Until now, if your budget for a multi-track tape recorder was around £10,000, you had to settle for a used 24-track machine and someone else's problems... or settle for fewer tracks and compromised quality.

Soundcraft decided today's economy demanded a line of new multi-track recorders that are fully professional, yet reasonably priced. We took a look at all the major professional machines and went back to the drawing board. The result is a new line of tape machines... basic in design, but with all the professional features and reliability you demand.

The new Soundcraft multi-tracks are lighter and smaller than other machines. The 24-track is compact enough to fit in the most cramped mobile production truck and light enough to roll between rooms.

Best of all, you can buy the new Soundcraft two-inch, 24-track recorder from £9750*... its 16-track counterpart from £8500 with a complete list of options so you can tailor your machine to your own requirements.

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* Model T2/24

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München: Hausmann, Tel: (089) 433 1097

GREECE: Ion Studio Systems, Tel: 0121 41775

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JAPAN: Hitachi Elect. Soc. Inc., Tel: 03 864 4961

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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 tumbled slowly past, or the mysterious tone which the 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 gladly omit the name of the facility, and give merely the event, as we do in our similarly apocryphal Agony items (and we could do much more of those, too—don’t tell me that nothing silly or disarmingly 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
Editing with our new PCM recorders requires this sophisticated hardware...

The AEG-Telefunken MX80 and MX80a are a completely new breed of PCM tape recorders. Now, for the first time, you can use cut and splice editing procedures on a PCM machine. Smooth, silent splices are ensured by a sophisticated automatic cross-fade technique which joins the signals before and after the splice.

But AEG-Telefunken didn't stop with just one innovation. They designed these machines to be so simple that anyone familiar with analogue master-tape machines can operate them. For example, they use standard analogue controls; they aren't unduly sensitive to dust and dirt; they're rugged, reliable and simple to maintain and service.

Another important feature is that the head assembly is finished to a tolerance of 10 microns, which results in complete compatibility between machines.

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The AEG-Telefunken MX80 and MX80a — the new breed of PCM recorders.

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STUDIO SOUND, JUNE 1982
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* Audio control section has the same functions as the 2" Otari MTR90 series. All audio functions and transport functions repeated on optional remote control.
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**Contact Information:**

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<table>
<thead>
<tr>
<th>Description</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teac 80/8 ½&quot; 8 track/varispeed</td>
<td>£2,600.00</td>
</tr>
<tr>
<td>8 track Teac DX8 noise reduction</td>
<td></td>
</tr>
<tr>
<td>8 track 1&quot; Brenell Mini 8 1&quot; varispeed/remote control</td>
<td>£5,495.00</td>
</tr>
<tr>
<td>Allen &amp; Heath 16x8</td>
<td></td>
</tr>
<tr>
<td>16 track 1&quot; Tascam 85/16 inc. dbx</td>
<td>£9,950.00</td>
</tr>
<tr>
<td>Tascam Mod 15 24x8 16 track monitoring, auto locator.</td>
<td></td>
</tr>
</tbody>
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- Teac 80/8 ½" 8 track/varispeed
- 8 track Teac DX8 noise reduction
- 8 track 1" Brenell Mini 8 1" varispeed/remote control
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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 record 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.

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Fostex

Bandive Ltd. 10 East Barnet Road, New Barnet, Herts EN4 8RW. Tel. 01-440 9304
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, which is regarded as 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.

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, restaurant air fare, 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 during the period of time in question are not exempt, the realization that the retroactive taxation and penalties are reasonable is to seriously squeeze the Californian recording industry financially, and that this will probably cause the demise of many of the 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.

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: 091422 4515.

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 acoustic 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.
Our Performer Series units are professionally designed for you with the utmost reliability.

The DL-2A ACOUSTICOMPUTER® is simply the cleanest sounding, most flexible, widest range, digital delay and special effects processor.

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Scenic Sounds Equipment Limited
97-99 Dean Street, London W1V 5RA Telephone: 01-734 2812/3/4/5 Telex: 27 939 SCENIC G
Autograph Sales Ltd
A new company, Autograph Sales Ltd, has been formed by David Solar, the former 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 distributors for Meyer Sound Laboratories Inc, designers and manufacturers of compact PA and sound reinforcement loudspeaker 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 NW 1 8AH, UK. Phone: 01-267 6677.

Agencies
- Calrec Audio Ltd has added Audio & Design Recording Inc as its American agents for the company's range of professional mixers including the Ambisonic Soundfield mic. Audio & Design Recording Inc, PO Box 786, Bremerton, Washington 98330, USA. Phone: (206) 275 5009. Telex: 152426
- Elliott Bros has been awarded by the English National Opera to supply and install a back-stage communication system including a Philip Drake talkback system, at the London Coliseum. Elliott Bros has also recently completed the installation of Chiltern Radio's Dunsfold studios.
- A&K has asked us to point out that in addition to Atlantic Music, national distributors of its microphone ranges are Audio Services, Stockport; Wilkinson Music, Glasgow; and Keith Hand Musical Supplies, Manchester.

Address changes
- Webber Tape 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, Frederik 1, N 207 Kieller, Norway. Phone: 02-716820. Telex: 11886.

Contracts
- Syco Systems has recently installed a Fairlight CMI 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 upgrade.
- FWO Bauch has supplied a Harrison MR3 console with associated tape equipment to Tapestry Studios, London. The company has also supplied a Lexicon PCM 41 and Valley People Dynamic effects unit to Genesis.
- Quad-Eight has delivered the second of two Compumix III automatic 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 System 55/16 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 Ursula Major digital reverber. Other recent installations include a JH-636 console, 24-track and two stereo tape machines to ERT, London; four stereo tape machines and a 1/2 in stereo machine to CBS, London; a JH-542LM automated console to Hungarian Records, Hungary; a JH-636 console to Ieland Radio; and a JH-110C 8-track tape machine to Satter Audio Visual, London. In addition the company in conjunction with Clyde Electronics has delivered a mobile to Melodya Records, Moscow - the mobile being equipped with a JH-60 mobile console and JH-110 stereo mastering machines.
- FWO Bauch has supplied two complete Melkusit fader packages to De Wolfe Ltd for its Angel Studio complex. The systems comprise Melkusit automated faders and G24 automation systems, most are fitted to Neve consoles. FWO Bauch has also supplied and installed a 48-input Harrison MR2 console with Melkusit automation, a Studer A80 24-track and Studer A80 mastering machines to Atomic Records and Screen Works in Munich.
- Elea 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 TV music and FX mixers 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-locks, 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 Fonolorma (Italy).
- Aplex Systems has supplied Aural Exciter units to Compact Video, Burbank, and ITV Ltd, Edmonton, Canada, for audio sweetening purposes.
- Cerec 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 Kwang 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 900B programme automation system. The six-track system includes MCI tape reproducers, Instacart cart machines, a single play cart machine, and two studio source. Harris has also supplied KyXy, San Diego, with an FM-25K, 25KW FM transmitter.
- Radio Televisija Sarajevo in Yugoslavia has ordered a 20-input 20-output microprocessor controlled audio routing switcher, distribution amps, patchfields and several custom control panels from Scitech Equipment Ltd.
- Midas is to supply five TR System 24/8 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 a Series 24A mixer and a TMS 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 Melkusit sub-grouping. Other recent contracts include a Series 30 console and TRS 24-track tape machine for Mayfair Sound, Newport; plus 22/16 Trinitx consoles for Westroom, Manhattan, Delta Recording, and a 32/16 Trinitx for Tiki Studios, Long Island.

3M acquire ITC
3M and ITC (International Tape- tronic 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-Vision Products Division. This acquisition will merge 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.
Your noise reduction frame is doing half the job it should — in twice the space necessary!

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

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Analog/Digital Associates who produce the STD-1 stereo tape delay (detailed in New Products, February) are also acting as worldwide distributors for two units produced by Carrotron. These are, respectively, the C920BI Noise Fader and the C921BI 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 buzz. Features of the unit include an adjustable threshold control; a footswitched low-noise active volume control; and discrete FET and transistor circuitry. The unit is housed in a die-cast aluminium case measuring 4 ¼ x 2 ¼ x 1 ¾in 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 -120dB, while the footswitched active volume control, which allows the signal to be boosted by up to +20dB, 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.

**Carrotron units**

**Quantec room simulator**

The Quantec Room Simulator (QRS) is a new rack-mounting digital reverb unit, 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 the 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 100 cu m in seven steps, and the decay time is selectable from 0.1 to 100s (up to 400s at 50Hz), while the LF decay time is separately selected in 11 steps between 0.1 and 10 times the main setting. Similarly, the high end decay time may be varied in eight steps between coefficients of 0.1 to 2.5 related to the selected decay time. Pre-reverb delay is set between 1 and 200ms in steps of 4ms, and its level may be similarly stepped between -30 and 6dB in steps of 1dB plus an 'off' position. Seven different 'enhancement' programs facilitate the simulation of rooms, without perceptible reverberation. 16-bit coding is used at a 20kHz sampling rate, giving typically 0.1% distortion. The processor is a 26-bit unit with a 20.48MHz clock and approx. 2MB of RAM. The frequency response of the unit is quoted as 20Hz to 8kHz at 0±3dB, and the frequency range is 90dB unweighted. The unit is 19in rack mounting and is 2U high.

Quantec GmbH, Postfach 152, D-8016 Feldkirchen bei Munich, West Germany. Phone: 089 903.67.25.

UK: Syco Systems Ltd, 20 Conduit Place, London W1. Phone: 01-723 3844.

**Crucible Theatre console**

**Computer automation for the theatre**

P.B. 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 of 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 music 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 bus 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 of 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.

P.B. 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 403 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 the preset is 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.
Pinewood chose Theatre Projects

For their new fully custom 60 channel/32 group film post production console

5.5 metre long console designed for operation by a three man dubbing team. Facilities and functional layout were tailored to the customer's needs. Special features include 'Multipan', Theatre Projects' multi-output programmable memory panning system.

Theatre Projects Services Ltd.,
Electrosound House,
11 Marshalsea Road,
London S.E.1.
Tel: 01 403 3998
Telex: 885655 YODEL G
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 'electronics' 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 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 Dean, a young operator/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 NAII cart machines for sound effects, rather than the ubiquitous Revoxs. The trouble with Revoxs 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...
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 Aisle 9046 speakers binned with Alice amps. These gave a brassy American sound which was just right for the production. Half a dozen Sennheiser MKE 802 electret directional mics were used in the foils (along the front of the stage) while five MKE 815 rifle mics were flown overhead. A Chorus Line was really choreographed for the microphones in that the cast stood, almost all the time, on a white line which was six feet or so upstaged from the foils, 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.

"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.

Monitor mixers are unusual, though not unknown, in theatrical sound balancing and the monitor mix is flown overhead 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 there were 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 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 system is large, fourteen seats to be taken out, the back of the show will lose, fourteen times £1.50 or so. There is a direct ratio between the size of the sound desk and the profitability per night. It is, "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 Fleximix, 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 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 complete 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 a 'seat' for Julian," says Andrew, "no one's going 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
**Autograph**

myth to them; they only know what's coming back, they don't understand the reasons. So you do need a sound 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 complain 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 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 are more than 'just paper-thin'—Autograph recently had a faulty radio mic, where the cable appeared to be intermittently 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 arrangements 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 have 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 this principle which we thought would work actually wouldn't, so we had to re-opt the whole speaker system."

Julian continues, "It wasn't a conventional prosenium 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 prosenium 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 centre 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 panel, the show's speciality 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 cables and microphone leads, and a lot of thought went into the cables. Micron 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 sides of 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 KM82 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 MKHR16s—are suspended over centre stage, and there is one specialised B16 rifle mic, which hangs beneath the front right loudspeaker, pointing to where the main 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 KM66 plus two Outputs 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 keyboards, who play four Prophet 3 synths in one four-tour, plus one Yamaha, and a Fender Rhodes. One player plays two Prophetis stacked, one plays a Prophet on top of the Rhodes, and the third plays a Prophet on top of the Yamaha. The keyboards are Di'ed. They all have Roland Cube amps for their own monitoring.
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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 high头顶, 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 driven with bass (DI), guitar (DI’d plus acoustic), and drums, which have an overhead U89, KM84 on snare/hihat, and a DI2 on bass drum, Galaxy Audio Hospar 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 355 4-channel NR unit are premixed in the control room 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 him, and this video 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 comma 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 339 room equalisers on the delay rings, which are controlled by bass 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 Audiotrons which are mounted on stands 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 System is used. This is a parametric equaliser, an ADT module, plus a couple of noise gates.

Two compressors are also fitted in the racks. 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 rag above the stage and three Electro-Voice LE148s 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-30ST 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 Audiotrons 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, again a pair. These are all down. Over the stage, on the year, 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 all 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 to 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 the target 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 the four heads is 20/24 although its expansion possibilities make it an investment for the future. Other equipment includes a Studer B67, a Cucumser 982 cartridge machine, an EMT Piano 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 their 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 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 Mr. Harpur, in which bats are moved on two movable hand 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 hand trucks behind the stage, driven by heavy black drapes, only to reappear for the finale playing The South Bank Show theme whilst trucking 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 in a number of European countries. 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 to try to make 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 making is even bigger contribution to theatre. 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.

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

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 Shaplehall Street premises, and it wasn't until October 16, 1980, that work actually started on the construction of the studio. 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 painted 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 Helmholz 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 velveteen 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.

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 £35.00 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.
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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 upgrading of equipment under the leadership of Jose Ma Batlle Simon. Previously José had been chief engineer at RCA Studios (Madrid) and had recorded many top artists for the leaders of different owners, but Audiofilm eventually became the employer.

In 1970, Audiofilm expanded from its main 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. After this time work was principally record oriented 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 Borracho" 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. Since these jingles have been steady business for the studios, particularly Studio B, while Studio A continued recording for records. One particularly good client was Javier Iurralde 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 founded Antonio Morales (who had been with the studio since its earliest days) making a team of three engineers. In 1973 Santiago Ladake 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 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 fade 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; 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 room was carried out under the supervision of Eduardo Pastor and José Iturralde Jr. 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 booking 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 decor of the control room is similar to Studio A. The author produced several singles 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 size of the 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 a general purpose of this studio is for recording radio programmes there are two Technics turnables of professional radio calibre. It also has a Nakamichi cassette deck and an Ursa Major. The Station Monitors are Tannoy Super Reds and Auratone. Reverb is AKG, however, the EMT's upstairis 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 Ladake. 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 Cucinacesi 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, no one 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 now, the new owners of Audiofilm Studios SAL are working very hard and enjoying what they know best how to do: record music!
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Model 2000: modular console available with 32, 24 or 16 inputs, four submix, four master and four four-channel strip.

AUDIARTS (USA)
Audiarts Engineering, 286 Downs Road, Bethany, Connecticut 06525. Phone: (203) 393 0887.

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

4000 mixing system: modular recording and reinforcement console, 1210/2 input channels, four subgroups, 2- and 2-track outputs, separate reinforcement outputs.

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: 24/4 console with four submaster outputs. Also available as 1642 with only 16 input channels. 1682/128/8800: 16, 12 and 8 input channel stereo mixers.

BOGEN (USA)
Lear Singler 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 Techcraft range of mixers for PA applications.

CAE (USA)
Custom Audio Electronics, 2828 Stommel Road, Ypsilanti, Michigan 48197. Phone: (313) 482-6688.

16/4: channel stereo mixer, built-in power amp, EQ and tone controls. Also the Flex system, a modular system capable of accepting up to 36 channels with either 2 or 4 output formats.

CHILTON (UK)
Chilton Tape 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 4/2, 8/2, 12/2, 16/4, 24/2 and 32/2/2, also the Canflex System, a modular system capable of accepting up to 36 channels with either 2 or 4 output formats.

CUST SOUND (UK)
Custom Sound Solid State Technology Ltd, Custom House, Arthur Street, Oswestry, Shropshire SY11 1FN. Phone: 0991 52901.

Model 701: 8-channel mixer with built-in power amp, 6/4/2, 8/2, 12/2, 16/4, 24/2 and 32/2/2. Also the Canflex System, a modular system capable of accepting up to 36 channels with either 2 or 4 output formats.

DAA (UK)
DAA Ltd, Unit 7B, Worton Hall Trading Estate, Worton Road, Islington, Middlesex TW7 5ER. Phone: 01-847 0363.

Custom design and manufacture of PA and sound reinforcement consoles.

D & R (Netherlands)
D & R Electronica BV, Chassestraat 26, NL-1057JE Amsterdam. Phone: (020) 18-35-56. Telex: 18503. UK: D & R Marketing, Weston Road, London NW9 9JU. Phone: 01-204 4234.

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

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

DYNACORD (West Germany)
UK: Beyer Dynamic GB Ltd, 1 Clair Road, Haywards Heath, Sussex RH16 3DP. Phone: 0444 510323.
USA: Dynacord Electronics Inc, PO Box 2608, Philadelphia, Pennsylvania 19128. Phone: (215) 492-4992.

MC Series: MC123C/12/2 mixer for vocal and orchestral PA, also 122 and 162 on-stage mixes plus a 20/82 mixer.

EELA AUDIO (Netherlands)
UK: Eela Audio Industries Ltd, 13 Molseworth, Hoddendon, Hants EN11 9PT. Phone: 09924 86674.
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, 8, 12, 16 and 32.

ELECTROSONIC (UK)
Electrosonic Ltd, 815 Woolwich Road, London SE7 5LT. Phone: 01-855 1101. Telex: 896532.

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 feedback. Also PM-80 modular mixing system.

GELF (UK)
Gelf Electronics Ltd, Unit 5, Mount Avenue, Bletchley, Milton Keynes MK1 1LS. Phone: 0908 77503/47262.

Manufacture of a range of mixers for PA and sound reinforcement including 12/2, 16/4, 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, Borough Wood, Herts WD6 4RZ. Phone: 01-953 0091. Telex: 27952.

Alive: live performance console available in either 24 or 32-channel formats with the ability to extend extenders of either 24 or 32 inputs. Features include automated VCA faders with group, eight VCA matrix subgroups, direct communications interface, and four main stereo output pairs.

HH (UK)

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

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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
HILL (UK)  

B2 Series: modular mixers available with 16 to 24 input channels and 4 or 8 outputs.
J2 Series: modular sound reinforcement console available in 24/82 and 32/82 configurations with optional 8- or 16-channel extensions.
M2 Series: on stage monitoring console available from 16 to 32 inputs and four, six, eight or 10 monitors.

HIWATT (UK)  
Hylight Electronics (Hiwatt Amplification) Ltd, Park Works, 16 Park Road, Kingston-on-Thames, Surrey. Phone: 01-349 0252.

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

ITAM (USA)  
Industrial Tape Applications, 1 - 7 Harewood Avenue, Marylebone Rd, London NW1 6LE. Phone: 01-724 2479. Telex: 21879.

Portamix: portable 6-channel, 2-group mixer, may be battery powered.
10/4/12, 4/16/14: portable PA mixers of modular construction with 10, 12 or 16 inputs, four monitors plus stereo monitor output.

LIBRA (UK)  
Libra Electronics Ltd, Bentfield Road, Stansted, Essex CM248HS. Phone: 0799 41156. Telex: 817444.

Manufacture and design of live sound mixers for theatres and conference/arts centres. Original mixers have been redesigned. Current format provides basic frames with up to 12 inputs (extendable to 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 Stannhope Street, London NW1 3EX. Phone: 01-388 7579.

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 film sound mixing applications. System is fully modular and is available in 24, 30 and 36 input channel formats with eight subgroups and eight outputs.

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 buses 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 Kneen Street, Royston, Herts SG8 5AD. 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 12- or 20-channel stereo or 4-track mixers suitable for PA applications.

NEPTUNE (USA)  

410P: 6P0: 4- or 6-channel mixer with integral 100W power amp.
611: six input mono mixer
821: eight-channel stereo general purpose mixer.
1420: similar to above but 14 input channels.

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

PEAVEY (USA)  
Peavey Electronics Corp, 711 A Street, Meridian, Mississippi 39301. Phone: 0601 483-3565.

UK: Peavey Electronics (UK) Ltd, Unit 8, New Road, Ridgewood, Uckfield, Sussex TN22 5SX. Phone: 0925 5586. Telex: 957088.

XR Series: range of stereo power amplifiers with 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) 7911.11. Telex: 5121.

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.

SM: modular console system suitable for concert and theatre sound reinforcement applications. Wide range of modules available with each console comprising two sets of masters, eight aux buses and programmable muting.
LDC25: range of dynamic audio mixing consoles with a capacity of 24 input channels.

PRIMROSE (USA)  
Primmrose Electronics Ltd, Reddings, Kirkby on Bain, Woodhall Spa, Lincs. Phone: 0526 52850.

PEL20: modular PA mixer accepting up to 30 inter-changeable input channels. Three stereo groups.

RAINDIRK (UK)  
Randirk Ltd, 33A Bridge Street, Downham Market, Norfolk PE38 9DW. Phone: 0386 382165. Telex: 817737.

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

USA: Audicon, 7138 Santa Monica Boulevard, Hollywood, California 90064. Phone: (213) 851-7172.

RM61: 6-input single output rack mounting mixer.

RAMSA (Japan)  
UK: National Panasonic Ltd, 308-318 Bath Road, Slough SL1 6JB. Phone: 0753 34522. Telex: 947602.

USA: Professional Audio Division, Panasonic Co, 1 Panasonic Way, Secaucus, New Jersey 07094. Phone: (201) 348-7000. Telex: 710-892-8985.

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

RSD/STUDIOMAKER (UK)  
Recording Studio Design Ltd, Home Farm, Northall, Dunstable, Beds. Phone: 0525 221331.

USA: StudioMaker Inc, 1385C Dynamics, Anaheim, Ca 92806.

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

RSD (Canada)  

USA: Listec Television Equipment Corp, 39 Cain Drive, Plainview, NY 11803. Phone: (516) 694-8963. Telex: 840470.

MB2 Series: large range of mixers available in various configurations including sound reinforcement and musicians mixer formats. Facilities include stereo group and direct outputs withebra subgroups and level control. Sizes vary from 4 to 24 channel.

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 12 inputs.
Pro-Tour Series: modular touring systems with 32 to 40 inputs, stereo and mono outputs and four stereo submasters.
Soundproxim Series: modular mixers with eight to 48 inputs, stereo zoom system, four stereo and mono submasters, separate mono and stereo outputs.

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

Manufacture computer-assisted theatre mixers, maximum inputs/output format 32/16. (See New Products page 28).

New

Midas 28/24 PR Series console

44
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MX Series: stereo and mono, passive and active mixers in a variety of formats.

SOUNDCASTRIITK)
Soundcraft Electronics Ltd, 5-8 Great Sutton Street, London EC1V 0BX. Phone: 01-251 3631. Telex: 21198
USA: Soundcraft Electronics USA 2010 Manahattan Place, Torrance, Calif 90405. Phone: (213) 339-2506.
Series 15: portable non-modular PA mixers available in 12, 16 and 20-input versions.
Series 400: modular mixers available in 12, 18 and 24-channel frame formats with four subgroup and separate stereo mix groups.
Series 800: modular mixers available in 18- and 36-channel configurations with eight PA outputs.

SOUNDTRAKS (UK)
Soundout Laboratories Ltd, 91 Ewell Road, Surbiton, Surrey. Phone: 01-399 3392. Telex: 8691073.

SOUNDTEC (USA)
Sonic Sound Electronics, 15101 Avenue of the Stove, Chatsworth, Calif 91311. Phone: (213) 349-4747.
Alpha Series: although designed for stereo broadcast applications, custom sound reinforcement versions are available.

STRAND SOUND (UK)
Strand Sound Ltd, PO Box 51, Great West Road, Brentford, Middlesex T8 9HR. Phone: 01-568 9222.
USA: Strand Century Inc, 20 Bush Street, Elmwood Park, New Jersey 07407. Phone: (201) 791-7000.
System 1/System 2: theatre and sound reinforcement systems. System 2 offers additional facilities. Basic systems are 16/4 expandable to maximum 32 modules.

TAC (UK)
Total Audio Concepts Ltd, Islington Mill, James Street, Saltford M5 9HW. Phone: (061) 519 6747. Telex: 668127.
UK Sales: Scenic Sounds Equipment Ltd, 97 -99 Dean Street, London W1V 5RA. Phone: 01-734 2812. Telex: 27939.
TAC 1681B: 16/8 sound reinforcement console extendable to 32-channel configuration. Similar console, the TAC 1681F/1B, 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 2 or 3 mainframes sizes with 12 or 20 inputs and direct outputs from each channel. Ax Series: sound reinforcement consoles in four mainframes sizes with 8, 12, 16, or 24 inputs and full monitoring facilities.

TAPCO (USA)
USA: Quilton Europe Ltd, Ecole Voice Division, Maple Works, Old Shoreham Road, Hove BN3 7EY. Phone: 0273 23329. Telex: 87680.
6000 Series: rack of rear mounting PA console or musical instrument mixers with six or eight inputs and mono or stereo outputs. 8201B stereo mixer similar with eight inputs.

Series 7274: semi-modular mixers. Series 72 available in 12, 16, and 24-channel formats all with stereo mono outputs. Series 74 available in 18, 24, 32 and 32-channel formats with 4/24 output section.
C-12 Series: Two=12/4/2 format mixer expandable up to 44 input channels with stereo or mono subgroups.

TECHNOICIEL (France)
Techniobie, 8 rue de la Croix Maire, BP 26 91122 Palaiseau Cedex. Phone: (1) 920.83.39. Telex: 629543.

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

TESLA (Czechoslovakia)

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

THEATRE PROJECTS (UK)

TOA (Japan)
UK: Toa Electric Co, Ltd, Castle Street, Ongar. Essex CM5 5JY. Phone: (0277) 4333. Telex: 995554.
RX Series: modular consoles suitable for sound reinforcement and on-stage monitoring purposes. Formats include 6/2, 12, 16, 16/8, 32/8 and 32/16.

TRIDENT (UK)
Trident Audio Developments Ltd, PO Box 38, Studios Road, Shepperton, Middx TW17 001. Phone: 03932 60241. Telex: 881398.
USA: Trident Audio Inc, 625 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 8 module mainframes.

TRIMIX: compact modular console based on the Series 80 multi-track concept. Mainframe houses 24 modules, any configuration can be configured from 2 track to 24 track or to various sound reinforcement formats.

TURNER (UK)
Turner Electronic Industry Ltd, 175 Uxbridge Road, London W7 3TH. Phone: 01-567 8472.

TM 24/12 module PA sound control desk with 24 input channels, 4 stereo subgroups and separate stereo master output.

YAMAHA (Japan)
UK: Ban Electromusuc, 89 - 97 St John Street, London EC1M 4AB. Phone: 01-253 9410. Telex: 259580.
USA: Yamaha International Corp, PO Box 6000, Buena Park, Calif 90620. Phone: (714) 522 9105.
M Series: sound reinforcement mixers for fixed or portable installations. Configuration 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 SE5 2AH. Phone: 01-653 6018. Telex: 945307.

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 16/8 and 24/8 on stage monitor mixers.
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Surrey
Tel. Wentworth 4416

Manufactured in the USA by Standard Tape Laboratories Inc.
AB SYSTEMS (USA)
AB Systems Design Inc, PO Box 754, Folsom, CA 95630. Phone: (916) 988-8851.
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 per channel; additional subwoofer output.

ACES (UK)
AC Electronic Services, Broad Oak, Albrighton, near Shrewsbury, Shropshire SY4 3AG. Phone: 0959 290574.
ACXV: 2-way and 3-way stereo electronic crossovers, fixed frequencies.

ACCUPHASE (Japan)
Model F 5: 2-channel 3-way crossover with choice of 15 adjustable crossover frequencies.

ALTEC (USA)
Altec Corp, 1515 South Manchester Avenue, Anaheim, CA 92803. Phone: (714) 774-2900. Telex: 655415.
UK: Rank Strand Sound, PO Box 51, Great West Road, Brentford, Middx TW8 9HR. Phone: 01-768 9222 Telex: 27976.
Model 130A: two-way active system but can be operated in pairs or in an active 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.
Range of electronic crossovers all offering similar facilities but with different formats: stereo 2-way SC-27, mono 3-way SC-70 and mono 4-way SC-80.

AUDIOARTS (USA)
Audioarts Engineering, 286 Downs Road, Bethany, Connecticut 06525. Phone: (203) 393-0087.

1400: parametric electronic crossover for 3-way systems, crossover points provided for compensation of speaker frequency abnormalities in the crossover region.

1500: tunable notch filter, feedback suppression, 1 oct/dip bandwidth, five identical sections covering 50Hz to 12kHz.

2100A: tunable electronic crossover, parametric with crossover frequency continuously variable between 70Hz to 9kHz.

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 4LS. 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, CA 90250. Phone: (213) 973-8900.
UK: Court Acoustics Ltd, 35 – 39 Britannia Row, London N1 0HQ. 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.

BROOK SIREN SYSTEMS (UK)
Brook Siren Systems, 92 Conley Hatch Lane, Muswell Hill, London N10 1LR. Phone: 01-444 7892. Telex: 812881.

FDS 300 Series; frequency dividing systems. FDS 300 two-way, FDS 400 switchable 3-way 4-way.

COURT ACOUSTICS (UK)
Court Acoustics Ltd, 35 – 39 Britannia Row, London N1 0HQ. Phone: 01-359 0956/5275. Telex: 268279.
EC-234: stereo 2, 3, or 4-way system. Each crossover point has choice of four frequencies with switch free operation to allow A/B tests during use.

CROWNAMCRON (USA)
U.K.: HHB Hire & Sales, Unit F, New Crescent Works, Nicoll Road, London NW10 9AX. Phone: 01-961 3295.

FX-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. Mono 1 can be used as a 2- or 3-way system.
MX-4: mono electronic crossover, 3-way plus subwoofer.

DAA (UK)
DAA Ltd, 78, 85 Hall Lane Trading Estate, Worton Road, Isleworth, Middx TW7 6ER. Phone: 01-847-0393.
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, 180-1 Cecil Street, Buchanan, Michigan 49107. Phone: (616) 695-6831.
UK: Gulton Europe Ltd, Electro-Voice Division, Maple Works, Old Shoreham Road, Hove BN3 5YE. Phone: 0273 23529. Telex: 81562.

EQ-1A: electronic crossover, 2 band. 5-position Thiele LF equalising network.
EQ-2: 2-way active crossover/equaliser similar to EQ-1A.

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Hauppauge, New York 11788
(516) 582-6210 Telex 649230
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 Mixdown 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 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.

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Electronic music synthesis—Larry Fast comments

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 multiflack 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.

"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 happen 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 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 when he would drive up to the offshore oil drilling platform to record the narration for his television 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. Even those who come in from the artistic side, they sort of 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 which 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 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 ambiance

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 synthesizer 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, 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 Acousticomputer which I carry around in my rack with me and an old Eventide Harmonicer 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 god at sketching environmental sounds around you—no 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's project, or a largely electronic project, then you have to rely very heavily on creating the space for the instruments.

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Studios and signal processing

A lot of studios are in the arms race as far as outboard gadgets go, outboard equipment, and even recording gear—consoles and autolocate equipment—that are becoming so complex that it's beyond the one person in the studio who sequence of buttons does what, especially when it's simultaneous button depressions, memory recall points... it's just too much. I still like to this day cannot figure out the Studer Autorecorder, 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. 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...
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 Dyno-matic 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. This and now 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 digital 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, 441k 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 gone 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 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. That 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—mishapen waveforms and a kind of sluggishness to the sound that is compounded with each additional transfer—seemed to lift a bit with digital. Of course, taking programme material and multitrack down to those two little analogue tracks, cramping 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-disc-based, rather than tape-based, digital recording system which allows instant random access and 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 many 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...
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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 Catryse 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 6dB 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 microprocessor 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 sensations of soundwaves being converted by a 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 to find a 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 Jekclin 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 fact that the 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 propagation, 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% THD up to 120dB SPL, equivalent noise level 125dB 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 1869), 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 interframe intermodulation distortion (IIM) in power amplifiers (AES Preprint No 1869) and was presented by W Sansen, L Gheyselinck 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.

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 time delay 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 optimizing 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 Picherl 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 by 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 acquiring an accuracy of 1/2LSB 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 D/A 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 tape film for high density cartesian, 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 Hengsberg describing a special purpose digital hard-ware 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, mixing 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 final 2-channel professional digital audio sampling frequency converter was the next subject. This paper (AES Preprint No 1882) presented by Dr Roger Lagade, and Messers 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.

A further paper from Dr Lagade, 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.

A paper of considerable interest for the potential development of digital audio in the immediate future was presented by Isao Owaki, Susumu Saito and Shinya 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 alternator 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 synchronisation) produced by a 12-bit digital-to-analogue converter which is a result of comparison runs at 17.4cm/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.
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 hum, interference spikes, and there's an add-on PPM meter with LEDs to signal user-press 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 preset 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 to lower some levels as things are being heard.

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. It 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 Berkowitz 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 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. 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 is in the form of light pulses which send 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 electromagnetical interference. Because the carriage is by 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.

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 boosters. 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 10km, 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 laser or light transmitters that will operate at a faster rate. But even so, think of 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. This would 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-M225X audio cassette deck, with dbx circuits built-in, for just under £200. So what's special about that? Well it is 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 will 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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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 Fanshaw 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 Sin 'J', Ottawa, Ontario, Canada.

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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 gap 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 1/4in head at 7/8in/s (19.05 cm/s), a 10° azimuth error will lead to a loss of about 2.5dB at 4kHz and 1.1dB 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 \( \sin X \cdot 1/N \) 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 half 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 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
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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 fluxivites 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 dB = 20 log (F1/F2), but care must be exercised as different calibration tapes use different frequencies so that the producer’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 using the standard European fluxivity of 320nWb/m, thus giving compatibility between stereo and monophonic recordings.

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

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 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 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 tape.

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 PM6 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 equalisation standards 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 the corrections derived from Table 3.

As an example, if we have a 15in/s NAB 50 + 3,180nWb 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 2.7dB up (10.36 — 7.66) so that the CCIP/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 effect of 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 MRA ‘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 4in 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, 4.5dB, 5.5dB and 6.5dB respectively.
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TABLE 3

<table>
<thead>
<tr>
<th>Time constant</th>
<th>Frequency (Hz)</th>
<th>17.5/s</th>
<th>35/s</th>
<th>50 &amp; 318/s</th>
<th>70/s</th>
<th>70 &amp; 318/s &amp; 100/s</th>
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<td>-1.43dB</td>
<td>0dB</td>
<td>-4.08dB</td>
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<td>-0.04dB</td>
<td>0dB</td>
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<td>-0.25dB</td>
<td>+0.03dB</td>
<td>-0.23dB</td>
<td>0dB</td>
<td>-0.07dB</td>
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<td>-0.76dB</td>
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<td>-0.12dB</td>
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<td>+0.02dB</td>
<td>-0.07dB</td>
<td>+0.08dB</td>
<td>-0.06dB</td>
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<td>0dB</td>
<td>+0.17dB</td>
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<td>+0.31dB</td>
<td>0dB</td>
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<td>1,000</td>
<td>+0.05dB</td>
<td>+0.21dB</td>
<td>+0.40dB</td>
<td>+0.77dB</td>
<td>+0.01dB</td>
<td>0dB</td>
<td>+0.03dB</td>
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<td>+0.50dB</td>
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<td>+0.62dB</td>
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<td>+1.74dB</td>
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<td>2.0k</td>
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<td>+0.70dB</td>
<td>+1.44dB</td>
<td>+2.49dB</td>
<td>+2.49dB</td>
<td>0dB</td>
<td>+1.10dB</td>
<td>0dB</td>
<td>+5.14dB</td>
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<td>2.5k</td>
<td>+0.32dB</td>
<td>+1.15dB</td>
<td>+2.08dB</td>
<td>+3.44dB</td>
<td>+3.44dB</td>
<td>0dB</td>
<td>+1.74dB</td>
<td>0dB</td>
<td>+6.58dB</td>
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<tr>
<td>3.15k</td>
<td>+0.49dB</td>
<td>+1.70dB</td>
<td>+2.96dB</td>
<td>+4.65dB</td>
<td>+4.65dB</td>
<td>0dB</td>
<td>+2.49dB</td>
<td>0dB</td>
<td>+8.22dB</td>
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<td>4.0k</td>
<td>+0.71dB</td>
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<td>+4.11dB</td>
<td>+6.12dB</td>
<td>+6.12dB</td>
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<td>+3.15dB</td>
<td>0dB</td>
<td>+10.04dB</td>
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<td>+1.15dB</td>
<td>+3.44dB</td>
<td>+5.40dB</td>
<td>+7.66dB</td>
<td>+7.66dB</td>
<td>0dB</td>
<td>+4.08dB</td>
<td>0dB</td>
<td>+12.86dB</td>
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<tr>
<td>6.3k</td>
<td>+1.70dB</td>
<td>+4.65dB</td>
<td>+6.92dB</td>
<td>+9.38dB</td>
<td>+9.38dB</td>
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<td>0dB</td>
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<tr>
<td>8.0k</td>
<td>+2.49dB</td>
<td>+6.12dB</td>
<td>+8.64dB</td>
<td>+11.20dB</td>
<td>+11.20dB</td>
<td>0dB</td>
<td>+6.58dB</td>
<td>0dB</td>
<td>+17.32dB</td>
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<tr>
<td>10.0k</td>
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<td>+7.66dB</td>
<td>+10.36dB</td>
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<td>+13.08dB</td>
<td>0dB</td>
<td>+8.22dB</td>
<td>0dB</td>
<td>+19.32dB</td>
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<tr>
<td>12.5k</td>
<td>+4.61dB</td>
<td>+9.32dB</td>
<td>+12.15dB</td>
<td>+14.95dB</td>
<td>+14.95dB</td>
<td>0dB</td>
<td>+10.04dB</td>
<td>0dB</td>
<td>+21.10dB</td>
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</table>

TABLE 4

<table>
<thead>
<tr>
<th>Frequency (Hz)</th>
<th>30 in/s</th>
<th>75 in/s</th>
</tr>
</thead>
<tbody>
<tr>
<td>15 in/s</td>
<td>31.5</td>
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<td>125</td>
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<td>250</td>
<td>250</td>
<td>250</td>
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<td>500</td>
<td>500</td>
<td>500</td>
</tr>
<tr>
<td>1k</td>
<td>1k</td>
<td>500</td>
</tr>
<tr>
<td>4k</td>
<td>4k</td>
<td>2k</td>
</tr>
</tbody>
</table>

-0.8dB, +1.6dB and 0dB, whilst it is clear from Fig. 2 that the alignment of this head gap is a multiple of the recorded wavelength, a head gap, and the time constants in the table will show the gap loss at 15kHz.

The second most important result is that the gap loss is caused by the two heads being in contact, which results in a loss of 52.5% of a tape head-to-tape contact. This plots at Fig. 5 for a tape speed of 71.5 in/s and a tape speed of 15 in/s, it being seen that the latter has a much higher gap loss effect at short wavelengths.

Any attempt to manufacture short wavelength calibration tapes is to become impossible to account for 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 is 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 3 in/s) the recorded flux density does not correspond to the standards 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...
The BSS AR130 is a unique PHASE CHECK system that departs from the conventional unidirectional pulse method, with all its inherent inconsistencies. The AR130 utilises a continuous encoded-tone test system, that gives outstandingly consistent results in applications such as multiple driver speaker arrays, amplifier racks, multiways, etc.

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

**AGENTS:**
- **France:** Regis audio, Paris 374 56 96, Belgium: T.E.M. Brussels 369 16 21
- **Holland:** Amsco BV Utrecht 333 54, Germany: Audio Vertrieb GmbH Hamburg 524 51 54
- **Spain:** Jesus Distribuciones, Barcelona 234 40 44
- **Italy:** Pire Cie., Parma 408 144
- **Australia:** Audio Mix Systems, P.O. Box, Sydney 234 51 51
- **South Africa:** Colossus Acoustics, Johannesburg 234 51 51
- **Austria:** Bourke & Dissertori GmbH, Wels 452 42 714
- **Canada:** Ceri Electr. Acoustics, Toronto 860 52 46
- **América:** KlarkTeknik Inc., N.Y. 249 3660
- **Japan:** Matsuda Trading Co., Tokyo 255 3047
- **UK AGENTS:**
  - HHB Hire and Sales, London 916 3255, Scenic Sounds, 917 344 884, Maxi Laboratory 01 388 3292, Turnkey 01 481 9221, Wolfeum Acoustics 0706 68766, Ashgrove Sales 01 267 6677

**Brooke Siren Systems, 92 Coley Hatch Lane, London N10. Tel: 01 444 7892, Telex: 912881 BSSAUDIO**
equalisations as measuring techniques improve so that 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 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 the 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 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 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 3½in/s, and below, the ISO standard centre frequency is 315Hz, which has strictly replaced 133Hz 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

 TABLE 5 MANUFACTURERS' DATA

<table>
<thead>
<tr>
<th>Reference level (nWb/m)</th>
<th>30 in/s AES</th>
<th>15 in/s IEC</th>
<th>15 in/s NAB</th>
<th>7½ in/s IEC</th>
<th>7½ in/s NAB</th>
<th>3¼ in/s IEC</th>
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<tr>
<td>DIN</td>
<td>ANSI</td>
<td>ANSI</td>
<td>ANSI</td>
<td>ANSI</td>
<td>ANSI</td>
<td>ANSI</td>
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<tr>
<td>Accuracy (±)</td>
<td>±2%</td>
<td>±2%</td>
<td>±2%</td>
<td>±2%</td>
<td>±2%</td>
<td>±2%</td>
</tr>
<tr>
<td>Frequency accuracy</td>
<td>±3%</td>
<td>±2%</td>
<td>±3%</td>
<td>±3%</td>
<td>±3%</td>
<td>±3%</td>
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<tr>
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<td>&lt;1%</td>
<td>&lt;2%</td>
<td>&lt;1%</td>
<td>&lt;2%</td>
<td>&lt;1%</td>
<td>&lt;1%</td>
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<tr>
<td>Azimuth frequencies (Hz)</td>
<td>15kHz</td>
<td>700</td>
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<td>15kHz</td>
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<td>±1</td>
<td>±1</td>
<td>±1</td>
<td>±1</td>
<td>±1</td>
<td>±1</td>
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<td>Azimuth level</td>
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<td>0dB</td>
<td>0dB</td>
<td>0dB</td>
<td>0dB</td>
<td>0dB</td>
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<td>Frequency range (Hz)</td>
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<td>15k</td>
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<td>0dB</td>
<td>0dB</td>
<td>0dB</td>
<td>0dB</td>
<td>0dB</td>
<td>0dB</td>
</tr>
<tr>
<td>Accuracy to 4kHz</td>
<td>±5dB</td>
<td>±5dB</td>
<td>±5dB</td>
<td>±5dB</td>
<td>±5dB</td>
<td>±5dB</td>
</tr>
<tr>
<td>Accuracy to 10kHz</td>
<td>±10dB</td>
<td>±10dB</td>
<td>±10dB</td>
<td>±10dB</td>
<td>±10dB</td>
<td>±10dB</td>
</tr>
<tr>
<td>Accuracy overall</td>
<td>±20dB</td>
<td>±20dB</td>
<td>±20dB</td>
<td>±20dB</td>
<td>±20dB</td>
<td>±20dB</td>
</tr>
</tbody>
</table>

AGFA (West Germany)
AGFA-Gevaert AG, D-509 Leverkusen.
UK: AGFA Gevaert Ltd, 27 Great West Road, Brentford, Middlesex TW8 9AX.
USA: AGFA Gevaert Inc, 275 North Street, Teterboro, New Jersey 07608.

AMPEX (USA)
AMPEX Corp, 401 Broadway, Redwood City, CA 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, Haddington House, 2-4 Fitzroy Street, London W1P 5AD.
USA: BASF Systems Inc, Crosby Drive, Bedford, Mass 01730.

CAMFORD (UK)
Camford Productions, 4 Cambridge Drive, Eastcote, Ruislip, Middlesex HA4 9JS.

MRL (USA)
Magnetic Reference Library Inc, 229 Polaris Avenue, Suite 4, Mountain View, CA 94043.
UK: FWO Bausch Ltd, 49 Theobald Street, Boreham Wood, Herts WD6 4RZ.

STL (USA)
Standard Tape Lab Inc, 26120 Eden Landing Road, No 5, Hayward, CA 94545.
UK: Precision Audio Marketing, Bimini House, Christchurch Road, Virginia Water, Surrey.
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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 opinion. 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 case is to use the reference tape, which was recorded at the highest frequency at which there was a single spot 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 ±0.5dB 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 6. The results were then arranged to show the spread between tapes rather than attempt any absolute measurement. 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 Spin cine type spoons 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 7⅓/10 or 16kHz at 3⅓/10. The spot frequencies were at the standard ISO octave centre frequencies up to 8kHz, above which the standard ⅔-octave centre frequencies are employed. Spot frequencies from 4kHz upwards.

TABLE 6  MEASURED PERFORMANCE

<table>
<thead>
<tr>
<th>Relative fluxivity</th>
<th>Frequency</th>
<th>Third harmonic</th>
<th>30Hz</th>
<th>10kHz</th>
<th>15kHz</th>
<th>18kHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ampex 30 in/s AES</td>
<td>-0.1dB</td>
<td>698Hz</td>
<td>0.4%</td>
<td>-0.7</td>
<td>+0.7</td>
<td>+1.3</td>
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<tr>
<td>Ampex MRL</td>
<td>+0.0dB</td>
<td>1013Hz</td>
<td>0.22%</td>
<td>-0.7</td>
<td>+0.7</td>
<td>+0.4</td>
</tr>
<tr>
<td>Ampex STL</td>
<td>+0.5dB</td>
<td>699 8Hz</td>
<td>0.25%</td>
<td>-2.0</td>
<td>+0.5</td>
<td>+0.5</td>
</tr>
<tr>
<td>BASF MRL</td>
<td>-0.2dB</td>
<td>698Hz</td>
<td>0.63%</td>
<td>+2.0</td>
<td>-0.5</td>
<td>-0.8</td>
</tr>
<tr>
<td>BASF STL</td>
<td>-0.4dB</td>
<td>1002Hz</td>
<td>1.0%</td>
<td>+1.0</td>
<td>+0.3</td>
<td>+0.4</td>
</tr>
<tr>
<td>BASF</td>
<td>+0.0dB</td>
<td>994 8Hz</td>
<td>0.63%</td>
<td>+1.4</td>
<td>-0.8</td>
<td>+0.2</td>
</tr>
<tr>
<td>Camford 30 in/s</td>
<td>-0.8dB</td>
<td>994 8Hz</td>
<td>&lt;0.1%</td>
<td>+2.0</td>
<td>-0.2</td>
<td>+1.4</td>
</tr>
<tr>
<td>BASF MRL</td>
<td>+0.3dB</td>
<td>1005Hz</td>
<td>0.45%</td>
<td>+0.5</td>
<td>-0.6</td>
<td>-1.1</td>
</tr>
<tr>
<td>BASF STL</td>
<td>-0.4dB</td>
<td>699Hz</td>
<td>&lt;0.1%</td>
<td>+2.0</td>
<td>-0.2</td>
<td>-1.4</td>
</tr>
<tr>
<td>BASF</td>
<td>+0.5dB</td>
<td>1003Hz</td>
<td>0.8%</td>
<td>-0.2</td>
<td>+1.9</td>
<td>+0.7</td>
</tr>
<tr>
<td>BASF</td>
<td>+0.7dB</td>
<td>992Hz</td>
<td>0.45%</td>
<td>+0.8</td>
<td>-1.6</td>
<td>-0.2</td>
</tr>
<tr>
<td>Camford 7½ in/s</td>
<td>+0.4dB</td>
<td>1000Hz</td>
<td>1.3%</td>
<td>+0.7</td>
<td>-0.6</td>
<td>-1.5</td>
</tr>
<tr>
<td>BASF</td>
<td>+0.0dB</td>
<td>1002Hz</td>
<td>1.0%</td>
<td>+0.4</td>
<td>+1.2</td>
<td>+1.0</td>
</tr>
<tr>
<td>BASF</td>
<td>+0.5dB</td>
<td>1013Hz</td>
<td>0.45%</td>
<td>-0.2</td>
<td>+1.2</td>
<td>+1.0</td>
</tr>
<tr>
<td>BASF</td>
<td>+0.6dB</td>
<td>704Hz</td>
<td>0.32%</td>
<td>+0.8</td>
<td>-0.5</td>
<td>-0.5</td>
</tr>
<tr>
<td>BASF</td>
<td>+0.8dB</td>
<td>335Hz</td>
<td>1.0%</td>
<td>+0.3</td>
<td>-0.1</td>
<td>+0.2</td>
</tr>
<tr>
<td>BASF</td>
<td>+0.9dB</td>
<td>316Hz</td>
<td>0.32%</td>
<td>-0.2</td>
<td>0</td>
<td>-0.3</td>
</tr>
<tr>
<td>BASF</td>
<td>+1.0dB</td>
<td>324Hz</td>
<td>1.0%</td>
<td>+0.3</td>
<td>-0.1</td>
<td>+0.2</td>
</tr>
<tr>
<td>BASF</td>
<td>+1.0dB</td>
<td>316Hz</td>
<td>0.32%</td>
<td>-0.2</td>
<td>0</td>
<td>-0.3</td>
</tr>
</tbody>
</table>

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We've cut a slot along the windscreen.
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- L.E.D. indicator of Limiter action.
- 18dB/Octave HP Filter — 30Hz cut-off frequency.
- LF and HS XLR output socket unbalanced.
- Power supply from either S600M or S300M.

---

**CLXF**

Compressor Limiter, Crossover, High Pass Filter Module.

- XLR Input electronically balanced.
- Variable threshold Compressor Limiter.
- L.E.D. indicator of Limiter action.
- 18dB/Octave HP Filter — 30Hz cut-off frequency.
- LF and HS XLR output socket unbalanced.
- Power supply from either S600M or S300M.

---

**SCLF**

Stereo Compressor Limiter, High Pass Filter Module.

- XLR Inputs electronically balanced.
- Variable threshold Compressor Limiters.
- L.E.D. indication of Limiter action.
- 18dB/Octave HP Filters — 30Hz cut-off frequency.
- XLR output sockets unbalanced.
- Power supply from either S600M or S300M.

S600M power o/p 2 x 300w 4 ohms
S300M power o/p 2 x 150w 4 ohms
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 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 AEGB 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 hub to effectively increase the hub diameter for the calibration tape.

At the start of the tape there is a non-magnetic leader followed by 30s of nominal 3kHz tone for checking wow and flutter. This is followed by 30s of a transverse tape primed with stroboscopic light 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 the initial 10kHz for 7in/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 tape showed these to be typical errors such that the tape ran 0.6% slow with 50Hz illumination. This feature was confirmed by measurements on a recorder and also measurement of the strobe line spacing with a travelling microscope.

Waves and flutter on testing sections on the two tapes gave a 5°C 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 spot drops occurring at medium frequencies.

**MRL**
All MRL calibration tapes were supplied wound tall 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 adjustment levels of 500Hz, 8kHz and 16kHz each of 20s duration.

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

Following the azimuth section the spot frequencies proceed upwards from 31.5kHz 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 7in/s tape, or at reference fluxivity at the higher speeds.

The frequencies on the 30in/s and 7in/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 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 tapes 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

---

**USEFUL FORMULAE**

a) Wavelength of a recorded sinewave:

\[ \lambda = \frac{v}{f} \]

Where \( v \) is the tape speed and \( f \) the frequency.

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

\[ \text{Loss (dB)} = 56 - 6SL \]

Where \( S \) is the head to tape separation and \( L \) the recorded wavelength in the same units.

c) Transition frequency in equalisation:

\[ f = \frac{1}{2} \times (x + 1) \]

Where \( t \) is the time constant in seconds.

d) Gain loss of equalisation curve:

\[ G(dB) = 20 \times \log \frac{f + 1}{f + 2} \]

Where \( f \) is the desired frequency, \( x \) the higher transition frequency and \( f \) the lower transition frequency.

e) Gap loss

\[ \text{Loss} = \frac{\sin(x/n)}{x/n} \]

Where \( s \) is the effective gap and \( n \) the recorded wavelength in the same units.

f) Azimuth loss

\[ \text{Azimuth loss} = \frac{\sin(x/n)}{x/n} \]

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

---

**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 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 sensitive to gauss and may require the use of a bulk eraser for proper degaussing.

3. Any residual magnetism in a machine will first start to erase the short wavelength sections of calibration tapes.

4. Never wind calibration tapes at high speeds. If a contoured spool is rewound it is best to run to the end of the tape, turn it over, and rewind in a high speed play mode.

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

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

7. Tape should be stored away from magnetic fields away from heaters, boilers, hot pipes, etc. The spool should be stored in a vertical position.

76 STUDIO SOUND, JUNE 1982

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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 -30dB 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 ¼ in 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: ¼ in 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: 20kΩ.
Meter: taut band moving coil movement scaled -20dB to +2dB.
Power requirements: 240/110VAC at 5VA.
Size: (whd) 6¾ x 2½ x 5¼ in; 175 x 67 x 127mm.
Weight: 2¾ lb (approx) 1.3kg.
Manufacturer: Bulgin Electronics Soundex Ltd, Park Lane, Broxbourne, Herts EN10 7NJ.

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 18.20Ω 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 602.40 - more than adequately accurate.

Common mode rejection of the input varied...
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Webber Test Tapes are produced by studio engineers for studio engineers. They are manufactured in England on Europe's finest studio tape machines. Each test tape is a master individually calibrated during its manufacture, the results being constantly monitored for uniformity and slitting accuracy.

The format and tone durations are of convenient length for speedy, day to day machine alignment.

<table>
<thead>
<tr>
<th>Tape (INS)</th>
<th>Width (MM)</th>
<th>Tape (IN/S)</th>
<th>Speed (MM/S)</th>
<th>EQ NAB</th>
<th>Fluxivity (Wb/M)</th>
<th>Fluxivity (Wb/M)</th>
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</thead>
<tbody>
<tr>
<td>1/4</td>
<td>6.3</td>
<td>7 1/2</td>
<td>190</td>
<td>200</td>
<td>200 or 320</td>
<td>200 or 320</td>
</tr>
<tr>
<td>1/2</td>
<td>12.5</td>
<td>7 1/2</td>
<td>190</td>
<td>200</td>
<td>200 or 320</td>
<td>200 or 320</td>
</tr>
<tr>
<td>1</td>
<td>25</td>
<td>7 1/2</td>
<td>190</td>
<td>200</td>
<td>200 or 320</td>
<td>200 or 320</td>
</tr>
<tr>
<td>2</td>
<td>50</td>
<td>15</td>
<td>380</td>
<td>NAB</td>
<td>200 or 320</td>
<td>200 or 320</td>
</tr>
</tbody>
</table>

Other tape configurations are available by request. All Webber Test Tapes are recorded across the full width of the tape and each Test Tape is supplied with a Specification Chart and a line up procedure leaflet.

Distributed by: SCENIC SOUNDS EQUIPMENT LTD., 97/99, Dean Street, London, W.1.
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Tel: 01-889 9347 Telex: 266170 DIGWEB

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Current Equipment Available includes:

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Daily Rate</th>
</tr>
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<tr>
<td>STUDER A80 MkII 24tk</td>
<td>£125.00</td>
</tr>
<tr>
<td>STUDER A80 RC 1/4&quot; STEREO</td>
<td>May be supplied as 16tk, 8tk - 7 1/2/15 or 15/30ips £275.00</td>
</tr>
<tr>
<td>SONY PCM 1610 + BVU200B</td>
<td>Stereo Digital Recording System £275.00</td>
</tr>
<tr>
<td>AUDIO KINETICS Q LOCK 210</td>
<td>Various Interfaces for Audio/Video Equip. £60.00</td>
</tr>
<tr>
<td>DOLBY M24 NOISE REDUCTION</td>
<td>XLR Interface £60.00</td>
</tr>
<tr>
<td>DOLBY A361 NOISE REDUCTION</td>
<td>£15.00</td>
</tr>
</tbody>
</table>

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widely with the selected measuring range, on the
-10dB, -20dB and -30dB ranges being 30dB 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 30kHz 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
10kΩ" was the meter indication with output
correlation at 5V RMS output with the
source impedance being 10 kΩ.

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 1
<table>
<thead>
<tr>
<th>Actual input</th>
<th>Indicated Input</th>
</tr>
</thead>
<tbody>
<tr>
<td>-50dBm</td>
<td>-50.3dBm</td>
</tr>
<tr>
<td>-60dBm</td>
<td>-60.6dBm</td>
</tr>
<tr>
<td>-70dBm</td>
<td>-71.5dBm</td>
</tr>
<tr>
<td>-80dBm</td>
<td>-83.0dBm</td>
</tr>
</tbody>
</table>

TABLE 2
<table>
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<tr>
<th>Burst length (ms)</th>
<th>1</th>
<th>2</th>
<th>5</th>
<th>10</th>
<th>20</th>
<th>50</th>
<th>100</th>
<th>200</th>
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</thead>
<tbody>
<tr>
<td>Reading (dB)</td>
<td>-16.0</td>
<td>-12.0</td>
<td>-8.0</td>
<td>-6.5</td>
<td>-5.8</td>
<td>-4.8</td>
<td>-3.2</td>
<td>-1.6</td>
</tr>
<tr>
<td>Specification max</td>
<td>-17.4</td>
<td>-13.0</td>
<td>-9.3</td>
<td>-7.7</td>
<td>-7.1</td>
<td>-6.0</td>
<td>-4.7</td>
<td>-3.3</td>
</tr>
<tr>
<td>Specification min</td>
<td>-13.4</td>
<td>-10.0</td>
<td>-6.6</td>
<td>-5.2</td>
<td>-4.4</td>
<td>-3.3</td>
<td>-2.2</td>
<td>-0.7</td>
</tr>
</tbody>
</table>

TABLE 3
<table>
<thead>
<tr>
<th>Repetition Frequency</th>
<th>2Hz</th>
<th>10Hz</th>
<th>100Hz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading (dB)</td>
<td>-7.3</td>
<td>-2.6</td>
<td>-0.3</td>
</tr>
<tr>
<td>Specification</td>
<td>-7.3</td>
<td>-2.6</td>
<td>-0.3</td>
</tr>
</tbody>
</table>

FIG.1
SOUNDex AMM200,
FREQUENCY RESPONSE - AMPLIFIER OUTPUT

FIG.2
SOUNDex AMM200,
CCIR-WEIGHTED RESPONSE

BROADCAST MONITOR RECEIVER 150kHz-30MHz

APRS STAND 35

We have taken the synthesised all mode FRG7700M communications receiver and made several well thought out modifications to provide a receiver for rebroadcast purposes or checking transmitter performance as well as being suited to communications use and news gathering from international short wave stations.

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Audio Systems Ltd
Professional Film Recording Equipment Purchased
Equipment for Sale

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nagra IV S, Mint</td>
<td>£2500</td>
</tr>
<tr>
<td>Nagra SNN, Mint</td>
<td>£750</td>
</tr>
<tr>
<td>Nagra SOLO, Mint</td>
<td>£750</td>
</tr>
<tr>
<td>Nagra Mix BMT-3, New</td>
<td>£200</td>
</tr>
<tr>
<td>Nagra R S-L, New, 3 available</td>
<td>£2100</td>
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<tr>
<td>Nagra R S, New (non sync)</td>
<td>£1600</td>
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<tr>
<td>Nagra IV S-J, Mint</td>
<td>£2200</td>
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<tr>
<td>Nagra E Pola, Mint</td>
<td>£1500</td>
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<tr>
<td>Westrex 10mm Recorder</td>
<td>£2500</td>
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<td>Westrex 35mm Recorder Valve</td>
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<tr>
<td>RCA Optical PM80A 16mm</td>
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<tr>
<td>RCA SUNBURY 16/35mm Replay</td>
<td>£2500</td>
</tr>
<tr>
<td>RCA 99 Replay</td>
<td>£1250</td>
</tr>
<tr>
<td>RCA 86 Mechanisms only</td>
<td>£250</td>
</tr>
<tr>
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<td>“Rock and Roll”, completely reconditioned</td>
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Tel.: 01-908 4008

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For further information on this service please contact Ben Bernfeld

c/o harmonia mundi acustica
In den Sigristmatten 6
D-7600 Freiburg (West Germany)

Phone: +49761-491506 or -41399
Telex: 772552 ema d (West Germany)

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The 9th Course in the Series will be held September 11-17, 1982, Surrey University

The purpose of the course is to provide information on a wide range of technical subjects relating to recording operations and by bringing together engineers of differing skills and specialties from all over the world, create a forum for interactive discussion in the exchange of ideas and experience.

Prospectus from:

APRS
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Chorleywood, Herts. U.K.
Telephone: 09237 72907

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An informal exhibition of Sound Equipment for broadcasters.
Tuesday, 28th September, 1982
in Birmingham.
Details from:

Audio & Design (Recording) Ltd.,
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Advertisements for this section must be pre-paid. The rate is 35p per word, minimum £8.75. Box Nos. £1.50 extra. Semi-display rates on application. Copy and remittance for advertisements in AUGUST issue must reach these offices by 9th JUNE addressed to: The Advertisement Manager, Studio Sound, Link House, Dingwall Avenue, Croydon CR9 2TA.

Note: Advertisement copy must be clearly printed in block capitals or typewritten. Replies to Box Nos. should be addressed to the Advertisement Manager, Studio Sound, Link House, Dingwall Avenue, Croydon CR9 2TA, and the Box No. quoted on the outside of the envelope. The district after Box No. indicates its locality. SEX DISCRIMINATION ACT 1975: No job advertisement which indicates or can reasonably be understood as indicating an intention to discriminate on grounds of sex (e.g. by inviting applications only from males or only from females) may be accepted, unless (1) the job is for the purpose of a private household or (2) it is in a business employing less than six persons or (3) it is otherwise excepted from the requirements of the Sex Discrimination Act. A statement must be made at the time the advertisement is placed saying which of the exceptions in the Act is considered to apply.

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Sony ECM 150 mics. £15. Tel. 0455-47298.

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One MCI ⅜ " 2 track Tape Recorder... 2,500 o.n.o.
Please contact Norma 01-438 9451 (11am-6.30pm)
Delivery can be arranged.

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Don't turn away sessions because your engineers are on vacation, ill or overworked. Do call one of the most experienced and versatile freelance engineers in the business.

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There are normally about six or seven students on each course and everyone is tutored to their own level and with regard to their own particular interest. The cost is £98 including hotel accommodation. For more details phone 01-980 4750.

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London Weekend Television
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