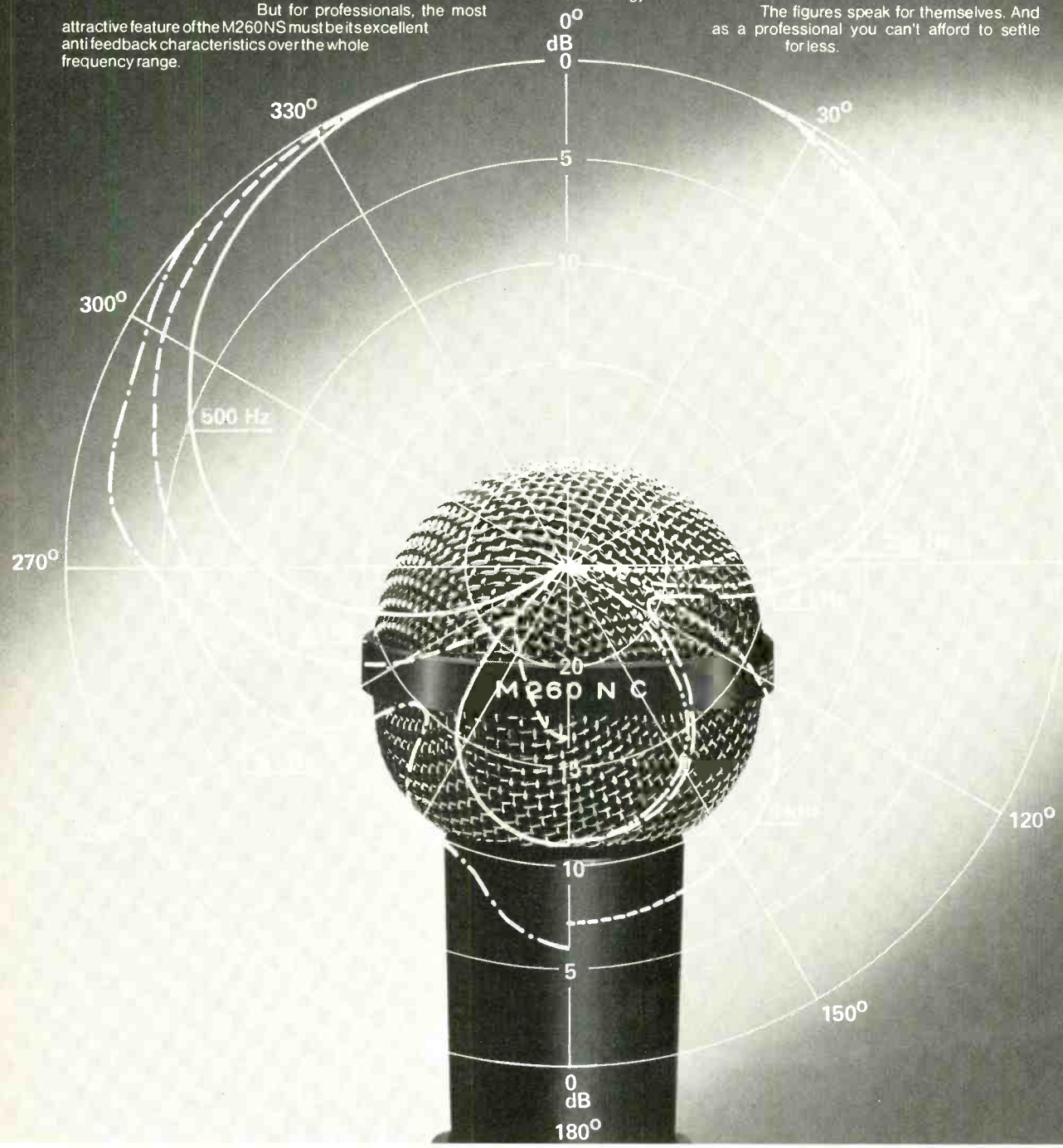

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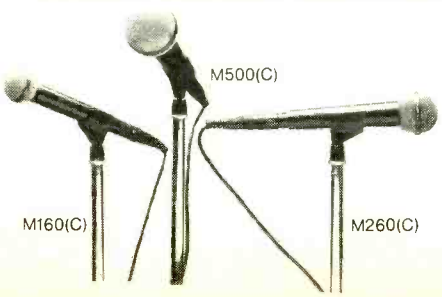

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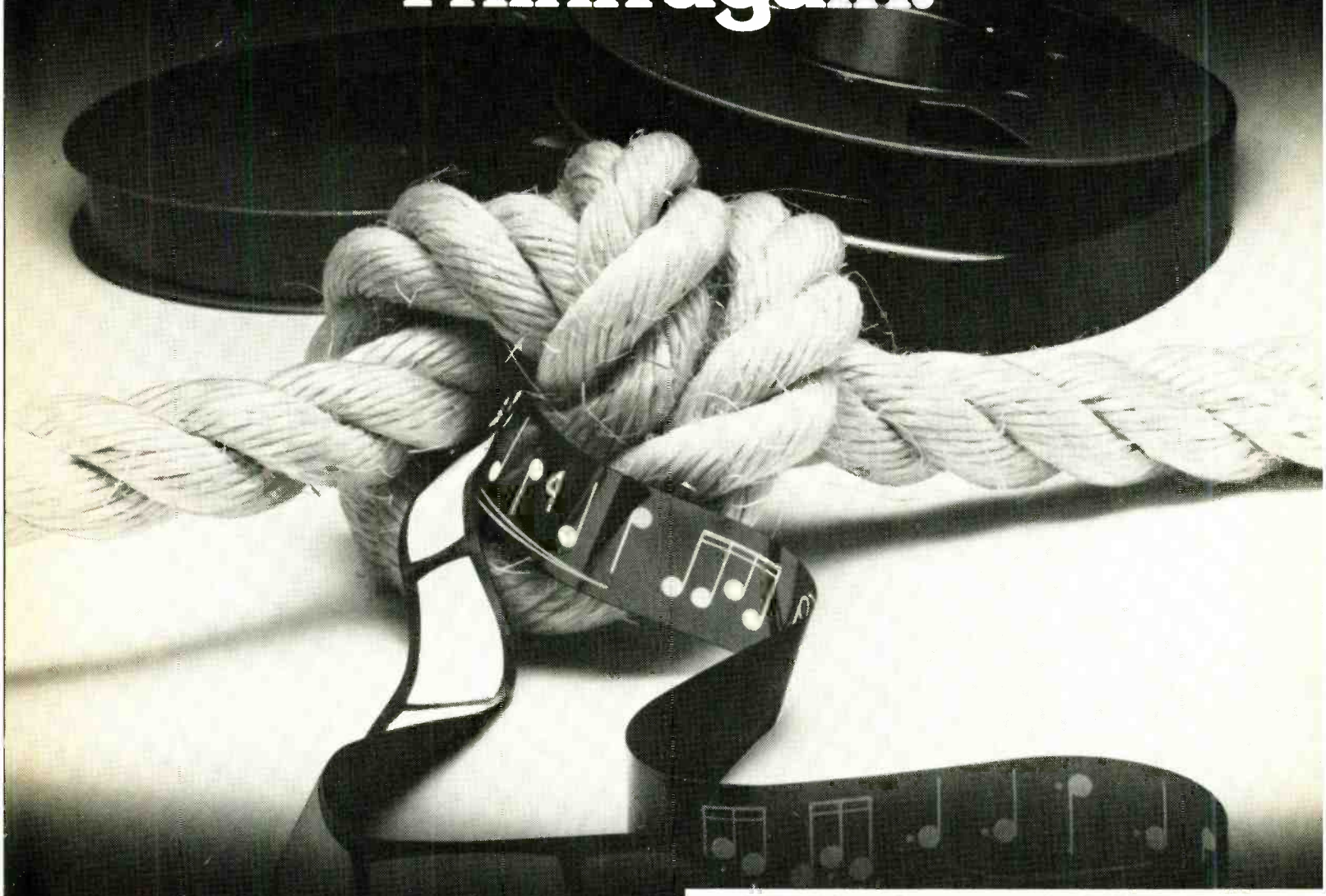

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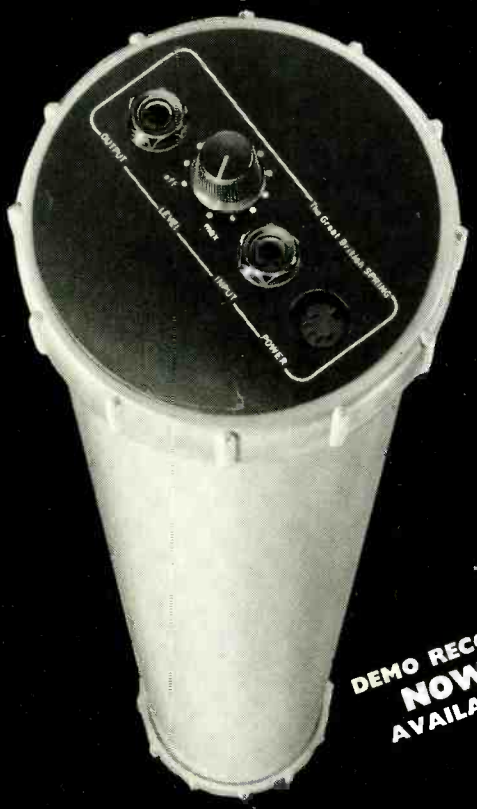

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The internal pink noise generator enables the electrical or electro-acoustic frequency response of systems to be accurately and rapidly determined.

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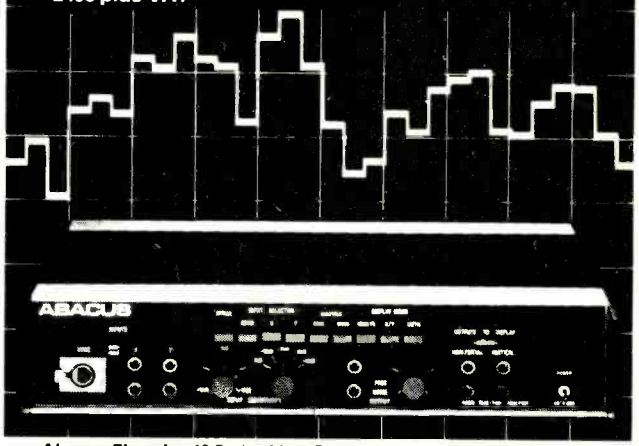

Abacus Electrics 10 Barley Mow Passage, London W4 4PH England
Telephone: London 01-994 6477 Telex 8811418

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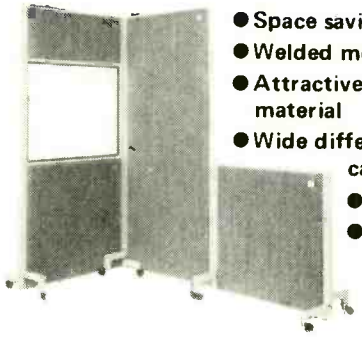

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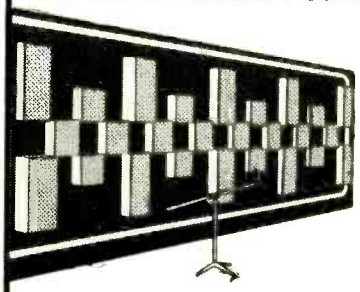

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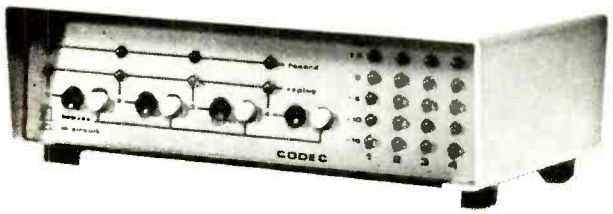

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Over 17dB of noise reduction with complete absence of audible side effects. Less than ·1% T.H.D. Bandwidth ±3dB 20Hz-20kHz full encode/decode cycle. Headroom 14dB ref. 0dBm nom. operating level.

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16mm Magnetic Recorders/Reproducers. Single and Twin Racks. All Solid State. Very good condition. Eight machines available.
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Cassette and open reel copying in large and small runs.
Blank cassettes supplied between C-3 and C120.
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The products consist of an established range of professional audio recorders, together with a new generation of advanced multi-track digital recorders. The successful candidate will have UK-wide responsibility for sales, but will obviously be expected to concentrate on the lucrative London and South-East area.
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A very attractive remuneration package will be backed by extensive large-company benefits including company car. Prospects of career advancement are excellent.

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PA Advertising

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PA

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Classified Advertisements

Advertisements for this section must be pre-paid. The rate is **25p** per word, minimum **£5.00.** Box Nos. **75p** extra. Semi-display rates on application. Copy and remittance for advertisements in **DECEMBER 1980** issue must reach these offices by **3rd OCTOBER 1980** addressed to: The Advertisement Manager, **Studio Sound,** Link House, Dingwall Avenue, Croydon CR9 2TA.
Note: Advertisement copy must be clearly printed in block capitals or typewritten.
Replies to Box Nos. should be addressed to the Advertisement Manager, Studio Sound, Link House, Dingwall Avenue, Croydon CR9 2TA, and the Box No. quoted on the outside of the envelope. The district after Box No. indicates its locality. **SEX DISCRIMINATION ACT 1975:** No job advertisement which indicates or can reasonably be understood as indicating an intention to discriminate on grounds of sex (e.g. by inviting applications only from males or only from females) may be accepted, unless (1) the job is for the purpose of a private householder or (2) it is in a business employing less than six persons or (3) it is otherwise excepted from the requirements of the Sex Discrimination Act. A statement must be made at the time the advertisement is placed saying which of the exceptions in the Act is considered to apply.

The attention of advertisers is drawn to "The Business Advertisements (Disclosure) Order 1977", which requires that, from 1st January 1978, all advertisements by persons who seek to sell goods in the course of business must make that fact clear. From the above date, consumers therefore should know whether an advertisement relates to a sale by a trader or a private seller.

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PRECISION ONE-TO-ONE COPIES WITH PHASE-EQUALISATION FOR OPTIMUM TRANSIENT RESPONSE
Ring **David Wright** onw on **(0344) 54935** for further details, or write: **'Braeside', London Rd, Binfield, Bracknell, Berks RG12 5BS**

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to fit in your Noise Reduction Rack, dbx K9 Cards, **£55** per day.
Urei Time Aligned Monitors, Model 813, **£50** per day.
Phone 01-229 9595

CASSETTE DUPLICATING inc L/case. Label and inlay card printing.

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50-99	48p	50p	52p	55p	58p	61p	68p	76p	84p	94p	104p	114p
100-149	47p	49p	51p	52p	54p	56p	63p	72p	79p	89p	99p	109p
150-249	43p	45p	47p	48p	50p	52p	60p	69p	74p	84p	94p	104p
250-499	41p	43p	45p	46p	47p	48p	56p	64p	70p	80p	90p	100p
500-999	39p	40p	41p	42p	43p	44p	51p	59p	67p	77p	87p	97p
1000+	33p	35p	37p	38p	40p	42p	48p	54p	64p	74p	84p	94p
10,000+	32p	34p	36p	37p	39p	41p	47p	53p	63p	73p	83p	93p

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Cassette Duplication	Empty Tape Spools
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STUDIO ACOUSTIC DESIGN

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Blank cassettes supplied in bulk.
A growing reputation for reliability.
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For super quality Master Discs, Demo Discs and Pressings. Scully lathe with our latest MKW 80 Stereo Cutting System.
Also half speed cutting for that very special disc.
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Hi-speed or 1-1.
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Audio Consultant Engineer

Independent Consultancy Service for all your Audio needs.

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★**Bose 802 speakers** with equalisation, £499 per pair or £473 without equalisation. Amcron DC 300 £530 and D150A at £335. All prices plus VAT. Contact Geoff Yates, C.A.V.S. Ltd. 01-363 6125. X

★**Yorkshire Erricks** of Bradford. Tascam, JBL, Bose, AKG, Beyer, Calrec, Revox, Ferrograph, Spendor. Sales, servicing, exchanges, leasing. Bradford (0274) 22972 (Paul). X

M & B Radio

10½" empty NAB Alloy Spools. £1.25 ea. or 10 for	£10
Jack-fields 20-way 10¾ x 3¼ x ¼. New. Per strip	£12
Sennheiser Mikes, MKH110, new	£50
Ferrograph Tape Recorders from	£35
Ferrograph Tape Recorder Test Set, R.T.S., as new	£310
Uher 4000L Tape Recorder, as seen	£70
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EMI BTR2 Tape Recorders, fully refurbished, solid state electronics, new motors, stereo and mono. A constant running machine. Beautiful condition	£300
EMI BTR2 Decks only, with head-blocks	£55
Twin 301 Record Decks, instant start mech., groove and speed indication, pre-amp and fader, in oak cabinet	£100
Single Deck Unit as above	£65

Carriage and VAT extra. **Wanted:** used equipment.

86 Bishopgate Street, Leeds LS1 4BB. 0532-35649.

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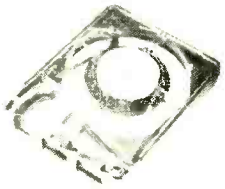
Large selection available ex stock. Competitive prices. Standard lengths.



Custom winding. Lubricated tape. Also full range of tape cartridge storage systems.

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Professional Recording Equipment

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16 TRACK Acoustically Designed Control Room £9.50 per hr.

JBL Monitors/Phasing/Flanging Comp/Lim's/Noise Gates/A.D.T. Dolby A's For Mastering.

Contact Jeffrey on 01-435 3076 or 01-637 9977

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Not usually obtainable in the UK

£5.00 per 100

While stocks last (Plus VAT)

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Telephone 01-580 4314

Have you seen the superb new Uher portables with monitoring head?

They are actually in stock and at competitive prices at:

SIMMON

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★**Stereo plate echo.** Brand new, £600 plus VAT. Trade enquiries welcome. Smile Studio Sales. Steve Foley, 061 226 5369. L

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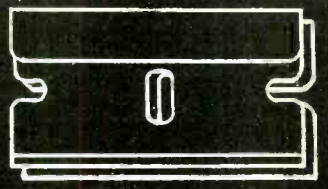
£4·50 (inc VAT) per box of 100. Cheque with order please. Agents wanted in most areas. Very Special Prices are available for Wholesalers.



ODD-JOB BLADES LTD

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For the best prices and Service

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WE SUPPLY ALL TYPES OF MICROPHONE, TRANSFORMERS, BRIDGING TRANSFORMERS, INPUT TRANSFORMERS FOR **RECORDING, BROADCASTING AND PUBLIC ADDRESS APPLICATION.**

We call your attention to our very successful

MICROPHONE SPLITTER/COMBINER TRANSFORMER

type 4079

with a high impedance 200ohm primary and two 200ohm secondaries. It will handle up to 2.3 volts rms at 30Hz and has a frequency response of plus/minus ½dB from 20Hz to 20kHz. It is contained in a Mumetal Can 33mm diam x 37mm high and **WORKING DETAILS OF THE CONSTRUCTION OF A SPLITTER ARE AVAILABLE ON REQUEST.**

WE HAVE AVAILABLE STANDARD DESIGNS OF **OUTPUT TRANSFORMERS** WITH EXCEPTIONAL PERFORMANCE FOR **ALL TYPES OF VALVE AMPLIFIERS.**

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24 TRACK STUDIO

for sale, Central London. 3,000 sq. ft. Two floors with offices.

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John Smailes

AMPEX GRAND MASTER Cassette Tape wound to special lengths—also **BASF, Memorex, Agfa** and **Pyral.** Full details of endless Cassettes and Tape duplicating.

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Main 3M WOLLENSAK Dealers

Meticulous alignment of all machines before sale. Excellent servicing facilities. Suppliers of quality virgin cassettes in bulk. Fast-copying service. Prompt personal attention.

SOUND CASSETTE SERVICES Ltd.

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Tel. 04606 5393

Further Classified Advertising appears on page 101

SITUATIONS VACANT

★**Recording engineer** wanted for new, purpose-built, 16-track Studio in Leicestershire. Experience in Recording and/or Broadcasting essential. Telephone (0533) 608813 or 394976. K

★**Audio/Visual** Company require freelance maintenance engineer. The Playback Studio, 01-969 8216. K

★**Mobile 4-track studio** in Yorkshire requires hardworking, reliable engineer to work on freelance basis. Would suit experienced engineer wanting extra part-time work. Box 838 c/o *Studio Sound.* K

WANTED

★**Used** 16 or 35mm Magnetic recording and reproducing equipment, and associated electronics. Tecnocine, P.O. Box 503, Madrid (Spain). K

FOR SALE—PRIVATE

●**Alice 828 Mixer.** Eight channels, VU meters. Used in a small, private studio. Excellent condition. £350. Tel. 0670 58101. K

●**For sale: Ampex MM1100** 16-track 2in, very good condition. SFr.25,000. Sunrise Studios, CH9533 Kirchberg 010 41 73 31 34 61. K

●**Ampex MM1100 16-track** Tape Machine with autolocate and almost new 8-track headblock. Good condition. £10,000. Contact The Studio Manager, Sabre Mobile Recording Studio, 55 Cliff Drive, Canford Cliffs, Poole, Dorset. Phone 0202 708303. K

●**Studio package** comprising Allen & Heath 16 into 8 mixer, ITAM 805 8-track recorder, both excellent condition, all linking cables, and assorted extras. Spring reverb, compressors/limiters, etc. Tel. 0733 242520 or 0406 22044 evenings. K

Leevers Rich 1in tape transport with 3M 8-track heads, erase, sync, play, in cabinet with 19in card rack. No electronics. Moving; must sell. £600, but open to offers. Phone High Wycombe 448928. K

●**Absolute bargain.** Hill "K" series mixing consul, 20 x 16, immaculate, 18 months old, 96-way patching, P. & G. faders, 16 output VU's, 2PPM's, 3-way led input overload. £3,400+V.A.T. o.n.o. 01-552 0655. K

●**Teac A3340-S** 4-channel recorder with Teac remote, immaculate, £625. AKG Stereo reverb, £225. HH Stereo 16 mixer with cannons, £450. 2 MXR Stereo Companders, £100 each. All home use only. Ipswich 710051 (Office), Ipswich 43038 (Evenings). K

●**Revox A77 Mk11** high speed, full tack. Two machines for £500 the pair. 01-888 1909. K

●**One pair JBL 4315** Studio Monitors, 18 months old, very good condition, £850. Exeter 33138. K

●**Cadey 16-track** 2in recorder, £3,500. 18 months old. Good condition. 0634 76117. L

SITUATIONS WANTED

●**Ex-B.B.C. Television Sound** Supervisor with studio, outside broadcast, radio and sweetening experience requires interesting post, not necessarily mixing. Will move or travel at Home or Abroad. Box 839 c/o *Studio Sound.* K

STUDIO FACILITIES

★**Fanfare Records.** Tape-disc pressings, demo's masters, any quantity. Studio/mobile Neumann disc cutter. S.A.E. brochure. 1 Broomfield Close, Rydes Hill, Guildford, Tel. 0483 61684. X

★**Disc Cutting** master and demos, pressings, cassettes, mobile recording studio. Free brochure. TAM Studio, 13a Hamilton Way, London N.3. Tel. 01-346 0033. X

★**New Wollensak cassette copiers** directly imported by C.A.V.S. Ltd., cost less and have full service/spares back up. E.g. Wollensak 2770 still costs £999 plus V.A.T. Also available Telex Copuette at £299 plus V.A.T. and all other Wollensak, Telex, Pentagon similar units. Contact Yates, C.A.V.S. Ltd., 01-363 6125. X

★**Accurate level** control starts with a Cathedral LA3 comp/limiter module, from £30 per channel. Telephone Halsall (0704) 840328. B

AUDIO PRODUCT SPECIALIST

(Sussex Coast)

Reporting to the Marketing Director, the successful applicant will be responsible for providing overall guidance and direction in the Marketing of existing products (audio test equipment, etc) and the planned introduction of new equipment to achieve growth objectives. Sales visits in the UK and overseas will be involved.

Degree level or equivalent qualifications in electronics together with previous experience essential.

Enthusiasm, self motivation and ability to use iniative will be rewarded with an excellent salary and working conditions plus Company Car. Relocation expenses will be paid where appropriate.

Please telephone or write to:

Mrs. Miller,
Personnel Manager,
Wayne Kerr,
Durban Road,
South Bersted,
Bognor Regis,
West Sussex.

Tel. (0243) 825811

ADVISION RECORDING STUDIOS

Have a vacancy for a Senior Technical Engineer. The post includes a wide range of duties, but primarily the applicant will he involved with the maintenance, development and installation of recording equipment at our London based Studios.

The successful applicant will have a sound electronic knowledge coupled with a good background in digital technology.

Applications in writing please to:
Roger Cameron, Advision Recording Studios, 23 Gosfield Street, W.1.

SOUND STUDIO ENGINEER

Sound recording studio requires a presentable engineer preferably with 4-track audio-visual mixing and pulsing experience, to handle a wide variety of sound work. Sales experience would be a bonus. A retainer fee for a reliable freelance would be considered.

A.V.E. (U.K.) Ltd.,
73 Surbiton Road, Kingston, Surrey.
Tel. Elaine Wilson on 01-549 7521

FOR HIRE

●**Tannoy Monitors for hire.** Tannoy Speakers repaired. Rapid turn round plus evening/weekend service. Bell Hire. Berkhamsted 74653. K

Assistant Film Dubbing Mixer

to work in a newly built dubbing, Perfectone equipped, complex. You will assist the dubbing mixer on a wide range of productions. Your duties will include relief mixing. You will have had some experience of mixing film for television.

Salary £6914 with ACTT conditions.

Sound Camera Operator/Transfer

to work in a new transfer suite. You will be principally involved with the transfer of ¼" master tapes and sound effects to 16mm films.

You will have had previous experience handling tapes.

Salary £7652 with ACTT conditions. Although applicants (male/female), should be experienced for both positions consideration will be given to trainees who show practical interests in sound. Trainee salary is £4850. Additional benefits are a pension scheme, free life assurance and 23 days holiday. Write, stating age and experience to

Fiona Hallworth Ref: G55 Granada Television Ltd
Quay Street Manchester M60 9EA

GRANADA TELEVISION

CBC 221

CARDIFF BROADCASTING requires

An experienced Broadcast Engineer (ILR 2 grade) to assist the Chief and Deputy Chief Engineers in the running of this exciting new radio station. Write with details to:

THE CHIEF ENGINEER
CARDIFF BROADCASTING
P.O. BOX 221
CARDIFF
CF1 5XJ

For Further INFORMATION on

STUDIO SOUND

contact

PHIL GUY

on 01-686 2599

CHIEF ENGINEER

INDEPENDENT LOCAL RADIO STATION

Applications are invited for the position of Chief Engineer for a New I.L.R. Station based in the West of Scotland (Mainland). The Appointment would take effect from January 1981 and applicants should be suitably qualified individuals having an enthusiasm for Local Radio and practical experience in all aspects of Installation, Maintenance and Technical Operation of Sound Broadcast Equipment to the I.B.A. Code of Practice Standard.

Salary would be by negotiation.

Please reply by 31st October 1980, giving fullest Career and Qualification details, to:

Moorfoot Services,
'Argentine',
Whiting Bay,
Isle of Arran KA27 8PZ.

Applicants for other Engineering Positions, to be engaged by May 1981, are invited to respond to this advertisement.

ITN

SUPERVISORY ENGINEER

PLANNING AND INSTALLATION PROJECTS

Salary: in excess of £12,500 p.a.

Independent Television News Limited has vacancies for Engineers to take responsibility for a range of Capital Projects concerned with Television Studios and their associated audio and video facilities.

For one of the vacancies specialist knowledge of audio techniques and equipment would be an advantage but a thorough understanding of broadcast engineering is essential in all cases.

Each engineer will be responsible for system planning and specification in liaison with Operational Sections, Management and Manufacturers and the organisation of installation and commissioning.

The successful applicants, reporting to the Manager, Engineering Projects and Development, will be expected to offer original thought in system design and equipment selection.

ITN's Capital Projects Section is based at the Central London Studio Centre near Oxford Circus. Benefits include free life insurance and a contributory pension scheme.

Please telephone 01-637 3144 for an application form, quoting vacancy number 30709/10.

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STEP OUT IN FRONT

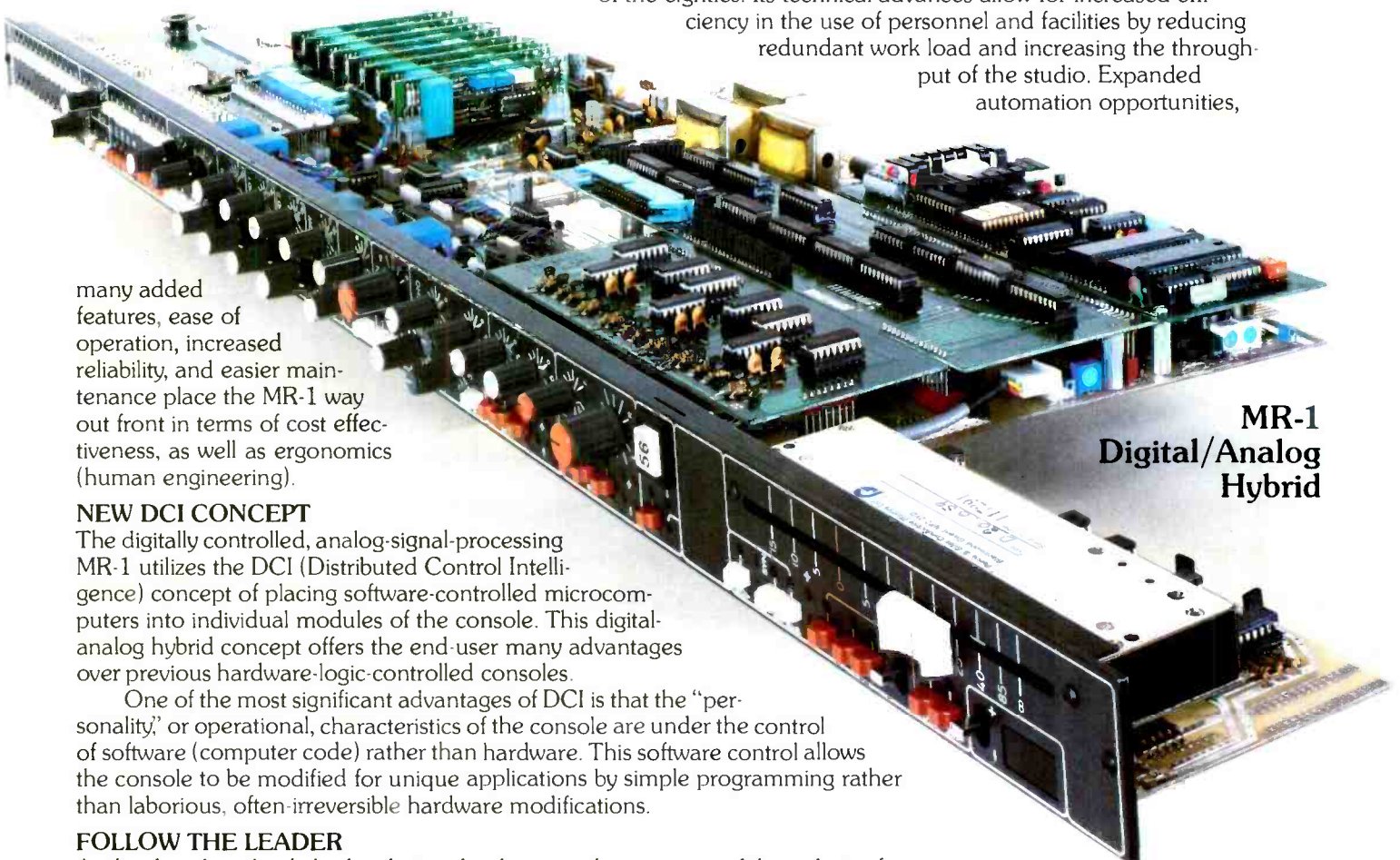
With a giant step forward, the MR-1 has become the first of its kind—the first in a whole new generation of recording consoles.

Making its entry at the beginning of the eighties, the MR-1 is unquestionably a radically new and different breed of console from that of the seventies. Through its inception, a giant step toward digital has truly been taken.

For the first time—with the advent of the MR-1—many of the advantages obtained through digital have become both practical and available. By incorporating all existing cost-effective digital-control technology into advanced analog formats, Harrison Systems has designed and produced the industry's first digital-analog "hybrid" music recording console . . . the MR-1.

MORE VALUE – NOW

The MR-1 is clearly a console designed for the eighties, with the new technology of the eighties. Its technical advances allow for increased efficiency in the use of personnel and facilities by reducing redundant work load and increasing the throughput of the studio. Expanded automation opportunities, many added features, ease of operation, increased reliability, and easier maintenance place the MR-1 way out front in terms of cost effectiveness, as well as ergonomics (human engineering).



MR-1
Digital/Analog
Hybrid

NEW DCI CONCEPT

The digitally controlled, analog-signal-processing MR-1 utilizes the DCI (Distributed Control Intelligence) concept of placing software-controlled microcomputers into individual modules of the console. This digital-analog hybrid concept offers the end-user many advantages over previous hardware-logic-controlled consoles.

One of the most significant advantages of DCI is that the "personality," or operational, characteristics of the console are under the control of software (computer code) rather than hardware. This software control allows the console to be modified for unique applications by simple programming rather than laborious, often-irreversible hardware modifications.

FOLLOW THE LEADER

As the digital-analog hybrid is destined to become the mainstay of the industry for some time to come, other console manufacturers are sure to follow the lead in the use of these new methods and technologies. But as of now, the concepts are unique to Harrison, and the MR-1 has moved out in front of its field.

The eighties hold many challenges for the audio industry, and Harrison offers a console to help you meet those challenges.

. . . or stay back with the pack

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