broadcast sound

November / December 1982 £1

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National Public Radio

The Producer Package

The New Series 1600 + the SCM 762 Multi-Track.

The Series 1600 offers 4 mainframe configurations with 16 track monitoring: 16, 24, 32 channel and, as featured, 24 channel with patchbay.

This format is wired for 24 track interface and the patchbay also accesses 32 external signal processors.

The SCM 762 is a fully professional 2 inch recorder which may be ordered as a 16 track, 16 track prewired 24, or as a 24 track machine, each of which has the option of a nine memory autolocator.

The Producer Package from Soundcraft – The Innovators.

Soundcraft

Soundcraft Electronics Limited,
5-8 Great Sutton Street, London, EC1V 0BX, England.
Telephone: 01-251 3631 and 251 0581. Telex: 21198.

Soundcraft Inc.,
20610 Manhattan Place, Suite 120,
Torrance, California 90501, USA.
Telephone: (213) 328 2595. Telex: 182499.

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Printed in England

A LINK HOUSE PUBLICATION

broadcast sound

Cover:
The Fairfield Halls, Croydon—not a million miles away from our editorial offices—form the backdrop to our front cover, illustrating an apocryphal radio interview street scene. Apart from the human flotsam culled from the editorial offices by Rent-a-crowd, focus of attention is the Sony *TC-D5PRO* portable cassette recorder which Hugh Ford reviews in this issue. Associated goodies on display (other than our new *Broadcast Sound* secretary) include the recently introduced AKG *K4* dynamic/electrostatic headphones which we will be reviewing in the next issue, and nuzzling below its appropriately autumnal brown windshield, a Shure *SM63* omnidirectional dynamic microphone.
Photography: David Darby.

Compact Disc

On show at the International Broadcasting Convention in Brighton, and discussed in greater detail in our convention report and new products sections of this issue, was an item of equipment which could have considerable impact on sound in broadcasting. The unit in question was a professional *Compact Disc* player and associated analyser unit from Sony. By itself this unit would not be over remarkable, however, taken within the context of the launch of consumer CD players in Japan in November (with Europe following in Spring 1983), this makes available to broadcasters a new medium for high quality prerecorded music.

Philips, who together with Sony are co-sponsors of the *Compact Disc* format, inform us that within the first year of the players being marketed some 300 to 500 CD titles will be available through Polygram Records. Of these roughly two-thirds are scheduled to be pop-light music, with the remaining third being classical releases. Whilst not all these will be digitally recorded, several of the releases will be from analogue master tapes, the increased dynamic range, the in-built programming and indexing coding, the lack of wow and flutter, surface noise, wear, distortion, rumble, clicks and locked grooves, offer great potential to broadcasters as a high quality prerecorded music source.

Undoubtedly, a prime use for *Compact Disc* will be in radio broadcasting. However, before chief engineers rush to place their orders for playback units and vast quantities of discs, two words of warning. Firstly, availability. It is likely that with only one CD pressing plant currently in production (in Hanover), that the discs will only be available in small quantities. Thus, actually obtaining pressings could be a considerable problem. Also there is likely to be limited availability of the professional players themselves in the initial phase of the launch of *Compact Disc*. Whether broadcasters could get by in the meantime by using consumer players remains to been seen, however, I would anticipate that any pitfalls involved in using consumer players would be more operational than technical in nature.

The second problem area is dynamic range. Although early CD pressings are unlikely to offer the full dynamic range capabilities of the format, it is still likely that unless *Compact Disc's* are broadcast with compression and limiting, signals received over air will have quiet passages hidden by transmission noise and with peak signals giving distortion. Clearly in this area some careful thought will have to be given to the audio levels to be broadcast, with probably only operational experience giving the full answer. Depsite these potential problems, though, *Compact Disc* could open up a new era in sound broadcasting.

Subscriptions

Readers will notice that this issue includes a subscription card insert opposite page 18. We ask any reader who has already completed a subscription card to ignore the insert, but ask anyone who has not returned a subscription card, to complete it and return it to us, to ensure that they continue receiving copies of *Broadcast Sound*.

Noel Bell

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TRIMIX

Trident Audio are proud to announce their new range of expandable consoles: Trimix.

Trimix offers all the previous features of the well established Fleximix system, plus more facilities at a similar price

Trimix features

- Compact size: Each mainframe housing up to 24 modules measures only 40'' wide.
- Any module can be placed anywhere in the mainframe allowing 'ergonomic tailoring' to customer's requirements.
- 4 band equalisation on each input plus 60 Hz filter and EQ bypass.
- 4 auxiliary sends, each switchable pre or post fader.
- Separate mic and line gain controls.
- Precision five L.E.D. level indicator on each input module.
- Eight group outputs plus separate stereo master outputs.
- Long throw conductive plastic faders on both inputs and outputs.
- Comprehensive monitoring facilities including monitor pan, monitor level and mute for each group output/machine return.
- Full sub-grouping facilities.
- V.U. metering as standard, L.E.D. column P.P.M.'s available as an option.
- Can be 'Fadex' automated at any time.
- Frames can be joined together both electrically and mechanically to make larger systems.
- Eight way monitor module available to provide sixteen track monitoring.
- Integral patchbay available.

Trident Worldwide Representation:

U.S.A. Studio Maintenance Services, Los Angeles. Tel: 213-877-3311
Wilson Audio Sales, Nashville. Tel: 615-794-0155
Trident (U.S.A.) Inc., 652 Glenbrook Road, Stamford, Connecticut 06906 U.S.A. Tel: 203-357-8337

Australia John Barry Group, Sydney. Tel: 2-439-6955

Belgium A.S.C. Professional Audio Consultants, Brussels. Tel: 2-520-0827

Canada Heint Electronics Inc., Markham, Ontario. Tel: 416-495-0688

France Lazare Electronics, Paris. Tel: 1-878-62-10

Holland Dick Swaneveld, Hilversum. Tel: 35-17722

India Kapco Sound Studio, New Delhi. Tel: 43718

New Zealand Mandrill Recording Studios, Auckland. Tel: 9-793222

Norway Protechnic A.S., Oslo. Tel: 2-46-05-54

S Africa Leephy (Pty) Ltd., Blairgowrie 2194, Johannesburg. Tel: 11-789 2424

Sweden Stage & Studio, Gothenburg. Tel: 31-22-40-90

Taiwan Linfair Engineering & Trading Ltd., Taipei. Tel: 3214454-7

Trident Audio Developments Ltd.
Shepperton Studio Centre,
Post No. 38, Studios Road,
Shepperton, Middx. TW17 0QD, U.K.
Tel: Chertsey (09328) 60241.
Tlx: 8813982 (TRIMIX G).
Contact: Steve Gunn.

TRIDENT

News

NOS OB vehicles. Inset: interior view with Neve 8108 console.

NOS OB vehicles

Neve has announced completion of a major turnkey project for the Dutch broadcast organisation NOS, (Nederlandse Omroep Stichting). The project which involved three large OB vehicles was completed in July this year with the commissioning of the final pair of vehicles. The vehicles which are based on Mercedes chassis comprise one vehicle for TV usage with the others being for radio. All the vehicles were fitted out by Neve with a large range of equipment and each houses a Neve *8108* 48 channel/32 track console. Neve *8108* consoles are used by NOS as standard, and their incorporation within the new OB vehicles was a matter of policy. NOS now possess a total of nine *8108* consoles, three of which are fitted with the Neve *Necam* automation system.

Anglo/Dutch co-operation on this turnkey project involved Neve in working to the detailed requirements of an NOS designed master layout plan for the vehicles, plus working in conjuction with local coach builders who had been commissioned by NOS. The NOS plan dictated a considerable amount of custom building by Neve, who not only designed and constructed the electronics, but also the fitments and housings for them, the intercom system, the complex cabling, and extensive terminal and connection panels—including an *XLR* patchpanel with over 500 connectors.

Equipment installed in the vehicles included Studer *A80RC* and *A800* tape machines with *Telecom* noise reduction; Studer *TLS 2000* synchronisers; Lexicon *224* digital reverbs and *Model 122* digital delay lines; Telefunken *M15A* stereo tape machines (with Neve custom built tape fader and monitor unit); Barth *Dynaset* comp/limiters; Klark-Teknik *DN27* graphic equalisers; Valley People *Kepex* noise gates; Crown, Dynacord and HH power amplifiers; Philips FM stereo tuners and colour TV monitors; Sony *Trinitron* TV monitors; Technics FM stereo tuners and cassette decks; NTP phase meters; Aston timecode readers; a Michael Cox video switcher; and Klein & Hummel active monitor loudspeakers. Neve also installed its own distribution amplifiers and its *33609* comp/limiters, plus custom designed powered cable reels.

IBA Technical Review

Fresh from the pens of the men in the know comes the 19th in the series of *IBA Technical Reviews* containing seven articles describing engineering training facilities available within independent broadcasting. The articles which also cover the philosophy behind the courses, detail the training of IBA transmitter engineers at the Harman Engineering Training College and at the Newcastle upon Tyne Polytechnic; the training facilities for broadcast production engineers at Thames Television, Leeds Polytechnic, and the Ravensbourne College of Art and Design; IBA residential and remote training schemes; and studio operations and maintenance training at The National Broadcasting School. Ideally suited as a overview and introduction to anyone who intends making a career in broadcasting this issue of the *IBA Technical Review* is available, to individuals or to technical libraries and educational centres, free of charge from: **The IBA Engineering Information Service, Crawley Court, Winchester, Hants SO21 2QA, UK. Phone: 0962 822444.**

Technical Projects

In order to more closely reflect its broad base of work in the film, broadcast and recording industries, Theatre Projects Services Ltd has changed the name of its Special Projects Group to Technical Projects. Technical Projects will encompass electronic design, manufacturing and installation projects, with retail sales of sound and lighting equipment remaining under the banner of Theatre Projects Services.

In pursuing its goal of becoming a major force in the electronics entertainment industry, Technical Projects will combine the skills and experience of MJS Electronics in broadcast and test equipment design with the capabilities of the Theatre Projects team. The combined resources available, along with the teams' custom-design approach, makes Technical Projects capable of supplying almost any equipment need in audio electronics for the entertainment industry, from the largest television studio to the smallest radio production facility.

Technical Projects standard products include broadcast consoles; wired and wireless intercom systems; a distribution amplifier system; direct injection boxes and other interface products; *Multipan*, a unique multichannel, programmable, memory panning system, and the industry standard MJS Electronics audio test sets. Custom manufacture has covered everything from a small news announcer console for Radio City through to a 60 channel, 32 group automated post-production console for Pinewood Studios, and OB vehicles for BRMB and Radio City.

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

FCC to be trimmed?

The US Senate voted in mid-August to trim the size of the Federal Communications Commission from seven members to five, in a proposal which forms part of the Senate's 1983 Budget Reconciliation cost cutting package. Rationale for the proposal is that the majority of other regulatory commissions have five commissioners or less, while the move's proponents claim that the proposal will save taxpayers $3.1 million in 1983 and $500,000 per year from then on. The move which emanates from the Senate's Commerce Committee is contrary to the wishes of White House staff and FCC chairman Mark Fowler who claim that such a reduction would severely reduce the FCC's ability to maintain its workload. The proposal is now before the US House of Representatives.

Harris AM Stereo

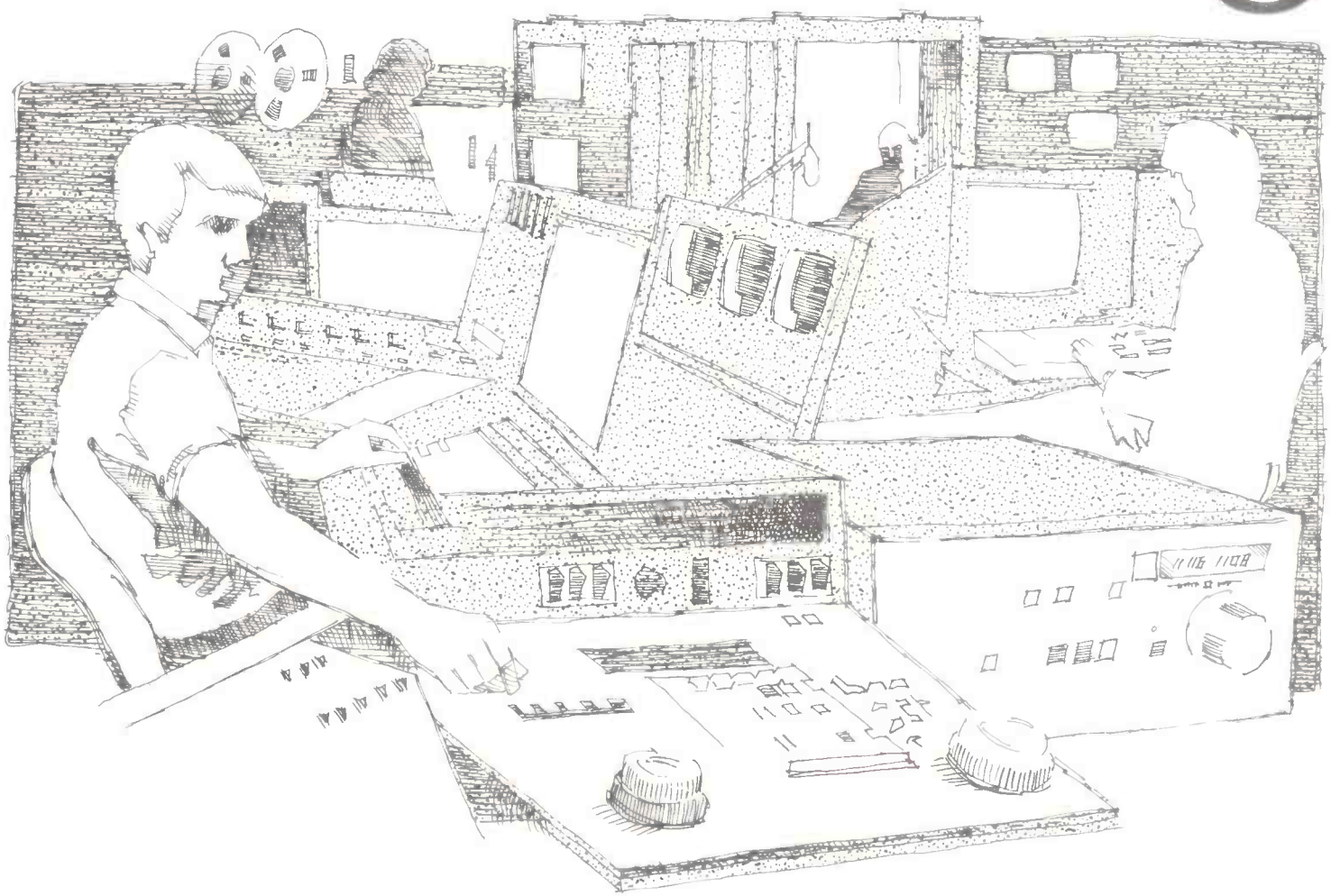
Following the granting of FCC approval for the on-air use of its *STX-1* AM stereo exciter in early August, the broadcast division of Harris has begun shipping units to radio stations. According to Gene Whicker, vice president/general manager of the division, Harris has firm orders for 111 stereo broadcasting systems from US and Canadian AM stations, plus a further 17 from overseas customers. A number of the stations have had this equipment on order for more than four years.

First station to go on-air with the Harris system was WQXI in Atlanta, Georgia, which commenced AM stereo broadcasting on August 6. At this station the *STX-1* operates in conjuction with a Continental *315R1* 5 kW transmitter and pair of Orban AM *Optimods* with polarity reversal defeated. The *Optimods* operate with a 10 to 20 dB boost at 10 kHz, the amount of boost being controlled by the programme content. WQXI operates on 790 kHz, with a non-directional daytime transmitter and a 4-tower directional array at night.

ILR News

- The IBA has received four applications for the contract to provide the ILR service for the Maidstone and Medway area. The applicant groups are: Double M Sounds Ltd; Mid-Kent Radio Ltd; Northdown Radio; and Pilgrim Sound. Each of these groups will be interviewed by the IBA in mid-October and it is anticipated that a decision on the successful contractor will be announced in November.
- Radio Wyvern, the Hereford and Worcester area ILR contractor is to commence broadcasting at 7 am on Monday, October 4. Radio Wyvern is the 35th ILR station to go on-air and will serve a potential listening population of 520,000. Initially the broadcasting hours will be from 6 am to 8 pm (Monday to Saturday) and 7 am to 8 pm (Sunday). Wyvern will broadcast on 196 metres (1530 kHz) MW and 96.2 MHz stereo VHF to the Worcester and Great Malvern area, and on 314 metres (954 kHz) MW and 95.8 MHz stereo VHF to the Hereford area.
- County Sound, the successful ILR contractor for the Guildford ILR franchise, has appointed David Lucas as its managing director. David is currently chief executive at CBC (Cardiff Broadcasting) and was previously programme controller at Swansea Sound, and prior to that a producer with Capital Radio. County Sound, which currently has studios under construction in the Friary Centre, Guildford, expects to go on-air in the first half of 1983.

Products for Broadcasting



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News

Radio West OBs

Tim Lyons, chief engineer of Bristol ILR station Radio West has provided us with details of a number of interesting outside broadcasts the station carried in August. During the week August 8 to 14, Radio West linked up with Boston radio station WRKO for an hour-a-day simulcast. The stations exchanged news editors for the week with Radio West's Mike Stewart co-presenting from Boston, and WRKO's Ed Walsh doing the same from Bristol. British Telecom International provided links via satellite and the audio bandwidth was approximately 6 kHz, this giving perfectly acceptable quality on VHF and making it virtually impossible for listeners on MW to discern which presenters were in Boston and which were in Bristol.

Subjects covered on the programmes ranged from the obvious exchange of views and questions between the presenters on the two stations, to phone-ins, in which callers on both sides of the Atlantic could talk to each other, or to guests in either studio. On one such programme the chief constable of Avon and Somerset Constabulary was able to discuss law and order with Boston's chief of police. This prompted a quick reaction from callers, and one Welsh caller amused American listeners by his explanation of the British system of driving licence endorsements—"...you get three and you win a bike..." Overall, the exercise proved very interesting, with the Friday programme linking Radio West, WRKO and the latter's Jerry Williams live, via satellite, from Tel Aviv, Israel.

Both stations have a maximum total audience of some one million people, and at the Radio West end, the link-up was set to coincide with Bristol's America Week celebrations. Interestingly, some advertising was sold on the basis of airtime in both Bristol *and* Boston.

Radio West intend repeating the link-up with an American station again next year. Almost small beer by comparison was a link-up with BFBS Gibraltar during the Dave Cash Radio Programme on Sunday, August 29. This was a fairly standard music and request programme, but again aroused considerable listener interest.

Radio Marti

Radio Marti, the US government-run radio station which will broadcast programmes to Cuba on 1040 kHz AM, has been authorised by the US House of Representatives. The new station which will have a budget of $7.5 million in 1983 for construction and operation, is to be overseen by the Board for International Broadcasting, the Federal agency which also oversees Radio Free Europe and Radio Liberty. The House voted down amendments that would have required Radio Marti to broadcast on short wave rather than AM or FM, thereby failing to take account of broadcaster's worries that Cuba will jam Radio Marti broadcasts and seriously interfere with US AM broadcasting. Since Cuban leader Fidel Castro has already indicated that Cuban jamming will take place if Radio Marti goes ahead, it was not surprising that on August 31 the Cubans jammed seven AM frequencies for two hours in the evening. As the opening shot in what could turn out to be an interesting battle of wits between the US Administration and Cuba, the jamming perhaps caused one or two 'we told you so' grins from broadcasters. However, no doubt eventually sanity will prevail and Radio Marti will be moved from 1040 kHz and kept clear of any frequency allocated to non-governmental radio broadcasting.

EDXC Conference 1983

The 1983 European DX Council Conference, the annual meeting point for international broadcasters, technical staff and DXers, is to be sponsored by Marconi Communication Systems Ltd. The conference which will be organised by a British shortwave listeners' club, the DX Association of Great Britain, will be hosted by BBC External Services and will be held from May 20 to 23, 1983 at the London Penta Hotel, Cromwell Road, Kensington, London. Further information on the conference is available from: **The European DX Council, PO Box 4, St Ives, Huntingdon, Cambs PE17 4FE, UK.**

Exhibitions

November 23 to 26, 1982
Professional Video Show, Wembley, UK.

January 24 to 28, 1983
Midem '83, Cannes, France.

February 22 to 24, 1983
Sound 83, London, UK.

March 15 to 18, 1983
AES 73rd Convention, Eindhoven, Holland.

April 10 to 13, 1983
NAB Convention, Las Vegas, USA.

May 28 to June 2, 1983
International Television Symposium, Montreux, Switzerland.

June 22 to 24, 1983
APRS Exhibition, London, UK.

October 9 to 12, 1983
AES 74th Convention, New York, USA.

Contracts

● The Industrial Acoustics Company Ltd has supplied a self-contained voiceover studio and control room to TV South in Southampton. The new studio which is located externally to the main studios and linked to them via an access tunnel was constructed from the company's *Noiselock* acoustic panels.

● Neve has received a number of broadcast contracts recently; in Australia, Television Channel 10 has ordered a *51 Series* console for its Sydney studios; the Egyptian Television and Broadcasting Federation has ordered 15 *51 Series* consoles, plus an *8108* 48-channel console; in the Netherlands, Bosch/Fernseh has placed the audio section of its NOS (Nederlandse Omroep Stichting) contract for five audio consoles with Neve; in Japan NHK (Nippon Hoso Kyoho) has ordered a *5116* 24-track console with *Necam* automation; TVE Spain, the Spanish national TV company, has ordered a *5106* 36-channel TV sound production console, plus four *5104* 16-channel consoles; and in the UK, TV-AM, the new breakfast television service contractor, has ordered two *51 Series* consoles and an audio turnkey package for its new studios in London.

● Kennet Refrigeration has supplied the IBA with over 30 *Prestair President 199* unitary air conditioners, manufactured by Temperature Ltd, to provide air conditioning for transmitter rooms serving ILR stations throughout the UK. The units maintain a steady room temperature of 68 °F, ±3 °F, thereby aiding transmitter reliability.

● Neve has received an order from the BBC to supply six stereo broadcast consoles for use in new local radio stations. The consoles which are based on the *5402* mixer have 16 channels with three subgroups.

● Racal has supplied two *Autostore* logging recorders to London Weekend Television. The recorders monitor direct sound output from the company's South Bank studios and off-air sound from remote transmitters.

● Standard Telephones and Cables (STC) is to supply British Telecom with new sound broadcast link equipment for the UK phone network. The new equipment operates over the digital phone network and utilises the BBC's *Nicam* system to carry up to six mono channels or three stereo channels on one dedicated 2048 kbit/s bit stream.

● Rank Cintel has supplied OBTF Egypt with *MkIIIC* flying-spot telecines and *FeRRIT* sound followers, plus a custom switching system and remote control and communication systems, in a deal worth just under £1 million.

● Swedish Radio has taken delivery of four Otari *MTR90* 24-track tape machines and three machines with 16-track heads prewired for 24-track. Swedish TV has also received two 24-track machines.

● The Harris Broadcast Division is to supply General Electric Broadcasting with four *FM-20K*, 20 kW FM transmitters, plus an *FMD-50* 50 kW FM transmitter for four of the Group's radio stations, KOAQ Denver, KFOG San Francisco, WSIX-FM Nashville and WGFM Schenectady, New York. Harris has also received a $6 million order from the Government of Thailand for 11 radio transmitters to extend the national radio system. These will comprise nine AM units, from 20 kW to 100 kW in power, and two 5 kW FM transmitters.

● CCL Associates has supplied Ampex *ATR-100* tape machines, a number of Neve sound consoles, plus equipment from EMT and AKG to the Ministry of Education of the Gulf State of Qatar.

● Rediffusion has supplied a 1 kW MF transmitter, a *BT1002*, to the British Forces Broadcasting Service to provide a second channel for British forces stationed in Cyprus.

Agencies

● Marconi Communication Systems Ltd has appointed Denis Tyler Ltd as its sales and liason representatives for the Democratic Socialist Republics of Eastern Europe.

● Telecommunications Ltd, the Philips antenna manufacturing company, has appointed Scannest Ltd as a stockist of its *Finglas* range of professional base station antennae. **Scannest Ltd, 49–51 Stanhope Road, Northampton NN2 6JU, UK. Phone: 0604 719901. Telex: 312517.**

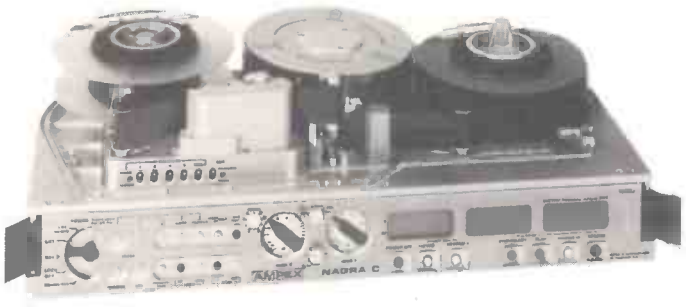
● EECO has appointed Custom Video Systems Inc of Seattle and Portland, Oregon; and Lerro Electrical Corp of Philadelphia as distributors of its range of timecode equipment.

People

● Edward Fritts has been elected president of NAB to succeed Vince Wasilewski. The new president-elect operates eight small radio stations in Arkansas, Kentucky, Louisiana and Mississippi, and was previously NAB Board Chairman.

● Clyde Price, president and general manager of WACT AM/FM, Tuscaloosa, Alabama, has joined the NAB's Radio Board of Directors as representative for District 5 which includes Alabama, Florida, Georgia, Puerto Rico and the Virgin Islands. He fills the seat vacated by William Stakelin, executive vice president of Bluegrass Broadcasting, Orlando, Florida, who was elected Joint Board Chairman in mid-August.

New products



Ampex/Nagra C/VPR-5

Probably the star exhibit at the International Broadcasting Convention was the introduction of the jointly developed Ampex/Nagra *C/VPR-5* C-format VTR. This machine which is the lightest portable battery operable VTR to come on the market, weighing in at a mere 6.8 kg, combines the audio know how of Nagra with the video expertise of Ampex. Produced in a compact $17\frac{1}{2} \times 8\frac{1}{2} \times 5\frac{1}{2}$ in and accepting $5\frac{1}{2}$ or 9in reels of Ampex tape for respectively 20 minute or one hour recording capacity, the new VTR is available in versions for either NTSC or PAL/SECAM. Purely apart from the video orientated features which include dual-cue editing, video camera interface modules, and a microprocessor controlled built-in character generator allowing selected character signals to be seen in the camera viewfinder—the audio technology includes such features as individual record control lockouts for two audio channels and a standard timecode channel; seven built-in switch selectable filters to match scene acoustics (particularly LF reverberation cancellation); a unique LCD display with selectable PPM or VU characteristics which will indicate AGC limiting simultaneoulsy with level readings; and a variety of interfaces to cater for various microphone and/or line inputs. Manual or AGC level control is switchable between mono, stereo or dual channel operation, and the AGC is of the peak compression type with user control of the limiting threshold.

Specifications of audio section: (specification based on a replay via an Ampex *VPR-2B* VTR) frequency response (ref 400 Hz, 100 nWb/m) ±1 dB, 500 Hz to 10 kHz, ±2 dB, 50 Hz to 15 kHz; S/N ratio with respect to 8 dB above ref level −56 dB (−50 dB timecode channel); distortion at 1 kHz, <1% at 100 nWb/m ref level (+8 dBm), <3% at 251 nWb/m peak level (+16 dBm); depth of erasure −70 dB; wow and flutter (NAB unweighted) 0.15% RMS; crosstalk at 1 kHz ref +8 dBm or 100 nWb/m, <−50 dB; nominal tape speed 9.6 in/s (NTSC version), 9.44 in/s (PAL/SECAM) version); audio equalisation 15 µs and 3180 µs (NTSC version), 15 µs (PAL/SECAM version); audio inputs—microphone (with optional interface) >150 µs into 200 Ω, maximum 40 dB above, line (with optional interface) nominal +8 dBm into 25 kΩ bridging, +24 dBm maximum, −20 dBm minimum; audio monitor outputs 1 V peak-to-peak unbalanced, 600 Ω (optional balanced or floating).

Ampex Corporation, Audio-Video Systems Division, 401 Broadway, Redwood City, Cal 94063, USA. Phone: (415) 367-2011. Telex: 348464.

UK: Ampex International, Acre Road, Reading RG2 1QR. Phone: 0734 875200. Telex: 847611.

Nagra Kudelski SA, CH-1033 Cheseaux-sur-Lausanne, Switzerland. Phone: 021 91.21.21. Telex: 24392.

Eventide broadcast DDLs

Making their debut at NAB were two new digital broadcast delay units from Eventide, the *BD931* mono DDL and the *BD932* stereo DDL. Designed as a low cost alternative to tape loop delay systems, the new units are available with either 3·2 s or 6·4 s of fixed delay, and use circuitry incorporating 64 Kbyte RAM chips for memory. Both units offer >90 dB of dynamic range with a bandwidth extending to 16 kHz.

Further news from Eventide is that its *BD955* range of broadcast delay units with auto catch-up feature has been reduced in price through the passing on by Eventide of price reductions to the RAM memory devices used in the units.

Eventide Clockworks Inc, 265 West 54th Street, New York, NY 10019, USA. Phone: (212) 581-9290. Telex: 710-581-2593.

UK: Feldon Audio Ltd, 126 Great Portland Street, London W1N 5PH. Phone: 01-580 4314. Telex: 28668.

New SCA generator

Displayed for the first time at IBC was the *Model FC-30* SCA generator from Broadcast Electronics. This unit which is designed to match the *Model FS-30* FM stereo generator, is a compact 1U 19 in rack unit suitable for mounting either in the FM transmitter cabinet or in a separate rack enclosure. The *FC-30* is suitable for either high performance audio or DC-coupled data transmission on a multiplexed carrier and uses a very low FM noise, highly stable, ultra-linear 67 kHz modulated oscillator to ensure minimum distortion. Subcarrier muting is adjustable over a 0.5 to 10 s range and is controlled by an advanced dual controlled-decay subcarrier attenuator which ensures noise free receiver muting. Other features of the *FC-30* include extensive RFI filtering to permit trouble free operation in high RF fields; front panel LED peak modulation indicators and control adjustment access; and memory logic which will retain the unit's operating mode for up to one hour, in the event of power interruption, automatically returning to operation when power is restored. The *FC-30* is designed for full remote control operation utilising a unique optically-isolated interface which accepts either positive or negative polarity control logic. Mode status outputs are also optically-isolated. A further feature is the provision of a front panel mounted subcarrier test jack for easy frequency measurement.

Specifications: subcarrier frequency 67 kHz (39 to 95 kHz to order); subcarrier frequency stability ±0.5%; subcarrier harmonic content <0.3%; subcarrier output level 0.5 to 4.0 V into 600 Ω peak-to-peak, adjustable; subcarrier output impedance 600 Ω unbalanced, resistive; subcarrier envelope decay >100 ms; modulation capability ±20% of subcarrier frequency; FM noise 72 dB below ±6 kHz deviation at 400 Hz with 150 µs de-emphasis; audio input impedance 600 Ω balanced, resistive; data input impedance 75 Ω unbalanced resistive, DC coupled; audio input level adjustable +10 to −10 dBm for ±6 kHz deviation at 400 Hz; data input level adjustable 1 to 4 V peak-to-peak for ±6 kHz deviation (DC coupled); pre-emphasis 150 µs standard, 75 µs with internal jumper; audio frequency response 10 Hz to 10 kHz, +0.5 dB exclusive of 4.3 kHz programmable active lowass filter fitted as standard (sixth order, −3 dB at 4.3 kHz); data frequency response DC to 10 kHz, +0.5 dB (audio lowpass filter may be bypassed in this mode); THD <0.5%, typically 0.06% at 1 kHz; crosstalk >−60 dB (SCA to stereo, below 100% modulation, 75 µs de-emphasis), >−50 dB (stereo to SCA, below ±6 kHz deviation of SCA using 150 µs de-emphasis and *FS-30* stereo generator); IM distortion <0.5%, typically 0.1%, auto muting level adjustable 10 to 30 dB below programme level; auto muting delay adjustable 0.5 to 10 s.

Broadcast Electronics Inc, 4100 N 24th Street, PO Box 3606, Quincy, Illinois 62305, USA. Phone: (217) 224-9600. Telex 250142.

UK: Lee Engineering Ltd, Napier House, Bridge Street, Walton-on-Thames, Surrey KT12 1AP. Phone: 09322 43124. Telex: 928475.

Symetrix TI-101

Symetrix has added the *TI-101* hybrid telephone interface unit to its range of audio signal processing equipment. This new telephone hybrid which is a 1U 19 in rack mount unit, has facilities for one incoming phone line and studio send with the capability of conference linking, whereby two units may be selectably linked together for conferencing two incoming lines simultaneously. Features of the *TI-101* include two band caller equalisation at 400 Hz and 2·5 kHz; send AGC with a user adjustable range control; receive AGC and a noise reduction expander for use on long distance calls; VCA controlled caller mute facility; LED clip indicators; mix-minus facility to obviate potential echoes caused by looping a callers voice through the audio console and hybrid back down the phone line; and back panel gain switches allowing operation with virtually any available console.

Symetrix Inc., 109 Bell Street, Seattle, Washington 98121, USA. Phone: (206) 624-5012.

New products

Audix MXT1200

Shown for the first time at this year's IBC Exhibition was the new *MXT1200* studio or OB sound mixer from Audix. This mixer which is a development from the successful *MXT1000* mixer, is a fully modular mixer available in table-top or console mounting versions, or as a special version as a self-op mixer. The mixer which may be configured to a wide variety of permutations, features mic/line or stereo/mono line input channels; two, four or eight output groups, with optional mix-down to two main outputs; two or four auxiliary outputs; VU or PPM metering; full monitor facilities including optional multitrack monitor mixdown; plus talkback and compressor/limiter modules. The *MXT1200* also features built-in power supplies on smaller configuration mixers.

Audix Ltd, Station Road, Wenden, Saffron Waldon, Essex CB11 4LG, UK. Phone: 0799 40888. Telex: 817444.

Electro-Voice monitor

Electro-Voice has announced the availability of a new broadcast and studio recording monitor loudspeaker, the *Sentry 500*. The monitor which is a constant directivity design utilises a 'super-dome' tweeter capable of handling 25 W inputs while faithfully reproducing programme material up to 18 kHz, the tweeter being coupled to an HF, dispersion controlling 'director'. This is used with a 30 cm direct radiator woofer in a vented enclosure with fourth-order Butterworth tuning. The *Sentry 500* has a frequency response extending from 40 Hz to 18 kHz ±3 dB; a power handling capacity of 100 W (400 W for 10 ms); and will deliver 96 dB SPL at 1 m on axis for a 1 W input. Crossover frequency is 1·5 kHz with coverage angles being 110° ±30° horizontal and vertical from 250 Hz to 10 kHz, and 60° ±15° from 10 kHz to 20 kHz. The monitor is housed in a scratch-resistant matt black vinyl cabinet measuring 603 × 686 × 330 mm (whd).

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

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

Melkuist Event Selector

Melkuist who are best known for the *GT 800* console automation system, have now come up with an events selector for synchronising sound in video post-production applications. The new unit which is a 19 in rack mount unit comprises 32 changeover relay contacts, which are user programmable to control external sound effects from open-reel tape or cartridge machines. The unit is synchronised by SMPTE timecode and is programmable such that up to 250 cue points can be programmed to switch any combination of contacts. As an additional feature comprehensive 'Freeze' mode facilities are included for the entry and modification of events for users who prefer not to work directly with SMPTE timecode.

Event entry is via a simple keyboard with timing of events being controlled by incrementally increasing the timecode display. The timecode value can also be individually trimmed. To ease editing of event sequences the unit can insert new events into the existing timecode, or exising events can be overwritten. The unit automatically amends the cue sequence. An optional facility provides automatic dumping of memory contents onto audio tape for storage.

Melkuist Ltd, 35a Guildford Street, Luton LU1 2NQ, UK. Phone: 0582 416028.

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

Enertec F500

Making its debut at IBC was a new 2-track tape machine from Enertec, the *F500*. This machine which bears a passing resemblance in its compact styling and facilities to the Lyrec *TR55*, is designed for general broadcast applications and is available in four versions: a console/trolley mounted version; 19 in rack mount version; a vertically orientated transport case version; and a horizontally orientated case version. Depending upon the version chosen the new recorder may be configured with or without VU meter panel, or with or without balanced transformer inputs/outputs.

A quick perusal of the machine's constructional and operative features at IBC, gave the impression that the *F500* is likely to find wide acceptance from broadcasters, as it is undoubtedly a well engineered machine with a number of useful features. These include three speed operation ($3\frac{3}{4}$, $7\frac{1}{2}$ and 15 in/s); the capability of accepting NAB, CCIR and Cine hubs; a tape counter display which indicates time for all speeds with the beginning always being memorised by the counter whatever the speed modifications; full remote control facilities including fader start and optionally all functions plus the tape counter display; and optional varispeed unit with a range of ± seven semitones. The tape transport utilises a phase locked loop with microprocessor control, this also ensuring constant tape tension control in all modes. Three separate EQ chains (one per speed) are available and the recorder is fitted with three separate bias adjustments with the facility that frequency response curves can be modified by HF equalisation for a variety of tape types. The *F500* is available in a number of formats including mono, mono/stereo compatible (0.75 and 2 mm), 2-track, 2-track with sync play, mono with *Neopilot* tone, stereo with *Synchrotone* code, and stereo with Nagra *IV S* code. As an additional facility all stereo machines are compatible for mono or stereo operation, allowing the recording and replay of mono tape without the need to modify output level.

Specifications: wow and flutter <0.15% ($3\frac{3}{4}$ in/s), <0.08% ($7\frac{1}{2}$ in/s), <0.06% (15 in/s); NAB or CCIR EQ; starting time <0.5 s for twice nominal wow and flutter; rewind time <100 s for 2,000 ft of tape; inputs >5 kΩ from 31.5 Hz to 20 kHz balanced input, 0 dB minimum level, +6 or +12 dB nominal level, +22 dB maximum; outputs load impedance >600 Ω, <50 Ω balanced output 31.5 Hz to 20 kHz, 0 db minimum level, +18 dB maximum; frequency response (record/replay) 60 Hz to 8 kHz ±1 dB ($3\frac{3}{4}$ in/s), 60 Hz to 12 kHz ±1 dB ($7\frac{1}{2}$ in/s), 60 Hz to 16 kHz ±1 dB (15 in/s), 40 Hz to 10 kHz ±2 dB ($3\frac{3}{4}$ in/s), 31.5 Hz to 16 kHz ±2 dB ($7\frac{1}{2}$ in/s), 31.5 Hz to 18 kHz ±2 dB (15 in/s); signal to noise ratio >52 dB to >63 dB ($3\frac{3}{4}$ in/s), >54 dB to >74 dB ($7\frac{1}{2}$ in/s), >56 dB to <74 dB (15 in/s)– dependent on track format, minimum 2-track 2 mm, maximum mono NAB standard; harmonic distortion <2% ($3\frac{3}{4}$ in/s), <1% ($7\frac{1}{2}$/15 in/s), CCIR 320 nWb/m, <3% ($3\frac{3}{4}$ in/s), <2% ($7\frac{1}{2}$/15 in/s), CCIR 510 nWb/m, <1.5% ($3\frac{3}{4}$ in/s), <1% ($7\frac{1}{2}$/15 in/s) NAB 185 nWb/m; crosstalk at 10 kHz >40 dB stereo, >46 dB 2-track; erasure >75 dB at 1 kHz.

Enertec SA, Dept Audio Professional, 226-296 Avenue Napoleon Bonaparte, F-92505 Reuil Malmaison Cedex, France. Phone: (1) 732.92.23. Telex: 203404.

UK: Crow of Reading Ltd, PO Box 36, Reading RG1 2NB. Phone: 0734 595025. Telex: 847056.

New products

Compact Disc for broadcasters

Making its first appearance at IBC was a professional *Compact Disc* playback and analysing system for broadcast and recording studio applications, from Sony. The system, which neatly ties in with the imminent launch of consumer playback units and the availability of the first discs themselves, comprises two units—the *CDP-5000* professional *Compact Disc* player, and the *CDA-5000* professional *Compact Disc* analyser.

The *CDP-5000* is a console type playback unit with a number of features aimed at giving broadcasters quick and accurate access capability to the discs with the added bonus of reliable and durable mechanics particularly configured for professional heavy duty usage. Main features of the *CDP-5000* include a minimum access time of 13.3 ms per audio time signal frame; rapid random access to any music selection within 2 s; a 10 key and search dial facility to access particular start or cueing points; and the use of mechanical, block and block mounting construction techniques to aid reliability and maintenance.

The accompanying *CDA-5000* analyser unit which is designed to interface with the player, incorporates a 9 in CRT display with in-built analyser and a special keyboard interface. This unit displays data prerecorded on the disc in real time and prints out information as required. Capabilities of the unit include indication of the total playing time of a disc; the start time of each music selection (equivalent to a table of contents); the checking of any subcode dropout or irregularity; the checking of any noise generated by the error rate; the checking of any mistracking of the disc's laser reader; indication of the contents of the subcodes; free selection of the data to be checked; and the capability of remote control of the *CDP-5000* player.

Specification CDP-5000: *Compact Disc* Philips/Sony system; quantisation 16-bit linear; sampling frequency 44.1 kHz; error correction CIRC format (25% redundancy); frequency modulation EFM format; playback frequency response 20 Hz to 20 kHz ±0.5 dB; maximum output level +19 dBm; dynamic range >94 dB; distortion <0.01%; wow and flutter undetectable; loudspeaker output level 1 W maximum (mono); headphone output 8 Ω (stereo).

Specification CDA-5000: 9 in green monitor display; ACSII-format keyboard section with 14 special keys for remote control and checking purposes; 16 k Bytes buffer memory available to hold up to 270 lines of data ready for printout; printer output Centronics style 8-bit parallel.

Sony Corporation, PO Box 10, Tokyo Airport, Tokyo 149, Japan. Phone: 03 448-2111. Telex: 22262/24666.

UK: Sony Broadcast Ltd, City Wall House, Basing View, Basingstoke, Hants RG21 2LA. Phone: 0256 55011. Telex: 858424.

USA: Sony Corporation of America, 9W 57th Street, New York, NY 10019. Phone: (212) 371-5800.

ASC Revox PR99

Audio Systems Components has produced a customised version of the Revox *PR99* 2-track tape machine configured particularly for broadcast users. Modications to the *PR99* include the removal of all control knobs, buttons and meters (except the headphone level control and tape transport controls—speed change buttons are optional); the fitting of a new front panel; replacement of the stereo headphone monitor socket with a GPO pattern socket; removal of the machine's case and the fitting of an access door to prevent 'pre-set' alignment twiddling; and the finishing of the modified case with a black scratch resistant finish. The ASC version of the *PR99* includes the standard ILR crosstalk modifications, and all the ASC version changes may be retro-fitted to any existing *PR99* machine.

Optional extras which may be fitted to the modified machine include retro-fit plug-in Repro-amplifiers with adjustments for EQ, both speeds, to accommodate headwear; and an H.MM.SS digital tape timer.

Audio Systems Components Ltd, 19 The Green, Theale, Berks RG7 5DR, UK. Phone: 0734 302108.

THE MELKUIST EVENT SELECTOR

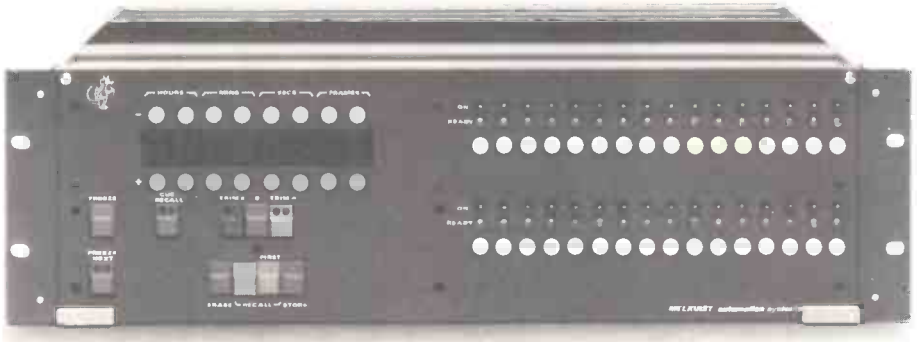
SETTING NEW STANDARDS FOR SYNCHRONISED SOUND

The Melkuist Event Selector is a SMPTE time code based event/cue storage system. Any combination of up to 32 relay contacts (events) can be programmed at up to 250 cue points. It is available as either a stand-alone unit or as an intelligent peripheral for the Melkuist GT800 mixing console automation system.

Easy to operate, versatile and accurate, the unit sets new standards for synchronised sound in video post-production.

Event entry is a simple push-button operation. New events can be inserted into existing timecode or existing events can be over-written or trimmed with the cue sequence being amended automatically.

Write or telephone for details:



Melkuist Ltd
AUTOMATION SYSTEMS

F.W.O. Bauch Limited

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

Public Radio in the USA
National Public Radio

Paul Lehrman

Non-commercial public radio in the USA is an area of broadcasting which has expanded significantly over the last decade. A prime motivator behind this expansion being the National Public Radio network—a national programme service for an affiliation of over 270 AM and FM non-commercial stations. In this, the first of two articles examining public radio in the USA, Paul Lehrman takes a close look at NPR and outlines the background, broadcast philosophy, funding, facilities and future plans of the organisation. Our next issue will continue the theme with a look at the Pacifica subscription network.

IN the face of the domination of television in the USA by the three commercial networks, whose entertainment fare, it has been said, exists for the sole purpose of delivering huge audiences to advertisers, it is encouraging to note that the largest *radio* network in the country, National Public Radio, is dedicated to providing music, information and entertainment of a high technical and creative calibre to both general and specialised audiences, with no sales pitches for cars, soda pop, or detergents.

There are few real networks left in commercial radio, and those that exist are generally occasional or one-off syndicates put together to carry musical programmes from companies like Starfleet Blair, DIR Broadcasting, or NBC's *The Source*, or are loose hook-ups that air news summaries or sports programmes.

On the other hand, National Public Radio (NPR), an affiliation of over 270 AM and FM stations, powerful and miniscule, in 48 states (including Alaska and Hawaii), the District of Columbia, and Puerto Rico, feeds an astonishing variety of programmes both to and from its member stations around the clock, to a listenership that numbers over seven million.

The fare includes such award winning news and information programmes as *All Things Considered, Morning Edition*, and *NPR Journal*, as well as a new arts magazine called *The Sunday Show*; classical music from the San Francisco, New York City, and Vienna State Operas, the Saint Paul Chamber Symphony, and the Los Angeles Philharmonic orchestras, and the Moscow Tchaikovsky Piano Competition; *Jazz Alive* and *Jazz Revisited*—programmes covering present and past American and international artists; unique drama series like *Earplay, Star Wars*, and *NPR Playhouse*; and programming not otherwise available to American audiences from the BBC and other foreign services.

Where did it come from?

NPR was incorporated in 1970 as a national programme service for 90 then-existing non-commercial stations. Such stations were operated by colleges and schools, municipalities, or educational foundations, and their number had begun to become respectable following the FCC's decision in the '50s to set aside the lowest 4 MHz of the standard FM band for non-commercial use. The number of stations continued to grow, and still increases today, at a rate of 20 each year.

The umbrella funding organisation of NPR (and also of PBS, the television Public Broadcasting System) is the Corporation for Public Broadcasting (CPB), founded by an act of Congress in 1967. The CPB disburses a large proportion of the operating funds of the two systems, although this situation, as we shall see later, is changing. There are a number of non-commercial stations in the country that are not part of NPR, but if they pass certain organisational, professional, and technical standards, they are considered 'CPB-qualified' and may receive funding too. Although they may not be on line very much, all CPB-qualified stations can receive NPR's 'Extended Program Service' if they wish, for a fee.

Does all this sound complicated? Well, consider that several individual states and regions have their own public radio sub-networks, like Alaska, California, Florida, Minnesota, and the Northeastern states; that NPR's news programmes use live and taped feeds from all over the world; that there are 17 satellite uplinks feeding 12 audio and three data channels in the NPR system, and that at any time any ground station may be feeding any channel with a programme that any of the hundreds of downlink-equipped stations may run live, or tape for delayed broadcast; and that NPR often uses its satellite facilities to distribute programming to commercial stations and may soon involve itself in private data transmissions; and you can begin to understand the vastness and complexity of the system.

NPR's headquarters are in downtown Washington DC, in a high-rise office building close by the Washington bureaux of its commercial brethren. Two labyrinthine floors are devoted to administrative, programming, and planning offices, while below is a floor with studios and offices for news and information, and below that are more studios for music production and recording as well as a large maintenance shop. More office space is being negotiated for.

NPR does more live and live-on-tape music than any other broadcasting institution in the USA. About 60% of the classical and 75% of the jazz is handled by the Washington staff. Considering the volume and quality of the work, it is surprising at first to realise that there is hardly any multitrack equipment here. "Ninety percent of everything we do here, music and news, is multiple 2-track," says audio engineer Skip Pizzi. "We record a little music right here, and one of our studios has variable acoustics and can be used for a soloist or small chamber group, but most of our recording is done in the field. We had built a large room with a floating floor and conduits for a concert hall we could broadcast from, but we needed the space for the maintenance shop, so for now that's still on our 'wish list'.

"When we record classical music, we'll generally use a Neumann *SM69* in M-S pattern, along with X-Y coincident or spaced-omni ambience mics, run through a Studer console into either a Studer *B67*, a Nagra *4S* with $10\frac{1}{2}$ in adaptors, or occasionally an Otari *MX-5050B*. We have a truck that goes out to the more complex sessions, and we have Scully *280*s and MCI tape machines we can put in it.

"Our engineers are very used to mixing live to 2-track. For some jazz sessions, we'll rent one of the Record Plant trucks or Fedco's, but we'll use our own mixers. Often as not, we'll end up using our own live monitor mix. If we need to mix down, we'll go to a facility here in Washington, or in Baltimore, or sometimes even in New York."

Classical masters are recorded with Dolby A noise reduction, mostly so that print-through on the Ampex *406* or *456* tape is kept to a minimum. Masters are generally kept intact, so what goes over the air is a second-generation tape, to which has been added appropriate voice-overs and fades. No noise reduction is used on most of the jazz tapes, and these masters, too, are never aired. Jazz masters remain the property of the artists due to contractual agreements, although NPR actually stores them.

High technical standards are not difficult to maintain on tapes or live broadcasts that come in from member stations (one interesting recent experiment involved a digital recording of the San Francisco Opera on equipment donated by Sony), but programmes from the BBC or EBU are harder to control. "They usually send us good quality 15 in/s tapes, but occasionally we'll get something at $7\frac{1}{2}$ in/s on some weird pink tape," laughs Pizzi. "We got some tapes from China recently, and they were red of course."

The music production studios are centred around Auditronics-built Spectra Sonics consoles, which look like a strange hybrid between recording and broadcast designs. They date from the early '70s, and although Pizzi says they have been maintained meticulously, the network is

Typical music production studio

looking at other boards to replace them before long. Processing gear includes Orban stereo synthesisers for mono sources that may show up in an otherwise stereo programme (like the music-heavy *Sunday Show*, for which the announce mic, instead of the usual Neumann *U87*, is an *SM69*), and AKG *BX10* reverb. "We're saving our pennies for a Lexicon," Pizzi smiles.

News and drama

Multitrack equipment is available at some of the member stations, and it is occasionally used for drama production. A case in point is WHA in Madison, Wisconsin, where *Earplay* is produced. "WHA has 16-track capability and a Foley stage," explains Pizzi," so when we're doing something that requires multitrack, we'll sometimes send a crew up there. You spend more time laying tracks than you do with 2-track, but much less time mixing, because everything is already synchronised together, and you don't have to worry about starting and stopping individual machines. Also everything is already timed out before you mix, so you don't have to worry about running long and having to cut after it's all done."

However, the preferred method of production, at least in Washington, is on stereo decks. "That advantage of having everything locked in time on a multitrack tape works against you if you have to move something," says Pizzi. "You have to redub, and it knocks the whole of the rest of the reel off." There are three studios used for news, each containing at least four reel-to-reel decks, with spares floating around that are available at short notice—it's not uncommon to see as many as eight machines lined up in a studio. When reporters come in from the field, they transfer their cassettes on to reel-to-reel in one of two 'Record Central' rooms, each of which sports four MCI decks, two Technics cassette decks, cart machines, limiters and equalisers. Incoming telephone and satellite feeds are wired in here too. To avoid the hassle of patchcords, the NPR staff have built an ingenious routing system that allows the operator to dial up his sources and destinations on a digital keypad.

The reel of tape is then taken to a small edit booth or the producer's office, where Scully *285*s, Ampexes and Otaris are available for rough editing and leadering. The next step is the production studio, where a production assistant—"the lowest paid and hardest working people on the staff," according to Pizzi—takes out mistakes, times the segment, and types up an introduction for the live show host to read.

The mono tape decks in the news department are all left-channel only, to reduce azimuth error and to avoid confusion and 'splice lag." Most of the production machines are MCI decks with 4-register memories, which help to speed up the mixing process considerably, although Pizzi says that final cueing must still be done by hand.

"We have some of the first *JH-110B* decks that MCI made," says Pizzi,"and we keep asking for modifications, and they keep sending us new stuff to try out. One thing we asked for was stainless-steel deck plates, because all the editing we do destroys the painted surfaces. Unfortunately, we found that with the steel plates, when you left the room and turned the lights off, the electric-eye sensors went crazy and sent all the machines into fast-forward. It sounded like the room was about to take off. MCI has since changed the sensing circuitry, so that doesn't happen any more."

All Things Considered is the daily afternoon news show, and is one of the most popular of NPR's programmes. As Pizzi says, "It's an amazing education to watch it go out." Like a TV show, there is a director who has direct contact with the engineers, intercoms to the talent in the studio, and phone contact to other studios or outside correspondents or facilities. When a show is running long, he will instruct a production assistant to trim the next segment. Said assistant proceeds to edit feverishly so that it is done in time for it to roll. "The splices go by looking like a snowstorm," says Pizzi, "but somehow it all stays together." Timings on all of the news programmes must be kept to the second, so that individual stations can easily, if they choose, delete certain segments and/or drop in local newscasts.

All Things Considered is produced in Studio 5, the largest of the three news studios. Despite all the incoming feeds, processing equipment is relatively simple, and a standard proceedure is used on phone lines. They are first passed through a UREI *565T* notch filter, where tones and buzzes are pulled out, while the unit's 18 dB/octave lowpass filter lops off high-end noise. Next is an Orban equaliser with 6 dB of cut at 400 Hz and small boosts at 150 Hz and 2.5 kHz to aid intelligibility. Finally, a dbx *160* comp/limiter keeps the line's level consistent with the live studio microphones. Custom gates wired into the phone patches keep lines from piling up on each other in the final mix. The studios are equipped with *Spotmaster* cart machines, but unlike most radio stations they aren't used much—first, because there are no commercials to run, and second, because most of the news segments are assembled on reel-to-reel, and there are plenty of these machines to go round.

In the days of land line distribution, Master Control, a large room on the ground floor, was NPR's nerve centre, but since the bulk of programming has gone to satellite its name is no longer accurate. The room still functions as the hub of the production studios, and the tie lines to every room come through here. It is also the entry point for incoming land lines. There are six Scully tape decks here and a slew of cassette machines, as well as extensive patching facilities. Dubbing for NPR's own tape library is done here, as are cassette copies of programmes and off-air logging.

Distribution

Impressive and extensive as NPR's production facilities are, the most technologically-advanced part of the system is the satellite distribution network. At the end of 1979, NPR leased four full-frequency mono audio channels from Western Union on its *Westar I* satellite. Today, the system has 12 audio (12 mono, six stereo, or some combination) and three data channels on a transponder on *Westar IV*. The transponder is currently shared with services such as Muzak and Mutual Broadcasting, but soon NPR will have use of all of it, (although Muzak will remain), which will make available as many as 24 audio ▷

Studio 5, the main news studio

and 90 data channels. Exactly what the organisation will do with all this capacity is still to be decided.

Member stations of NPR receive the network's programming at no charge outside of membership fees, but two new services that will use some of the new capacity are being put on tap at an extra charge to stations—similar to a 'second-tier' cable television service. One is *Classicsat*, a five-day-per-week classical music service being offered by Minnesota Public Radio. The other is *NPR Plus*, a round-the-clock classical 'needle-drop' channel, that will also programme six hours of jazz each night, hourly newcasts, and a half-hour daily news show. It is aimed at stations that do not have the staff or facilities for producing their own such programming.

Another chunk of satellite space will soon be devoted to the American Public Radio Network, which consists of five key NPR stations, who are stepping up their efforts to produce programming for the entire NPR system.

NPR's 12 channels, which are not 'dedicated' to any particular programme, but instead are slotted and scheduled on a daily basis, are also used occasionally on a 'fully-distributed-cost' basis by commercial broadcast interests including NBC, Blair, and Wold Communications. However, their primary job, of course, is to link the 250 or so NPR affiliates that have ground stations. Washington's programmes are sent by microwave to the Main Origination Terminal, 10 miles away in Bren Mar, Virginia. Besides Washington, there are 16 uplinks all over the country from Alaska to Florida that feed programming into the system. Programmes are often repeated to match station schedules in different time zones (including Alaska, Hawaii, and Puerto Rico, NPR serves *six* time zones). A typical member station will depend on NPR for about 25% of its programming, either relayed live from the satellite feed or recorded on tape for broadcast later.

The satellite is also used for the 'Extended Program Service', which is open to independent producers and stations who are interested in reaching wider audiences than they could on their own. The service is also suited for narrowcasting special-interest programmes into educational and health institutions around the country.

Another use for the satellite is to distribute programming within the state or regional subnetworks. "Even within a small area, it's more economical to use the satellite than land lines or tapes," explains Pete Lowenstein, who is on the technical support staff of NPR's distribution division. "For years, we were bound into an expensive, relatively low-quality land line system. Considering what a mono 5 kHz land line cost, having four 15 kHz channels on the satellite paid for itself very quickly. Now that everyone's on satellites, land lines have become an even lower priority for the telephone company, so it's no longer just a matter of economics, it's now a question of availability."

The data channels also see a wide variety of use. One sends messages from Washington to the affiliates: daily programming schedules; timings and warnings; job announcements; and even personal messages. A system is about to be put in place whereby messages can be addressed, through 'black boxes' at the downlinks, to specific users or groups, so that each station's printer doesn't have to deal with every message on the system. A second data channel is used by the field uplinks to send messages to Washington. The third channel is now being used for experimental purposes, and will soon provide automation cues for the downlinks: putting receivers on line; selecting channels; and starting tape recorders, all by remote control. Some of the new data channels may eventually be leased out to commercial data carriers.

Master Control, hub of the production studios

The expansion of the satellite service ("beyond our wildest dreams," says Lowenstein) has forced the NPR technical staff to deal with some interesting problems. For example, the house monitoring system at NPR's offices is now an FM cable network containing the entire local FM broadcast band, with NPR's 12 satellite channels sandwiched into blank spaces on the dial. Another problem was how to clean up overseas telephone links so that they would sound as good as the domestic links were starting to. Skip Pizzi talks about the link from London: "the line is a dedicated 300 Hz to 3 kHz feed, about the same quality as a dial-up, but with a slightly better noise figure. On our domestic satellite system, dbx had installed a custom 3:1 compander, so we pulled some of the cards out and put them on the line. We're also using a Comrex low-frequency extender. It linerarly shifts the signal down 250 Hz, so our response becomes 50 Hz to 2750 Hz. By itself, this wouldn't help intelligibility at all—in fact, that much low end will make things worse—but if London plays tapes back at *half speed* and runs them through the Comrex, and we play them back at double speed, we end up with 100 Hz to 5.5 kHz, which sounds great. With the compander on top of that, the limiting factor is no longer line noise, it's tape hiss. It sounds like the correspondent is mailing his tapes in."

Yet another project in the works is a portable uplink, which could feed programming into the network from virtually anywhere on the continent. "It's turning out to be more difficult than it first seemed," says Pizzi. "We need FCC approval every time we set it up. It's basically just a rubber-stamp procedure, but it's time consuming."

Not all of NPR's problems have been solved by the satellite. One weak spot is still the less-than-perfect land lines that connect uplinks and downlinks in some cities. "The 'first mile' is always the hardest part," says Pizzi. "They tell me the New York lines are waterlogged, and they sound it. In Chicago, on the other hand, they're using all new fibre-optic lines, and they sound great. Actually, I think it all sounds OK, but our Telco wizards here aren't satisfied with a lot of it."

Another sore point with Pizzi concerns the way tapes are prepared for satellite distribution. The Main Origination Technical Center (MOTC—pronounced MOTT-see) consists of a McCurdy switcher controlled by an imposing bank of computers, fed by eight MCI *JH-110B* stereo decks. In the interest of uniformity, all of the decks have to be loaded with 10½ in reels of 1.5 mil tape recorded at 7½ in/s with no noise reduction. "That's fine for voice programmes, but it gets a ▷

Main Origination Technical Center (MOTC)

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little sticky with music," complains Pizzi. "The decision to do it this way was made more with policy in mind than quality. Of course with live feeds, there's no problem." MOTC also has visual monitoring facilities for quick-checking all of the satellite channels, and a 20-channel slow-speed logging recorder, strapped at the moment for 12-channel operation, is hooked into the local downlink.

Before satellites, of course, there was tape, and NPR's duplication facilities—an Electrosound five-slave 120 in/s stereo system and a heavily-modified Ampex 16-slave 60 in/s system—still see substantial use. Many of the member and non-member stations that carry NPR programmes don't yet have access to satellite ground facilities, and considering the demise of land lines, tapes are the only alternative.

The duplicators are also used for making copies for producers, artists, or other interested parties, in-house and outside. One staffer reports that the duplication facility is being shrunk to accomodate the needs of the satellite maintenance crew.

Who pays for all this?

Although technical developments at NPR are certainly getting plenty of attention, the major questions on everybody's mind in Washington have to do with funding. For one thing, it's going to take a huge amount of capital to upgrade the existing ground facilities to accomodate all the new satellite channels. But federal funds, disbursed by the CPB, which amounted to $14.5 million of NPR's $18 million 1981 budget, are, if President Reagan has his way, going to disappear. Present plans call for at least a 20% cut in federal support for the CPB for 1983, and by 1985 that figure may well be over 40%. Federal money is also drying up for groups like the National Endownments for the Humanities and the Arts, and the National Science Foundation, who have contributed heavily to production costs of many NPR programmes. Member stations, who currently receive an additional $19 million from the CPB, which amounts to as much as 30% of their budgets, are already stepping up their fund-raising efforts from listeners and corporate programme underwriters. Some, like WGBH in Boston, who have recently put on the road an impressive 24-track audio mobile unit and a 40 ft video production truck, are offering their technical services and facilities to commercial clients.

In response to the financial threat, NPR as well is looking at novel ways of maintaining its bottom line. One, of course, is renting its excess satellite capacity, both on the transponder itself and the ground facilities, to commercial radio networks, 'cable audio' services, and private data services. Such rentals would be on a "cost-sharing" basis, explains Tom Bartunek, director of distribution for the network. They would not contribute directly to NPR's coffers, but would instead help member stations by lowering their membership fees, part of which help pay for the satellite network. More funds, therefore, would be available to the individual stations for creative uses.

Another venture, which NPR President, Frank Mankiewicz, estimates could bring in $1 million a year, would be to sell NPR programmes on prerecorded cassettes to educational institutions.

A more radical proposal, already in place, involves selling tax-deductible 'shares' in NPR's news and performance general funds, at $250,000 each, to corporations in exchange for frequent on-air credits. Other non-broadcasting ventures, which might be made more attractive to investors by NPR's tax-exempt status, are being looked into as well. Mankiewicz has said, "we are prepared to enter into almost every profession—except the oldest one—in pursuit" of new sources of revenue. An ominous note was struck when Congress approved, early this year, the broadcasting of genuine commercials on several public television stations, but due to the strenuous objections of NPR's members, the practice has not yet spread to radio.

The looming crisis has led to some strange new alliances. Mankiewicz, a former broadcast journalist and campaign manager for liberal Democrat George McGovern's unsuccessful bid for the US Presidency in 1972, has enlisted the aid of the former Reagan campaign adviser, public-relations expert Peter Hannaford (whose firm once included Reagan's current deputy chief of staff) to sell the idea of corporate support for the network to the private sector.

According to Mankiewicz, "we share President Reagan's belief that corporations and foundations will help take up the slack caused by the decline in federal dollars," and he is going all out to prove it. His goal is to make NPR self-sustaining by 1988, with approximately half of its budget coming from corporate sponsorship, while the rest comes from its own money-making business operations. What little federal funding that still exists, therefore, can be given to the member stations. However, the nation is still in a serious recession, and loose private money, as any arts organisation will attest, is hard to come by these days. It remains to be seen whether National Public Radio will be able to remain healthy and truly public, whether it will suffer an agonising death by unnatural causes, or whether it will slowly indenture itself to the well-heeled corporations that control almost all of the rest of the nation's media. Stay tuned. □

Next issue: Public radio on a shoestring—a look at the Pacifica network.

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product guide — Tape Machines

This product guide includes details of analogue tape machines ranging from mono to 40-track. In addition to these, the following companies manufacture digital tape machines: **EMT** (West Germany); **JVC** (Japan); **Mitsubishi/Telefunken** (Japan/West Germany); **3M** (USA); **Sony** (Japan); and **Technics** (Japan). Full details of these machines will appear in the December 1982 issue of our companion magazine *Studio Sound*.

ABE (West Germany)

ABE Becker GmbH & Co, Mainaustrasse 5, D-7750 Konstanz. Phone: 07531 21536.

MTR Series: 8-track on 1 in; 16-, 24- or 32-track on 2 in; 7½/15 in/s; CCIR or NAB EQ.

ACES (UK)

AC Electronic Services, Broad Oak, Albrighton, Near Shrewsbury, Shropshire SY4 3AG. Phone: 0939 290574.
Worldwide marketing: Intersound Ltd, 103 Layston Park, Royston, Herts SG8 9DY, UK. Phone: 0763 44470.

ACTR 16: 16-track on 2 in; 15 in/s; NAB EQ.

ACCURATE SOUND (USA)

Accurate Sound Corp, 114 5th Avenue, Redwood City, Cal 94063. Phone: (415) 365-2843. Telex: 348327.

Model 2600: tape transport with Inovonics or ASCO electronics; 2-track and full track on ¼ in; 4-track on ½ in or ¼ in; 8- or 16-track on 1 in; 16- or 24-track on 2 in; 3¾/7½/15/30 in/s.

ALLEN AND HEATH (UK)

Allen and Heath/Brenell Ltd, Pembroke House, Campsbourne Road, London N8. Phone: 01-340 3291. Telex: 267727.
USA: Audio Marketing Ltd, 652 Glenbrook Road, Stamford, Connecticut 06906. Phone: (203) 359-2312.

Brenell Mini 8: 8-track on 1 in; 7½/15 in/s.
Syncon M16/M24: 16- or 24-track on 2 in; 15/30 in/s; NAB/IEC/AES assignable EQ.

AMPEX (USA)

Ampex Corporation, 401 Broadway, Redwood City, Cal 94063. Phone: (415) 367-2011. Telex: 348464.
UK: Ampex Great Britain Ltd, Acre Road, Reading RG2 0QR. Phone: 0734 875200. Telex: 848346.

ATR100: 1- or 2-track on ¼ in; 4-track on ½ in; also 2-track on ½ in mastering format; 3¾/7½/15/30 in/s; 4-speed dual EQ padnet.
ATR700: 1-, 2-track or ¼-track on ¼ in; 3¾/7½ or 7½/15 in/s.

Ampex ATR800

ATR800: 1-, 2- or 4-track on ¼ in; 7½/15/30 in/s; NAB or IEC EQ.
ATR 124/116: 16- or 24-track on 2 in; 7½/15/30 in/s; NAB/IEC/AES assignable EQ.
MM1200: 8-track on 1 in; 16- or 24-track on 2 in; 7½/15 or 15/30 in/s.

ASC (West Germany)

Audio System Componenten GmbH & Co, Seibelstrasse 4, D-8752 Hosbach. Phone: 0 60 21 53021. Telex: 04188571.
UK: Uher Sales and Services Ltd, 30-31 Lyme Street, London NW1. Phone: 01-485 0943/4.

AS6002: 2-track on ¼ in; optional ¼ track; 3¾/7½/15 in/s.

AUDIO SYSTEMS COMPONENTS (UK)

Audio Systems Components Ltd, 19 The Green, Theale, Berks RG7 5DR. Phone: 0734 302108.

Revox PR99: customised version of the Revox *PR99* for broadcasters.

CEI (Australia)

Consolidated Electronic Group, PO Box 21, Anderson Road, Thornbury, Victoria 3071. Phone: 44 07 91. Telex: 32463:

Cuemaster 77: full and 2-track on ¼ in, 4-track also available; 3¾/7½/15 in/s; IEC EQ, NAB option.
Cuemaster Series 2000: mono or stereo on ¼ in; 3¾/7½ in/s or 7½/15 in/s.

ELECTRO SOUND (USA)

Electro Sound, 160 San Gabriel Drive, PO Box 60639, Sunnyvale, Cal 94088. Phone: (408) 245-6600. Telex: 346324.

Tape recorder: full, 2-track and stereo on ¼ in; 4- and 8-track on 1 in; ¼ in transport 3¾/7½ or 7½/15 in/s; 1 in transport 7½/15 or 15/30 in/s; NAB EQ, IEC option.

ENERTEC (France)

Enertec SA, Dept Audio Professional, 226-296 Avenue Napoleon Bonaparte, F-92505 Reuil Malmaison Cedex. Phone: (1) 732.92.23. Telex: 203404.
UK: Crow of Reading Ltd, PO Box 36, Reading RG1 2NB. Phone: 0734 595025. Telex: 847056.

F462: full, 2-track or stereo on ¼ in; 7½/15 in/s, options for 3¾/7½ or 15/30 in/s; CCIR/NAB EQ; optional pilot track models.

F500: mono, mono/stereo compatible (0.75 and 2 mm), 2-track, 2-track with sync play, mono with *Neopilot*, stereo with *Synchrotone*, and stereo with *Nagrasync* on ¼ in; 3¾/7½/15 in/s; CCIR/NAB EQ.

FERROGRAPH (UK)

Ferrograph Recorders, Unit 21, Royal Industrial Estate, Jarrow, Tyne & Wear NE32 9XX. Phone: 0632 893092. Telex: 537227.
USA: Neal-Ferrograph (USA) Inc, 652 Glenbrook Road, Stamford, Connecticut 06906. Phone: (203) 348-1045. Telex: 643678.

Studio 8: 1- or 2-track on ¼ in (or 0.15 in to special order); 3¾/7½ or 7½/15 in/s; available with penthouse electronics.
SP7: 1- (full or ½) or 2-track (½ or ¼) on ¼ in; 3¾/7½/15 in/s, 1⅞/3¾/7½ in/s or 15/16/1⅞/3¾ in/s; IEC or NAB EQ; logging and delay versions available.
Logic 7: 2-track (½ or ¼) on ¼ in; speeds as for *SP7*.
Edit: replay only machine; 3¾/7½/15 in/s; mono or stereo versions.
SP744: 4-channel version of the *SP7*.

FOSTEX (Japan)

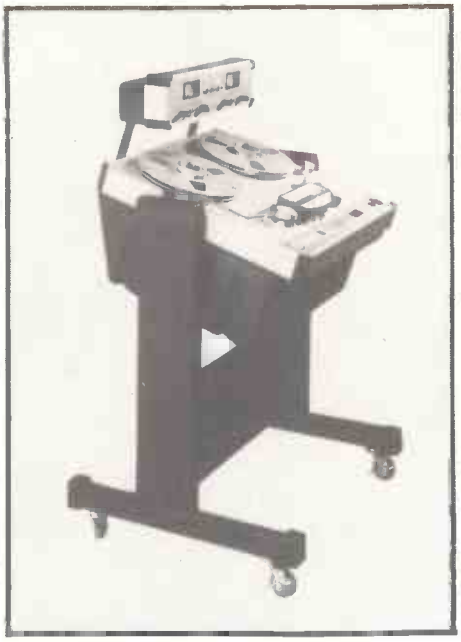
Fostex Corp, 512 Miyazawacho, Akishima, Tokyo. Phone: 0425-45-6111. Telex: 2842-203.
USA: Fostex Corporation of America, 15431 Blackburn Avenue, Norwalk, Cal 90650. Phone: (213) 921-1112.
UK: Bandive Ltd, 8 East Barnet Road, New Barnet, Herts EN4 8RW. Phone: 01-440 9304. Telex: 25769.

A-2: 2-track on ¼ in; 7½/15 in/s; NAB EQ, optional IEC.
A-4: 4-track on ¼ in; 7½/15 in/s; NAB EQ, optional IEC.
A-8: 8-track on ¼ in (2×4-channel record, 8-channel reproduce); single speed 15 in/s; IEC EQ; incorporates Dolby-C noise reduction.

IEM (USA)

International Electro-Magnetics Inc, Eric Drive and Cornell Avenue, Palatine, Illinois 60067. Phone: (312) 358-4622.

1100A Series: 1- or 2-track on ¼ in; 4-track on ½ in; 7½/15/30 in/s.
1100B Series: 4-track on ½ in; 8-track on 1 in; 7½/15/30 in/s.



Enertec F462

1000 Series: 8-track on 1 in; 16- or 24-track on 2 in; 7½/15/30 in/s.

ITAM (UK)

Industrial Tape Applications Ltd, 1-7 Harwood Avenue, Marylebone Road, London NW1. Phone: 01-724 2497/7368. Telex: 21879.

806: 8-track on ½ in; single speed 15 in/s; Dolby-A and dbx noise reduction.
810: 8-track export only version of the *1610*; 8-track on 1 in; 7½/15/30 in/s; dbx noise reduction.
1610: 16-track on 1 in; 7½/15/30 in/s; optional dbx noise reduction.

LEEVERS-RICH (UK)

Leevers Rich Ltd, 319 Trinity Road, London SW18 3SL. Phone: 01-874 9054. Telex: 923455.

Proline 2000TC: 1- or 2-track on ¼ in; 3¾/7½, 7½/15 or 15/30 in/s; NAB/IEC EQ; various control panel options for TV and radio applications.
Proline 1000SC: 1- or 2-track on ¼ in; 3¾/7½, 7½/15 or 15/30 in/s; NAB/IEC EQ.
E200: 1- or 2-track on ¼ in; 3¾/7½ or 7½/15 in/s; NAB/IEC EQ on plug-in cards.

Lyrec TR55

LYREC (Denmark)

Lyrec Manufacturing A/S Hollandsvej 12, DK-2800, Lyngby. Phone: 02 87.63.22. Telex: 37568.
UK: Lyrec (UK) Ltd, 19 Erncroft Way, Twickenham TW1 1DA. Phone: 01-891 2022.
USA: Rupert Neve Inc, Berkshire Industrial Park, Bethel, Connecticut 06801. Phone (203) 744-6230. Telex: 969638.

TR55: 1- or 2-track on ¼ in; 7½/15 in/s; NAB or CCIR EQ.
TR532: 8-track on 1 in; 16- or 24-track on 2 in; 15/30 in/s; NAB or CCIR EQ.

MCI (USA)

MCI Division of the Sony Corporation of America, 1400 W Commercial Blvd, Fort Lauderdale, Florida 33309. Phone: (305) 491-0825. Telex: 514362.

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Our DN60/RT60 Data Sheet.
Our DN30/30 Data Sheet.

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Tape Machines

UK: MCI (Professional Studio Equipment) Ltd, MCI House, 54-56 Stanhope Street, London NW1 3EX. Phone: 01-388 7867. Telex: 26116.

JH-110 Series: 1- or 2-track on $\frac{1}{4}$in; 4-track on $\frac{1}{2}$in; 8-track on 1in; $3\frac{1}{4}/7\frac{1}{2}/15$in/s or $7\frac{1}{2}/15/30$in/s; NAB/CCIR EQ.
JH-24: 8-track on 1in; 16- or 24-track on 2in; 15/30in/s; NAB/CCIR/AES EQ.

MC1 JH-110BC

MECHLABOR (Hungary)
Electroimpex, PO Box 296, H-1392 Budapest. Phone: 321330. Telex: 225771.

STM-600 Series: mono, stereo, 2-track on $\frac{1}{4}$in; $3\frac{1}{4}/7\frac{1}{2}$ or $7\frac{1}{2}/15$in/s.

3M (USA)
3M Company, 3M Centre, St Paul, Minnesota 55101. Phone: (612) 736-9567. Telex: 297434.
UK: 3M (UK) Ltd, PO Box 1, Bracknell, Berks RG12 1JU. Phone: 0344 26726. Telex: 849371.

M79: 8-track on 1in; 16- or 24-track on 2in; $7\frac{1}{2}/15$ or 15/30in/s.

NAGRA (Switzerland)
Kudelski SA, CH-1033 Cheseaux-sur-Lausanne. Phone: 021 91.21.21. Telex: 24392.
UK: Hayden Laboratories Ltd, Hayden House, Chiltern Hill, Chalfont St Peter, Bucks SL9 9UG. Phone: 02813 88447. Telex: 849469.
USA: Nagra Magnetic Recorders Inc, 19 W 44th Street, Room 715, New York, NY 10036. Phone: (212) 840-0999. Telex: 710-581 2443.

IV-S: 2-track plus *Nagrasync* on $\frac{1}{4}$in; $3\frac{3}{4}$, $7\frac{1}{2}$ and 15in/s; NAB/CCIR EQ; mains or battery powering; optional Dolby noise reduction.
4.2: 1-track plus *Neopilot* on $\frac{1}{4}$in; speeds and features similar to *IV-S*.
SN: 1-track (with or without pilot-tone) on 0.15in; $1\frac{7}{8}$ and $3\frac{3}{4}$in/s; miniature battery powered portable.
SNS: $\frac{1}{2}$-track; $\frac{15}{16}$ and $1\frac{7}{8}$in/s; similar to model *SN*.
T-1: 4-channel on $\frac{1}{4}$in; $\frac{15}{32}/\frac{15}{16}/1\frac{7}{8}/3\frac{3}{4}/7\frac{1}{2}$/15/30/60ins. *T-1* is an instrument recorder designed to operate to the IRIG intermediate band.
T-Audio: based on the *T-1*; 2- or 4-track on $\frac{1}{4}$in; $3\frac{1}{4}/7\frac{1}{2}/15/30$in/s.
T-RVR: 1- or 2-track plus timecode track on $\frac{1}{4}$in; $\frac{15}{16}/1\frac{7}{8}/3\frac{3}{4}/7\frac{1}{2}$in/s.
IS: full track plus optional *Neopilot* on $\frac{1}{4}$in; $3\frac{1}{4}/7\frac{1}{2}$in/s; NAB or CCIR EQ.

OTARI (Japan)
Otari Electric Co, Otari Bldg 4-29-18 Minami, Ogikubo, Suginamiku, Tokyo. Phone: 03 333-9631. Telex: 26604.
USA: Otari Corp, 2 Davis Drive, Belmont, Cal 94002. Phone: (415) 592-8311.
UK: Industrial Tape Applications Ltd, 1-7 Harewood Avenue, Marylebone Road, London NW1. Phone: 01-724 2497/7368. Telex: 21879.

MX-5050B: 1- or 2-track on $\frac{1}{4}$in; $3\frac{1}{4}/7\frac{1}{2}$ or $7\frac{1}{2}/15$in/s; NAB EQ, optional EIA, CCIR and IEC.
MX-5050 BQII: 4-track on $\frac{1}{4}$in; $7\frac{1}{2}/15$in/s; NAB or IEC EQ.
MX-5050 MkIII-8: 8-track on $\frac{1}{4}$in; $7\frac{1}{2}/15$in/s; NAB or IEC EQ.
MX-7800: 8-track on 1in; $7\frac{1}{2}/15$ or 15/30in/s; NAB EQ.
MTR-10: 2-track on $\frac{1}{4}$in; 4-track on $\frac{1}{2}$in; $3\frac{3}{4}/7\frac{1}{2}/15$ or $7\frac{1}{2}/15/30$in/s; NAB/IEC/AES EQ.
MTR-90: 16- or 24-track on 2in; 15/30in/s; NAB/IEC/AES EQ.

PHILIPS (Holland)
Philips Industries, Eindhoven. Phone: 040 72.33.31. Telex: 51121.
UK: Philips Electrical Ltd, City House, 420-430 London Road, Croydon, Surrey CR9 3QR. Phone: 01-689 2166.
USA: Philips Audio Video Corp, 91 Mckee Drive, Mahwah, New Jersey 07430. Phone: (201) 529-3800.

N4520: 2-track on $\frac{1}{4}$in; $3\frac{1}{4}/7\frac{1}{2}/15$in/s; NAB or IEC EQ.

SCULLY (USA)
Ampro/Scully, Newton Yardley Road, Newton, Pennsylvania 18940. Phone: (215) 968-9000.
UK: Lee Engineering Ltd. Napier House, Bridge Street, Walton-on-Thames, Surrey KT12 1AP. Phone: 09322 43124. Telex: 928475.

280B Series: full, $\frac{1}{2}$-, 2- and 4-track on $\frac{1}{4}$in; 4-track on $\frac{1}{4}$in; 8-track on 1in; $3\frac{1}{4}/7\frac{1}{2}/15/30$in/s.
250: 1- or 2-track on $\frac{1}{4}$in; $3\frac{1}{4}/7\frac{1}{2}$ or $7\frac{1}{2}/15$in/s.
255: $3\frac{1}{4}/7\frac{1}{2}$in/s replay only version of the model *250* for broadcast use.

SONY (Japan)
UK: Sony UK Ltd, Pyrene House, Sunbury-on-Thames, Middlesex TW16 7AT. Phone: 09327 89581/876441. Telex: 266371.
USA: Sony Corporation of America, 9W 57th Street, New York, NY 10019. Phone: (212) 371-5800.

TC766-2: 2-track on $\frac{1}{4}$in; $7\frac{1}{2}/15$in/s; $\frac{1}{4}$-track playback.
TC765: $\frac{1}{4}$-track version of *TC766-2*.
TC880-2: 2-track on $\frac{1}{4}$in; $7\frac{1}{2}/15$in/s.
TC510-2: 2-track on $\frac{1}{4}$in; $3\frac{3}{4}/7\frac{1}{2}$in/s.

SOUNDCRAFT (UK)
Soundcraft Magnetics Ltd, 5-8 Great Sutton Street, London EC1V 0BX. Phone: 01-253 9878. Telex: 21198.
USA: Soundcraft Inc, PO Box 2023, Kalamazoo, Michigan 49003. Phone: (616) 382-6300. Telex: 224408.

SCM381: 8- or 16-track on 1in; 15in/s single speed; NAB EQ.
SCM762: 16- or 24-track on 2in; 15/30in/s; NAB EQ others to order; many options available.

STELLAVOX (Switzerland)
Stellavox, CH-2068 Hauterive/NE. Phone: 038 33.42.33. Telex: 35380.
UK: Future Film Developments, 36-38 Lexington Street, London W1V 3LE. Phone: 01-437 1892. Telex: 21624.
USA: ADB Alnaco, 6630 Tailor Road, Box 108, Blacklick (Columbus), Ohio.

SM8/SQ7: 2-track (*SM8*) and 4-track (*SQ7*) on $\frac{1}{4}$in; $7\frac{1}{2}$ and 15in/s; battery or mains powered portable.
SP8: 1- or 2-track on $\frac{1}{4}$in; $3\frac{3}{4}$, $7\frac{1}{2}$ and 15in/s; similar to *SM8* with 50/60 Hz pilot generator and cuetrack playback amp or synchroniser; EBU timecode option also available.
TD88: 1-track (optional *Neopilot*) or 2-track (optional *Synchrotone*) on $\frac{1}{4}$in; 2-, 4- or 8-track on $\frac{1}{2}$in and *Perfotape* for 16mm magnetic tape; $1\frac{7}{8}$, $3\frac{3}{4}$, $7\frac{1}{2}$, and 30in/s, plus 24 and 25 frames/s.

STEPHENS (USA)
Stephens Electronics Inc, 3513 Pacific Avenue, Burbank, Cal 91505. Phone: (213) 842-5116.

Capstanless Multitrack: 4-track on $\frac{1}{2}$in; 8-track on 1in; 16-, 24-, 32- or 40-track on 2in; 15/30in/s, plus 60in/s scan; capstanless tape transport system.

STUDER/REVOX (Switzerland)
Studer International AG, Althardstrasse 150, CH-8105 Regensdorf. Phone: 01 840.29.60. Telex: 58489.
UK: FWO Bauch Ltd, 49 Theobald Street, Boreham Wood, Herts WD6 4RZ. Phone: 01-953 0091. Telex: 27502.
USA: Studer Revox America Inc, 1819 Broadway, Nashville, Tennessee 37203. Phone: (615) 329-9576. Telex: 554453.

B67 Mk II: 1- or 2-track on $\frac{1}{4}$in; $3\frac{1}{4}/7\frac{1}{2}/15$/s or $7\frac{1}{2}/15/30$in/s; NAB or CCIR EQ via plug-in cards.
A700: 2-track ($\frac{1}{2}$- or $\frac{1}{4}$-track) on $\frac{1}{4}$in; $3\frac{1}{4}/7\frac{1}{2}/15$in/s.
B77: 2-track ($\frac{1}{2}$- or $\frac{1}{4}$-track) on $\frac{1}{4}$in; $3\frac{1}{4}/7\frac{1}{2}$ or $7\frac{1}{2}/15$in/s; NAB or IEC EQ. Almost 70 variants of the *B77* are available including $\frac{15}{16}/1\frac{7}{8}$ and $1\frac{7}{8}/3\frac{3}{4}$in/s slow speed versions.
PR99 Series: 2-track on $\frac{1}{4}$in; $3\frac{1}{4}/7\frac{1}{2}$ or $7\frac{1}{2}/15$in/s; NAB EQ.
A80/RC: 1- or 2-track on $\frac{1}{4}$in; $3\frac{1}{4}/7\frac{1}{2}$, $7\frac{1}{2}/15$ or 15/30in/s; NAB or CCIR EQ on plug-in cards.
A80/VU Mk II: 1-, 2- or 4-track on $\frac{1}{4}$ or $\frac{1}{2}$in; 4- or 8-track on $\frac{1}{2}$ or 1in; $7\frac{1}{2}/15$ or 15/30in/s; CCIR or NAB EQ.
A80/VU Mk III: 16- or 24-track on 2in; $7\frac{1}{2}/15$ or 15/30in/s; CCIR or NAB EQ.
A800: 8-track on 1in; 16- or 24-track on 2in; $7\frac{1}{2}/15$ or 15/30in/s; NAB/CCIR EQ switching.
A810: full track, stereo 2-track and 2-track with timecode versions; $7\frac{1}{2}/15$ or 15/30in/s; NAB or CCIR EQ.

TANDBERG (Norway)
Tandberg A/S, Fetveien 1, PO Box 53, N-2007 Kjeller.
UK: Tandberg (UK) Ltd, Unit 1, Revie Road Industrial Estate, Elland Road, Leeds LS11 8JG, West Yorkshire. Phone: 0532 774844. Telex: 557611.
USA: Tandberg of America Inc, Labriola Court, Armonk, NY 10504. Phone: (914) 273-9150. Telex: 137357.

TD20A: 2-track ($\frac{1}{2}$ or $\frac{1}{4}$-track) on $\frac{1}{4}$in; $\frac{1}{4}$- track $3\frac{1}{4}/7\frac{1}{2}$in/s; $\frac{1}{2}$- and $\frac{1}{4}$-track $7\frac{1}{2}/15$in/s; NAB/IEC EQ.

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

A3340: 4-track on $\frac{1}{4}$in; $7\frac{1}{2}/15$in/s; optional dbx noise reduction.
35-2: 2-track on $\frac{1}{4}$in; $7\frac{1}{2}/15$in/s; NAB EQ.
32-2: 2-track on $\frac{1}{4}$in; $7\frac{1}{2}/15$in/s; NAB EQ.
22-2: 2-track on $\frac{1}{4}$in; $7\frac{1}{2}/15$in/s; NAB EQ; optional dbx.
22-4: 4-track on $\frac{1}{4}$in; $7\frac{1}{2}/15$in/s; NAB EQ; optional dbx.
44: 4-track on $\frac{1}{4}$in; $7\frac{1}{2}/15$in/s; NAB EQ.
80-8: 8-track on $\frac{1}{2}$in; 15in/s single speed ; IEC EQ; optional dbx.
85-16: 16-track on 1in; 15in/s single speed; IEC EQ; optional dbx.

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

MGB 60: 1- or 2-track on $\frac{1}{4}$in; $7\frac{1}{2}/15$in/s standard, $3\frac{1}{4}/7\frac{1}{2}$ or 15/30in/s to order.

TELEFUNKEN (West Germany)
AEG-Telefunken, Postfach 2154, D-7750, Konstanz. Phone: 07531 862460. Telex: 733233.
UK: Hayden Laboratories Ltd, Hayden House, Chiltern Hill, Chalfont St Peter, Bucks SL9 9UG. Phone: 02813 88447. Telex: 849469.
USA: Gotham Audio Corp, 741 Washington Street, New York, NY 10014. Phone: (212) 741-7411. Telex: 129269.

M12A: 1- or 2-track (optional pilot-tone) on $\frac{1}{4}$in; $3\frac{1}{4}/7\frac{1}{2}$ or $7\frac{1}{2}/15$in/s; NAB/CCIR EQ.
M15A: 1- or 2-track (optional pilot-tone or timecode) on $\frac{1}{4}$in; 4-track on $\frac{1}{2}$in; 8-track on 1in; 16-, 24- or 32-track on 2in; $7\frac{1}{2}/15$ or 15/30in/s; NAB/CCIR/AES switchable EQ.

TELEX (USA)
Telex Communications Inc, 9600 Aldrich Avenue South, Minneapolis, Minnesota 55420. Phone: (612) 884-4051. Telex: 297053.
UK: Avcom Systems Ltd, Newton Works, Stanlake Mews, London W12 7HA. Phone: 01-749 2201. Telex: 897749.

1400 Series: 1- or 2-track on $\frac{1}{4}$in; $3\frac{1}{4}/7\frac{1}{2}/15$in/s.
230: series of heavy duty tape transports with two speeds and available in a wide variety of formats including a logging version.
3000 Series: 1-, 2- or 4-track on $\frac{1}{4}$in; $3\frac{1}{4}/7\frac{1}{2}$ or $7\frac{1}{2}/15$in/s.

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

TSR Series: 16- or 24-track on 2in; 15/30in/s; autolocate supplied as standard.

TTS (West Germany)
TTS-Electronic GmbH, Dammuhlenweg 4, D-6270 Idstein. Phone: 61 26 2014. Telex: 4182297.

PR-8: 8-track on $\frac{1}{2}$in; 15in/s (optional $7\frac{1}{2}$in/s); IEC EQ (NAB option); uses Studer transport and incorporates *High-Com* noise reduction.

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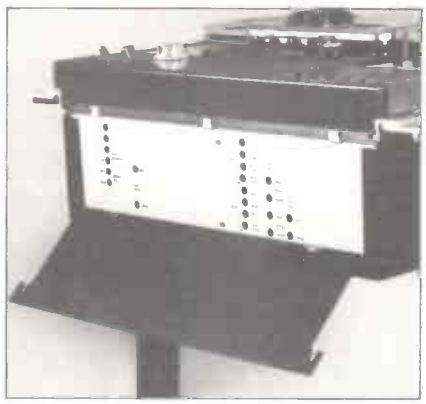

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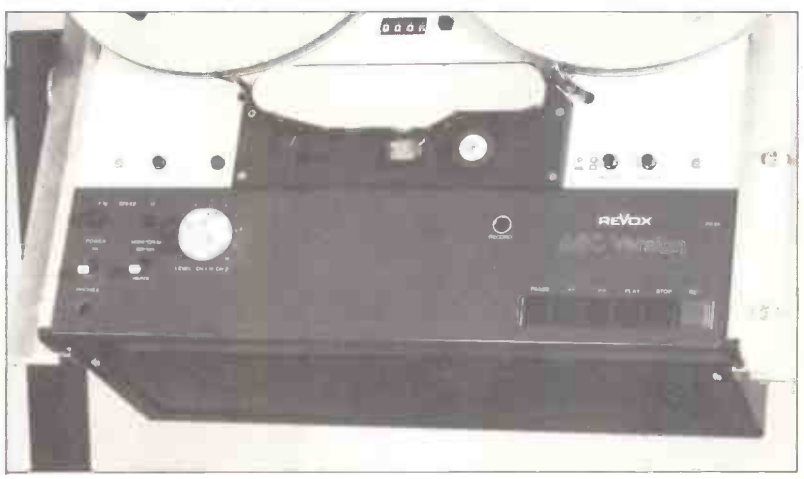

ASC AUDIO SYSTEMS COMPONENTS LTD.
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Telephone: Reading (0734) 302108

Tape Machines

UHER (West Germany)
Uher Werke Munchen, Barmseestrasse 11, D-8000, München 17. Phone: 089 78721. Telex: 0522932.
UK: Uher Sales and Services Ltd, 30-31 Lyme Street, London NW1. Phone: 01-485 0943/4.

SG630: 2-track ($\frac{1}{2}$-or $\frac{1}{4}$- track) on $\frac{1}{4}$ in; $1\frac{7}{8}/3\frac{1}{4}/7\frac{1}{2}$ in/s.
4000 Series: $\frac{1}{2}$-track mono, $\frac{1}{2}$-track stereo, $\frac{1}{4}$-track stereo on $\frac{1}{4}$ in; $\frac{15}{16}/1\frac{7}{8}/3\frac{3}{4}/7\frac{1}{2}$ in/s; battery or mains powered portables with built-in monitor loudspeakers.
1200 Synchro: 1-track plus *Neopilot* on $\frac{1}{4}$ in; single speed $7\frac{1}{2}$ in/s. □

This guide provides a listing of contractors for the construction of mobile broadcasting and recording units.

AFA (USA)
AF Associates Inc, 100 Stonehurst Court, Northvale, New Jersey 07647. Phone: (201) 767-1000.

AMPEX (USA)
Ampex Corp, 401 Broadway, Redwood City, Cal 94063. Phone: (415) 367-2011. Telex: 348464.
UK: Ampex International, Acre Road, Reading, Berks RG2 0QR. Phone: 0734 875200. Telex: 847611.

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

BOSCH (West Germany)
Robert Bosch GmbH, PO Box 429, Robert Bosch Strasse, D-1600 Darmstadt. Phone: 06151 808270. Telex: 419256.
UK: Robert Bosch Ltd, Rhodes Way, Watford WD2 4LB. Phone: 0923 44233. Telex: 935244.

BRABURY (UK)
Brabury Electronics Ltd, Smitham Bridge, Hungerford, Berkshire RG17 0QU. Phone: 048-86 3511. Telex: 848760.

CENTRO (USA)
Centro Corp, 4848 Ronson Court, Suite 1, San Diego, Cal 92111. Phone: (714) 560-1578.

CLYDE (UK)
Clyde Electronics Ltd, Ranken House, Blythswood Court, Anderston Cross Centre, Glasgow G2 7LB. Phone: 041-221 5906/248 3001.

COMPACT VIDEO (USA)
Compact Video Systems Inc, 2813 West Alameda Avenue, Burbank, Cal 91505. Phone: (213) 843-3232.
UK: Compact Video Systems Ltd, 15 North Avenue, London W13 8AP. Phone: 01-977 5959.

DELL (UK)
Dell Technical Vehicles Ltd, Brokenford Lane, Totton, Southampton SO4 4DX. Phone: 0703 860044/5. Telex: 477426.

EPO (UK)
Evershed Power-Optics Ltd, Bridge Wharf, Chertsey, Surrey KT16 8LJ. Phone: 09328 61181. Telex: 929945.
USA: Power Optics Inc, 1055 W Germantown Pike, Fairview Village, Pennsylvania 19409. Phone: (215) 539-5300. Telex: 846314.

GARBETT (UK)
John Garbett (Audio Visual) Ltd, 8 Broad Street, Wokingham, Berks RG11 1AB. Phone: 0734 790415.

GERTENSLAGER (USA)
The Gertenslager Company, Wooster, Ohio 44691. Phone: (216) 262-2015.

GOWRINGS (UK)
Gowrings Engineering MVC Ltd, Darwin Close, Reading RG2 0RW. Phone: 0734 81654. Telex: 847572.

HARRIS (USA)
Harris Corp, PO Box 4290, Quincy, Illinois 62301. Phone: (217) 222-8200. Telex: 404347.
UK: Dynamic Technology Ltd, Zonal House Alliance Road, Acton, London W3. Phone: 01-993 2401. Telex: 935650.

LINK (UK)
Link Electronics Ltd, North Way, Andover SP10 5AJ. Phone: 0264 61345. Telex: 47132.
USA: Television Equipment Associates Inc, Boway Road, PO Box 20, South Salem, NY 10590. Phone: (914) 763-8893. Telex: 710-575 2600.

MARCONI (UK)
Marconi Communication Systems Ltd, Marconi House, New Street, Chelmsford CM1 1PL. Phone: 0245 353221. Telex: 99201.
USA: Marconi Electronics Inc, 100 Stonehurst Court, Northvale, New Jersey 07647. Phone: (201) 767-7250. Telex: 9919752.

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

PYE (UK)
Pye TVT Ltd, PO Box 41, Coldhams Lane, Cambridge CB1 3JU. Phone: 0223 45115. Telex: 81103.
USA: Philips Broadcast Equipment Corp, 91 McKee Drive, Mahwah, New Jersey 07430. Phone: (201) 529-3800.

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

RCA (USA)
RCA Broadcast Systems, Front and Copper Streets, Camden, New Jersey 08102. Phone: (609) 338-3000. Telex: 834357.
UK: RCA Ltd, Lincoln Way, Windmill Road, Sunbury-on-Thames, Middlesex TW16 7HW. Phone: 09327 85511. Telex: 24246.

REDIFFUSION (UK)
Rediffusion Industrial Services Ltd, Rediffusion House, 214 Red Lion Road, Surbiton, Surrey KT6 7RA. Phone: 01-397 5133. Telex: 929989.

SIEMENS (West Germany)
Siemens Aktiengesellschaft, D-7500 Karlsruhe 21, West Germany. Phone: 0721 595 2428. Telex: 7826851.

SMITH (UK)
A Smith Gt Bentley Ltd, The Pightle, Great Bentley, Essex CO7 8PR. Phone: 0206 250380. Telex: 98346.

SONY (UK)
Sony Broadcast Ltd, City Wall House, Basing View, Basingstoke, Hants RG21 2LA. Phone: 0256 55011. Telex: 858424.

STONEFIELD (UK)
Stonefield Vehicles Ltd, Cumnock, Ayrshire KA18 1SH. Phone: 0290 21822. Telex: 777536.

SWANLIND (UK)
Swanlind Ltd, Stafford Road, Fordhouses, Wolverhampton WV9 5HA. Phone: 0902 783405/789212.

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

TELEVISION ENGINEERING (USA)
Television Engineering Corp, 519 Rudder Road, Fenton, Missouri 63026. Phone: (314) 343-5606.

THOMSON-CSF (France)
Thomson-CSF, Division Radiodiffusion-Television, 94 Rue Du Fosse Blan, F-92231 Gennevilliers. Phone: (1) 790.65.49. Telex: 620573.
UK: Thomson-CSF Equipment and Systems Ltd, Hunting House, Central way, North Feltham Trading Estate, Feltham, Middlesex TW14 0UD. Phone: 01-751 6241. Telex: 934215.

ZOOM (UK)
Zoom Television Ltd, Systems Division, Cowley Mill Industrial Estate, Longbridge Way, Uxbridge, Middx UB8 2YG. Phone: 0895 57982. Telex: 848534. □

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Independent Local Radio—Brighton prospects

Norman McLeod

Norman McLeod continues his in-depth look at the setting-up of an ILR station from the ground up, concentrating on the new commercial station for Brighton, Sussex. The franchise has been awarded, so attention is now turned to what the station intends to do—and the stance of the IBA with regard to ILR in general—along with how the BBC is likely to react to the new challenge.

IT finally happened last month, more or less on schedule. The IBA announced that its franchise for the Brighton area had been awarded to "Southern Sound", and the news trickled around town in the milieu of people sufficiently eccentric to be interested in such things. A spokesperson for Southern Sound emerged from obscurity for long enough to say how pleased they were and to read out something from the franchise application and then disappeared again.

A few Brighton residents were for a while aware that something to do with radio had happened, but a week after the announcement not one person surveyed in my admittedly small poll could remember the name of the successful applicant. There was no televised ceremony of wisps of white smoke emerging from the IBA's Brompton Road headquarters as the secret conclave of IBA executives chose their latest protégé. The new Southern Sound pontiff did manage to promise that the service would be an indispensible one, according to reliable reports, which was a little upsetting. Since we are all dispensing with it at the moment, how can it be so essential to our lives in the future?

Maybe the answer is to do with the fate of BBC Radio Brighton at about the same time as the new ILR station is due to open. The BBC seems to have grabbed hold of the idea that it is better for everyone in the country to have a dilute BBC local radio service for six hours a day than it is for selected parts of it to have a proper service. This idea has been promulgated in BBC local radio planning as universal truth and wisdom, though it doesn't seem to be supported by anything other than whimsy. So BBC local radio stations are getting bigger and bigger: Radio Birmingham has been born again as Radio West Midlands, the new stations in Cambridgeshire and Lincolnshire encompass vaster areas than many of their predecessors—and Radio Brighton is to turn into Radio Sussex.

By that time, if current trends are anything to go by, the BBC's committment to local broadcasting in the county will have shrunk to six hours or so, and the rest of the time the newly-fortified transmission system will perform the pointless task of relaying Radio 2, in stereo if you are very lucky.

Stereo, incidentally, only appears on BBC transmissions in remote parts of the country when there is an imminent threat that the IBA might get there first. Listeners in Central Scotland only saw their multiplex beacons light just before Radio Clyde came on the air in 1973, while VHF listeners in Aberdeenshire had to wait until the ILR station was a spectre looming on the horizon before network transmissions were supplied from a circuit with more than 8kHz bandwidth. Meanwhile, in Brighton, the BBC is finally spending what is rumoured to be a quarter of a million pounds refurbishing its studios for stereo operation.

The IBA will supply its Brighton station with a pair of transmitters offering very much the same coverage as the Brighton BBC station achieves at the moment: VHF and medium-wave penetrating a coastal strip a few miles wide from Seaford in the East to just beyond Worthing in the west, with additional MF daytime coverage as far inland as Haywards Heath, even Crawley for the enthusiastic. And it seems that just as Southern Sound comes on the air, the BBC will vacate this editorial delineation for a much wider empire including such foreign parts as Eastbourne and Hastings.

People in Eastbourne and Hastings are reported to be mildly grateful for the prospect of the BBC taking some notice of them. In this part of England better radio reception can often be had from France than from the remote BBC transmitter in North-East Kent, and locals do feel rather neglected. But, says retired manager Bob Gunnell, the people in Brighton did not relish the prospect at all. Presumably he would not have drawn the threat of Radio Sussex to our attention if he relished the expansion process either.

No doubt the IBA is delighted with the idea that the BBC service should be watered down just at the time their new station will come on air. The IBA definitely likes its companies to do well for themselves. Its role is like that of an anxious parent, not afraid to rap the knuckles of any child behaving recklessly, but nevertheless keen to have happy, healthy offspring to parade before Auntie.

The parental code is based on the maxim that health equals wealth equals happiness, and that wealth is inextricably linked with what the market analysts call "reach". I believe that "reach" is a figure which relates to the percentage of people in the service area of a station whose consciousness is intercepted by the station's broadcasts in any given week, though I confess that the whole business strikes me as arcane to say the least.

Some idea of what the IBA might be looking for from a would-be ILR service can be gleaned from a study of a document entitled *ILR Programming: Some Priorities for Development*, issued by the IBA Radio Consultative Committee last March. Presumably the priorities detailed in this document are not at variance with existing operators' thinking, since "points... put forward by the ILR companies have in many instances been incorporated."

"What can ILR achieve," it is asked, "both for its individual stations and for 'Independent Radio'?". Note (i) that the local audience does not enter into this type of consideration and (ii) that "Independent Radio" appears in capital letters and is surrounded by inverted commas. It is clear that in addition to being local services for local communities, ILR stations are expected to live up to the idea that "Independent Radio" is a national force in its own right. Emphasis is placed on scoring over the BBC—not just locally, but against its network services too.

"Co-operations and effective use of programming and technical resources may be essential if ILR is to meet the competition from BBC Radio (e.g. from a much improved Radio 1 and 2)." ILR companies should try to fly the flag nationally wherever possible, swapping prestigious programmes around and getting ILR productions reviewed in the *national* press. "...Major commercial or industrial organisations may well consider it attractive to have their products associated with a system that receives... mention in the national press, and wins awards against the BBC."

There is thus a committment to 'prestige' over and above the demands of a modest service to a local audience. But many newer ILR stations are experiencing as their main problem "...achieving a level of revenue which will allow for profitability when set against the basic capital and running costs of an ILR station." In other words, having spent, say, half a million pounds establishing a studio complex to the IBA's tight technical specifications, smaller stations are finding that their return on this substantial and compulsory investment is rather slower and slimmer than they would like.

There are of course two ways to improve the balance sheet: you can earn more or you can spend less. There are no signs whatever that the latter option is one which ever receives serious consideration in IBA circles, though there is ample evidence elsewhere to suggest that £500,000 is vastly in excess of what is really needed to establish a station which people will listen to. Instead the emphasis is forever on 'audience reach'.

"If an ILR station does not achieve a following in the 'breakfast show', then it will certainly not achieve an audience reach acceptable either to local opinion, to its own pride, to the IBA or to potential advertisers.... Yet some stations still put their main production effort into programming available only to a minority audience....". Minority audiences are indeed in for a lean time. "Stations will need to limit and pace themselves; select among the possible targets; and then focus on chosen, even if deliberately restricted, objectives."

This does not square too well with the Association of Independent Radio Contractors' recent haughty dismissal—as 'narrow and sectarian'—of the objectives of the sundry organisations campaigning for new, different forms of radio broadcasting in the UK. ILR seems both to be narrowing its objectives, and enjoying as sectarian a rivalry as ever there was in its perception of the activities of Broadcasting House.

With the Authority in its current frame of mind, what sort of presentation would be likely to impress it? Newcomers to the ranks of "Independent Radio" (capital I, capital R, if you don't mind) are expected to restrict their broadcasting hours, to concentrate to peak listening hours and let the rest of the output dwindle, and to get up earlier in the morning to produce better breakfast shows. This is all carried out in the name of "audience reach", and despite occasional long-

winded attempts in IBA journals to obfuscate this matter, head-counting is, at the end of the day, the one utterly overriding factor determining what is broadcast on ILR. There is no attempt anywhere in the IBA paper to establish a qualitative analysis of the relationship between a commercial local radio station and its audience. We are told, instead, that "marketing areas need to be supported by the editorial service..." which would seem to mean that would-be advertisers have to be appeased and appealed to by the editorial content of the station.

Southern Sound certainly seem to have struck a few chords: while the IBA was talking about the need to focus and conserve resources, Southern Sound was promising to issue its 'top grade professionals' with a brief 'of attempting only what can be done really well'. While the IBA was asking its stations to sharpen up their breakfast programmes in particular, the successful Brighton company claimed that it would start broadcasting earlier than most radio stations—at half-past-five in the morning—and that the breakfast programme would be "on time" (whatever that means) "pacey, and well-produced". Also, its envisagement of the appointment of a "Southern Sunrise" producer to the breakfast show during its second year of operation clearly shows its acceptance of the paramount nature of the early programme.

Although Regency Radio claimed to regard its breakfast show as the 'flagship programme slot of the day's listening' they could not find much more to promise than a 'lively programme with latest travel and traffic news, weather forecasts and timechecks, etc.'. They also seemed to be keen on the 'personality DJ' idea, which does not find favour in high circles, by stating that 'the choice of presenter is obviously crucial'. Neither Channel Contemporary Radio nor Southdown Radio, the other two groups, appeared to have devoted special attention to getting up early and putting together a better breakfast programme.

The breakfast show seems to be the most readily identifiable point where Southern Sound's application was clearly different in emphasis and more closely in line with IBA thinking than the other hopefuls. There is also a promise to establish the Southern Sound Charitable Trust, for which the station will raise money through unspecified 'on air' and 'off air' activities.

This Trust "would maintain a close relationship with Southern Sound, but would be an independent entity" and its concerns would cover a range of financial needs, including "one bursary each year to a student wishing to specialise at a university or college of further education." A former director of East Sussex Social Services and two CBE's are named as the future Trustees of this "independent entity" which would nevertheless "maintain a close relationship with Southern Sound."

Southern Sound also claims to have set up four consultative panels, to deal with sport, religion, the arts and education matters. These panels have been established to contribute advice and ideas and to maintain strong links between the radio station and various fields of activity in the community. All good stuff, and entirely in keeping with the more benign elements of ILR, though I might suggest that they add 'music' to their list of specialised subjects worthy of broad consultation. All too often the reason why the music output on ILR is is so banal and trite is because the people choosing it have got far too much other work to do to be properly aware of what is available, and are completely out of their depth whenever anything remotely unusual comes along.

Southern Sound's attitude to the records they will play does not inspire confidence: "...our music will be carefully planned and selected because of its friendliness and popularity. We would avoid music which alienated our listeners." Nowhere is there any evidence that a team of interested cognoscenti will be applied to this task, and it would seem that music will be chosen out of purely commercial considerations rather than for any intrinsic merit or relevance. Yet even the IBA seems to be aware that many of the records played on ILR are boring—its own words are that "the musical element in output shows some signs of fatigue..." and it notes with (I think) regret that "...many smaller stations' resources do not provide for exploration of the less obvious sources of interesting and potentially popular music...". It even talks of ILR "...fulfilling an educational role through deliberately, but often imperceptibly, guiding and leading public taste across the range of music."

I can think of at least half-a-dozen people of my personal acquaintance who could fulfil an educational role by leading many an ILR station across previously uncharted musical territory. I find the idea that the station leads its audience in musical taste difficult to grasp when I compare the contents of my musical friends' record collections with the type of material endlessly repeated on IBA radio frequencies. It is never recognised that the audience—some of them, anyway—could lead the station in new directions of musical awareness—particularly if they are involved in music in some way or other.

Finally, in looking back at the process of setting up an ILR station, now that it has progressed to the stage of naming the new company, it is quite proper to look at whether the listener (for whose benefit the station is allegedly established) has been made aware of, or consulted about, the new addition to his wavebands. Most of the people who will be expected to listen to the station have yet to be made aware of its name, existence or purpose. No doubt in a year's time, when arrangements are complete and finalised, the man in the street will be bombarded by T-shirts, car stickers, and the rest of the promotional razzamatazz which commercial stations are so good at. Publicity to date has been much more muted.

Initially, the Home Office Local Radio Working Party—a body of twelve people, four from the BBC, four from the IBA, and four from the Home Office—determined, in Whitehall, that Brighton should be in line for the offer of an IBA franchise. No-one bothered to asked Brighton residents whether or not they wanted a new radio station, or set in front of them any other possibilities aside from the standard ILR model. The IBA then smoothed the way for applicants to compile their plans, supplying tentative and not-very-widespread publicity to the effect that the station was on its way, and explaining (as a fait accompli) what an ILR station is about.

Most people, of course, regard radio stations as such fantastic and wonderful things that they are simply grateful for the prospect of someone going to a lot of trouble and expense in order to set one up for them. The whole process is made sufficiently complex and mysterious—not to say expensive—to deter all but the most enthusiastic or wealthy from bothering their heads about it at all. In the meantime, it is hard to distinguish between the aims and objectives of the IBA and the franchise holders as far as their definitions of what is proper and desirable are concerned.

This is not altogether surprising: IBA executives and ILR directors come from similar, professional backgrounds and appear to be interchangeable to a degree. Capital director John Whitney is to become the next Director-General of the IBA, while the same station's former chairman, Sir Richard Attenborough, is now deputy chairman of Channel 4 TV. The IBA ends up simply doing what is best for 'Independent Radio'—as a national concept—since as a central organisation it can hardly contribute anything useful to the individual, local relationships between the station and its audience. And composed as it appears to be of hard-headed professionals who are basically in tune with the commercial and popular aspirations of other professionals, it seems that the regulatory action of the IBA consists of little more than paternal, fussy guidance on prudent business strategies.

Critics of the IBA from within the industry include the more cavalier and radical elements of the radio business—often with experience of offshore piracy or the diverse nature of US programming policy—who would much rather be running a station in the States than here. They would broadcast longer hours with skeletal resources, run different programmes on AM and FM transmitters, and aim squarely at limited sections of the market rather than trying to be all things to all people. An unsuccessful format would be dropped in favour of a new one overnight, the amount of money spent on studios would be drastically cut, and staff would be paid as little as they could get away with. Theirs is altogether a purer form of commercialism which has not, yet, become official Government policy. Even with our present right-wing administration, the broadcasting consensus in this country is too well-rooted in the political centre for this type of individual adventurism to be wholly acceptable.

The most daring official statement of this type of thinking emerged in the Association of Independent Radio Contractors' submission to the Hunt Committee, but even that is almost self-effacing. "This, in our opinion, may be the appropriate time for a fresh appraisal of the complex problems of supervision... possibly leading to a freer and more enterprising approach to regulation, the search for which does not imply any move towards a diminution of standards."

Critics of the IBA from a left-wing point of view tend to be mainly 'professional' radicals and well-meaning *Guardian* readers who do not, as a rule, work within the lion's den itself—a point which is often advanced to try to diminish the authority of their arguments. Those who do work in ILR come from places like the 'community' station in Cardiff—a station which the rest of the network would like to disown entirely. One argument is the converse of the 'libertarian' approach—the rules surrounding ILR are not tight enough, and in particular, if the amount of time stations were allowed to spend playing records were cut, the amount of 'better' programming might increase. This is the line taken by *City Limits*' radio editor Johnathan Coe, and together with Local Radio Workshop, he is trying to 'improve' the programmes brought to the public's attention by ILR.

Another view, from the more liberal-minded on the left, takes the view that ILR is long past praying for, and that what will improve radio broadcasting is the unleashing of a diversity of smaller, more specialist, locally-controlled stations without allegiance either to the BBC or to the prestigious pomp of 'Independent Radio'. This had been dismissed by the other left sector as 'the biggest money-spinner yet', and there are signs that they might be right. Suddenly, minority broadcasting is becoming fashionable—with cable promoting the benefits of 'narrowcasting' and a general free-for-all—and disillusionment with the middle-of-the-road approach to programming is spreading within and without the industry.

Even the IBA—though contemptuous of current 'third force' initiatives—does not turn up its nose at the prospect of overseeing new cable developments, including various types of 'narrowcasting'. No doubt it will proceed on the basis that what is good for the industry is good for the man in the street, and he will not need to have his limited intellectual capabilities taxed by a surfeit of consultative procedures. □

International Broadcasting Convention a report

Noel Bell

As with the previous International Broadcasting Conventions, this year's Convention and exhibition was dominated by video orientated hardware. Likewise the technical programme concentrated upon television matters. However, despite this natural preponderance of matters pertaining to the 'box', this year's IBC also saw an increased awareness of audio matters. This was reflected by an increased number of audio-only exhibitors and by a greater emphasis being given to audio subjects in the technical programme.

Exhibition overview

Following the usual pattern, the IBC exhibition tended to be dominated by the large video-orientated companies. Once again the likes of Ampex, Hitachi and Sony mounted their all embracing Mega-displays festooned with cameras, recorders, mixers and television monitors. On these and many other television dominated stands if one searched out the farthest—and most difficult to get at—corner you would find the audio section. However, once discovered these sections did not necessarily hide new items to interest the audio engineer. Indeed in many respects the audio side of the exhibition did not see the introduction of a wealth of new items, but there were a number of products that caught the eye. Whilst I will briefly mention a number of new products here, full details of all these new items will appear in the New Products section of this and future issues of *Broadcast Sound*.

Principal among the new arrivals was the Ampex/Nagra *C/VPR-5* C-format VTR. This is an incredibly lightweight portable VTR combining some of the best features of the Nagra portable audio tape machines with Ampex's knowhow in the video department. An extremely versatile machine, the *C/VPR-5* has that solidly engineered Nagra look—indeed the machine's front panel is decidedly Nagra-like—but in addition to its undoubted ENG video uses, it also offers many audio-only features which are likely to be attractive. The provision of two audio channels, plus a timecode channel, together with switch selectable filters to match the LF reverberation characteristics of a recording venue, being prime examples of the forethought which has gone into this recorder.

Staying with tape machines, but moving on to an audio-only tape recorder, Enertec introduced a new recorder suitable for studio or mobile applications. The new machine, termed the *F-500*, will be marketed alongside the existing *F-462* studio machine, but unlike its big brother the new recorder is almost flimsy in appearance. Very compactly styled with a neat layout of controls, its appearance belies its solid construction and the high quality engineering loitering beneath its fascia. A three speed machine, the *F-500* features wide ranging EQ adjustment facilities and is available in a wide range of formats.

Another new tape machine on display was the Studer *A810*. Although at present only pre-production models are available, this new 2-track plus timecode tape machine (other versions to mono, 2-track and stereo formats will be available), typifies the Studer approach. Solid mechanical engineering coupled to innovative microprocessor controlled electronics form the basis of the *A810*. The facilities available are truly comprehensive and ideally suited to the needs of broadcasters, and include transport command keys with tape address facilities, full remote input control via serial interface, and phase corrected audio electronics. In addition, as one has come to expect from Studer the quality of construction is exemplary, and with the provision of modular construction and full electronic control, the *A810* probably becomes *the* analogue machine for broadcasters.

Moving on to audio consoles, the star in this department was the first public showing of the new Solid State Logic *SL 6000 E Stereo Video System*. Whilst obviously being based on the company's highly successful music recording console—which has found favour with a number of broadcasters including the BBC and ABC in the USA—the new console includes several marked differences from the company's familiar music recording console. First off, there are six mixing groups instead of the standard stereo or quad busses, thereby allowing three stereo mixes to be provided for music, effects and dialogue mixes. Secondly, the new console has three master facility panels containing the master console electronics; a command keyboard for the SSL Primary Studio Computer, master video machine or synchroniser, a built-in video display and the SSL Video Switcher; and a third panel for the control of mix master machines and stereo matrixing, and programmable controls for external carts, tape machines, turntables and VTRs. The new console which is suitable for both post-production and live production applications, is available in two standard mainframe sizes accepting 24 or 32 input/output modules. Outside broadcast versions with remote patchbays are also available, as are custom built versions with up to 56 I/O modules. Versions with more than 40 I/O modules may be configured with up to three mix positions. (A detailed report on this console will appear in the January/February issue of *Broadcast Sound*).

Running a close second to the new SSL console, was a prototype assignable audio console from Audix. This console which takes the form of a compact control desk with the audio electronics being remotely located in 19 in racking, points the likely way ahead for audio consoles in the future. With a control desk which is comparable in size to a vision mixer panel, yet which still offers full control of 32 input channels and all ancillary facilities, the prototype desk advances the art of the possible for audio mixers. Utilising digital control techniques and with interconnection between the control desk and audio electronics being via coaxial cables, the prototype console features extensive memory facilities allowing instant recall of individual channels or any one of a number of complete desk settings at the touch of a button. Particularly noteworthy, is the fact that the number of input channels and groups which may be configured within the system is far in excess than anything currently realisable using existing audio mixing technology. In addition the console incorporates the ability to expand facilities without having to completely rebuild the whole system.

Almost commonplace in relation to the two consoles just described, was the announcement by ▷

APL series

The APL series, which is now in use at Radio 210 Reading, was designed for the discerning user who is aware of all the pitfalls and performance problems of conventional cartridge machines and wishes to extract the ultimate performance from the NAB cartridge.

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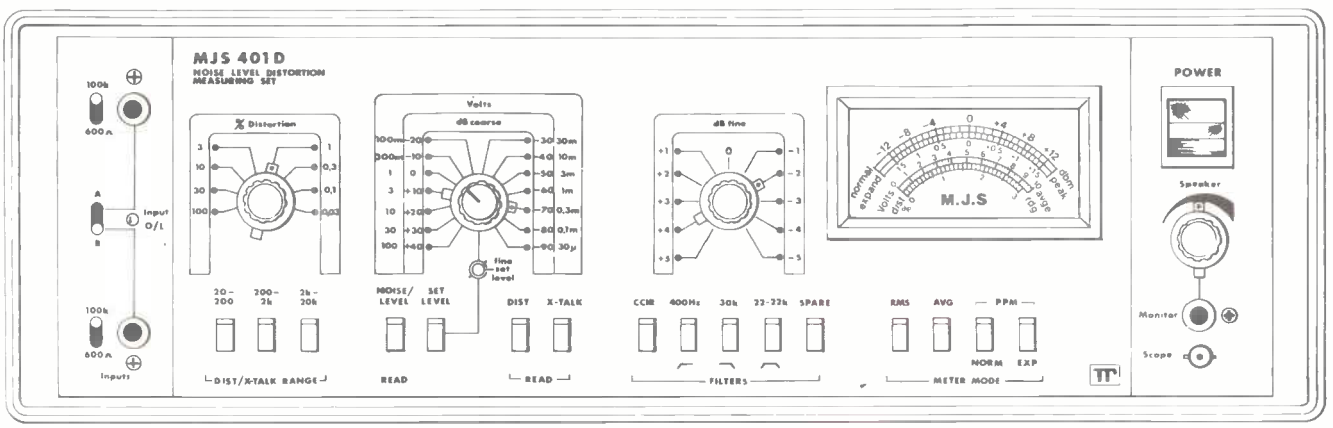

The 401 noise and level test set has been in widespread use since 1977 throughout the broadcasting industry. Continuous development has taken place since the 401 was first introduced to evolve it into one of the most popular, foolproof, easy-to-use and well proven test instruments in use in the professional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

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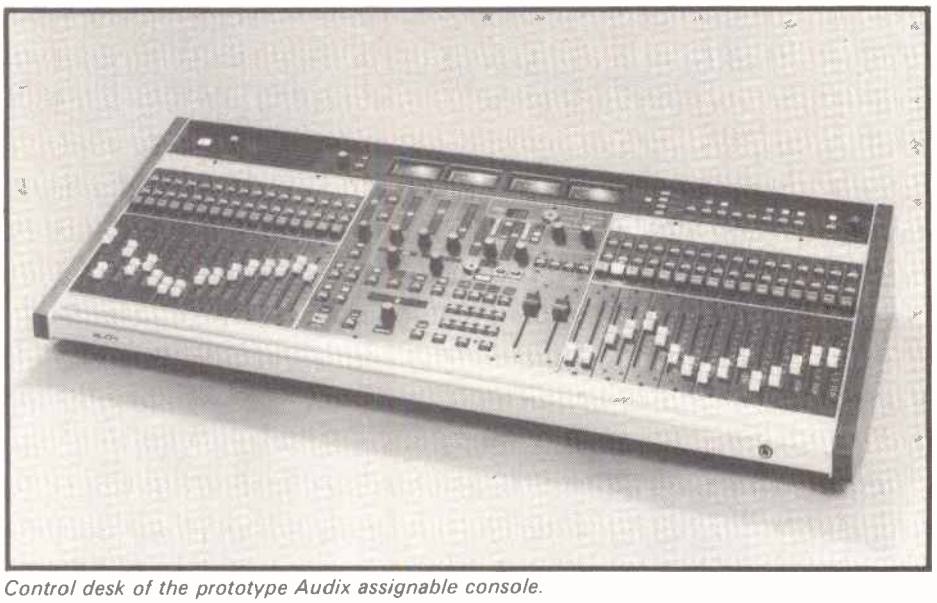
Enertec of a new mixing desk suitable for applications such as mixing in small production studios, continuity studios, and for mobile usage. The new console, termed the *UPS 6104*, forms part of the established *6000 Series* and is the most compact mixer in this product range. Main features of the mixer include 10 mono input channels; two echo returns; two main plus two auxiliary groups; two main and two auxiliary outputs with limiter; full talkback and monitoring facilities; and 3-band EQ plus highpass and lowpass filters.

Somewhat similar in format to the Enertec is the MCI *JH-800* console which was making its UK debut at IBC. Tucked away in a corner of the Sony Mega-display—somehow I still haven't adjusted to the fact that MCI is now a division of Sony—this interesting little console seemed lost amongst its bigger brethren and all those confounded video machines. However, the *JH-800* is an excellent compact, portable, general purpose 12 channel audio console with specifications and features similar to MCI's studio consoles. The *JH-800* has 12 input modules with mic and line inputs, 3-band EQ and high and low cut filters, plus dual stereo mix capability and four sends. Level control is via VCA controlled faders with four selectable groups. Each input module also includes a line output to enable multitrack recording or feeds to an auxiliary mixer. The *JH-800* also includes three additional line returns (two mono and one stereo) and both stereo mix pairs include a built-in comp/limiter. Other features include full talkback and monitoring facilities; bargraph metering for each mix pair, the four sends and the comp/limiter; and the facility to accept either external AC or DC powering. The mixer also has phantom power facilities.

Also lurking in the audio corner of the Sony stand and making its debut was the company's professional *Compact Disc* player and analyser system. Comprising two units, the *CDP-5000* playback unit and the *CDA-5000* analyser, the system holds out the promise of a freely available digital audio medium, immediately accessible to broadcasters. The system which is configured as a heavy duty playback unit with rapid access; and a comprehensive analyser unit which is capable of remote control of the player, analysis of the discs themselves and with facilities for CRT display and hard copy printout; illustrates that as usual Sony seem to have provided all the answers before even the question, 'How are Compact Discs going to be interfaced to the broadcast medium?', was asked. In the light of the slightly unexpected early appearance of the Sony professional system, perhaps what pundits should now be asking is how soon will *Compact Disc* become an accepted prerecorded music source for broadcast purposes.

Whilst the aforementioned products comprised the highlights of the exhibition, others worthy of mention include the *DAS 175* digital audio synchroniser from Quantel—this unit marking Quantel's entry into the audio field; the Orban *424A* gated compressor/limiter/de-esser; the Amber *Model 3501* noise and distortion measurement system; and the first European showing of the *System II* intercoms from Clear-Com.

Perhaps not quite falling into the normal exhibit category were the displays mounted by BBC Engineering and the IBA. While the IBA somewhat unusually for them had nothing new to offer on the audio front, the BBC had much of interest. Resisting the temptation of playing with the BBC Microcomputer, a perusal of the stand revealed an operational VHF receiver modified to receive the BBC's *Radio-Data* transmissions; the *LS 5/9* two-way compact monitor loudspeaker; and a self-powered headphone sound level protection unit. Additional to these, the BBC also showed a Band II 2 kW modular power amplifier bay; a digital solid-state recorder for audio line identification signals and jingles, using 8-bit A-law coding and with a sampling rate of either 8 kHz or 16 kHz depending on the type of storage RAM fitted; and finally, details of the Design Department's system of providing centretrack SMPTE/EBU timecode facilities on Studer *B62*, *A80RC* and *B67* $\frac{1}{4}$ in tape machines. The system which was pioneered in 1979 on a modified *B62* provides a 0.8 mm wide timecode track in the 2 mm guardband between the audio tracks.



Control desk of the prototype Audix assignable console.

Outside the main exhibition centre in the Metropole, one had to brave the rigours of teeming rain on all but one of the days of the Convention, if those exhibitors in the Bedford Hotel, or if the mushroom like display of satellite dishes and gaggle of OB units on the Brighton promenade were to be visited. Despite the lack of weatherproof clothing I braved the elements to discover that the most interesting item lurking outside was one of two new BBC Radio mobile studios designed particularly with the requirements of complex OB events in mind. These vehicles are based on a Ford coach chassis and are split into three main operational areas—a studio and production control area with a Glen Sound 24-channel communications facility; a centrally placed control room with a 30-channel Glen Sound mixing console and space for four stereo tape machines and two disc reproducers; and at the rear a radio-link section. These vehicles are most impressive and have already proved their value on such OB events as The Derby, Wimbledon and the Pope's visit to Britain.

On the subject of OB vehicles, it is worth noting that Brabury Electronics, a company which is much respected for its construction of such vehicles, was put in the hands of the Receiver in late August. Despite this unfortunate turn of events the company was in attendance at the exhibition and I was informed that constructive efforts are being made to save the company. Indeed, it is hoped that an announcement to this effect will be made in the near future.

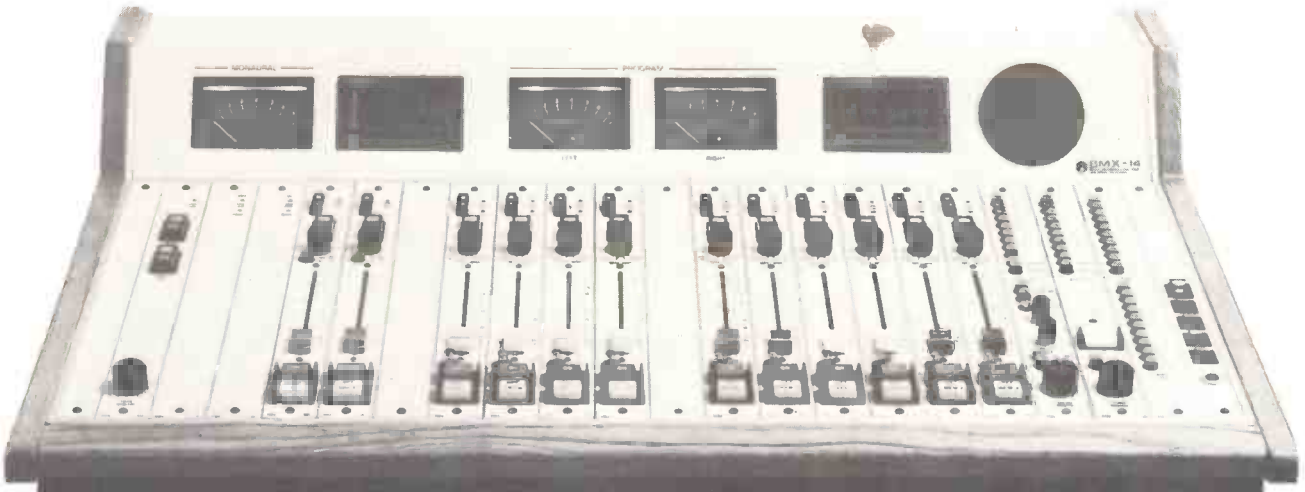
Finally, in this exhibition overview, brief mention should be made of those video products that caught the eye. The video highlight, other than the Ampex/Nagra C-format VTR discussed above, was the demonstration by Sony and Philips of High Definition Television. Sony in particular mounted an impressive display in a hotel outside the main exhibition centre. Here the high quality definition and more cinema-like widescreen picture format proved especially effective. From the audio point of view what is most relevant about the widescreen format is that it is ideal for linking to stereo TV sound, the width of picture lending itself to a more creatively effective stereo image spread.

Technical programme

Whilst high definition television, digital video and satellite and cable television loomed large in the scope and number of papers presented in the technical programme, this year's convention also addressed itself to a greater number of audio topics than has been the case at previous Conventions. Accordingly, this section of my report is devoted to the most interesting technical papers devoted to audio subject matters.

Kicking off the whole technical programme was a session entitled 'Broadcasting Technology for the Future'. Although this session mainly concerned itself with television matters a number of points relating to audio emerged. The first was a plea by J Barnathan of ABC for international co-operation in creating an international RF spectrum for newsgathering. What Mr Barnathan feels is necessary is one designated set of radio frequencies—for video, audio and communications—for use in newsgathering in every country in the world. This would allow broadcasters to operate rapidly throughout the world wherever a news story broke, and would greatly facilitate the speed with which stories could be reported. Unfortunately, though such agreement would be advantageous, parochial self interest by government agencies, usually couched in the terms of a requirement to protect home-based equipment producers from the threat of foreign imports, usually entails the use of a wide number of frequencies worldwide. Whether such self interest can be overcome through the efforts of agencies such as the EBU and FCC remains to be seen, but one suspects that despite the logic of Mr Barnathan's plea, it will be some time before internationally agreed RF spectra for newsgathering are formulated.

Continuing this session, Mr CP Sandbank of the BBC's Research Department presented an interesting overview of the impact of new technology on future broadcast service. Here direct satellite broadcasting, digital television and high definition television loomed large, but one or two audio pointers to the future were covered. Particularly relevant was information on the number of multiplexed sound channels which experiments have shown can be accommodated on a subcarrier of the vision signal for direct digital satellite broadcasting. These experiments indicate that six digital sound channels sampled at 32 kHz can be accommodated with a vision signal in the 27 MHz FM bandwidth provided by the planned WARC allocations. Such a service if implemented would offer stereo sound with vision with the ▷



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facility for using the extra capacity for additional sound and data services. Since it is planned to introduce TV transmission by DBS to the UK by 1986, it would be particular neat if the service also offered direct digital sound broadcasting.

Also in this paper, Mr Sandback detailed the existing and potential uses of microprocessors in radio broadcasting. Microprocessors are already being used in radio receivers to control frquency-synthesisers with digital readout of tuning information. However, looking to the future, the broadcasting of radio data for station and programme identification—as already being demonstrated by the BBC—will make radio receivers even easier to use. The BBC system is configured as an alphanumeric display facility, but it is possible to use radio data to address a speech synthesiser too. This is particularly interesting in connection with the intention to provide auxiliary services such as weather or traffic information via radio data, but in addition it also provides a feasible alternative to alphanumeric display for in-car usage where displays could be considered as a potentially hazardous distraction.

Turning now to radio transmitters, a complete session was devoted to this subject. No less than six papers were presented of which five were of interest. In the first W Tschol and J Kane of BBC Brown Boveri & Co outlined the new directions being taken in the design of high power broadcast transmitters. The authors contend that principal design criteria are now minimum operating costs, minimum capital cost, ease of servicing and accessability, and simplicity of use. To meet these criteria the authors describe the development of high power LW, MW and SW transmitters using a new AF amplification technique termed pulse step modulation (PSM). This technique, which uses a PSM switching amplifier rather than analogue amplification or a pulse duration modulation switching amplifier, allows the use of semiconductors rather than high power tetrodes in the modulators of 250 kW to 600 kW transmitters. Accordingly,it is possible to produce SW transmitters using only two tetrodes and LW and MW transmitters with a single tetrode.

Two papers in this session were addressed to PDM type transmitter technology. The first paper from JE Brett and RB Molyneux-Berry of Marconi discussed the design of PDM drive units, with particular reference to the Marconi *Pulsam* drive unit fitted to the new *B6127* 500 kW HF transmitter. Considerations dealt with included stray capacitance at the pulse output point, valve linearity, valve anode voltage and current considerations, drive power capability, and the use of constant current drive. The resulting Marconi unit uses constant current drive with the drive unit being powered by a 50 Hz transformer of very low capacitance, a similar transformer being provided for the valve filament. The drive unit and regulators are solid state devices and the PDM input and control and monitoring functions are carried by optical fibres. Although the Marconi drive unit is configured to a series/shunt arrangement in the *Pulsam* system, it is also suitable for use where a direct-coupled modulator is required.

The second paper dealing with PDM transmitters was presented by B Wysocki of AEG-Telefunken and K Breitkopf of RIAS, Berlin. This paper concerned the topic of saving energy with PDM-type transmitters and introduced the concept of volume dependent amplitude modulation for AM transmitters. This technique which can be applied to modern PDM transmitters of the AEG-Telefunken *Pantel* type gives direct control of the anode voltage of the final RF amplifier dependent upon the AF volume. Since in the *Pantel* system the pulse duration modulator and final RF amplifier are in series, this means that both modulator and DC anode voltage for the RF stage are supplied effectively from one source, hence the DC anode voltage can be easily controlled by means of the pulse ratio of the PDM signal.

Moving on to VHF FM transmitters, RAW Brocks of Marconi presented a paper discussing various design options for solid state FM transmitters. Factors considered included power output capability, load VSWR, reliability, cooling, output protection, power dividing/combining arrangements, gain and phase stability, internal arrangement of the amplifier stages, and arrangement of the power supplies. Mr Brooks conclusions were that apart from applications requiring extreme reliability, fan cooled rather than convection cooled designs should be utilised. He also concluded that high redundancy solid state amplifiers although more costly than equivalent equipment using thermionic valves offer increased reliability and fault tolerance and thus are more cost effective.

Finally in this session, P Gerlach and P Menes of Thomson-CSF described a new tetrode for single-tube RF power stage radio transmitters delivering more than 1 MW of carrier power. The new tetrode, termed the *TH 539*, overcomes the neccesity to use two lower power tubes in parallel for 1 MW transmitters operating on LW or MW. The *TH 539* is suitable for use with either a push-pull class B AF stage or a PDM AF stage, only requires approximately 1 kW of drive power for the tube itself, and obtains its amplitude modulation not only by anode modualation but also by 75 to 80% modulation of the screen grid voltage.

Satellite broadcasting was well to the fore in the technical programme and three papers considered sound aspects. In the first JB Watson of the IBA outlined a proposed digital sound and data multiplexing system for satellite broadcasting. This system has a transmission rate of 2048 Kbit/s, a repetition rate of 1000 frames/s, and each 2048 bit frame is prefixed by a 16-bit framing code and a 16-bit main header code. Single and double error correction is possible with the system and the function of the main header is to provide a 'directory' of the fixed length blocks, specifying whether multi-commentary foreign language channels, etc, are present. Audio parameters of the system include a 32 kHz sampling rate; a 14:10 near instantaneous companding scheme; audio data arranged as 32 10-bit samples; and a 15-bit audio header code giving single and double error correction, plus data bits indicating the channel function, eg mono/stereo/surround sound, etc.

The second paper of interest in this session, from MD Windram and DKW Hopkins of the IBA, discussed modulation methods and the FM channel for DBS. Main contention of the authors was that the plan to use conventional PAL and SECAM television signals with an FM sound subcarrier, could be improved upon by using an alternative picture coding system, Time Division Multiplexed Analogue Components (MAC), which would eliminate cross colour and luminance effects and give a substantial noise advantage. The MAC system can be used either with a subcarrier audio system as outlined in the paper from JB Watson, or alternatively the sound channels may be time division multiplexed with the time compressed MAC video. With the latter the audio is transmitted either as a burst of baseband pulses, or as a burst of carrier modulation. Using such a system the authors state that eight high quality audio channels can be accommodated, whereas using the subcarrier method only six channels are available.

Finally in this session, PA Ratliffe and A Oliphant of the BBC, outlined the BBC's proposals for television and radio satellite broadcasting. After a brief overview of the four alternatives available, (analogue/digital sound subcarriers with FM video; FM video with digital sound in the line-blanking interval of the video baseband; FM video time division multiplexed with a digital sound carrier in the line-blanking interval; and an all digital video/audio multiplex), the authors conclude that a six channel digital sound system modulated on a 7 MHz subcarrier is preferable. The BBC's proposal has digitally coded signals using the near-instantaneous companding technique, and multiplexed together to form a 2.048 Mbit/s data stream, in a manner broadly similar to the BBC's *Nicam 3* system. Should such a system be adopted, the BBC intends assigning two digital channels to the television service, leaving up to four channels per television service available for radio broadcast.

Whilst satellite broadcasting should be available in Europe in the second part of this decade, terrestial sound and television broadcasting will not suddenly disappear overnight. Accordingly, a paper from SM Edwardson of the BBC addressed to the topic of stereo and two channel TV sound was of interest. This paper discussed the BBC's investigations into four alternatives—pilot-tone stereo; FM-FM sound (as used in Japan); two-carrier sound (as used experimentally in West Germany); and digital sound. The results to date of these investigations point to the likely adoption by the BBC of either a two-carrier system, or depending upon further tests a digital system.

Finally, Matti Otala in conjuction with K Ilmonen of the Finnish Broadcasting Company, presented an interesting paper discussing the measurement (and amount) of dynamic distortion in sound broadcasting. The measurement methods used several variants of the dynamic intermodulation method, and as a result of their investigations the authors propose that a modified DIM test signal, termed DIM B, should be adopted for testing band-limited systems. The DIM B method uses a square wave frequency of 2.96 kHz which is passed through a lowpass filter having a 15 kHz cut-off frequency, the sinusoid frequency being 14 kHz and the peak-to-peak amplitude ratio of the sinusoid to the square wave being 1:4. Using such a test method the authors measured high levels of dynamic distortion in equipment which performs well in conventional distortion testing. The reason for this being that the effect is caused by signals having moderate to high temporal rate of change. Due to this, at nominal signal levels, distortion in excess of 10% was routinely encountered. The conclusion of the authors was that such measured distortion may explain some of the audible distortions encountered in broadcasting which have previously been classified as 'high-frequency overload'.

Conclusion

This year's International Broadcasting Convention was yet another successful sojourn to Brighton. Attendance at the convention was 40% higher than the previous convention held in 1980, with a record attendance of more than 7,000 delegates, exhibitors and press representatives. The international character of the convention being highlighted by the fact that visitors from 60 countries attended and that nearly half the participants came from overseas. As if to confirm the success, the dates for the next IBC have already been announced and the 10th convention will again be held at the Metropole Conference and Exhibition Centre, Brighton, from September 22 to 25, 1984.

Finally, any reader wishing to obtain the full text of the papers presented in the technical programme can still purchase the Convention Publication from the **IBC Secretariat, Institution of Electrical Engineers, Savoy Place, London WC2R 0BL, UK. Phone: 01-240 1871. Telex: 261176.** □

CKLW—Windsor Ontario

Paul Lehrman

Most Canadian radio stations have to take into account an audience outside of their own country—after all, 90% of Canada's population lives within 200 miles of the border with the United States. But CKLW is a little different. It's located in Windsor, Ontario, a city that is often considered a suburb of a city in another country, Detroit, Michigan, U.S.A.

DETROIT'S population of 1.2 million is six times as large as Windsor's. Much of Windsor's economy, like Detroit's, is dependent on automobile manufacturing, and Windsor has been seriously affected by the economic downturn that has crippled the American auto industry. Thousands of workers cross the border every day, and the wait to pay the toll on the Canadian side of the Detroit-Windsor Tunnel (by a quirk of topography, the *southern* side) is often longer than the delay at the customs booths.

Yet there are differences between the two cities that are greater than the 200 or so yards of river that separate them. While Detroit is home to the wide variety of ethnic groups that epitomize the "melting pot" character of many urban centres in the US, especially blacks (about 60 percent), Greeks, and Poles, Windsor maintains a distinctively Canadian mixture of French and English, with small proportions of other European groups. Windsor is quiet and clean compared to its neighbour, and open farmland and small-scale lakefront development areas are accessible only a few minutes' drive out of the city.

Radio waves, of course, know no borders, especially when the local terrain is as flat as southern Ontario's, and CKLW's listenership, which lives in the fifth largest market on the continent, is split about equally between Canadians and Americans. The station's 50 kW AM signal can actually be heard a thousand miles away, and it has loyal audiences as far east as New York and Boston. Although studies show that, at any one time, 70 to 90% of Windsor's radio audience is tuned in to US stations, CKLW-AM is currently in the top two in the local ratings, and at one time was number three or four in Cleveland, 65 miles away across Lake Erie. "That stopped," says advertising and promotions director Al Cecile, "when Cleveland radio got better."

The international audience causes the station some unique problems, not the least of which is how to stay within the restrictions of the Canadian Radio and Television Council (CRTC) while remaining competitive in the free-wheeling US market. For example, between the hours of 6 am and midnight, the station must play 30% Canadian music. This can get very sticky for Canadian artists with large American followings—if CKLW places their new records in the rotation, American stations protest that they are "subsidised hits," and won't take them seriously. For that reason, Canadian artists often release their records in the US first.

CKLW does not have to devote the amount of time to public service that the FCC requires of stateside stations, but the CRTC prevents Canadian broadcasters from instituting the lightning-fast format changes to keep up with changing markets that have become rampant in the US. On the other hand, technical regulations for stations and operators, which in Canada are under the jurisdiction of the Department of Commerce (DOC), are much further along the road to deregulation than they are in the USA.

Despite the restrictions, CKLW is well respected throughout the industry as a hit-making radio station for both American and Canadian music, and it is common on Thursday afternoons to see limousines with Michigan license plates lined up in front of the station, while artists, record company executives and distributors from all over the continent wait for audiences with Rosalie Trombley, CKLW's music director. Trombley has been with the station since 1963, and the dozens of gold and platinum records that line the walls of her office attest to her influence and sagacity.

CKLW went on air in 1932 as CKOK, 5 kWs at 540 kHz. It was part of the CBS Radio Network, but within three years was taken over by the Mutual Broadcasting System. It switched frequencies a couple of times, finally settling at 800 kHz in 1941. In 1949, a new RCA 50 kW transmitter went on air, and in 1950 the station dropped its network affiliations.

An FM license was granted in 1948, for a 250 W station at 93.9 MHz, which went to 50 kW in 1963, and is now licensed (although not yet geared up) for 100 kW. In 1964, a TV outlet went on the air as well, but it was sold off in 1970. The FM station commenced producing its own programming in 1967, and by 1972 was broadcasting a completely separate 24-hour country-and-western format in stereo. That same year, the stations moved into their present studio and office facilities. CKLW AM and FM have been owned since 1970, when the CRTC decreed that all Canadian broadcast facilities be owned by Canadian companies, by Baton Broadcasting, a firm which has other interests as diverse as oil and natural-gas exploration.

It's a considerable history, especially as the station is currently celebrating its 50th anniversary, and a lot of engineering, too. Much of that engineering history is still in the basement of the AM transmitter building in the town of Harrow, some 20 miles outside of Windsor, close by the shores of Lake Erie. The original RCA transmitter is still in place (although it is now a standby unit), and so are the original RCA equipment racks, which are now overflowing with new Moseley studio-transmitter-link (STL) and TFT frequency-monitoring equipment. In the "artifacts room" are the old phase monitors, distor-

tion meters, and disc-cutting equipment that vice-president of engineering Ed Buterbaugh would like someday to donate to the Smithsonian Institution in Washington, D.C. There is also a collection of spare *5671* tubes for the old transmitter. "They're irreplaceable," says Buterbaugh, "and even though we only turn the thing on a couple of times a month for testing, we keep some at hand. The way you change them is with a special hydraulic lift," which also lives in the basement. As a matter of interest, I looked up the price of the tube in a 1963 Harvey Radio catalogue—if you are old enough to remember the days when a *12AV6* tube cost all of 83¢, then you'll appreciate the figure next to the listing for a *5671*: $1.600. (There's also a spare oscillator, but exactly where it is we'll get to later).

One of the first things Buterbaugh does when he shows his visitors around the transmitter building is to flip the switch on his 750-horsepower, 400 kW supercharged *V-12* diesel backup generator. "It's sort of like standing next to a locomotive," he shouts. "What'd you say?" say the visitors.

Buterbaugh, who is from a little Pennsylvania town near Pittsburgh called, confusingly enough, Indiana, came to the station in 1972, by way of stations in Washington and New York. He recalls, "When I first came here, I asked the president of the station what his biggest engineering problem was. He said it was lightning striking the antennas. So we put in a system that had never before been used on an AM installation, that neutralizes thunder clouds. There are discs on top of each of the five towers that radiate current, either from the ground to the clouds or vice versa, at a slow rate, so there's no arcing. They also set up an ionised layer of air that cushions the towers if lightning should strike. Essentially, the lightning doesn't know that the towers are there. It hits the local power lines, which really aren't protected any more, before it hits us. In addition, there's a device that samples electrical changes in the air, which can fire up the emergency generator and put it on line in less than 10 s. This not only keeps the station on the air, it also prevents voltage spikes and surges from electrical storms from damaging the transmitter."

The main transmitter is now a Gates *MW-50*, which Buterbaugh installed in 1975, and a third transmitter is at the site: a 5 kW RCA that is rarely used. The last time it was turned on, he says, was to tune the new antenna system that was installed in 1979.

To complete the asbestos-lined non-air-conditioned Art Deco building there is a complete emergency air studio, with turntables, cart machines, and Ampex tape decks. "That's never used, either," says Buterbaugh.

After the drive over old farm roads, past corn fields and quarries, back to Windsor, Buterbaugh commenced his personal guided tour of the production and air studio facilities. And an exhaustive tour it is. It starts in the small overdub and cue studio, which is used mainly for putting music on tape cartridges. "Everything goes on carts immediately," explains Buterbaugh. "We look for any weirdness in the programme sources with an Amber spectrum analyser, and we overcome the effects of most AM receivers by juicing up the sound with Quad-Eight parametric EQ." There are ITC cart machines and an old Gates unit, Scully and Ampex tape decks, and Technics turntables.

Next stop is the main production studio, which is just over a year old. An LEDE concept was used in its design: reflections shorter than 5 ms are eliminated to provide optimum imaging. The console is a 24-channel Quad-Eight with four echo sends. Tape machines are Scully *280* 4-track, stereo, and mono, as well as three ITC stereo cart recorders. There are Technics *SP-15* turntables equipped with Denon arms and Grado *F3+*

Transmitter room with Gates MW-50 (right) and RCA transmitter (left)

cartridges. Enough processing gear is on hand to outfit a respectable multitrack recording studio, including Urei *LA-3A* compressors and ⅓-octave graphic equalisers, Eventide *Phaser* and *Harmonizer*, and a Quad-Eight *CPR-16* digital reverb. Speakers are JBL *4333Bs* and *Auratones*, which are powered by Bryston and Crown amplifiers.

"Because the CRTC encourages domestic talent, we're set up here as an operating recording studio, and we can do demo tapes for local acts," says Buterbaugh. "For the time being, four tracks are sufficient, but except for a big machine, we're all set to go with 24-track, and when the need arises, we'll probably get a Studer."

The studio room itself, about 10 × 20 ft, is very versatile, and has movable wall panels as well as bass traps in the ceiling. Microphones in use are Neumann *U87s*, Shure *SM 85s*, and *SM5s*. These last, according to Buterbaugh, are particularly good for AM broadcasting because of their assymetrical output. When wired correctly into a typical assymetrical AM modulator, they pack an extra punch.

As the astute reader has by now gathered, Buterbaugh has designed his entire programme chain for AM stereo, and in fact the station should be on the air in stereo by the time you read this. Buterbaugh is on the DOC's advisory committee for AM stereo, and conducted some tests on CKLW in 1979 using the Harris system. "It would have been pointless for Canada to approve a system that wasn't compatible with whatever the FCC approved for use in the USA," he says, "but since the FCC decided not to approve any one system (after backing out on approval of the Magnavox system two years ago) we've decided to go ahead and negotiate special permission from the DOC to broadcast with the Harris."

Apparently, CKLW's large US audience had a lot to do with the decision to go to stereo. "Surveys taken by the Canadian Association of Broadcasters showed that stations here want to wait. FM stereo is not as popular in Canada as it is in the States, partly because of the CRTC's format restrictions, so Canadian broadcasters don't see the need for it that Americans do," Buterbaugh says.

Despite the long wait for approval, Buterbaugh ▻

Production control room and studio

has been ready for stereo for some time. "We think we're capable of sound quality as good as any FM station's," he declares. "We're using a broad-band antenna system whose impedance doesn't vary more than 1Ω all the way up to 20 kHz, which eliminates any phase shift in the outer sidebands. We're still waiting for the DOC to approve a stereo microwave STL, but we have phased and equalised stereo phone lines in place."

We then move on to the main AM air studio, where morning disc jockey Johnny Williams is combo-ing his show. Surrounding a McCurdy console, ITC cart machines, Ampex *440* and Scully tape decks, and a set of Lang equalisers are four Tannoy monitors and storage racks for 4,000 cartridges. The speakers are wired with partial mutes, so that different parts of the room can be turned down to suit the situation: whether the announcer is working the board himself, using an engineer, or doing an on-air interview.

Across the hall is a small voice-over production studio with a McCurdy console, more Lang equalisers, and another Scully deck, while crammed into a narrow corridor at the side of the room is the audio processing rack, all stereo of course. Yamaha crossovers split the signal into three bands for treatment—Urei *LA-3As* handle below 250 Hz and the 250 Hz to 5 kHz band, while Spectra Sonics units, chosen for their speed, work on the high frequencies. There are also redundant Metrotech logging recorders for air checks and sponsor confirmations.

The busy newsroom, which is totally staffed by Canadians even though its biggest stories often happen across the border, is equipped with yet another McCurdy console and more Ampex tape decks. Teletype and audio feeds come in from the Associated Press, the Canadian Broadcast News service, and both the domestic and international bureaus of United Press International.

Although it operates from the same building, CKLW-FM is almost totally separate from its older brother. The country music is supplied by a service called TM Programming in Dallas, Texas. The station is completely automated, and doesn't even use live announcers except during am and pm drive times. Music and announce breaks are all loaded onto two *Instacarts*, each of which can instantly randomly select among 48 cartridge slots, all of which are equipped with their own transport and head. In the event of a missed or jammed cart, a silence sensor automatically switches in the next programme source after 6s of dead air. A Harris *9000-2* computer runs the system, but Buterbaugh is hoping to interface it with the IBM computer in the basement of the building, which is currently being used for book-keeping, traffic, and other office work. A disc memory serves as the back-up for the Harris, and an Extel printer handles the programme and commercial logging. The computer is capable of storing sufficient numbers of commands to run the station for several weeks without human intervention, but Buterbaugh says that it is never programmed for anything longer than a three-day holiday weekend.

AM on-air studio, producer's position (foreground) engineer's position (facing)

An indication of the international character of the station is that, while the FM sales offices are in the basement of the building in Windsor, the AM sales offices are in downtown Detroit. Phone lines link the two offices, and the Windsor switchboard can be reached by dialing either an American or a Canadian number, while two full-time couriers traverse the border several times a day with mail and inter-office memos. A fine example of how national borders can get confused in people's minds is the oft-told 1980 Mardi Gras story.

It seems that at the time, the US was feeling very warmly towards its northern neighbour because the Canadian embassy in Iran had managed to smuggle out several Americans who were being held hostage in that unfriendly land. Dick Purtan, whom Ed Buterbaugh says may be the second-highest-paid disc jockey in North America, had come on staff barely a year before, after CKLW had managed to lure him away from one of its competitors. A New Orleans radio station invited Purtan, along with other well-known Canadian media personalities, to ride in a float in the Mardi Gras parade honouring the land of the maple leaf. Imagine the embarrassment all around when it was realized that not only was Purtan an American citizen, but he was still living in Detroit and commuting every day to his job in a "foreign" country!

But by far the most unusual way in which CKLW has chosen to serve its international audience has been to broadcast to the suffering commuters in the Detroit-Windsor Tunnel beneath the Detroit River. A 5 kHz audio line from the station feeds the spare oscillator from the old RCA transmitter, modulating it with a Bogen amplifier. The "transmitter" output, which is less than 1 W, goes through a matching network and then to a wire running the length of the tunnel, lying on top of it. "The power is low enough that it doesn't interfere with our main signal and cause beats anywhere," says Buterbaugh. "Since we've improved our main audio so much recently, but haven't done much in the tunnel, you can hear the difference in quality even on a car radio—in the tunnel, we sound just like any old AM station. We're working on that."

The tunnel broadcasts are popular, due in some measure to the fact that CKLW has that particular market all to itself. The idea, it should be noted, is not unique—a similar installation is in Florida, and when Buterbaugh was working in New York, he seriously considered wiring the Holland and Lincoln Tunnels there for radio, but dropped the idea when he ran into bureaucratic hassles.

No such hassles exist here, as the Tunnel is owned by a private corporation, and "the DOC has given us a verbal okay on it—as long as there's no interference, they ignore it," according to Ed Buterbaugh. Its success proves that traffic jams, like electromagnetic radiation and good music, respect no national boundaries. □

FM on-air/production studio with automation rack in the background

Voiceover

NORMAN McLEOD

Night flight

I am slowly evolving into one of those nocturnal creatures. For the past fortnight, your chances of finding me awake at 3 am have been considerably better than the prospects of a conscious response at eleven. Working in the small hours of the morning has many compensations—mainly peace to get on with the job in hand—but it's a deadly dull time for broadcasting.

What is (or rather isn't) happening during the hours from midnight until 6 am? Inside the UK, you're only likely to receive a service from ILR if you're within range of one the big city stations—which I'm not. And the prospect for an improved service from ILR during these impoverished hours is hardly encouraging. Radio Tees has recently announced the closure of its 24 hour service—with an admission that there are times at night when the station apparently had no listeners at all. Since ILR stations would no doubt be quick to claim that high audience figures were mainly a result of their programming policy, one wonders how this confession relates to the quality of the broadcast output in the small hours.

So the number of ILR stations covering all 24 hours is now down to 10 out of a possible 34. With the recession showing few signs of abatement, it is most unlikely that ILR stations will be adding to their existing contribution to the small hours. No new station planned to come on the air will start with a 24-hour schedule, and it would be discouraged from doing so if it wanted to. The IBA is quite clear where ILR's priorities must lie—in the peak listening slots of 7 to 9 am, noon to 1 pm, and 4 to 6 pm. Few tears are likely to be shed at IBA HQ over the loss of Tees' overnight sessions.

So, let's turn to the BBC. You will remember that the BBC is public-service broadcasting. Where the BBC is supposed to differ from commercial broadcasting is in its provision for 'markets' which are 'unprofitable'. Otherwise, there doesn't seem to be much point in having it. And the late-late audience might expect to be better served by the Corporation.

Well, the BBC has no fewer than 448 domestic radio transmitters at its disposal, probably more since the 1980 tables on which this calculation is based. There are 116 MF and LF transmitters, ranging from the 400 kW LF station at Droitwich to a tiny 150 W Radio 3 relay in Hull. On VHF, there are 332 transmitters, covering areas as large as several counties, right down to tiny Welsh valley communities. Every possible shape, size and character of community (or 'market'—if you prefer) has its own representative among the vast assortment of BBC outlets.

Apart from the shipping forecast, the Open University, and the occasional filching of the 200 kHz Droitwich sender by the World Service, the BBC's attitude to the night-time radio audience is Radio 2—like it or lump it. About a third of the 448 transmitters are plugged into the Radio 2 distribution network, either directly or through idle local radio desks. The main effect of this is to make sure that in any one location Radio 2 is available on at least four different frequencies just in case it's hard to find in the dark. The other transmitters are simply turned off. Their frequencies and this broadcast resource are completely and utterly wasted.

We are continually reminded that the frequency spectrum in this country is a scarce resource, and that it must be carefully regulated in the public interest. It would seem, however, that during a quarter of every day the BBC has no use for two-thirds of its allocation, and that it would therefore be in the public interest for these frequencies to be handed over (or rented out) to somebody—anybody—who has.

Meantime, on the frequencies which are occupied, Radio 2 plods away, starved of needletime and inspiration. All the dreary reworks of well-worn standards, all the music too mindless to inflict even on the day-time audience, is dragged from the non-needletime shelves and given an airing. At ten to four in the morning, there doesn't appear to be much to do in the Radio 2 studio except waffle.

Decline of an empire

One of my business activities involves constructing and installing small, inductive-loop medium-wave transmitters for university and hospital radio stations. And so the other day I went shopping for a transistor radio in order to show off to potential customers just what good quality we have achieved. I did not want a digital clock, microprocessor memory bank, a built-in cassette recorder or a frequency counter—just an ordinary old-fashioned set with what the punters would call a 'nice tone'. Most of the modern sets—like, for instance, the Sony *ICF 2001*, have amazing frequency agility, but hardly maintain this standard of excellence in the audio and loudspeaker departments. You can tune to any station in the world, but they all sound like 'communications' transmissions rather than broadcasting.

So eventually I spent nearly £70 on a set from Roberts Radio. It's British and it's clearly a no-nonsence set. It also bears the legend 'by appointment to Her Majesty the Queen'—so you would imagine that if it's good enough for Elizabeth Windsor it should be good enough for me. Unfortunately, I can't help feeling rather disappointed with it. The speaker inside is a very mundane elliptical type—the sort of thing that might grace the front panel of a domestic telly. My old Grundig *Concert Boy* had a much more substantial unit.

Also, IF transformers seem to have gone out of fashion, and the dictates of economics now tell us that you have to use ceramic filters if you want to be with it. This would be fine if they worked as well as five or six tuned circuits, but they don't. This one has too narrow a 'nose' and too wide a 'skirt'—the BBC World Service being audible over the top of about six channels. Maybe if I scour Brighton's junk shops I might come across an old Bush or Hacker set from the Sixties, before the rot set in. Meantime, if anyone hears of a set with decent sound quality on AM, let me know. Beware of microprocessors—they never made a radio sound any better!

No secret

My good friend Peter Lewis has his heart in entirely the right place, though sometimes I think he sees conspiracies when in fact there are none. At least, that's how I read between the lines of an account of his activities at the recent Edinburgh Radio Festival. He is reported to have persuaded the BBC's Dick Francis to 'come clean' about the BBC's attitude to Band 2—the VHF radio broadcast band. What is presented as a revelation to a shocked world is that the BBC has carved the whole of the spectrum between 88 and 108 MHz into seven slices of cake. In due course, it will proceed to devour all but one—and that will be be consumed by the IBA.

In fact there has been no secret about this—I have a little folding hand-out from BBC Engineering Publicity in front of me which tells the whole sorry story. It was launched several months ago, complete with a fanfare in *Ariel*, the BBC staff magazine, about how the Corporation was boldly tackling the Home Office over the question of using the broadcasting band for broadcasting instead of police radios.

I'll go along with them on that principle, but not much further. The BBC plans involve carving out five segments of spectrum 2.8 MHz wide, which leaves 6 MHz, to be divided equally between BBC Local Radio and ILR. These five segments are arranged as national networks, and will carry Radios 1, 2, 3 and 4, plus an extra channel for "curricular educational programmes". These are presumably programmes like the Open University and *Study on 4*, which currently displace Radio 3 and Radio 4 programmes from their VHF outlets—much to the annoyance of VHF listeners to the main service.

Now it's perfectly true that at the moment the BBC's VHF service is an untidy mess, with irritating opt-outs all over the place, and the Radio 2 transmitters being switched uneasily into the heavier parts of Radio 1 late at night and at weekends. However, I am suspicious of the BBC's past record in the use of its available frequencies, and I would not like to see almost all the new spectrum handed over to this wastrel for yet more profligacy. Remember that this reshuffle will not add *one single service* to the choice available to most listeners at any given time of the day or night. It will make some services which are not transmitted on VHF at the moment available on FM, true, but this new spectrum is not going to be used for an expansion of radio services—merely a consolidation of what we already have. It will then make the excuse "we have no frequencies available" a perfect barrier against any innovative radio structures in this country for evermore.

If this plan comes into effect, the radio listener in 1990 will tune across the VHF band to find Radios one to four, then a BBC local station, a commercial station or two, and the 'fifth network'—the educational channel, which is likely to be mute (or relaying Radio 2?) for hours on end. And that will be *ALL*. Seven services if you're lucky, plus in the evenings the choice of probably three different VHF frequencies to listen to Radio 2 on. How come in the States you can have fifteen or even twenty different stations on the FM band? Different, not only from each other, but from the programmes available on AM? There are, of course, many reasons for this, one being that they do not have the BBC protecting the interests of the general public . . . .

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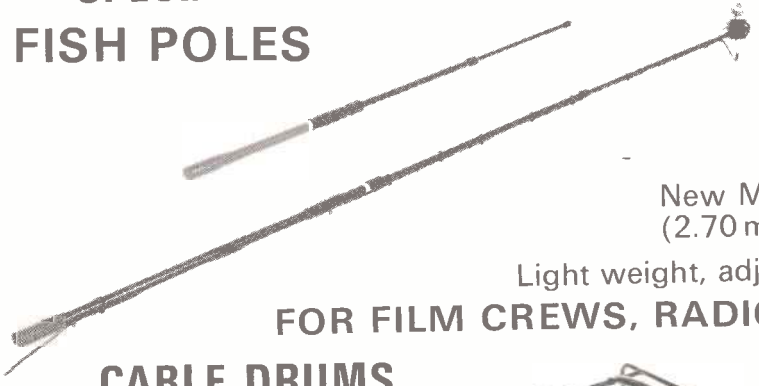

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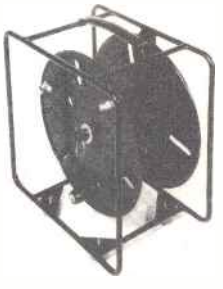

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Sensitivity: −20 dBu to +20 dBu.
Input impedance: 10 kΩ.
Maximum level: +44 dBV without pad for 1% THD at 40 Hz.
Level at insert points: −6 dBu.

Line outputs
Source impedance: 200 Ω transformer balanced, 100 Ω unbalanced.
Maximum output: +19 dBV into 200 Ω or less without transformer.

Filters and equalisation
LF filter: 12 dB/octave giving −3 dB at 100 Hz ±5 Hz.
HF equalisation: shelving ±15 dB, selectable 6 kHz or 12 kHz.
MF equalisation: parametric, sweepable 220 Hz to 7 kHz, range ±15 dB.
LF equalisation: shelving ±15 dB, selectable 80 Hz or 160 Hz.

Frequency response: +0.5, −1 dB with filters switched out.
Overload margin at channel fader: 25 dBV for 1% THD.
Distortion: <0.02% at unity gain, 1 kHz, +6 dBu. <0.03% 40 Hz to 15 kHz without output transformer.
Crosstalk: L/R crosstalk is dependent on panpot track end resistance. Group to group crosstalk >−70 dB.
Noise: < 86 dB with master faders closed. < 83 dB for a single channel at unity gain (filters switched in and out). < 80 dB for 11 channels at unity gain (filters switched out). < 75 dB for 11 channels at unity gain (filters switched in). (All noise measurements made with a Radford *ANM1*, 20 Hz to 20 kHz).
Power supplies: internal amplifier supply ±15.3 V, 300 mA. Phantom supply (mains only) 48 V, 60 mA. External supply 1 A maximum. Batteries 12 V (maximum time of operation 12 hours).
Size (whd): 19 in×5¾ in×17½ in approx excluding control knobs for the 8/4 input/output version. (480×145×445 mm).

Manufacturer: Amek Systems and Controls Ltd, Islington Mill, James Street, Salford M35HW, UK.
UK: Scenic Sounds Equipment Ltd, 97–99 Dean Street, London W1V 5RA.
USA: Everything Audio, 16055 Ventura Boulevard, Suite 1001, Encino, Cal 91436.

THE Amek *BCO1* is designed for mobile and broadcast use and is available in either 8 or 12 input configurations currently with one type of input module. However, it is understood that alternative modules such as a gramophone input will become available.

The desk operates in the programme/audition mode with the addition of two monophonic auxiliary busses.

Input module

Each input module has integral *XLR* sockets for the microphone and line inputs, plus ¼ in tip, ring and sleeve jack sockets for the two unbalanced insert sends and returns. All controls, except the Penny and Giles fader, mount directly onto the single printed circuit board equipped with a gold plated edge connector. All components were clearly identified and the three integrated circuits socketed for easy maintenance.

Each module plugs into a printed circuit socket mounted on the mother board which extends the length of the mixer, a few components being mounted on the mother board. Modules are secured onto the alloy frame by two Allen screws,

the frame being of solid construction with wooden sides attached to alloy side plates.

Reverting to the input module, next to the gain control at the top of the module are four locking pushbutton switches. These select line microphone input, invert phase, insert a 20 dB pad and insert a high pass filter. There follows a high frequency shelving equaliser potentiometer with a pushbutton switch selecting either 6 kHz or 12 kHz. All equaliser potentiometers have a detented zero position.

Proceeding down the panel there is a mid-frequency parametric equaliser with its cut/boost potentiometer and frequency control covering 220 Hz to 7 kHz. A low frequency shelving equaliser follows, again with a cut/boost potentiometer and with the frequency being pushbutton switched to 80 Hz or 160 Hz with a second pushbutton switching the equalisers in/out.

The two auxiliary buss feeds are via potentiometers with adjacent pre/post fade pushbuttons. There is then the detented pan potentiometer with a pushbutton on/off switch and three further pushbuttons which select the programme sends (1–2), the audition sends (3–4), pre-fade listen with a momentary pushbutton and mute with a red warning LED. Finally the channel fader at the bottom of the module is calibrated to +10 dB.

Master module

Turning to the master module this is three times the width of the input module and is based on three major printed circuit boards, one of which has an edge connector which mates with the mother board. In addition there is a harmonica connector on a flying lead. Interconnection between the boards is by DIL connectors.

A considerable number of wires are used for interconnections on the main board and for feeding the outputs, etc.

At the top of the module the two meters (which can optionally be either VU meters or PPMs) are in vertical array, the top meter indicating the left channel or the oscillator, with the bottom meter indicating the right channel or the pre-fade listen level.

Alongside the meters an *XLR* socket is provided for the talkback microphone. Below this are seven locking pushbutton switches of the indicating type. Five of these switches select the source of the main output which may be busses 1 or 3 for the left channel or busses 2 or 4 for the right channel, thus a mixture of the programme busses and the audition busses may be selected with the fifth button giving a mono output. The remaining two switches with three nearby LED indicators switch power on/off and overall phantom power at the microphone inputs.

Below the meters are the controls for the auxiliary busses. Auxiliary send and return level potentiometers are fitted with a momentary pushbutton providing after-fade listen at the sends. There are then the auxiliary pan potentiometers with pushbutton on/off switches and switches to send the signal to the programme busses, the audition busses or both. In addition there is a locking mute button with a red warning LED for each auxiliary send and a momentary pre-fade listen button.

At the bottom of the module are the four faders for the programme and audition outputs. To the right of the faders three momentary pushbuttons send talkback to the auxiliary, audition or main outputs with a $\frac{1}{4}$ in jack socket provided for headphones. The latter was stupidly located so that the headphone jack interfered with operation of the audition faders.

The monitor output is controlled by three locking pushbuttons and a level potentiometer, the pushbuttons selecting the main or audition signals or a playback input and providing a monitor dim. Two further buttons select the metered signals from the main output, monitor output or oscillator/pre-fade listen buss. The internal oscillator has pushbutton selected frequencies of 10 kHz, 1 kHz and 40 Hz with a locking slate button and a screwdriver operated level trim.

Finally there is a talkback level potentiometer, with the controls being sensibly colour coded for ease of operation. Whilst the setting of most controls is clear I would like to see some better indicator of the feed to the meters, preferably within the meters or nearby.

At the rear of the master module *XLR* connectors are provided for the transformer coupled main and audition outputs plus the auxiliary sends and returns.

Quarter inch tip, ring and sleeve jack sockets provide insert points for the left and right channels in the programme and audition outputs. Further sockets are provided for the left and right playback inputs, the monitor output, the oscillator output and communications input.

Powering

Beneath the mixer a four-pin *XLR* connector may be used for powering in the absence of internal batteries which fit in a compartment underneath the faders. Either external batteries may be used (with reduced overload margins at +12 V, or the separate mains power unit.

The latter is a 1U high rack mounting unit containing a toroidal mains transformer and voltage stabilisers. The unit was very nicely made with all mains connections properly insulated and front panel indicators for mains and the three power rails. The mains and the three rails have separate, properly identified, front panel fuses.

The 8 input into 4 output version may itself be rack mounted into a 19 in rack, or used free standing. In the latter case it is excellent for mobile work in view of its light weight and battery powering capability.

Inputs and outputs

The phantom powering at the balanced microphone inputs was found to be 48.2 V with the input impedance being 999 Ω without the 20 dB pad or 1010 Ω with the pad. The pad offered an attenuation of 21.5 dB at both the line and microphone inputs.

At fader maximum the gain from the microphone inputs to the outputs was 76 dB with the gain trimmer having a 40 dB range for line and microphone inputs. At maximum input gain the microphone inputs could handle −32 dBm rising to −12 dBm with the pad, whilst at minimum gain the input could handle +7 dBm at 1 kHz or 0 dBm at 100 Hz, these increasing by 20 dB with the pad in circuit.

The balanced line input had a maximum gain of 35 dB to the output with a constant input impedance of 11.2 kΩ with the maximum input levels being +8 dBm at maximum gain and greater than +22 dBm at minimum gain without the pad.

Common mode rejection at the microphone inputs was excellent at 90 dB at 1 kHz falling at 6 dB/octave with increasing frequency. The line inputs had a similar pattern but with the common mode rejection being 46 dB at 1 kHz.

Insert points within the input modules, in the form of tip, ring and sleeve $\frac{1}{4}$ in jack sockets, had satisfactory impedances of 220 kΩ input impedance and 48 Ω output impedance. The maximum gain from the microphone inputs to the insert points was 54 dB with the input and output signal handling capability being +21 dB.7V.

The impedance at the main and audition outputs was rather high at 160 Ω with a drive capability of +22 dB.7V or +19.5 dBm loaded into 600 Ω.

Insert points in the output module had an input impedance of 10 kΩ and an output impedance of 48 Ω, with the monitor output having an impedance of 65 Ω. Similarly the headphone output was satisfactory with an impedance of 20 Ω and a drive capability of 9.7 V.

The oscillator output had a rather high impedance of 220 Ω with the screwdriver operated multi-turn gain trim giving levels up to +6.3 dB.7V at 1 kHz. Distortion was 0.45% second and 0.18% third at all three frequencies ▷

FIG.1
AMEK BCO1
FREQUENCY RESPONSE MICROPHONE INPUT

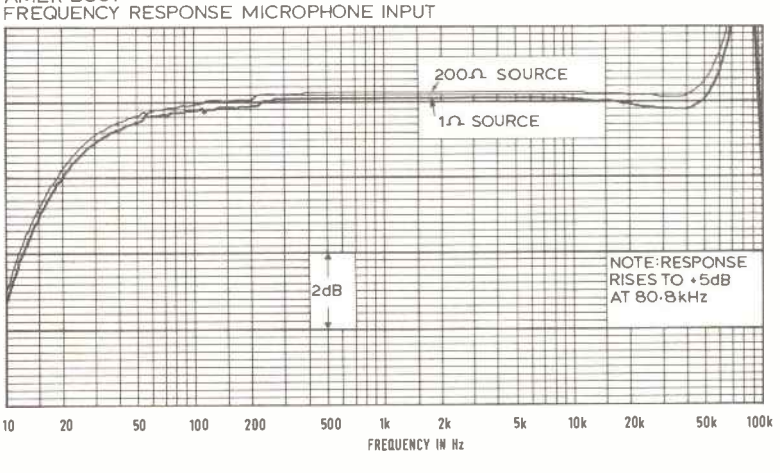


TABLE 1

Measurement method	Max gain	Main gain	All shut
22 Hz to 22 kHz RMS	−44 dBm	−69 dBm	−69 dBm
A-weighted RMS	−46 dBm	−71 dBm	−71 dBm
CCIR-weighted RMS ref 1 kHz	−38 dBm	−62 dBm	−62 dBm
CCIR-weighted quasi-peak	−34 dBm	−58 dBm	−58 dBm
CCIR-weighted ARM ref 2 kHz	−44 dBm	−69 dBm	−69 dBm

which were not particularly accurate. Nominal 40 Hz was 38.7 Hz, 1 kHz was 979 Hz, whilst 10 kHz was 9280 Hz.

Frequency response

The frequency response from the microphone input to the main outputs with the equalisers switched out is shown in **Fig 1** for 1 Ω and 200 Ω source impedances, it being seen that there is little difference between the two. Both the frequency response of the line input, as shown in **Fig 2,** and that of the microphone input showed a significant rise at very high frequencies. This was found to be connected with loading at the outputs, a 10 kΩ load reducing the microphone input's 5 dB boost to 2 dB. It is felt that the manufacturer should pay some attention to this matter.

The characteristic of the switched high pass filter which was independent of the equaliser in/out switch is shown in **Fig 3,** with the −3 dB point at 100 Hz. Also shown is the effect of the low frequency equaliser at its 80 Hz setting for the extreme, mid position and intermediate positions of the potentiometer. Switching the equaliser to its 160 Hz setting simply shifted the frequency up one octave whilst retaining the same characteristics.

The same principles applied to the high frequency shelving equaliser for its 6 kHz and 12 kHz switch settings, the effect of the latter being shown in **Fig 4.** In the case of both equalisers a very wide range of cut and boost was available making accurate setting a bit fiddly.

Turning to the mid-frequency parametric equaliser, the maximum cut and boost settings for frequency settings of 220 Hz, 2.2 kHz and 7 kHz are shown in **Fig 5.** The characteristics of the cut/boost control for a frequency of 1 kHz being shown in **Fig 6.** This equaliser also had a very wide range.

Noise

Noise was measured at the output with single channels at maximum gain and found to remain effectively constant for the microphone or line inputs irrespective of the 20 dB pad, the phase reverse switches and the equaliser in/out switch when the equalisers were flat.

Table 1 relates noise to the microphone input terminated in 200 Ω at minimum and maximum positions of the input module's gain trimmer and also the noise with all channels shut, but maximum output gain. Adding the microphone channel gain of 76 dB to the maximum gain figures show that the input is not particularly quiet, however, this would not be a problem with capacitor microphones.

All controls were very quiet in operation with the equalisers having the anticipated effect upon noise. No significant mains hum was present.

Distortion

The second and third harmonic distortion was measured under a large number of conditions of gain settings and levels and found to be consistently low, the equalisers having no effect upon distortion. ▷

FIG.2
AMEK BCO1
FREQUENCY RESPONSE LINE INPUT

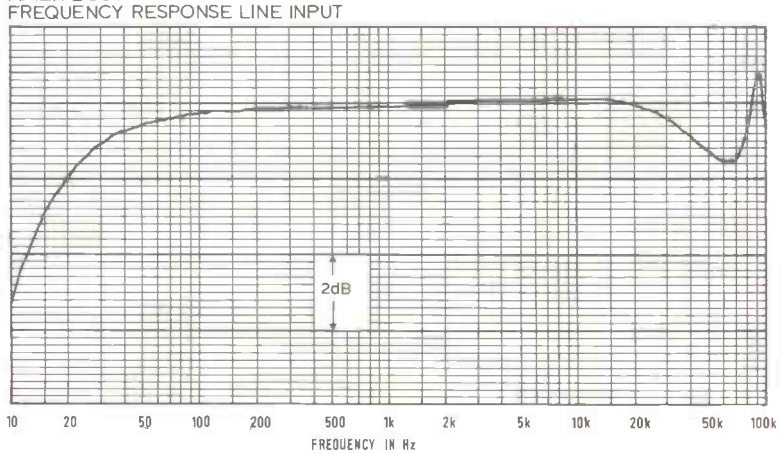


FIG.3
AMEK BCO1
HIGH PASS LOW FREQUENCY FILTER
AND LOW FREQUENCY EQUALISER AT 80Hz

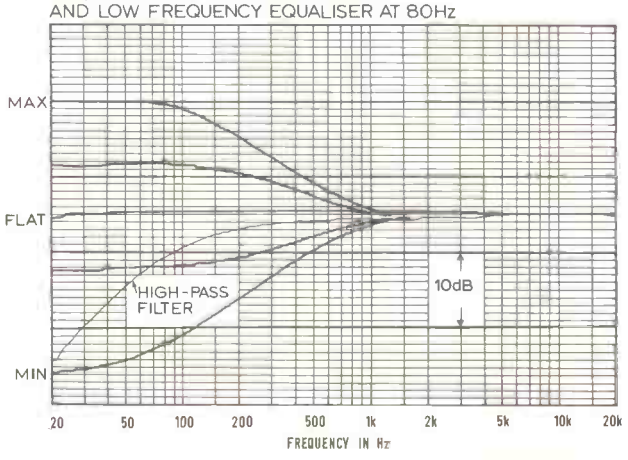
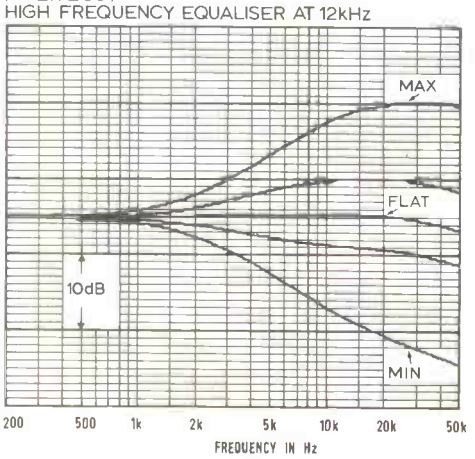
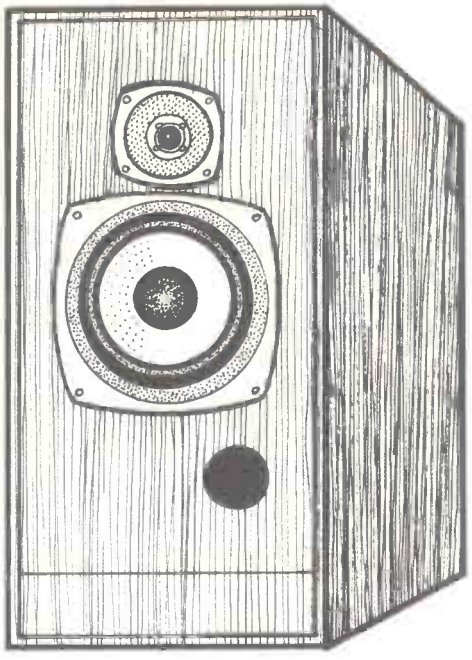


FIG.4
AMEK BCO1
HIGH FREQUENCY EQUALISER AT 12kHz



DON'T READ THE SPECS!



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Tel. 01-403 3838 Telex 885659 YODEL G.
A member of the Theatre Projects group of companies.

Fig 7 shows the limit of the line input without the 20 dB pad, driving +10 dBm into the input with the overall gain set for +20 dBm output. As is not surprising, at these levels the low frequency distortion increases due to the transformers at the input. At lower levels the harmonic distortion from 20 Hz to 20 kHz was generally below 0.01% and the CCIF twin tone intermodulation distortion using tones separated by 70 Hz was below 0.02%.

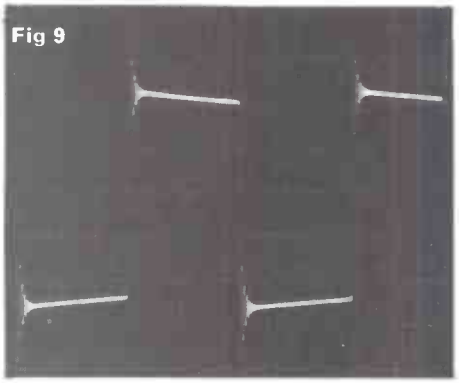
Line input and microphone input distortion was identical, it being believed that the two inputs use the same electronics with appropriate attenuators.

Crosstalk

Several potential sources of crosstalk and breakthrough were investigated. Firstly, breakthrough across the microphone/line switch was negligible, as it was across the mute switches.

Driving one module and measuring the crosstalk into the two adjacent modules at maximum gain in the microphone mode showed that crosstalk from 20 Hz to 20 kHz was below −100 dB. Crosstalk between adjacent output channels was also very good, being below −90 dB up to 15 kHz.

Fig 8 shows crosstalk between the programme and the audition busses which was the only significant source of crosstalk found in the mixer.



Other matters

The application of 1 kHz squarewaves to any input produced the result shown in **Fig 9** at the output with considerable ringing. However, loading the output with 1 kΩ or less completely eliminated the ringing.

Checking the two VU meters showed them to be genuine instruments to the American Standard C16.5 with the correct rectifier characteristic and ballistics.

The talkback microphone connection which is not phantom powered had a maximum sensitivity of −50 dBm for 0 VU which is rather on the low side for some microphones.

Finally, an irritating complaint, many of the control knobs fell off all too easily.

Summary

This is a well conceived portable mixer with the great advantage of being operable from batteries. The control layout was uncluttered, but it was not easy to identify the pushbutton positions.

Crosstalk and distortion were very good and the mixer had equalisers having a very wide range.

Some attention is needed to the output loading to prevent the high frequency peaking and consequent ringing.

Whilst the microphone input noise leaves something to be desired, this not likely to be a problem with capacitor microphones.

Overall this is an attractive mixer for portable film and broadcast use. □

FIG. 5
AMEK BCO1
MID-FREQUENCY PARAMETRIC EQUALISER
MAXIMUM CUT AND BOOST SETTINGS

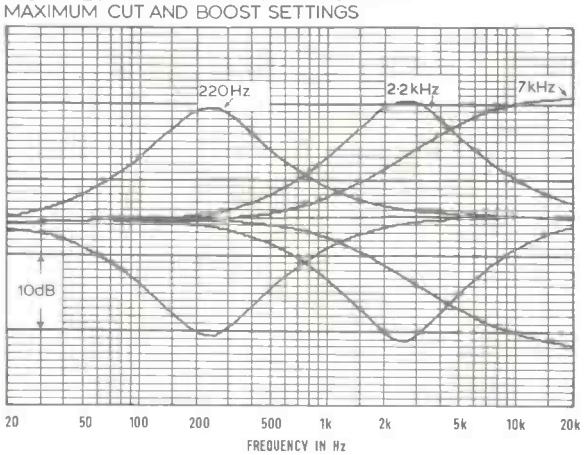


FIG. 6
AMEK BCO1
MID-FREQUENCY PARAMETRIC EQUALISER AT 1kHz

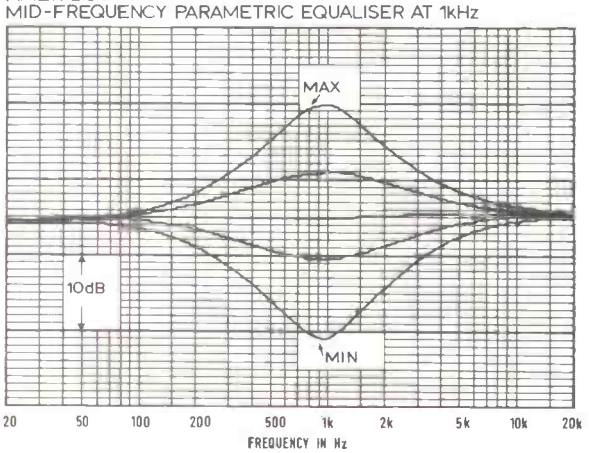


FIG. 7
AMEK BCO1
2ND AND 3RD HARMONIC DISTORTION
LINE INPUT +10dBm TO OUTPUT AT +20dBm (NO PAD)

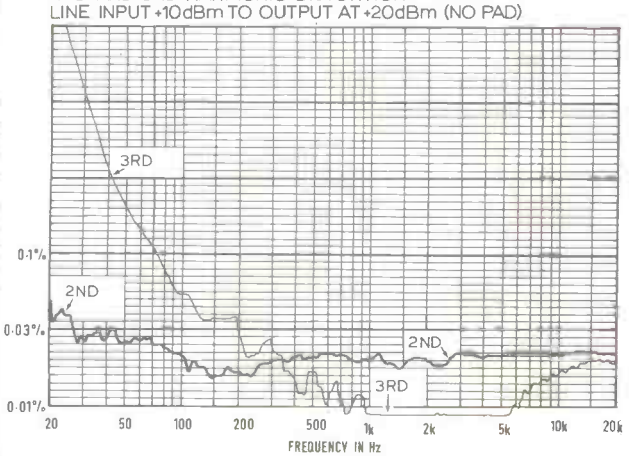
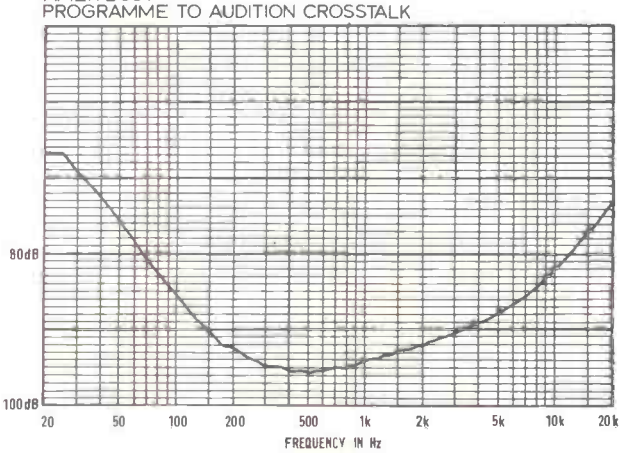


FIG. 8
AMEK BCO1
PROGRAMME TO AUDITION CROSSTALK



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1 Raised deck plate for easier editing
2 Improved tape start
3 Tape dump
4 Two-way self-sync with automatic sync/input switching
5 Balanced line inputs and outputs
6 Calibrated or uncalibrated level adjustments
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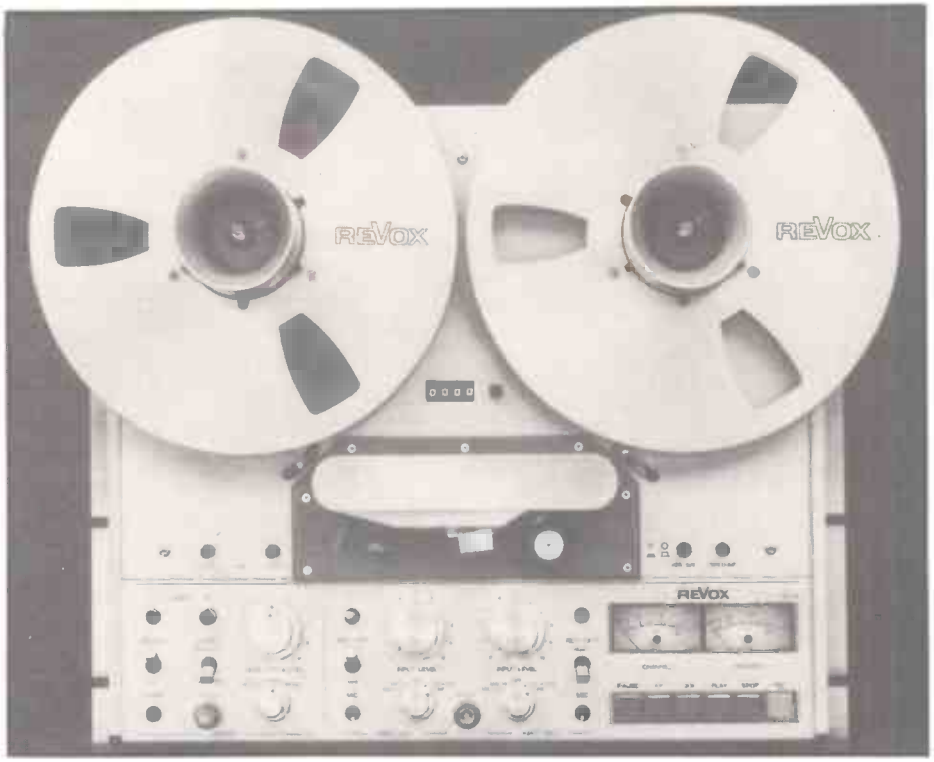
Review



Revox PR99

Hugh Ford

MANUFACTURER'S SPECIFICATION

Tape transport mechanism: three motor tape drive; two AC driven spooling motors; single AC driven capstan motor electronically regulated.

Tape speeds: 3¾ in/s and 7½ in/s or 7½ in/s and 15 in/s. Electronic changeover.

Tape speed tolerance: ±0.2%.

External variable speed: 2½ in/s to 11 in/s or 5 in/s to 22 in/s for low and high speed versions.

Wow and flutter: (to DIN 45507) at 3¾ in/s <0.1%; at 7½ in/s <0.08%; at 15 in/s <0.06%.

Tape slip: maximum 0.2%.

Reel size: up to 10½ in diameter (minimum hub diameter 2.36 in), tape tension switchable (for small hub diameters).

Winding time: aprroximately 120 s for 2500 ft of tape.

Tape transport control: integrated control logic with tape motion sensor provides for any desired transition between different operating modes. Contactless electronic switching of all motors. Remote control of all functions and electric timer operation are possible. Fader start facilities. Tape dump mode.

Equalisation: at 3¾ in/s NAB 90 µs+3180 µs; 7½ in/s and 15 in/s NAB 50 µs + 3180 µs.

Frequency response: (measured via tape at −20 VU); at 3¾ in/s 30 Hz to 16 kHz +2/−3 dB, 50 Hz to 10 kHz ±1.5 dB; at 7½ in/s 30 Hz to 20 kHz +2/−3 dB, 50 Hz to 15 kHz ±1.5 dB; at 15 in/s 30 Hz to 22 kHz +2/−3 dB, 50 Hz to 18 kHz ±1.5 dB.

Frequency response of guide track reproduction: at 15 in/s 100 Hz to 12 kHz +2/−3 dB; at 7½ in/s 100 Hz to 8 kHz +2/−4 dB.

Operating level: 250 nWb/m = 0 VU.

Level metering: VU meter in accordance with ASA standard, plus LED peak level indicators (6 dB above operating level adjustable).

Distortion: at 0 VU = 250 nWb/m; 3¾ in/s <1%; 7½ in/s <0.6%; 15 in/s <0.6%. At 0 VU+6 dB (500 nWb/m), 3¾ in/s <2.5%; 7½ in/s <1.5%, 15 in/s <1.5%.

Signal to noise ratio: (measured half track via tape ASA A-weighted referred to 500 nWb/m); at 3¾ in/s >63 dB; At 7½ and 15 in/s >66 dB.

Crosstalk at 1 kHz: stereo > 45 dB. Mono >60 dB.

Erase depth: at 7½ in/s >75 dB (1 kHz).

Line input impedance: >5 kΩ balanced.

Line input level: (0 dBu = 0.775 V); calibrated—+4 dBu (adjustable −10/+20 dBu referred to operating level) Uncalibrated—sensitivity externally variable up to 10 dB above calibrated input. Maximum line input level +22 dBu (>40 Hz).

Microphone input: unbalanced, impedance 100 kΩ. Mic Lo —−70 dBu (maximum −24 dBu). Mic Hi—−42 dBu (maximum +4 dBu).

Microphone Input option: balanced, impedance >1.2 kΩ 40 Hz to 15 kHz. Mic **Lo**—−85 dBu (maximum −36 dBu). Mic Hi—−54 dBu (maximum −7 dBu).

Line output impedance: 50 Ω balanced.

Line ouput level: calibrated—+4 dBu (load 600 Ω) adjustable −20/+9 dBu referred to operating level. Uncalibrated—output level externally variable up to 10 dB above calibrated output. Maximum line output level +22 dBu/600 Ω, +20 dBu/200 Ω.

Headphone output: maximum 5.6 V, internal resistance 220 Ω, short circuit proof.

Connectors: remote control of tape transport functions. Remote control of variable tape speed. Fader start.

Electric current supply: 100/120/140/200/220/240 V, 50/60 Hz, maximum 90 W.

Primary power fuse: 100...140 V—1 A slow blowing. 200....240 V—0.5 A slow blowing.

Weight: 40 lb 12 oz (18.5 kg)

Ambient temperature range: +40° F (+7° C) to +104° F (+40° C)

Working position: any between horizontal and vertical.

NOTE: all figures quoted are minimum performance values as measured with 3 M *250* tape and normally exceeded by all units.

Manufacturer: Willi Studer, CH-8105 Regensdorf, Zurich, Switzerland.

UK: F W O Bauch Ltd, 49 Theobald Street, Boreham Wood, Herts WD6 4RD.

A NUMBER of versions of the Revox *PR99* are available with the ability to be mounted into a standard 19 in rack occupying nine units of rack height. Available as mono or stereo machines there are two basic versions operating at 3¾/7½ in/s or 7½/15 in/s with the option of balanced or unbalanced microphone inputs and NAB or CCIR equalisation.

The basic concept of the machine is the same as has been used for Revox machines over many years. The tape transport is based on a lightweight alloy casting to provide accurate reference faces for the tape transport components. Both reel motors secure underneath the casting and take the form of direct drive outer rotor type AC motors equipped with solenoid operated band brakes. The reel hold down is for cine type spools with the machine being capable of taking 10½ in NAB spools if adaptors are used.

From the pay-off spool the tape passes over a spring loaded and damped tension arm before entering the detachable headblock. This is a separate alloy casting secured to the main casting at three points. At the entrance to the head block the tape passes over a rotating bearing with edge guides before the optical tape sensor and the twin track ferrite erase head. There are then the metal record and replay heads with spring loaded azimuth adjustment (which could be more solid) followed by a fixed edge guide post.

Following on from this there is a 9.06 mm diameter capstan directly driven from an AC motor equipped with a tachometer to provide servo control. The pinch roller is solenoid operated via a cast alloy arm which also actuates the tape lifter pins and the replay head shield, the roller having a oilite type bearing. Finally, before the headblock exit edge guide there is space for an extra head.

Between the headblock and the takeup motor a further spring loaded tension arm is fitted, this being rather a flimsy effort which secures to the decorative trim, the pay off tension arm also being rather flimsy, but secured to the main casting.

At the centre of the tape transport a tape counter is belt driven from the takeup spool motor.

The power supplies and the tape transport control electronics are suspended below the tape transport, all printed circuit boards and other components being plug connected for ease of servicing. Cast frames at the sides of the recorder attach to the transport casting and support the connector panel at the rear and the audio electronics at the front, these comprising a full width mother board into which six electronics boards plug with their controls being accessible through holes in the front panel.

All preset controls take the form of open potentiometers, many of the skeleton type. In the replay chain the only controls are two replay level and two output level controls with the sync mode having two further level controls, equalisation being fixed.

Each channel has separate VU meter and peak indicator light level controls with each speed having separate bias and high frequency equalisation controls. In addition there are two bias traps and two record level preset controls with line input sensitivity controls for each channel being located beneath the tape transport.

The connections at the rear include *XLR* connectors for the line inputs and outputs plus DIN type connectors for capstan speed, fader start and remote control.

With the exception of four locking pushbuttons on the tape transport which select sync replay for

the two tracks, reduce reel motor torque for small spools and initiate a dump edit, all controls are on a panel below the tape transport. This panel which matches the silver anodised trim is divided into three sections from left to right—the output section, the input section and the tape transport section.

Within the output section are the two tape speed selector pushbuttons, the power on/off switch and the $\frac{1}{4}$ in stereo headphone jack socket. The output is selected by a toggle switch which selects replay or input/sync with the replay output being further selected by a five position rotary switch which allows channel 1, channel 2, stereo, reverse stereo or monophonic modes to be selected. Finally in this section is a self illuminating, locking pushbutton which selects either the calibrated output or level control via coaxial potentiometers which also control the headphone level.

Within the input section each channel has a record/ready toggle switch and a level potentiometer which is activated when the single self illuminating pushbutton is switched out of the calibrate position. Each channel has its five position rotary input source switch and a clear red 'record activated' light. The source switch selects the adjacent microphone jack at two different sensitivities, the line input, the output of the other track, plus an off position.

Above the tape transport controls are the two illuminated VU meters within each of which is a red peak record level LED.

The six tape transport control pushbutton switches include the usual fast controls, stop, record, play and pause. The latter which also removes the tape lifters in the fast modes is not a locking control.

The controls which are fully electronically interlocked, allow change of mode without going through the stop mode, including entering record from fast wind which I regard as highly precarious!

Access to the heads for cleaning or editing was excellent with a slide control in the head area removing the tape lifters and de-muting the replay amplifiers for rock and roll editing in the stop mode with the replay head shield retracted.

Tape handling was gentle without any loop slinging or violent movements even in the event of power failure. However the high speed winding was poor with 3 M *250* tape, but good with Agfa *PEM468*.

Frequency response

The replay frequency response at the two tape speeds of 15 in/s and $7\frac{1}{2}$ in/s was measured using BASF calibration tapes to the CCIR equalisation of 35 µs and 70 µs respectively. The spot figures in **Table 1** show an excellent balance between the two channels together with a very flat response.

Using 3M *250* tape, for which the machine is normally aligned, the record/replay frequency response was measured at −20 VU. Again both the channels were identical from 20 Hz to 20 kHz within ± 1 dB with typical results for 15 in/s and $7\frac{1}{2}$ in/s being shown in **Fig 1** and **Fig 2**, respectively.

As stated earlier, no adjustment is available in the replay equalisers, with only high frequency record equalisers for each speed. Again using 3M *250* tape, the range of the record equaliser at 15 in/s was satisfactory as shown in **Fig 3**. However, at $7\frac{1}{2}$ in/s, whilst the range was satisfactory the equaliser was at its extreme cut setting as shown in **Fig 4**.

Sync replay is always a compromise with record head gaps, crosstalk, etc, and this is reflected in the sync replay frequency response shown in **Fig 5** for the two speeds.

TABLE 1

Replay frequency response

Frequency	Channel 1		Channel 2	
	15 in/s	$7\frac{1}{2}$ in/s	15 in/s	$7\frac{1}{2}$ in/s
31.5 Hz	+1.8 dB	−1.0 dB	+2.0 dB	−0.9 dB
63 Hz	+1.1 dB	+0.4 dB	+1.2 dB	+0.4 dB
250 Hz	+0.2 dB	+0.4 dB	+0.3 dB	+0.3 dB
1 kHz	0.0 dB	0.0 dB	0.0 dB	0.0 dB
6.3 kHz	+0.5 dB	−0.2 dB	+0.2 dB	−0.1 dB
12.5 kHz	+0.2 dB	+0.3 dB	0.0 dB	+0.4 dB
16 kHz	−0.4 dB	0.0 dB	−0.6 dB	+0.1 dB
18 kHz	−1.0 dB	−0.5 dB	−1.2 dB	−0.5 dB

Distortion and metering

The maximum output level for 3% third harmonic distortion was measured with reference to a fluxivity of 320 nWb/m at 1 kHz and found to be +8 dB at $7\frac{1}{2}$ in/s or + 11 dB at 15 in/s with 0 VU being satisfactorily set at 8 dB below the $7\frac{1}{2}$ in/s MOL, or 11 dB below the 15 in/s MOL.

Third harmonic distortion at 0 VU was very low, being 0.25% at $7\frac{1}{2}$ in/s or 0.04% at 15 in/s.

Measurement of the performance of the VU meters showed them to correspond to the ASA standard C16.5 with the peak indicator lights being very fast peak reading devices, becoming illuminated 6 dB above 0 VU—a sensible alignment.

Fig 6 shows the result of recording and replaying a 1 kHz square wave at 15 in/s with a degree of ringing being present. Output loading did not ▷

FIG. 1
REVOX PR99
RECORD/REPLAY FREQUENCY RESPONSE
AT 15 IN/S

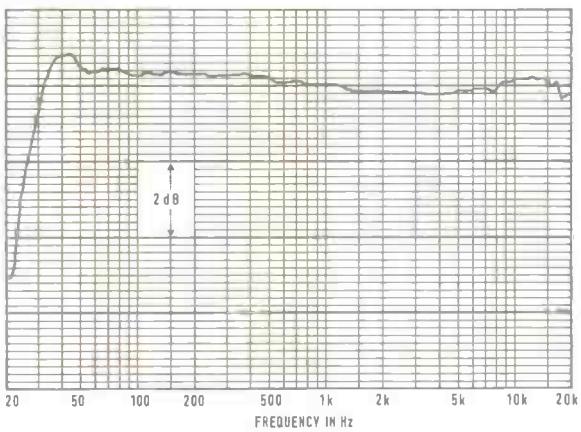


FIG. 2
REVOX PR99
RECORD/REPLAY FREQUENCY RESPONSE
AT 7½ IN/S

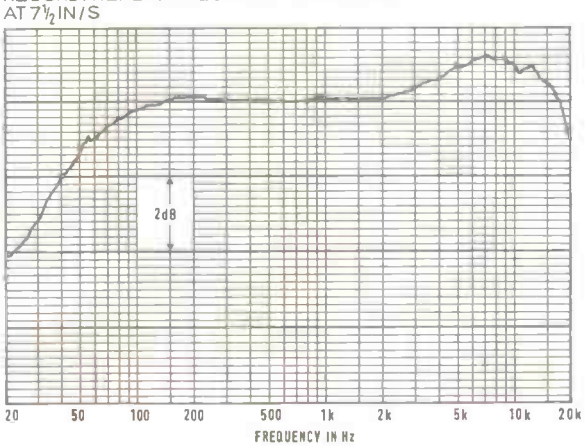


TABLE 2

	Reference level to noise			
	15 in/s		7½ in/s	
Measurement method	Tape	No tape	Tape	No tape
22 Hz to 22 kHz RMS	−60.0 dB	−63.5 dB	−59.5 dB	−63.5 dB
A-weighted RMS	−66.0 dB	−73.5 dB	−63.5 dB	−70.5 dB
CCIR-weighted RMS	−57.5 dB	−67.0 dB	−55.0 dB	−64.0 dB
CCIR-weighted quasi-peak	−53.5 dB	−63.5 dB	−51.0 dB	−60.0 dB
CCIR-weighted ARM (2 kHz)	−64.5 dB	−74.0 dB	−61.5 dB	−70.5 dB

affect this ringing as with some machines.

Noise

With the exception of unweighted noise the two channels were effectively identical, the unweighted noise in channel 2 being 2 dB higher than the figure quoted below for channel 1.

Table 2 shows noise related to a fluxivity of 320 nWb/m for the machine alone, and for machine erased 3M *250* tape, showing a satisfactory margin between machine noise and tape noise.

TABLE 3

	Reference level to noise	
Measurement method	Sync replay	Line input
22 Hz to 22 kHz RMS	−50 dB	−73 dB
A-weighted RMS	−60 dB	−75 dB
CCIR-weighted RMS	−54 dB	−67 dB
CCIR-weighted quasi-peak	−50 dB	−64 dB
CCIR-weighted ARM ref 2 kHz	−60 dB	−74 dB

Noise when replaying in the sync mode was controlled by the machine noise, being the same with or without tape.

Table 3 shows this noise and the noise performance from the line input to the output.

When monitoring the line input in the record mode, bias frequency was at rather a high level in the line output, being at −35 dBm at 7½ in/s or −33 dBm at 15 in/s.

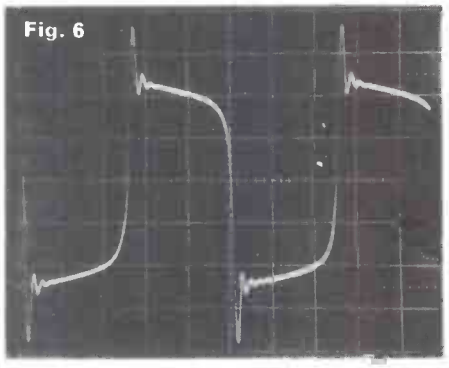
Inputs and outputs

The balanced line inputs had a good common mode rejection, but one channel was about 10 dB better than the other, the worst channel's performance being shown in **Fig 7.**

Line input impedance was constant at 6100 Ω with input gain setting, with the calibrated gain setting being +4 dBm input for 0 VU when the input at clipping was +17 dBm.

In the uncalibrated setting the maximum sensitivity was −8.5 dBm for 0 VU, with the record

Fig. 6



amplifiers being capable of driving 23 dB above 0 VU—a very good margin.

The unbalanced microphone inputs had a constant 109 kΩ impedance in both the Mic Hi and Mic Lo settings. In the Mic Hi setting the maximum sensitivity for 0 VU was 350 μV with a maximum input capability of 80 mV, or in the Mic Lo setting a sensitivity of 8 mV and signal handling capability of 1.5 V.

The equivalent input noise at the microphone inputs was on the high side when terminated in 200 Ω, being −117.5 dBm A-weighted in the Mic ▷

FIG.3
REVOX PR99
RECORD EQUALISATION AT 15 IN/S

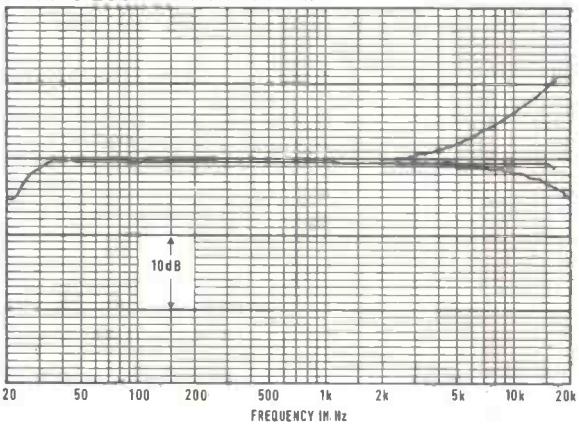


FIG.4
REVOX PR99
RECORD EQUALISATION AT 7½ IN/S

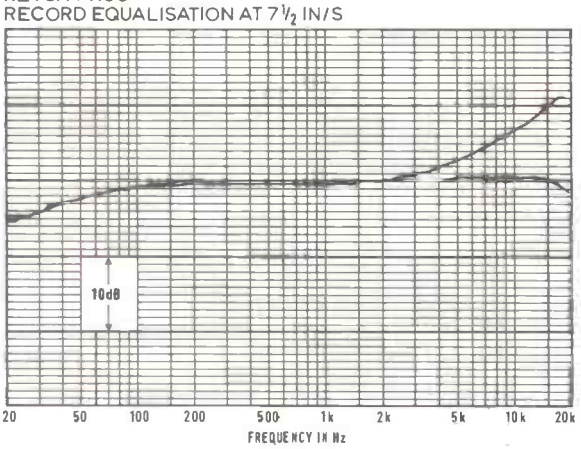


FIG.5
REVOX PR99
SYNC REPLAY FREQUENCY RESPONSE

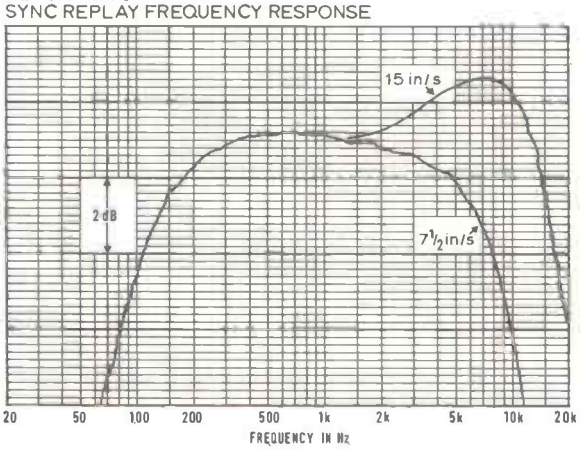
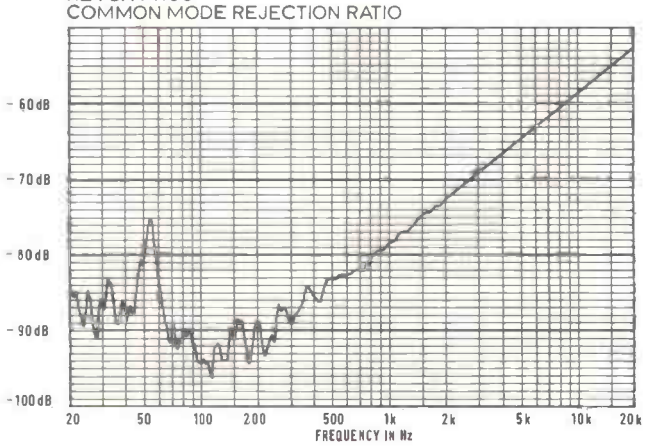


FIG.7
REVOX PR99
COMMON MODE REJECTION RATIO



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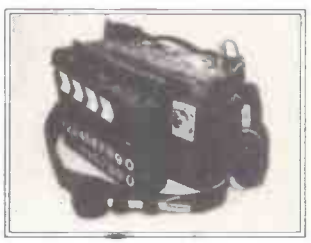

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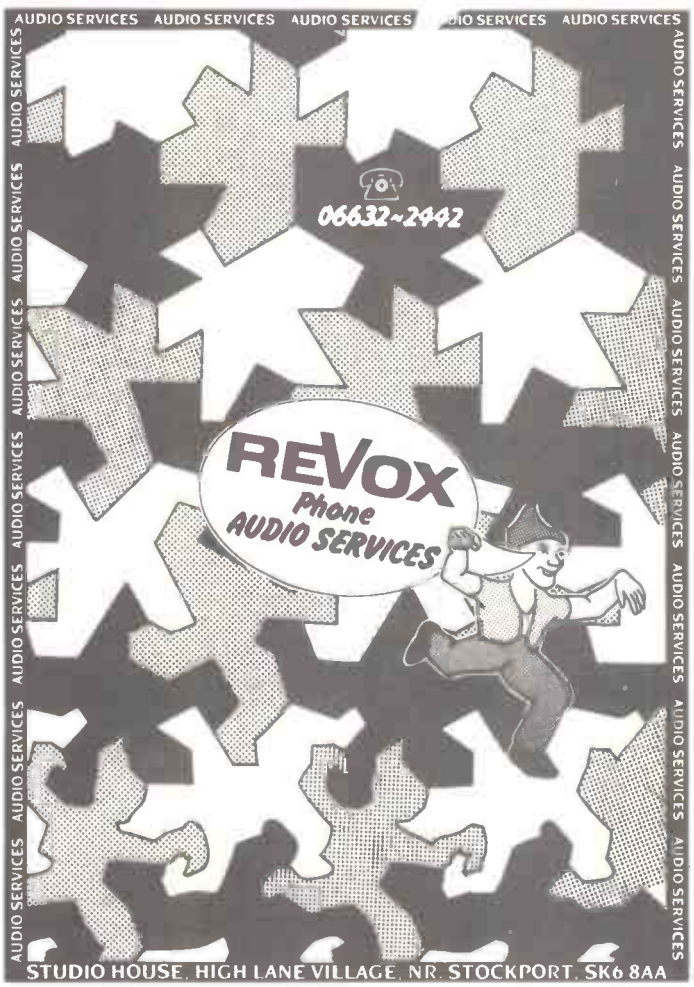


Hi setting, or −104 dBm in the Mic Lo setting.

The floating line outputs had a source impedance of 42 Ω at 1 kHz delivering +4 dBm for 0 VU in the calibrated setting. Uncalibrated the outputs could give +14 dBm for 0 VU, with the output at clipping of the output stages being +24 dBm loaded into 600 Ω, or +25 dB.7V.

At the stereo headphone output the maximum level was 6.2 V from a source impedance of 220 Ω, suitable for driving most headphones.

Wow, flutter and speed

Quasi-peak weighted wow and flutter was measured to the IEC standard at the beginning, middle and end of a full NAB reel of standard play tape with the results shown in **Table 4.** The same figures were found with the recorder in the vertical or horizontal plane, but the wow and flutter varies more in the vertical plane.

A spectrum analysis of a 10 kHz tone recorded and replayed at 15 in/s **(Fig 8)**, showed distinct sidebands at ±10 Hz corresponding to the capstan diameter and at ±50 Hz corresponding to the power line frequency.

The relation between the two tape speeds was within less than 0.01%, with the drift from one end of a reel of tape to the other being 0.05% slow at the end of the tape.

Phase jitter between the tracks using a 10 kHz tone at 15 in/s was not very good as shown in **Fig 9**, where one vertical division corresponds to 5° and a horizontal division to 1 s.

TABLE 4

	Beginning	Middle	End	Specification
15 in/s	0.017%	0.03%	0.035%	0.06%
7½ in/s	0.06%	0.06%	0.06%	0.08%

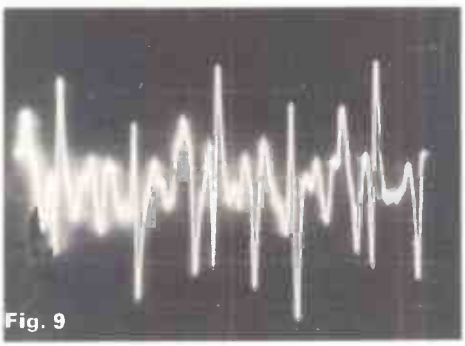


Fig. 9

Other matters

The available range of bias was more than adequate with the depth of erasure of a 1 kHz tone at 15 in/s being 76/80 dB for the two tracks.

Replaying a 10 kHz tone on one track whilst erasing the other track did not produce any measurable loss of level in the adjacent track.

Crosstalk between the two tracks was good as shown in **Fig 10** for 15 in/s, being similar at 7½ in/s with a slightly improved low frequency performance.

For the sync mode the crosstalk is shown in **Fig 11,** when recording one track and replaying the other in the sync mode—a situation which is always troublesome.

Summary

The Revox *PR99* is in many ways similar to earlier Revox recorders, being based on a well tried tape transport design with modern control logic.

This is a well made semi-professional machine which should be easy to service and easy to use with a generally good overall performance.

As mentioned there are a few shortcomings, but none of these are of a serious nature. □

FIG.8
REVOX PR99
SPECTRUM ANALYSIS OF 10kHz TONE
RECORDED AND REPLAYED AT 15 IN/S

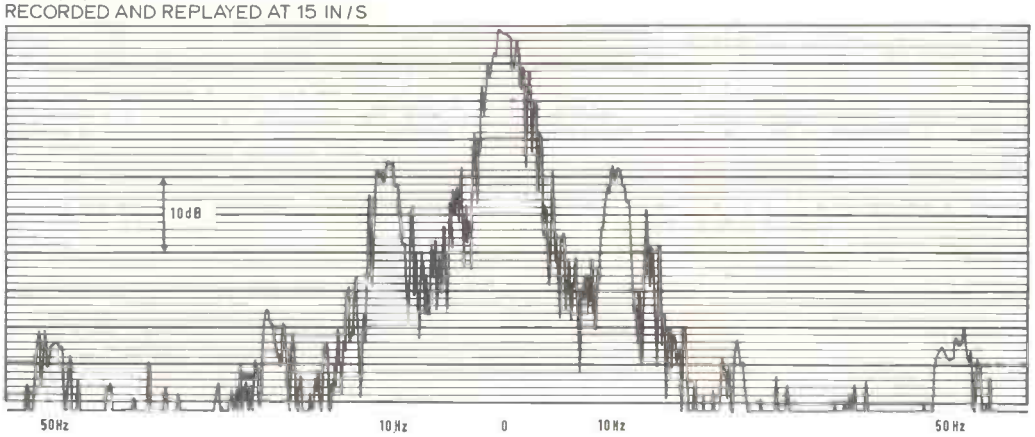


FIG.10
REVOX PR99
CROSSTALK AT 15 IN/S

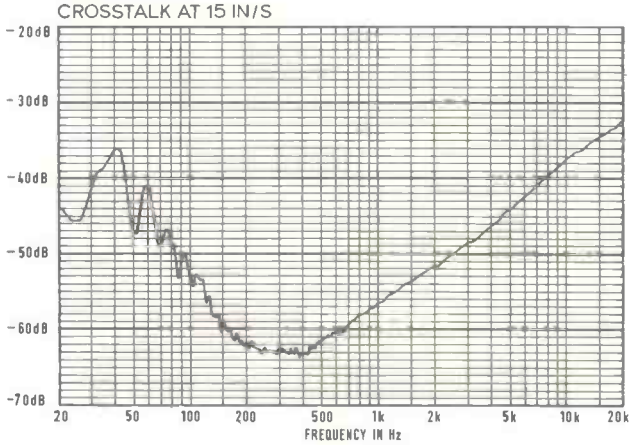
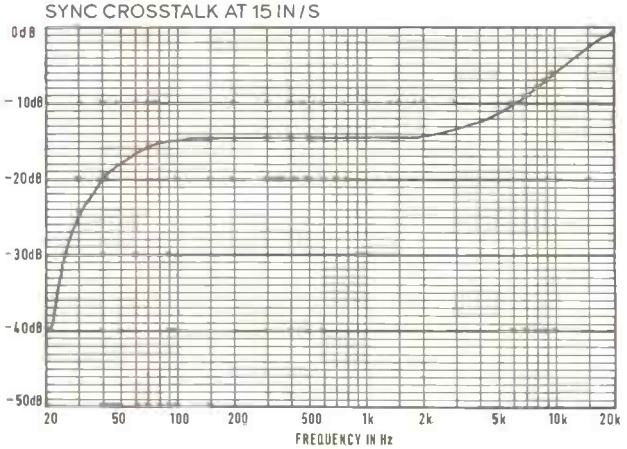


FIG.11
REVOX PR99
SYNC CROSSTALK AT 15 IN/S



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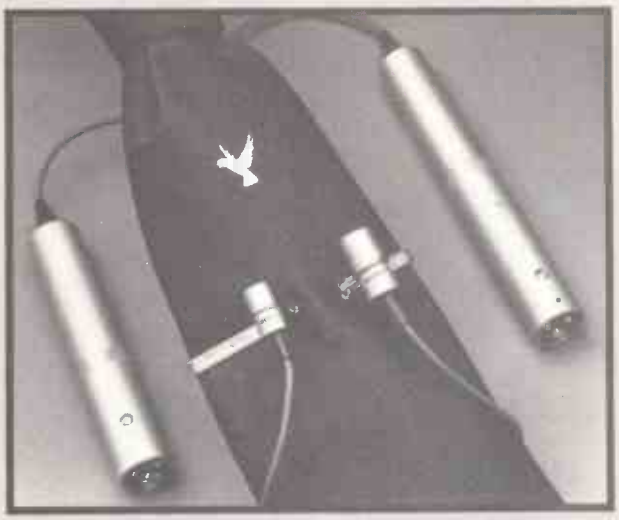

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Sony TC–D5PRO

Hugh Ford

MANUFACTURER'S SPECIFICATION

Recording system: 4-track, 2-channel stereo.
Tape speed: $1\frac{7}{8}$ in/s.
Tape speed deviation: ± 1%.
Fast winding time: approximately 150 s with Sony C-60 cassette.
Wow and flutter: 0.06% weighted RMS, ±0.17% DIN.
Bias frequency: 85 kHz.
Frequency response: (Dolby noise reduction switched out); ferri-chrome cassette (tape select—type III) 40 Hz to 16 kHz ±3 dB (NAB), 40 Hz to 16 kHz (DIN); chrome type II cassette 40 Hz to 15 kHz ±3 dB (NAB), 40 Hz to 15 kHz (DIN); standard ferric type I cassette 40 Hz to 12 kHz ±3 dB (NAB), 40 Hz to 12 kHz (DIN).
Signal to noise ratio: (Dolby noise reduction switched out); ferri-chrome cassette (tape select—type III) 58 dB at peak level (NAB); chromium dioxide type II cassette 55 dB at peak level (NAB); standard ferric type I cassette 53 dB at peak level (NAB). Ratio improved by 6 dB with Dolby noise reduction switched in.
Total harmonic distortion: 1.3%.
Inputs: two balanced microphone inputs (Cannon *XLR-3-32* type connectors). Sensitivity 0.25 mV (−70 dB) for low impedance microphones with Cannon *XLR-3-11C* connectors.
Outputs: two unbalanced line output phono jacks, load impedance 10 kΩ or higher. Rated output 0.435 V (−5 dB) at a load impedance of 47 kΩ.
Headphone output: stereo binaural jack for low impedance headphones. Rated output 0.2 mW into 8 Ω, maximum output 20 mW into 8 Ω.
Monitor loudspeaker: approximately 2 in (50 mm) diameter drive unit. Power output 200 mW for 10% harmonic distortion with DC operation.
Power requirements: 3 V DC; two D size batteries (IEC designation R20).
Battery life: approximately $4\frac{1}{2}$ hours with Eveready *No E95* alkaline batteries; approximately $1\frac{1}{2}$ hours with Sony *SUM-1S* dry batteries.
Operating temperature range: 0° C to 40° C (32° F to 104° F).
Dimensions: approximately $9\frac{3}{8} \times 1\frac{7}{8} \times 6\frac{5}{8}$ in (whd), 237 × 48 × 168 mm including projecting parts and controls.
Weight: approximately 1.7 kg (3 lb 12 oz) including batteries.
Manufacturer: Sony Corporation, PO Box 10, Tokyo Airport, Tokyo 149, Japan.
UK: Sony Broadcast Ltd, City Wall House, Basing View, Basingstoke, Hants RG21 2LA.

THE Sony *TC-D5PRO* is a portable battery operated stereo recorder which is designed to use type I, II or III compact cassettes—that is ferric, chrome or ferri-chrome.

The recorder which tips the scales at just under 1.8 kg, complete with the two D size 1.5 V batteries, is very neat in design with most controls being well protected. A sensible and strong carrying strap is supplied together with a rather fiddly carrying case which has a separate belt for holding the recorder against the body.

Cassettes are inserted into the recorder under a transparent flap on the top surface with the cassette location not being too positive. The ejection mechanism was rather violent in action such that the cassette flips right out of the recorder.

Bias and equalisation selection for chrome (type II) tapes is automatic with a fluorescent indicator, positioned below the cassette flap, showing the automatic selection of chrome characteristics. Also underneath the cassette flap are two toggle switches, one selecting Dolby on/off and the other bias and equalisation for type I and III (ferric and ferri-chrome) tape types. Remaining top of recorder features are a three digit resetable tape counter and a 2 in loudspeaker located under a grille to the right of the unit.

To the front of the recorder are the usual interlocked tape transport movement buttons, with the record button being interlocked both with the play button and with the record inhibit apertures of cassettes. All these buttons and the pause control were positive in action with a solid feeling.

On the front panel of the recorder is a $\frac{1}{4}$ in stereo monitoring jack, the use of which inhibits the internal loudspeaker. Adjacent to this is a knurled monitor level control affecting both the loudspeaker and the headphones.

To the right of the front panel knurled coaxial potentiometers control the record level which is monitored by two circular VU type meters which may be illuminated by a battery check/light push-button. When this is pressed both meters are illuminated with the left meter indicating on the battery check scale such that the left channel cannot be monitored in the dark!

Two red LEDs located above the meters respectively indicate that the unit is in record and indicate peak record level, with a toggle switch to the right of the meters inserting a limiter in the record chain when desired.

At the right hand face of the recorder are the inputs and outputs plus two recessed toggle switches, one for inserting a 20 dB pad in the inputs and the other switching the record function between stereo and mono. The two inputs are balanced connections at *XLR* plugs without phantom powering, whilst the fixed level outputs are at phono sockets.

The two D size batteries fit under a removable flap underneath the recorder and are very easy to change. Very sensibly both the base and the back of the recorder are fitted with non-slip surfaces so that it doesn't slide about when placed on a flat surface.

In operation the control layout was found to be excellent with the exception of setting the stereo balance with the coaxial potentiometers, which was fiddly.

So far as the standard of construction is concerned the external finish was good and relatively substantial, but the design of the tape transport itself can only be described as to a good domestic standard.

All the electronics are mounted onto a single printed circuit board with access to this and the mechanical components being none too good.

TABLE 2

Tape	CD ALPHA		CHF	
	Left	Right	Left	Right
5% MOL	+0.1 dB	−2.2 dB	+1.1 dB	+0.3 dB
3% MOL	−1.7 dB	−3.7 dB	−0.4 dB	−1.7 dB
Zero VU	−1.2 dB	−1.2 dB	−1.9 dB	−2.2 dB

Inputs and Outputs

The balanced microphone inputs at the *XLR* connectors were found to have a satisfactory input impedance for dynamic microphones which remained constant with gain at 4.5 kΩ.

Common mode rejection was good as shown in **Fig 1** with the input sensitivity being −72.5 dBm for an indication of 0 VU without the 20 dB pad, ▷

FIG. 1
SONY TC-D5PRO
COMMON MODE REJECTION RATIO

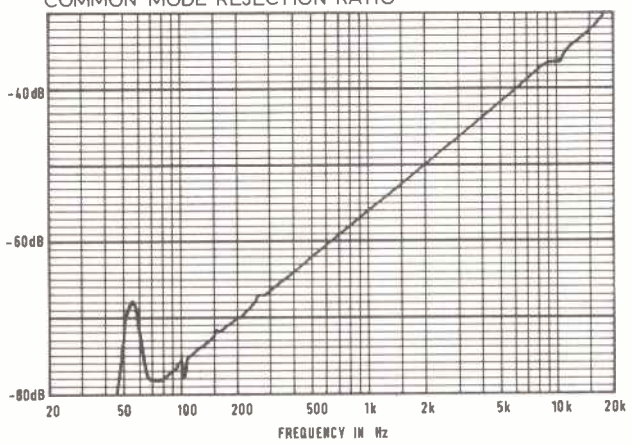


FIG. 2
SONY TC-D5PRO
RECORD/REPLAY FREQUENCY RESPONSE
SONY CHF FERRIC TAPE DOLBY OFF

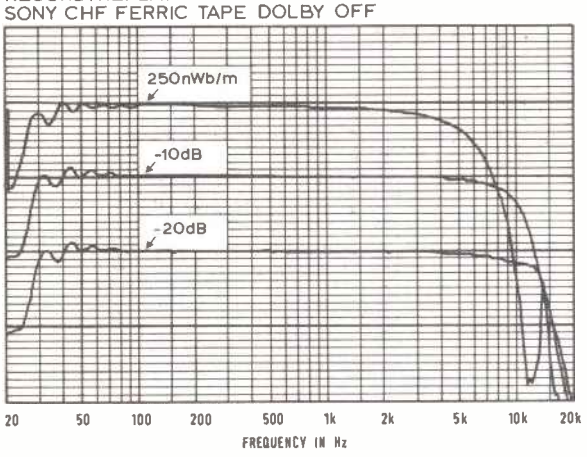


TABLE 1

Frequency	(Hz)	31.5	40	63	125	250	315	500	1k	2k	4k	6.3k	8k	10k	12.5k
Ferric	(dB)	+2.0	+0.8	−0.1	−0.2	−0.3	0	−0.1	0.0	−0.4	−0.7	−1.3	−1.8	−2.8	−4.3
Chrome	(dB)	+4.0	+2.4	+0.8	−0.2	0.0	0	−0.3	−0.6	−0.9	−0.8	−0.6	−0.4	−0.8	−1.7

or −52.5 dBm with the pad in circuit. The maximum acceptable input was −25 dBm without the pad or −5 dBm with the pad, the latter being just acceptable for some electret type microphones at high sound pressure levels.

The output impedance at the unbalanced outputs was found to be 3 kΩ with a maximum output drive capability of 3 V. Zero VU corresponded to an output of 4.5 V, the output impedance being very high by professional standards.

At the headphones jack the impedance was 12 Ω with a maximum output of 0.7 V giving adequate levels into low impedance headphones.

Battery drain was found to be 330 mA in the play mode or 520 mA in the record mode. This should give a good battery life using alkaline cells which typically have a rating of 8 AH.

TABLE 3

Measurement method	Reference level (250 nWb/m) to noise			
	Ferric setting		Chrome setting	
Machine only	Dolby	No Dolby	Dolby	No Dolby
22 Hz to 22 kHz RMS	68 dB	52 dB	59 dB	55 dB
A-weighted RMS	67 dB	59 dB	70 dB	63 dB
CCIR-weighted RMS ref 1 kHz	64 dB	54 dB	67 dB	58 dB
CCIR-weighted quasi-peak	60 dB	50 dB	63 dB	54 dB
CCIR-weighted ARM ref 2 kHz	70 dB	60 dB	73 dB	64 dB
Machine with tape				
22 Hz to 22 kHz RMS	55 dB	50 dB	57 dB	53 dB
A-weighted RMS	62 dB	54 dB	65 dB	57 dB
CCIR-weighted RMS ref 1 kHz	56 dB	46 dB	58 dB	49 dB
CCIR-weighted quasi-peak	52 dB	42 dB	54 dB	45 dB
CCIR-weighted ARM ref 2 kHz	62 dB	53 dB	65 dB	55 dB

Frequency response

The replay frequency response for the 120 µs + 3180 µs and the 70 µs + 3180 µs equalisations for ferric and chrome type tapes respectively was checked using BASF calibration tapes with the results referenced to 315 Hz being shown in **Table 1.**

The results for only one channel are quoted as both channels were very similar, however, at high frequencies the lack of positive cassette location led to variable azimuth errors.

The record/replay frequency response was checked at record levels of 250 nWb/m, −10 dB and −20 dB with Dolby off using Sony *CHF C60* ferric tape and Sony *CD ALPHA* chrome tape. The results shown in **Fig 2** and **Fig 3** respectively clearly demonstrate the advantages of the chrome tape at high frequencies and high levels, in both cases the machine's performance being satisfactory for interview work.

In order to assess the tracking of the Dolby B system, frequency response plots were made at four 10 dB increments below a fluxivity of 250 nWb/m. The results from this being shown in **Fig 4** for Sony *CD ALPHA* tape. As might be anticipated there was minor mistracking at −30 db resulting from the mild frequency response errors at higher levels.

Noise and distortion

The maximum output level for 3% and 5% third harmonic distortion was measured at 315 Hz for the ferric *CHF* tape and the chrome *CD ALPHA* tape and the output level for recording 0 VU also noted with reference to 250 nWb/m, the results being shown in **Table 2.**

From this is to be seen that for some reason the two channels are not identical and that 0 VU is set at far too high a level. Furthermore, the peak indicator became illuminated at +6 VU which is again at too high a level.

Noise in the output was measured for ferric and chrome equalisations with and without tape, and with and without Dolby, with the two channels giving closely similar results as can be seen in **Table 3.**

The weighted figures show a very good margin between machine and tape noise and demonstrate the effectiveness of the Dolby B noise reduction.

Noise was also checked referred to the microphone inputs and found to be good at an effective input level of −124.5 dBm A-weighted with the inputs loaded with 200 Ω.

Wow and flutter

IEC quasi-peak weighted wow and flutter was measured at the beginning, middle and end of cassettes and found to be to a creditable standard between 0.1% and 0.12%. Furthermore, movement of the recorder by walking with it around the laboratory made no difference to the wow and flutter.

Other matters

The switchable limiter was found to be effective in limiting speech, but to have a rather long release time leading to 'breathing' effects. Using a 10 dB overload the limiter operated in 30 ms, limiting to around the 5% distortion point with the full release time of 400 ms accounting for the subjective 'breathing' effects.

Measuring the VU type meters showed them to have a peculiar rectifier characteristic (probably using a half wave rectifier) with the rise time being 180 ms and the fall time being 400 ms, compared with the genuine VU meter requirements of 300 ms for both.

Erasure of a 315 Hz tone by >75 dB was entirely satisfactory, as was the crosstalk between tracks of 33 dB at 315 Hz falling to 30 dB at 100 Hz.

Summary

The Sony *TC-D5PRO* is an attractive recorder for radio interview work, being very compact, lightweight and simple to use. Using Dolby and chrome tape the performance is more than adequate for such purposes with a good dynamic range and very low wow and flutter. However, the metering was too insensitive and whilst peaking around −5 VU seemed alright for speech, any attempt at 0 VU gave poor distortion.

With the limiter in circuit the performance was far happier and I would recommend its use rather than relying on the meters. □

FIG.3
SONY TC-D5 PRO
RECORD/REPLAY FREQUENCY RESPONSE
SONY CD ALPHA CHROME TAPE DOLBY OFF

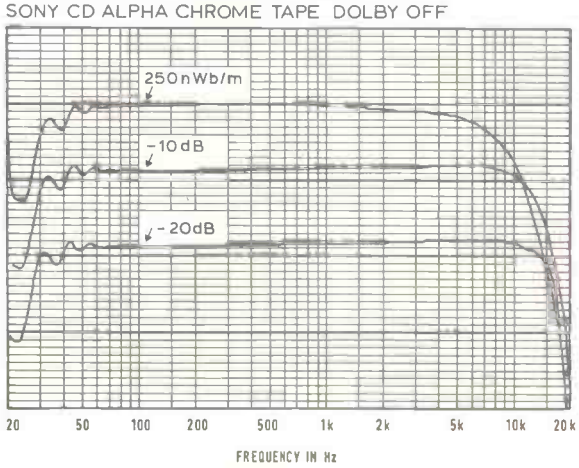
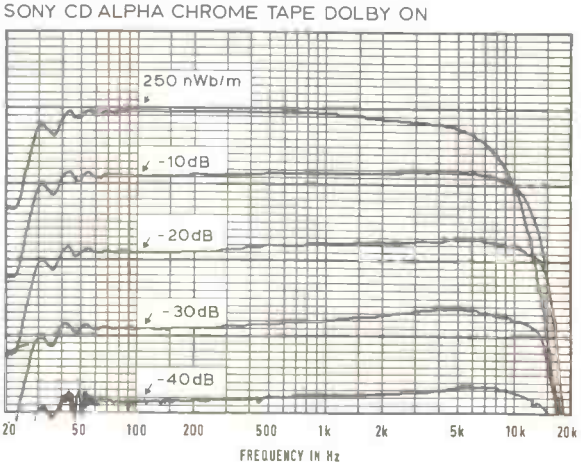


FIG.4
SONY TC-D5 PRO
RECORD/REPLAY FREQUENCY RESPONSE
SONY CD ALPHA CHROME TAPE DOLBY ON



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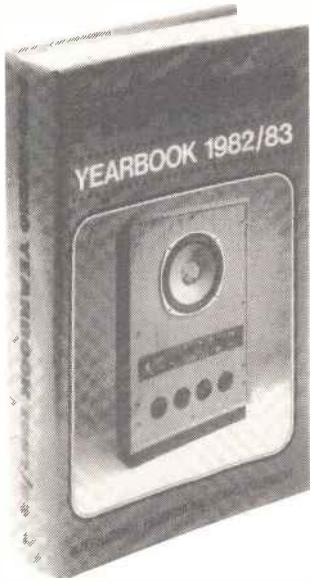

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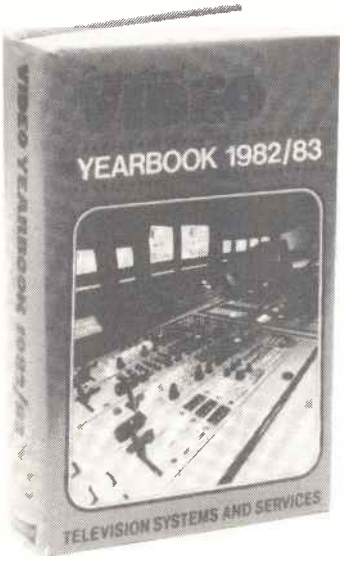

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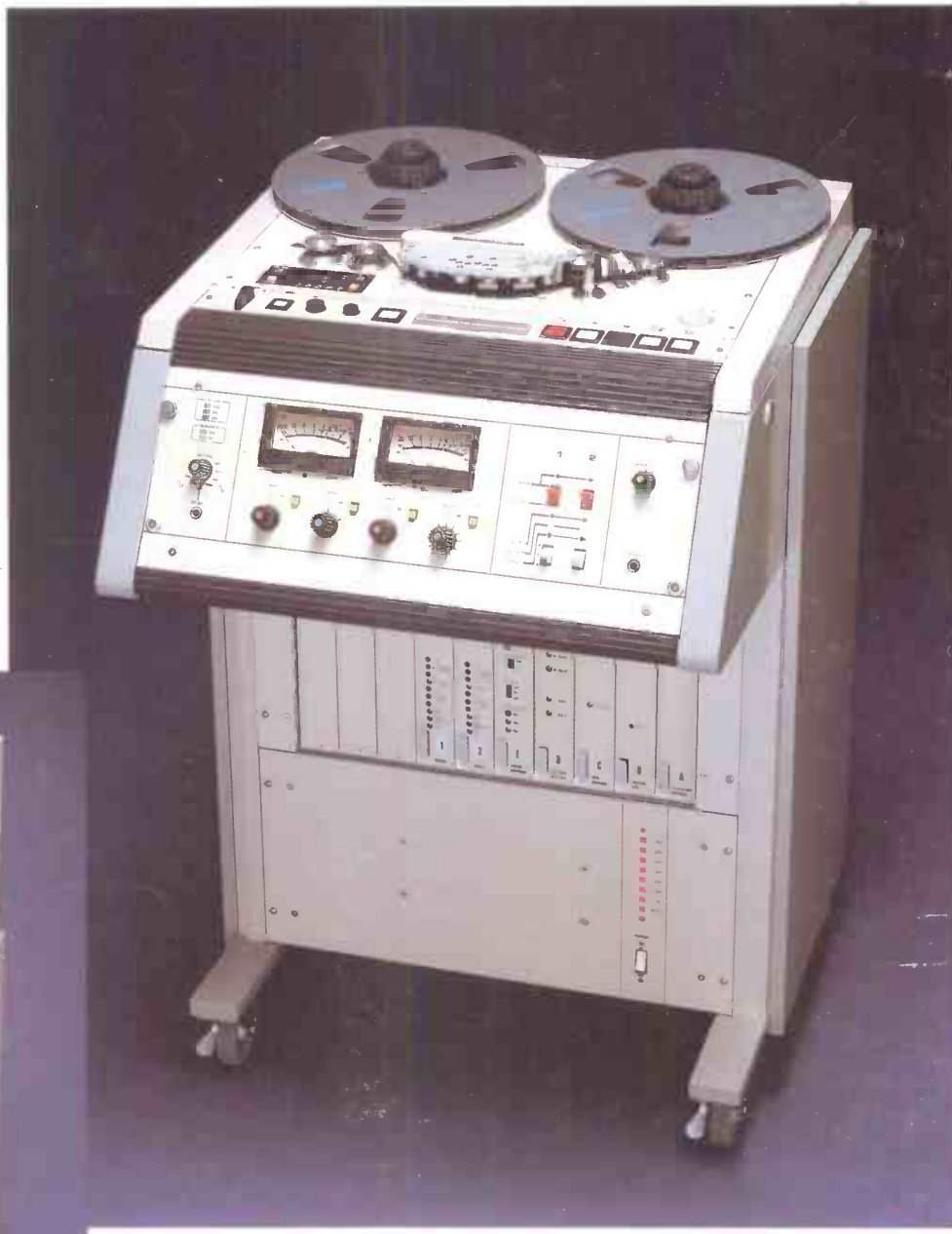

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