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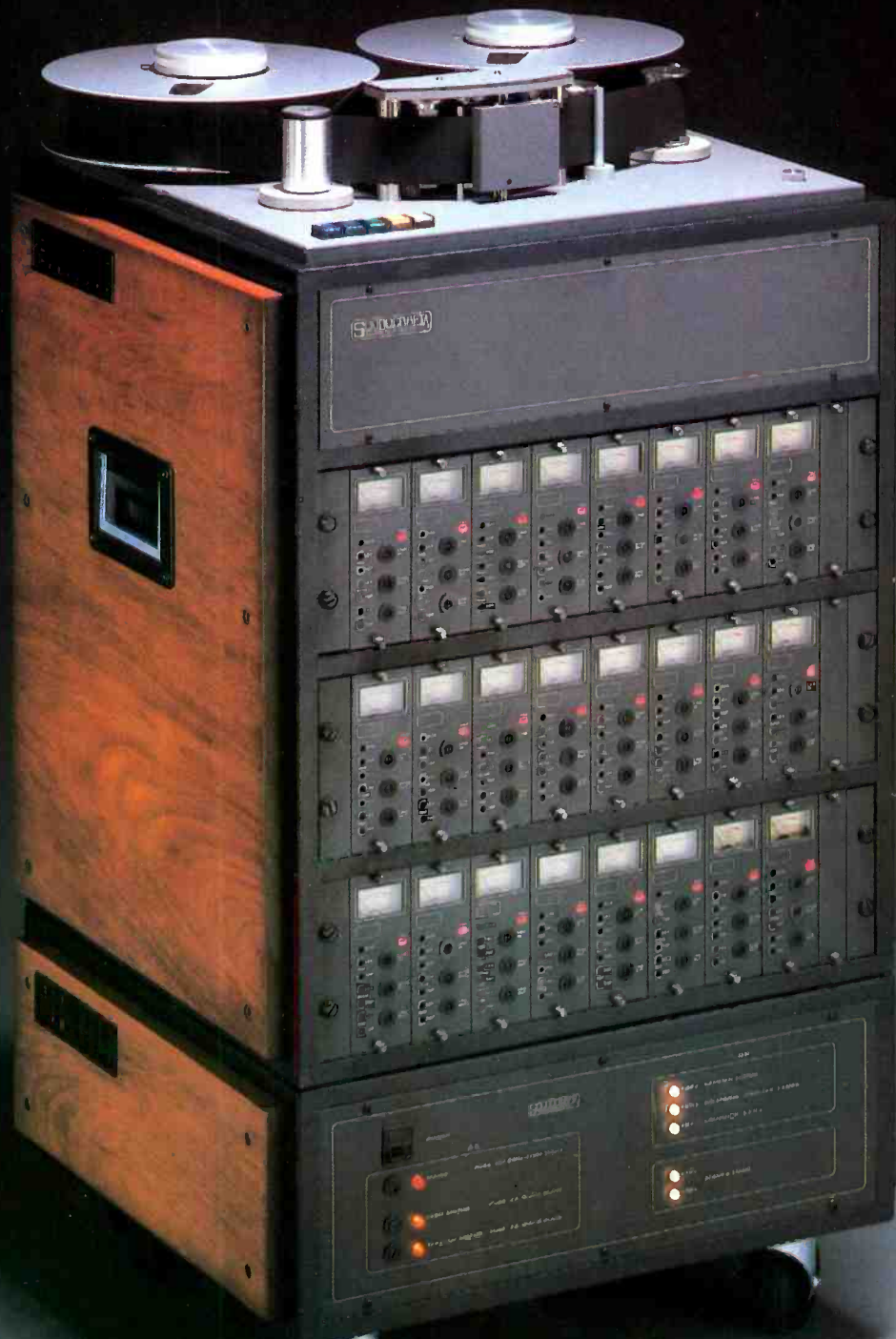
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A LINK HOUSE
PUBLICATION



MEMBER OF THE AUDIT
BUREAU OF CIRCULATIONS

This month's cover courtesy of Autograph and David Darby

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Sound and the supernatural

Many of the people I have met during the years I have been involved in the sound industry have had tales to tell of strange goings-on in the studios or auditoria in which they work. They range from simple stories like that of the engineer who was playing the piano late at night after a session in a deserted studio complex when an acoustic screen trundled slowly past, or the mysterious tone which came from nowhere and moved about in the studio as maintenance engineers tried to trace it, to more complicated accounts, for example of the allegedly haunted theatre in which disconnected mains cables suddenly generated 110V AC at 60Hz (in Britain) and lighting arrays inexplicably fell from the upper circle, or the remarkable account of the staff and musicians who returned to a studio control room after a break to discover that a mysterious string arrangement had been inexplicably added to their backing track, recorded in stereo, which faded slowly away over a period of about thirty minutes...

There are many such stories, some reasonably substantiated, others less so. All in all, they are fascinating. Other events are recorded which are less specifically related to the industry, but nevertheless defy purely materialistic evaluation, like the musician I once encountered who

opened a locked studio front door with a brief incantation.

In studios and other organisations all over the world, in recording, live sound, broadcasting and other professional audio areas, there must be many of these fascinating tales of the unexplained, and it would be most interesting to publish a collection of such stories if readers would like to send them in. Obviously, the more authenticated, the better they'll be, but of course this is not always possible. There's no need to make them up, as there must be quite enough 'true' stories or apocryphal tales around without having to invent them. If you are worried that giving away the name of the studio or whatever would scare off superstitious clients, we will happily omit the name of the facility, and give merely the event, as we do in our similarly apocryphal *Agony* items (and we could do with more of those, too: don't tell me that nothing silly or disastrously funny ever happens any more!).

I hope readers will be interested in sending in items which we can either compile into a feature article, or run as a series of reports on a month-to-month basis. We'll call it something like *Sounds Supernatural*. Let's hope there will be a good response which will make fascinating reading for everyone.

Richard Elen

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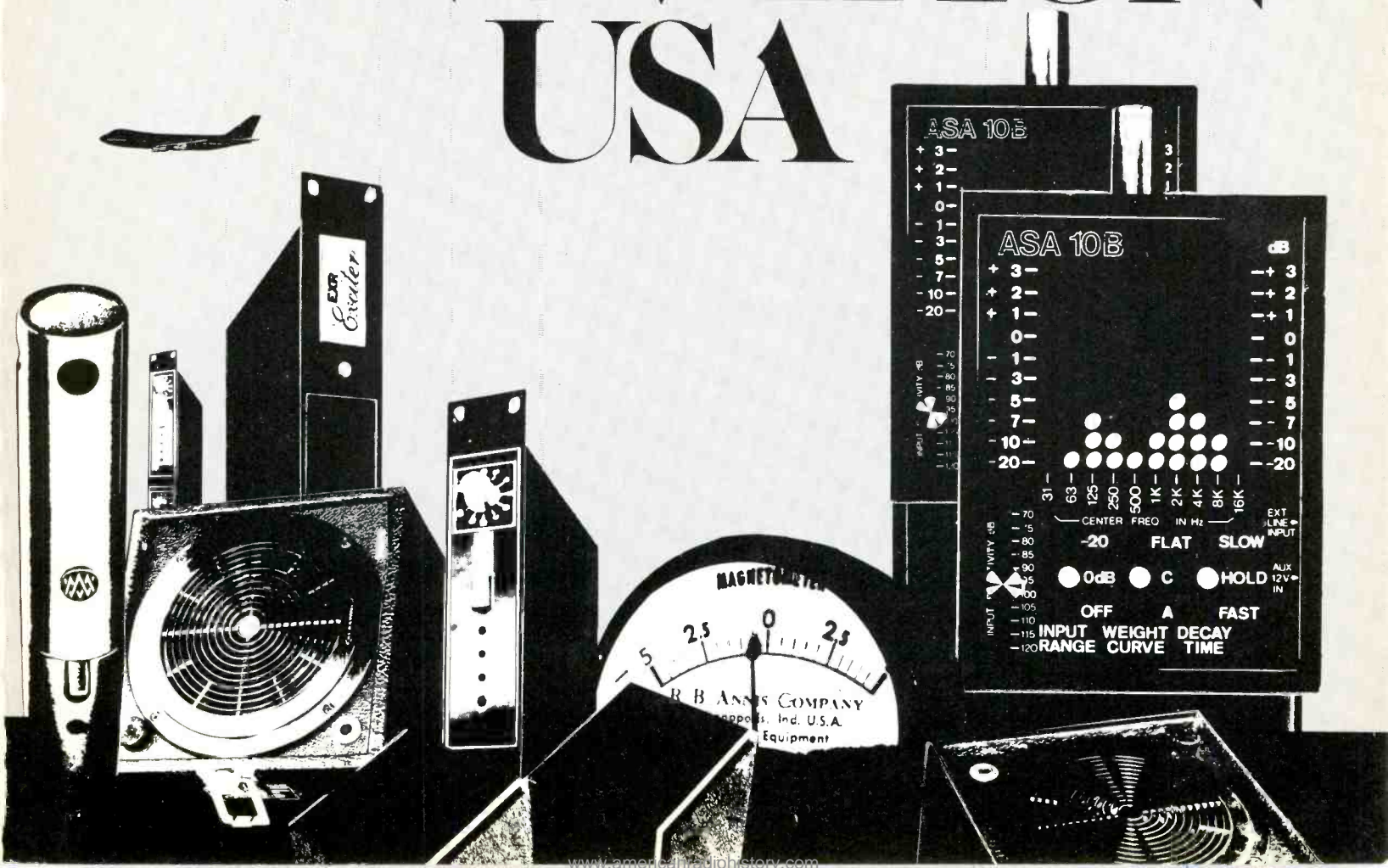
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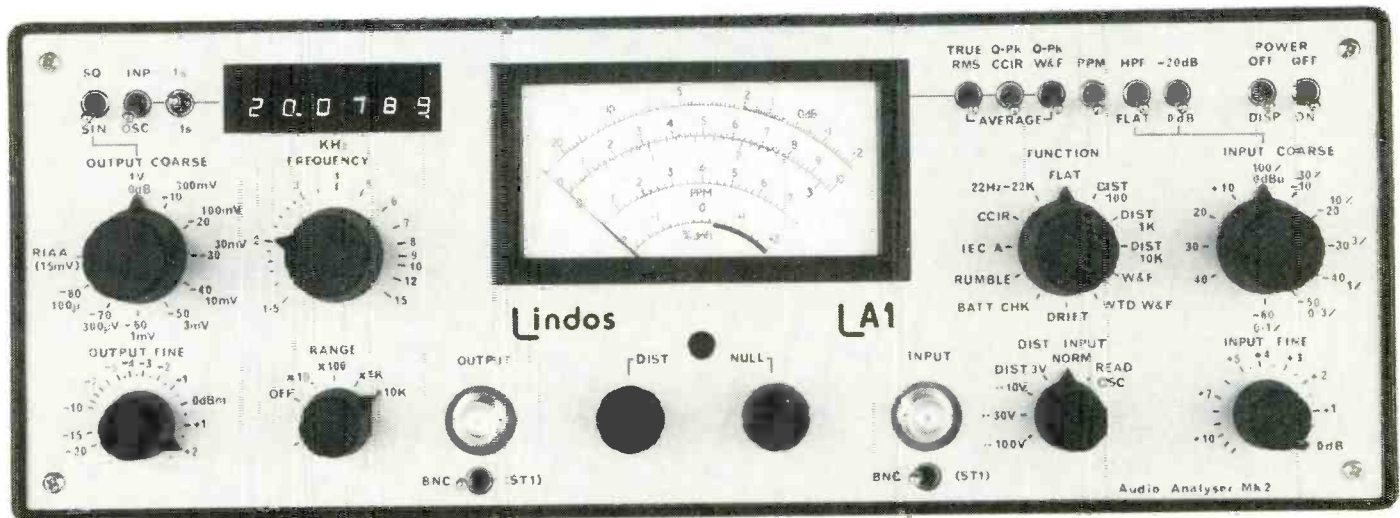
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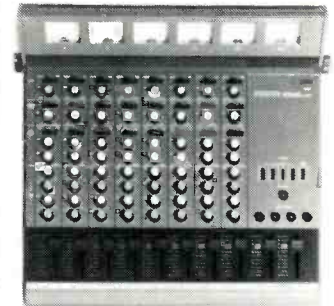
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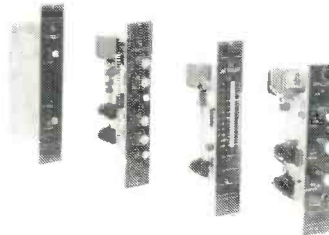


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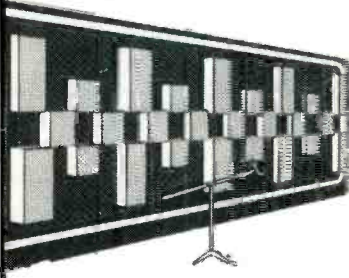
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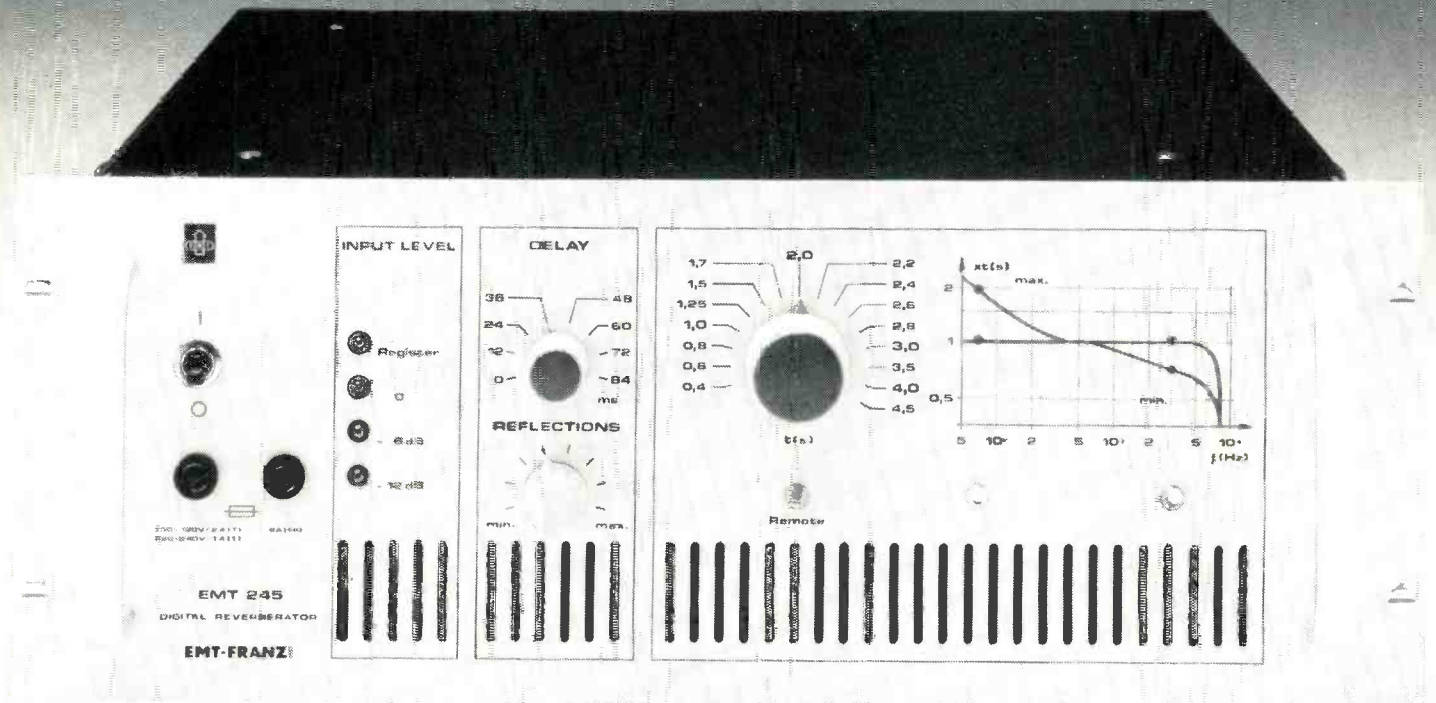
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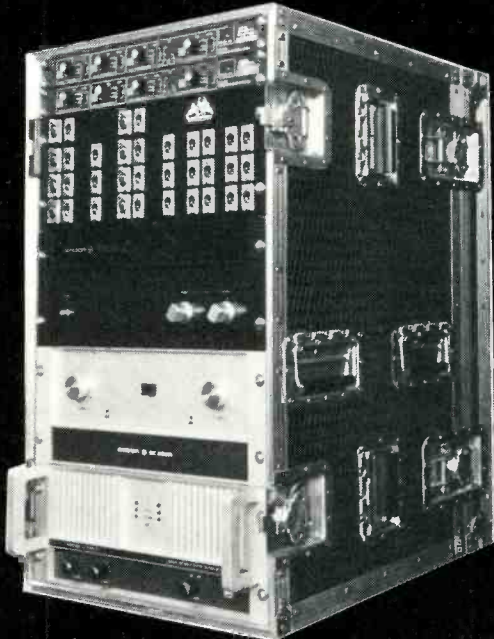


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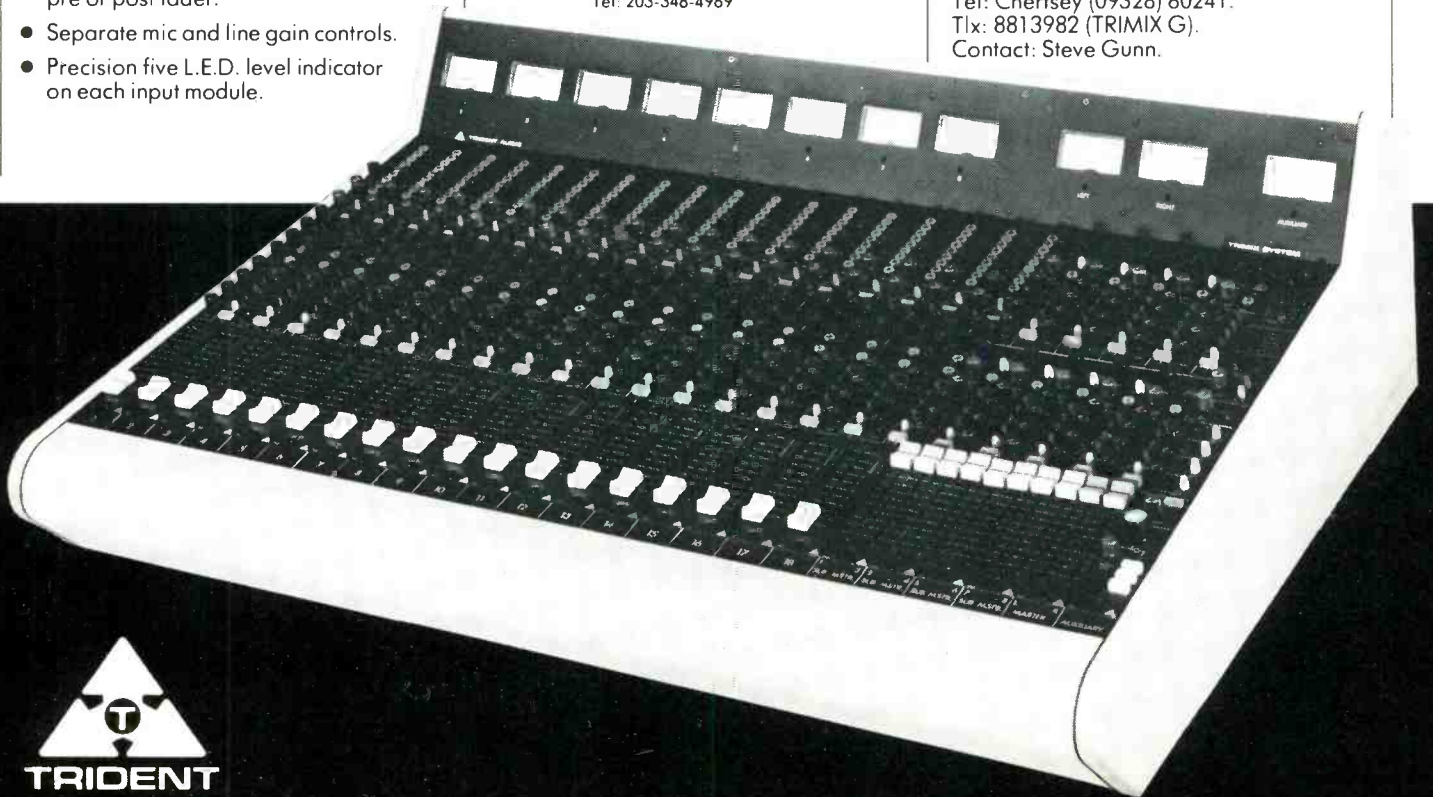
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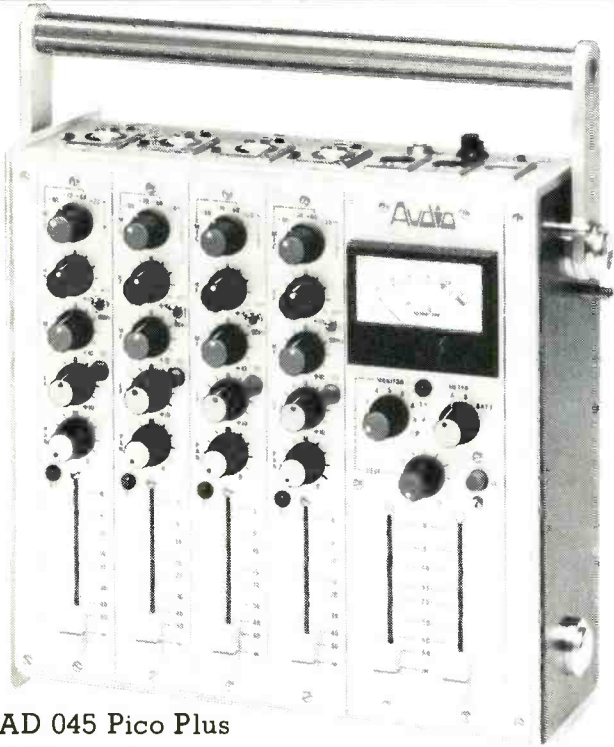
Teac 80/8 1/2" 8 track/varispeed 8 track Teac DX8 noise reduction	= £2,600.00
8 track 1" Brenell Mini 8 1" varispeed/remote control Allen & Heath 16x8	= £5,495.00
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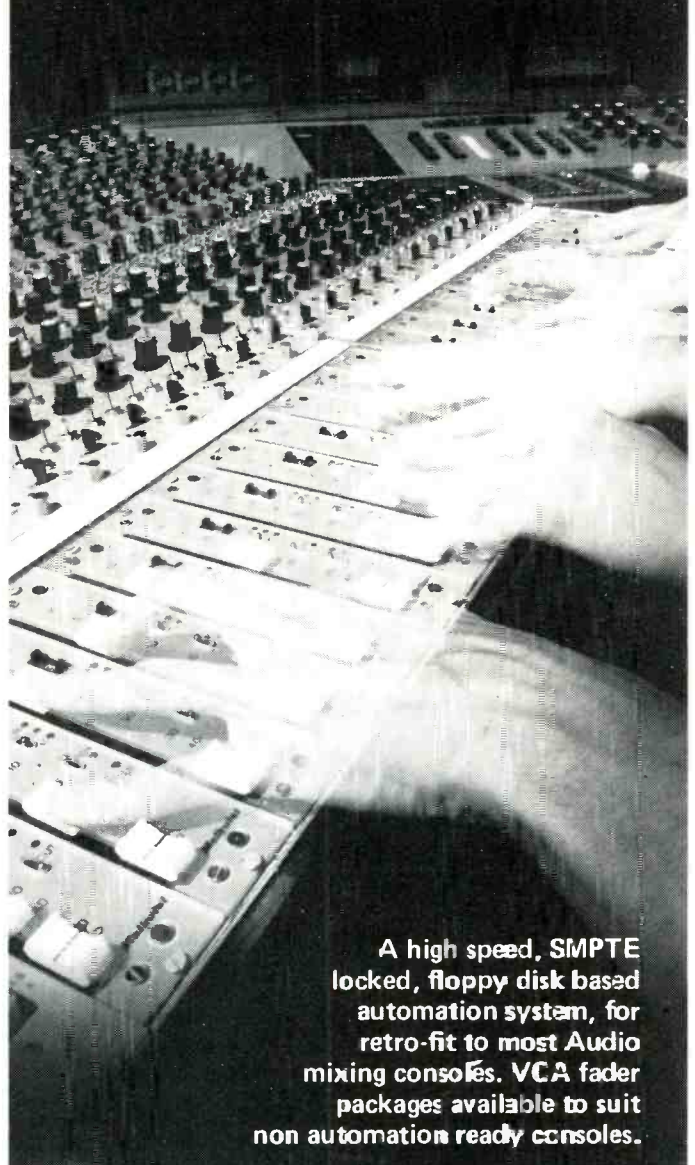
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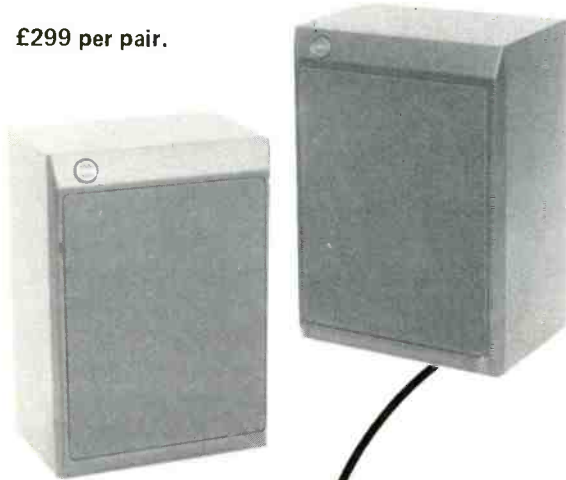
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The 828, a high quality stereo output mixer with 8 or 12 mono mic/line inputs, HF, MF & LF equalisation, echo and foldback sends, PFL on headphones, limiters on outputs. PPMs & phantom power optional.



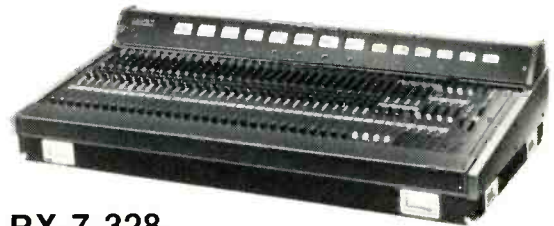
The 828-S, a broadcast quality stereo output mixer with 3 mono mic/line inputs and 5 stereo RIAA (phono) or line inputs. Comprehensive monitoring facilities include stereo 'B' check input with gain control, phase reverse, mono and dim, PFL on meters, VU's or PPMs to order. 48v phantom power standard. LS mute by fader micro-switch available.

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TOA's professional mixing console—great sound when you're on the road.

Toa's modular RX-7 mixing console comes in three ruggedly portable models, allowing you to select just the right amount of mixing versatility and convenience for your needs. Our most powerful unit is the RX-7-328, with an impressive 32 input channels, 4 group outputs and 8 program outputs. For those requiring fewer input channels, our RX-7-248 has 24, along with the same number of group and program outputs as the 328. Thanks to the modular construction of the RX-7 mixing consoles, all the functions are exactly the same, except there are 8 blank panels in the 248 replacing the input modules. The RX-7-164 has its own, smaller frame, but the the same high-quality modules are used to provide 16 input channels, 4 group outputs and 4 program outputs. All three mixing consoles are powered by the RPS-7 independent power supply, making them easier to carry and eliminating AC line noise. With all that each unit in Toa's powerfully versatile RX-7 series has to offer, you're sure to find one that's a perfect match for all your sound mixing needs.



RX-7-328



RX-7-164



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The Fostex Multitracker is a Personal Recording Studio, that challenges the quality and facilities of open reel.

Separate but together?

Mixer and recorder work as one but you can use them independently. The mixer is four in, four out, with gain, tone, echo and pan. The four track tape deck has remarkable features.

How about noise?

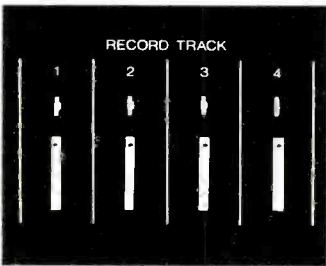
Sound quality is astonishing. The latest Dolby 'C' circuitry achieves a drama-



DOLBY C NR

tic 71dB signal to noise ratio. It's performance you would expect from open reel. And there's more. Dolby's new system has side benefits that result in tighter, more transparent recordings.

Full function four track?



There are no restrictions, all four tracks can be recorded at once. Any input can be switched to any track. Or plug into the recorder direct, from another mixer, to add more channels or to capture a live performance.

Is ping-pong possible?

Selsync is fully automatic, and you can bounce adjacent tracks with quality. With a little forethought, you can perform the ten track bounce with hardly any noise build up.

It's a solenoid transport?

The high speed, two motor design is microchip



controlled, with varispeed and a digital counter plus return to zero. It's all there to speed your creativity.

Why a footswitch?

Have you ever tried to work a tape recorder while playing an instrument? With the Multitracker you simply preselect the tracks you want to overdub or correct, then run the machine in 'recrd ready' and hit the footswitch on cue.

Are four inputs enough?

The whole point of multitrack is to record a tune a part at a time. With one or two musicians, four is plenty. When you overdub, the inputs are used over again.

Is monitoring complicated?

An automatic 'monmix' switches between live and signal already on tape, depending on which tracks you select for record. All you adjust is level. You can also check the stereo mixer output for quality and balance.

How about effects?

Your echo unit connects to the 'aux' send and return sockets. You can

also use limiters, equalisers etc or existing pedal effects.

Why Personal Multitrack?

The Fostex Multitracker, and each product in the range is designed for musicians and songwriters. Easy to use and own. We don't believe you need to go into the studio business to own the tools of your trade.

Visit a Fostex Dealer and discover the remarkable Multitracker for yourself. It will make you think twice about open reel.

Call or write for a full dealer list and 12 page brochure covering the entire range of Personal Multitrack products.

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Fostex®

California tax threat

The California State Board of Equalization has imposed a retroactive sales tax on all independent producers, independent engineers, production companies and recording studios, in a move designed to boost tax revenue. The means by which the Board has gone about its task, by re-interpreting the tax codes, has led to a furor within the industry and the formation of a group to fight the board's interpretation, the California Entertainment Organisation.

Crux of the battle about to ensue, between the Board and the CEO, is the new interpretation of tax codes which holds all monies received by recording studios, etc, are subject to a 6% sales tax, retroactive to 1974. The state's interpretation also holds that even though a consumer pays sales tax on the retail purchase of records, sales tax should also be levied when a record manufacturer purchases a master tape from a producer or production company, for the services a recording studio provides a producer or production company, or for the services an independent engineer provides. Each of these stages are regarded as separate fabrication costs, to be taxed separately. In addition, the state is seeking to impose a 10% penalty for failure to file sales tax returns, plus 1% per month interest.

The state is claiming that prior to 1976 the taxable sales price is the

total gross received by a production company including recording costs, artist advances, producer's and engineer's fees, and all royalties received. Similarly, after 1976 the state claims that the taxable sales price is the total gross spent on producing a tape including recording costs, all fees and advances, plus hotel expenses, rental cars, air fares, lunches and dinners—indeed anything connected with the 'fabrication' of a tape. In both cases the state claims that production companies did in fact collect sales tax on behalf of the state, and failed to remit it to the state. Thus, any independent producer, engineer, production company, or recording studio is liable to the retroactive tax.

Without going into the issues of double or triple taxation, and the fact that non-residents of California who have done business in the state over the period of time in question are not exempt, the realisation that the retroactive taxation and penalties are liable to seriously squeeze the Californian recording industry financially, and that this will probably cause the demise of many of the state's smaller studios is to say the least disturbing. Quite how the state's tax demand and the recording industry's fight against it will be resolved remains to be seen, but let's hope sanity prevails and that permanent damage to the Californian recording community is avoided.

EMI Tape

As most readers are aware production of EMI recording tape ceased shortly after the takeover of EMI by Thorn, the company's manufacturing plant and Hayes offices being closed down. However, this has not meant the end of the company's involvement in the tape field. A new company, Thorn-EMI Tape Ltd

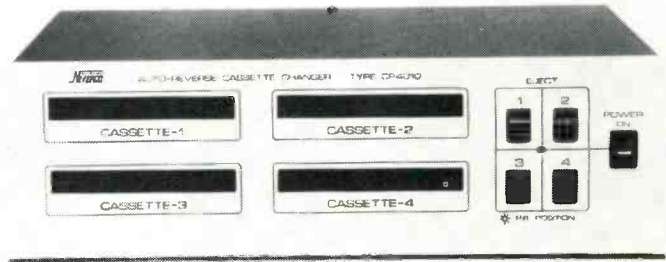
based in Windsor, has been set up and it is responsible for marketing EMI cassette duplication tapes, plus the Capitol Magnetic Products range of tapes manufactured in the USA. Full details of the range of products available are obtainable from: **Thorn-EMI Tape Ltd, Alma Road, Windsor, Berks SL4 3JA, UK. Phone: Windsor (07535) 59171.**

State of the industry

The APRS has released details of its first professional studio survey, conducted for the APRS by Booth, Anderson & Co. The results indicate a number of interesting factors, but because they are the first in a series, they have to be viewed in isolation and, except for turnover, do not indicate trends. The results show most notably that average turnover (over the last five accounting periods) has risen from £79,975 to £233,807—a figure which needs adjustment to allow for inflation—while profits as a percentage of turnover average out at 14.15%. Average capital employed is £118,816, and average insured value

of equipment is £221,500.

Probably the most interesting statistic is that despite the effects of inflation the average percentage of profit represents a return on capital employed of 28.5% (average) which is quite high even after allowing for the comparatively small average turnovers of each studio. This latter statistic, which indicates that the recording studio industry is outperforming the majority of UK industry, needs to be viewed with caution in as much that a fuller picture will emerge when further surveys are completed. However, it does tend to belie the usual 'times are hard' picture portrayed by studios.



Canford/Niverco

Canford Audio has been appointed sole UK distributor for the new Niverco CP4010 continuous cassette player. The CP4010 features four logic controlled auto-reverse tape mechanisms operating in sequence, to give six hours continuous play, from four C90 cassettes. Designed to

operate non-stop, the unit is ideal for commercial and industrial applications. Available with stereo or mono playback, the unit features AGC on the output for constant level reproduction.

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

Melkuist/Param

FWO Bauch has informed us that Melkuist Ltd are currently working with Peter Leumig, designer of the Param programmable equaliser system, to produce a console automation system which will, for the first time, allow automated EQ changes during a mix. It is hoped that further details of the system will be available in the near future.

AM stereo

In a somewhat surprising move the American Federal Communications Commission has decided that it will not establish a single technical standard for the transmission and reception of AM stereo. Instead it has decided to permit all of the five proposed systems (Belar, Harris, Kahn, Magnavox and Motorola) and any others to compete for acceptance by broadcasters and receiver manufacturers. The FCC decision is unprecedented and possibly owes much to the ramifications of anti-trust law legislation. However, the decision to let the 'marketplace' decide which system it wants is likely to result in confusion among broadcasters and the public, as well as prohibitively expensive home and car radios which would be necessary to receive all five types of AM stereo signals. This decision is also likely to be detrimental to the orderly growth of AM stereo in the USA. The FCC move is rather surprising as not only were the competing system proponents coming to the conclusion that a single standard was preferable, but the majority of AM stations were also of the opinion that a single standard should be agreed.

Gary Hedden Ltd

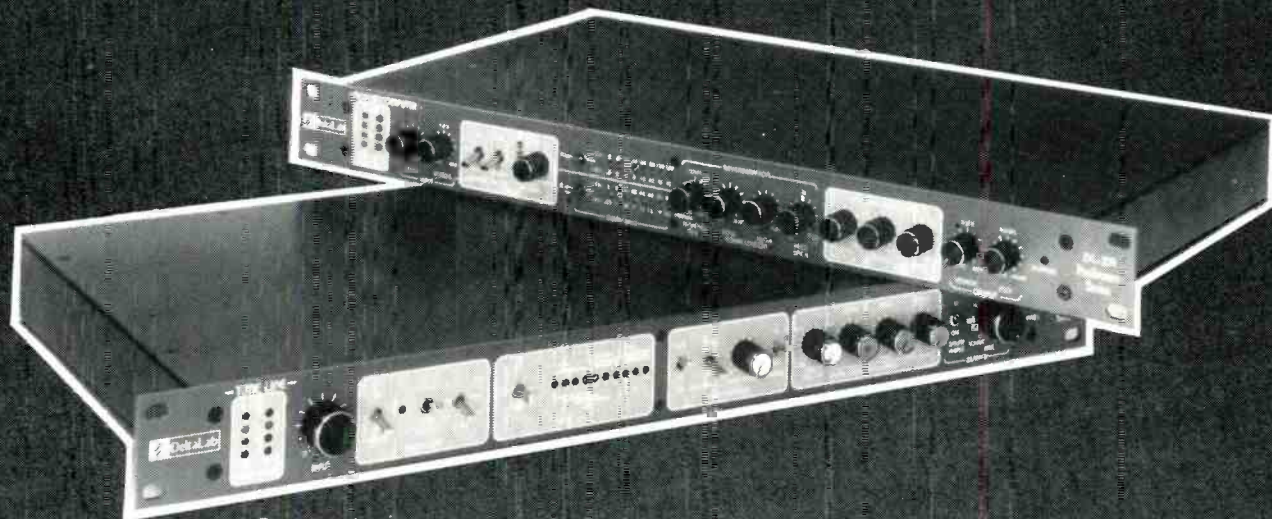
Gary Hedden, well known in the Chicago area and throughout the USA as a studio designer, consultant and session engineer, has formed Gary Hedden Ltd, a new company specialising in the above and related fields. Gary, who is probably best known for the design and construction of Hedden West's two recording studios in Chicago, is offering design, construction, audio equipment and acoustics consultation, and session engineering services. In addition to himself, Gary has appointed Marty Sargent as his technical consultant. Projects undertaken by the new company include a dual 24-track mobile housed in a 26ft GMC motorhome and equipped with a custom Sphere console, Otari tape machine, Fostex monitors and CCTV facilities; plus the design of Ohio's first 24-track studio, JD Blackfoot Studios in Columbus. Full details of the services offered by the company are available from: **Gary Hedden Ltd, 911 S Grove Avenue, Barrington, Illinois 60010, USA. Phone: (312) 381-8360.**

Mitsubishi/Telefunken digital

Further to our reviews of the Mitsubishi/Telefunken MX-80 digital tape machine and DDL-1 digital preview unit (May issue), we have been informed that these units will in future operate at a sampling frequency of 48kHz rather than the present 50.4kHz. This decision brings these units into line with the 48kHz standard adopted by Ampex, 3M, Sony, Soundstream and Studer.

24 ▶

COST EFFECTIVE!



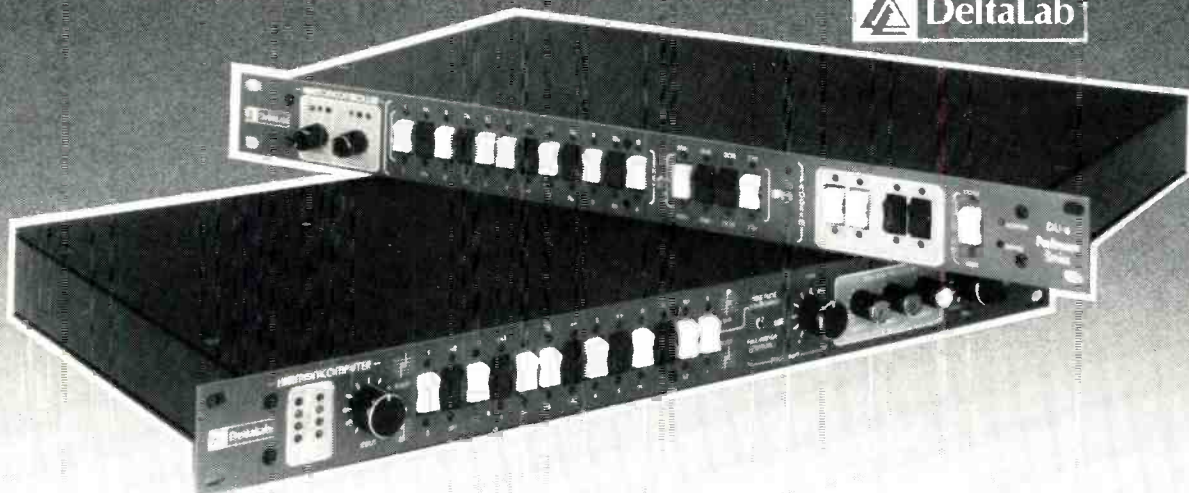
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Switzerland Audio Bauer Zurich Tel: 016 432 30

Finland Studiotec Espoo Tel: Espoo 90520604

Norway LydRommet Oslo Tel: 02 1140 85

Autograph Sales Ltd

A new company, Autograph Sales Ltd, has been formed by David Solari, formerly sales and marketing manager for Midas Audio Systems, with Julian Beech and Andrew Bruce of Autograph Sound Recording Ltd. The new company has been appointed exclusive European distributor for Meyer Sound Laboratories Inc, designers and manufacturers of compact PA and sound reinforcement loud-speaker systems. In addition, the company are acting as exclusive UK distributors for the Klark-Teknik range of professional audio equipment and the American range of power amplifiers manufactured by AB Systems Design, and as a London dealer for Brooke Siren Systems. In conjunction with the sales and marketing of the above products, the company intends using Autograph Sound Recording's extensive experience in sound systems design, installation and maintenance to provide a complete service to the sound reinforcement industry.

Autograph Sales Ltd, Stable 11, British Rail Camden Depot, Chalk Farm Road, London NW1 8AH, UK. Phone: 01-267 6677.

DDA Ltd

David Dearden and Gareth Davies, formerly technical sales manager and product development manager with Soundcraft Electronics Ltd, have left to devote their full attentions to DDA Ltd, a recently formed company manufacturing a range of electronic crossovers, power amplifiers and mixing consoles. The company has also moved to larger premises at the following address: **DDA Ltd, Unit 7B, Worton Hall Trading Estate, Worton Road, Isleworth, Middx TW7 6ER, UK. Phone: 01-847 0363.**

3M acquire ITC

3M and ITC (International Tape-tronics Corporation) have jointly announced an agreement for the purchase of ITC by 3M. Under the terms of the agreement ITC will become a subsidiary of 3M's Magnetic Audio/Visual Products Division. This acquisition will marry ITC's tape cartridge equipment with 3M's *Scotch* audio tape manufacturing operation. Although final details of the agreement are still under negotiation, it is anticipated that there will be no major changes to the ITC management structure. In addition, FWO Bauch Ltd will continue as ITC's UK agents.

Agencies

● Calrec Audio Ltd has appointed Audio & Design Recording Inc as its American agents for the company's range of professional mics including the Ambisonic *Soundfield* mic. Audio & Design Recording Inc, PO Box 786, Bremerton, Washington 98310, USA. Phone: (206) 275-5009. Telex: 152426.

● Capitol Magnetic Products has appointed Leavers-Rich Equipment Ltd as agents for the company's AA-3 broadcast cartridge. Leavers-Rich Equipment Ltd, 319 Trinity Road, London SW18 3SL, UK. Phone: 01-874 9054. Telex: 923455.

● Elliott Bros has been awarded a contract by the English National Opera to supply and install a backstage communication system, including a Phillip Drake talkback system, at the London Coliseum. Elliott Bros has also recently completed the installation of Chiltern Radio's Dunstable studios.

● AKG has asked us to point out that in addition to Atlantex Music, national distributors of its microphone ranges are Audio Services, Stockport; Wilkinson Music, Glasgow; and Keith Hand Musical Supplies, Manchester.

Address changes

● Webber Tapes Ltd has moved to Coburg House, Western Road, Wood Green, London N22, UK. Phone: 01-889 9347.

● Norwegian tape machine manufacturer, Tandberg A/S, is now located at PO Box 53, Fetveien 1, N-2007 Kjeller, Norway. Phone: 02-716820. Telex: 11886.

Contracts

● Syco Systems has recently installed a Fairlight *CM1* synthesiser at the BBC Radiophonic Workshop, Maida Vale.

● Solid State Logic are to install an *SSL 4000E Series* console with studio computer and *Total Recall* at Sarm Studios, London. In addition a 40-input *4000E* console with computer is to be installed at The Manor as part of a comprehensive control room update.

● FWO Bauch has supplied a Harrison *MR3* console with Melkuist *GT840* automation to Tapestry Studios, London. The company has also supplied Lexicon *PCM 41* and Valley People *Dyna-Mite* effects units to Genesis.

● Quad-Eight has delivered the second of two *CompuMix III* automated 40-input *Coronado* consoles to NBC, Burbank for video 'sweetening' purposes.

● CB Electronics has supplied a 24-

track tape machine with autolocate and remotes to Peter Gabriel.

● Neve has announced substantial orders for its consoles from Eastern Europe. A 32-channel *8108* console has been ordered for a radio station at Riga, Latvia, USSR: while three 24-channel *5316* broadcast consoles have been ordered for a radio station in Sofia, Bulgaria. This latter contract is in addition to two 16-channel *5462* consoles and a *5422* console recently installed there.

● MCI (Professional Studio Equipment) Ltd has installed a studio for Maurice Gibb of the Bee Gees outside London. The studio is equipped with a *JH-636* 36-input automated console plus a 24-track and *JH-110* stereo tape machines, and various outboard equipment including an *EMT Gold Foil* and *Ursa Major* digital reverb. Other recent installations include a *JH-636* console, 24-track and two stereo tape machines to EVTR, London; four stereo tape machines and a 1/2in stereo machine to CBS, London; a *JH-542LM* automated console to Hungaraton Records, Hungary; a *JH-636* console to Iceland Radio; and a *JH-110C* 8-track tape machine to Sarnar Audio Visual, London. In addition the company in conjunction with Clyde Electronics has delivered a mobile to Melody Records, Moscow — the mobile being equipped with a *JH-636* mobile console and *JH-110* stereo mastering machines.

● FWO Bauch has supplied two complete Melkuist fader packages to De Wolfe Ltd for its Angel Studio complex. The systems comprise Melkuist automated faders and *GT800* automation system retrofitted to Neve consoles. FWO Bauch has also supplied and installed a 48-input Harrison *MR2* console with Melkuist automation, a Studer *A80* 24-track and Studer *A80* mastering machines to Atomic Records and Screen Works in Munich.

● Eela Audio has supplied a wide range of consoles to various broadcasting companies. Radio West, Bristol has received a custom *Concord* console and custom on-air mixer; Radio Essex has received two custom news mixers, a 24 input OB stereo music console, a miniature on-air mixer and a general purpose portable mixer; Radio 210, Reading has received a custom news mixer and a *S100* mixer; and Radio Orwell has received a custom *S100* for OB usage. Contracts from TV companies include a custom *S200* for editing purposes for London Weekend Television; seven special ENG editing mixers to BBC specifications for the BBC; two editing mixers for Central TV; and a sound

effects mixer for ATV, Boreham Wood. Other contracts include a *S100* radio programme mixer for Odyssey Studios and a custom *S200* mixer for Carr Communications, Eire.

● Audio Kinetics has supplied *Q-Lock* synchronising systems to Ewart TV, Anvil Abbey Road, Molinare, and Good News Productions in the UK. Overseas contracts for the system include Denmark Radio, Finnish Broadcasting, Queensland Television (Australia), Central Films (Norway), and FonoRoma (Italy).

● Apex Systems has supplied *Aural Exciter* units to Compact Video, Burbank, and ITV Ltd, Edmonton, Canada, for audio sweetening purposes.

● Cetec Gauss has supplied cassette duplicators and associated equipment to two companies in The People's Republic of China: Pacific Audio and Video Co Ltd, an affiliate of the Kwong Tung Province Broadcasting Group (China Broadcasting Company) for installation in Canton; and Gui Yang No 4 radio manufacturing plant for installation in Gui Zhou (Kwei Chow).

● The Harris Corp has supplied KSEA, Seattle, with a *9003* programme automation system. The six-rack system includes MCI tape reproducers, *Instacart* cart machines, a single play cart machine, and two live studio sources. Harris has also supplied KyXy, San Diego, with an *FM-25K*, 25kW FM transmitter.

● Radio Televizija Sarajevo in Yugoslavia has ordered a 20-input/20-output microprocessor controlled audio routing switcher, distribution amps, patchfields and several custom control panels from Seltech Equipment Ltd.

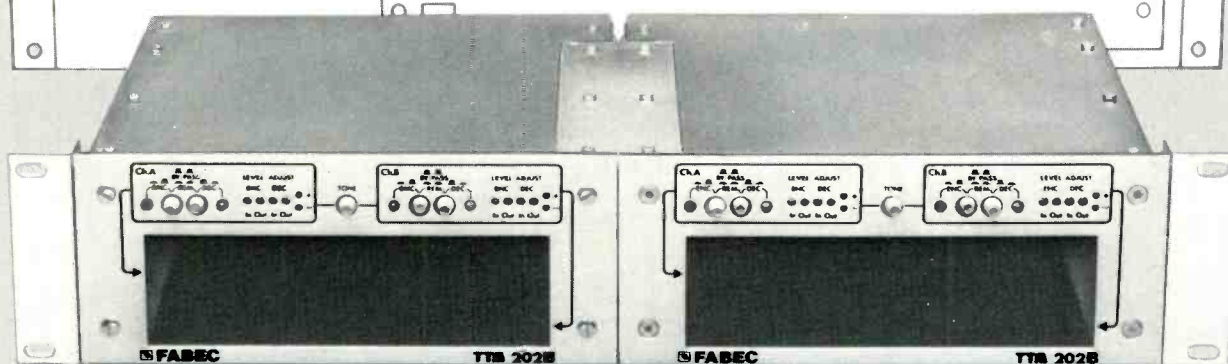
● Midas is to supply five *TR System* 24/8/8 modular consoles to the National Theatre, London in a contract worth in excess of £150,000.

● Radio Wyvern, the ILR station which will serve the twin areas of Hereford and Worcester, has ordered *Series 24A* mixers and a *TXS System* microprocessor based studio/transmitter switcher from MBI Broadcast Systems. MBI will also be responsible for equipment installation at Radio Wyvern.

● Trident (USA) has supplied A & R Recording, New York, with a *Series 80* console equipped with Melkuist sub-grouping. Other recent contracts include a *Series 80* console and *TSR* 24-track tape machine for Mayfair Sound, Manhattan; plus *Trimix* consoles for Westroom, Manhattan, Delta Recording, and a *32/16 Trimix* for Tiki Studios, Long Island.

Announcing a size reduction in noise reduction.

TTM 202B.



Your noise reduction frame is doing half the job it should—
In twice the space necessary!

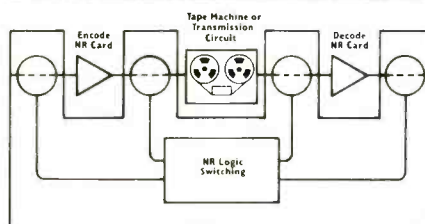
But don't feel bad. Everybody had the same problem—until now.

Until the introduction of the TTM 202B.

For both the recording and broadcasting industries—where rack space is often a problem—this remarkable unit offers a happy solution:

The TTM 202B takes up no more than half the space of the system you're now using. Whichever system it is.

And regardless of your present system, it also lacks our unit's flexibility: TTM 202B—and *only* TTM 202B—takes all types of N.R. cards. Now you



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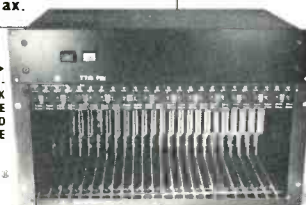
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new products



Carrotron units

Analog/Digital Associates who produce the *STD-1* stereo tapped delay (detailed in *New Products*, February) are also acting as worldwide distributors for two units produced by Carrotron. These are, respectively, the *C920B1* Noise Fader and the *C821B1* preamp. The first unit is intended to suppress hum and noise generated by amplified musical instruments without the drawbacks of conventional noise gates. Utilising *Signal Track* circuitry, the unit tracks the input signal and fades any noise in a smooth, predictable manner without chatter, abrupt signal shut-off, or lingering fuzz. Features of the unit include an adjustable threshold control; a foot switched low-noise active volume control; and discrete FET and transistor circuitry. The unit is housed in a die-cast aluminium case measuring $4\frac{1}{4} \times 2\frac{1}{4} \times 1\frac{1}{4}$ in and is powered by a 9V battery.

The preamp is similarly configured to the *Noise Fader*, but with a gain control replacing the threshold control. This unit has an equivalent input noise of -120 dB, while the footswitched active volume control, which allows the signal to be boosted by up to $+20$ dB, is not in the signal path hence not inserting pops or tonal changes. The unit draws a scant 2mA of current from its 9V battery.

Analog/Digital Associates, 2316 Fourth Street, Berkeley, Cal 94710, USA. Phone: (415) 548-1311.

Quantec room simulator

The Quantec *Room-Simulator (QRS)* is a new rack-mounting digital reverberation device, premiered at AES Montreux by Quantec GmbH. Unlike other digital reverb units, the system enables the user to 'dial up' actual room volumes (in cu m) as well as adjusting other parameters such as reverb time, equalisation, time delay to first reflection and pre-delay. The unit offers a stereo input plus four outputs and additionally enables a number of effects to be added, one of which allows a reverb 'picture' to be held indefinitely, and new signals added.

The unit simulates over 10,000 reflections per second and incorporates novel anti-aliasing filters which, at the AES demonstration, appear to give a very clean and natural sound, in which rooms from cupboard to cathedral size were realistically emulated. Eight files, each with eight locations, allow storage of programmed reverb characteristics.

Room sizes may be specified between 1 and 10^6 cu m in seven steps, and the decay time is select-



Crucible Theatre console

Computer automation for the theatre

PB Theatre Systems has introduced and recently completed installation of one of the first computer-assisted sound mixing consoles to be designed specifically for the theatre market. The system, of which the first example is installed at The Crucible Theatre, Sheffield, is expandable and can accommodate any input/output combination up to a maximum 32/16. The Crucible Theatre system is in a 16/16 format and features automation of input and output routing to satisfy the needs of increasingly complex taped sound effects in the theatre. Selection of sources to input channels, and routing of left and right channel information to output groups is via a solid state matrix under microprocessor control. In addition, 100 memories are provided of the complete routing state of the console.

Features of the console include the provision of two quad channels fitted with Penny & Giles quad pots for variable positioning of effects, in

addition to the usual facilities. As flexible bussing techniques are used throughout, the physical format of the console may be varied to individual specification. The Sheffield system is fully portable to permit use either in the control room or in the auditorium, and this design constraint resulted in the construction of the processor, routing matrix, and console as separate units. As a result the automation system can be retrofitted to any console using standard signal levels. Back-up is provided by pin-matrix plugging in the event of processor failure.

Although the system, which represents a radical change in the design of theatre mixing consoles, is manufactured by PB Theatre Systems, it was conceived by Tim Foster and George Glossop of Hardware House (Sound) Ltd.

PB Theatre Systems Ltd, 12 Century Street, Sheffield, South Yorks S9 5DX, UK. Phone: 0742 447511.

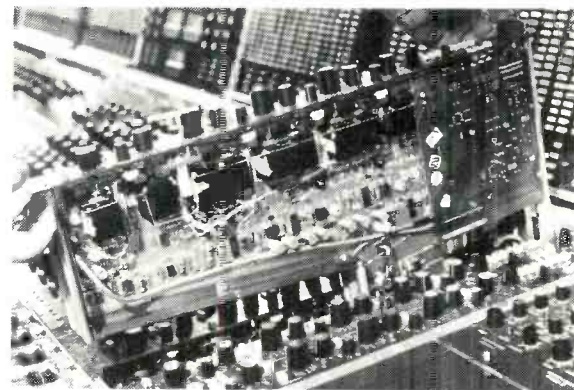
Quad FM4

Quad Electroacoustics, manufacturer of the much respected *Quad 405* power amplifier and *Quad 44* preamplifier, has now introduced a matching FM tuner, the *Quad FM4*. Designed primarily as an adjunct to the preamp, the new tuner uses microprocessor control to recall required stations from memory with accurate control of muting and AFC. The new tuner has no controls other than seven preset station buttons, a 'Tune' button and a manual tuning knob, all other functions being controlled by the microprocessor. To programme the unit, the manual tuning knob is used to find the desired frequency which is indicated in figures via an LED digital display (a bargraph simultaneously displays signal strength and centre tuning), the 'tune' button is depressed together with the appropriate preset button, and hey presto it's consigned to memory. For occasions where more than the seven presets are required, other stations may be tuned manually.

Quad Electroacoustics Ltd, Huntingdon, Cambs PE18 7DB, UK. Phone: 0480 52561.

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Autograph - sound for the stage

Richard Elen

AUTOGRAPH Sound Recording began about 10 years ago. At that time, Philip Clifford and Andrew Bruce were sound engineers at the Royal Opera House, Covent Garden. In those days, there were only about three full-time sound engineers employed by any theatre in London, all the rest of the sound mixers were 'electricians' crew who were doubling as sound people whenever necessary. But the Opera House was employing two, and the Aldwych was employing one. "We were allowed plenty of facilities," says Andrew, "and had a good deal of money to spend, and we were allowed to buy—for a specific show—a Neve 16/4. It was quite a departure from the normal kind of mixers you found in theatres at that time, but it was needed for a piece of *musique concrète* by Luciano Berio, *Laborintus*, which included a lot of tape and a good number of vocalists. So we got that mixer, plus a lot of goodies. One of the things at the Opera House was that we had several different companies to service. There was the main Royal Opera House, there were touring companies and offshoots of those like the touring ballet company, and a number of others. All the companies needed tape machines, microphones and the like. It was deemed that it was not worth the Opera House owning all that gear, because they weren't all on the road at the same time, so they had to hire the gear in. By and large, the quality of the hired equipment was not really good enough and we

Autograph Sound Recording have, despite their name, become one of Britain's top theatre sound companies in the ten years of their existence. Recent shows which have involved the North London-based company include *The Sound of Music* and Andrew Lloyd Webber's phenomenally successful *Cats*. In this article, Richard Elen talks to Andrew Bruce and Julian Beech and looks at the history of Autograph, including some of their shows, giving an interesting insight into modern theatre sound techniques.

felt that anyone could do a better job, so why not us?"

However, the idea didn't get off the ground until Philip and Andrew were asked by one of the great London impresarios, Michael Codron, who specialises in mounting straight plays, to talk to his production manager and tell him why the quality of sound equipment that he was renting was so bad. They were asked to give a brief rundown of what was available, and told him their feelings on the subject. At the end of the discussion, the production manager told them that, if they ever considered starting up on their own, they should contact him. "It was an open invitation to start a company," as Andrew puts it. While the amount of work provided by one or two straight plays in London was not great, it was enough to keep two people in business. Back at the Opera House that night the partners-to-be discussed the subject in depth and decided to go ahead. They tossed for who would leave the Opera

House first, and Andrew stayed at the Opera House while Philip went off to get the company going.

At the same time, their first contract came along, from a completely different source: it was the installation of a pretty standard PA system in a church in St Johns Wood. "That came through a neighbour of mine," says Andrew. The project went well, and it wasn't until three or four months later that they suddenly remembered Michael Codron! They had been so busy from day one that they hadn't even had the chance to call him and tell him that the company was now in business.

Joe Scott-Parkinson, the production manager, asked them over to talk. They were doing two shows, one of which was just about to go into a theatre. The sound for the other one, however, *Absurd Person Singular*, was offered to Philip and Andrew. They bought the gear and rented it to Codron, and that was their first show. During the run, they met Jonathan Deans, a young opera-

tor/sound engineer just out of stage school. He joined them, and is still with the company.

For two or three years, they handled straight plays, picking up all Michael Codron's work at the time. "I like to think," says Andrew, "that our equipment was better, and sounded better, than the opposition." They also picked up other work, notably Michael White's production *Murderer*, which was a straight play with many sound effects. It was technically significant in that this was the first time in the West End that anyone had used NAB cart machines for sound effects, rather than the ubiquitous Revox. The trouble with Revoxes was that they did make a loud 'clack' on entering play; as a result, the audience tended to be aware that an effect was on the way. Cart machines solved this problem, and also allowed the operator greater flexibility. There was a good deal of resistance to this: after all, cart machines are generally a good deal more expensive than a Revox. However, Autograph felt that their job was really to find the best way of doing something, and made the hire rate disproportionately low to overcome that kind of resistance. The wow and flutter of cart machines, however, tends to preclude their use for classical music cues.

At about the same time, they did their first musical in London, *Teeth and Smiles* at the Royal Court, about a rock band on the road. This was transferred to the West End and

although it did not run for very long, it helped Autograph to discover that they liked musicals. At that time they did not feel up to competing head-on with people like Theatre Projects. At the beginning of 1976, Michael White was involved in bringing *A Chorus Line* over from the States, and the sound designer of the show, Abe Jacob, came over to select a hire firm to supply the equipment. He

Far more musicals are produced in America than in Britain, and working with an American sound designer taught them a great deal. The gear used on *A Chorus Line* included a 35/8/2 Trident Fleximix, and Altec 9846 speakers biamped with Altec amps. These gave a brassy American sound which was just right for the production. Half a dozen Sennheiser MKE 802 electret

“It was the first—and possibly the only—time,” says Andrew, “that you could be absolutely sure that someone was standing in exactly the right place. You could be sure of the right level every night—and that’s never occurred since!” The orchestra was close-miked and hidden some distance away in a covered pit, so there was no danger of rear pickup, which can often be a problem. Monitors in the wings supplied the music to the performers.

One major problem was the fact that very often the musicians were different night to night, and this played havoc with any concept of preset balances—a headache which is all too common. The operator has to mix differently, and dynamically every night, and it is common practice for the operator to go round before the show and ask the musical director which musicians are ‘new’ that night. Failure to keep an eye on the corresponding faders during the performance can often mean that the cast get unhappy, as they cannot hear something that perhaps they had been used to hearing, and they tend to blame the sound balancer.

doing all they can to get the right equipment for the show at the right price”.

Indeed, costing is a very important aspect of the planning for sound on a show. The mixing position takes up seats, and if the sound company require, say, fourteen seats to be taken out, the backers of the show will lose, fourteen times £7.50 or so. There is a direct ratio between the size of the sound desk and the profitability per night. It is a constant battle. “We’re currently touring with a Midas desk on *Jesus Christ Superstar*, and there’s no doubt that it must take up more room than a *Flemimix*, and the loss of seats must be that much more.”

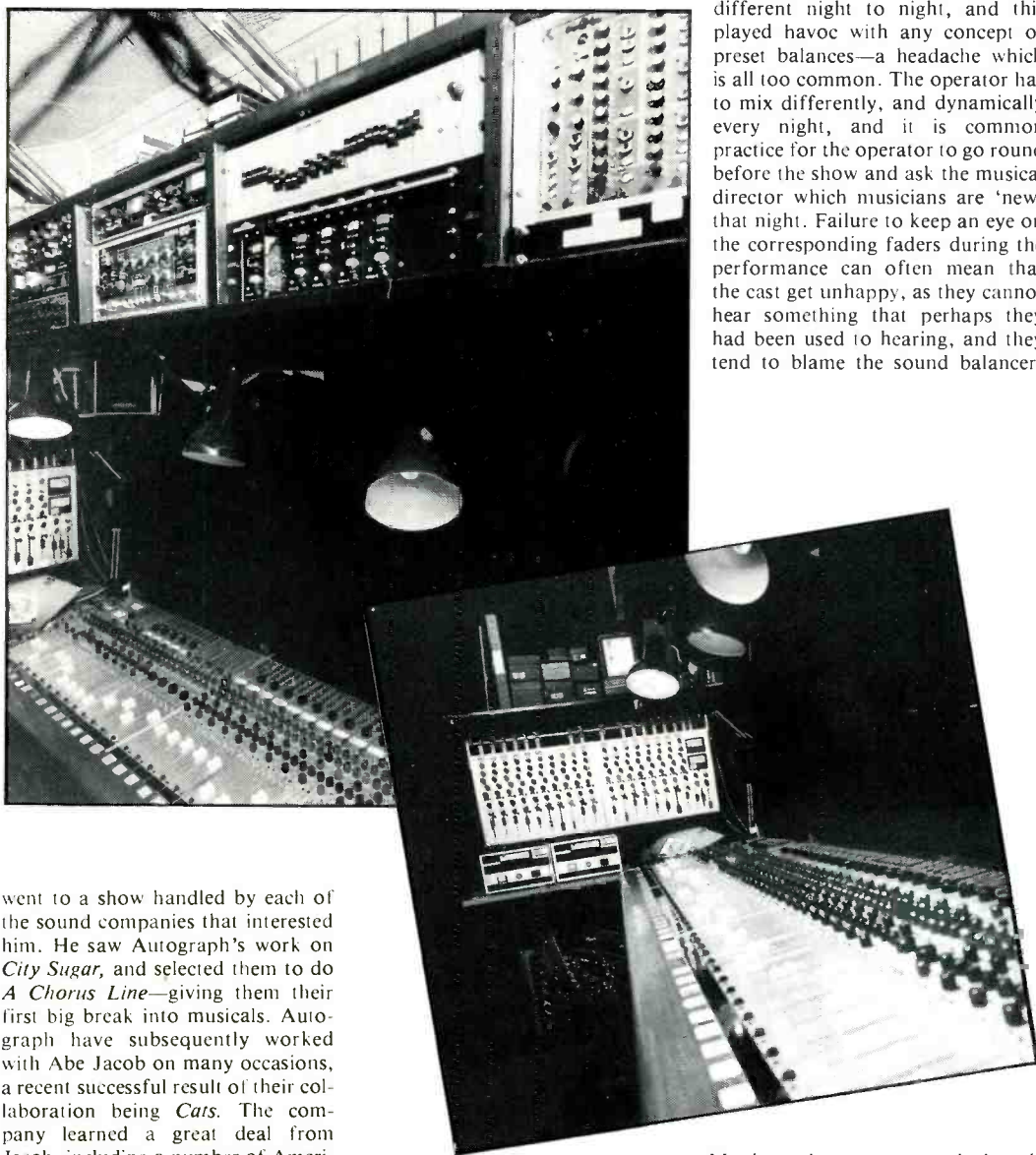
After *A Chorus Line*, the next landmark for Autograph was *Annie*, which was once again brought over by Michael White, in 1978 and Autograph’s Philip Clifford designed the sound. Once again, the gear was sold to the show, rather than being hired out. The set-up was quite standard, a significant point about the show being that the company was responsible for the sound right from the planning and design stage. Philip Clifford, who has since left Autograph, is now in charge of the system and has gone out on tour with the show. At about this time Philip Leaver and Julian Beech (ex Royal Opera House and National Theatre respectively) both joined Autograph.

The next show, which came up about three months after *Annie*, was *Evita*, in 1978. Unlike the others, this show actually started in England. It was produced by the Robert Stigwood Organisation, Bob Swash being the executive producer. Autograph were asked to quote for a hire or sale; once again, the producers decided to buy and the show is still running.

Again the show was designed by Abe Jacob, highlighting what is becoming a more important aspect of stage sound in the UK. American sound designers tend to live in America and after they have designed a show, they go home. It is a problem, because after the designer has left, who is to sort out the problems, the re-rehearsals with new members of the cast and any necessary re-designs of the sound, without flying the designer back? Sometimes a change of a leading role can make a great deal of difference; for example, one singer may need a compressor/limiter while another might need a completely different treatment. And apart from the technical alterations, a new member of the cast will not have been in at the design stage. “There should really be someone,” says Julian, “to explain to them why they are using a particular microphone, why they don’t hear the foldback so well upstage, or whatever. Sound is a

32 ▶

Equipment line-up for *Evita*—including 34/8/2 Trident Fleximix console, Audio Developments band mixer and ITC cart machines



went to a show handled by each of the sound companies that interested him. He saw Autograph’s work on *City Sugar*, and selected them to do *A Chorus Line*—giving them their first big break into musicals. Autograph have subsequently worked with Abe Jacob on many occasions, a recent successful result of their collaboration being *Cats*. The company learned a great deal from Jacob, including a number of American techniques not previously applied in the UK: for example the use of delayed speaker feeds.

Having decided on the equipment, Michael White gave them the option that he would either hire the gear or buy it outright. Unfortunately, the bank was not happy with the idea of Autograph buying the gear to rent to the show, so it was bought outright. Unfortunately because the show ran for three years. Even so, *A Chorus Line* was an important milestone for the company.

directional mics were used in the floats (along the front of the stage), while five MKH 816 rifle mics were flown overhead. *A Chorus Line* was really choreographed for the microphone, in that the cast stood, almost all the time, on a white line which was six feet or so upstage of the float mics, except when they broke away to dance. Additionally, it is American lighting practice to put numbers along the front of the stage so that everyone works to the grid.

Monitor mixers are unusual, though not unknown, in theatrical sound balancing and the monitor mix is usually generated from the main board by the operator, at the same time as doing the house balance. Says Andrew, “It’s never been possible to justify a foldback mixer for most stage shows—yet. There’s a financial problem in that the same number of seats are available as were there ten years ago, and the prices have to be reasonable. With the cost of sound equipment and personnel going up all the time, everyone is

Autograph

myth to them; they only know what's coming back, they don't understand the reasons. So you do need a sound designer in there just to put people in the picture, and wander round the auditorium to listen; to deal with the complaints of Granny who sat in balcony row B37 and says that she couldn't hear a single word all evening". A fair number of people comment on the sound of a show, and from time to time—as with *Evita*—there is already an album out, and visitors expect to hear that kind of sound live. As well as designing shows themselves, Autograph are increasingly taking on the role of 'stand-in sound designers' in cases like this.

An important aspect of *Evita* was the use of radio mics. This was the first time that Autograph had used more than the odd radio mic on a show. Previously there had been a tendency by many in the theatre sound world to steer clear of radio mics, as they rarely worked very well. Sound designers viewed them suspiciously. From this time, they began to be regarded as 'the answer to all problems'—which they aren't. But they do remove some of the restrictions on choreography and even musical composition—the composer can write for electric instruments without compromising the arrangements.

The next big use of radio mics was on *Sweeney Todd*, another American import, with a different sound designer, Jack Mann. That had even more mics than *Evita*, and raised obvious problems with the fact that only a limited number of frequencies may be used in the UK, and that number can't be exceeded. The show produced other problems, notably the fact that the set was almost entirely fabricated out of steel girders, which produced a large number of reception difficulties. Autograph use *Micron* radio mics, made by Audio Engineering Ltd, because they have found the overall performance to be excellent. But it isn't just transmission and reception which cause the problems. Radio mics are subjected to a very harsh physical environment. Generally being worn close to the body, they often get saturated with sweat; cables suffer too, as do mic capsules. There is a continual stream of people in and out of Autograph, repairing faulty capsules, leads and plugs. On *Cats*, the capsules themselves have to be thrown away every nine months or so, because the sweat and general humidity ruins them. Sometimes these problems can be quite esoteric! Autograph recently had a faulty radio mic, where the cable appeared to be intermittently going open-circuit. It wasn't, however, and the trouble was hard to find. It was

eventually tracked down to the fact that sweat had caused the plating on the connector pins to be eaten away by electrolysis.

As musicals have become more technically complicated in recent years, the capital cost of equipment has risen dramatically so management now rarely wish to buy the gear themselves these days, and in addition, they don't want to be landed with all the equipment after a show has finished its run. Hire is becoming the rule, although if a show runs for more than about a year the management will be paying more in hire charges than if they bought the gear outright, but they do get the benefit of an instant repair and replacement service.

One of the most important shows which Autograph has done recently is Andrew Lloyd Webber's *Cats*, at the New London Theatre, which has been running since May 1981. Work began on the show, with Abe Jacob, in February, although little design work was possible at that time since the theatre had not been decided. Once a hold on the New London Theatre had been obtained, full design could go ahead. The New London Theatre is important for this show, as it has a large revolving stage which is the centrepiece of this 'in the round' presentation. At the time the design was done, they had little idea of how it would actually sound. Unlike *Evita*, there was no record of the 'soundtrack' to work from. "We made it up as we went along," says Andrew. "As time went by, we came to realise that principles which we thought would work actually wouldn't, so we had to re-rig the whole speaker system." Julian continues, "It wasn't a

conventional proscenium arch musical, where everybody sits the same way looking at a picture. It's two concentric circles, the revolving stage being an eccentric circle inside the roughly circular auditorium, the cast perform over virtually 270°." "In addition," says Andrew, "whereas in a conventional proscenium theatre, the effective acting areas are fairly limited by such considerations as sight lines, the set, and common sense, so that errors in speaker delay settings introduced by the movement of actors relative to the audience and the loudspeakers are necessarily assumed to be insignificant, the exact opposite is true of *Cats*." Normally the active acting area is the width of the stage, and with a limited depth. Movement within that space results in a negligible error as far as delay settings are concerned. In *Cats*, the problem is such that a performer can be bang on top of one member of the audience, with his back to other members of the audience, and the dimensions of the theatre and the stage are such that they can move up to 100% away. They could be as close as 3ft, or as far away as 50ft from a given part of the audience. And that distance is significantly different for almost everyone in the auditorium. For delayed feeds you would need one delay to increase by up to 50ms or so, while another delay decreased by a similar amount.

A show that Autograph are working on currently, Andrew Lloyd Webber's *Song and Dance*, is even more 'studio-like' in its approach to sound than *Cats*.

The whole rig for *Cats* was bought new, and it centred around a Midas

36/8/8 *TR Series* theatre console—the first time Autograph had used one. It provided a matrix output, which offered the large number of separate mixes which the show requires. Also, Midas were prepared to build a dedicated quad panpot, the show using rear channels for effects. The two quad pots needed to be able to route any subgroup into any of four main groups. Thumbwheels select this aspect of the routing.

Several *Micron* radio mics are used, and one person is solely responsible for moving radio mics around between the different performers, many of whom need access to radio mics at various times during the performance. Actors come off at different parts of the stage, so a runner has to collect the mics from one place and deliver them to where they are next needed. There was quite a problem in concealing the transmitter packs and microphones, mics generally being located in the centre of the chest, while the transmitters may be worn more or less anywhere—the thighs, the small of the back, in a pocket in the costume, and so on. The actual transmitters are mounted upside down, to reduce the chance of moisture collection, and they are fitted to elastic harnesses to enable them to be moved rapidly between performers without complex setting up.

A ring of eight Neumann *KMR82* rifle mics is built into the 'rubbish' on the side of the stage. They require a lot of operation, as many of them are pointing directly at loudspeakers, so you can never aim to use more than one or two at a time because of potential feedback. Two more rifle mics—Sennheiser *MKH16s*—are suspended over centre stage, and there is one specialised *816* rifle mic which hangs beneath the front right loudspeaker pair, next to where a swing is located for when one of the cats swings off a platform.

There is a chorus booth, in which the members of the cast who are not on stage can add weight to the vocals, supplementing the voices of those on stage. The booth is off to one side, and is made up of two layers of heavy black velvet with Rockwool sewn between them, and it's practically invisible. They have a single *KM86* plus foldback in the booth, and a TV monitor with a picture of the conductor. The band is also off to one side.

The band includes three keyboardists, who play four *Prophet 5* synths (plus one spare), one Yamaha electric grand piano, and a Fender *Rhodes*. One player plays two *Prophets* stacked, one plays a *Prophet* on top of the *Rhodes*, and the third plays a *Prophet* on top of the Yamaha. All the keyboards are DI'd. They all have Roland *Cube* amps for their own monitoring.

Cats set-up with a 36/8/8 Midas TR Series console

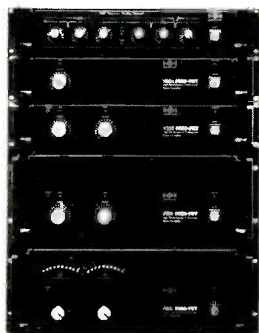




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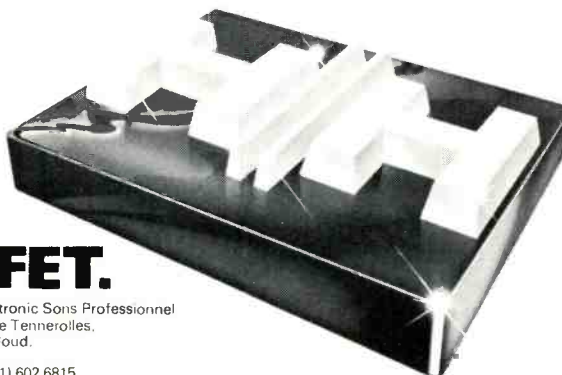


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Autograph

There is a single cello, with a *KM84* on it, plus a large percussion section with tympani, bells, xylophone, gongs, and other instruments, which are miked with two overhead *U89s*, one lower down so that handheld percussion instruments can be picked up successfully. Autograph also tried a Sony *ECM-50* worn round the percussionist's neck, so that as he moved the mic would go with him. However, the mic cable got in his way and the mic couldn't cope with the high sound levels, so they went back to the overheads. Then there is a line of three woodwind players, each with a *KM84* on a gooseneck clamped to the side of the stand; two horns are on the end of the woodwind line, each with a Shure *SM57* pointing into the bell. The brass section includes two trumpets, each with an *SM57*, also on goosenecks, plus one trombone which also has an *SM57*. The band is completed with bass (DI), guitar (electric DI'd plus acoustic), and drums, which have an overhead *U89*, *KM84* on snare/hi-hat, and a *D12* on bass drum, Galaxy Audio *Hotspot* mini-wedge monitors supply the band's requirements in this department.

Other inputs to the system include an ITC three stack cart machine for effects, which after processing via a dbx *155* 4-channel NR unit are pre-mixed in a Shure mixer and fed to an aux input to the quad pots. Due to the isolation of the band particularly complex monitoring systems are required for the MD, who has a video monitor showing the stage in front of him. A camera points at him, and this image is supplied to the stage performers via two monitors over the exit doors. He also has headphone foldback via two separate feeds. Autograph supplied the communications systems for the show, including comms facilities for lighting and stage personnel. A ring of comms stations carries two circuits selectable at each station by the user. The stage manager can listen and talk to either or both channels. The communications equipment is by RTS Systems.

On the ancillary equipment side, Klark-Teknik *DN22* graphics are used on the four main groups, plus UREI *539* room equalisers on the delay ring of overhead speakers which carry only vocals. A *539* is also in circuit on the float mic group, while a further unit equalises the feed to a ring of *Auratones* which are hidden in the 'rubbish' around the stage perimeter and are used to reinforce the sound to the front rows of the audience. The UREI *562* feedback suppressor is on the radio mic group. Additionally, an ADR *Scamp* rack contains two parametric equalisers, an ADT module, plus a couple of noise gates.



Sound of Music mixing system with Trident Fleximix 6/7 sound effects board and 44/8/2 main desk

Two compressors are also fitted in the rack. Two outputs of a DeltaLab *DL-1* are used, one set to a short delay (about 15ms) to delay all the vocal signals, while the other is used to return a much longer delay to the rear groups, which are quite a long way from the stage. Next in the rack is a Klark-Teknik *DN70*, which provides further loudspeaker delay feeds for the ring above the stage and three Electro-Voice *LR4Bs* which are mounted under the balcony facing backwards. "These," says Andrew, "are about the only speakers which are on the 'right' delay, because by the time you get back there, the movement on stage relative to the audience is insignificant." A Master Room *XL-305T* stereo reverb is used for vocals and band, each channel being used separately.

Amplification is by Amcron. *PSA2s*, racked in pairs (with the crossovers mounted in the racks), are fitted right up in the roof at about the 2 o'clock position, and these drive the main Meyer speakers. *DC-300As* drive four Martin *215* double bass bins which are underneath the stage in a radial pattern and are used every so often on a separate group. One pair has reversed polarity with respect to the others to make this a 'push-pull' arrangement. These are crossed over with a Brooke Siren Systems *FDS-320*. The eight *Auratones* around the stage are driven by a pair of *D-150As*. The EV units are also driven by similar amps.

The main speakers are Meyer *UPA-1s*, and these represent quite an innovation. Autograph had been introduced to them by Abe Jacob on *The Best Little Whorehouse in Texas* at Drury Lane. They are intended for smaller auditoria, yet they are quite expensive, due to the extensive design work which has gone into them. Autograph hadn't really used them to their full potential before and they were amazed by their performance on *Cats*. There are four

main groups in the auditorium: rear left, one single unit; front left and front right, a pair each; and rear right, a single unit. These are all flown. Over the stage, in addition, four single units handle vocals only, and these do most of the work. *Cats* represents one of the most exciting live shows yet seen in London, and no small part of this is due to the excellent work that Autograph have put in on the sound. It is a stunning show, and well worth a visit—if you are prepared to book well in advance. The show opens in the USA shortly, no doubt to similarly packed houses.

It was during the production period of *Cats* and later *The Sound of Music*, which opened in August 1981 at the Apollo Victoria, that Autograph realised the extent of their involvement with Meyer Sound Laboratories. In terms of their increasingly regular purchasing, the refinement of smooth importation channels, and the holding of spares for their own self-protection, it was beginning to appear to be not far short of a distribution operation. Before approaching *MSL1*, however, it was necessary to find a person with previous experience to co-ordinate this new venture. Andrew and Julian had met David Solari, then of Midas Audio Systems, earlier in the year and discussions began with a view to setting up a sales company aimed at the sound reinforcement industry. In January, Autograph set up a separate company called Autograph Sales Ltd, run by David Solari. Besides handling European distribution for Meyer Sound Laboratories, Autograph Sales now distribute Klark-Teknik and AB Systems power amplifiers in the UK.

In addition, Autograph has always needed to have studio facilities to produce sound effects and voice recordings in order to do the industrial work into which they have gradually diversified. In 1979 they set up a small studio in their building

in Camden Town run by Jonathan Deans where they could do 16-track recording and make use of various pieces of processing equipment which would otherwise be redundant between jobs. The studio itself is built on a floating floor due to the close proximity of the main railway line into Euston Station. The studio includes a couple of Ampex 4-track machines and a Scully 16-track of the 2-head variety, and what Julian describes as "the smallest Trident TSM ever made". It is currently a 10/8 and its maximum configuration in the present frame is 20/24 although its expansion possibilities make it an investment for the future. Other equipment includes a Studer *B67*, a Cuemaster *983* cartridge machine, an EMT *Plate* and a collection of ancillaries. Monitoring is via UREI *838s*.

But it is the sales company that is Autograph's newest development. The two companies can work very effectively together, increasing the flexibility of the overall operation. The hire company can, for example, thoroughly test and gain experience with new pieces of equipment, and make this invaluable information available to buyers. Conversely, the sales company helps the hire side to secure stable supplies and broadens their trading base.

Of course, a number of new shows are on the way. *Song and Dance* goes a stage further with the Meyers, introducing the larger *MSL-3s* to Britain. The show consists of two pieces, both by Andrew Lloyd-Webber, and both previously issued on record. In *Tell me on a Sunday* the orchestra, which is seated on two movable band trucks on stage, are gently reinforced when required for effect. The second half consists of a full-blown reproduction of *Variations* as accompaniment to a modern/classical ballet. For this, the band trucks are moved up-stage behind heavy black drapes, only to reappear for the finale playing *The South Bank Show* theme whilst trundling inexorably towards the audience. After this is on and running, work starts immediately on a limited run of *Not in front of the Audience* at Drury Lane, closely followed by *The Pirates of Penzance*.

In addition, the company does not just operate in Britain. They have worked a great deal in Europe. But they want to remain a small, intimate company of under a dozen people. As Julian puts it: "The theatre is still a relatively small area, and one shouldn't get too grand. We've never even had entries in the theatrical trade directories." And the future? Julian concludes: "We want to continue to develop the equipment being used, and to make sure that sound makes an even bigger contribution to theatre, that it's understood better and that people are prepared to use it more creatively". What better aim can one have? ■

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The Dual Limiter's remarkable versatility is based on the fact that it can be viewed as two independent mono limiters that can be patched together via front panel switches for stereo limiting applications. Each channel has an In/Out switch, Slope switch, Input, Output, Attack and Release controls and an LED display, showing the amount of gain reduction. On the rear are

both XLR and 1/4" phone jack (ring-tip-sleeve) input and output connectors. Each channel's detector is accessible via rear panel phone jacks to permit external tailoring of the detectors' frequency response. This feature allows for de-essing (reduction of vocal sibilance) and a wide variety of frequency dependent limiting needs.

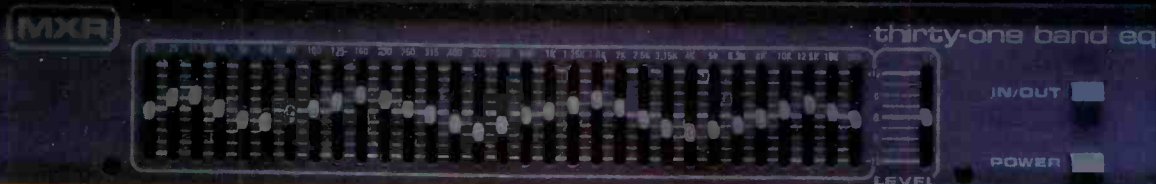
Because virtually every form of musical signal was used to evaluate the Dual Limiter's response during the initial stages of development, its sophisticated internal circuitry enables it to sound musically *natural* — even at extreme compression settings.

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Studiofile:1

Mayfair, London

Towards the end of 1977, Mayfair Studios, then in its old location in South Molton Street, was not doing very well; business was slow, and by all accounts, the place was going downhill. It was during this period that it was first offered for sale to John Hudson, then Mayfair's chief engineer and sometime technical mainstay.

It was John's opinion that the studio's location in South Molton Street was unsuited to its purpose: there had always been complaints from neighbours about sound leaking from the studio, and the lack of space meant impractical layouts and other limitations. After detailed discussions with his wife Kate, they decided to take over management of the studio on the understanding that they would buy it when they found a suitable new location. It was over a year later, in September '79 when they finally found the Sharpleshall Street premises, and it wasn't until October 16, 1980, that work actually started on the construction of the studios. The final year's wait had been very hard. At a time when studios were going bust in rapid succession, it was very difficult for them to find anyone to give them the long-term financial backing that they needed to see the project through. During that year, Kate informed me with a slightly pained look in her eyes, they became liable for almost £16,000 interest, payable on the initial loan. It appeared that they had reached the point of no return.

They recorded their first album with Bucks Fizz in April 1981, with builders continuing to work around them, and since that time they have been booked solid with new clients and existing clients carried over from the South Molton Street days.

Isolation

Surrounded by houses, one of the main construction criteria was good isolation, and with this in mind they called in a firm of industrial sound insulators, JHA Crockett and Associate, who through the use of dense concrete block work and mechanically isolated structures, have established a very high degree of separation, such that to date there have been no complaints from any neighbours.

John took care of the design of the acoustic treatment for the two control rooms and the main studio floor area, which is simple and functional. The main control room is very large and its rear wall is covered with what John and I agreed might loosely be termed a multiple Helmholtz resonator—open board

work over a spaced Rockwool backing, against a concrete block wall. The rest of the wall area is covered with a thick velvet-like material and Audio Kinetics acoustic boxes. Monitoring is handled by a pair of JBL 4320s positioned on top of a pair of Tannoy speakers which are used simultaneously to help provide the necessary acoustic output at the lower end. White equalisers are used to correct any irregularities in the room.

The console is a 40-channel Amek with eight VCA subgroups and Allison automation. When using the computer, the changing level of each channel is shown very conveniently by a series of LEDs running up the side of each channel fader. John intends to add another eight channels to the desk shortly in order to make 46-track work easier.

Tape machines comprise a Studer A80 24-track, a 1/4in stereo Studer A80VU, a Studer A80RC with 1/2in stereo headblock, and a Revox A77 together with high quality cassette decks and record deck. There is also a 3M M79 24-track, which really belongs to Studio Two, but is brought into Studio One for 46-track work. A second Studer 24-track is soon to be purchased, together with a further 24 channels of Dolby. The communication window is large and visual contact with the studio floor and isolation booths is good. There is a fair

selection of compressors, limiters, expanders and gates, and a limited selection of effects units.

The main studio area is 56sq yd in the shape of an L. The larger part of the L is divided into a live end with parquet flooring and slate covered walls, and a dead end with deep pile carpet and absorptive treatment on the walls of a similar design to the control room. The smaller part of the L which goes around the side of the control room is divided into two isolation booths, one live, one dead and both with windows looking into the control room and patio doors to separate them from each other and from the main studio area.

A rather good looking 1927 Steinway grand and an old, but faithful, Hammond organ are available free of charge. Studio One goes out at £65.00 per hour.

Studio Two is rather more like a demo studio or overdub area, and consists of a fairly large control room and a booth. The acoustic treatment takes the same form as in Studio One, and the equipment is installed on a temporary basis, especially the console, which is to be replaced by the old South Molton Street desk as soon as John finishes rebuilding it. Monitoring is via a pair of JBL 4502s or Tannoy Golds with Auratones occupying their usual place on top of the console. Studio Two goes out at £30.00 per hour.

There is also a copy room equipped with 20 Aiwa L50 cassette decks, a Studer A80, a Revox A77 and a custom built 12/2 mixer, together with a small vocal booth for simple voiceover work.

The building in which the studios are contained is huge, 7,000sq ft over its two storeys—so there is plenty of room for future development. It may not be the most palatial studio in town, but with five singles in the top 60 and four albums in the top 100, it is certainly successful.

James Betteridge

Mayfair Studios, 11a Sharpleshall Street, London NW1, UK. Phone: 01-586 7746.

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Studiofile:2

Audiofilm, Madrid

Located near the new business centre of Madrid and the football stadium of Real Madrid (where the World Cup Final will take place) Audiofilm Studios SAL is one of Madrid's most active studios. Its three studios are often running 24 hours a day and its four resident engineers would probably complain to the owner about overwork if they weren't the owners themselves! It's not that rare to find a studio being run by its owners, but Audiofilm is rather different as the employees have recently become the employers.

Opened in 1966 as a 4-track studio, Audiofilm has made steady improvements both in studio area and updating of equipment under the leadership of José Ma Batlle Simon. Previously José had been chief engineer at RCA Studios (Madrid) and had recorded many top artists including Los Brincos and Lionel Hampton.

In 1970, Audiofilm expanded from its one studio format to a two studio complex with a Neve 16/4 console plus 8-track and Telefunken tape machines in Studio A, and the original 4-track set up in Studio B. At this time work was principally record orientated and clients included the duo of Donna Hightower and Danny Daniel and singers Juan Pardo and Camilo Sesto. The singer Peret also recorded his hit *El Borriquito* at Audiofilm.

In 1973 Audiofilm went 16-track with a Neve 24/8 desk and a Studer 16-track tape machine. The 4-track was phased out and Studio B received the 8-track desk. About this time Audiofilm began to take in more advertising work and since then jingles have been steady business for the studios, particularly Studio B, while Studio A continued recording for records. One particularly good client was Javier Iturralde who began arranging and producing for a group of liberal priests who recorded a great deal of light religious music at the studio. Javier has branched out into the commercial record scene with great success now, but can still often be seen in the studios with religious charts tucked under his arm.

In 1970 sound engineers Luis Fernandez Soria and Luis Miguel Gonzalez joined Antonio Morales (who had been with the studio since its earliest days) making a team of three engineers. In 1973 Santiago Lardies became the fourth resident engineer. It should be mentioned here that both Luis Fernandez and Santiago are graduates of the Spanish School of Radio/Television. From 1973 to 1981 the personnel remained the same as did, unfortunately, the equipment. That is a very long time to go in the studio business without



Basement Studio C with Neve console

updating and the lack of planning by the original owners began to show in the profits. Other Spanish studios updated during this period to 24-track and the newest fads in studio design, leaving Audiofilm lagging behind with its 16-tracks and its large studio with wooden floors and bare walls.

The employees realised that the studios would only continue to suffer, unless they upgraded the equipment and design. A decision was then made to try to purchase the studios as the original owners (non-music types) were not interested in investing money in new equipment. Although such a decision sounds easy to make, a great deal of thought, worry and work obviously went into the final arrangement and the fortitude of those involved should certainly be applauded. Not only did the employees purchase the studios but they updated and made Audiofilm the only complex in Spain to include 24-track, 16-track and 8-track studios.

Studio A is now 24-track with an MCI JH600 automated desk with all tape machines also being MCI. Monitors are Tannoy, but will soon be replaced with JBL 4430s. Also included are the omni-present *Auratones*. An air-cooled, wheel-based rack houses outboard equipment including four UREI comp/limiters; a Lexicon *Prime Time*; Eventide H910 *Harmonizer* and *Instant Phaser*; two MXR auto phasers, a digital delay and two auto flangers; two UREI graphic equalisers; six *KepeX II* noise gates; four home grown noise gates; and a Nakamichi 582 cassette deck. In addition, there are two EMT units for reverb plus an AKG and the studio is also willing and able to hire any other equipment needed from a local hire company—from the new Eventide H949

Harmonizer and Lexicon 224 to vocoders and the Aphex *Aural Exciter*.

Redesigning of the control rooms was carried out under the supervision of Eduardo Pastor and José Ma Batlle. Actually, everyone's ideas and experience was put together on the project and the result is a pleasant atmosphere and excellent acoustics.

The positioning of the control room requires a bit of neck twisting as the studio lies to the right hand side of the desk and down a short flight of stairs. The studio is large by today's standards and will hold up to 50 musicians. Instruments include a Yamaha grand piano, a Fender Rhodes electric piano and a Hammond X77 organ with Leslie. A complete drum set and bass and guitar amps are also available. As is the custom of all Spanish studios the above mentioned musical instruments are hired out to the client per session booked which adds somewhat to the basic hourly charge of approximately £40 for 24-track.

Musicians can listen to recorded takes in the studio area by way of Tannoy speakers flying overhead in custom cases. The various types of microphones available include Neumann, Sennheiser and AKG.

Studio B features the aforementioned Neve 16-track console and Studer 16-track plus two 2-track Telefunken tape machines. Monitors are Tannoy and *Auratone*. Any of the outboard equipment can be patched in from Studio A or brought in physically. There are four more noise gates permanently in the studio which are once again an Audiofilm creation.

The studio is positioned directly in front of the desk in this studio and the design and décor of the control room is similar to Studio A. The author produced several jingles in

Studio B shortly after its re-opening and the ever-revealing test of listening to tapes at home on one's own gear proved that this room is one of the clearest and sharpest in Madrid!

The actual studio is considerably smaller than Studio A but there is ample room for up to 15 musicians and it is ideal for groups. Instruments available include a Yamaha baby grand, drum set and various amps. The Fender is shuffled back and forth between studios.

Studio C is located in the basement and features the original 8-track Neve console with 16 in and 4 out. Tape machines are Telefunken 8-track and three 2-tracks. As the general purpose of this studio is for recording radio programmes there are two Technics turntables of professional radio calibre. It also has a Nakamichi cassette deck and an Ursa Major *Space Station*. Monitors are Tannoy *Super Reds* and *Auratone*. Reverb is AKG, however, the EMTs upstairs can be patched in. As a matter of fact all three studios are linked together for any type of joint work necessary.

Studio C is manned by engineer Santiago Lardies. Between radio programmes, A/V, voice overdubs and editing, he keeps busy. Santiago has an uncanny talent for editing and probably holds the title of Spain's champion editor, if such a title exists. He even enjoys it!

Mention, of course, should also be made of Mari Jesus Carnicero who handles the studio bookings. She works the three studios' time schedules like a puzzle and steady clients can always count on getting into the studio for an urgent mix or recording. Even a 1-hour gig will get squeezed in if it's really necessary—and with a bright and shining fresh engineer, not one that is missing his lunch over the job! Mari Jesus and Manolo Velazquez (tape op) are always prepared to run across the street to bring clients a hot cup of coffee or a *Bacardi* and *Coke* (Cuba Libre). In fact, about the only thing they can't do for you is bring the warm Spanish sun indoors!

One might suspect that Audiofilm delves in film work due to its name but that part of the name has always remained 'a future possibility'. Chief engineer Luis Fdz Soria is an avid video fan and is often leering out from behind a video camera so that interest could one day lead to a branching out in the direction of video. For the time being, the new owners of Audiofilm Studios SAL are working very hard and enjoying what they know best how to do: record music!

Jim Kashishian

Audiofilm Studios SAL. Alonso Cano 68, Madrid 3, Spain. Phone: 254-4766/5158.

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Feel after reel, batch after batch, Scotch 226 Tape delivers headroom and distortion properties that are simply second to none.

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For further information please contact:

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Bracknell, Berkshire RG12 1JU
Telephone: Bracknell (0344) 58398



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3M

product Sound reinforcement consoles guide

ACES (UK)

AC Electronic Services, Broad Oak, Albrighton, near Shrewsbury, Shropshire SY4 3AG. Phone: 0939 290574.

ACSM12/2, ACSM16/2: 12- and 16-channel stereo PA mixing consoles with 5-band EQ and balanced inputs.

ALLEN & HEATH (UK)

Allen & Heath Brenell Ltd, Pembroke House, Campsbourne Road, London N8. Phone: 01-340 3291. Telex: 267727.

USA: Allen & Heath Brenell (USA) Ltd, 652 Glenbrook Road, Stamford, Connecticut 06906. Phone: (203) 359-2312. Telex: 996519.

Mini Mixer: small mixer designed for on-stage submixing.

SD 12-2: 12-channel portable stereo mixer with 4-way monitoring system.

16:4:2: 16-input, 4-subgroup, stereo output mixer. Also available as 8:4:2 and 24:4:2.

SR Series: modular consoles accepting up to 28 inputs and with a choice of 4, 6 and 8 subgroups feeding the stereo master output stage.

ALLINGTON (UK)

Allington Audio Developments, 14 Lenton Boulevard, Nottingham. Phone: 0602 44943.

SRM Series: 16 input PA consoles with either two or four outputs.

ALTEC (USA)

Altec Corp, 1515 South Manchester Avenue, Anaheim, Cal 92803. Phone: (714) 774-2900. Telex: 655415.

Europe: Altec Lansing International Ltd, 17 Park Place, Stevenage, Herts SG1 1DU, UK. Phone: 0438 3241. Telex: 825495.

UK: Rank Strand Sound, PO Box 51, Great West Road, Brentford, Middx TW8 9HR. Phone: 01-568 9222. Telex: 27976.

1674A/1678A: four and eight channel automatic mic mixers.

Model 1690: portable eight channel stereo mixer/preamp.

AMEK (UK)

Amek Systems and Controls Ltd, Islington Mill, James Street, Salford M3 5HW. Phone: 061-834 6747. Telex: 668127.

UK: Scenic Sounds Equipment Ltd, 97-99 Dean Street, London W1V 5RA. Phone: 01-734 2812. Telex: 27939.

USA: Everything Audio, 16055 Ventura Boulevard, Suite 1001, Encino, Cal 91436. Phone: (213) 995-4175. Telex 651485.

M1000: 32/8/2 + 8 concert sound reinforcement console with 8-track monitor mix section.

APSI (USA)

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

Model 2000: modular console available with 32, 24 or 16 inputs, four submix, four master and four quad channels.

AUDIOARTS (USA)

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

Monitor 10: stage monitoring and mixing system, five subgroups, 10 mix busses, 26 inputs and outputs (16-channel configuration).

4000 mixing system: modular recording and reinforcement console, 12 to 32 input channels, four subgroups, 4- and 2-track outputs, separate reinforcement outputs.

new

8000 mixing system: modular recording and reinforcement console, 16 to 32 input channels eight subgroups, left and right master outputs.

BIAMP (USA)

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

2442: 24/2 console with four submaster outputs. Also available as 16/42 with only 16 input channels. 1682/128/28802: 16, 12 and 8 input channel stereo mixers.

BOGEN (USA)

Lear Siegler Inc, Bogen Division, PO Box 500, Paramus, New Jersey 07652. Phone: (201) 343-5700.

Range of basic mixer/preamps with rotary level controls. Also the *Tech-craft* range of mixer/amps for PA applications.

CAE (USA)

Custom Audio Electronics, 2828 Stommel Road, Ypsilanti, Michigan 48197. Phone: (313) 482-6568.

XPC-16P Series: modular sound reinforcement mixer. Modules include basic input module, expanded input module with built-in limiter, submaster module, 8-mix master module, 8-line input module for effects returns and submixes, and a communications module.

CANARY (UK)

Canary Mixing Desks Ltd, 17 West Hill, Wandsworth, London SW18 1RB. Phone: 01-870 7722. Telex: 889294.

Wide range of PA and sound reinforcement mixers. Configurations include 10/2; 12/2; 16/2; 16/4; 16/6; 24/2 and 32/8/2. Also the *Canflex System*, a modular system capable of accepting up to 35 channels with either 2 or 4 output formats.

CHILTON (UK)

Magnetic Tapes Ltd, Chilton Works, Garden Road, Richmond, Surrey TW9 4NS. Phone: 01-876 7957. Telex: 912881.

QM3 Series: 24/8/2 and 20/4/2 PA console formats with auto channel mute system. Options include parametric EQ, filters, LED bargraphs on meters, and comp/limiters on outputs.

M Series: recording and PA mixers available in 10/2 and 16/2 formats.

CUSTOM SOUND (UK)

Custom Sound Solid State Technology Ltd, Custom House, Arthur Street, Oswestry, Shropshire SY11 1JN. Phone: 0691 59201.

Model 701: 8-channel mixer with built-in power amp delivering either 150W or 300W into 4Ω. Model 700P similar but only 5-channel.

P12-2: 12 channel stereo mixer.

DDA (UK)

DDA Ltd, Unit 7B, Worton Hall Trading Estate, Worton Road, Isleworth, Middx TW7 6ER. Phone: 01-847 0363.

Custom design and manufacture of PA and sound reinforcement consoles.

D & R (Netherlands)

D & R Electronica BV, Chasséstraat 26, NL-1057 JE Amsterdam, Phone: (020) 18.35.56. Telex: 18503.

UK: DSN Marketing, Westmorland Road, London NW9 9RJ. Phone: 01-204 4234.

MR600 Series: recording/PA mixers available with 6, 12 and 18 input channels, four outputs.

1000 Series: recording/PA mixer, 10, 20, 30 input/output versions, eight subgroups, direct out facilities.

DYNACORD (West Germany)

Dynacord Electronic GmbH, Siemenstrasse 41-43, D-8440 Straubing. Phone: 09421 3101.

UK: Beyer Dynamic (GB) Ltd, 1 Clair Road, Haywards Heath, Sussex RH16 3DP. Phone: 0444 51003.

USA: Dynacord Electronics Inc, PO Box 26038, Philadelphia, Pennsylvania 19128. Phone: (215) 482-4992.

MC Series: MC1233C 12/2 mixer for vocal and orchestral PA; also 12/2 and 16/2 on-stage mixers; plus a 20/8/2 mixer.

EELA AUDIO (Netherlands)

Pieter Bollen BV, Hondsruglaan 83a, NL-5628 DB Eindhoven. Phone: 040 42.44.55. Telex: 59281.

UK: Eela Audio Industries Ltd, 13 Molesworth, Hoddesdon, Herts EN11 9PT. Phone: 09924 68674.

USA: Audicon Inc, 1200 Beechwood Avenue, Nashville, Tennessee 37212. Phone: (615) 256-6900. Telex: 554494.

System 100: modular block mixer which may be configured for sound reinforcement applications. Standard formats of 4/2, 8/2, 12/2 and 16/2.

ELECTROSONIC (UK)

Electrosonic Ltd, 815 Woolwich Road, London SE7 8LT. Phone: 01-855 1101. Telex: 896323.

Manufacture of custom built sound control desks for theatres, conference centres, PA systems, etc. Also a stage manager's desk.

FORMULA SOUND (UK)

Formula Sound Ltd, 3 Waterloo Road, Stockport, Cheshire SK1 3DB. Phone: 061-480 3781.

Manufacture and installation of sound reinforcement systems, plus custom built mixing consoles for PA and foldback. Also *PM-80* modular mixing system.

GELF (UK)

Gelf Electronics Ltd, Unit 5, Mount Avenue, Bletchley, Milton Keynes MK1 1LS. Phone: 0908 77503/647262.

Manufacture of a range of mixers for PA and sound reinforcement including 12/2, 16/4/2, and 26 channel into eight monitor formats. Also customisation of larger desks for PA applications.

HARRISON (USA)

Harrison Systems Inc, PO Box 22964, Nashville, Tennessee 37202. Phone: (615) 834-1184. Telex 555133.

UK: FWO Bauch Ltd, 49 Theobald Street, Boreham Wood, Herts WD6 4RZ. Phone: 01-953 0091. Telex: 27502.

Alive: live performance console available in either 24- or 32-input mainframes with satellite extender frames of either 24 or 32 inputs. Features include automated VCA faders with groupers, eight VCA matrix subgroups, direct communications interface, and four main stereo output pairs.

HH (UK)

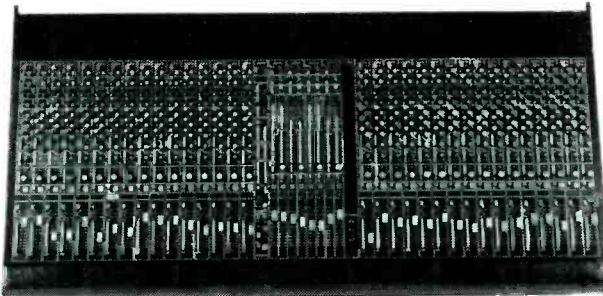
HH Electronic, Viking Way, Bar Hill, Cambridge CB3 8EL. Phone: 0954 81140. Telex: 817515.

USA: Audio Techniques Inc, 652 Glenbrook Road, Stamford, Connecticut 06906. Phone: (203) 359-2312. Telex: 996519.

Stereo 16: 16-input stereo mixer also available as the *Stereo 12* with 12 input channels.

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Harrison 'Alive'
32-input console



Nothing reproduces better than a Sony microphone.



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

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

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

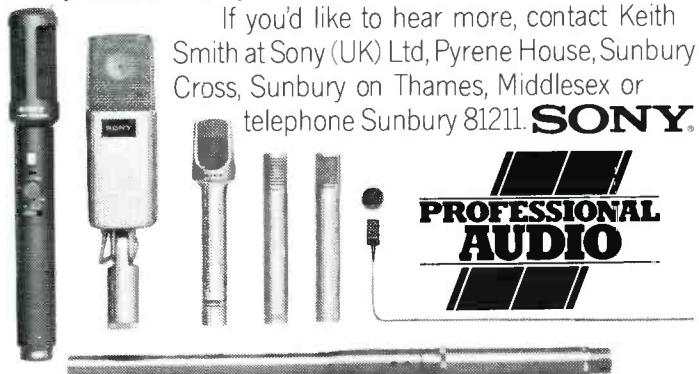
In theatre and outside broadcast situations Sony C74 and C76 shot gun type microphones will accurately pick up frontal sound, with excellent indirect and ambient noise rejection.

Newer additions to the Sony microphone range include the ECM 969 and 989 single point stereo mikes with the option of remote control of directional axes, and the F550 and 660 uni-directional dynamic types, particularly suited to vocal performances.

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

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

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



**PROFESSIONAL
AUDIO**

product Sound reinforcement consoles guide

new

HILL (UK)

Malcolm Hill Associates, Hollingbourne House, Hollingbourne, Kent. Phone: 062780 556.

B2 Series: modular mixers available with 16 to 24 input channels and 4 or 8 outputs.

J2 Series: modular sound reinforcement console available in 24/8/2 and 32/8/2 configurations with optional 8- or 10-channel extensions.

M2 Series: on stage monitoring console available with from 16 to 32 inputs and four, six, eight or 10 monitors.

new

HIWATT (UK)

Hylight Electronics (Hiwatt Amplification) Ltd, Park Works, 16 Park Road, Kingston-on-Thames, Surrey. Phone: 01-549 0252.

Type D: modular PA mixer available in multiples of four inputs and with two output groups.

ITAM (UK)

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

Portamix: portable 6-channel, 2-group mixer, may be battery powered.

10.4/12/12.4/16.4: portable PA mixers of modular construction with 10, 12 or 16 inputs, four monitors plus stereo monitor output.

new

882: similar to the 10.4 but only eight inputs each with a direct output.

INTERFACE (USA)

Interface Electronics, 6710 Alder, Houston, Texas 77081. Phone: (713) 660-0100.

Model 16T8: theatre mixer with 16 inputs, eight submaster busses and eight outputs. *Model 24T8* is similar with 24 inputs.

Series 104: stage monitor mixer with direct matrix (32 x 8), 32 inputs.

new

Model 400B: compact modular mixers available in three configurations 10/4/2, 16/4/2, or 24/4/2.

JBL (USA)

James B Lansing Sound Inc, 8500 Balboa Boulevard, Northridge, Cal 91329. Phone: (213) 893-8411. Telex: 674993.

UK: Harman (Audio) UK Ltd, Mill Street, Slough SL2 5DD. Phone: 0753 769111. Telex: 849069.

7510: automatic mic mixer for PA applications, four to 24 inputs expandable in groups of four.

new

KELSEY (USA)

Dallas Music Industries, 150 Florence Avenue, Hawthorne, New Jersey 07506. Phone: (201) 423-1300.

Pro-Club Series: six to 24 input configurations with separate mono and stereo outputs.

Professional Series: 12 to 24 inputs with two stereo submasters or four mono submasters.

Stagemix Series: four output stage monitor mixer available with eight to 24 inputs.

Pro-Tour Series: modular touring systems with eight to 32 inputs, stereo and mono outputs, and four stereo submasters.

Soundprism Series: modular mixers with eight to 48 inputs, stereo zoom system, four stereo and mono submasters, separate mono and stereo outputs.

LIBRA (UK)

Libra Electronics Ltd, Bentfield Road, Stansted, Essex CM24 8HS. Phone: 0799 41156. Telex: 817444.

Manufacture and design of live sound mixers for theatres and conference/art centres. Original mixer has been redesigned. Current format provides basic frames with up to 12 inputs (extendable up to 60 inputs) with 10 main outputs and four aux outputs. Optional group output extension module available.

MIDAS (UK)

Midas Audio Systems Ltd, 54 - 56 Stanhope Street, London NW1 3EX. Phone: 01-388 7679.

PR System: range of consoles for live sound reinforcement, on-stage monitoring, etc. Consoles configured from over 20 modules. Examples of possible formats include 44/8/2 PA system; 32/8/2 concert sound console; 24/4 effects console; and 36/8 on-stage monitor console.

TR System: range of consoles specially developed for theatre sound mixing applications. System is fully modular and is available in 24, 30 and 36 input channel formats with eight subgroups and eight outputs.

new

Concert Series: range of live sound/concert sound reinforcement consoles available in a variety of formats. Facilities include routing to 16 subgroups and two sets of masters, eight aux busses and programmable muting.

MILLBANK (UK)

Millbank Electronics Ltd, Uckfield, Sussex TN22 1PS. Phone: 0825 4166. Telex: 95505.

MCC Mark III: self powered mixer with 10 input channels and two output groups.

Musicmaster III: stereo entertainment mixer with six channels.

MM (UK)

MM Electronics, PACE Musical Equipment Ltd, 63 Kneesworth Street, Royston, Herts SG8 5AQ. Phone: 0763 45321. Telex: 817929.

DM Series: range of mixers expandable from 8/2 up to 32/8. Four and eight output versions feature centralised microprocessor channel and group routing system.

MP Series: semi-modular 8-, 12- or 20-channel stereo or 4-track mixers suitable for PA applications.

NEPTUNE (USA)

Neptune Electronics Inc, 934 NE 25th Street, Portland, Oregon 97232. Phone: (503) 232-4445.

UK: Court Acoustics Ltd, 35 - 39 Britannia Row, London N1 8QH. Phone: 01-359 0956/5275. Telex: 268279.

410P/610P: 4- or 6-channel mixers with integral 100W power amp.

611: six input mono mixer.

821: 8-channel stereo general purpose mixer.

1420: similar to above but 14 input channels.

new

XM Series: versions available with eight, 12, 16 or 24 input channels; four submasters; and mono and stereo outputs.

new

PB (UK)

PB Theatre Systems Ltd, 12 Century Street, Sheffield, South Yorks S9 5DX. Phone: 0742 447511.

Manufacture computer-assisted theatre mixing consoles, maximum input/output format 32/16. (See *New Products* page 28.)

PEAVEY (USA)

Peavey Electronics Corp, 711 A Street, Meridian, Mississippi 39301. Phone: (601) 483-3565.

UK: Peavey Electronics (UK) Ltd, Unit 8, New Road, Ridgewood, Uckfield, Sussex TN22 5SX. Phone: 0825 5566. Telex: 957098.

new

XR Series: range of stereo power amp/mixers with six, eight or 12 input channels.

Mark III Series: range of stereo mixers with monitor facilities, available in 12, 16 or 24 input versions.

Mark I Series: stereo or mono output mixers in a variety of formats including 8, 12 or 16 input versions.

PHILIPS (Netherlands)

NV Philips Gloeilampenfabrieken, Eindhoven. Phone: (040) 79.11.11. Telex: 51121.

UK: Philips Business Systems, Cromwell Road, Cambridge CB1 3HE. Phone: 0223 245191. Telex: 81547.

USA: Philips Broadcast Equipment Corp, 91 McKee Drive, Mahwah, New Jersey 07430. Phone: (201) 529-3800.

SM4: modular console system suitable for concert and theatre sound reinforcement applications. Wide range of modules available with each console being effectively a custom desk.

LDC25: range of dynamic audio mixing consoles with a capacity of 24 input channels.

PRIMROSE (UK)

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

PEL202: modular PA mixer accepting up to 30 interchangeable input channels, three stereo groups.

RAINDIRK (UK)

Raindirk Ltd, 33A Bridge Street, Downham Market, Norfolk PE38 9DW. Phone: 0366 382165. Telex: 817737.

USA: Audicon Inc, 1200 Beechwood Avenue, Nashville, Tennessee 37212. Phone: (617) 256-6900. Telex: 554494.

USA: ACI/Filmways, 7138 Santa Monica Boulevard, Hollywood, Cal 90046. Phone: (213) 851-7172.

RM61: 6-input single output rack mounting mixer.

new

RAMSA (Japan)

UK: National Panasonic Ltd, 308-318 Bath Road, Slough SL1 6JB. Phone: 0753 34522. Telex: 847652.

USA: Professional Audio Division, Panasonic Co, 1 Panasonic Way, Secaucus, New Jersey 07094. Phone: (201) 348-7000. Telex: 710-992-8996.

WR-8716: sound reinforcement mixer with 16 input channels, four group and two master outputs.

RSD/STUDIOMASTER (UK)

Recording Studio Design Ltd, Home Farm, Northall, Dunstable, Beds. Phone: 0525 221331.

USA: Studiomasster Inc, 1365C Dynamics, Anaheim, Cal 92806.

Wide range of mixers suitable for PA applications. Models include 12/2, 16/4, 16/8 and 20/8 formats.

RSD (Canada)

Richmond Sound Design Ltd, 1234 W 6th Avenue, Vancouver, British Columbia V6H. Phone: (604) 736-7207. Telex: 0454667.

USA: Listec Television Equipment Corp, 39 Cain Drive, Plainview, NY 11803. Phone: (516) 694-8963. Telex: 640470.

M82 Series: large range of mixers available in various configurations including sound reinforcement and musicians mixer formats. Facilities include stereo, group and direct outputs with VCA subgrouping and level control. Sizes vary from 4- to 24-channel.

44 ▶



Midas 28/24
PR Series console

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

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If you'd like brochures covering the Sony Digital Audio Range, phone Keith Smith or Mike Jopp on Sunbury 81211.

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product Sound reinforcement consoles guide

88, 816, 1224: range of theatre mixers in 8- or 12-channel sizes. Outputs range from eight to 16 to 24. Consoles accept *Memory Pack* modular automation system for theatre sound control.

SAIT (Belgium)

Sait Electronics Ltd, 66 Chaussee de Ruisbroek, B-1190 Bruxelles. Phone: 02376.20.30. Telex: 61130.
UK: Sait Electronics UK, Wireless House, 31 River Road, Barking, Essex IG11 0BX. Phone: 01-594 5642. Telex: 897576.
USA: Sait Inc, 33 Rector Street, New York, NY 10006. Phone: (212) 422-6690. Telex: 222411.

Sait manufacture a range of mixers suitable for theatre and remote purposes including the *ESM 601, 082, 1202* and *S19*.

SAJE (France)

SAJE SA, 5 rue de Solferino, F-92100 Boulogne. Phone: (1) 609.15.54.

CSM 6: modular console suitable for live sound applications and available in sizes from four to 40 inputs with two to eight outputs. Custom modules may be incorporated.

SHURE (USA)

Shure Brothers Inc, 222 Hartrey Avenue, Evanston, Illinois 60204. Phone: (312) 866-2200. Telex: 724381.
UK: Shure Electronics Ltd, Eccleston Road, Maidstone, Kent ME15 6AU. Phone: 0622 59881. Telex: 96121.

M Series: range of four into one mic mixers.

new

Model 706: mono mixer with eight input channels, includes 200W power amp.

SR109-2E: rack mounting 8-channel mono mixer.

SOLIDYNE (Argentina)

Solidyne Srl, Tres de Febrero 3254, 1429 Buenos Aires. Phone: 701-8622.

Series 3000: modular consoles suitable for theatre and sound reinforcement applications.

new

Series 4000: sound reinforcement mixer with 6/8 input channels and two outputs.

401-CI: portable 4-channel mixer, battery operated, mic and built-in amp.

SONETEC (France)

Sonetec, 21 Avenue du Fort, F-92120 Montrouge. Phone: (1) 654.07.07. Telex: 202347.

CM1243, CM1843, CM3264: range of modular sound reinforcement consoles in 12/4, 18/4 and 32/6 formats. *CM3264* has VCA subgrouping.
CM 2044: modular 20-channel mixer with four outputs and six VCA subgroups.
CM804 portable 8/4 mixer uses same modules.

new

SONOSAX (Switzerland)

Sonosax, Route d'Yverdon 27, CH-1028 Prévengens/Lausanne. Phone: (021) 71.13.13.

SX-B: compact mixer with five stereo inputs plus two mic inputs, two independent stereo outputs and two mono outputs.

SX-A: modular mixer available with 10, 16, 24 or 32 inputs and 4 + 6 outputs.

SONY (Japan)

UK: Sony (UK) Ltd, Pyrene House, Sunbury-on-Thames, Middx TW16 7AT. Phone: 09327 81211. Telex: 266371.
USA: Sony Corporation of America, 9W 57th Street, New York, NY 10019. Phone: (212) 371-5800. Telex: 424595.

MX Series: stereo and mono, passive and active mixers in a variety of formats.

SOUNDCRAFT (UK)

Soundcraft Electronics Ltd, 5-8 Great Sutton Street, London EC1V 0BX. Phone: 01-251 3631. Telex: 21198.
USA: Soundcraft Electronics USA, 20610 Manhattan Place, Torrance, Cal 90505. Phone: (213) 328-2595.

Series 1S: portable non-modular PA mixers available in 12-, 16- and 20-input versions.

Series 400: modular mixers available in 18- and 26-channel frame formats with four subgroup and separate stereo mix groups.

Series 800: modular mixers available in 18- or 36-channel configurations with eight PA outputs.

new

SOUNDTRACS (UK)

Soundout Laboratories Ltd, 91 Ewell Road, Surbiton, Surrey. Phone: 01-399 3392. Telex: 8951073.

16 Series: range of PA mixers in various formats including 16/2, 16/4, 16/4/2 and 16/16/4/2. Also a 16/6 monitor mixer.

SPECTRA SONICS (USA)

Spectra Sonics Inc, 3750 Airport Road, Ogden, Utah 84403. Phone: (801) 392-7531.
UK (modules and components): Sun Recording Services Ltd, 34 - 36 Crown Street, Reading, Berks. Phone: 0734 595647.

Model 1100: rack mount line/mic mixer for sound reinforcement applications.

SPHERE (USA)

Sphere Electronics, 20201 A Prairie Avenue, Chatsworth, Cal 91311. Phone: (213) 349-4747.

Alpha Series: although designed for stereo broadcast applications, custom sound reinforcement versions are available.

STRAND SOUND (UK)

Rank Strand Sound, PO Box 51, Great West Road, Brentford, Middx TW8 9HR. Phone: 01-568 9222. Telex: 27976.

USA: Strand Century Inc, 20 Bushes Lane, Elmwood Park, New Jersey 07407. Phone: (201) 791-7000.

System 1/System 2: theatre and sound reinforcement mixers. *System 2* offers additional facilities. Basic models 16/4 expandable to maximum 32 modules.

new

TAC (UK)

Total Audio Concepts Ltd, Islington Mill, James Street, Salford M3 5HW. Phone: (061) 834 6747. Telex: 668127.

UK Sales: Scenic Sounds Equipment Ltd, 97 - 99 Dean Street, London W1V 5RA. Phone: 01-734 2812. Telex: 27939.

TAC1682: 16/8/2 sound reinforcement console extendable to 32-channel. Similar console, the *TAC168/16B*, is a complementary monitor desk.

TANGENT (USA)

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

Series 4: sound reinforcement consoles in two mainframe sizes with 12 or 20 inputs and direct outputs from each channel.

Ax Series: sound reinforcement consoles in four formats with eight, 12, 16, or 24 inputs and full monitoring facilities.

TAPCO (USA)

EV-Tapco, 3810 148th Avenue NE, Redmond, Washington 98052. Phone: (206) 883-3510. Telex: 910-449-2594.

UK: Gulton Europe Ltd, Electro-Voice Division, Maple Works, Old Shoreham Road, Hove BN3 7EY. Phone: 0273 23329. Telex: 87680.

6000 Series: range of rack mounting PA or musical instrument mixers with six or eight inputs and mono or stereo outputs. *8201B* stereo mixer similar with eight inputs.

Series 72/74: semi-modular mixers. *Series 72* available in 12-, 16-, and 24-channel formats all with stereo or mono outputs. *Series 74* available in 8-, 16-, 24-, and 32-channel formats with 4/2/1 output section.

C-12/Series Two: 12/4/2/1 format mixer expandable up to 44 input channels with stereo or mono subgroups.

TECHNICOBEL (France)

Technicobel, 8 rue de la Croix Maitre, BP26 F-91122 Palaiseau Cedex. Phone: (1) 920.80.39. Telex: 692543.

CX40: sound reinforcement and special effects console for theatre applications. 16 input channels with 16 outputs, four output busses, five cue sends and returns, master group VCA level control and routing matrix.

TESLA (Czechoslovakia)

Exports: KOVO Foreign Trade Corp, Jankovcova 2, 170 88 Praha 7, Czechoslovakia. Phone: 874 1111. Telex: 121 481.

ESR Series: range of mixing consoles suitable for PA, sound reinforcement and theatre applications. Available in portable or fixed formats in a variety of configurations. Examples include 6/2, 8/6/4, 18/6/2, and 24/16/24 all for mono or stereo operation.

THEATRE PROJECTS (UK)

Theatre Projects Services Ltd, ElectroSound House, 11 Marshalsea Road, London SE1. Phone: 01-403 3838. Telex: 885659.

Custom design and manufacture of mixing consoles for theatre, sound reinforcement and PA applications.

TOA (Japan)

UK: Toa Electric Co Ltd, Castle Street, Ongar, Essex CM5 9JY. Phone: (02 776) 4333. Telex: 995554.
USA: Toa Electronics Inc, 1023 Grandview Drive, San Francisco, Cal 94080. Phone: (415) 588-2538. Telex: 331332.

RX Series: modular consoles suitable for sound reinforcement and on-stage monitoring purposes. Formats include 8/2, 12/2, 16/4, 16/8, 32/4 and 32/8.

TRIDENT (UK)

Trident Audio Developments Ltd, PO Box 38, Studios Road, Shepperton, Middx TW17 0QD. Phone: 09328 60241. Telex: 8813982.
USA: Trident (USA) Inc, 652 Glenbrook Road, Stamford, Connecticut 06906. Phone: (203) 357-8337.

Fleximix: modular system whose configuration can be rapidly altered. Systems built using four basic modules in 15 or eight module mainframes.

new

Trimix: compact modular console based on the *Series 80* multitrack console. Mainframe houses 24 modules, may be configured from 2-track to 24-track or to various sound reinforcement formats.

TURNER (UK)

Turner Electronic Industries Ltd, 175 Uxbridge Road, London W7 3TH. Phone: 01-567 8472.

TPM 24/8/2: modular PA sound control desk with 24 input channels, four stereo subgroups and separate stereo master output.

YAMAHA (Japan)

UK: Ban Electromusic, 89 - 97 St John Street, London EC1M 4AB. Phone: 01-253 9410. Telex: 25960.
USA: Yamaha International Corp, PO Box 6000, Buena Park, Cal 90620. Phone: (714) 522-9105.

M Series: sound reinforcement mixers for fixed or portable use. Configurations include 16/2 + 2 matrix, 16/4 + 4 matrix and 32/4 + 4 matrix.

PM Series: wide range of modular PA and sound reinforcement mixers ranging from 6-channel stereo output mixers to 32 or 24/8 + 8 matrix formats.

ZOOT HORN (UK)

Zoot Horn, 31 Station Road, London SE25 5AH. Phone: 01-653 6018. Telex: 945007.

PMR Series 2: modular console system with PA and sound reinforcement formats, may be customised.
Link Series: modular PA and sound reinforcement consoles with formats including 10/2 and 16/2. Also 16/6 and 24/6 on-stage monitor mixer formats. ■

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product PA processing equipment guide

AB SYSTEMS (USA)

AB Systems Design Inc, PO Box 754, Folsom, Cal 95630. Phone: (916) 988-8551.
UK: Martin Audio Ltd. 54 - 56 Stanhope Street, London NW1 3EX. Phone: 01-388 7162.

Model 2400: 2-channel rack mounting unit with separate gain and two fully adjustable crossover controls per channel; additional subwoofer output.

ACES (UK)

AC Electronic Services, Broad Oak, Albrighton, near Shrewsbury, Shropshire SY4 3AG. Phone: 0939 290574.

ACXV: 2-way and 3-way stereo electronic crossovers, fixed frequencies.

ACCUPHASE (Japan)

Kenosonic Laboratory Inc, 2124 - 6 Motoishikawa-cho, Midori-Ku, Yokohama. Phone: 045 901-2771. Telex: 3823780.
USA: Teac Corporation of America, 7733 Telegraph Road, Montebello, Cal 90640. Phone: (213) 726-0303. Telex: 677014.

Model F-5: 2 channel 3-way crossover with choice of 16 adjustable crossover frequencies.

ALTEC (USA)

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

Model 1630A: two-way active system but can be operated in pairs for a tri-amped system; switchable crossover points.

Model 9025: two-way passive low level crossover networks.

ASHLY (USA)

Ashly Audio Inc, 100 Fernwood Avenue, Rochester, NY 14621. Phone: (716) 544-5191.
UK: Atlantex Music Ltd, 34 Bancroft, Hitchin, Herts SG5 1LA. Phone: 0462 31511. Telex: 826967.

Range of electronic crossovers all offering similar facilities but with different formats: stereo 2-way SC-22, stereo 3-way SC-77, mono 3-way SC-70 and mono 4-way SC-80.

AUDIOARTS (USA)

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

1400: parametric electronic crossover for 3- or 4-way systems, crossover depth provided to compensate for speaker frequency abnormalities in the crossover region.

1500: tunable notch filter, feedback suppressor; 1/3 octave bandwidth, five identical sections covering 52Hz to 7.3kHz.

2100A: tunable electronic crossover, parametric with crossover frequency continuously variable between 70Hz to 8kHz.

AUDIOMARKETING (USA)

Audiomarketing Ltd, 652 Glenbrook Road, Stamford, Connecticut 06906. Phone: (203) 359-2312. Telex: 996519.

Time/Sync: crossover designed to be compatible with Audiomarketing's Red Series studio speaker system, or any 604-type loudspeaker; incorporates

time delay in the lowpass section to align the output of the drive units.

AUDIX (UK)

Audix Ltd, Station Road, Wenden, Saffron Walden, Essex CB11 4L9. Phone: 0799 40888. Telex: 817444.

Custom design of rack systems including ambient-noise sensing amplifiers.

BGW (USA)

BGW Systems Inc, 13130 S Yukon Avenue, Hawthorne, Cal 90250. Phone: (213) 973-8090.
UK: Court Acoustics Ltd, 35 - 39 Britannia Row, London N1 8QH. Phone: 01-359 0956/5275. Telex: 268279.

Model 10: single-channel 2-way crossover system with subsonic filter.

BIAMP (USA)

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

M2/V: mono 2-way rack mountable crossover with transformerless balanced inputs and outputs; includes low frequency filter and high frequency phase control.

SM23: stereo 2-way or mono 3-way identical to M2/V but lacks LF filter and HF phase control.

BROOKE SIREN SYSTEMS (UK)

Brooke Siren Systems, 92 Colney Hatch Lane, Muswell Hill, London N10 1LR. Phone: 01-444 7892. Telex: 912881.

MCS Series 200: modular expandable crossover system with integral limiting and output metering. Maximum capacity of 5-way stereo. Frequencies set by plug-in cards.

FDS 300 Series: frequency dividing systems. FDS 320 two-way; FDS 340 switchable 3-way/4-way.

COURT ACOUSTICS (UK)

Court Acoustics Ltd, 35 - 39 Britannia Row, London N1 8QH. Phone: 01-359 0956/5275. Telex: 268279.

EC-2/3/4: stereo 2-, 3- or 4-way system. Each crossover point has choice of four frequencies with click free operation to allow A/B tests during use.

CROWN/AMCRON (USA)

Crown International Inc, 1718 West Mishawaka Road, Elkhart, Indiana 46514. Phone: (219) 294-5571. Telex: 810-295 2160.

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

VFX-2A: stereo filter system that can be used to provide crossover network or bandpass functions. Two filters per channel high and lowpass. Setting both filters in one channel to a common frequency provides a 2-way crossover at that frequency. In mono it can be used as a 2- or 3-way system.

MX-4: mono electronic crossover, 3-way plus subwoofer.

DDA (UK)

DDA Ltd, Unit 7B, Worton Hall Trading Estate, Worton Road, Isleworth, Middx TW7 6ER. Phone: 01-847 0363.

DD1000: active frequency dividing network with plug-in programming modules. May be configured for 2-, 3- or 4-way stereo operation.

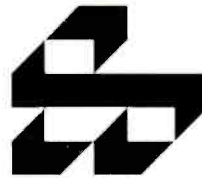
ELECTRO-VOICE (USA)

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

UK: Gulton Europe Ltd, Electro-Voice Division, Maple Works, Old Shoreham Road, Hove BN3 7EY. Phone: 0273 23329. Telex: 87680.

XEQ-1A: electronic crossover, 2-band, 5-position Thiele LF equalising network.

XEQ-2: 2-way active crossover/equaliser similar to XEQ-1A.



sound workshop representatives

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and South Africa

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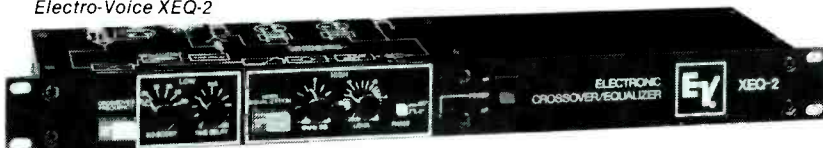
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Electro-Voice XEQ-2



Sound Workshop on the right to bear ARMS.

When Sound Workshop introduced its computer automation system several years ago, we named it ARMS — a tongue in cheek acronym for the **Auto-Recall Mix-down System**. At that time, recording industry use of console computer automation was focussed on the multitrack mixdown process and a system designed to aid that process would thereby provide additional "arms" for the engineer.

Technology has continued to evolve since that time, and so has the idea of using a computer to do more than just assist in the mixing process. One can spend more than a quarter of a million dollars for a computerized recording console nowadays. And the computer in that board will eliminate the use of pencil and paper forever by allowing the "recall" of virtually all of the console set-up information. A definite advantage in the creative process, but the price tag can be forbidding (even when you consider the money saved on pencil and paper).

Sound Workshop is not presently building consoles in the highest price brackets. We have concentrated our expertise on designing and building cost-effective professional console systems that in many ways outperform their more expensive counterparts. The Series 30 shown here provides a perfect example of what we do. And we have maintained this same approach regarding console automation.

Although ARMS was specifically designed to aid the recording engineer during complex mixdown situations, it actually functions throughout the recording process by providing computer control/assistance to a number of mechanical operations previously done manually, with the help of other engineers, or not at all. ARMS Automation includes the following functions:

- Automated control of channel levels (Level Write)
- Independent automated control of channel on/off status (Mute Write)
- Full In-Place Solo System
- Total integration of all automated functions into all group structures
- Super-Group

The most vital aspect of ARMS Automation is its ability to control the on/off status of each input channel totally independent from its control of channel level information. Even if ARMS was used just to turn channels on and off without writing level information (i.e. having the system control the actual "mix," normally the stated purpose of automation), a number of mechanical operations common to nearly all mixdown sessions would be eliminated. These include: noise gating; erasing unwanted sections on the multitrack master; selecting proper tracks from duplicate performances; switching

between "time shared" tracks; changing EQ, Echo, Panning etc. during specific "sections."

Another major asset of ARMS Automation is its computer-controlled sub-group system named **Super-Group**. Super-Group permits all grouping functions to be controlled by the computer, eliminating previously awkward systems of group selection, modification and visual confirmation. Conventional systems require the user to scan each input module's thumbwheel switch (or digital display) to determine which inputs belong to a given group, an often cumbersome process on today's larger consoles. With Super-Group, the user merely pushes the button on any channel and all members of that group light up — **instant visual group confirmation!** Other Super-Group features include:

- **Solo Dim** Allows all channels except the one (or ones) soloed to be attenuated by any preset amount.
- **Negative Grouping** Allows instant selection of a group consisting of all channels **except** those selected.
- **Grand Master** Any fader may be established as the console Grand Master.
- **Local Control** Any Group master can be changed over to local channel control without affecting the group level.

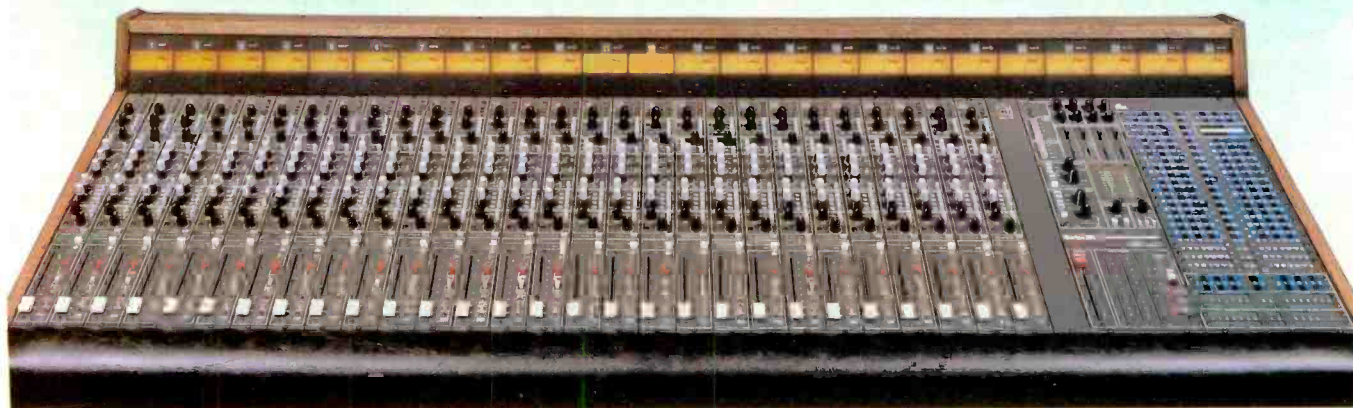
ARMS Automation is available in the Sound Workshop Series 30 and Series 40 recording consoles. The exceptional performance and practical value of these consoles can be confirmed by sitting behind one of them or by consulting with a studio who owns one. Twenty-four track automated consoles from Sound Workshop start at less than \$25,000.

Sound Workshop's ARMS Automation is genuinely innovative and amazingly cost-effective. Much more than just a mixdown aid, it provides a variety of functions not found in other systems regardless of cost. And Sound Workshop will soon be introducing **DISKMIX™** — a disc-based storage system designed to augment ARMS with the capability to store and merge a number of mixes while providing off-line editing, computer control and storage of session documentation.

Just a part of your right to bear ARMS.



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Electronic music synthesis— Larry Fast comments

Tony Bacon



Electronic music has made its way into many different areas of music: popular music in particular. It's made major inroads into rock, disco and jazz, even pop—any area you can think of. Classical probably less so—it's more 'pure' electronics when it's used in the classical area. And that starts a definition problem with the record companies, because they hear a Donna Summer record or a Bee Gees record as electronic, and any of the current things that are happening in the UK that haven't really happened in America yet—OMD or Human League for example—are also viewed as electronic.

Many record company people say, 'What do you mean there's a problem about electronics? We've got huge hits here that are electronic!'—so it's a matter of how the individual composers and musicians see themselves and what they're doing. All I try to do is be honest about what I'm doing and say, 'Does this fit into the mainstream of what the industry's really geared up to sell?' They're struggling as it is, trying for hits, and they just can't afford to take chances, so they don't. That is going to be compounded by my saying, 'You don't sell electronic music.' They'll say, 'Well, that's your way of looking at it—we do! You haven't

Larry Fast has been one of the most consistently interesting synthesiser players of the last few years, a studio-bound musician who only ventures out on the road with his best-known partner-in-sound, Peter Gabriel. Despite Fast's busy session schedule with everyone from Hall & Oates to Meatloaf, he finds time to put out the occasional 'one-man multitrack project' under the name Synergy, and to delve deeper into analogue and digital synthesis and recording. While his musical and technical approaches remain personal, even idiosyncratic, he is undoubtedly in a unique position to elaborate on the harmony between electronic musicians and recordists.

had a hit but other people have, so you should be writing like them.' It just puts you in a quandary—what do you do? If there are hits that make use of electronics and, from a particular point of view they're a sell-out, then do you sell out to have a hit? Or do you stick to your guns?

I can be associated with Peter Gabriel, who has his commercial success—one of the few cases of commercial success without compromise, and the maintenance of a very high degree of creative integrity. I don't have to rely on my Synergy albums as the focus of my career—they may be the public focus, but they don't have to be the financial or survival focus—I can

afford to do more or less what I want with them. So if anyone has accused me of 'not being *avant-garde* enough or 'not experimental enough', it's more because I've chosen to do that in a compositional sense rather than attempting a commercial sell-out.

A major label needs one hit to pay for 15 that are going to lose money, and they budget for that. But they don't go in there assuming that this one's not going to sell—they go in assuming that every one is going to be the hit, knowing that one of them will be bigger than all of the others. If something isn't making money within a year or two, it's not going to happen. Smaller labels have

smaller overheads, it's true—they're not carrying the staff—but it also means that they haven't got the advertising dollars. And a lot of it comes down to marketing. There are excellent records made on small labels that, in the States, you can't get into the market. Market penetration not only means reaching the stores with the records, it also means generating the interest in the public. And that's very expensive, *much* more expensive than making the records. The conglomerates that own the major labels are all parts of the communication, TV and film media and there's a lot of money available from there. It works reasonably for them.

Until public tastes change to the point where an instrumental, electronic album of experimental music is going to be considered something that's mainstream, which hasn't happened in classical or virtually any other form of music, it will never achieve major pop success. It will be very hard to change things, and I don't know if it's the composer's right to demand that they be changed around, because ultimately it's the public voting with their wallets that counts.

It would be great to have one huge hit somewhere along the line, but it's not an over-riding goal in what I'm

... it's good to feel your creativity isn't impinged upon at all ...

doing. I don't think I expect that—if it happens it would be one of those lucky things, like something being picked for the soundtrack of a movie, a theme song to this or that. Carl Sagan made use of a number of my things in his *Cosmos* TV series: they're on the compilation album. There was a little boost in back sales when that happened. But it's not an over-riding commercial thing for me, and I think that's good. Charles Ives, the American composer, spent his entire life as an insurance executive; he wrote one of the manuals of life insurance sales, and was very respected in that industry. And he wrote absolutely wonderful, bizarre musical pieces and symphonies in his very calm suburban house—they were far too strange, most of them, to be performed in his lifetime. He said that it's good to feel your creativity isn't impinged upon at all, and not to try to support yourself by your music.

I've been lucky because I can support myself with music, and I can afford to keep my own studio running at home, and all the luxuries that go with it. Sometimes I feel as though it's that Synergy's been successful, but by being involved in many other projects financial security has been there for quite a while. I just don't have to worry about it, so I can do what I want with my own albums and not have to get into the rat-race of commerciality. I can't hold the industry in too much contempt because I've seen it from both sides: I was involved in radio before I was even doing recording studio work. I've seen how that operates, and I know the kind of pressure they're under—the industry, this big thing, the roller-coaster ride that they're on. It's difficult.

Probably my most serious complaint about it is that, because it's such an economic roller-coaster, most of the conglomerate executives come from the financial and legal ends, rather than from the artistic end. Although they can pull the organisation together on a balance sheet, they would find that they would have a better return in the long run if they took a more artistic approach and still kept a good sense of financial responsibility. In the old days, sometimes it was entirely the other way: you had very artistic organisations that would drive themselves into bankruptcy through bad management. I think there's a

happy medium—we may have gone a little too far now with the lawyers and accountants running the companies.

One day the lawyers and accountants will realise that there's nobody in the executive office that listens to their product any more, that none of them really understands what they're signing any more, that there's some 22 year old A & R kid who's the only one who really understands artistically what's going on in the company. Then they'll say, 'Oh, he's the one who's got all the hits, we should hire more like him, it's cost-effective'.

There are other opportunities now, too: the independent labels, the smaller home-recording systems, the so-called semi-pro stuff which can be used to great advantage and turn out great musical ideas, and exist as an alternative to the standard industry, the high-powered, high-money version. There are some very powerful tools for a lot of people, and they're a good training ground.

Synthesisers and ambience

The normal systems that are used for enhancement in studios where you've already got room ambience of some sort 'attached' to the natural sounds—over the drums, or even a synthesiser connected to an amplifier in a room—have got something happening so that just a little extra chamber of some sort can usually bring in enough life. But when you're doing an all-electronic project, or a largely electronic project, then you have to rely very heavily on creating the space for the instruments.

What I try to do is to get an idea of what's supposed to fit in the context of the music, and then decide what to do. The little DeltaLab *Acousticcomputer* which I carry around in my rack with me and an old Eventide *Harmonizer* can be used to give a wide variety of room areas, right from very close quarters out to very spacious, reverberant qualities. They're very good at sketching environmental sounds around you—not sound effects, but the type of space that's supposed to be around the sound. Roland make a little box called the *Dimension D* which really helps, it's a great little box, a whole lot of phase shifters all working in different ways, but it doesn't give you the swirling, clichéd, sweeping phase shift, just a depth—you never hear the

individual sweeps if you're using it right which is what I like. It's not calling attention to itself, it's just another ambience texture. So those boxes are as much a part of the patch as what waveform is being used, or how the filtering is going, just as long as it's not to the point where it becomes an echo effect but stays as ambience. That's where I try to draw the line, and that line is a little different for each sound.

One of the nicest new toys that has shown up is the new AMS delay—they've just come up with an electronic reverberation system. It's not very expensive—it's still not cheap—but it's a good bit less than the EMT or any of the others. I think that they've put all the right things in it. It sounds great, it's got the minimum of controls but it has what you need, without getting to the point where it's an engineer's nightmare and takes half an hour to set up.

Another interesting thing in electronic music: there is no real stereo. I mean, all we have is 2-track mono. You can give some indications of a bit of the phase error and delay, the real psycho-acoustic clues that are used to create an environment. I've played with all these a little bit, all three: level, phase error and time. With a lot of work you can make it sound somewhat passable in headphones, but it's probably not worth all the effort—it takes away from the effort that could have gone into the musical composition. So it's really more a part of an abstraction of stereo image using different delay devices, to give the feeling of depth and the impression of it, without having the defined points of true localisation cues.

Studios and signal processing

A lot of studios are in the arms race as far as outboard gadgets go,

and even recording gear—consoles and autolocate equipment—that are becoming so complex that it's beyond one person to remember which sequence of buttons does what, especially when it's simultaneous button depressions, memory recall points. . . it's just too much. I still to this day cannot figure out the Studer *Autolocator*, I'm always having to refer to the manual. It's just not the kind of thing that makes it easy to remember—it's a beautiful piece of machinery, but it's not always the easiest thing to do when you're trying to juggle the musical end, and some musician has just come up with a musical idea and needs to go on something right away. It's easier to look at the numbers and wind back to it rather than try memory bank 11, location 4—trying to keep track of all that is just too much. It's another of the problems I've found with some of the computer mixers—they're too much trouble sometimes! It's not worth the effort, you can just do it manually more easily and more effectively. I've been finding engineers rebelling against that, because they feel that it keeps them from being as directly involved in the music as they would like to be, being part of the process of working creatively with the producer and the artist.

Most manufacturers are quite responsive—you point these things out to the ones that I've been in touch with, they go, 'Oh, we didn't realise that the Studer required this'. Very often, in many of the companies, the engineering department could be a bunch of kids out of engineering school or experienced design engineers, but they don't realise that to push two buttons as opposed to one at 4-in-the-morning really makes a big difference!

Digital recording

I think that an awful lot of

"Another interesting thing in electronic music: there is no real stereo."

because that's what can bring in clients from the guy down the street. But I think there's a bit of overkill—how many different delays do you need there? You get into such subtleties that it ceases to make any difference, and if the songs aren't any good and the music isn't interesting all the technical support in the world isn't going to help very much—it will help a little, but not that much. I think sometimes the engineers are given a problem by the manufacturers in that they're getting

producers, recording engineers and artists are saying, 'Well, let's check out digital, there's been quite a buzz on it. Let's see how different it is and whether it lives up to the expectations.' It's going through a shake-out right now—the standards and the different approaches that are being taken, it's going to take a while to settle down. I don't think it's really there yet, but it's quite good and it's got much better in the past two years. I'm *sure* that's

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Larry Fast

way it's going—it's a little hard to predict where it's all going to end.

My main experience of digital recording has been with the Mitsubishi open-reel system which we had at House Of Music for a couple of mixes. I got familiar with it on that system, and in a more general sense at Bell Labs where there has been direct-to-computer, mainframe memory digital recording for several years. That's the way a lot of the sound analysis and some of the digital synthesis work—especially speech synthesis—that I was carrying out was done. So that was really the first time I got to play with any digitisation at all. But the rules are all the same, the basic digitisation and storage and reconversion and however that's achieved is met with varying degrees of success depending on how each manufacturer has attacked it. With the new Peter Gabriel album we're hoping to use Sony digital, ¼in VCR cassette.

But I still sense that all the sampling rates are too low, but they're about the only thing that's practical at this stage—so maybe we should start low and then in the latter part of the decade, when memory configurations are better and everything is a little more cost-effective, we'll kick up to a higher standard. It's probably fine for consumer use now, and is still better than anything that's going to be available in analogue form for quite some time. The D/A records that are available now I can only hope are temporary aberrations and all will be collectors' items when the true digital masters come out! It would be somewhat akin to the early 1950s when you had all these wonderful old Ampex full-track mono machines going into the studios, and they were making great sounding masters which were still coming out on 78 RPM discs, because that was the market standard at the time. But of course those tapes were later (in the mid-1950s) re-mastered on to microgroove LPs—at least they were there in the can somewhere. I think a lot of these good performances are in the can now—we're stuck buying them on scratchy old 33s, but they will later be available on whatever digital format becomes the accepted one.

I can hear the difference, a positive one, between, say, a simultaneous analogue and digital mix: a nice 15in/s Dolby master, and the other in one of the digital formats. We've done that at House Of Music between the Mitsubishi and a Studer A80 master of Southside Johnny and the Asbury Dukes' live album. It was the first time that any of the digital machines

had come into the House Of Music, (about two years ago) and we wanted to hear the difference. It ended up being done digitally. The way it sounded to me was that the tape transfer problems inherent to analogue—misshapen waveforms and a kind of sludginess to the sound that is compounded with each additional transfer—seemed to lift a bit with digital. Of course, taking programme material from a multitrack down to those two little analogue tracks, cramming it all on there—it's always been good enough, but it seemed that the clarity remained on digital.

Different digital systems will have their own characteristics, but the transient response seems better and you have that dead silence when the tape is running with no programme material on it. It has a lot going for it; I'm just not sure that it's all shaken-out yet. One idea that I've been dreaming about and mouthing off about for a while has finally come to fruition: EMT have got their hard-disk-based, rather than tape-based, digital recording system which allows instant random access editing using proven computer hardware, and I think that bodes very well for the future. I think it's much more convenient, again just for artistic use. The fact that with most digital systems at the moment you can't edit on-site is a big hindrance, a very big musical inhibition. I can understand completely on a technical basis why it's not possible or economical for most places to have three VCRs and an editing desk and all that, but it's going to have to work up to that at some point. I can only let it go by for so long before I get frustrated and say, 'OK, this system is not valid because it's not reaching its ultimate goal of musical creativity'.

I think digital has already had a better start than stereo did, in terms

“... I can only hope the currently available D/A records are only temporary aberrations ...”

Digital doesn't seem to have that overt carnival attitude about it to begin with.

Digital synthesis

Since analogue synthesiser innovation effectively stopped in about 1973, the whole digital synthesis thing has been growing up out of the laboratories. It's perhaps still in the state that the modular synthesiser industry was in around 1967 or 1968: still feeling around for exactly what it wants to do. What feedback the early system purchasers can give to the manufacturers and what changes the next generations of instruments will have on them is starting to evolve. It's very hard to condemn anything, because anyone who's brave enough to go into it right now I have to give a lot of

Fairlight than any of the others so I'm more sensitive to its strengths and weaknesses. They've all carved out different areas that they want to cover and that makes them hard to compare. It's not like the analogue systems where one is pretty much the same as the next at least in the general sense—they've all got oscillators, they've all got filters, they've all got envelope generators, and you can say that X's envelope generators are better than Y's. But it's hard to say with the digital ones because they've all done it differently.

First it's just an attitude about who wants to do what: the Fairlight CMI is based very strongly, entirely even, on additive synthesis. There's a bit of a mixture of FM and additive in both the *General Development System (GDS)* and the



Synclavier II

“... anyone who's brave enough to go into digital synthesis now, I have to give a lot of respect to.”

of its marketing to the consumer, and far better than quad ever did! Quad had a whole set of different problems, of course, but stereo started out as nothing but sound effects records, ping-pong and trains whistling from right to left. That did put a lot of people off because it came over as a gimmick, and nothing but a gimmick artistically. It had to sneak back in quietly with a little bit more integrity over the following years, before stereo was recognised as the way to do it.

respect to. There are varying degrees of usability—I think part of what will be so good and what is already so good about the digital systems is that they're not locked up to their own hardware, so much of it is in the software designing. And that constantly gets better and more responsive.

The systems that are available at the moment all have strengths and weaknesses. I've had a little experience with all of them—I've probably spent more time with the

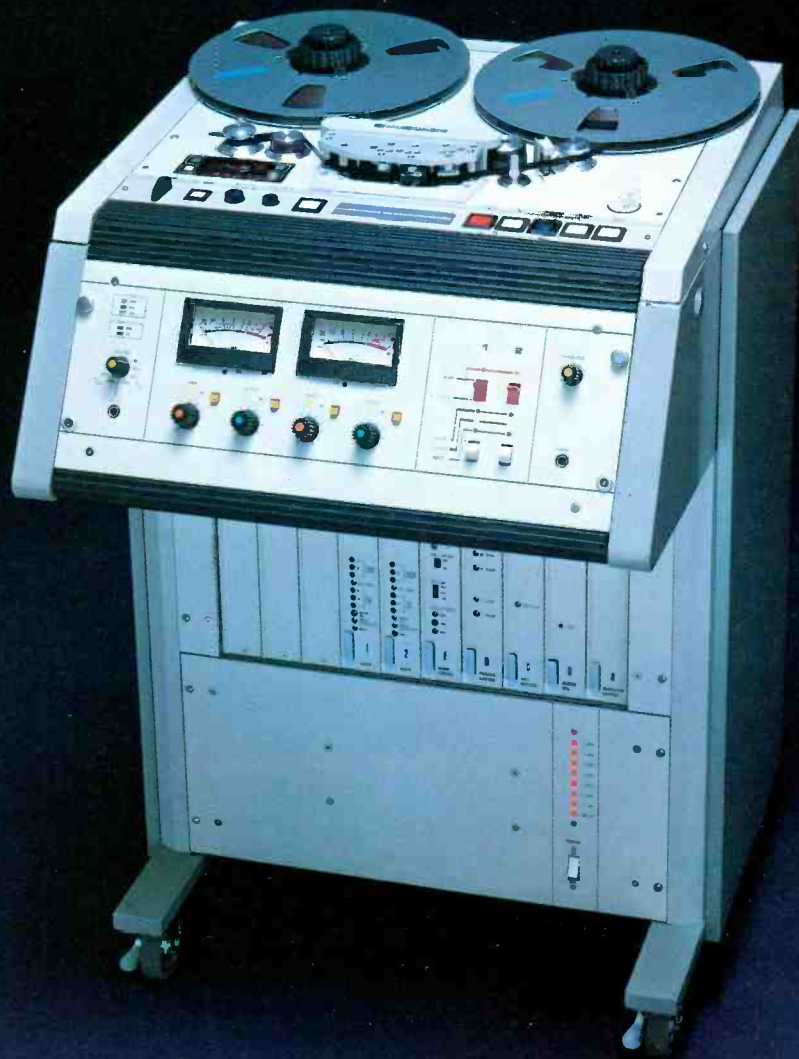
New England Digital *Synclavier*. I'm not sure what the genesis of the Fairlight is, because they're operating out of Australia they've been a little removed from the environment that developed the other two. With the *Synclavier*, they've had all the resources of the computing community at Dartmouth, and they're already into their second generation instrument. That crowd has a long and distinguished history in their endeavours with computing, music and electronics. The *GDS* people have the legacy from the Bell Labs system and people involved in that. There are some similarities in what I've seen of the *GDS* and what I remember of the Bell Labs, although there are of course changes as well.

Just taking those different basic viewpoints, the additive versus the additive-and-FM combinations, the *Synclavier* seems to take away some of the abilities to go for certain

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AES 71st Convention

report

This year's European AES Convention held in Montreux, Switzerland, saw the presentation of 46 technical papers covering the now well established gamut of audio subjects. There were seven technical paper sessions and all had papers of particular interest. However, as usual we present here a pot-pourri of highlights from the sessions rather than detailing each individual paper.

The first technical session covered the subjects of measurement and instrumentation and produced three papers of interest. In the first, Professor Catrysse from Belgium gave a tutorial overview of the applications of mathematical transforms in filtering techniques (AES Preprint No 1863). This paper details the formulae and mathematics behind many of the techniques used in modern filters, and includes a wide variety of analogue and digital applications. Mathematical transforms discussed included the Fourier transform, the Laplace transform, and state-space methods—where a transfer function is simulated using differentiators or integrators. Applications include transversal filters, state-space filters and digital state-space sampled filters.

A stimulating paper from Lis Grete Møller from Danmarks Radio (AES Preprint No 1862) addressed itself to the question of whether amplitude distribution of music programmes has changed, such that overload occurs on sound programme transmission. In particular the paper dealt with the changes that have taken place to contemporary music where a high content of HF energy (due to close mic recording techniques and the use of electronic music instruments) in a broadcast signal increases the likelihood of overload in a transmission system where pre-emphasis is used. To answer this question a series of measurements were taken on the instantaneous signal level of recent and older programme material, with the measurements being carried

out both before and after pre-emphasis to the CCITT J17 standard. The results of these investigations indicated that the amplitude difference between a signal with and without 50µs pre-emphasis is greater for contemporary recordings than older material, with the difference being much larger for rhythmic music than classical music. However, it has been discovered that by using CCITT pre-emphasis with 6.5dB attenuation at 800Hz, the probability of overload is negligible. Accordingly, it should be noted that CCITT pre-emphasis with 6dB gain at high frequencies, as proposed for digital broadcasting systems, may increase channel capability significantly, compared to a channel without pre-emphasis.

Staying with broadcasting, Bronwyn Jones and Emil Torick of CBS presented a paper detailing a new loudness indicator for broadcast applications (AES Preprint No 1878). This paper described the design and research behind the new indicator, which uses principles similar to the CBS Loudness Level Monitor developed in 1967. The new indicator takes the form of a horizontal LED display with a linear decibel format and is 5in long.

Moving on to the second technical session which covered the topics of studio techniques and transducers, two papers were of interest. The first, from AM Bourget of Studer, discussed a number of new developments in audio recording and reproducing electronic circuitry for analogue tape machines. Particularly covering the parameters of circuit design which influence signal quality, the paper (which was not preprinted) paid notable attention to the optimisation of circuitry where noise, headroom, bandwidth and phase interact. A variety of solutions to optimising signal quality between signal input in the record mode and signal output in the reproduction mode were presented, and these solutions are to be incorporated in a new range of Studer analogue tape machines to be introduced later this year.

The second paper of interest in this session was presented by D Berger from Neumann. This paper (which again was not preprinted) described

a system for the automatic storage of mixing console settings. The system, which is micro-processor controlled, is capable of storing a variety of console settings and operates as a computer-assisted system with versatile operational interface facilities. As an example of the system's format a self-contained equaliser system with a central operating panel was shown, this system retaining most of the traditional equaliser operating methods.

Digital techniques

The third session of papers brings us to the topic of digital techniques. Here there were three papers of interest. However, none of these was preprinted. In the first, AES President Barry Blesser discussed the philosophical trap of digital audio. Echoing to some extent the thoughts of Roger Lagadec in his recent article *Digital Audio—the Studer view* (March issue), Barry pointed out that now the audio industry has been exploring the use of digital technology for some 10 years, it is a good time to take stock of the standards and quality we expect from professional audio systems. Old notions of quality would appear to need reappraisal as technology has improved. However, Barry stated that there were pitfalls in accepting such a viewpoint unreservedly. In particular Barry stated that there is a need to define exactly what objectives the audio industry should be setting itself. Should, for example, digital audio as it stands today be formally standardised, when it is known that higher standards are achievable in the future? The problem being that technical implementation of digital audio is not exceedingly difficult, what is difficult is articulating the goals to be aimed for with digital systems.

Coming back from the realms of philosophy to more empirical aims, Dr Hirsch of EMT presented a paper detailing the possible approaches to producing a digital microphone. Dr Hirsch began his presentation with an explanation of the operation of the human ear from the audio



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AES report

engineer's point of view, showing that nature employs a two step conversion to give the listener aural sensing—soundwaves being converted by mechanical excitement to an analogue voltage and then to a digital signal. Not surprisingly, therefore, Dr Hirsch, after briefly surveying the possible propositions for producing a digital mic, came to the conclusion that the most probable system should mimic the human ear. Namely a conventional diaphragm will be necessary for a digital microphone too, and that the properties of the diaphragm will control the mic quality regardless of any digital processing.

The third paper in this session detailed the Transdyn process, a solution to the problem of reproducing the dynamic range of PCM recordings under normal home listening conditions. Presented by Jurg Jecklin of the Swiss Broadcasting Corp, the paper gave an overview of the problems of reproducing original dynamic range in home listening environments, also giving justification to the view that reproduced dynamic range is dependent on the size of the room. In order to overcome these problems the Transdyn process transforms the original dynamic range by reducing the loudness of a recording without changing the musical impression of dynamic range.

Mics and amps

Moving on to the next session entitled studio techniques, a further three papers were of interest. The first two dealt with the same subject, namely sound transmission with free propagating infra-red light, and were presented by Messrs Werner and Griese of Sennheiser. In the first, the use of continuous modulation techniques in such a system were described (AES Preprint No 1879), while in the second the use of pulse modulation techniques are described (AES Preprint No 1880). Together these papers fully explain the techniques of infra-red transmission for audio purposes and provide an excellent grounding to the technical background behind the Sennheiser infra-red systems.

The third paper of interest in this session was from Alexander Fritz of AKG (AES Preprint No 1876) and describes the new AKG *C460B* mic preamp designed for use with the company's existing modular condenser mic system. The new pre-amp, which also has two new capsules to accompany it, the *CK1X* cardioid and *CK2X* omni, uses recently developed semiconductor devices to produce a state-of-the-art mic preamp, suitable for use with the latest digital 16-bit PCM systems. The preamp sets new standards in mic technology and its specifications are impressive: 0.01% THD at 1kHz at max SPL; 0.15% TIM up to 120dB SPL; equivalent noise level 15dB SPL to DIN/IEC 179/A; dynamic range 125dB SPL; supply voltage 9 to 52V; and current consumption 1mA.

The fifth technical session on the topic of sound reproduction had two papers of interest. J Celen and W Sansen presented a paper on the practical use of current dumping for high power amplifiers (AES Preprint No 1868), this paper detailing the advantages and difficulties of building high power current dumping audio amplifiers and describing different ways of producing a practical design. The authors also describe a 500W current dumping amp with no quiescent current and using a Class-G output stage configuration.

Another paper of interest in this session

addressed itself to the potential problem of intermodulation distortion (IIM) in power amplifiers (AES Preprint No 1869) and was presented by W Sansen, L Corveleyn and F Bossuyt. Dealing with the problem of intermodulation distortion caused by loudspeaker-induced error signals, the authors believe such distortion can exist where a loudspeaker injects an independent current source into the amplifier's output. Having theoretically illustrated that such conditions can exist, the authors then experimentally attempted to reproduce IIM distortion with a real loudspeaker. However, despite heavy overloading of the loudspeaker, the experiment showed that a real loudspeaker is not able to generate measurable signals which would cause IIM distortion.

The next technical session covering the subjects of sound reinforcement and acoustics produced a further two papers of interest. In the first Karl Bader of EMT discussed the parameters responsible for the subjective perception of reverberation. Dealing with the perceived differences between the artificial reverb parameters chosen by sound engineers and those listeners expect to hear according to the characteristics of a corresponding room, Karl Bader indicated that when injecting artificial reverb, the amplitude, frequency range and timing of the reverb time together with the positioning of early reflections and cluster reflections are important aural clues to reproducing an acceptable and natural effect.

The second paper of interest in this session was a description by Bob Berkovitz of the Acoustic Research *ADSP*, a prototype adaptive digital signal processor. This unit is an audio-frequency signal processor which uses a 16-bit microcomputer to automatically compute and effectively construct a digital filter to alter the power spectrum and frequency response of loudspeakers in a listening room, thereby optimising the performance of loudspeakers in a listening environment. Accordingly, the *ADSP* can be used to compensate for the effects of room modes, loudspeaker directivity and boundary absorption at high frequencies.

Digital hardware

The final technical session at Montreux brings us to the subject of digital audio hardware, and here as usual a large proportion of the papers were of interest. Kicking things off in this session was a paper from H Pichler and F Pavuza (AES Preprint No 1874) giving details of a test procedure and a digital test generator for digital audio systems. The test procedure described by the authors uses a combined test method including a digital and analogue signal path in a digital audio system. This allows digital data processing and analogue processing to take place with the usual analogue test configuration converted to bring digital systems to the front and rear of the test configuration. For use in combination with this test procedure the authors also give details of a 16-bit digital sinewave generator using low cost components which accepts arbitrary system sampling rates. The generator's digital output signal covers the full audio bandwidth in 10Hz steps. Using the proposed test system a small storage capacity is sufficient for attaining an accuracy of $\frac{1}{2}$ LSB because more than 98% of the required sample values can be calculated by interpolation. In addition the complete test procedure can be simply controlled and evaluated by microcomputers.

Next on the agenda was a comprehensive paper from Dr Toshi Doi of Sony (AES Preprint

No 1885) giving complete details on the company's *PCM-3324* professional multichannel digital audio recorder. This paper details the technology involved in producing the machine and discusses amongst other subjects the production and design of monolithic A/D and D/A converters with 16-bit accuracy without any trimming. Other subjects covered include head technology for high density recording, the potential use of thin film head technology, the design of tape transport mechanisms capable of handling thin digital tape, error correction techniques, the development of modulation schemes, and physical and electronic editing techniques.

Following on was a paper from Ragnar Hergum describing a special purpose digital hardware processor for filtering and mixing audio signals (AES Preprint No 1875). This paper describes a processor using two LSI multiplier-accumulator units to perform high speed processing with a 23-bit accuracy. The processor which is designed for use with conventional analogue consoles performs filtering, mixdown and final fading in real time. Processing is restricted to spectrum shaping in six channels, mixing the six channels to a stereo pair and a concluding master fader. Sampling rate is 50kHz with a resolution of 16 bits per sample.

A 2-channel professional digital audio sampling frequency converter was the next subject. This paper (AES Preprint No 1882) presented by Dr Roger Lagadec, and Messrs Pelloni and Weiss from Studer describes the Studer *SFC-16* unit and details the principles and mathematical analysis behind it. In addition the paper gives a number of practical applications for the unit. (Details of this unit appear in Dr Lagadec's article in our March issue.)

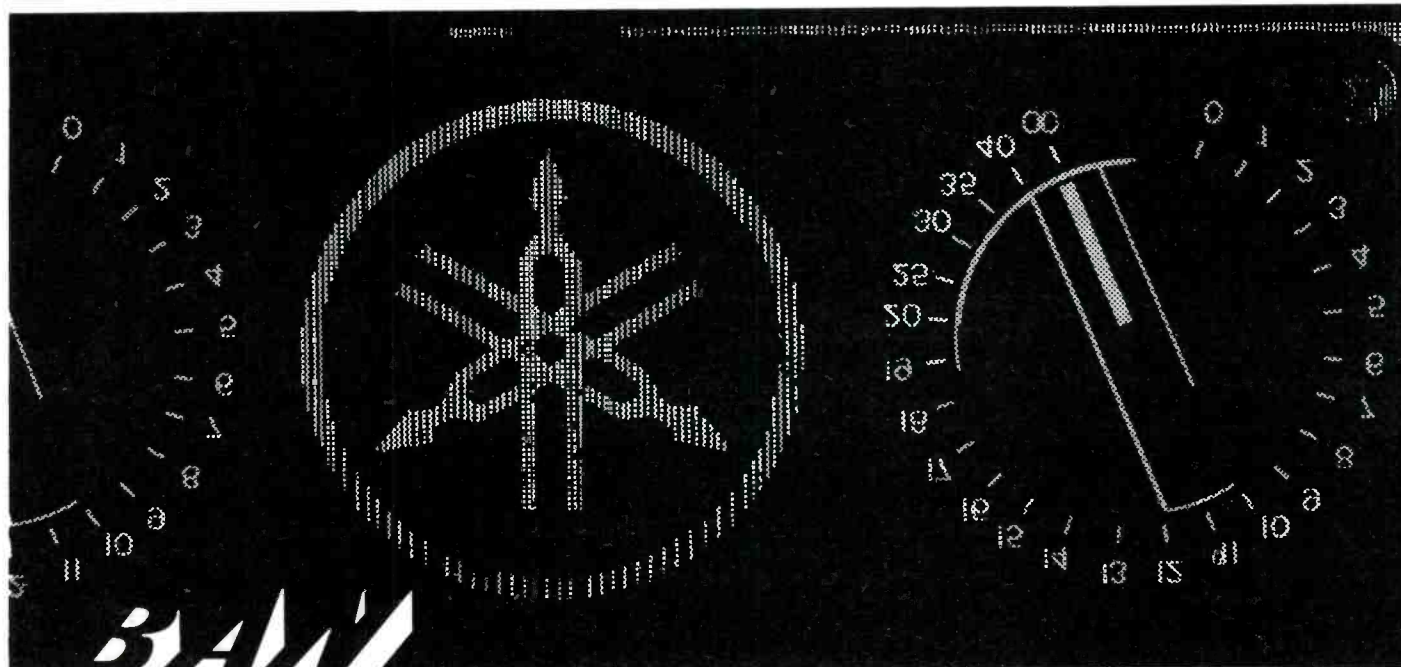
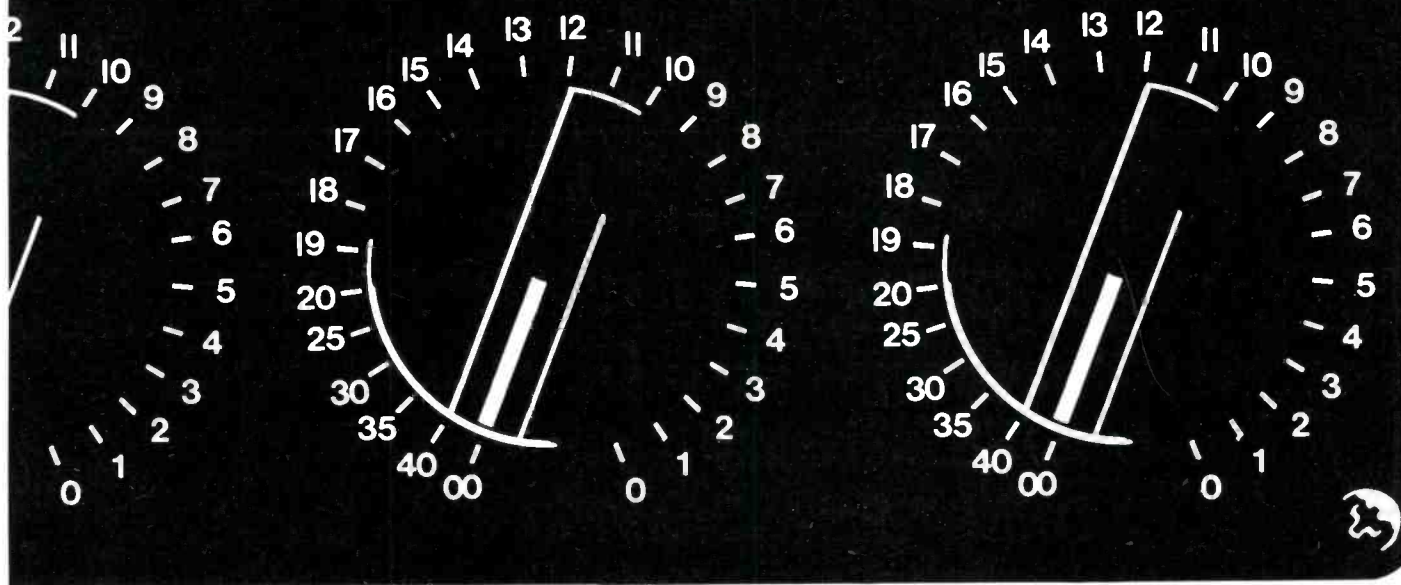
A further paper from Dr Lagadec, presented in conjunction with Dr Toshi Doi of Sony, presented details of the Sony/Studer digital interface for the interconnection of professional digital audio equipment. This digital interface is a serial interface capable of accommodating one, two and four channels of digital audio and has facilities for error protection, additional auxiliary digital audio channels, and user-defined information. (AES Preprint No 1883)

A paper of considerable interest for the potential development of digital audio in the immediate future was presented by Isao Owaki, Susumu Saito and Shinji Nakamura of JVC (AES Preprint No 1861). This paper describes the development of the world's first digital compact cassette deck, prototypes of which were first shown at AES New York last year. Although we have already published details of this deck (see page 34, January issue) anyone wishing to discover in greater detail how the deck is configured and the technology behind it, need look no further.

Finally, in a paper covering the same subject as the JVC paper mentioned above, a research team from Sony described a digital audio compact cassette deck with a thin film recording head (AES Preprint No 1859). This deck differs in format from the JVC alternative in a number of ways. While both decks have two digital audio channels, the Sony deck runs at 4.75cm/s, has a sampling frequency of 44.1kHz, uses 16-bit linear quantisation and utilises 37 tape tracks (32 data tracks, four auxiliary tracks, and one track for dynamic tracking). The JVC machine by comparison runs at 7.14cm/s, has a sampling frequency of 33.6kHz, uses 12-bit data words, and utilises eight tape tracks for the two audio channels (each direction) additionally having an auxiliary track. ■

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Damage protection

Watch out for something interesting later this year from QED, the Ashford, Middlesex, manufacturer of audio gadgetry. Whereas all too many professional and domestic audio gadgets are pointless, useless, and expensive, QED has built up a good reputation for selling things that serve a useful purpose. There are QED sockets which block mains-borne interference spikes and there's an add-on PPM meter with LEDs to signal user-preset overload levels. Now QED is to sell a speaker protection circuit. The idea is to disconnect a pair of speakers whenever the circuit senses that they are being driven dangerously hard. The cut-off level can be pre-set either to protect the speaker or a listener's ears.

The circuit monitors the signal being fed to the speakers and if its level exceeds the pre-set threshold for longer than 500 milliseconds, it switches in an attenuator. Cleverly the circuit "learns" to switch off more quickly if overload is persistent. It's also more sensitive at higher frequencies (crossover is at 5kHz with 6dB/octave roll off) because HF units are usually more vulnerable to abuse. And any DC offset over 5 volts also trips the circuit. The threshold is set by juggling a chain of fixed resistors.

Although obviously intended primarily as a protection system for a domestic system, the QED idea could well be of use in studios, for instance to protect monitors against abuse from visiting engineers. Also more and more studios are recognising the risk to an engineer's ears of listening for too long at too high a level. This could also be a legal risk to the studio, as employer. Remember that human hearing dulls temporarily over a long, loud session. So there is a tendency to keep on turning up the wick, and this creates the risk of long-term permanent loss. A pre-set switch-down could provide a useful reminder of when danger levels have been reached.

Auto-EQ for monitors

Acoustic Research, now best known for loudspeakers, is going back into electronics. AR was founded in 1954 after American audio engineer and inventor Edgar Villchur had a brainwave. He wanted bigger bass from smaller cabinets. Why not tailor the mechanical suspension of the loudspeaker cone to the stiffness of the air trapped in the cabinet, so that the net result of mechanical-plus-air suspension is equivalent to conventional mechanical suspension? Villchur experimented with speakers mounted in a hole dug in a field behind his home. Then he moved onto sealed cabinet designs and found that by the use of a slack-suspension diaphragm he could reduce cabinet size over conventional sealed box designs by a factor of four. The company Acoustic Research was formed to sell Villchur's speakers, and although the idea was patented, it wasn't long before it was being widely copied.

Villchur then designed a gramophone turntable with sprung suspension and good acoustic isolation, which was the forerunner of many modern units. AR also sold tuners and amplifiers, but, faced with competition from Japan, AR opted out of electronics and concentrated solely on loudspeakers. Bob

Berkovitz joined from Dolby Labs and started a computer research project to completely re-think loudspeaker design. One result was the current range of AR pillar speakers. Another result was a clever technique for analysing loudspeaker performance, using a genuinely 3-dimensional graph. It is viewed through red and green spectacles, like a 3-D photograph. But all this was only the tip of an iceberg. Now all is revealed. AR is to sell a system that automatically tailors the performance of any amplifier and loudspeaker system to any listening environment.

The system is called an ADSP (Adaptive Digital Signal Processor) and it's still only in prototype form. But it should be available later this year. It's not, repeat not, a conventional graphic or parametric equaliser. However many frequency bands an equaliser works on, and however much they can be stretched or bent, they are basically fixed at the design stage. The ADSP is a full blown computer that digitises the incoming sound signal, modifies it to suit the room acoustics while still in digital form, and then converts the modified signal back into analogue form for loudspeaker reproduction.

To set up or tailor the system to an audio chain, the ADSP has a built-in test function which produces a known noise signal. This is reproduced by the loudspeakers. The reproduced sound is picked up by a microphone connected to the ADSP, converted into digital code and compared to a stored reference code which represents the known test signal. This comparison shows up any errors which are being introduced by the amplifier, loudspeakers and room acoustics. The computer now uses this error signal to build a digital correction circuit. This is essentially a filter of which the characteristic is a mirror image of the errors detected in the test signal. Peaks in the room sound are compensated for by exactly matching troughs in the digital filter, and vice versa. In a typical system the ADSP will have to build a filter to compensate for around 50 peaks and dips in a band of 1kHz.

There's much more to it than that but fuller reports will follow.

British advance in opto-links

The British telephone system is now run by British Telecom or BT, the company hived off when Sir Keith Joseph broke up the arrogantly monopolistic British Post Office. Faced for the first time with real world commercial competition the BT staff have been running round in a frenzy announcing more or less anything they can think of. One of their announcements is of long-term interest to the audio industry.

Like 'phone companies all round the world, British Telecom has been working on optical fibre links. At one end of the link the electrical signal to be transmitted pulses a gas or solid state laser which sends light pulses down the fibre. At the other end of the link the pulses are received by a photocell and converted back into an electrical signal. Obviously such a link is immune from electro-magnetic interference. Because the carrier signal is a light wave, which has a very high frequency, it can be modulated with a very wide bandwidth signal. The snag so far has been attenuation and the need to boost the light signal every 10km along the link. At every booster

stage the light has to be converted into an electrical signal, amplified and reconverted back into light. This is inelegant and expensive.

Now British Telecom has developed a prototype fibre which is so optically pure that it can carry light for up to 100km without the need for any intermediate boosting. The fact that British Telecom has quietly abandoned its original method of making fibres, and adopted one pioneered by Bell Labs in the USA, doesn't detract from what they've achieved. And what it means for audio, and video, engineers is the prospect of very high quality land lines around Britain.

The 100km unbroken circuit can carry a digital signal of 140 megabits. Higher pulse rates can be handled but there is then greater risk of signal degradation due to pulse spreading, so boosters have to be used at closer intervals. As a guide, if the distance is halved, ie if boosters are used every 50km instead of every 100km, the bandwidth capacity is quadrupled. If a booster is used every 30km, then the fibre will handle a pulse stream of 100 gigabits. The system can't yet be pushed any further, simply because there aren't any lasers or light sensors that will operate at a faster rate. But even so, think of all the digital audio, and even digital video signals, you could send along a land line like that.

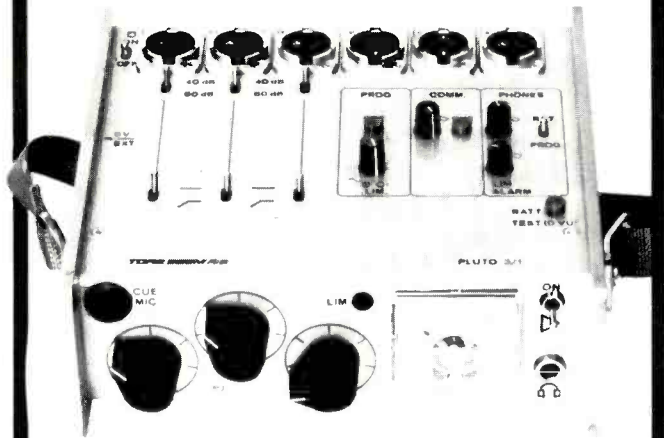
BT admits that the new fibre is only in prototype form. It isn't yet being manufactured and the fibre links now being laid in Britain must either operate at a much lower bit rate or use far more frequent boosters. But by the mid 80's we could start to see all the major British cities linked at 100km intervals by new fibres.

A single 140 megabit link can carry 2,000 phone calls simultaneously. As each individual fibre is only twice the width of a human hair, optical cables as thick as current copper cables will be under-used by the telephone system. So BT will have spare fibre capacity on their hands. This could mean that the cost of inter-city links for digital audio and video will be lower in the future.

Boost for dbx discs

CBS UK seem to be hoping that *CX* will just go away. Promised demonstrations of the system have never materialised, there haven't been any *CX* disc releases or *CX* press releases and no one in the company seems to know or care what is happening. It's *SQ* all over again. Meanwhile something interesting is happening on the dbx front. Technics is now selling the *RS-M255X* audio cassette deck, with dbx circuits built-in, for just under £200. So what's special about that? Well it was Technics, with a demonstration of a dbx deck in Japan last year, who won most of the hearts and minds of a party of European audio press who had until then been almost totally hostile to dbx. So the new Technics deck is likely to get good reviews in the consumer press and sell well. This is significant because the deck doesn't just record and replay dbx-encoded tapes. It also has a switch position which lets the user use it as a decoder for dbx discs. So every one of these Technics tape decks sold means another dbx disc decoder in British homes. And people who own dbx disc decoders will want to buy dbx discs. Small independent record labels, with the flexibility to issue double inventory titles (dbx encoded or non-encoded), take note. ■

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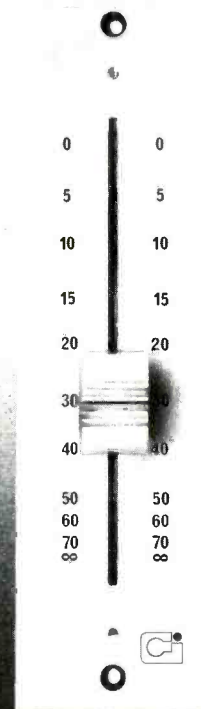
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letters

Closed shop

Dear Sir, Regarding your June editorial and the subsequent letter from Peter C Harris. As someone who is trying to enter the recording industry I thought my experiences and views on the subject may be of some interest.

Looking at the set of requirements in Mr Harris's letter, there are two I would take issue with:

● First, 'residence within a reasonable distance of the studio'. It would seem that about 90% of recording in the UK takes place in the London area, whereas only 10% of potential applicants live in this same area. Apart from being slightly unfair on the other 90% it means also that studios could be missing a lot of potential talent. Admittedly, a lot of London studios do allow time for out of town applicants to find accommodation, but there must be many cases when vacancies have to be filled at very short notice that it just isn't possible.

● Secondly, 'under 20 if inexperienced'. In my case, I was under 20 when I started applying but that was over two years ago, and of course, the only place I can gain experience is in a studio.

Some of the statements I have heard at interviews contradict both Mr Harris's letter and each other. In one instance I was told that a technical background was of little use, also that I was about the right age (20) to apply. However, on a visit to another studio, when asked about my age, the reply of 20 brought the reply that one

of their engineers was 25 and had had 10 years experience!

Having written to approximately 20 to 30 studios in the last two years I have had only three formal interviews in that time, despite having, seemingly, all the necessary requirements (apart from those mentioned above). Of course, in one case I could not afford to live on the wages offered, in a second case I spent four months continually telephoning the studio concerned only to be told finally that they had decided not to take anyone on. In only one case have I been turned down after an interview.

The recording industry seems to remain very much a 'closed shop'. Unlike those living in London I cannot continually visit studios to see when vacancies might occur, I have to rely on them contacting me. Whether the word of mouth system of recruitment continues I am in no position to say. What I can say is that, in the 20 or so studios I have written to, despite the current recession, surely there have been more than three definite vacancies since August 1979? Yours faithfully, Steven Mantz, 39 Thornwick Avenue, Willerby, Hull HU10 6LS. UK.

Professional standards

Dear Sir, I'd like to take the opportunity to discuss the Recording Industry's educational system in Canada.

First let me state that I am a graduate of a recording engineering course in my country. I'm

proud to say I attended the country's best course, a three year programme recognised by the NARAS organisation in the US and sponsored by the Canadian Government. This programme from Fanshawe College, London, Ontario called 'MIA' is according to Canadian University Orientation standards, Canada's best. The standards in qualifying are high: 1,200 applications per year, 60 are chosen, 15 will graduate in Recording Engineering and 15 will graduate in Music Production.

The problem now in our country is that there are several courses being offered mostly by studios or private companies stating they can make anyone a recording engineer in 13 to 26 weeks (at a very high tuition price). The results are, as you may guess, hundreds of people believing that they are professional engineers. Added to this, is the fact that the present industry is in a not too favourable situation for employment.

We now have studios making money offering these 'Mickey Mouse' courses. What we need is an international standard set by an organisation consisting of engineers selected by their past achievements. The Best people to start out this organisation for recording standards should be already known and involved internationally in the recording industry.

Yours Faithfully, Robert Peladeau, DAZZ Productions Inc, PO Box 6759 Stn 'J', Ottawa, Ontario, Canada. ■

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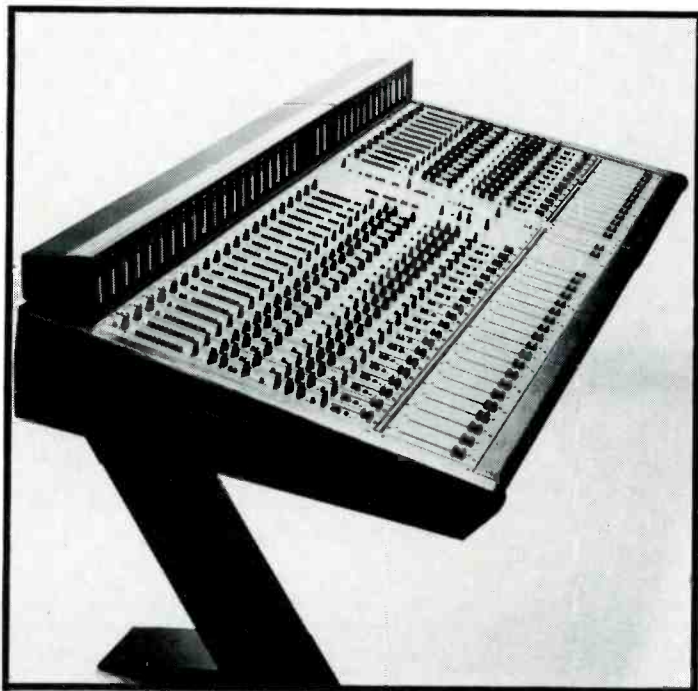
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Calibration tapes

THE calibration of magnetic tape replay chains involves the setting of three parameters. Firstly, the gap of the replay head must be aligned at exactly 90° to the edge of the tape; secondly, the gain of the replay chain must be adjusted such that the replaying of a given fluxivity on tape produces the desired output; and thirdly the fluxivity/frequency response must be defined.

Azimuth

The adjustment of the angle of the head gap relative to the edge of the tape is called azimuth adjustment and failure to achieve correct azimuth will lead to two troubles, incorrect phase between tracks in stereo recordings and loss of high frequencies. As with many parameters we are often more interested in recorded wavelength rather than frequency, the wavelength being the tape speed divided by the recorded frequency.

In Fig 1 a tape is illustrated with a constant wavelength recording, it being seen that when the head gap is at a right angle to the tape edge it can resolve the recorded wavelength in terms of north and south magnetisations. However, severe misalignment of the head gap at the angle shown, leads to the head gap overlapping north and south magnetisations with the result that they cancel and the head cannot sense any flux change. What should be immediately apparent from Fig 1 is that the wider the track width the more critical the azimuth adjustment. Of course increasing frequency or lowering tape speed make the azimuth adjustment more critical.

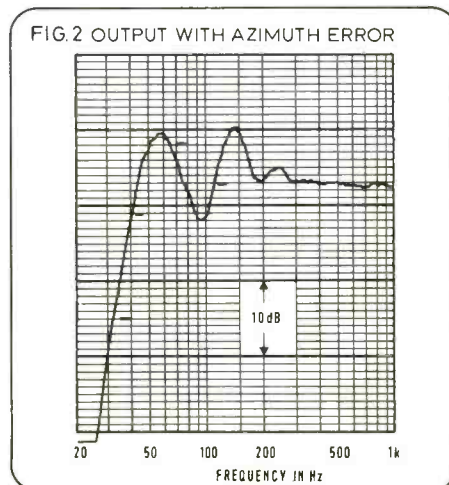
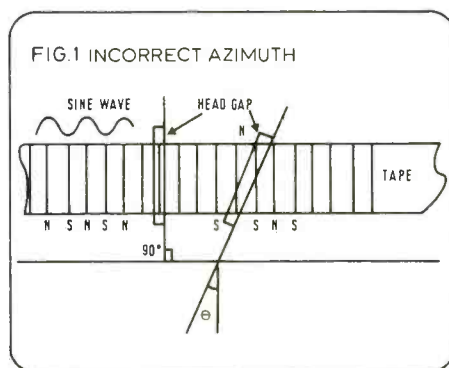
Using a full-track ¼in head at 7½in/s (19.05 cm/s), a 10° azimuth error will lead to a loss of about 2.5dB at 4kHz and 11dB at 8kHz with zero output at 10kHz. Clearly such errors are very serious, but such a small azimuth error is quite invisible to the naked eye.

The loss of output due to azimuth error takes the form $(\sin X)/X$ which is a series of peaks and troughs similar to those shown in Fig 2. Calibration tapes contain an azimuth setting section which consists of either a single high frequency tone section, or tone sections at more than one frequency.

In the case of monophonic recorders the replay head angle is adjusted for maximum output using the azimuth section of the calibration tape but if

only a single HF section is provided care is needed to make sure that the head is adjusted for the largest peak in the output.

With stereo or multichannel recorders the replay azimuth can be adjusted more accurately by connecting a double beam oscilloscope or a phase meter to the outputs and adjusting the replay head for minimum phase error between tracks using the highest frequency azimuth adjusting section of a calibration tape.



Inconsistencies in the output or phase will result from damaged calibration tapes or from a tape transport in poor condition, in addition to the use of poorly slit tape.

If you have a stereo recorder with reliable heads of minimum gap scatter, and with the facility to record and replay using the same heads, it is not too difficult to make accurate azimuth alignment tapes. First make a high level recording at a medium wavelength, say 1kHz at 15in/s (38.1 cm/s). Next replay this recording using the same heads with a double beam oscilloscope or phase meter connected to the stereo outputs – there should be a zero phase error, only jitter.

Next turn the tape oxide coating out away from the heads and again replay the tape and note the phase error, then adjust the head azimuth to halve the phase error and repeat the performance with a new recording until there is no phase error with the tape replayed oxide out from the heads.

This procedure can be simplified if you have the means to measure the head angle. In this case measure the change in angle required to correct azimuth with the tape oxide out and set the head to halfway between the original setting and the new setting.

Azimuth setting can not be ascertained by just reversing the tape, this is to no avail!

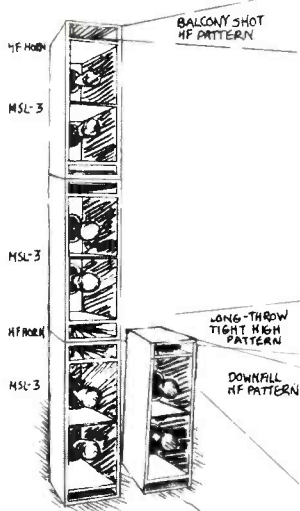
Level setting

In order to record tapes with compatible levels and to align recorder metering – in addition to measure noise and distortion performance – it is essential to have some reference level in terms of magnetic fluxivity. In the past each tape manufacturer related these matters to a X% third harmonic distortion point at a given HF bias for tape sample Y which was kept locked away in someone's safe.

The result of this was that it was impossible to compare the specification from different manufacturers and sometimes impossible to compare products within an individual manufacturer's range as he used reference tapes A1, A2, etc.

Fortunately this situation has changed because it is now possible to measure the fluxivity of recordings at long wavelengths with reasonable

Technical Information Series



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At Meyer Sound, we've applied over a decade of research and field experience to the production of a growing line of reinforcement loudspeaker systems optimized for arraying, and we've developed sets of simple, clear guidelines for applying these systems. For the professional user, calculation and experimentation are replaced by a body of dependable techniques offering the means to make arrays which afford consistent, exceptional performance.

Polar Control

An important key to this performance is careful control of polar response. Meyer Sound reinforcement systems are designed to be coherent not only in terms of propagation, but also in terms of phase. For this reason, the cross-over transition in Meyer systems is smooth and seamless, and frequency response remains consistent over long throws. In arrays, propagation coherence means smooth addition between adjacent units, minimizing lobing and pro-

ducing a coherent image of the source behind the array. In practical terms, this means even, controlled coverage, greatly enhanced clarity, and little or no need for room EQ.

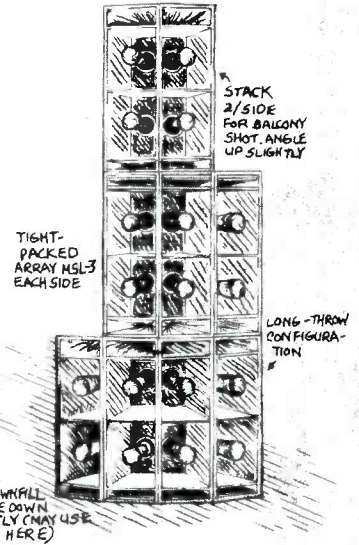
Modular Design

Meyer Sound reinforcement loudspeakers are designed as modular systems: full-range building blocks which offer the flexibility to meet a wide variety of demands. This means, for example, that the same product which serves for live music reinforcement in a 500-seat club can be used to make a large array for voice reinforcement in a 15,000-seat sports arena. Finally, since the array retains the performance of the modular unit with which it is made, its characteristics are predictable.

User Orientation

For the professional in the field, dependable real-world performance is the ultimate goal. At Meyer Sound, we direct our efforts in system design and documentation toward making that goal more

achievable. If you would like more information on the theory behind our arrayable systems, and how these systems can be made to work for you, call or write us today.



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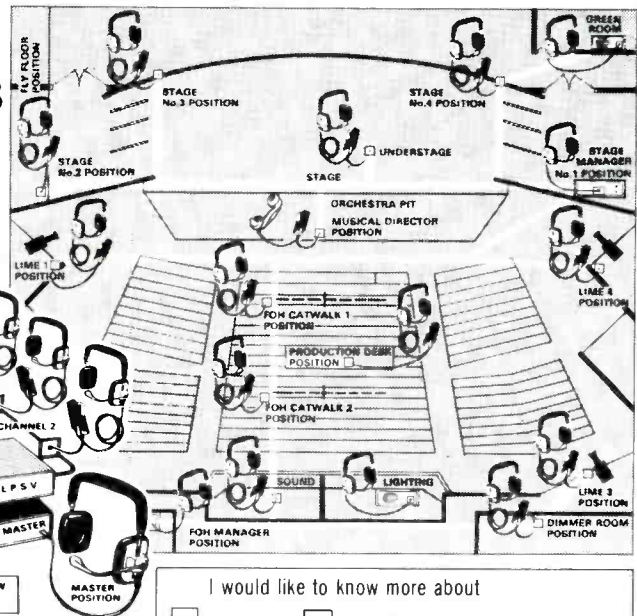
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accuracy in terms of nanowebers per millimetre tape width (nWb/mm), thus providing a reference level in terms of measurable magnetic parameters. However, there remains an area of confusion as there are two measurement methods which give slightly different results – 320nWb/m measured in the USA does not agree with 320nWb/m measured in Europe by about 0.7dB!

The common fluxivities used on calibration tapes are as shown in **Table 1**.

The comparison of one fluxivity with another in decibels is a simple matter as the difference is found by the simple formula $\text{dB} = 20 \log (F1/F2)$, but care must be exercised as different calibration tapes use different frequencies so that the reproducer's equalisation must be taken into account.

The 510nWb/m fluxivity at 1kHz is a European level for stereo machines using a 0.110in (2.79mm) track width. The reason for this fluxivity is that if a stereo tape is replayed on a monophonic machine the level will be the same as that using the standard European fluxivity of 320nWb/m, thus giving compatibility between stereo and monophonic recordings.

Whilst most reference fluxivity tapes are recorded full track the chosen recorded frequency is such that the wavelength on tape (tape speed/frequency) introduces no significant errors due to the fringing effect in multitrack reproducers.

The fringing effect results from a replay head picking up flux from recordings outside its actual track width and is a wavelength sensitive effect most pronounced at long wavelengths (low frequencies). The effect very much depends upon the design of individual heads and is related to the shape of the pole pieces, head screening and in some cases even the presence of hum shields. This is one reason why reference fluxivity tapes are recorded at medium frequencies, the other main reason being that replay equalisation has a minimum effect at mid-frequencies.

An area of considerable confusion is the relation between record/replay level metering and various recorded fluxivities or 'operating levels', 'elevated operating level' etc. So far as recorded levels are concerned there are two distinctly different requirements, one is to record compatible levels so that broadcasters can have levels which do not differ wildly from one recording to another. The second requirement is where a user wishes to use the maximum available dynamic range from a

particular tape type.

Tapes vary wildly in their maximum output level (MOL) capability, that is their output level for 3% third harmonic distortion at commonly 1kHz, with at least 6dB difference between tape types. Lower output tape having a MOL about 8dB above the 185nWb/m 'Ampex operating level' equivalent to 4dB above the European 320nWb/m.

It follows that with a VU meter if 0VU is set to correspond to 185nWb/m this will provide at least an 8dB margin between 0VU and the MOL which is satisfactory for a genuine VU meter where 0VU corresponds to a line level of +4dBm. Setting 0VU to correspond to the European 320nWb/m produces an incompatible situation which will result in levels 4dB too high and overload some tapes.

The level of 320nWb/m is intended for use with European peak programme meters and can be safely set to 4dB below the maximum meter reading, for instance PPM6 on a British Standard PPM.

Where it is required to make optimum use of a particular tape type it is necessary to know the MOL of the tape referred to a stated fluxivity. It is then possible to set the metering such that the maximum PPM reading corresponds to the MOL. In the case of VU meters 0VU should be set to a level at least 10dB below the MOL. For instance, if the MOL is +8dB reference 320nWb/m, 0VU should be set to -2dB (that is +8dB - 10dB) reference 320nWb/m. In other words replaying 320nWb/m fluxivity should produce a reading of +2VU.

Using a PPM with the same tape the maximum PPM reading may correspond to the MOL, thus, replaying 320nWb/m should be set to indicate 8dB below maximum peak reading.

Frequency response

In order to make compatible recordings the relationship between frequency and the recorded

fluxivity must be standardised for any given tape speed. In practice there are a number of current standards which are shown in **Table 2**, where the different standards are shown in terms of time constants.

All these standard equalisations give a HF boost in the replay chain and some also give a low frequency cut, the characteristics being tabulated in **Table 3**, which also shows the various transition frequencies (3dB points) for the theoretical record chain.

Table 3 may be used to find the corrections between different standards, such that an NAB calibration tape can be used to align a CCIR replay chain etc. In fact calibration tapes can even be used at speeds for which they were not intended by using corrections derived from **Table 3**.

As an example, if we have a 15in/s NAB 50 + 3,180µs tape and wish to align a 35µs CCIR replay chain we can note the difference at 1kHz (NAB is 0.19dB up). At 10kHz NAB is 2.70dB up (10.36 - 7.66) so that the CCIR/NAB difference is 2.70 - 0.19dB = 2.51dB hence with reference to 1kHz we set 10kHz to -2.51dB. This procedure can be repeated at all other frequencies.

The definition of the frequency/fluxivity characteristics in terms of time constants has over the years produced a number of problems as the measurement of fluxivity at short wavelengths is extremely difficult. Clearly the use of a time constant to define the characteristics of the record chain, as used in some standards, fails to take into account tape characteristics and thus cannot define the frequency response of the replay chain.

At long wavelengths (low frequencies) there are no significant losses in the record or replay heads and making calibration tapes is a relative simple matter. However, caution is required in the use of calibration tapes as a result of two potentially serious errors related to the replay head.

Firstly, there is the fringing effect which has already been mentioned. If the recorded track width exceeds the replay head width the fringing effect may be serious at long wavelengths (low frequencies) and the higher the tape speeds. Unfortunately the amount of fringing effect depends not only upon the head track width, but upon other features of the head design, so no universal correction factors are possible but the corrections taken from the MRL 'Application Recommendations' give a guide to likely errors; these are shown in **Table 4**.

The second wavelength related effect at long wavelengths is also very much related to the head design. Whilst the fringing effect itself would produce a smooth curve as is clear from the tabulated corrections for the 1.91mm track width in **Table 4**, there are other effects which make a mess of spot frequency calibration at long wavelengths.

Fig 2 shows the record/replay frequency response of a recorder at 30in/s, it being seen that the LF response goes through a series of troughs and peaks which are associated with the replay head effective pole piece length. In a poor ¼in 4-track machine these frequency response deviations can be around 10dB, in a very good stereo machine they may be 2dB total excursion.

Assuming the good stereo machine, the use of a calibration tape with typical spot frequencies of 31.5Hz, 40Hz, 63Hz and 125Hz will show these frequencies to read reference 1kHz, -3.5dB,

TABLE 1

European	USA	Comments
510nWb/m	Not used	Stereo test
320nWb/m	295nWb/m	7 ½ in/s
250nWb/m	270nWb/m	3 ¾ in/s
200nWb/m	185nWb/m	Dolby
160nWb/m	150nWb/m	Cassette

TABLE 2a Standard magnetic tape equalisation time constants

Standard	Tape speed (in/s)				
	30	15	7 ½	3 ¾	1 ½
AES	17.5µs	None	None	None	None
CCIR	35µs	35µs	70µs	None	None
DIN	35µs	35µs	70µs (DIN19S*)	3180 + 90µs	3180 + 120µs
IEC	35µs	35µs	3180 + 50µs	3180 + 90µs	3180 + 120µs
NAB 1965	None	3180 + 50µs	3180 + 50µs	3180 + 90µs	3180 + 90µs
NAB 1975	—	—	50µs	—	—

*DIN 19S is a Studio standard, 3180 + 50 µs in the DIN 19H Home standard.
Compact cassette universal standard is 3180 + 120µs for ferric tapes or 3180 + 70µs for chrome tapes.

TABLE 2b Magnetic film equalisation time constants

Standard	Film size (mm)				
	70	35	17.5	16	8
DIN	None	35µs	35µs**	70µs	3180 + 90µs
SMPTE	3180 + 35µs*	50µs	None	70µs	3180 + 90µs

* Current proposal
** 70µs is used at 45/minute, 35µs at 90/minute
NB Current ISO proposal for 70mm and 35mm stripe is 1590 + 35µs

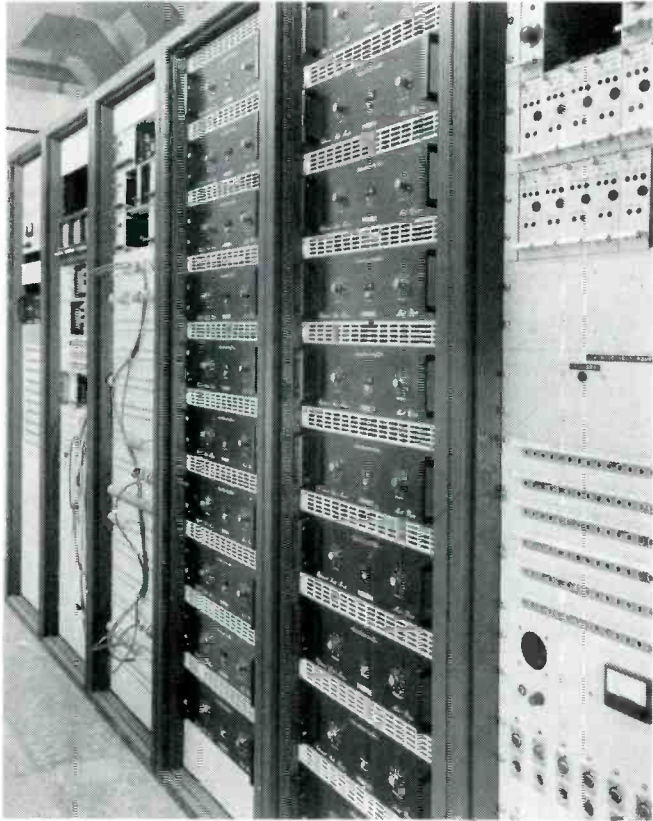
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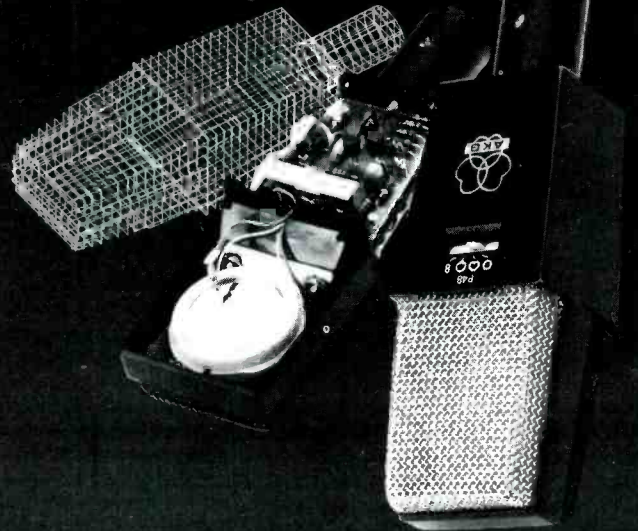
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TABLE 3

Time constant Frequency (Hz)	17.5µs	35µs	50 & 3180µs	70µs	70 & 3180µs	90 & 3180µs	100µs	120 & 1590µs	120 & 3180µs
16	0dB	0dB	-10.33dB	0dB	-10.33dB	-10.33dB	0dB	-16.04dB	-10.34dB
20	0dB	0dB	-8.61dB	0dB	-8.61dB	-8.61dB	0dB	-14.16dB	-8.61dB
25	0dB	0dB	-7.00dB	0dB	-7.00dB	-7.00dB	0dB	-12.31dB	-7.00dB
31.5	0dB	0dB	-5.47dB	0dB	-5.47dB	-5.47dB	0dB	-10.45dB	-5.47dB
40	0dB	0dB	-4.09dB	0dB	-4.09dB	-4.09dB	0dB	-8.61dB	-4.09dB
50	0dB	0dB	-3.01dB	0dB	-3.01dB	-3.01dB	0dB	-6.99dB	-3.01dB
63	0dB	0dB	-2.12dB	0dB	-2.12dB	-2.12dB	0dB	-5.46dB	-2.12dB
80	0dB	0dB	-1.43dB	0dB	-1.43dB	-1.43dB	0dB	-4.08dB	-1.43dB
100	0dB	0dB	-0.97dB	0dB	-0.96dB	-0.96dB	+0.02dB	-2.99dB	-0.95dB
125	0dB	0dB	-0.64dB	+0.01dB	-0.63dB	-0.63dB	+0.03dB	-2.11dB	-0.61dB
160	0dB	+0.01dB	-0.40dB	+0.02dB	-0.38dB	-0.37dB	+0.04dB	-1.37dB	-0.34dB
200	0dB	+0.01dB	-0.25dB	+0.03dB	-0.23dB	-0.21dB	+0.07dB	-0.87dB	-0.17dB
250	0dB	+0.01dB	-0.14dB	+0.05dB	-0.12dB	-0.09dB	+0.11dB	-0.50dB	-0.02dB
315	+0.01dB	+0.02dB	-0.07dB	+0.08dB	-0.03dB	-0.03dB	+0.03dB	-0.18dB	+0.13dB
400	+0.01dB	+0.03dB	0dB	+0.13dB	+0.06dB	+0.15dB	+0.27dB	+0.11dB	+0.31dB
500	+0.01dB	+0.05dB	+0.06dB	+0.21dB	+0.16dB	+0.29dB	+0.41dB	+0.41dB	+0.53dB
630	+0.02dB	+0.08dB	+0.14dB	+0.32dB	+0.29dB	+0.49dB	+0.63dB	+0.76dB	+0.86dB
800	+0.03dB	+0.13dB	+0.25dB	+0.51dB	+0.49dB	+0.79dB	+0.98dB	+1.28dB	+1.33dB
1.0k	+0.05dB	+0.21dB	+0.40dB	+0.77dB	+0.76dB	+1.19dB	+1.45dB	+1.91dB	+1.94dB
1.25k	+0.08dB	+0.32dB	+0.62dB	+1.15dB	+1.14dB	+1.75dB	+2.09dB	+2.73dB	+2.75dB
1.6k	+0.13dB	+0.51dB	+0.97dB	+1.75dB	+1.74dB	+2.60dB	+3.03dB	+3.88dB	+3.90dB
2.0k	+0.21dB	+0.77dB	+1.44dB	+2.49dB	+2.49dB	+3.57dB	+4.11dB	+5.14dB	+5.15dB
2.5k	+0.32dB	+1.15dB	+2.08dB	+3.44dB	+3.44dB	+4.77dB	+5.40dB	+6.58dB	+6.58dB
3.15k	+0.49dB	+1.70dB	+2.96dB	+4.65dB	+4.65dB	+6.20dB	+6.92dB	+8.22dB	+8.22dB
4.0k	+0.77dB	+2.49dB	+4.11dB	+6.12dB	+6.12dB	+7.86dB	+8.64dB	+10.04dB	+10.04dB
5.0k	+1.15dB	+3.44dB	+5.40dB	+7.66dB	+7.66dB	+9.54dB	+10.36dB	+11.82dB	+11.82dB
6.3k	+1.70dB	+4.65dB	+6.92dB	+9.38dB	+9.38dB	+11.36dB	+12.22dB	+13.72dB	+13.72dB
8.0k	+2.49dB	+6.12dB	+8.64dB	+11.26dB	+11.26dB	+13.32dB	+14.19dB	+15.73dB	+15.73dB
10.0k	+3.44dB	+7.66dB	+10.36dB	+13.08dB	+13.08dB	+15.18dB	+16.07dB	+17.62dB	+17.62dB
12.5k	+4.61dB	+9.32dB	+12.15dB	+14.95dB	+14.95dB	+17.07dB	+17.97dB	+19.53dB	+19.53dB
16.0k	+6.12dB	+11.26dB	+14.19dB	+17.03dB	+17.03dB	+19.18dB	+20.09dB	+21.66dB	+21.66dB
20.0k	+7.66dB	+13.08dB	+16.07dB	+18.94dB	+18.94dB	+21.10dB	+22.01dB	+23.59dB	+23.59dB
25.0k	+9.32dB	+14.95dB	+17.97dB	+20.86dB	+20.86dB	+23.03dB	+23.94dB	+25.52dB	+25.52dB
31.5k	+11.14dB	+16.90dB	+19.95dB	+22.85dB	+22.85dB	+25.03dB	+25.94dB	+27.52dB	+27.52dB
40.0k	+13.08dB	+18.94dB	+22.01dB	+24.92dB	+24.92dB	+27.10dB	+28.01dB	+29.59dB	+29.59dB
50.0k	+14.95dB	+20.86dB	+23.94dB	+26.85dB	+26.85dB	+29.03dB	+29.95dB	+31.53dB	+31.53dB
Transition frequencies	9094.57Hz	4547.28Hz	3183.10Hz 50.05Hz	2273.64Hz	2273.64Hz 50.05Hz	1768.39Hz 50.05Hz	1591.55Hz	1326.29Hz 100.10Hz	1326.29Hz 50.05Hz

-0.8dB, +1.6dB and 0dB, whilst it is clear from Fig 2 that the alignment is already in fact optimised. Any attempt to adjust the replay frequency response using the calibration tape will lead to a worse frequency response.

The solution to this problem is not to use calibration tapes for LF equalisation but to use a flux loop. The simplest form of the flux loop is a small coil of wire fed by a constant current and placed in front of the replay head. If the loop has only a few turns it may be fed in series with 600Ω from the output of an oscillator with a 600Ω output impedance.

When an LF time constant is involved in the replay equalisation either corrections may be obtained from Table 3, or a capacitor may be placed in series with the flux loop, the capacitor value being T/300µF where T is the LF time constant in µs.

Flux loops may also be used at short wavelengths but errors will be introduced as their use will amongst other things ignore the gap loss and the spacing loss - calibration tapes are better at short wavelengths.

Turning first to the gap loss, the fundamentals of this are shown in Fig 3 where a sinusoidal magnetisation, is shown recorded along a tape. Clearly the upper pair of replay head pole pieces shown can resolve the magnetisation, but the wider gap with the lower pair of pole pieces is incapable of 'seeing' any tape flux as its width equals the recorded wavelength.

Consideration of other shorter wavelengths shows that when the effective head gap is a multiple of the recorded wavelength the head output will disappear. Fig 4 shows what happens, with the

TABLE 4

Frequency (Hz)	Fringing correction (dB)	
	Stereo (2.79mm)	2-track (1.91mm)
30in/s		
31.5	0.3	3.3
63	0.3	3.0
125	0.3	2.7
250	0.3	2.1
500	0.3	1.4
1k	0.2	0.9
2k	0.2	0.5
4k	0.1	0.3

figure showing the computed gap loss for a 5µm gap at 7½in/s. From Fig 4 it can be seen that the gap loss is far from insignificant at 15kHz.

The second most important loss not taken into account by a flux loop is the spacing loss which results from imperfect head to tape contact - this is plotted in Fig 5 for a tape speed of 7½in/s and head to tape separations between 5µm and 0.1µm, it being seen that even the latter has a highly significant effect at short wavelengths.

Any attempt to manufacture short wavelength calibration tapes has to take these imponderable factors into account in addition to the use of an 'ideal' head.

All calibration tapes are based on measurements with an ideal head, or rather a head with known shortcomings. Unfortunately, what was thought to be an ideal head 10 years ago is no longer an ideal head today, and today's ideal head will no longer be 'ideal' in 10 years time.

The upshot of this is that at short wavelengths (particularly with compact cassette tapes at 1½in/s) the recorded fluxivity does not correspond to the time constants in the published standards! At least in the world of compact cassettes this has created considerable confusion,

but the fact of the matter is that we are incapable of measuring short wavelengths with accuracy.

Obviously it is undesirable to change practical

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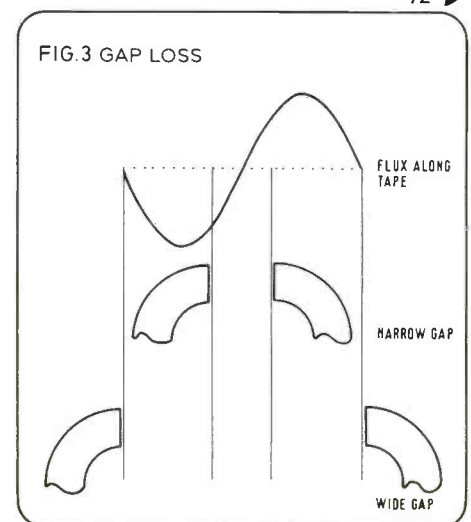
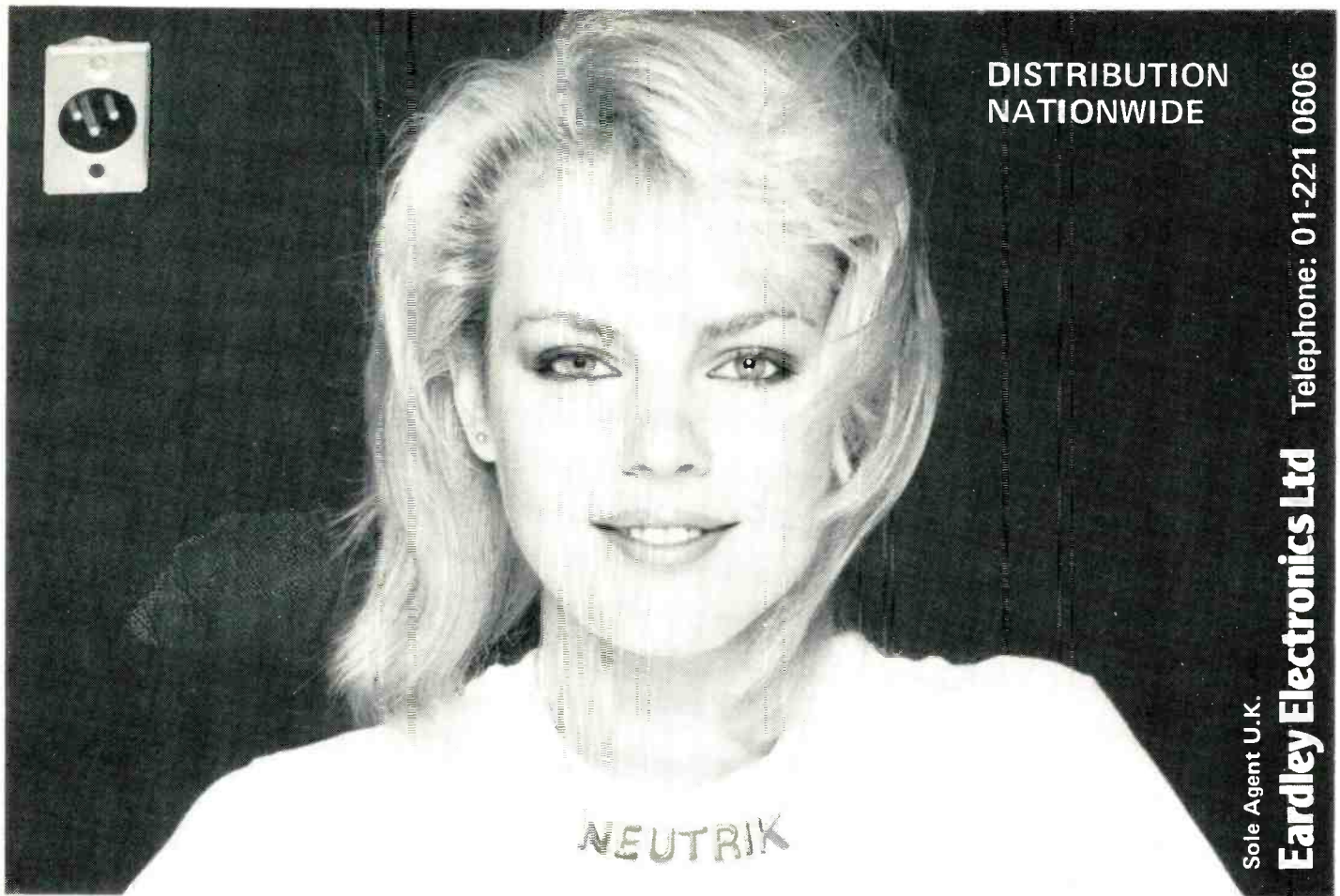
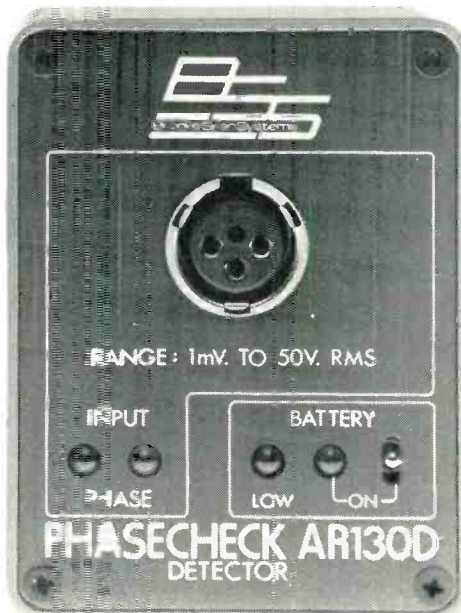
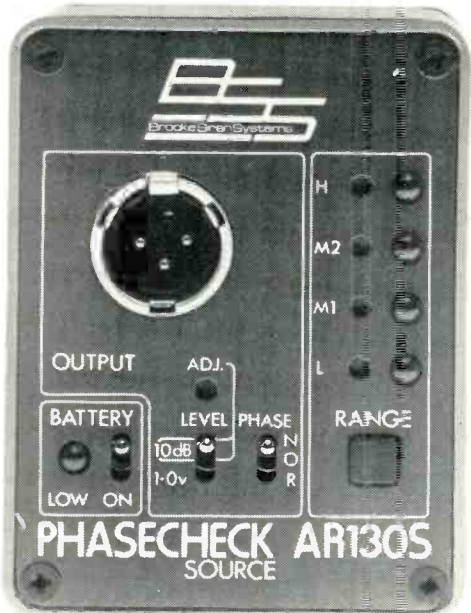


FIG. 3 GAP LOSS



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equalisations as measuring techniques improve so the industry has generally agreed to stick to the existing accepted practical equalisations.

Available calibration tapes

There are a limited number of calibration tape manufacturers, but many of them manufacture a wide range of tapes to different equalisation standards and in different tape widths and in some cases different track formats. There is also a call for calibrated magnetic film, compact cassettes, NAB cartridges etc, and these items are available from a very limited choice of manufacturers.

For the purpose of this review all known manufacturers were invited to provide samples of their professional calibration tapes.

Calibration tape formats

All calibration tapes embodied a reference level section recorded at a specified frequency and fluxivity in addition to a frequency response section containing spot frequencies. In addition azimuth alignment was provided by one short wavelength section, or more sections at lower frequencies. These features for each tape sample supplied are shown in Table 5 which is extracted from the manufacturer's data.

The reference level available is purely a matter of convenience as it is very easy to convert from one reference level to another and the levels are such that they can always be read on a correctly adjusted programme meter. Similarly, the choice of 700Hz or 1kHz at the higher tape speeds is of little consequence. At 3 3/4 in/s, and below, the ISO standard centre frequency is 315Hz which has strictly replaced 333Hz which was the older European standard.

So far as the azimuth sections are concerned the availability of more than one frequency is a convenience, as with a single high frequency it is necessary to detect the largest peak, but this is

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FIG.4 GAP LOSS AT 7 1/2 in/s

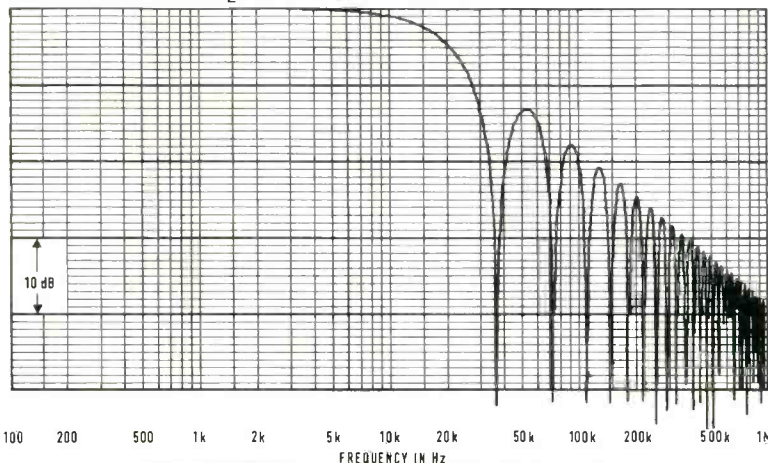


FIG.5 SPACING LOSS AT 7 1/2 in/s

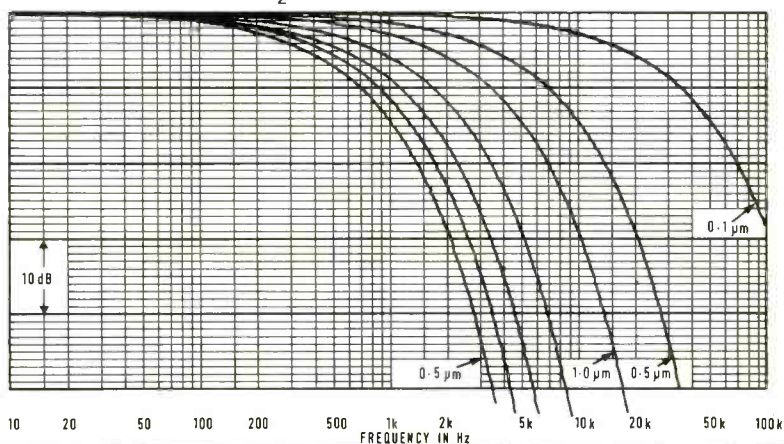


TABLE 5 MANUFACTURERS' DATA

	30 in/s AES			15 in/s IEC		15 in/s NAB			7 1/2 in/s IEC			7 1/2 in/s NAB			3 3/4 in/s IEC		
	Ampex	MRL	STL	Ampex	BASF	Ampex	Camford	MRL	STL	Agfa	BASF	Camford	BASF	MRL	STL	Agfa	BASF
Reference level (nWb/m)																	
DIN	200	200	280	200	320	200	320	200	200	320	320	320	320	200	200	250	250
ANSI	185	185	260	185	295	185	295	185	185	295	295	295	295	185	185	230	230
Level accuracy (±)	—	.25dB	—	—	.5dB	—	.5dB	.25dB	—	—	.5dB	.5dB	.25dB	—	—	—	.5dB
Reference frequency (Hz)	700	1k	700	700	1k	700	1k	1k	700	1k	1k	1k	1k	1k	700	333	315
Frequency accuracy	—	±2%	—	—	±.3%	—	±2%	±.3%	—	—	±.3%	—	±.3%	±2%	—	—	±.3%
Distortion	—	<1%	—	—	—	—	<2%	<1%	—	—	<2%	—	<1%	<1%	—	—	—
Azimuth frequencies (Hz)	15kHz	500	700	15k	1k	15k	16k	500	700	1k	1k	10k	1k	500	700	333	315
		8k	15k		10k		8k	8k	15k	10k	10k	10k	10k	8k	15k	10k	10k
		16k					16k	16k					16k				
Azimuth accuracy	—	±1'	—	—	±3'	—	—	±1'	—	±2'	±3'	—	±3'	±1'	—	±2'	±3'
Azimuth level	0dB	0dB	0dB	0dB	-10dB	0dB	—	0dB	0dB	-10dB	-10dB	—	-10dB	-10dB	0dB	-15dB	-15dB
Frequency range (Hz)	30	31.5	30	30	31.5	30	30	31.5	30	31.5	31.5	30	31.5	31.5	30	31.5	31.5
Level	15k	20k	15k	15k	18k	15k	20k	20k	15k	18k	18k	16k	18k	20k	15k	16k	16k
Accuracy to 4kHz	—	±.5dB	—	—	±.5dB	—	—	±.5dB	—	—	±.5dB	—	±.5dB	—	—	—	±.5dB
Accuracy to 10kHz	—	±.5dB	—	—	±1dB	—	—	±.5dB	—	—	±1dB	—	±1dB	±.5dB	—	—	±1dB
Accuracy overall	—	±.5dB	—	—	±1dB	—	—	±.5dB	—	—	±1dB	—	±1dB	±1dB	—	—	±2dB

AGFA (West Germany)

Agfa-Gavaert AG, D-509 Leverkusen.
UK: Agfa-Gevaert Ltd, 27 Great West Road, Brentford, Middx TW8 9AX.
USA: Agfa-Gevaert Inc, 275 North Street, Teterboro, New Jersey 07608.

AMPEX (USA)

Ampex Corp, 401 Broadway, Redwood City, Cal 94063.
UK: Ampex Great Britain Ltd, Acre Road, Reading RG2 0QR.

BASF (West Germany)

BASF AG, Carl Bosch Strasse 38, D-6700 Ludwigshafen/Rhein.
UK: BASF UK Ltd, Haddon House, 2-4 Fitzroy Street, London W1P 5AD.
USA: BASF Systems Inc, Crosly Drive, Bedford, Mass 01730.

CAMFORD (UK)

Camford Productions, 4 Cambridge Drive, Eastcote, Ruislip, Middx HA4 9JS.

MRL (USA)

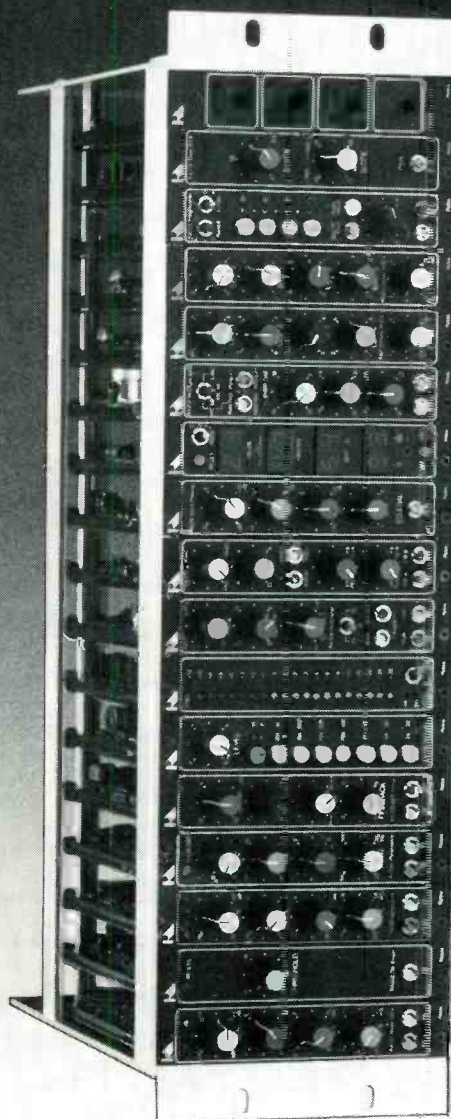
Magnetic Reference Library Inc, 229 Polaris Avenue, Suite 4, Mountain View, Cal 94043.
UK: FWO Bauch Ltd, 49 Theobald Street, Boreham Wood, Herts WD6 4RZ.

STL (USA)

Standard Tape Lab Inc, 26120 Eden Landing Road, No 5, Hayward, Cal 94545.
UK: Precision Audio Marketing, Bimini House, Christchurch Road, Virginia Water, Surrey.

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reviews

TABLE 6 MEASURED PERFORMANCE

	Relative fluxivity	Frequency	Third harmonic	30Hz	Level reference 1kHz (dB)			Azimuth error
					10kHz	15kHz	18kHz	
30 in/s AES								
Ampex	-0.1dB	698Hz	0.4%	-1.6	+0.7	+1.3	—	0.72'
MRL	+0.1dB	1013Hz	0.22%	-0.7	-0.5	-0.4	+0.5	0.90'
STL	-0.5dB	699.8Hz	0.25%	-2.0	+0.5	+0.5	—	0.96'
15 in/s IEC								
Ampex	-0.2dB	698Hz	0.63%	+2.0	-0.5	-0.8	—	0.72'
BASF	-0.4dB	1002Hz	1.0%	+1.0	+0.3	-0.4	+0.7	1.08'
Camford	-0.8dB	994.8Hz	0.63%	+1.4	+0.3	+0.2	+1.4	0.12'
15 in/s NAB								
Ampex full-track	-0.4dB	699Hz	0.45%	-0.8	-0.7	-1.0	—	0.60'
Ampex half-track	-3.0dB	698Hz	0.32%	-0.5	-0.6	-1.1	—	0.14'
MRL	+0.3dB	1005Hz	0.45%	+0.5	-0.8	-1.3	-1.4	0.54'
STL	-0.4dB	699Hz	<0.1%	+2.0	-0.2	-1.3	—	0.30'
7½ in/s IEC								
BASF	+0.4dB	1003Hz	0.8%	-0.2	-0.2	+1.9	+0.7	0.53'
Camford	+0.1dB	992Hz	0.45%	+0.8	-1.6	-0.2	—	1.31'
7½ in/s NAB								
AGFA	+0.4dB	1004Hz	1.3%	+0.7	-0.6	-1.5	-1.1	1.05'
BASF	0.0dB	1002Hz	1.0%	+0.4	-0.2	+1.2	+1.0	0.21'
MRL	+0.5dB	1013Hz	0.45%	+0.4	+0.4	+1.2	+0.5	0.33'
STL	+0.3dB	704Hz	0.32%	-0.7	+0.8	+1.5	—	0.77'
3¼ in/s IEC								
AGFA	+0.4dB	335Hz	1.0%	+0.3	-0.1	+0.2	—	0.26'
BASF	+0.4dB	316Hz	0.32%	-0.2	0	-0.3	—	0.26'

usually quite a straightforward operation. Generally the higher the recorded level of the azimuth section the better.

Turning to the frequency response sections the level at which these are recorded makes a big difference in operation. If they are recorded at 0dB (the reference fluxivity) frequency response alignment may be done using a correctly aligned programme meter, but lower levels frequently involve the use of an external meter. However, the characteristics of some tapes dictate a lower level at short wavelengths due to tape saturation with the result that the highest frequency on some calibration tapes is 15kHz which is restrictive.

All calibration tapes had an adequate number of spot frequencies, most starting at the LF end and working upwards, but the Ampex tapes work downwards which does have advantages where there are no repetitions of the spot frequencies. However, the most convenient arrangement in this respect is found on the BASF and Agfa tapes which work up to the highest frequency and then have two repetitions of the spot frequencies from 4kHz upwards. This feature saves much rewinding and replaying of the tapes which inevitably shortens their lives, in addition to providing a check on the high frequency levels.

The Agfa and BASF products also contained an unrecorded section of reference tape for bias and equalisation adjustment but, this section will be of little interest to many users. BASF were in fact the only products which claimed conformity to IEC 94-2.

Finally, whilst most manufacturers offer wow and flutter test tapes, the Camford products contained such a section.

Sample examination

All samples were initially examined for mechanical damage and quality of winding with no defects being noted in this respect. The universal use of matte backed tapes clearly helps in this respect and all samples wound well in use at sensible tape speeds.

The reference level sections were then examined

on a stereo recorder and the levels of both tracks, frequency and third harmonic distortion noted. These normalised results are shown in Table 6, from which it can be seen that the spread of reference fluxivities is generally within ± 0.5 dB with the 0dB point being obtained from a known laboratory reference tape.

Distortion at reference level was always adequately low but the frequency accuracy varied, with the BASF and STL tapes being best in this respect.

The levels of the frequency response sections were then plotted with 0.1dB resolution and the results for each equalisation corrected to a single standard using the figures in Table 3. The results were then arranged to show the spread between tapes rather than attempt any absolute measurements. These results for 30Hz, 10kHz, 15kHz and 18kHz, where appropriate, are shown in Table 6. With reference to 1kHz it can be seen that the differences between different calibration tapes were remarkably small.

The azimuth section was checked for correct azimuth using a very carefully aligned recorder and then measuring the phase errors between stereo tracks and converting this to an azimuth angle

error. All samples were satisfactory in the azimuth sections with no manufacturer having preference over another.

All sections of all samples were checked for azimuth, frequency, level and uniformity and the results of these and other checks are to be found in the following individual product descriptions.

Agfa

The Agfa samples were supplied on large centre 5in cine type spools in plastic cases. The tapes commence with a non-magnetic leader followed by announcements in German. Furthermore the instruction leaflets were in German which will be annoying for those who do not understand technical German!

There follows a reference fluxivity section which has accurate azimuth and frequency. Further German announcements precede the -20dB spot frequency sections each of 8s duration and extending to 18kHz at 7½in/s or 16kHz at 3¼in/s. The spot frequencies were at the standard ISO octave centre frequencies up to 8kHz, above which the standard ½-octave centre frequencies are employed. Spot frequencies from 4kHz upwards

76 ▶

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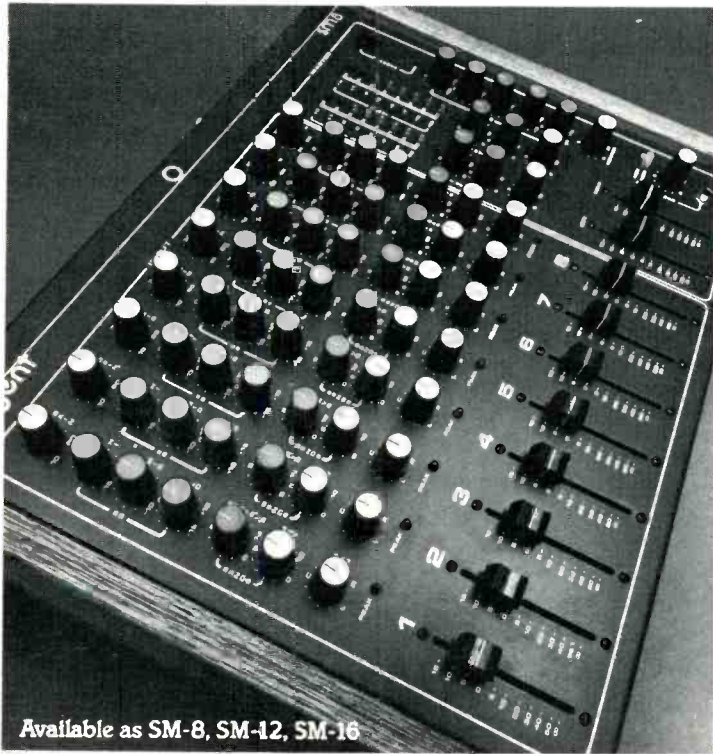


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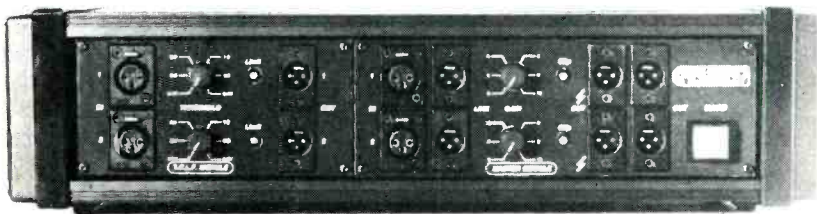
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were repeated twice together with the reference frequency.

The accuracy of the spot frequencies was good with a worst error of 1% but in both samples the short wavelength uniformity was rather poor although the integrated level accuracy was good.

Ampex

The Ampex tapes were supplied on 7in large centre cine type spools contained in a cardboard box. The format of the four samples was the same with an initial announcement followed by a 700Hz reference level section lasting 20s.

There follows a 15kHz level and azimuth section of 30s duration and then spot frequencies of 12, 10, 7.5, 5, 2.5, and 1kHz followed by 500, 250, 100, 50 and 30Hz all at the reference level for convenience. The accuracy of the spot frequencies was excellent and always within 0.3% of nominal, and the phase stability good.

With the exception of the 30in/s sample the uniformity of the output was exceptionally good, the 30in/s sample having an average performance. The use of a 50Hz spot frequency could be troublesome in Europe due to beating with the power line frequency.

BASF

With the exception of the 15in/s sample the BASF tapes were supplied on large centre 5in cine spools, the 15in/s sample being supplied on an AEG hub. However, when transferred to a 7in cine spool it still fitted into the original fairly solid box.

The configuration of the BASF tapes was identical to the Agfa tapes, also with announcements in German, but the descriptions were in English, German and Japanese.

All four BASF samples had very consistent azimuth at all spot frequencies which themselves were generally within 0.5% of nominal.

The uniformity of output and consistency of levels on all four BASF samples was excellent with the azimuth accuracy of the spot frequencies being outstanding on all four tapes.

Camford

The Camford products were different from the others in a number of respects. To start with they are supplied in metal cans giving protection from external magnetic fields which can easily spoil calibration tapes by accidental demagnetisation. The tapes come on normal 7in cine type spools, but a length of dummy tape is wound on the hubs to effectively increase the hub diameter for the calibration tape.

At the start of the tapes there is a non-magnetic leader followed by 30s of nominal 3kHz tone for checking wow and flutter. This is followed by 30s of translucent tape printed with strobe bars for accurate speed checking using a 50Hz powered light source.

Following this there is a 20s section of reference fluxivity and a 40s section of azimuth adjustment at 16kHz for 15in/s or 10kHz for 7½in/s.

After this there are spot frequency sections at 20dB below the reference fluxivity starting with a 1kHz reference and then proceeding upwards from 30Hz.

Checking the accuracy of the strobe tapes showed these to be 0.6% in error such that the tape ran 0.6% slow with 50Hz illumination. This feature was confirmed by measurements on a

USEFUL FORMULAE

a) Wavelength of a recorded sinewave:

$$l = v/f$$

Where v is the tape speed and f the frequency.

b) Spacing loss due to head to tape separation in replay:

$$\text{Loss (dB)} = 54 \cdot 6s/l$$

Where s is the head to tape separation and l the recorded wavelength in the same units.

c) Transition frequency in equalisation:

$$f = l/(2\pi \times t)$$

Where t is the time constant in seconds.

d) Gain/loss of equalisation curve

$$G \text{ (dB)} = 20 \log_{10} \frac{f}{fh} \sqrt{\frac{fh_2 + f_2}{fl_2 + f_2}}$$

Where f is the desired frequency, fh the higher transition frequency and fl the lower transition frequency.

e) Gap loss

$$\text{Loss} = \frac{\sin(\pi s/l)}{(\pi s/l)}$$

Where s is the effective gap and l the recorded wavelength in the same units.

f) Azimuth loss

$$\text{Azimuth loss} = \frac{(\sin \pi X)}{\pi X}$$

Where $X = r \times w \times f$ (r is the azimuth error in radians, f the frequency and w and s the track width and tape speed in the same units).

recorder and also measurement of the strobe line spacing with a travelling microscope.

Wow and flutter of the test sections on the two tapes gave an IEC weighted wow and flutter of <0.025% with the frequency of the 3kHz (not the current 3,150Hz standard) tone being within 0.2%.

Within the spot frequency sections the frequency was within 2% of nominal, adequate for practical purposes with good azimuth stability. On both tapes the level stability was within ±0.1dB but, there were a number of short term dropouts even at medium frequencies.

MRI

All MRI calibration tapes were supplied wound tail out of 7in cine type spools with a large hub diameter. The tapes start with a recorded announcement followed by 30s of reference fluxivity at 1kHz. This was followed by three azimuth adjust-

ment frequencies of 500Hz, 8kHz and 16kHz each of 20s duration.

Each tape is provided with an individual calibration chart having 0.1dB resolution and showing the duration and level of all tones.

Following the azimuth section the spot frequencies proceed upwards from 31.5Hz on the ISO standard octave centre frequencies to 8kHz which is followed by 10, 12.5, 16 and 20kHz (finishing with a 1kHz reference at reference fluxivity, which is 10dB above the spot frequencies on the 7½in/s tape, or at reference fluxivity at the higher speeds.

The frequencies on the 30in/s and 7½in/s tapes tended to be 1% high, with those on the 15in/s tape being within 0.5% of nominal. On all tapes the azimuth stability was good as was the consistency of all the levels. However, the short term uniformity at all wavelengths was below average with deviations up to ±0.2dB not being uncommon.

STL

The STL tapes all arrived on 7in cine spools with large diameter hubs. All the tapes started with a 15kHz azimuth adjustment section of 30s duration and good stability. Following this there is the reference fluxivity section of 700Hz for 20s followed by 12s spot frequency sections.

The spot frequencies start at 15kHz followed by 12, 10, 7.5, 5, 2.5, and 1kHz and then proceeding through 500, 250, 100, 50 and 30Hz. The azimuth stability throughout was excellent as was the frequency accuracy which was always far better than 0.5% of nominal.

All tones were at the reference fluxivity and consistent with deviations less than ±0.1dB and little presence of dropouts.

Summary

So far as reference levels and the equalisation characteristics of the tapes are concerned there were remarkably little differences between the samples. However, significant differences existed in terms of level variations and dropouts, plus of course the wide choice of tape formats and convenience of spot frequencies and their levels.

Hugh Ford

CARE OF CALIBRATION TAPES

Calibration tapes are easily damaged by misuse, use on poor machines or improper storage. Whilst catastrophic damage is obvious, characteristics change slowly even with careful use and such changes can be far from obvious.

It follows that it is advisable to have master and slave tapes, particularly when tapes are frequently used. Masters and slaves can then be compared at regular intervals. Whilst it is desirable to have a master for each tape speed, it is not necessary to have a master for each equalisation for as explained corrections can be used when comparing tapes of different equalisations.

The following precautions will increase the life of calibration tapes:

1 Check the cleanliness and mechanical alignment of machines before using calibration tapes. Such matters as worn tape guides will cause edge damage to the tape and lead to azimuth and other errors.

2 Always properly degauss machines before using calibration tapes. Some ferrite heads are very difficult to degauss and may require the use of a bulk eraser for proper degaussing. Any residual magnetism in a machine will first start to erase the short wavelength sections of calibration tapes.

3 Never wind calibration tapes at high speeds. If a controlled speed rewind is not available it is best to run to the end of the tape, turn it over, and rewind in a high speed play mode.

4 The tape should never touch the flanges of the spool—only use spools that are in good condition and properly aligned for height.

5 Calibration tape must be kept away from external magnetic fields which can originate from motors, loudspeakers, transformers etc.

6 Tape should be stored at constant and cool temperatures away from heaters, boilers, hot pipes, etc. The spool should be stored in a vertical position.

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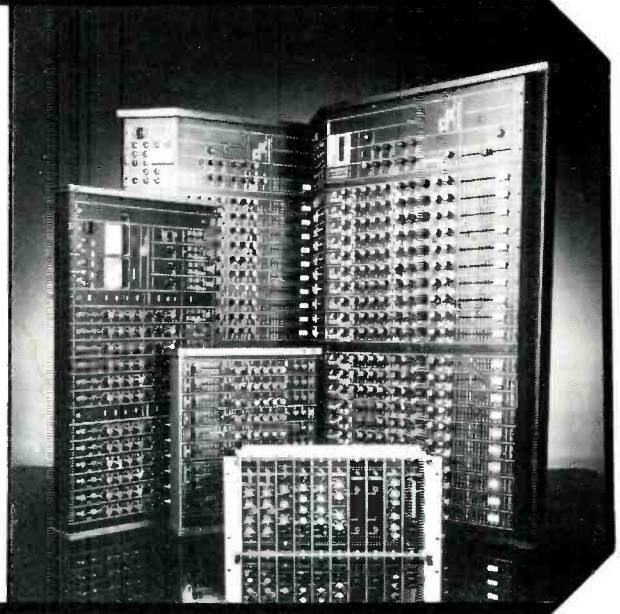
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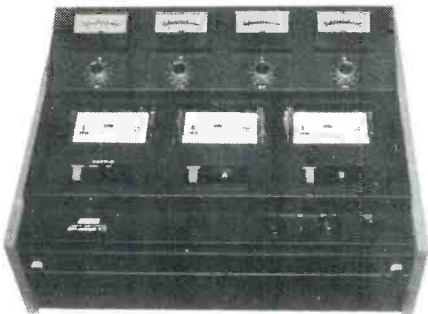
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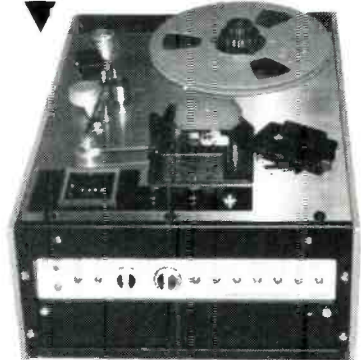


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Soundex AMM200



THE Soundex *AMM200* is a meter solely intended for measuring noise to the CCIR Recommendation 468 to the weighted and unweighted methods.

Housed in a strong plastic case the instrument is compact, with the rear of the case showing basic data and containing the IEC mains power connector and a 20mm power line fuse.

To the front a Sifam moving coil meter is scaled from +2dB to -20dB in 1dB increments down to -10dB and thence 2dB increments. Interlocked pushbuttons select the measuring range such that meter zero can correspond to between -10dBm and -80dBm in eight 10dB ranges.

At the left a tip, ring and sleeve ¼in jack socket provides the electronically balanced input, the impedance of which is nominally 20kΩ or 600Ω according to the setting of a pushbutton switch. A further switch puts the CCIR-weighting network in or out of circuit with a final switch putting a bandpass filter into the monitoring output which is a BNC socket. The final front panel feature is a red LED overload indicator which is illuminated if the output of the input stage exceeds a preset level.

MANUFACTURER'S SPECIFICATION

Input impedance: 20kΩ or 600Ω balanced within ±0.25dB (either signal input grounded).

Input connector: ¼in telephone jack (signal tip and ring and sleeve connected to instrument 0V).

Ranges: calibrated -100dB to -8dB (-80dB to -10dB switched in 10dB steps) ±0.3dB.

Headroom: 22dB on any range.

Frequency response: unweighted 22Hz to 22kHz, CCIR-weighted or wideband.

Pulse response: to CCIR requirements.

Output level: approximately -13dB.

Output impedance: 10kΩ.

Meter: taut-band moving coil movement scaled -20dB to +2dB.

Power requirements: 240/110VAC at 5VA.

Size: (whd) 6⅞ × 2½ × 5⅜in/175 × 67 × 127mm.

Weight: 2¼lb (approx)/1.3kg.

Manufacturer: Bulgin Electronics Soundex Ltd, Park Lane, Broxbourne, Herts EN10 7NQ.

Within the instrument the circuits are contained on six good quality PCBs which are interconnected by pins and sockets. Overall the construction was to a good standard, but some circuit modification had clearly been included.

Whilst the instruction book supplied includes calibration information, no circuits or layout diagrams were supplied and the PCBs did not have any component identifications.

In general this is a very nicely laid out instrument which is extremely easy to use, however, I feel it is unfortunate that the maximum measurable levels do not extend up to at least +10dBm. As the instrument stands it cannot be used with any normal line reference levels such as 0VU (normally corresponding to +4dBm).

Performance

The balanced input was found to have an impedance of 18.2Ω in parallel with 20pF irrespective of the measuring range selected, with the impedance being 16.6kΩ when operating unbalanced. Insertion of the internal 600Ω load reduced the input impedance to 602.4Ω — more than adequately accurate.

Common mode rejection of the input varied

80 ▶

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		15	380		200		200 or 320	
1	25	7 1/2	190		200		200 or 320	
		15	380		200		200 or 320	
		30	760	AES	200		200 or 320	
2	50	15	380	NAB	200		200 or 320	
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TABLE 1

Actual input	Indicated Input
-50dBm	-50.3dBm
-60dBm	-60.6dBm
-70dBm	-71.5dBm
-80dBm	-83.0dBm

widely with the selected measuring range, on the -10dB, -20dB and -30dB ranges being 38dB at 1kHz and falling at 6dB/octave with increasing frequency. On the -40dB range the common mode rejection increased to 66dB at 1kHz and improved on the more sensitive ranges.

Absolute voltage measurement accuracy was excellent on the 10dB range with 0dBm indication being measured as -10.04dBm. Whilst at 1kHz and 10kHz the attenuators remained within 0.1dB on the -20dB, -30dB and -40dB ranges, on the more sensitive ranges cumulative errors built up as a result of what is thought to be factory calibration errors (Table 1). Also trouble was experienced on the most sensitive ranges due to pickup through the unscreened case.

Fig 1 shows that the frequency response from the input to the monitoring output was within 1dB from 30Hz to 20kHz irrespective of gain, but that above 60kHz the response became sensitive to the gain setting. Also shown in Fig 1 is the effect of the output filter which was identical to the meter's performance in the unweighted mode. This filter with its 24dB/octave highpass and 18dB/octave lowpass characteristics met the requirements for CCIR Recommendation 468-2 unweighted measurements.

Insertion of the weighting filter gave the meter and the output the frequency response shown in Fig 2, which met the requirements for the CCIR weighted measurements as shown.

The ballistics of the meter were checked with the application of isolated bursts of 5kHz tone and found to be well within the CCIR requirements as shown in Table 2.

Similarly, as shown in Table 3, the application of repetitive 5ms bursts of 5kHz tone again showed the instrument to meet the CCIR Recommendation.

At the monitoring output 150mV RMS corresponded to 0dB meter indication with output clipping occurring at 5V RMS output with the source impedance being 10.4kΩ.

At all gain settings the overload handling capabilities were well in excess of the CCIR requirement of 20dB.

In practical use the overload indicator was of little use as it only served to indicate overload of the input stage. If the unit was used as an amplifier the subsequent stages could be driven well into clipping with no overload indication.

Summary

The Soundex AMM200, with the exception of the calibration at high gains, performed to a very high standard well within the CCIR Recommendation 468-2 requirements.

It is a nicely made instrument, very easy to use, but does have limitations depending upon the precise applications for which it is intended.

Hugh Ford

TABLE 2

Burst length (ms)	1	2	5	10	20	50	100	200
Reading (dB)	-16.0	-12.0	-8.0	-6.5	-5.8	-4.8	-3.2	-1.8
Specification max	-17.4	-13.0	-9.3	-7.7	-7.1	-6.0	-4.7	-3.3
Specification min	-13.4	-10.0	-6.6	-5.2	-4.4	-3.3	-2.2	-0.7

TABLE 3

Repetition Frequency	2Hz	10Hz	100Hz
Reading (dB)	-6.9	-2.6	-0.3
Specification	-7.3/-5.5	-2.9/-1.7	-0.5/0

FIG.1
SOUNDEX AMM200
FREQUENCY RESPONSE - AMPLIFIER OUTPUT

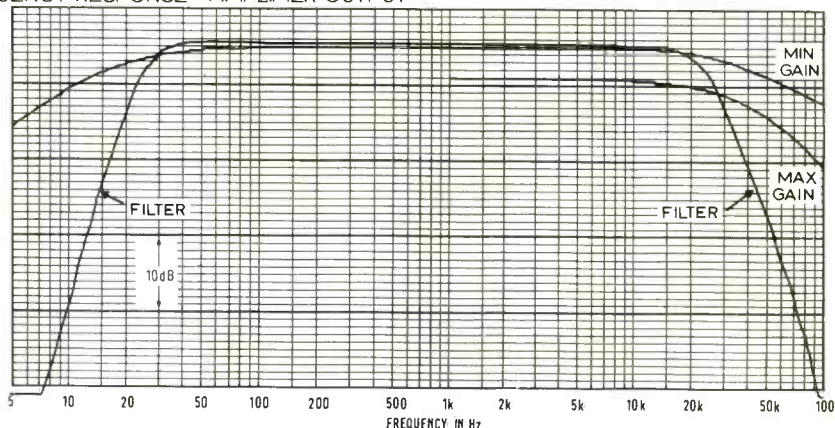
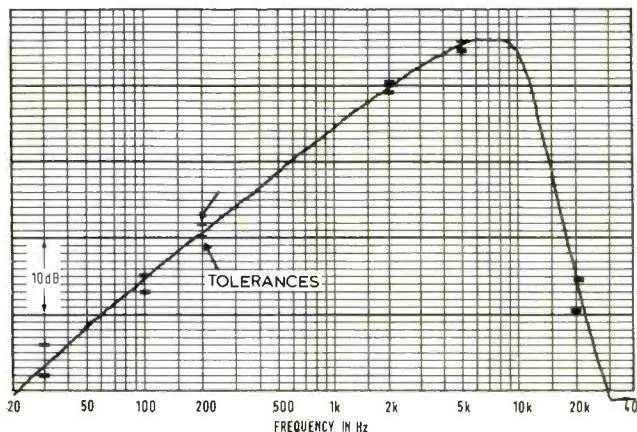


FIG.2
SOUNDEX AMM200
CCIR - WEIGHTED RESPONSE



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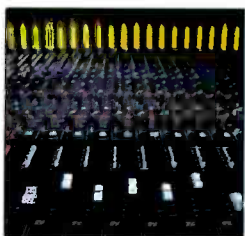
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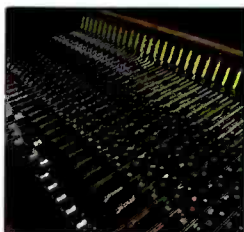
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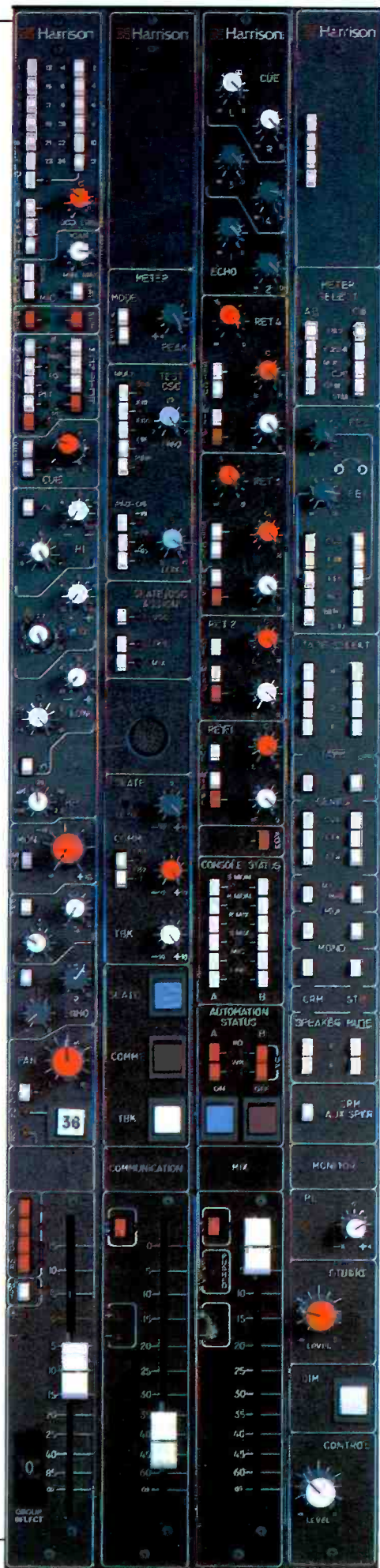


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