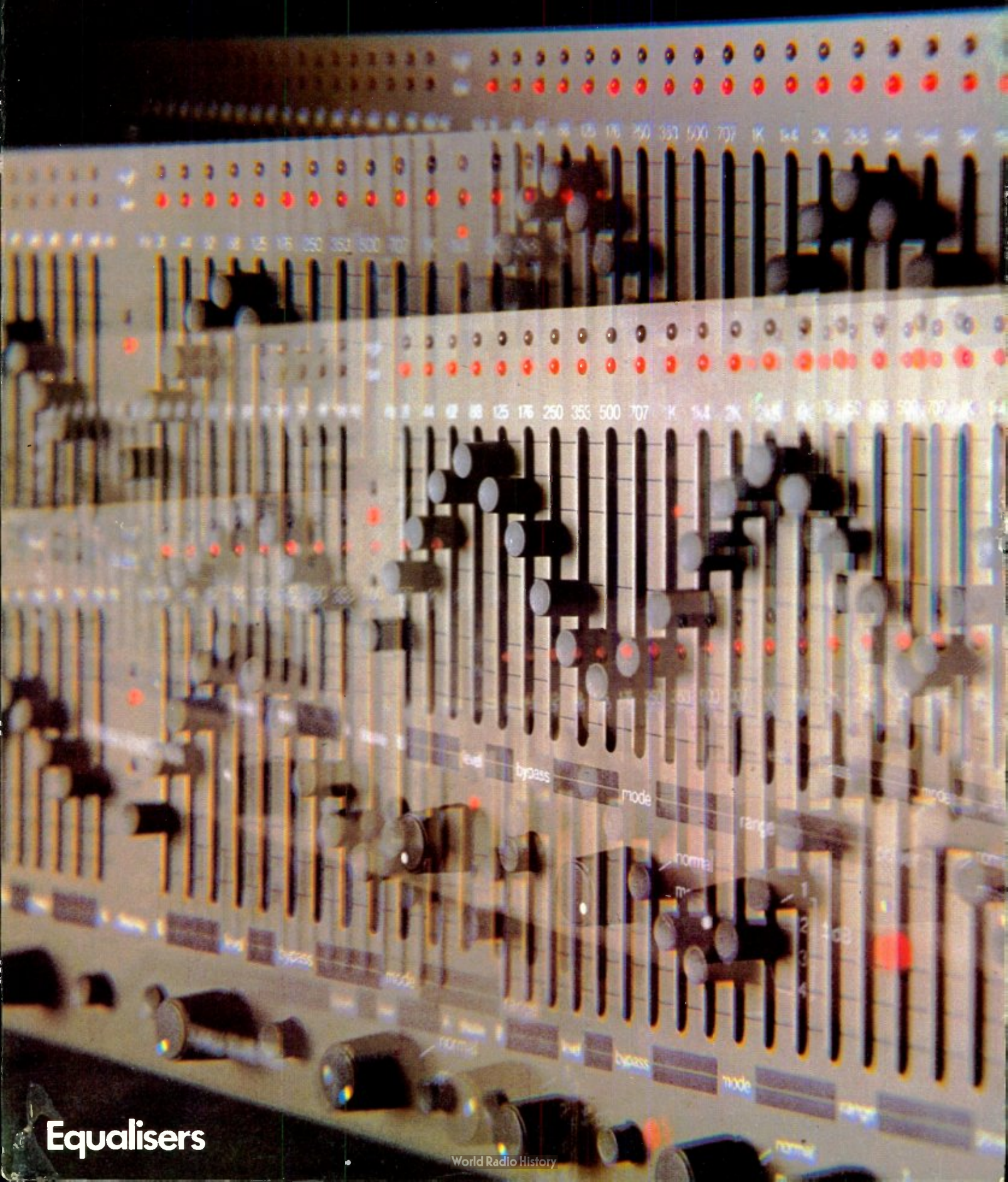
October 1979 60p

studio sound

AND BROADCAST ENGINEERING

A LINK HOUSE PUBLICATION



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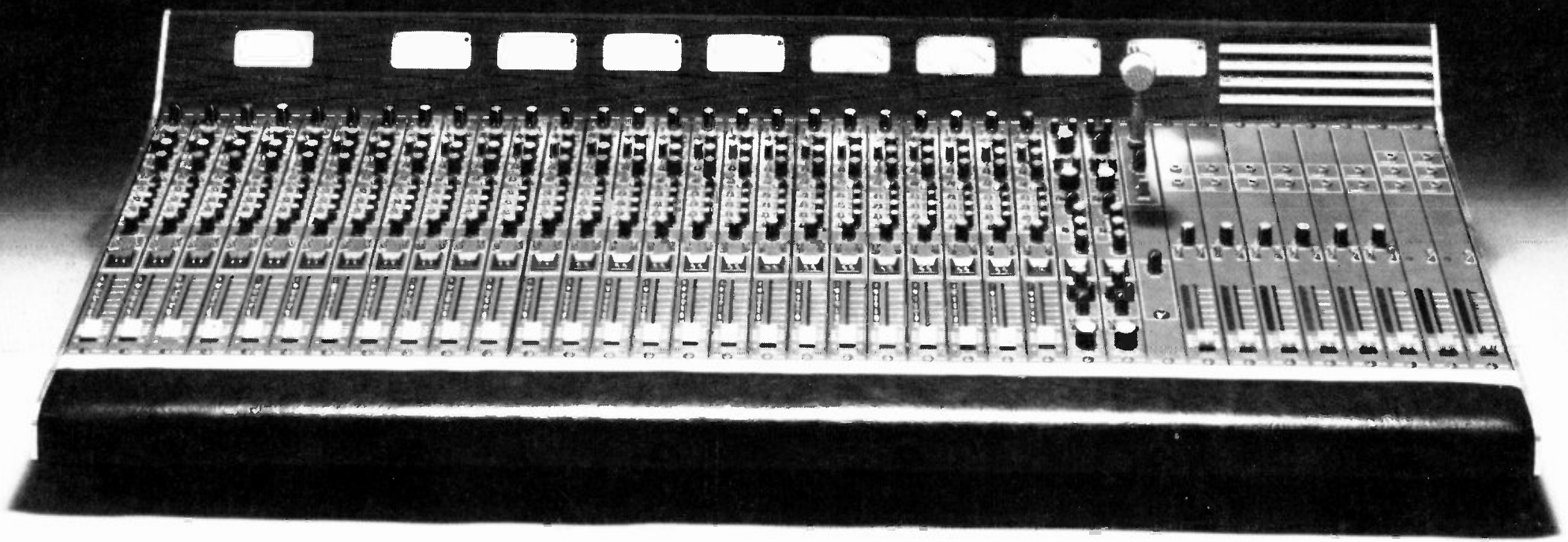

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A LINK HOUSE GROUP MAGAZINE

studio sound

AND BROADCAST ENGINEERING

Last October I included a list of geographic areas which the Independent Broadcasting Authority suggested as being suitable for new British commercial radio stations, and the following January's issue included the final list of nine areas selected by the Home Office. These new franchises have been variously advertised over the past few months, and most of the new stations have now been offered to suitable consortiums, who are now presumably selecting their staff and premises, and seeing how much money they have left for technical equipment. It is no secret that some surprise has been expressed at some of the consortiums selected by the IBA, but that is another story. And while these nine new stations are expected on-air progressively during 1980, the Home Office (with a recent change of Government, previously responsible for the initial introduction of commercial radio six years ago) has wasted no time in suggesting a further 15 possible sites bringing the total to 43 stations; potentially operating by 1981 (if the IBA can get the transmitters up fast enough). The new areas proposed are: Ayr, Barnsley, Bristol, Bury St Edmunds, Canterbury/Dover, Guildford, Leeds, Leicester, Londonderry, Luton/Bedford, Newport, Preston/Blackpool, Swindon, Worcester/Hereford and Wrexham/Deeside. But what technical experiences have been learnt from the first six years of commercial radio—apart from the obvious fact that most of the early stations are now on their second round of equipment, and mostly not for life-expiry reasons? Next February's issue should tell all.

Meanwhile, here is a thought for future chief engineers. Do you really require thousands of NAB cartridges cluttering up your new station? With complex cart machines that even require motor-driven azimuth correction, due to fundamental design deficiencies in the original cartridge design? Or has technology provided a potentially new technique to replace cartridges? Two separate developments have provided the technology for a new type of commercial transmission system: computerised commercial scheduling systems and digital audio. Digital storage is reducing in cost each year, and computer discs can now store about 250Mbytes for £6,000, which is sufficient to digitally record over 80 30s stereo commercials or promos, complete with logging data. The computer would know which commercials were scheduled for which times of the day and present them to the presenter or engineer (complete with alphanumeric display of title etc) ready for transmission upon the simple press of a button. Alternatively, the commercial could be selected by code number or even keywords. Regularly used promos could be allocated to a single switch by simple computer programming, retaining the instant access of carts. Only panel space would limit the number of promos thus available by pressing a single switch, while all material would be automatically selected from the computer disc however chosen for transmission. All logging, billing and transmission certification would be automatic and inherent in the system. Distribution of commercials to stations could be in digital form on a floppy computer disc, down a conventional phone line (10 minutes for a 30s commercial, but even that is rather faster than Red Star parcels or post), or preferably down a data circuit operating at 50k bits/s which would handle stereo in real time, with addresses so that all the stations destined for the commercial receive and store it automatically. While the computer might already be on the shopping list for new stations, the digital disc drive cost would probably be less than that of the several triple stacks, and then no cartridges to buy, or handle. Something for the future? It's all possible today.

Cover of Formula Sound equaliser by Adrian Mott and Ray Hyden

OCTOBER 1979 VOLUME 21 NUMBER 10

Peace and quiet

The quietest sound the ear can hear moves the eardrum about 10^{-9}cm, one tenth the diameter of a hydrogen molecule. Movement due to random thermal bombardment of the eardrum by air molecules is around this same level and largely accounts for this limit of sensitivity.*

But the distortion contribution from a QUAD 405 amplifier in normal use (say 85dBa) moves the eardrum less than this amount.

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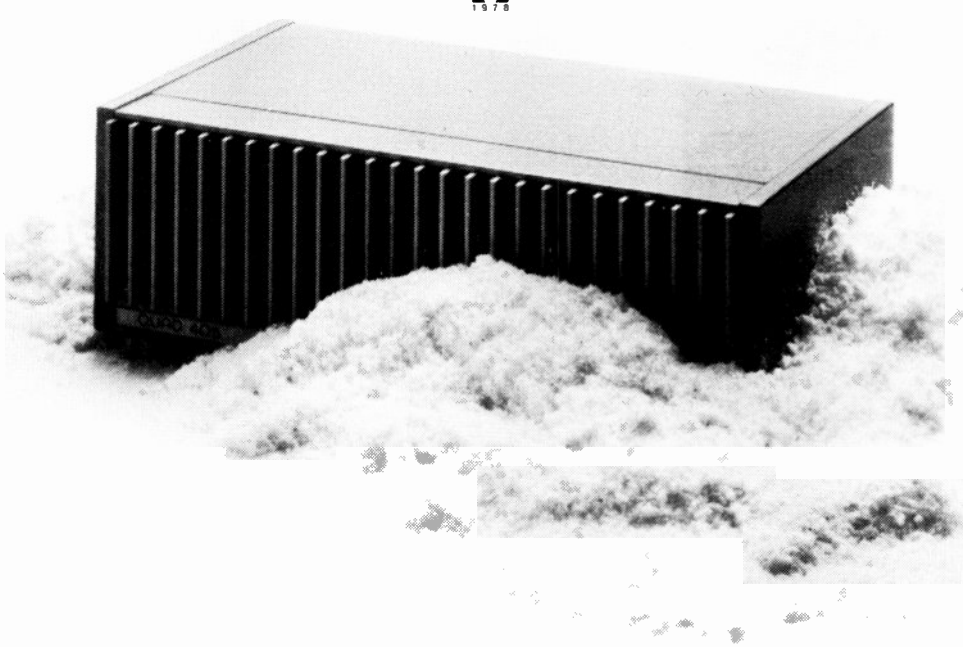

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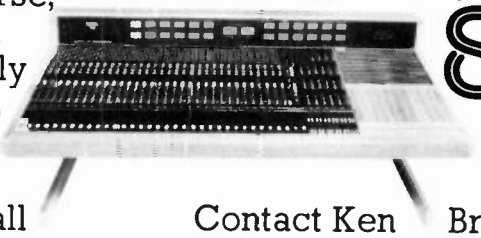
But the best feature of all is its highly competitive price: £15,000 — £20,000 depending upon format, with a financial package deal available.

SERIES 80



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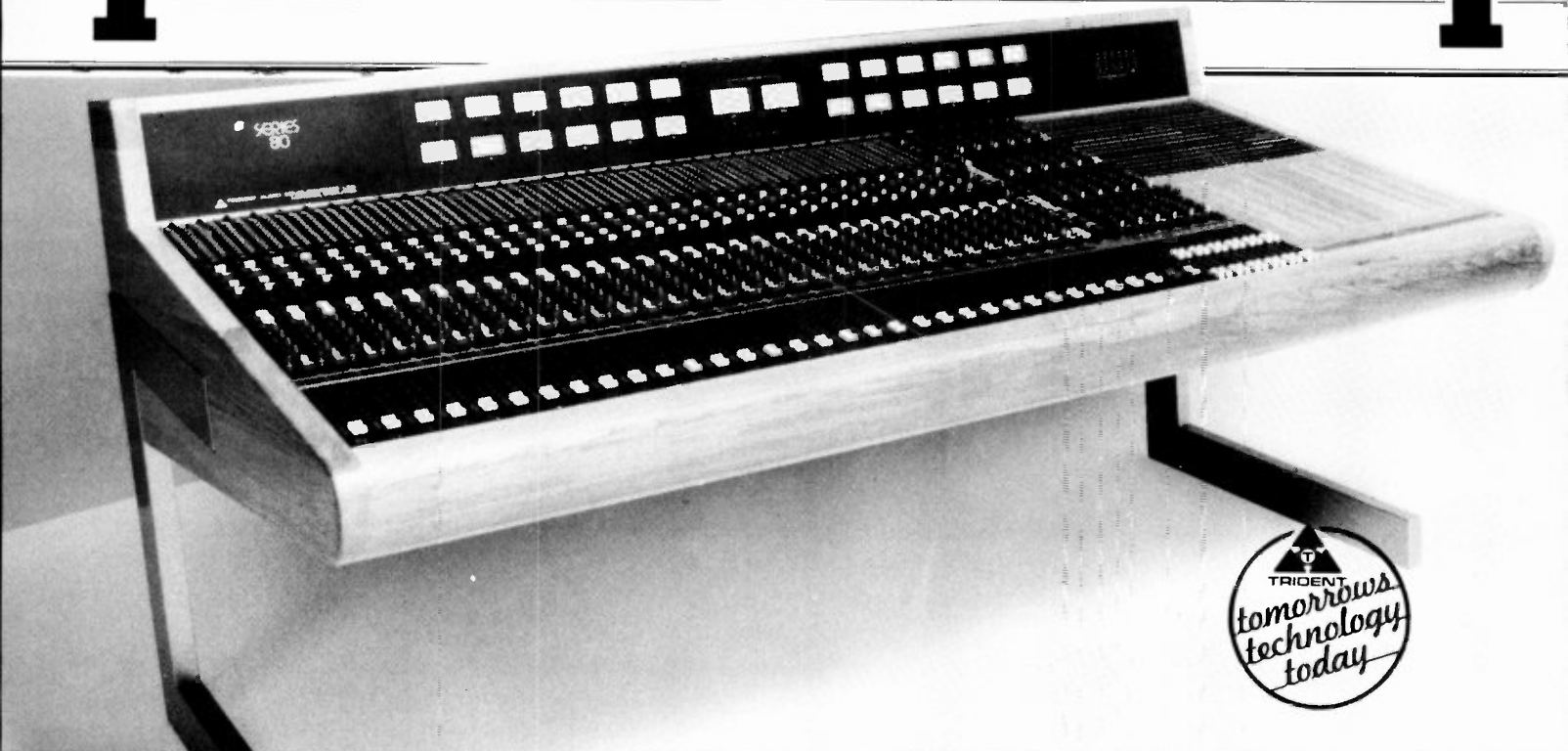

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- **Disco**
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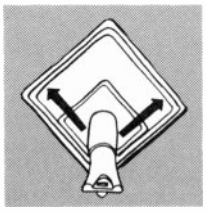
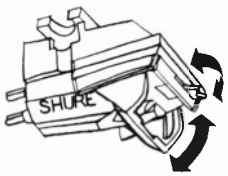


FLIP-DOWN Locking Stylus Guard

The exclusive lever-operated, locking stylus guard gives the stylus tip positive protection when not in use. With the flip of a lever, it snaps out of the way, and positions a highly visible cuing aid.



The Professional Challenge: Prolonged record (and lacquer master) playability without objectionable noise buildup.

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SC39B	Spherical		

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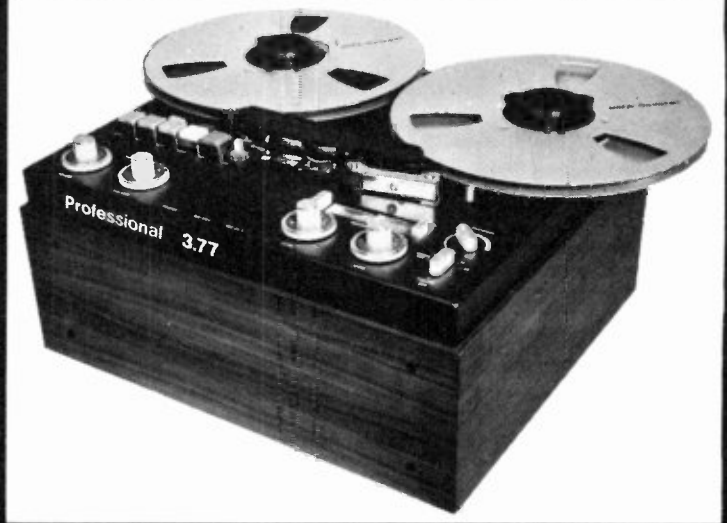

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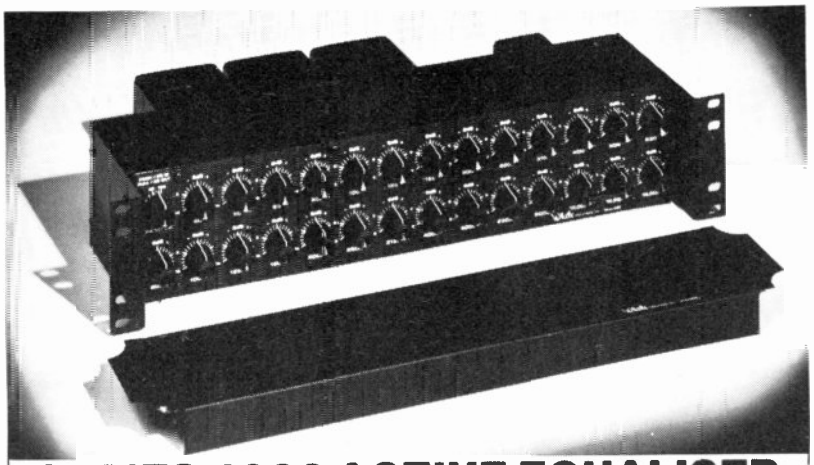

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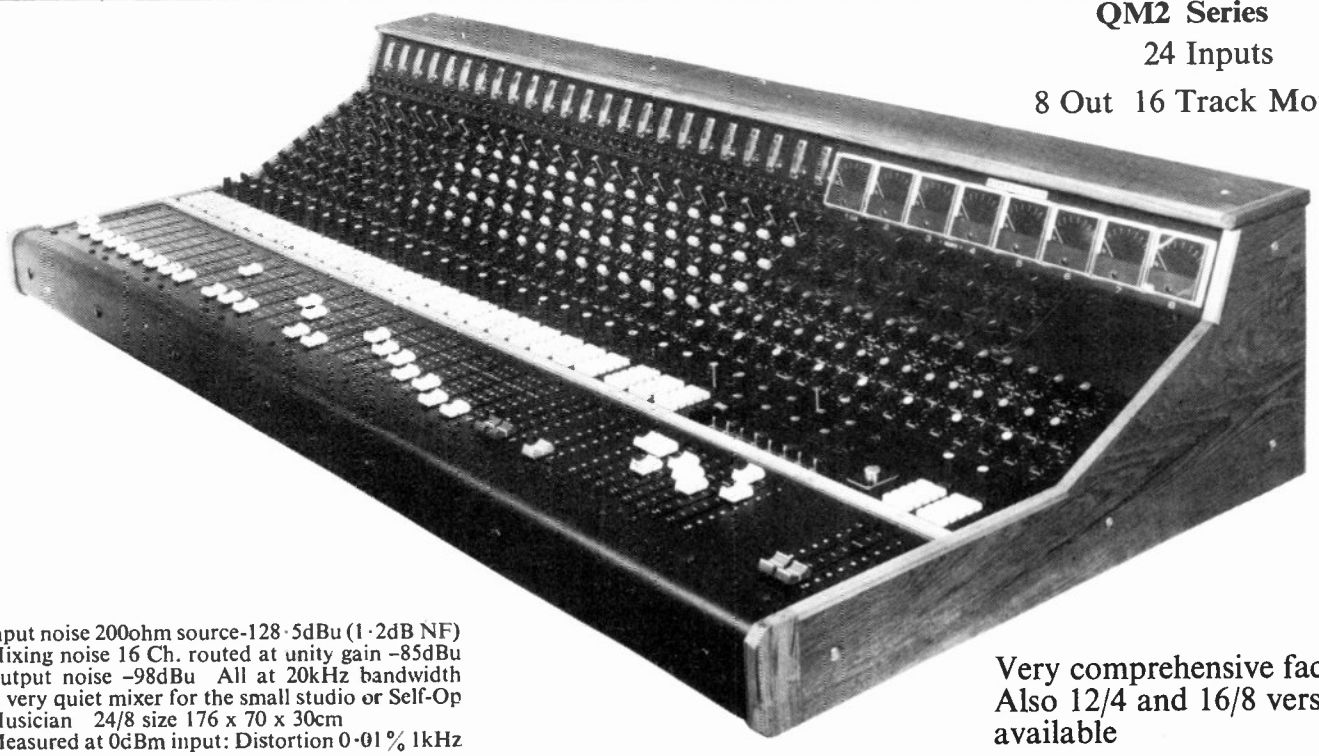

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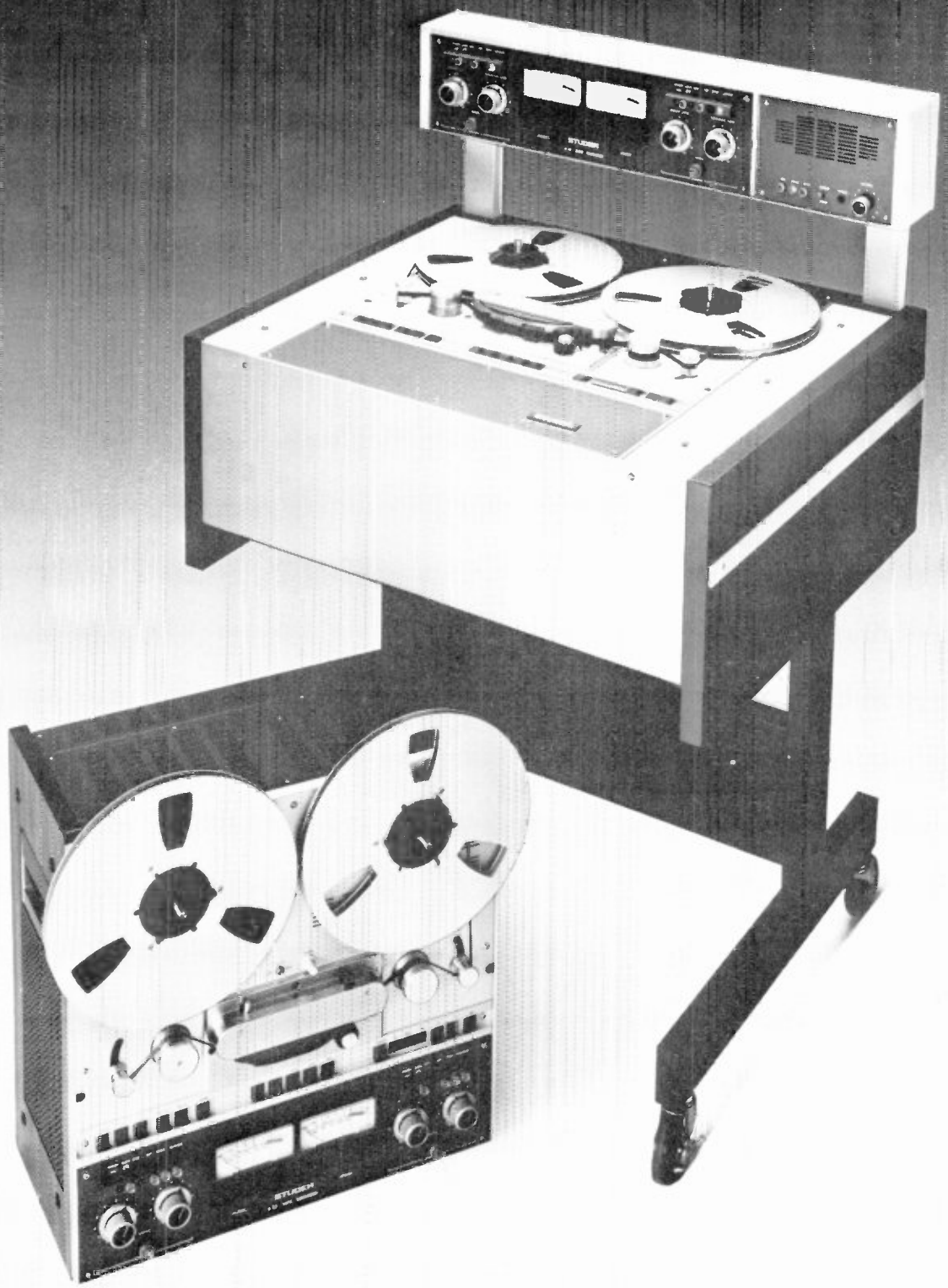

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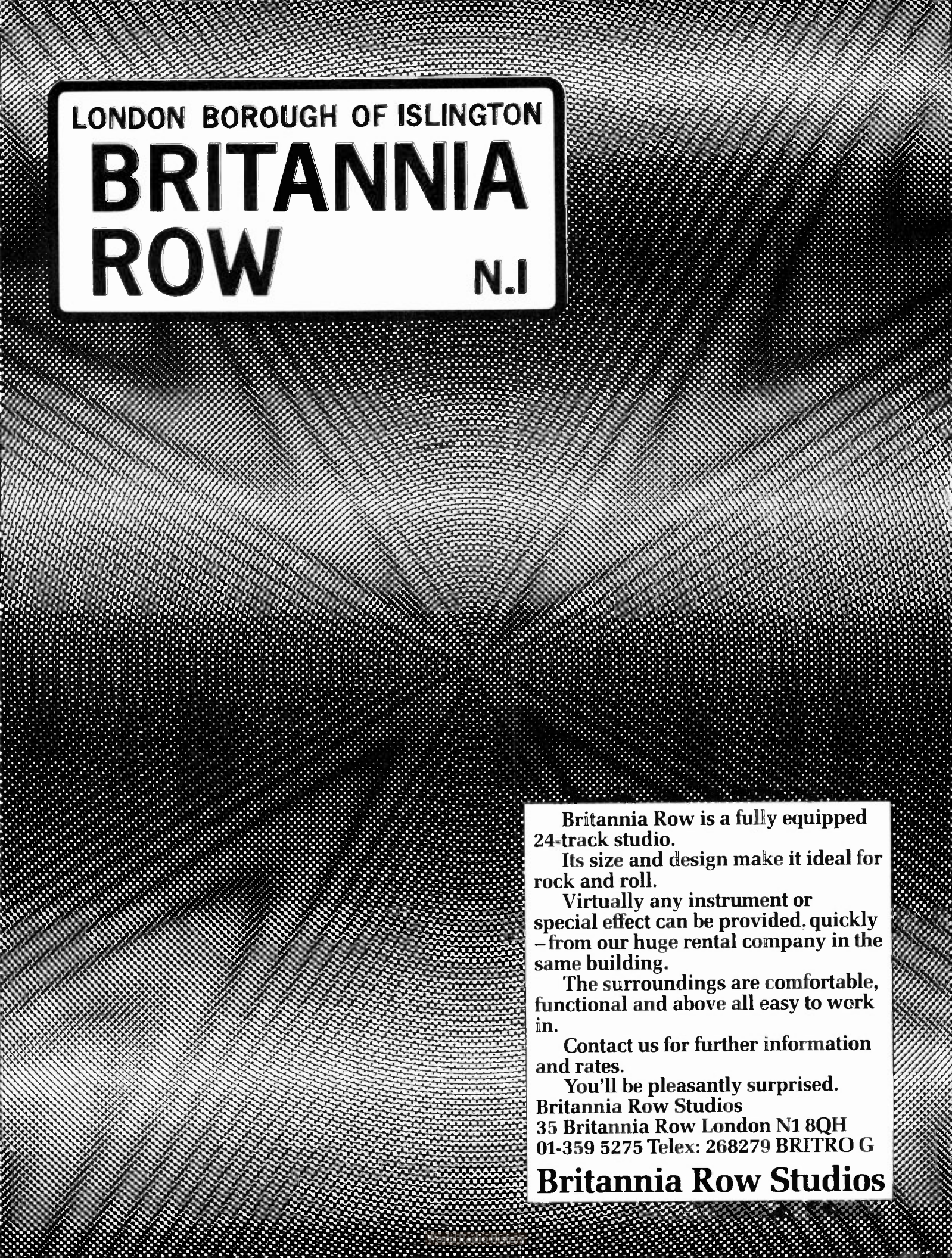

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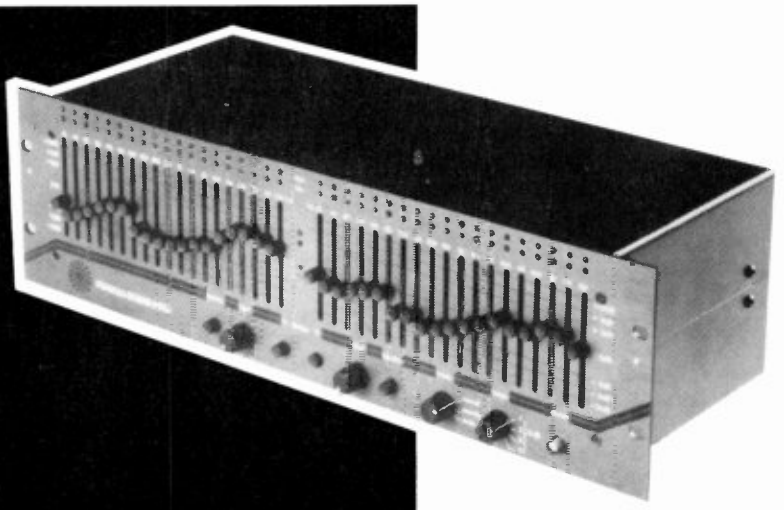
Analyse-Equalise-Eliminate



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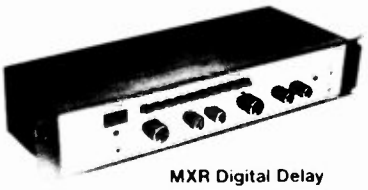

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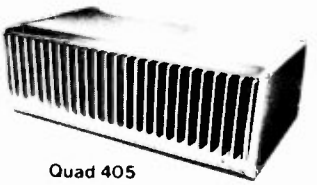
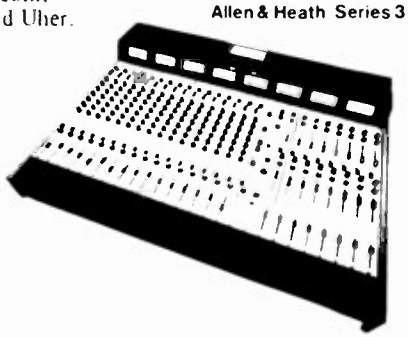


Quad 405

Allen & Heath Series 3



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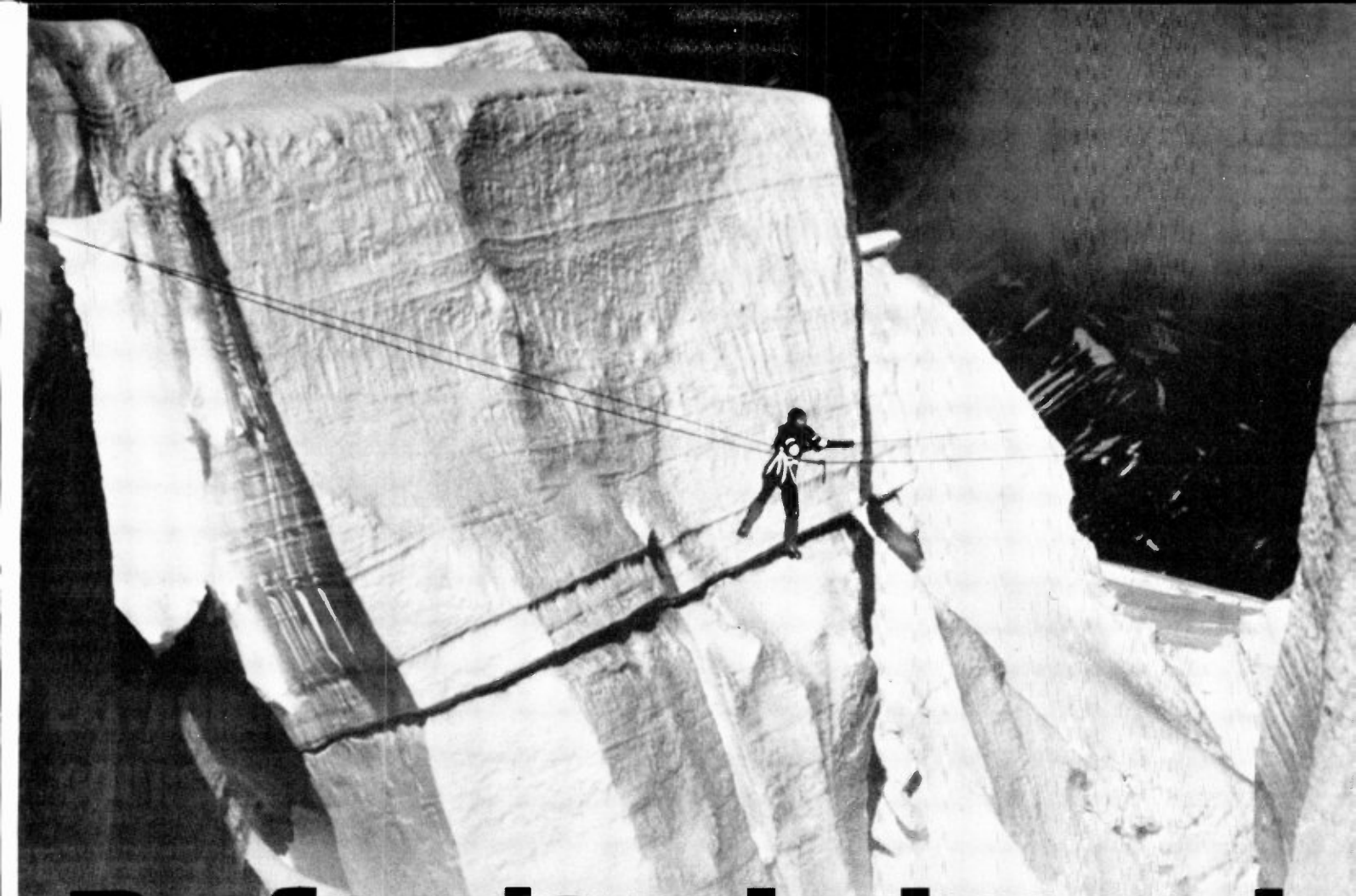

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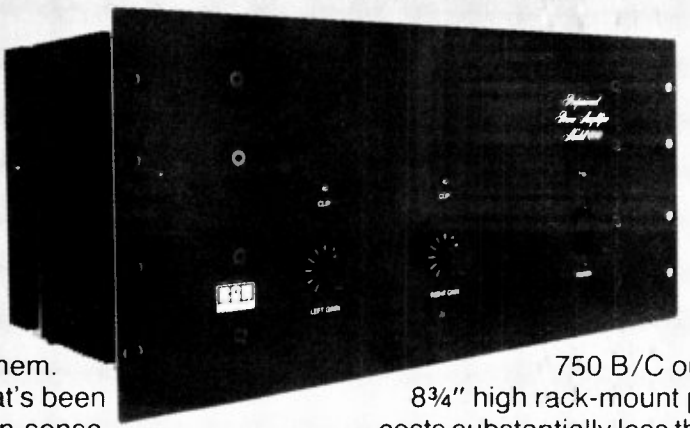

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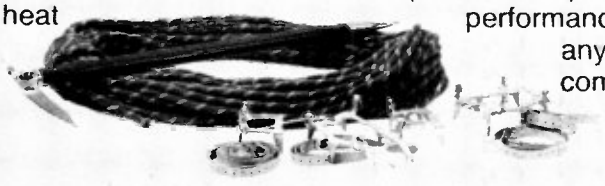
We are now proud to introduce a new cost-effective 175 watt per channel power amplifier... the Model 600. It's a quality basic power amp, built around our super reliable 750 B/C output modules. It's in a big 8¾" high rack-mount package so it runs cool and costs substantially less than a 750C. It's a quality BGW amp and the answer to the professional who wants BGW on a budget.

Check out the new 600 at your dealer. He'll show you an amp that lives up to your expectations with performance you can compare to anyone... and reliability that compares to no one.



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BGW SYSTEMS

BGW Systems Inc., 13130 S. Yukon Ave., Hawthorne, CA 90250 (213) 973-8090 In Canada: Omnimedia Corp., 9653 Cote de Liesse, Dorval, Quebec H9P 1A3
Exclusive U.K. distributor: Court Acoustics, 35/39 Britannia Row, London N1 8QH, England

The most versatile digital reverb ever made...

for one-third the cost of its rivals.

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

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

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USA (617) 489-0303

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The price is £364 plus VAT and carriage, and a stamped addressed envelope will bring you the gen about the "GEN-2".

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

Angus McKenzie (March 1978)

REVOX

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

PROLINE PROFESSIONAL

2000TC recorders

In action with the professionals– at Radio Clyde

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

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

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

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

LEEVERS-RICH EQUIPMENT LIMITED

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London SW18 3SL
Telephone 01-874 9054
Cables Leemag London SW18
Telex 923455 Wembley

The Series III De Luxe range of mixing console represents a high quality versatile system. A fully detailed colour brochure, including price lists, is available direct from the factory or agents.

AGENTS:

Canada C.O.R.A. Inc.
131-18eme Rue, 1046 Quebec P.Q.,
Canada Tel. 418-522-1397

Denmark Audiophil
Howitzei, 49-1, 2000 Copenhagen,
Denmark Tel. 134 1622

Netherlands & Belgium Pieter Bollen, Geluidstechniek bv,
Hastelweg 6, Eindhoven,
Holland. Tel. 40 512777/520662

South Africa Prosound,
Elkham, Upper Level Pretoria Street,
Hillbrow, Johannesburg 2001,
South Africa. Tel. 642-8721/1209

Spain Telco Sociedad Limitada, Gravina 27
Madrid, Spain. Tel. 1 2317840

France Reditec,
62-66 Rue Louis Ampere,
93330 Neuilly/Marne, France
Tel. 300 96 30

W. Germany Elmus GmbH,
D1 Berlin 12,
Herderstrabe 16,
W. Germany. Tel. 030 312 20 12

Acoustics Audio Import
Curtiusstrabe 85,
4300 Essen 1. Tel. 0201 70 17 34

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Keith Monks Audio (USA),
652 Glenbrook Road,
Glenbrook CT 06906
Tel. (203) 348-4969

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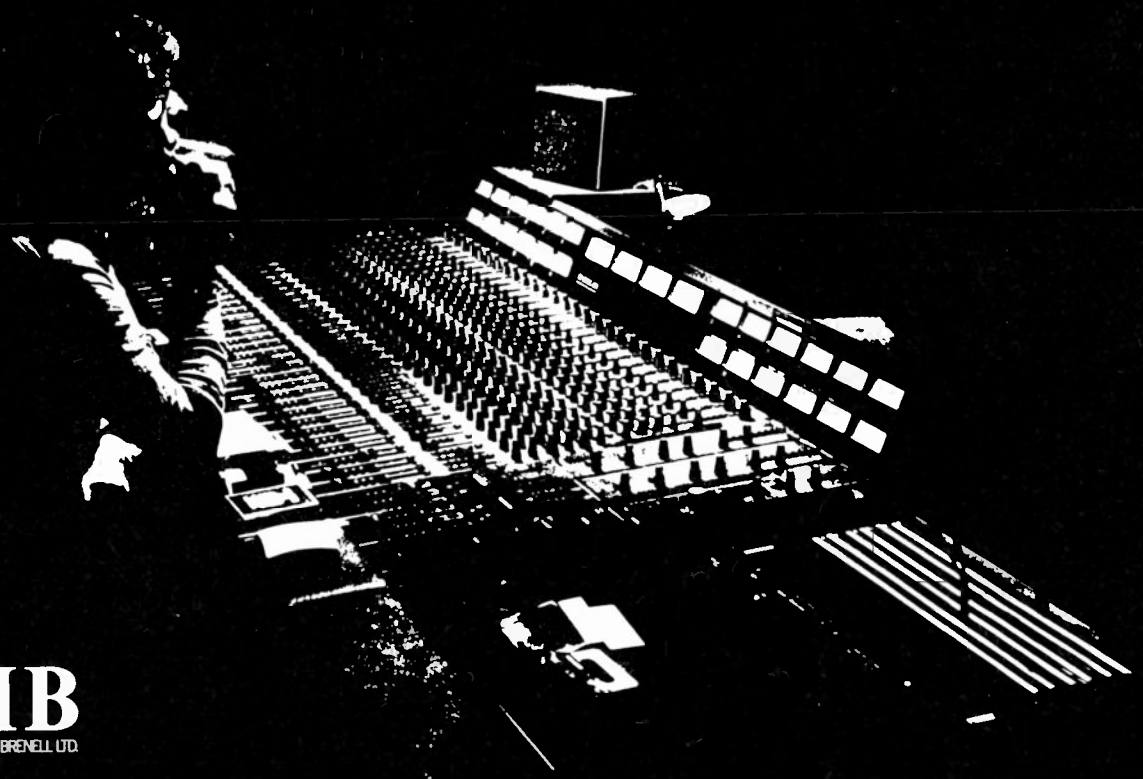
Rod Houison
with 28/28 Syncon
at Decibel Studios London.



Recording is a personal experience made better or worse by the ergonomics of the mixing console. Syncon has more creative facilities than any other unit in its price range, not that you will find many 24 track consoles at any price to compare with the following standard features. A 22 page information package will reveal even more. Write today.

- 28 input-output module capacity.
- 24 track monitoring and metering.
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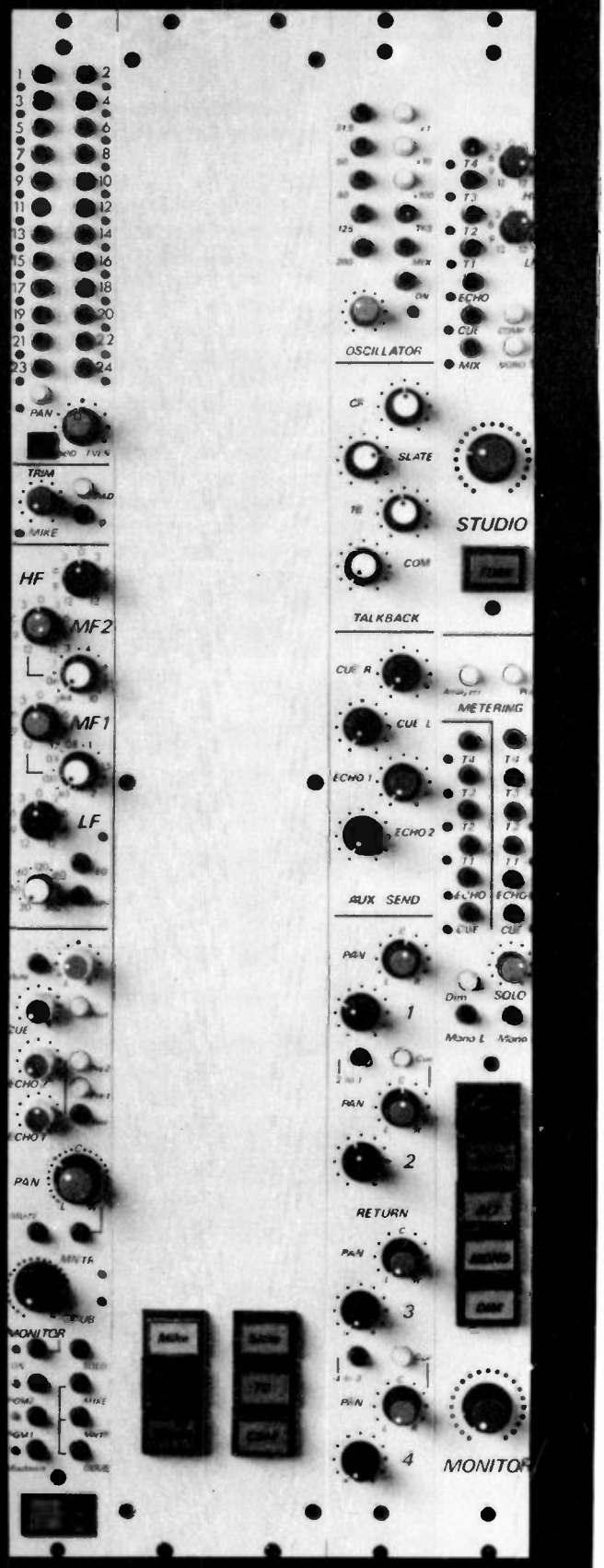

PLUS 30

42, rue Pierre Nicole
75005 PARIS - Tél. 634.01.36
FRANCE

The new multitrack recorder is now internationally recognized as an eligible standard for modern multitrack recording. It incorporates state-of-the-art technologies to make it the most functional machine in the market.

The sophisticated approach is represented by the outstanding transport response and stability backed up by the latest electronics. The PLL dc-servo for pinch-roller-free direct drive capstan plus dc-servo spooling motors. Full-fledged remote and gapless/noise-free punches. SMPTE interface access for any audio-video and audio-audio synchronization.

The MTR-90 is available in 16, 16 prewired for 24 and 24 track formats. For details, please contact us.

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Phone: 724 2497

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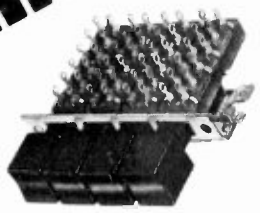
4-29-18 Minami Ogikubo
Suginami-ku, Tokyo 167
Phone: (03) 333-9631

The acclaimed approach to sophisticated multitrack recording.

OTARI MTR-90

A Switch Hit



Compact. High Quality. Switchcraft "DW" Multiple Station Push-button Switches with 1-18 stations available illuminated or non-illuminated. Four locking functions. Multiple-row arrays. Buttons on 5/8" centers. All the facts are in free Product Bulletin S-325.

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an "across the spectrum" show of Sound and Communications Equipment

TUESDAY & WEDNESDAY
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The exhibition opening times are . . .
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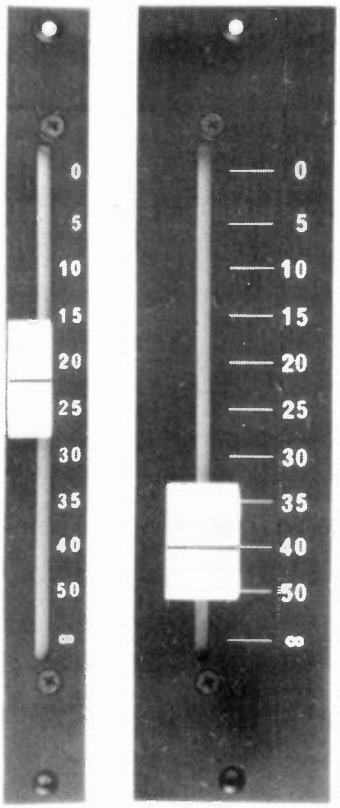
Another 'Star' Show organised by the Association of Sound & Communication Engineers
47 Windsor Road, Slough, Berkshire, SL1 2EE Tel. 0753 39455



studio faders

Audiofad Conductive Plastic mono and stereo 104mm stroke faders are available in logarithmic and linear laws. A shorter, 80mm, CP fader is also available as a direct replacement for the Model 810/800 wirewound.

For the latest brochure contact: **Audiofad, Unit 14,**
31 Poole Road,
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Dorset BH21 1QB
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news

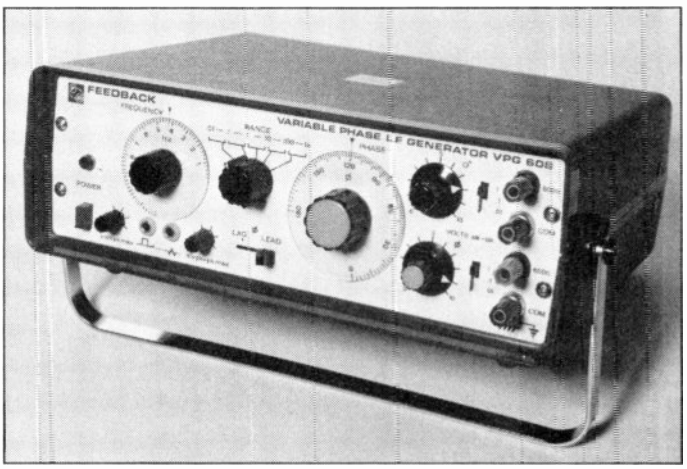
Society of Professional Audio Recording Studios

Representatives from a number of top American recording studios recently met in Fort Lauderdale to form an American professional society for recording studios along the lines of the APRS in the UK. The new organisation, which is to be known as the Society of Professional Audio Recording Studios, is dedicated to the achievement of excellence and intends establishing a code enumerating professional standards, quality and expertise. Additionally the society wishes to be a major force in influencing the advancement of engineering hardware and techniques, and also intends serving as a platform for statements on technical matters affecting the industry.

At the inaugural meeting of the society in mid-June caretaker officers were elected to serve until industry-wide elections are held. Joseph Tarsia, president of Sigma Sound Studios, was elected interim chairman and he will guide the society through its formative stage and membership expansion. Regional members of the interim board are Bob Liftin, New York; Chris Stone, Los Angeles; Mac Emmerman, Miami; and Glenn Snoddy, Nashville. Founding members of the society are: A & R Recording, Atlantic, Howard Schwartz Recording, Media Sound and Soundmixers in New York; Filmways Heider, Group IV, Kendun Recorders, Larrabee Sound, Record Plant and Studio 55 in California; Regent Sound and Sigma Sound in Philadelphia; plus Criteria in Miami, House of Music in New Jersey, and Woodland Sound in Nashville.

The society is intended to be a high profile contributing organisation, concentrating on the large studios who have common problems in common bond sessions. Accordingly, the society intends seeking additional members from the major American studio operations, membership being by studio and not by individual, and maximum membership is presently intended to be 60 studios. Membership requirements include at least three years in the business and a minimum studio requirement of two 24-tracks or two disc cutting rooms. Annual membership fees are $2,000 and a full-time staff will be hired to operate the society. Extensive seminars in all areas including maintenance, recording engineering, business management, etc, will be held on a continuing basis, and additionally conventions will be held bi-annually just prior to the AES Conventions in New York and Los Angeles. Close contact will be maintained between the society and the APRS.

Applications for membership of the society should be directed to Kent Duncan, c/o Kendun Recorders, 619 South Glenwood Place, Burbank, California 91506, USA. Phone: (213) 843-8096.



One of Feedback's new instruments - VPG608

Kintek = Colortek + dbx

John Mosely, president of Colortrak Inc, who is responsible for the development of the Colortek sound system, has announced that it will now be known as Kintek. This change results from the formation of a new corporation, Kintek Inc, which incorporates the motion picture interests of both Colortrak and dbx. President of Kintek is David Blackmer, with John Mosely and Zaki Abdun-Nabi as vice-presidents, while marketing director is George Finkhousen. The corporation's headquarters are in Newton, Massachusetts where it will engineer and manufacture equipment for motion picture sound recording and reproduction. Research and recording facilities will be operated from Hollywood, whilst marketing will be handled from Tucson, Arizona. The Kintek sound system has been under development for some four years and provides an Academy mono track together with four separate wide range stereo tracks within the standard optical sound track area. A recently introduced new product from Kintek is the *Stereophonizer*, which creates 3-channel stereo from monophonic prints.

Studio Sound 1980 Surveys

Below is a provisional list of the equipment surveys that *Studio Sound* will be carrying during 1980. Will manufacturers who wish to be included please supply information for publication not later than the 25th of the third month before cover date, ie for the February issue, by November 25. You have been warned . . .

February	1980	Cartridge Machines, Broadcast Ancillaries
March	1980	Synchronisers and Timecode Equipment
April	1980	Test Equipment — Part One
May	1980	Test Equipment — Part Two
June	1980	Metering, Faders and Modules
July	1980	Noise Reduction
August	1980	Power Amplifiers
September	1980	Monitor Loudspeakers
October	1980	Studio Designers and Suppliers
November	1980	Interconnection
December	1980	Broadcast Mixing Consoles
January	1981	Multitrack Mixing Consoles

New Feedback test instruments

Three new test instruments have been introduced by Feedback Instruments. These are the *SFG606* sweep function generator, the *VPG608* variable phase LF generator, and the *LAN521* 20in display oscilloscope with a 4-channel input control unit. The *SFG606* features both decade and octave sweep facilities; a frequency range of 0.01Hz to 1MHz; attenuation facilities of X1, X0.1 and X0.01; and a variable sweep time range of from 20ms to 60s. The *VPG608* has a frequency response of 0.01Hz to 1kHz in five switched ranges and has two main outputs of up to 10V peak-to-peak, one reference phase and one variable phase for gain/phase measurements. Square and triangular auxiliary outputs are also provided for transient response testing.
Feedback Instruments Ltd, Park Road, Crowborough, Sussex TN6 2QR, UK.
Phone: 08926 3322.

Roland apology

The publishers would like to offer their apologies for omitting the importer's name and address from the Roland advertisement carried on p55 of the September issue. This should have read, Brodr Jorgensen (UK) Ltd, Great West Trading Estate, 983 Great West Road, Brentford, Middx. TW8 9DN. Phone: 01-568 4578.

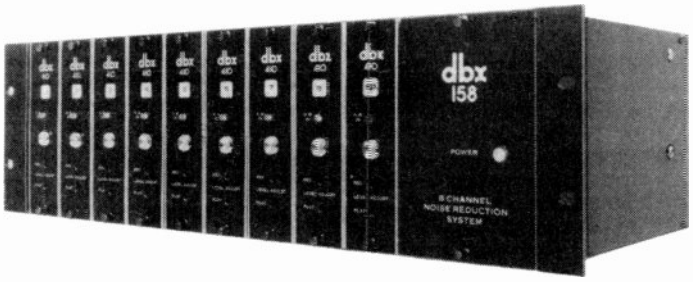
CA Audio Systems Limited

CA Audio Systems Limited has acquired the assets of Cadac (London) Ltd, the console manufacturing company which went into liquidation earlier this year. The new company has resumed full production of consoles for music recording, broadcast and theatre applications and are offering a full back-up service for facility expansion, spares and servicing for existing Cadac console owners. CA Audio Systems informs us that an improved version of the recently-introduced 'In-line' series of consoles is now available providing full function flexibility for recording and mixdown. As options dc sub-grouping, automation and centralised routing are available.
CA Audio Systems Ltd, 141 Lower Luton Road, Harpenden, Herts AL5 5EQ, UK. Phone: 05827 64351. Telex: 826323. 28 ▶

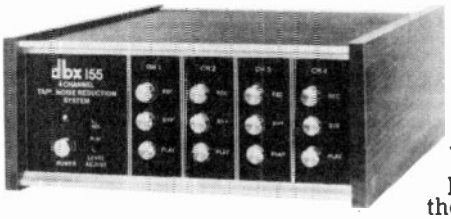
Budget dbx Noise Reduction for Multitrack.

Ideal for use with Teac, Otari, Itam and Dokorder machines
Unbeatable 30 db Noise Reduction.
Total compatibility with DBX Professional studio Noise Reduction equipment.
Modular format. Simplicity of operation.

MODEL 158 - £1,498.00
The 158 is the most comprehensive of the 150 series Noise Reduction Units. It provides eight channels of simultaneous encode and decode, obviating the need for mode switching of the noise reduction unit by operator or machine. The modular construction and inclusion of a spare one channel module within the frame ensure minimum down time and the provision of both molex and phono connectors allows rapid interface.



MODEL RM 155 - £650.00
The RM 155 is an eight channel rack mounting switchable record or play Noise Reduction Unit designed for use with Teac, Otari, Dokorder and other multi track tape machines. It provides more than 30 db of noise reduction at a price which makes this probably the most cost effective unit on the market.



MODEL 155 - £325.00
A free standing switchable 4 channel unit of identical performance to the RM 155 which is easily expandable as the studio grows.

The 150 series units are semi-professional versions of the well established DBX professional noise reduction units. Recordings made on any unit may be decoded by any studio using professional DBX equipment - and vice versa. More than 30 db of noise reduction allows extensive track bouncing without audible build-up of tape noise and DBX's unique and patented circuitry does not require critical matching of encodes (record) and decode (replay) levels, hence reference tones and metering are unnecessary.

For details on the DBX 150 series or any other DBX professional or semi-professional product please contact:-

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

Denmark
Lake Audio APS,
Artillerivej 40,
DK-2300 Copenhagen S
Tel : Copenhagen 570 600

France
3M France SA,
Mincom Div.,
Boulevard de l'Oise,
95000 Cergy
Tel : Paris 749 0275

Holland
Pieter Bollen
Geluidstechnik,
Hastelweg 6,
Eindhoven
Tel : Eindhoven 512 777

Norway
Kvam Audio,
Tollbugt 7,
Oslo 1
Tel : Oslo 412 998

Sweden
Tal & Ton Musik
& Elektronic AB,
Kungsgatan 5,
411-19 Gothenburg
Tel : Gothenburg 130 216

Spain :
Mike Llewelyn-Jones
AP Postal 8.178
Madrid
Tel : Madrid 637 0752

Local Radio
by Barrie Redfern

Focal Press Media Manuals
£2.95

After reading this book I am not sure whether Mr Redfern was the right man to write it. The introduction starts: "This is the book that tells you how to do almost anything in local radio", but the gaps in the text can in no way justify this.

Mr Redfern constantly avoids specifics, even to the point of not mentioning his own mentors—the BBC! And therein, I fear, lies one of the major drawbacks of this book—the author's lack of knowledge of Independent Local Radio which becomes clear after a cursory reading. Apart from the public's greater interest in commercial radio (borne out by listening figures), its comparative newness should surely warrant it the lion's share of the action. Let's face it, ILR is pretty different from BBC Local Radio.

Little thought seems to have gone into the order of items. The book starts out by explaining the basic broadcast chain, from microphone to receiver, with the aid of diagrams bearing more than a passing resemblance to the BBC's own training literature. It continues in the same manner with page headings like Discipline, Lines, Fader Modules, Frequency Correction, Transmitter Monitoring and Logging. Only about half way through the book does it begin to justify its claim to ". . . tell you how to *do* almost everything, etc, etc . . .". Pages of text face pages of diagrams of varying comprehensibility, from some which are laughable to a few excellent ones. There is a sketchy glossary of terms (mostly BBC) at the end of the text.

The author's lack of knowledge manifests itself in several ways. Primarily in terms of omissions; there is perhaps one paragraph devoted to Commercial Production, and no mention at all of Airtime Sales, Trafficking and that side of things. Secondly, there are some technical errors and generalisations. For instance, the author's explanation of a telephone balance unit is to equalise (sic) the lines! There is no explanation of *why* it is needed and *how* it works. Finally, as mentioned earlier, throughout the book the lack of *specifics* becomes annoying and at times misleading. Why can't Mr Redfern refer to Uhers instead of small portable tape recorders? and so on. Another disturbing point is the lack of pictures as the two target audiences of this book may never have set foot inside a radio station.

Although presented as a students' text book, it is also aimed at professional people who at one time may have something to do with their local radio station. I doubt if many will persevere and read to the end. As a basis of tuition it also has limited uses, but I could imagine it being reasonably useful as a part of a general studies course for, say, sixth formers.

In all, it is difficult to recommend. I suggest that in future Mr Redfern sticks to what he tells us he does best—broadcasting with the BBC. **Ian Sandall**

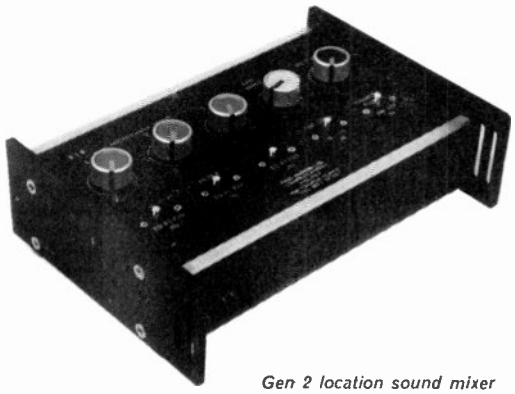
Dolby HX Headroom Extension System

At the Chicago Consumer Electronics Show in June, Dolby Laboratories demonstrated a new development for improving cassette performance. Called the Dolby *HX* Headroom Extension system, the new development comprises circuitry which operates in conjunction with the Dolby *B* noise reduction system to significantly improve the usable dynamic range of any cassette tape, especially at high frequencies. According to the Dolby engineers, the new system significantly reduces tape saturation by automatically and continuously varying a deck's record bias and record equalisation so as to optimise them in response to the changing level and high frequency content of the source material. This permits recording at 10kHz or above at a level of 10dB or more higher than is currently possible, while optimising performance at low and mid frequencies for minimal distortion, modulation, noise and drop-out effects. The *HX* system works in conjunction wiht Dolby *B* which is used to provide the control signal required to operate the system's variable circuits. A feature of the system is that the headroom improvement is inherent in the recording process, so no special playback processing other than regular Dolby *B* is required. The system is being made

available to all Dolby licensees for inclusion in cassette decks without further royalty or licensing charges. It will be some months before *HX* equipped decks become available. However, we learn that the parts cost of adding the new system only adds about one-third to the manufacturing cost of the Dolby noise reduction circuits within a recorder.
Dolby Laboratories Inc, 346 Clapham Road, London SW9, UK.
Phone: 01-720 1111.

Portable console support table

Darrell Schoenig, designer of the portable loudspeaker stand featured in *News* (May issue), has added a lightweight portable table — the *Versa-Table*—to his range. The table is suitable for supporting live performance consoles and has independently adjustable legs (seven height settings on each leg). Size of the table is 22in x 44in and although weighing only 13lb it can support up to 260lb. The table has no long bracing struts allowing it to be used straddling a row of seats in an auditorium or to sit squarely on uneven ground, and yet provide an operator with a smooth, tiltable surface.
Ultimate Support Systems Inc, 1808 E Lincoln, Fort Collins, Colorado 80524, USA.
Phone: (303) 493-4488.



Gen 2 location sound mixer

Gen 2 location sound mixer

Paul Simmon Ltd has designed and produced a new location sound mixer, the *Gen 2*, utilising high performance integrated circuits together with advanced variable gain circuitry. The unit has three mic inputs (maximum gain 80dB) with switchable phantom powering from a 9V internal battery, and switchable low frequency roll off filtering of −3dB at either 20/47/100Hz. A line input is provided with a maximum gain of 30dB; frequency response is 40-20kHz ±0.5dB; and distortion is typically less than 0.1%. Maximum output of the mixer is +10dBm and it requires an external −10V, 50mA power supply.
Paul Simmon Ltd, 2 Market Street, Halifax, West Yorkshire, UK.
Phone: 0422 57442.

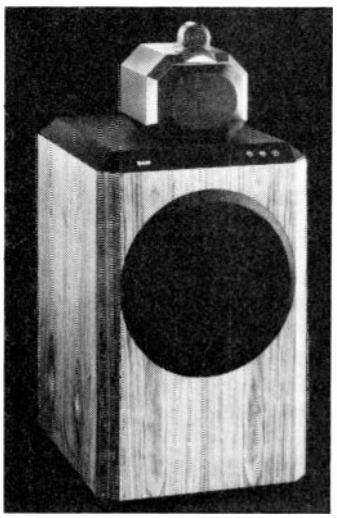
RSD modular automated theatre sound system

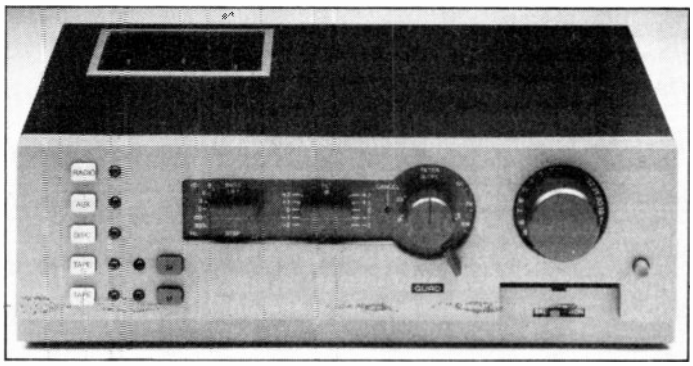
Richmond Sound Design has introduced a computer memory theatre sound control system based on a modular configuration. A typical small theatre system would comprise a standard two-scene *Memory Pack* 32-channel memory control console, with 32 control lines each of which could be set to any of 100 voltage settings in each of 100 cues; and a standard 19in card frame containing 16 of the company's *VCA-2* plug-in modules. Each *VCA-2* contains two voltage controlled audio amplifiers each of which is controlled by a separate *Memory Pack* control line. The 19in card frame is wired to form an audio matrix with four inputs being mixed in unlimited combinations to eight individual output channels. The system can be expanded at any time without extensive redesign and is also available with a 64-channel *Memory Pack*. RSD also manufacture theatrical sound control consoles in various configurations.
Richmond Sound Design Ltd, 1234 West 6th Avenue, Vancouver, British Columbia V6H 1A5, Canada.
Phone: (604) 736-7207. 30 ▶

B & W Model 801

B & W Loudspeakers has introduced the first model in a new range of 'no compromise' loudspeakers, the *Model 801*. Designed as a full professional monitor the loudspeaker was designed to have linear free-field amplitude response from 30-20kHz with minimum deviation both horizontally and vertically, and minimal distortion and colouration. The finished loudspeaker is a three driver, vertical in line, linear phase unit with a frequency response of 45Hz-20kHz ±2dB at 2m and is fitted with an overload protection device which automatically protects the drivers by sensing the peak voltage applied to each driver. The loudspeaker has mid and hf attenuation controls, is designed to handle amplifiers of 50W minimum, and has a sensitivity of 85dB at 1W and 1m into 8Ω. Price of the *Model 801* is £845 per pair without top cover and £895 per pair with top cover.
B & W Loudspeakers Ltd, Meadow Road, Worthing, Sussex BN11 2RX, UK.
Phone: 0903 205611.

Below: *B & W Model 801 Loudspeaker*
Centre: *Quad 44 control unit*





Quad 44 control unit

The much rumoured control unit designed to accompany the highly regarded Quad *405* power amp has finally become available. Designated the Quad *44*, it follows the same basic precepts as the Quad *33* but is more versatile and practical. Controls of the unit consist of a stepped balanced volume control, variable filter, balance control, mono / stereo switching, tilt and bass lift and step controls, and input switching for five inputs. All inputs are on plug-in board modules which can be changed to suit the user's requirements, hence up to five tape input modules can be accommodated. Each tape input has five record output levels and five input sensitivities and match all commercially available tape machines. The standard disc input has three sensitivity settings and two capacitor loads and will match virtually all moving magnet and moving coil cartridges of medium to high output. In addition optional modules are available to match low output moving coil cartridges and microphones. The Quad *44* is designed for use with power amplifiers with input sensitivities of 5V or less, has a frequency response of +0dB −1dB 30-20kHz, and typical distortion of 0.02%. Price of the Quad *44* will be around £244 with additional input modules costing £16 each. Quad say that it is unlikely the Quad *44* will be outdated since any future developments in either programme source (digital!) or circuit technology can be accommodated simply by adding a new input module.
The Acoustical Manufacturing Co Ltd, Huntingdon PE18 7DB, UK. Phone: 0480 52561.

Clear-Com RS-202 intercom ▶

Clear-Com has announced the introduction of the *RS-202S* 4-channel remote intercom station. This consists of two discrete intercom channels and two listen only programme channels which are mixed in the remote station and fed to binaural headphones with channel A intercom and programme being fed to one ear and channel B etc being fed to the other. The unit has a frequency response of 100Hz to 20kHz, and features two separate mic on/off switches plus listen volume controls allowing nine possible combinations of talk/listen functions. In addition channel A programme is transformer isolated and balanced and there are adjustable independent side tone controls on each channel. The unit can also be supplied with the output combined.
Clear-Com Intercom Systems, 759 Harrison Street, San Francisco, Ca 94107, USA.
Phone: (415) 989-1130.
UK: Rank Strand Sound, PO Box 51, Great West Road, Brentford, Middx TW8 9HR.
Phone: 01-568 9222. Telex: 27876.

New BKSTS lecture course

Details have just come to hand of a new course in the technology of sound recording organised by the British Kinematograph Sound and Television Society (BKSTS). The course is aimed at sound recordists and previous technical training is not a prerequisite for enrolment.

Lasting 10 weeks, commencing September 17, the course will be held at the Bowater Conference Centre in London on consecutive Monday evenings from 7 to 9pm. Each session will take the form of a lecture by an expert, a technical manual related to the course will be available, and the course includes a final seminar and studio visit. Total cost is in the region of £20 and up to 100 persons can be accepted. The lecture topics are: sound waves, acoustics, microphones, mixing consoles, tape recorders, noise reduction systems, loudspeakers, and maintenance. Full details including enrolment forms are available from Bill Pay, Secretary, BKSTS, 110-112 Victoria House, Vernon Place, London WC1B 4DJ, UK. Phone: 01-242 8400.

Macinnes Laboratories Ltd.

Macinnes Laboratories Ltd are no longer operating from their Saxmundham premises, but intend moving to new premises, the address of which is not yet fixed, according to Macinnes director Ian Marshall. When contacted during August, he explained that the company was on holiday.

Crown/Amcron amplifiers (which were previously imported by Macinnes) are now available from HHB PA Hire Ltd, Unit F, New Crescent Works, Nicoll Road, London NW10 (Phone 01-961 3295) and in Europe from Nilesco Europe, PO Box 11686, Amsterdam, Holland (Phone (20) 258420).
The Macinnes *S-220* tone arm (recently reviewed in *Studio Sound*) is now being distributed by Jaquecroft Ltd. a company run by Andrew Marshall, and of which Ian Marshall is also a director. Jaquecroft Ltd, Stoneham, Stowmarket, Suffolk. Phone: 04497 1502.

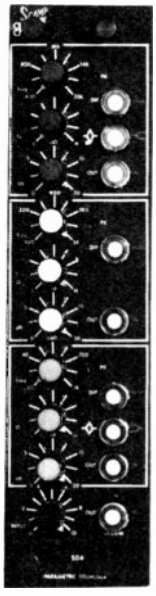
MJS Electronics test set

MJS Electronics has introduced the *Model 401* noise and level test instrument for use in lining up tape machines; checking OB lines; monitoring levels; carrying out wave analysis and acoustic measurements; and alternatively for use as a calibrated amplifier or standard peak programme meter. The unit has a 3μV-30V millivoltmeter, a scale expand facility with LED indication of mode, 100kHz 12dB/octave input filter, switchable 600Ω input load for line termination, input level controls in switchable 10dB and 1dB steps from +30dBm to −90dBm, and switchable 200kΩ balanced or 600Ω unbalanced input. Additionally the unit has an internal active CCIR weighting filter (CCIR 468), a highpass 36dB/octave filter at 100Hz, a lowpass 36dB / octave filter at 30kHz, jacks for external filters, and a headphone jack.
MJS Electronics, 27 Walnut Close, Yateley, Camberley, Surrey GU17 7DA, UK. Phone: 0252 871401. ■

EQUALISERS FOR SCAMP USERS

The **SO3 Sweep Equaliser** is a three section device having continuously variable frequency selection, amplitude controls and 'peak-off-dip' function switches. The range of control in each section is 40dB (20dB peaking or notching) which is ideal for instrumental as well as vocal work. Sections overlap each other in their coverage of the audio bandwidth. The wide mid-band section ranging from 75Hz - 7.5kHz at a 'Q' of 1.5; the HF range covers from 400Hz - 20kHz and the LF band is controlled over 20Hz - 1kHz both at a 'Q' of 3.

The **SO4 Parametric Equaliser** features three independent fully parametric sections with over lapping coverage of the audio frequency bandwidth.



The Amplitude control operates in either the peak or dip mode, dependent on the function selected with the push-button controls. The lift in the peaking or shelving mode is 0—20dB, whilst the notch or shelf filter obtainable is >30dB.

The **S07 Octave Sweep Equaliser** is a compact system and room equaliser with a 24dB control range (±12dB). Standard octave frequencies are peaked or dipped by variable pots which have flat response in mid-position (±0 5dB). The frequencies covered are: 31.25, 62.5, 125, 250, 500Hz, 1, 2, 4, 8 and 16kHz. An optimum modulation indicator is incorporated.

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studio diary

Highland Recording Studios, Inverness

As you might expect from the name, Highland Recording Studios are situated in the north of Scotland and are unique as they are the only 24-track studios in Scotland. Situated on a small estate 10 miles from Inverness, they are a welcome haven from the hectic pace of life which exists in most studios, no matter how relaxing studio owners and designers try to make them. I must have been lucky when I visited the studios, as I hit the first really hot summer's day we have had this year, so my visit was not only relaxing but I also got an excellent sun tan as studio owner Rod McQueen and I talked about the studios over an outdoor lunch on the croquet lawn. (Yes, I did say croquet lawn!)

Rod McQueen originally built Highland Recording Studios for his own use as a composer and producer, but has since made the studios available to allcomers. However, before detailing the studio facilities it is of interest to discover how Rod came to be in the fortunate position of being able to build his own 24-track studios. Rod began his involvement in the music and recording industry when at school. There he was in the ubiquitous school group, in this case playing skiffle. When he left school, though, unlike most he avoided the drudgery of taking a regular job by forming his own band and luckily gaining a number of dates in France. Here the band was successful and had so many regular engagements that apart from the odd break he remained in France from 1962 until 1968. Finally returning to the UK in 1969, he became a session bass player and gigged regularly, prior to running Chapter One Records. At about this time he also started writing songs and formed his own publishing company. This was a very fortunate move as the second song he wrote, *Beautiful Sunday*, was a hit record. From this point on he has never really looked back, having had a string of successes, particularly in Europe. He married a Scottish girl and moved to Inverness in 1973 and devoted his time to composition and production, setting up a demo studio for his own use in the process. As success and funds permitted he began looking for a house which would allow him to set up home in ideal rural conditions and also allow him to build a more comprehensive demo studio. In 1978 he found his present Georgian country house and set about renovating it. An added attraction was the fact that the house had a cottage and stables which could be converted into studios.

Having obtained suitable premises Rod naturally decided to build the studios to the best possible standards. His intentions at this time were merely to use the studios for his own composition and production of songs; plus jingles for television, radio and film commercials; and the production of tapes for use with slides or film.

In order to do this he felt the studios needed to be as well equipped as possible, and having already gone this far it made sense to make them commercially available. Originally he wasn't sure whether a 24-track studio in the north of Scotland would prove to be too far off the beaten track but on further reflection felt that the seclusion and relaxed pace of life were positive, rather than negative factors. From my own visit I can certainly confirm that the studios are ideal if relaxed music making is what you have in mind. It is worth noting, incidentally, that Rod has secured some of the best fishing and hunting rights in the area for studio users and if you ally to these some of the best golfing, sailing, skiing and sightseeing in the world you can see that if you want to combine business with pleasure Highland Recording Studios has few equals.

The above comments might give readers the impression that the studios are too secluded and therefore perhaps out of touch with the mainstream of the recording industry. However, I can vouch for the fact that they are not. Disregarding the studio's equipment for a moment, they offer fully centrally heated accommodation with full catering facilities and a separate TV lounge. Communication is no problem either. The studios are just five minutes drive from Inverness Airport which has twice-daily flights from London Heathrow, not to mention other connecting internal UK flights; the studios are also only 15 minutes from Inverness British Rail station which is served by many trains including sleeper accommodation from London.

Turning to the studios, these were designed by Rod in conjunction with Acoustic Technology and have only been operational since January of this year. Whilst Rod has had first call on the facility, especially in its initial opening stage, he's found that the presence in Scotland of such a complex facility has not only created work for him (ie a jingle package he has just completed for Radio Forth), but also stimulated a great deal of talent and interest in Scotland. For example he has had a number of local bands not to mention Scottish dance bands using the studios—people who perhaps previously would never have even considered making recordings! With the prospect of the Aberdeen/Inverness ILR contract being awarded in the not too distant future, this is another source of work which is available to him. Add to this outside users such as Chris Rainbow, who completed his latest album there recently, and the studios have already become very well patronised. In fact such is the rapid acceptance of the studios that Rod is intending expansion in the near future.

Although called Highland Recording Studios, the 'studios' part of the title is something of a slight misnomer as there is only one control room at present, and the studios are basically one room divided into two, although they can be combined. The studio area is 1,000 sq ft, will comfortably accommodate 30 musicians and can be separated by a heavy curtain where a low arch divides the two rooms. Room One, which is closest to the control room, has a high ceiling and is suitable for recording strings and other acoustic instruments, while Room Two is a much livelier room with a lower ceiling. At the rear of Room Two is a large drum booth, set on a floating stage and in addition this room has a bass amp plinth also on its own floating stage. Both the rooms have been acoustically treated with built-in bass traps, as has the control room. Rod has a wide range of instruments including a Yamaha grand piano, drum kit, Fender Rhodes *88 Stereo*, Fender *Twin Amp* and various percussion instruments. The studios also have a pair of Lockwood loudspeakers for foldback, plus Beyer headphones and a number of acoustic screen panels. Incidentally, both the studios and control room are air conditioned.

The control room measures 18 x 20 x 9ft and has a sloping ceiling and a raised stage where the console and tape machines stand. This stage is floating and isolated from the studios but is positioned so that the view through the control room window is open and unobstructed. Facing the window is the MCI *542LM* 28/28 automated console with plasma display, and on either side of and above the window is a pair of JBL *4350* monitors with JBL frequency dividing network and White equalisation. There is also a pair of Auratones mounted on the console. Situated behind the console are the tape machines: an MCI *JH-114* 24-track with *Autolocate III*, plus two MCI *JH-110* 2-tracks and a pair of Revox Varispeed *A77*s, all using Ampex tape.

The control room is fitted out with a comprehensive and wide

selection of ancillary equipment including Klark-Teknik *DN22* graphic eq, Orban *622B* parametric eq, Orban dynamic balance controller, Marshall *Time Modulator*, Klark-Teknik *DN36* analogue time processor, Urei *1176LN* limiters, Audio & Design *F760X-RS* compex/limiter, dbx *160* comp/limiter, Eventide *Harmonizer*, and EMT reverb. The studio's power supply is a TTM unit with a noise reduction frame from the same manufacturer, with 24 channels of *Cat 22*, while Dolby *A361* is also available. Monitor amplification comprises BGW *750Cs* for the JBLs and Quad *303s* for the Lockwoods. Microphones include models from Neumann, Shure, AKG, Sennheiser and Calrec.

This completes the survey of equipment, but Rod is constantly adding to it. At present he's musing over who's digital delay to purchase and is also considering installation of additional monitoring loudspeakers, the likely preference being a pair of Tannoys. Plans for the future include the building of three additional rooms beyond the present studios, a tape store and workshop, and two radio production studios. One of these will be for producing shows, jingles and voiceover commercials, while the other will be an interview studio. Rod told me that he will probably purchase a Trident *Flexi-mix* desk for these. As for the main studios, Rod is toying with the idea of going 32-track but as to when this is likely to happen he is unsure.

In the light of Rod's future plans it's likely that the main studios will take up slightly less of his production time than he originally envisaged, therefore they should become available to outside users on an even more regular basis. At present they are available for outside bookings for approximately 50% of the year and the current hire rate is £35 per hour excluding tape. For long-term users a weekly (7-day) rate of £3,500 includes unlimited 24-hour use and free accommodation.

Highland Recording Studios has every reason to be proud of being the only 24-track studio in Scotland. It is as well equipped as the majority of studios and certainly on par with most in London. Anything you can do in London you can do here. However, when you consider the relaxed atmosphere, marvellous surroundings, and the feeling of being totally divorced from the rat race, for all London's attractions I know where I would prefer to record!

Highland Recording Studios, Gollanfield, Nr. Inverness, Scotland. Phone: 06676 2304.

Noel Bell

Filmways/Heider, Los Angeles

Located on Cahuenga Boulevard in the heart of Hollywood is the sprawling 'empire' of the Filmways Audio Group. The group comprises Audio Services (sound reinforcements), Heider Recording (studio and remote) and the Heider Scoring service which acts as an audio production company contracting music scoring and other recording facilities for the motion picture and television industries.

The group is at present housed in three separate buildings all within five minutes walk of each other—the main building houses administration and studios 1-7 with the exception of studio 4 which is a few minutes down Cahuenga while studios A, B, C and D plus mastering are located in the RCA building a block away (these used to be the RCA studios). The origins of Filmways/Heider recording are humble by comparison. It all started in 1964 when Wally Heider (who finally left in 1976) began his first studio operation (which is now studio 1) in an alley off Cahuenga. Memories are vague about the early equipment, but the console was certainly no more than 6/2 and was dubbed the Grey board (and was built by Altec?) and was last seen when it was purchased by the Doors. Nevertheless, studio 1 was recording many hits of the day including April Stevens and Nina Tempo, the Venturas, the Beach Boys and Jan and Dean. Studio 1 is about to be re-vamped and at the time of writing is being used as a temporary maintenance shop for the remote truck equipment. The room itself is minute and has been dubbed 'The Pit'. Paul McCartney and Wings were once holed up in the pit for two months with the *Venus and Mars* album . . . more than justifying its existence. Studios 2 and 3 followed in 1967 by which time half the building was owned by Wally Heider. In 1968 Wally sold out to Filmways Inc (this was before the Heiders branch in San Francisco started) but continued to run the operation and completed studio 4 in 1972. And in 1978 the RCA studios on Ivar Street were taken over and totally re-vamped.

When Wally began with studio 1 he also had a small trailer which he used for live recording of big bands, and today this side of the operation remains equally important. Heiders is equally well known for its remote and studio recording. There are now three trucks constantly being updated when not on the road. Each truck is equipped with a 40/24 out API console (API because they sound good and are robust enough to take the rough handling and have been custom made to break down into five sections), with Ampex 24-track tape machines. What is perhaps unusual is that the truck equipment is quickly removable and can be flown anywhere in the world and installed in a truck the other end—the Heiders trucks however do a lot of mileage to and from the east coast ('same equipment, different truck' can make people nervous). Recent remotes have included shows like the Academy awards, the Emmies and Grammies and TV specials including a tribute to John Wayne, live albums by Kiss, The Bands *Last Waltz*, Bee Gees, and Jefferson Starship. It was Wally and his trailer that recorded the Beatles live at the Hollywood Bowl back in 1964.

More recently, live albums have been recorded for Peter Frampton and last New Year's Eve, the last days of Winterland were recorded in San Francisco with Grateful Dead and the Blues Brothers performing. This was a very complicated affair employing two 24-track machines with the API 40-input console being boosted by another 20 inputs and six ADR *Vocal Stressers* rented in for the occasion at the specific request of Dan Healy, sound engineer for the Grateful Dead. While most of the Heiders Studio recordings use independent engineers with assistants supplied by Heiders, independents tend to be scared by remotes, so chief staff engineer Biff Dawes does about 90% of all remote recordings.

A fourth remote truck is planned with new consoles for all trucks—could be a Neve, could be something else? The demand for remote recording is huge and is still growing and the large Heider truck was not seen for a couple of months while it recorded a new Little Feat album for the late Lowell George at a hide-away in Topanga Canyon. More and more artists are choosing to record at home or at a hide-away somewhere. Heiders is presently equipped entirely with Ampex 24-track recorders in Los Angeles (while San Francisco has 3M *79* 24-track machines) although in early days it was always 3M. Terry Stark explains: "Wally was the first to go 8-track in 1967, the first to go 16-track in 1969 and certainly one of the first to go 24-track in 1971 with the first five 3M prototypes. Unfortunately problems ensued with bugs and by the time 3M had de-bugged their machines Ampex came out with theirs which was already de-bugged and Heiders Los Angeles has been with Ampex ever since, while San Francisco continues with the 3M machines". Terry was quick to add that things are fine between Heiders and 3M now, it was simply a matter of wanting to be first with 24-track. Now when a client requests 3M a trade is done with San Francisco.

All Heider studios are to an in-house design and are generally live in character. Apart from Ampex tape machines, the studios are generally equipped with Altec *604*

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Dennis Mays in Filmways/Heider Studio 3

monitors with Mastering Lab crossovers, although all are planned to be equipped with the new Urei *Time Aligned* system which now seems to be regarded by many as the first alternative to the industry standard JBL or Altec systems—Heiders do have some Tannoys for those who ask together with risers in every room to accommodate any monitor system. Studio consoles vary within the group and apart from API in the trucks, studio 3 also has API while studio 4 has a custom De Medeo (shortly to be replaced by Neve complete with Necam automation).

Studios A, B, C and D in Ivar all have Neve which they inherited from RCA, but which have since been extensively upgraded. Most equipment is on wheels allowing switching of equipment between studios in LA, SF and the trucks, which happens constantly. On a brief tour of those studios open at the time, studios A and B in Ivar are probably the most impressive—huge virtual sound stages measuring 75 by 55ft and three stories high. Both are equipped with 32/24 Neve consoles and Urei *Time Aligned* monitors. Studio A, responsible for many recent film scores including *Grease*, a lot of *Sgt Pepper's Lonely Hearts Club Band*, *Lord of the Rings*, *Every which way but Loose* etc, was set up for a large (105-piece) orchestral film scoring session, the conductor using a video monitor in front of the rostrum—a full projection room is presently under construction above the control room with screen at the far end of the studio. Every kind of microphone seemed to be on the floor including a lot of Neumann tube *67*'s and *87*'s and some *PZM* plate microphones hung from the ceiling for ambience (although these have evidently been used successfully strapped to a percussionist's chest as well as taped to the underside of a piano).

Studio B was particularly interesting—set up at the time was a complete nightclub with tables and chairs, a buffet and bar, a stage and full sound reinforcement . . . all in aid of the forthcoming Martin Mull Comedy album. For the session, the studio is filled with an invited audience who eat, drink and laugh to enable Martin to get the necessary feel and feedback for a live album.

Recently the Rolling Stones have been using this room with Chris Kimsey (a former Heiders staff engineer) initially for rehearsals only—recordings of the live sound were made-up, then a few tracks were laid and evidently they could be back to complete the recording of their next album. Of course the Rolling Stones recorded *Satisfaction* in this room and many early Jefferson Airplane albums were also made here. Peter Frampton had also just finished laying tracks in B (with Chris Kimsey engineering) and was now in C for overdubs. C is a fairly small room and is ideal for mixing and over-dub. The Neve console here is 32/16, having started out with 24 inputs as ordered by a third party who defaulted. The board has since been upgraded to 32. Studio D is a very small experimental control room used entirely for mixdowns and tests/experiments containing a Neve 24/2 console, Urei monitors with Sonics woofer and Monitoring Lab crossover. There is also a mastering room in the Ivar building with a Neumann lathe.

Back on Cahuanga, a short walk from the main building is studio 4, a very popular room which is destined to be Heider's ace. A medium-sized room at present equipped with custom De Medeo console, extensive and very flexible patch bay, *604* monitors, and is shortly to be completely re-vamped and altered slightly to accommodate the new 32/24 Neve console, complete with Necam automation. The rather Fifties decor will be modernised but the characteristics of the room will remain unaltered—a lot of people really like the room which is dead at the front and live at the rear with movable curtains and isolation booth at the back. D has been used for recording, mixing, hard rock and strings etc. At present, Peter Granet (previously staff engineer at Heiders) is recording Eddie Rabbit, outboard equipment in evidence for the session apart from a full rack of Dolbies was a Helios RE24 equaliser (evidently a favourite) and an ADR *Vocal Stresser* and *E-900* stereo equaliser.

In the main building, all studios except the pit were in mid session. Briefly, studios 2, 3 and 5 are 'media' rooms used for radio and television productions and contain API consoles, while studio 7 is a voice-over booth with Yamaha *PM100*, 16-track and JBL monitors. Outboard equipment consists of anything you care to name and when not in use is kept in the large equipment store. Of note was the exclusive use of the interlocator with all Ampex machines. As Mark Davis, the equipment manager, put it: "they are very useful and will do so many things they'll tell the tape machine to play a song back so you can hear it, roll back and punch in for you—and at the end roll back and play again".

Heiders is looking forward to going digital shortly without actually trying to be the first this time having learned their lesson in being the first with 24-track. Norman Swartz (vice-president of engineering for the group) is also chairman of the digital standards committee founded by AES to seek out and set some sort of standardisation in digital recording about which there has been much furious debate in the press—this being highly necessary to enable tapes to be recorded here mixed there and mastered elsewhere on different manufacturers' machines; as is the present fashion. Heiders have done several digital recordings already with Soundstream of Salt Lake City (Dr Stockham's system) with extremely satisfying results. Norman Swartz is also chairman of the SMPTE committee for stereo television in the USA and is working closely with the FCC to allow this to move ahead—stereo television being common in Japan today, he is also working with the Japanese on how they operate. Heiders happen to have a sister company in Japan (Tamco) which is a similar type of operation, studios, remote trucks, TV, film, music etc. A two-way agreement exists between the two companies whereby each other's artists are catered for by the company on whose soil they happen to be. That then is Filmways/Heiders. All 11 recording entities, with a further six in San Francisco, and well over a hundred staff. It cannot be compared with anything else.

We will shortly look at Filmways/Heider, San Francisco.

Enbee

Swiss TV telecasts Sigma Sound

In late May Radio Television Suisse Romande spotlighted New York's Sigma Sound Studios as the focal point of an in-depth examination into the American disco phenomenon. The programme, which is to be broadcast in the Swiss *Temps Present* series, formed part of an hour-long programme devoted to examining the artistic, cultural, economic and sociological impact of disco upon American society. Sigma's involvement entailed an explanation of how American disco records are created, produced and recorded. Taking part in the programme were Jacques Morali, producer; Barbara Tiesi, Sigma's studio manager; and the Ritchie Family. A complete behind the scenes perspective of how disco records are created was provided as Morali took the Ritchie Family through a recording session. The programme is to be broadcast in Switzerland on the French channel and will also be shown in France, Belgium and Canada. The total anticipated audience for the programme is likely to be about 50 million viewers.

Swiss TV filming in New York's Sigma Sound Studios

The TD 20A employs the Actilinear* system, which gives better dynamic range and uses a special phase linearity network which improves the transient response remarkably. The Actilinear* system represents a 20dB improvement in signal-handling capacity over any conventional system on the market today. The TD 20A is operated by four separate motors which eliminate mechanical power transmission and gear systems. Separate power supplies for operational functions and audio functions. Special circuits for phase correction. PROM electronic 'brain' and TRIAC-controlled spool motors. 2-track and 4-track models available.

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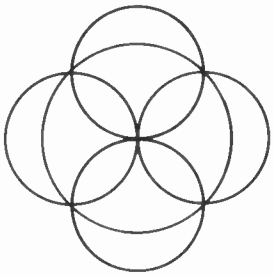
Ambisonics-The Theory and Patents



Adrian Hope

In the field of Ambisonics and Surround Sound, there are a dedicated group of researchers who have produced a large number of patents covering many different aspects of their research. Adrian Hope here attempts to unravel some of the more important patents.

WHEN the National Research Development Corporation, a quasi official body which backs a limited number of British inventions, announced a complicated cross licensing agreement or 'pool' with Duane Cooper of the USA and Nippon Columbia of Japan on surround sound patents the wholly predictable reaction was one big yawn. Hadn't some kind of agreement with Japan already been signed? What in Heaven's name is a patents pool? And I thought quadraphonics was dead anyway.

In fact the NRDC-Cooper-Nippon agreement could have very far-reaching consequences for the recording and broadcasting industry. Certainly 'quadraphonics', as the trade, press, record industry and public have grown to know and distrust it, is dead. But there is a good chance that a whole new generation of surround sound technology will reach the commercial market over the next few years. Indeed if anything now delays commercialisation of surround sound it will be our all too strong memories of the quadraphonic *debacle*. But until recently there was a risk that the second coming of surround sound would be delayed by a chaotic patent situation that was developing behind the scenes. The recent NRDC signing, which followed an informal agreement of a few years ago, was the end result of a considerable amount of often heated behind the scenes negotiations between the owners of a large number of key patents on future trends in surround sound technology. It became clear, early on in the development of Ambisonics technology, that there was a very real conflict of patent interest between Duane Cooper of the University of Illinois, USA, Nippon-Columbia of Japan and the British Ambisonics team including Michael Gerzon of the Mathematics Institute, Oxford University and Professor Peter Fellgett of the University of Reading.

Without the recently announced agreement, virtually all commercial development of Ambisonics style surround sound could well have been stifled. In effect and in simplified terms what NRDC, Cooper and Nippon have created is a patent pool, a collection of patent rights into which authorised parties can dip without fear of provoking a patent infringement action from any of the others. In this respect the NRDC pool resembles that created in late 1919 with the birth of the Radio Corporation of America, or RCA as the company subsequently became known. The early days of radio, just like the early days of surround sound and 'quadraphonics', saw a mass of patents granted to different inventors on different circuits and techniques. By the end of the Great War decade it had become almost impossible for anyone to make a radio set without infringing literally dozens, possibly hundreds, of other people's patents. The RCA patent pool was intended to rationalise the situation. The scheme never really worked as intended but without it there would probably never have been the radio boom that followed in the Twenties. The NRDC patent pool is far smaller than the radio pool, because it contains none of the patents granted to pioneering workers in the field and to companies such as Sansui and CBS on their QS and SQ systems. The pool contains nothing from Japanese Victor. Also outside the pool are crucial patents on multi-channel radio transmission techniques, for instance the broadcast of a third information channel by phase quadrature modulation of the conventional FM stereo difference channel as probably first patented by Dorren in 1970 (US Patent 3708623). But the pool does contain some potentially very valuable patent rights.

If, as now seems increasingly likely, the Ambisonics approach to surround sound is adopted commercially by broadcasting and record companies, the potential value increases. To understand the true value of the patent pool, and the problems which still remain unresolved, it's necessary to look very briefly at the lynchpins of Ambisonics surround sound technology. The patents themselves then offer some useful nuts-and-bolts detail on the techniques adopted in practice. It is also interesting to look at a few milestone patents in surround sound development which are not pooled. It should, however, be noted that this article is not intended as a legal opinion on the value or validity of any patent mentioned and the relevance or otherwise of any patents to competitors' activities. Such issues can only be decided by a court of law. But, frankly, Heaven help any court of law that has to decide the issues involved. And Heaven help the bank balance of any firm or individual who goes to court on a surround sound dispute. The technology involved is now so high and complex that any court action centring on a surround sound patent folio and alleged infringement is likely to be very long and very expensive for all concerned. In short, only the patent lawyers can hope to gain from any disputes that aren't resolved by out of court negotiations.

The essence of quadraphonics was to record or transmit a quartet of speaker-feed signals in as discrete a fashion as possible, ie with a minimum of crosstalk. The ultimate aim was to transmit or record the four speaker feeds as four separate signals, amplify them separately and feed them to four separate speakers arranged in the corners of the room. Matrix encoding techniques, whereby the four speaker feeds were mixed down into a stereo pair for recording or transmission, and then 'unmixed' for amplification and reproduction, was one of various compromises adopted. Multiplexing by frequency separation was another approach. There exist hundreds, if not thousands, of patents on variations of these basic themes. The basic concept of mixing or matrixing signals together and then recovering them, was first investigated by Bell Labs in the USA and patented by Alan Dower Blumlein of EMI in the early Thirties. Blumlein's British Patent 394325 of 1931—and arguably the most famous electronic patent ever granted—is to be found cited by name and number at the end of almost every technical paper on surround sound innovation. And Blumlein's ideas were certainly not just armchair dreams. Every stereo disc currently pressed and sold matrixes the stereo left and right channel signals by 45° double modulation of a 90° groove exactly as described by Blumlein.

Incidentally, even before the Bell and Blumlein patents, proposals for recording 2-channel

signals by vertical and horizontal modulation of the groove had been proposed and patented. Also before Blumlein, Bell Labs in New York had developed in 1929 and patented (USA patent 1910254) a clear forerunner of the so-called 'discrete' multichannel signal recording and transmission systems. Separate sound channels were displaced in the frequency scale 'to form a progressive series of bands separated by suitable intervals', ie the multiple channels were frequency-multiplexed. The frequency-multiplex approach was refined by William Livy of EMI in 1946. Livy's British patent 612163 proposes that a high frequency carrier should be recorded on the disc along with the programme and used on replay to lock an oscillator to actual disc speed. In 1954 an American inventor, Kenneth Hamman of Ohio, patented (US patent 2849540) a further development of the frequency-multiplex idea. This specifically described the use of a 30kHz carrier tone.

All patents have a limited legal life (for practical purposes 20 years can be safely taken as the maximum) and once a patent is dead, what it contains is public property. Everything so far mentioned is thus now public property.

The matrixing approach was probably first taken up again by David Hafler in the USA, who in 1965 patented a simple derived sum centre channel system (US 3417203). In 1971 Hafler went on to patent a derived difference rear channel system (BP 1356843). But it is generally acknowledged that much of what this patent claims is legally invalid because Hafler had already published his idea in an article which appeared in the August 1970 issue of *Hi-Fi News and Record Review*. (As a general rule a patent is invalid if it covers ideas already disclosed to the public.) The year before Hafler published his derived channel ideas, New York musician Peter Scheiber had lodged a series of patent applications which almost certainly represent the first legal claims to what became known as quadraphonics. A licensing deal was struck between Scheiber and CBS, so that Scheiber patents are now effectively pooled with the large number of CBS patents on SQ and derivative systems, mostly originating from Ben Bauer. The most important early Scheiber patents are BP 1328141 and 1328142. Broadly speaking the SQ folio relates to a wide variety of recording and transmission techniques intended, in one way and another, to preserve the integrity of separate speaker feed signals. Although this approach is eschewed by the Ambisonics team, it remains to be seen whether the extensive folio of CBS patents presents any legal obstacle to the NRDC Nippon pool covering Ambisonics and related technology. Without doubt the recent and untimely death of Ben Bauer will affect this whole issue. It is unlikely that anyone at CBS will now push SQ, and watch for possible patent infringement, with anything matching the enthusiasm of Ben Bauer. Another important string of patents under the CBS wing are those covering the Tate decoder (now being used by Dolby Labs for film surround sound decoding). British patent 1514162 and US patent 3944735 describe and protect the circuitry devised by Martin Willcocks of Huntingdon, England to enhance the directional decoding of any matrixed signal.

FIG.1 UHJ HIERARCHICAL ENCODING AND DECODING USING AMBISONIC TECHNOLOGY

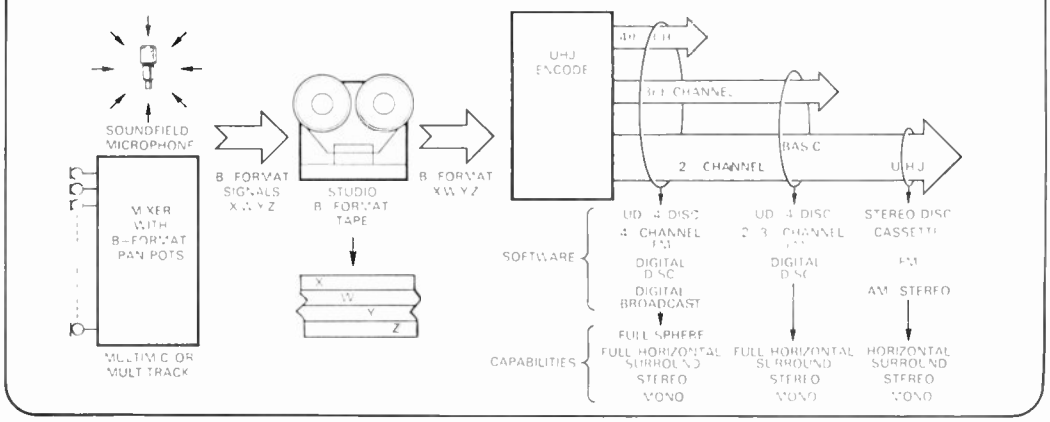
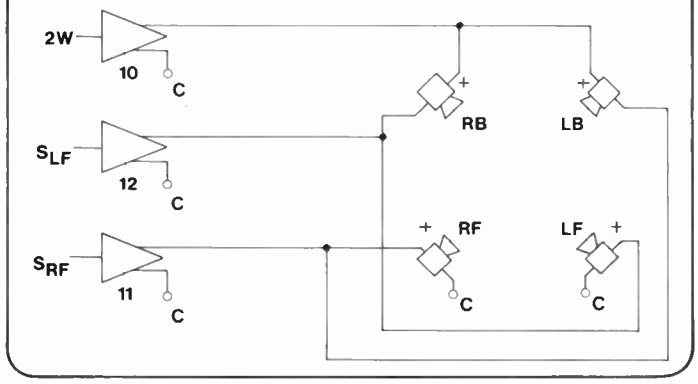


FIG 2



According to conventional stereo reproduction; as first patented by Blumlein pairwise blended signals are fed to two loudspeakers angled at about 60°. This presents a good illusion of a sound spread between the loudspeakers, but only for a listener facing the loudspeaker pair. The illusion breaks down if the speaker pair is behind or, worse still, to the side of the listener. But of course if four loudspeakers are spaced around a listener, only one pair can at any one time be to the listener's front. Also if four loudspeakers are spaced around a listener, each pair subtends an angle of 90°, which is too wide for a good stereo image even to the front. This is the obvious fallacy on which so much quadraphonic development has been based!

According to Ambisonics research the speaker feed signals necessary to create a reasonable illusion of sound from four, or ideally more, loudspeakers around the listener can be derived from two transmission channels. But a better illusion can be obtained if the speaker feeds are derived from signals carried by three transmission channels. As a compromise measure the third channel can be bandwidth limited, ie a so-called half-channel. If a fourth transmission channel (in this context 'transmission' includes 'recording') is used for such a simple speaker system, there will be quality degradation because the loudspeaker positions will be emphasised and the phantom images between them will be pulled towards speakers. Remember that any loudspeaker listening must rely on an illusion. When we hear sound naturally we hear it arriving from an infinite number of directions. The trick in loudspeaker listening is to disguise the fact that the sound is issuing from a very limited number of loudspeakers, each resembling a point source. If four transmission channels are used then speaker feed signals for six or preferably seven loudspeakers must be derived to prevent 'speaker emphasis'. Alternatively the fourth channel can be used to provide height information, ie to derive feed signals for speakers positioned above and below the listener. Ambisonics technology therefore involved (a) production in the studio of a clutch of four signals which contain all the necessary sound and height information, (b) encoding these studio or so-called 'B-format' signals into a clutch of signals suitable for recording or transmission with the facilities available, ie two signals for a stereo disc or stereo radio transmission, or two-and-a-half or three or four signals where extra channels are available, and (c) deriving from the arriving 2- 2½- 3- or 4-channel signals, a number of speaker feed signals tailored to the number and layout of loudspeakers in use (fig 1). An important aspect of the system is that it is hierarchical in approach; the total information available in the recording studio in the four B-format channels can be disseminated by recording or radio transmission in a manner tailored to the facilities available and reproduced in a manner tailored to the reproduction facilities available, ie mono, stereo or surround. Patents in the Nippon-NRDC folio now cover crucial aspects of all three stages in this hierarchical chain.

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Ambisonics - The Theory and Patents

To begin at the beginning of the sound chain, the *Soundfield* microphone manufactured and sold by Calrec is covered by NRDC British patent 1512514. In this patent the inventors Peter Craven and Michael Gerzon re-iterate the problem that when an attempt is made to sample the sound in a studio at a single point in space, it is physically impossible to have two separate microphones, let alone four, located at *precisely* one and the same point. This means that the output signal from a multi capsule microphone array will inevitably contain anomalous information, especially at high frequencies where the wavelength resembles the capsule size and spacing. The aim of the patent is to provide a multi-capsule microphone assembly which delivers a series of outputs which are doctored to resemble the outputs of notionally 'truly coincident' microphone capsules. The patented proposal is a 4-capsule assembly, with the capsules mounted as if one is on each face of an invisible tetrahedron. Each capsule has a cardioid or hypercardioid response pattern and the tetrahedron is positioned so that the maximum response directions are left back down, right front up, left front down and right back up. The four capsule outputs are separately amplified and fed to a matrix which delivers four equalised outputs. One of these outputs is the zero order harmonic and therefore an omnidirectional signal. The remaining three are first order spherical harmonics corresponding to the signals which would be produced by figure-of-eight microphones pointing front-to-back, left-to right, and up-and-down. The patent gives the necessary matrix equations along with the formula for equalising the frequency characteristics of the capsule outputs over the full audio range. The object of the exercise is to obtain identical frequency response of the *Soundfield* microphone to sounds arising from all directions. Essentially the frequency characteristic of the matrix at low frequencies follows one pattern and pivots at higher frequencies to a different pattern. Moreover a different equalisation pattern is applied to the omni signal than to the figure-of-eight signals and different pivot frequencies are used.

The four outputs from the matrix (equalised omni and equalised front-to-back, left-to-right and up-and-down figure-of-eight signals) are the B-format signals. As previously explained they can be recorded or transmitted in 2-, 2½-, 3- or 4-channel format. The method of hierarchical encoding is covered by a variety of patents. British NRDC patent 1369813 stems from the work of Peter Fellgett and dates back to 1871. The patent claims a method of encoding azimuth information in two transmission channels. One channel carries omnidirectional signal components which contain sound from all directions with equal gain; the other channel carries azimuth or phaser signal components with sounds from all horizontal directions of unity gain but with a phase shift relative to the corresponding omnidirectional signal component. A pair of patents from Duane Cooper (British patents 1411944 and 1411995) also date back to 1971 and in more detail cover the basic matrix theory (now referred to as BMX) proposed by Fellgett. Both Fellgett and Cooper were of course working independently, in ignorance of each others' activities. The BBC coincidentally filed a patent application in 1972 which was issued as British Patent 1414166 and virtually restated Fellgett's ideas in different words but with additional mention of a third channel. It is also known that around this time CBS looked at, but took a considered decision against, the use of 'New Orleans', a matrix which is closer to BMX than SQ. The Cooper patents are by far the most mathematical of the bunch and are most definitely not recommended as light bedside reading. But in essence they describe an encode/decode matrix which is directionally symmetrical. Source signals representative of sound from different bearing angles, measured with respect to a reference direction, are matrixed according to co-efficients corresponding to functions of those angles. The price paid for BMX symmetry was of course extreme phasiness in some sectors of the reproduced sound field. The manner in which the priority dates of the NRDC, and Cooper patents overlap is extremely complicated, some aspects of each invention being pre-dated by the other and so on. All concerned in the current patent pool agreement should give daily thanks that they no longer have to worry about arguing the issue of who dreamed up which equation first in front of a bemused high court judge who still listens in mono on an old *Quad* valve amp and had always thought *quad*raphonics was somehow related to Acoustical of Huntingdon.

It is now fairly widely appreciated that an answer to the phasiness inherent in 2-channel matrix compromises is the use of an additional channel or channels of information. The foundation for this hierarchical approach, or universal matrix UMX, was laid by Cooper's British patents 1411994/5 (followed by USA patent 3970788) and further developed in subsequent work by all parties to the patent pool. The recently agreed UHJ encoding format (or more accurately agreed range of formats including HJ) is not (yet) specifically referred to in any published patents, but a recent US patent by Gerzon (4095049) contains incomprehensible maths which should cover not only the current UHJ hierarchy but any future developments.

The extra channel (or channels) of information used in addition to the base band pair is transmitted by radio multiplexing techniques (such as the previously mentioned phase quadrature modulation of the stereo difference carrier) and recorded by disc multiplex techniques as used by Nippon Columbia for their previous releases in the *UD4* quadraphonic system and by JVC for their apparently now defunct *CD4* system. The techniques developed by Nippon and used for *UD4* are equally well suited to UHJ recording.

For instance in British patent 1473533 Cooper, along with inventors Toshihiko Takagi and Yoshihisa Kamo, describe a means of angle modulating the high frequency carrier with sum and difference signals to reduce clipping distortion, crosstalk and up-talk from the base band caused by tracking and tracing distortion in a disc reproduction system. Two more patents from Cooper were issued alongside this joint Cooper-Nippon UMX improvement. British patent 1473531, for instance, originates the concept of cutting a disc with the carrier channel signal reversely compensated by an anticipated amount of tracing distortion, so that up-talk from the baseband into the carrier is negated. Likewise Cooper's British patent 1473532 originates the idea of matching the recording pre-emphasis characteristic of the base band signals with the phase modulation index of the phase modulated carrier channel signals. This drastically reduces the FM beat distortion which can be produced when the modulated carrier channel signals are mixed with the main channel signals during recording on the walls of the disc groove. As anyone who has heard any of the relatively few Denon *UD4* discs pressed and released a few years ago by Nippon-Columbia will doubtless recognise, this trio of patents protects valuable advances in carrier cutting technology. It seems likely therefore that any record company outside the NRDC pool and serious about cutting carrier discs will need to look very closely at what those patents describe and what they legally monopolise.

Likewise, designers outside the pool might also be well advised to look closely at Nippon Columbia USA patent number 4070552. This patent, which dates back to 1975, describes an interesting cutting technique intended to reduce noise on carrier discs. Essentially the angle modulated carrier is recorded by constant acceleration cutting techniques. Another, related, Nippon patent 4075425 concerns reproduction systems and uses a level detection means to squash to the carrier if the signals recovered from the disc fall below an acceptable level and the signal-to-noise ratio degrades. Noise is of course a perennial bugbear with carrier disc cuts.

We now arrive in the home, as it were, at the decoding stage with derivation of speaker feed signals. NRDC British patents 1494751 and 1494752 originate from Michael Gerzon's work in 1974 and claim lynchpin aspects of the process for reproducing sound from signals delivered to the 'consumer', either from a disc or tape recording or from a radio transmission. This pair of patents protects important aspects of the decode process for converting the arriving signals into speaker feed signals tailor-made for the reproduction system used. The first concerns a layout control system to 'tune' the speaker feed output to the speaker layout adopted. The UHJ Consumer or C-format signals arriving from disc, tape or radio are decoded by an amplitude-phase matrix into signals which originated in the recording studio. Thus for a 3-channel UHJ input, the decoder matrix produces an omni or pressure signal, a forward velocity or front-back difference signal and a leftward velocity or left-right difference signal. If the UHJ input contains height information then a fourth, up-down difference signal is also produced by the matrix. These decoded signals are now doctored prior to amplification and fed to the loudspeakers. Signals decoded from other formats are similarly doctored. The nature of doctoring is in direct dependence on the number of loudspeakers used, their angle around the listener and their distance from the listener. Doctoring is not simply an alteration in gain between the signals fed to the various loudspeakers. For example in a simple four loudspeaker azimuth or horizontal-only situation, when the angle between the front speaker pair is narrowed

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Ambisonics-The Theory and Patents

from the not ideal 90° to the ideal 60°, the speaker layout is inevitably asymmetrical. In this case the gain for the front-back difference signal is reduced to compensate for increased front-back speaker width, and the gain for the left-right signal is increased to compensate for the decreased side-to-side loudspeaker width. Additionally the decoded signals are frequency filtered to compensate for the effect at the listening position of the distance between the loudspeakers and the listener. Any finite loudspeaker distance will of course inevitably produce some degree of bass boost and phase shift in the directional lower frequency components of the reproduced sound at the listener's position. This can degrade image quality and sometimes cause locational errors. Inverse highpass filtering is thus used to compensate for distance at the same time as the decoder outputs are balanced to compensate for loudspeaker layout.

The second patent is concerned with Gerzon's theories on sound localisation. Assuming a perfectly adjusted loudspeaker layout, there is still the very real problem of how to generate from those loudspeakers the audible clues which will fool a listener's ears and brain into believing that the sound field is originating from an infinite number of sources around the listener rather than a few point sources of sound. In the patent, Gerzon recaps on the now 100-year-old theory that human beings locate the source of a sound by complex evaluation of the relative amplitude and phase relationships as it arrives almost, but not quite, simultaneously at each of the listener's two ears. For low frequency, long wavelength sounds, a human head offers virtually no obstacle. So sound arrives at each ear with virtually the same amplitude. But there is a difference in phase between the sound arriving at each ear, because of the extra distance travelled. Thus at low frequencies the ear-brain combination uses phase as a directional clue. At higher frequencies, with wavelengths comparable to the size of a human head (which is the extra distance which the sound must travel) phase relationships become meaningless. But the head acts at high frequencies as a baffle and this creates a difference in amplitude across the head. So for high frequencies our ears and brain use amplitude as a directional cue. Traditionally the transitional frequency is put at around 700Hz. But the transition is of course gradual and Gerzon suggests in the patent that for surround sound reproduction purposes the turnover point should be taken as around 320Hz. This, he suggests, makes the listener's position with respect to the loudspeakers far less critical. So according to the patent, when reproducing programme material the listener's ears should be provided with amplitude clues to direction for frequencies above the transition frequency and with phase clues to direction for frequencies below the transition frequency. This calls for the design of a frequency dependent matrix which approximates to ideal low frequency design at low frequencies and ideal high frequency design at high frequencies. Most important of all is the band around the transition frequency where there has to be a suitably designed transition performance.

The patented solution is to provide identical shelf filters in the two difference signal paths and a third filter of different characteristic in the omni signal path. Each filter has identical phase response and each has one gain at low frequency (below the transition frequency) and another at high frequency (above the transition frequency). Most important, each shelf filter makes a transition from low frequency gain to high frequency gain across the frequency band spread round the transition frequency band. Incidentally, note that just as the layout control system operates in advance of the circuitry which derives and amplifies the speaker feed signals, so the frequency dependent circuitry operates in advance of speaker feed derivation. On most conventional quadraphonic decoders, any layout control or frequency doctoring is likely to be on signals which have already been decoded and designated to feed individual loudspeakers.

Gradually it becomes clear how the NRDC-Nippon pool could well have considerable long-term value. Although patents on disc cutting technology have a potentially limited life (because before too long the recorded and transmitted signals will simply be slotted into a digital stream without any need for disc or radio carrier modulation) the patented techniques for deriving B-format studio signals, for encoding and decoding them for recording or transmission and for deriving speaker feed signals from the decoded signals are an essential and immutable part of the system.

More patents, most it seems from Gerzon and the NRDC, are in the legal pipeline and issuing on a regular basis to protect sophistications of the basic system. USA patent 4139729 (and recently also British patent 1548674), for instance, describes Gerzon's scheme for using three power amplifiers to drive four loudspeakers, or four amplifiers to drive five loudspeakers, and so on, without unwanted information spill over. **Fig 2** of the patent shows the basic three amplifier/four loudspeaker layout. Such a technique clearly offers useful economies for the manufacturer of surround sound reproduction equipment. USA patent 4081606 (soon to issue as British patent 1550627) protects Gerzon's ideas for a variable decoder (christened the 'Variable Directional Preference' or VDP decoder. This employs logic circuitry similar to that used in quadraphonic systems to enhance directional decoding in continually varying dependence on the signals being decoded, but varies the width of individual images rather than the signal direction. This is achieved by reducing the phasiness of the most important signal at the expense of phasiness in less important signals. For instance, where the decoded signal is front orientated, the front signal phasiness is reduced at the expense of extra phasiness at the rear, where it is psycho-acoustically less important. In other words the preferred sound direction is made to sound sharper at the expense of others which become less sharp but remain unchanged in direction. USA patent 4151369 proposes the use of a time delay in the decoder speaker feed outputs, with the delay in each speaker feed being related to the distance between the speakers and a listener. As well as covering the UHJ hierarchy mathematics, USA patent 4095049 (soon to issue as British patent 1550628) covers an interesting idea for adding a third channel of information to a basic 2-channel system in such a way that the third channel can be reduced in amplitude, or restricted in frequency, without noticeably affecting important localisation criteria. This is achieved by the use of extra phase amplitude matrices. It apparently took Gerzon two full years to work out the maths involved. The advantages, especially for broadcasters, are, however, obvious. When a third channel of information is transmitted along with the stereo base band signal any third channel degradation, for instance due to poor reception conditions, produces a gradual changeover to 2-channel operation with the reproduced image positions remaining predominantly unchanged, but less precise.

Currently the IBA and BBC and the FCC are all looking at various aspects of surround sound broadcasting, so is Dutch radio, eg with regular Concertgebouw broadcasts. Sadly neither the BBC nor the IBA have made much public noise in surround sound of late. Although one might reasonably expect that these two quasi-official British broadcasting authorities would either co-operate with each other and the quasi-official NRDC *or* work completely separately and regard the other's progress as a challenge, it often seems to an outsider as if the IBA warms to surround sound as the BBC cools off and vice versa! There are, however, more practical reasons for the current cool-off. Happily the few senior bureaucrats who for years occupied seats of power in Broadcasting House and laid a dead hand of restraint on the small but enthusiastic band of BBC engineers devoted to the cause of surround sound broadcasting, are now out to pasture. But almost coincident with the bureaucrats' exit, some BBC engineers took to hampering their own progress by embarking on industrial action. Essentially the beef is that more loudspeakers at the monitoring stage warrant commensurately more pounds in the pay packet. However justifiable the extent of the claim may (or may not) be there is little likelihood at the moment of the impoverished BBC radio coffers coughing up the kind of rises sought. So, for the time being at least, there is unlikely to be any surround sound broadcasting from the BBC. Nevertheless the Calrec *Soundfield* microphone is being extensively used, for instance for the Proms, and informal surround sound, tapes are often made for research and evaluation purposes.

In the 1979 Proms season there was one concert in particular which it would be fascinating to hear in surround sound. *Star Child* (by the aptly named George Crumb, and with every bit as much artistic content as the Tate Gallery's now famous pile of bricks) embodies some impressive surround sound spacing effects. So spread is the orchestra, in fact, that six conductors were needed for the Albert Hall performance. At one point in the pretentious proceedings a string of muted trumpets play from balcony boxes spaced full circle around the hall. Most interesting of all a string section performs from the hall balcony high at rear dead centre. One of the most difficult tricks in surround sound matrixing is to encode rear dead centre, for accurate reproduction in surround and no significant loss of level in stereo and mono. Some matrices would lose the *Star Child* rear centre strings altogether in

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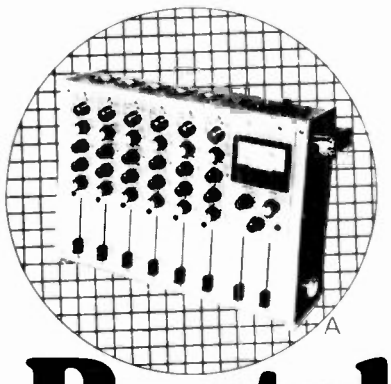
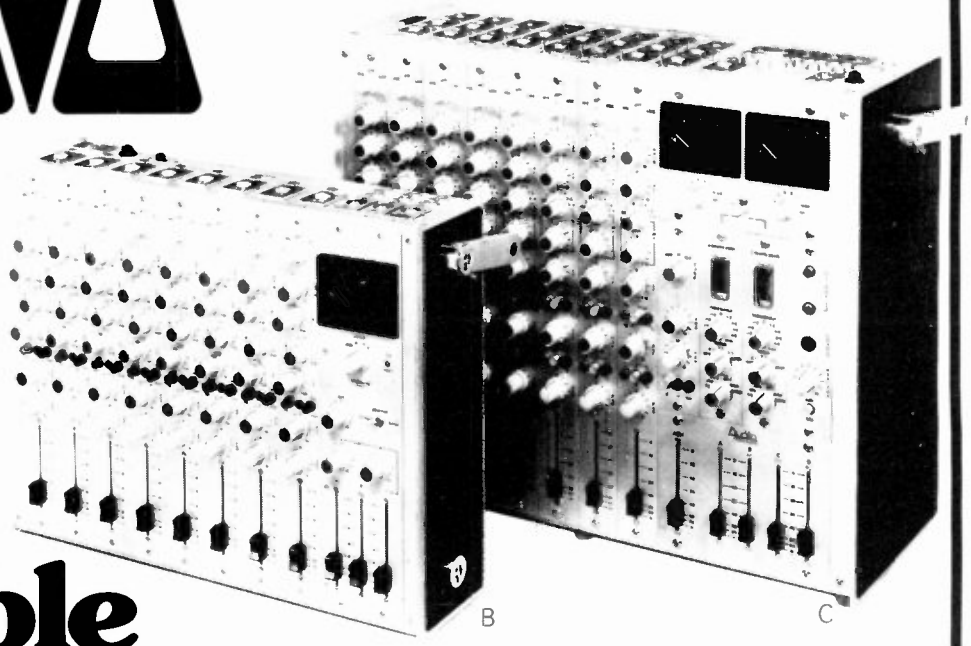
Audio Developments





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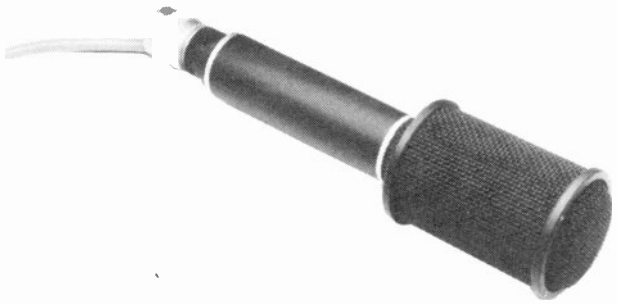
Ambisonics-The Calrec Soundfield Microphone



J Howard Smith, Calrec Audio Ltd

While much theory has been devoted to Surround Sound and Ambisonics, to date Calrec Audio Ltd is the only company that has developed a product using this theory, the *Soundfield* microphone.

ALTHOUGH THE original concept of the *Soundfield* microphone was to produce a coherent 3-dimensional signal suitable for replaying full surround sound, the most immediate advantage offered to the recording and broadcasting industry is a stereo microphone with several unique and quite revolutionary advantages.

1. The stereo output is truly coincident over most of the audio spectrum, ie the two outputs originate from capsules that apparently occupy the same point in space, thus greatly reducing the phase errors introduced by conventional microphones and their inevitable effect on the frequency response.

2. The microphone may be electronically rotated through 360° horizontally from a remote position.

3. The microphone may be electronically tilted vertically ±45° from a remote position.

4. The angle between the apparent capsules may be varied from 0° (ie mono) to 180° electronically from a remote position.

5. The microphone may be 'apparently' moved either forwards/backwards or up/down from its real position.

6. The polar pattern may be adjusted to any first order characteristic (ie omni to figure-of-eight via cardioid).

7. Functions 2 to 6 may be performed *post-session off tape* provided that the 4-channel B-format signal has been recorded.

8. The B-format master tape allows the recording to be re-issued in the future in whatever form of surround sound may eventually be adopted, up to a maximum of full periphony, ie 'with height'.

In order to understand the seemingly impossible task of moving and steering a microphone that was de-rigged three weeks ago, it is necessary to examine the construction of the B-format signal referred to earlier, but first a reminder of conventional microphone parameters.

The need for Soundfield

Nearly all microphones available today operate in either one of two modes or a mixture of both. They are either omnidirectional, figure-of-eight or some mixture of these two, a 50/50 mix giving cardioid.

Unfortunately it is impossible to design capsules with optimal omni (pressure) and figure-of-eight (gradient) responses as parameters which improve the performance of one system adversely affect the other, and as these two signals are normally generated either by one diaphragm or by two driving one circuit, they are inseparably mixed. It is tribute indeed to the makers art that modern microphones sound as well as they do when faced with this basic fact.

B-format construction

The Calrec *Soundfield* microphone has four very accurately matched cardioid capsules arranged in a regular tetrahedron. Both these facts are of vital importance to the correct operation of the microphone.

Fig 1 shows the capsule array with the front looking out from the paper. If the output of right front (RF) is subtracted from that of left back (LB) then the two pressure components cancel, being out of phase, and the gradient components add to form a figure-of-eight response. It is at this stage that the accurate matching of the capsules is important for provided that the capsules match perfectly, when added anti-phase any errors due to imperfect design are equal and opposite, and therefore cancel each other out. In practice the cancellation is not perfect, but is of a very high order. Consequently a figure-of-eight characteristic is generated whose purity is considerably better than the two cardioids from which it was formed.

The axis of the 'eight' is right/front, ie 45°, left/back, ie 225° and is horizontal; see fig 2. The fact that the original capsules were angled simply reduces the sensitivity of the resultant 'eight'.

44 ▶

FIG.1

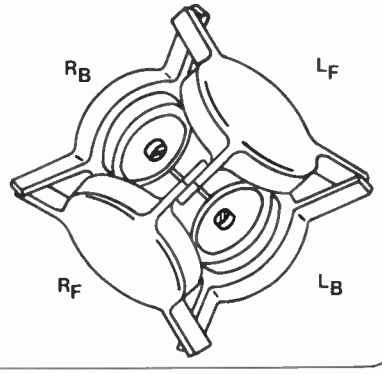


FIG. 2

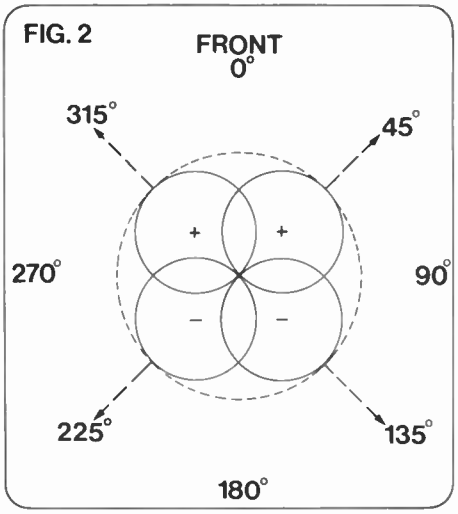
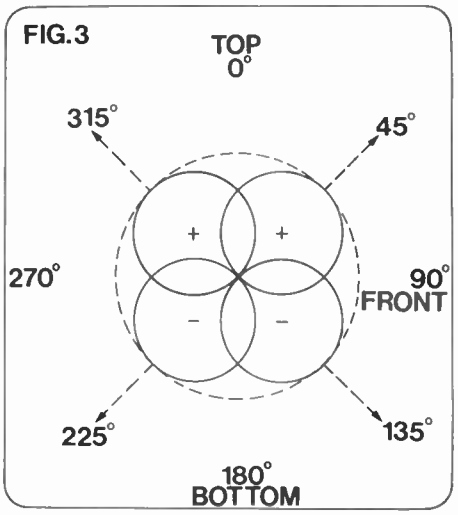


FIG.3



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Ambisonics-The Calrec Soundfield Microphone

The same operation with left front (LF) and right back (RB) produces a gradient signal on the 315°-135° axis, ie at 90° to the first, and a similar sum for vertical information using RF — RB and LF — LB produces two more gradients both on the 0°-180° horizontal axis but inclined in the vertical at 45° and 315° respectively (fig 3). If the two horizontal figure-of-eight patterns are now added in phase, the result is a gradient signal whose prime axis is 0°-180° and is termed 'X'. The same signals added out-of-phase, produce a 270°-90° gradient, termed 'Y' and adding the two 45° vertical signals produce a figure-of-eight at 90° to the horizontal, termed 'Z'.

We now have signals representing the gradient component of the sound in the three prime directions. Left-right, front-back and up-down and all that is now required to complete the characterisation, is a pressure signal, termed 'W'; this is produced by adding all the capsule outputs in-phase.

Let us now quote the component parts of the four B-format signals.

$X = LF + RF - LB - RB$
$W = LF + RF + LB + RB$
$Y = LF - RF + LB - RB$
$Z = LF - RF - LB + RB$

It can be seen that each B-format signal is made up of 25% of each of the original capsule signals and it is this fact together with the regular tetrahedral array that make it possible, for the first time ever, to correct for the physical spacing of the capsules and produce a truly coincident B-format master signal.

Examination of the frequency response of the B-format before equalisation reveals that while the three gradient signals XYZ sensibly follow each other, they all have a response that rises with frequency above about 1kHz whereas the pressure signal 'W' falls with rising frequency, the difference being up to 10dB (fig 4).

It must be stressed that this situation applies to all cardioid microphones, but can only be examined *and corrected* in the *Soundfield* system. As Gerzon remarked in his paper to the 50th AES Convention: "This should convince sceptics of the fallacy of assuming that 'nearly coincident' is good enough".

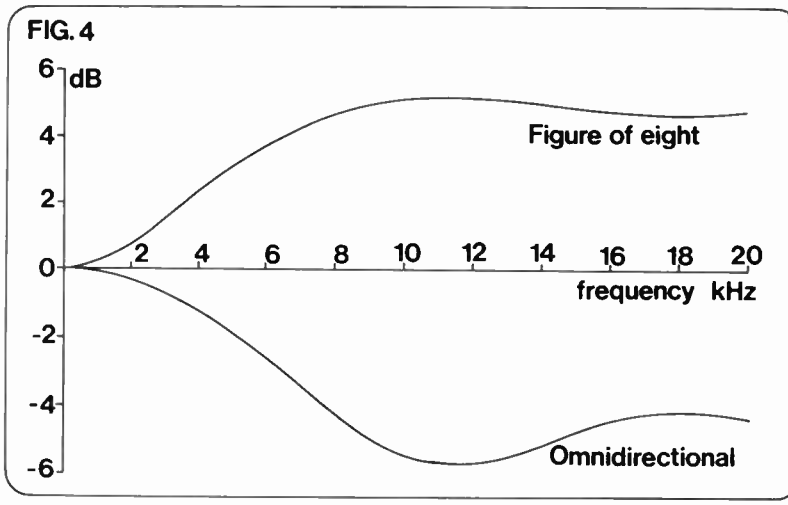
To use B-format to produce a stereo output it is necessary to recombine the signals in the correct proportions. For instance to produce a 90° crossed pair of figure-of-eights pointing to the front and horizontal, the formulae would be:

$L = \frac{1}{2}X + \frac{1}{2}Y$
$R = \frac{1}{2}X - \frac{1}{2}Y$

As X and Y are themselves 'eights' no other signals are required. If cardioids are required then the 'W' pressure signal must be half of the total energy:

$L = \frac{1}{4}X + \frac{1}{4}Y + \frac{1}{2}W$
$R = \frac{1}{4}X - \frac{1}{4}Y + \frac{1}{2}W$

FIG. 4



The system can generate any first order characteristic, that is any pattern from omni to figure-of-eight through all the cardioids and these may be adjusted during programme. Up to four such virtual microphones may be generated, two forwards and two backwards and the angle between each pair may be altered from 0° (mono to the front, mono to the back) to 180° (mono to the left, mono to the right) in a scissoring motion. The 'rig' may then be rotated through 360° horizontally and tilted ±45° vertically.

The last control facility to be described is proving in practice to be the most interesting. Dominance allows the ratio of direct to reverberant sound to be altered in either a forwards/backwards or upwards/downwards direction. This is achieved by acting on the appropriate part of the B-format signal, 'X' for F — B and 'Z' for U — D, without affecting any of the other parameters. The result of this is to apparently move the microphone in the direction indicated.

In addition to the above-mentioned features, the microphone control unit has 0dB line sending capable outputs for both B-format and stereo and can therefore be considered as a complete recording channel for a one microphone recording.

The *Soundfield* system, therefore, not only provides the world's first 'coincident' microphone for stereo, but also a signal storage format that allows recall of *total* directional information for future use. ■

Ambisonics-The Theory and Patents

mono. Mono and stereo compatibility are not just a technical exercise. Although Crumb's opus may not be everyone's musical cup of tea, there will doubtless be surround sound drama performances where important dialogue comes from the rear of the listener. It just isn't acceptable for a matrix to lose this in mono.

The IBA tests have ground to a halt after clearly suggesting that although 2½-channel transmission of UHJ signals can give very good surround results (comparable in fact to those obtainable from three channels), the stereo and mono compatibility of 2½ just isn't good enough for critical listening. And until extensive on-air 3-channel tests have been run, no one will really know whether this format is acceptable to stereo and mono listeners with existing equipment (from the standpoint of interference, such as birdies etc) and whether it will be acceptable to surround listeners on the fringe of the reception area. What is needed is more work on these issues on a European or world scale. The IBA are stymied because their radio stations are all local-only. Hopefully some of this work will be done by the FCC who are currently considering various issues relating to surround sound in preparation for a decision expected some time in, or after, 1981. Be patient. Speed in this context is not the essence. Any decision now taken on surround sound will be with us for decades to come. It *must* therefore be a carefully considered decision. It is also easy for Europeans to overlook the fact that although the BBC, IBA and other broadcasting organisations in Europe, such as Dutch Radio, are now fairly firmly committed to Ambisonics, the FCC has so far shown most enthusiasm for SQ. Thus the FCC has both inter- and intra-system choices to make. Little activity can reasonably be expected on the disc front until the broadcasters have made some positive moves and the listening public has been offered a real incentive to buy suitable decoding equipment. But already Nippon-Columbia is known to be pressing UHJ carrier discs (albeit mainly for test purposes) and the British record company Nimbus has a dozen or more classical issues in 2-channel UHJ. Occasional one-off issues are also available, for instance *The Organ at York Minster* is a 2-channel HJ recording which is available from Banks and Son (Music) Ltd, Stonegate, York. Incidentally, anyone interested in comparing HJ with the original BBC matrix-H format should try and obtain a copy of the BBC Records disc *40 Years of Television—Norrie Paramor Remembers* which was reputedly cut from an H-Matrix tape (remember that Matrix-H was the original BBC format, HJ is the new BBC format and Ambisonics UHJ is the hierarchy which incorporates HJ).

Currently all the signs are that future commercial contests will be between SQ on the one hand and Ambisonics UHJ on the other. For the reasons already explained, it is unlikely that there will be much conflict between the patent folio held by CBS on the one hand and the NRDC Nippon pool on the other. It also seems likely that with the death of Ben Bauer the drive for SQ will lose momentum. Certainly CBS Records are showing no interest in the system. Japanese Victor and Sansui appear already to have lost all enthusiasm for surround sound, and again it seems unlikely that the patents held by those companies will be of much significance to future development of Ambisonics and UHJ technology. So apart from some negotiations in the area of phase quadrature carrier modulation (patent monopoly on this basic idea is amost certainly owned by American interests) it seems unlikely now that patent litigation will seriously hamper progress of surround sound. Anyone hopeful that surround sound will eventually become available as a recording, broadcast and reproduction option should therefore be thankful that the NRDC pool has been negotiated. ■

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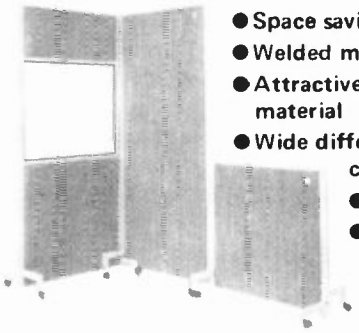

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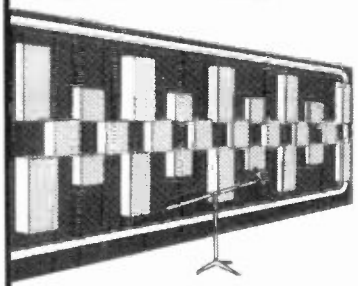

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Ambisonics-Soundfield Experience

Richard Elen

This year, the BBC took delivery of two Calrec *Soundfield Mk III* (production model) microphones. Prior to this, however, the BBC had already assessed the prototype *Mk II* microphone. Richard Elen describes the BBC's experiences with this novel microphone system, described by some as "the most important microphone development since Blumlein".

IT IS perhaps unfortunate that the prototype Calrec *Soundfield* mic didn't make its appearance on the BBC scene until after the first run of *Matrix-H* and *HJ* experimental surround-sound broadcasts had been completed. It is hoped that transmissions in the latter format will start again soon, and will no doubt make use of the *Soundfield* mic, but in the meantime, BBC Studio Managers and researchers are amassing a good deal of information on the performance of the mic in stereo applications, which will obviously be a great deal of use when surround broadcasts are continued. The IBA has also completed its first set of broadcast evaluations of the Ambisonic technique, deciding that a 3-channel Ambisonic transmission format is to be preferred to a 2 or 2½-channel format. The 3-channel system has certain technical problems associated with it, but these will no doubt be overcome, and with favourable reaction to Ambisonics from the EBU and FCC it may well be that this innovative British-designed system will form the basis of the record and broadcast output of the future. Of course, the technical difficulty of transmitting or cutting three or more channels of information disappears when we consider digital multiplex encode/decode techniques; even before this, however, it is likely that analogue methods will be devised to cope satisfactorily with the three channels required for 'horizontal' surround-sound, or the four channels needed for full 'with-height' reproduction.

In the meantime, however, it's well worth looking at the BBC's experience with the *Soundfield* microphone, because apart from the *UHJ* surround-sound possibilities of this mic, it promises a great deal in terms of stereo flexibility and response. To find out more about the BBC's work in this field, I discussed the system with Bob Harrison, from the Assistant Chief Engineer's department, Radio Broadcasting, and Antony Askew, who is a Senior Music Studio Manager. Bob Harrison's role enables him to experiment a fair amount with new techniques without being so far removed from actual operational situations as to be unable to relate his findings to the limitations of broadcasting requirements. Tony Askew, on the other hand, is frequently responsible for 'driving' the entire mixing system at major 'serious music' events like the Promenade Concerts, where the *Soundfield* mic has been employed over the last two seasons. Without doubt, the BBC has been in an excellent position to evaluate and apply the *Soundfield* mic 'in the field'. This process of extended and meticulous investigation is still continuing, of course, but already some firm results have been emerging.

In fact, the story of the BBC's involvement with mic techniques of the *Soundfield* type goes back to 1976, when the late Ben Bauer brought a prototype *Ghent* microphone over from the States for the BBC to examine. The *Ghent* mic is specifically designed to offer exact encoding to the Columbia *SQ* 'quadraphonic' standard, and part of this specification includes the requirement for the microphone to eliminate phase anomalies, particularly in the front quadrant. Phase—and frequency response—anomalies are a big problem in mic systems which make use of Blumlein and other coincident pair techniques, as used extensively for BBC music productions: with two discrete microphones it is theoretically impossible for the pair to exhibit full phase coherence over the entire audio range, resulting in problems with image location as the sound wavelength approaches the distance between the capsules of the array. The *Ghent* mic was designed to correct such anomalies —at least in the front quadrant— and thus it was expected that it would perform well in stereo configuration. This indeed proved to be the case at an Albert Hall test: the stereo imaging was excellent and the general 'cleanness' of the sound was very encouraging. At the very least it showed that the idea of developing a microphone without phase and frequency-response anomalies had a very good chance of success. However, the *Ghent* mic had the disadvantage of offering no variation of polar response characteristics; good results were thus largely dependent on finding exactly the right position and orientation in a hall, and this was very hard to attain. But the system showed promise.

A special mixer installed in the IBA's mobile which includes five special surround sound channels

The arrival of a *MkII* prototype *Soundfield* mic around the middle of 1978 enabled operational research in this direction to proceed a good deal further. It was first utilised in the recording of the last concert from the Cheltenham Festival in July 1978 with the BBC Symphony Orchestra. The mic was positioned about 8-10ft from stage level at a point which provided a good musical balance of the

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Ambisonics-Soundfield Experience

orchestra and the derived stereo output from the control unit was monitored. At first hearing the results were not very rewarding. The overall sound balance so close to the audience on a hot sticky July evening was dry and lifeless. Even so, the clarity and precision of the stereo image produced by the mic was exceptional and definitely supported the claims made for the mic. For the first time, the BBC had a microphone available which, firstly, had a flat response from 40Hz to 10kHz; secondly, all its parameters were variable from a remote position. Equalisation in the microphone produces the effect of 'true coincidence' of the capsules, thus eliminating phase anomalies, and manipulation of the B-format output of the mic's matrixing network enables the operator to adjust the effective physical orientation of the mic, including pan, tilt, and so on at the control unit, or—by recording the B-format Ambisonic signal on four tracks of a multitrack—alter these parameters after the event. Truly an amazing facility. The theory behind the microphone also offered the possibility that a single mic could be used to make perfect 2-channel phase-matrix recordings of the *Matrix-HJ* type — previously, a good *Matrix-HJ* programme had been dependent to a large extent on the manipulation and use of existing stereo techniques: the problem being that it was important to offer a good stereo balance as well as surround sound, and the interaction of conventional BBC stereo mic techniques in a surround-plus-stereo configuration was difficult to predict or set up with any degree of the necessary accuracy without a great deal of effort. The *Soundfield* mic, however, offered the promise of truly compatible surround and stereo decoding: a strong necessity if the BBC experimentation with the *HJ* part of the Ambisonic hierarchy is to continue.

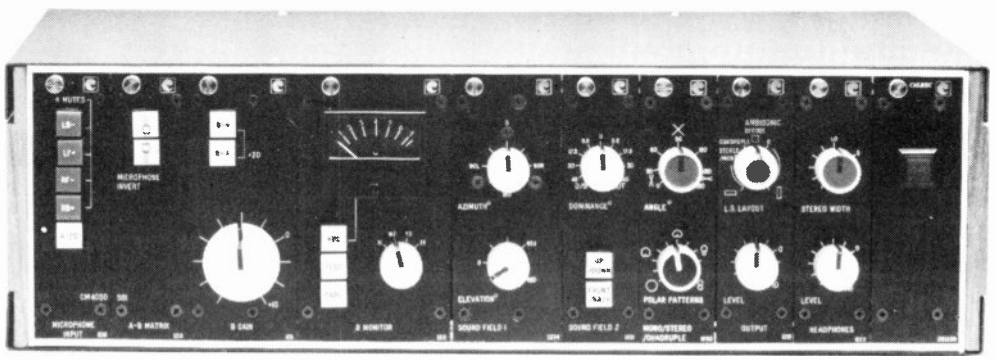
The *Soundfield* prototype was then installed at the Albert Hall for evaluation on a series of Promenade concerts. The version in use at this time—the *MkII* prototype—was fitted with Reading University equaliser and power supply and a prototype Calrec control unit with Reading electronics. Peter Fellgett and his technical designer Jeff Barton took time off to make sure everything was working correctly and reliably. The microphone was placed a little in front of the usual stereo main-pair position, about 15-20ft up and about 3 or 4ft in front of the fountain in the Albert Hall, and it was here that the first major advantage of the Calrec mic to the BBC was demonstrated.

Standard practice for rigging a stereo pair at the Albert Hall requires the dropping of a line over each end of the balcony to haul up a sling arrangement. The mic is centred in the sling and the audio cable is run off along one side of the sling line to the sockets at balcony level. Due to the weight and asymmetry of such an arrangement, it is often the case that the mic array twists as it is raised, necessitating at least half an hour of raising, lowering and correction of position in addition to the hour or more required to set up the sling in the first place. The *Soundfield*, however, took a mere 20 minutes to rig, dangling on its cable from a tightly-stretched sling. Any change of mic attitude could be corrected with ease by adjusting the B-format attitude knobs on the control unit. The BBC's current method of slinging the mic also includes a drawstring to the back of the arena, with the main sling a little further forward than before: this enables front-to-back movement of the mic's physical position to be carried out.

At this stage the mic was, of course, used in stereo only: the derived stereo signal from the control unit was brought up on the mixing console as an external feed, which could be compared in an A-B fashion with the 'conventional' mics and incorporated in the main output if the Studio Manager performing the concert mix so desired. During last year's Prom season, the mic's output was available about 60-70% of the time and was often used in the main mix.

Before discussing the results of this particular series of tests, it's important that we take a brief look at the standard BBC approach to miking up a concert of this type, and the basic premises upon which the 'sound' of a BBC 'serious music' broadcast are based. BBC stereo techniques are currently largely reliant on the Blumlein or coincident pair arrangement, often assembled from discrete microphones. Over the years, BBC sound balancers have built up what we might term an 'acoustic blueprint' of the *type* of 'sound' a music broadcast should have. This attitude, of course, is one that has produced superlative results, and continues to do so. It does mean, however, that impressions of an entirely new system will be based on what such a broadcast *usually* sounds like: this will modify sound balancers' opinions, which are, of course, highly subjective. A further consideration is the fact that venues like the Albert Hall are quite well-known to many radio listeners: they will have attended concerts themselves and will have a fairly good impression of the sort of sound they ought to be hearing. They're also used to BBC broadcasts, and the broadcasts themselves must create the best possible illusion of the sound of the Hall. Indeed, Proms are one of the few examples of a situation in which the listener is actually aware of what the 'original sound' would be, as opposed to a studio recording or broadcast.

The 'broadcast illusion' is to a large extent enhanced by actual *limitations* and 'faults' in conventional microphone design. With a standard setup which depends on one or two main stereo pairs backed up with ambience and solo mics, methods of compensating for the massive change of the Albert Hall acoustic between rehearsal and performance are well-known to BBC sound balancers. This change must not be underestimated: 7,000 people in the Hall have a tendency to remove any ambience picked up naturally by the main pair: ambience mics, with their attendant 'muddying' of the overall sound, must be introduced at relatively high levels into the mix to create the right sound. In these conditions, such effects as 'lobing' on the main pair—where the response of the mics at higher frequencies is rather more directional and peaky—tend to make the resulting output more satisfying to the listener. For example, 'lobing' tends to move a string section outwards from its actual position in the sound-stage to produce a more impressive stereo spread. Hf 'presence' provided by the complex phase cancellations that occur when several stereo pairs are superimposed also tend to brighten up the sound and make it more lively. These effects are almost entirely the result of manufacturers' attempts to compensate for the anomalies in stereo mic design inherent in variable polar diagram capacitor microphone types—methods varying from one maker to another—and as a result of the anomalies themselves. The difference with the *Soundfield* mic is that it does not suffer from these



This photograph shows the current (production model) control unit required to operate the Soundfield *microphone, as used by the BBC. The signal is fed from left to right via the following modules: the mic input module which takes the feeds direct from the mic head ('A-Format') after eq in the body of the mic, and offers individual mutes on the equalised capsule ouputs plus a —20dB A-Format pad; the A-B matrix module which converts the A-Format signals to standard B-Format (X, W, Y, Z outputs corresponding to a front-facing figure-of-eight, omni, left-facing figure-eight and up-facing figure-eight respectively) and offers mic-inversion facilities; the B-Gain module which offers switched control of the B-Format level (+6, +14 and +20dB lift) and a rotary gain-control attenuator; the B-Format monitor module which offers individual PPM monitoring of the B channels plus overall levels; two* Soundfield *modification modules which control azimuth and elevation, and dominance; a mono/stereo/quadruple module which handles the coincidence angle and polar diagram settings; and two output modules, one equipped with Ambisonic decode/loudspeaker layout control and main output level control, the other controlling the stereo-output width and headphone-monitor level. To the far right of the unit is the power-supply module with power-on pushbutton.*

useful but anomalous features. These factors should therefore be borne in mind.

In many ways, the appearance of the *Soundfield* mic came at a good time for the BBC in terms of mic technique. There had previously been a general swing away from a single coincident pair in favour of several superimposed coincident pairs supported by close and distant spaced mics; this move unfortunately coincided with the surround sound experiments, and almost certainly magnified the technical problems of compatibility earlier discussed. But by the time the new mic arrived, there had been a move back to primary dependence on a well placed main stereo pair: as a result it was not too difficult to incorporate the *Soundfield's* output into more traditional setups.

It was expected that the *Soundfield* mic, because of its true coincidence with attendant lack of phase anomalies, and its previously unheard-of flatness of frequency response, would similarly not suffer from the somewhat impressive audio effects such anomalies introduced. This indeed proved to be the case: the mic produced exactly what would be expected from a truly coincident array. Once again there was the excellent stereo imaging: Tony describes it as 'electrifying' and says that things actually sounded for the first time as they did in real life. Acoustic pianos, for example, lacked the usual 'clankiness' which occurs with some microphones. The Studio Manager actually performing the mix is given total autonomy over the type and positions of mics used at these concerts: in the case of the *Soundfield* mic, he also had a free rein in the application of the mic in the mix, making full use of the variable attitude and polar diagram controls.

One surprising feature of the mic in this respect was the fact that the array could be switched to 'omni' without the loss of stereo imaging! This effect is made possible on the *MkIII* production models by means of the addition of a control to vary the degree of effective coincidence of the capsules.

The one problem encountered with the *Soundfield* mic during these experiments was the very fact of its technical accuracy: the lack of 'lobing' and other anomalies tended to produce a very clear, but somewhat dull and unimpressive, sound. This can be compensated for, however, with the use of a rising equalisation curve, adding just a touch of 'sparkle' to produce a result that is psychologically more satisfying, and more like the usual sound that listeners expect.

These experiences with the *MkII* resulted in the BBC placing an order with Calrec for two production models, which were subsequently delivered and used during this year's Prom season. Tests have also been performed with the *MkIII* in control conditions at the BBC's Maida Vale studios, where Studio Managers have been able to experiment with different positions and settings of the mic, and compare it with other types. Initially the power unit on the new modules gave a little trouble, but Calrec rapidly redesigned and eliminated the teething troubles—prevalent in any new item of production. Bob Harrison praises Calrec's avowed keenness to 'get it right'.

In parallel with the Albert Hall evaluations in stereo broadcast configuration, comparison tests were performed by recording the B-format output on four tracks of an 8-track Brenell recorder, placing on the remaining tracks a selection of outputs from conventional stereo pairs. Apart from producing useful Ambisonic demonstration material, these tests provided an opportunity to evaluate the new mic in a number of operating modes on an A-B basis with conventional techniques under control conditions. The tests also proved useful in terms of discovering the general performance of the mic and the best way to interface it with recording equipment. Experiments proved that a level of about 200 nWb/m on tape combined with dbx noise reduction offered a dynamic range in excess of 84dB: it was possible to record an entire concert, with large variations of dynamics and playing levels, without adjusting the gain of the system. Some experimental recordings were also made in B-format on a Teac 4-track, and it is interesting to note that these seem to indicate that the B-format is far more tolerant of tape azimuth errors than a normal-format recording.

Bob and Tony feel that the *Soundfield* is about the best mic they've come across. The variable controls have proved exceptionally useful, the rigging time in a concert situation is very short compared with conventional arrays, and the sound, although a little dull without eq, offers superlative stereo imaging and depth. It offers 'the best sound from any part of the orchestra' that they have found, and the derived stereo signal can be listened to they have found, and the derived stereo signal can be listened to comfortably for long periods without strain. But an ideal mic will not necessarily give an ideal sound in non-ideal conditions—like the average concert broadcast—and certain adjustments, like the addition of a touch of eq, are necessary to produce a suitably satisfying result. The fact that the controls can be, in general, continuously varied during a performance, to optimise the aesthetic parameters of a broadcast or recording, suggests that the mic will have a great deal to contribute to the normal BBC setup at a concert where there may be as many as three separate groups—TV, Radio and the BBC Transcription Service—taking feeds from the main mics. The *Soundfield*'s output can be fed to a separate control unit for each group, so they can each obtain a fully-variable independent main stereo signal without duplicating mics and without affecting the versatility of any of the users' signal feeds. It is the BBC's intention that a second *Soundfield* mic should be tried near the stage, in addition to one in the original position, to provide a versatile output for more 'intimate' miking, where a digital time delay would be employed to bring the output of this mic back into perspective with the main system.

The BBC has very few complaints about the *Soundfield* system: surprisingly few considering the radical new techniques which this mic introduces. It finds that the production model appears to be a couple of dB noisier than the *MkII* prototype for some reason—hopefully Calrec will look into this, as it can't be a fundamental problem. The BBC also finds the azimuth control a little coarse: it would prefer a 4-position quadrant switch plus a pot to alter the azimuth within a quadrant, or perhaps a forwards/backwards switch pointing the mic in one of two positions at 180° to each other, plus a pot to vary the azimuth over the 180° segment, instead of the present continuously rotating 360° azimuth control, which doesn't offer sufficiently accurate positioning or repeatability (although the 360° control could be very useful in rock studios). The BBC is also interested in the *Soundfield*'s possibilities for opera, where a switch to 'position' the mic figuratively 'sideways' in addition to the present vertical inversion control would enable the mic to 'look' at the orchestra pit and stage with equal ease. At present this can be done by cross-patching the X and Z outputs, but a switch would be more convenient. Many operators feel that the dominance control is one of the most useful features of the control unit, but the present control is too coarse in operation, and ought to be replaced by a continuously variable front/back dominance control and an up/down dominance control.

One other slight misgiving with the mic is the fact that it requires a 60V phantom power voltage. The BBC, in common with many broadcasting organisations worldwide, uses a standard DIN voltage level of 48V for phantom power. This is a standing voltage on all BBC mic lines in such places as the Albert Hall, and means that the *Soundfield* mic presently requires its own separate cabling and cannot be plugged into existing lines. This is a disadvantage, and is presumably quite straightforward to rectify.

There is also a slight feeling that the present control unit is over-complex for purely stereo use; abandoning the modular concept to produce a simplified stereo-output-only controller would perhaps make the mic more affordable placing it in the same price range as other condenser mic arrays, although such a version would of course be rather more limiting for Ambisonic productions.

All in all, however, the BBC's opinion of the new Calrec *Soundfield* microphone is very good: it is a very significant development in microphone and audio design which offers great possibilities for current broadcast and other professional requirements and offers even more for the future of sound reproduction as moves continue to bring about the standardisation of a technically successful surround-sound medium: the *UHJ* system. ■

agony

A West London studio session was rained off earlier this year when one of the biggest storms ever to rumble across England passed directly overhead. First the mains voltage dropped so low that the electronic keyboards sank irrevocably out of tune. But this didn't really matter because there was so much static coming down the lightning conductor that the tape was recording more noise and crackles than out-of-tune music. The final piece de resistance, however, came with a bang and a flash directly overhead. En route to earth the high voltage charge produced just the right coded pulse to trigger the remote control 24-track machine into replay. Obediently it lurched into life like furniture under the influence of poltergeists. Wisely the assembled crowd called it a day and fled to the nearest pub. There are some things in this life that you just can't fight.

Doing It For Effect... Equalisation

Len Lewis

Devised initially for correcting the frequency characteristics of an electronic signal by restoring, to their original level, attenuated regions of the audio spectrum (either in recording, by transmission or by some other means), the equaliser has developed into what can nowadays often be described as 'the audio engineer's universal panacea' (or producer's placebo). Since, as the actress may well have said to the Bishop, it gets in everywhere !

THE EQUALISER has to be the granddaddy of all signal processing gear. To my knowledge it predates all auxiliary (or outboard) equipment likely to be found in latter-day control rooms yet has, like most, hardly changed concept from the early filters used in 'media transfer' work. Indeed, many equalisation curves exhibit remarkable resilience in surviving unchanged, come what may. RIAA disc equalisation, 50μs (or 75μs for US) broadcast transmitter pre-emphasis, CCIR (or NAB) tape equalisation to name but a few, are precisely for the purpose of facilitating 'media transfer' in disc, broadcast and tape applications and suggest, as indeed does the name 'equalisation', that some kind of necessary corrective process is taking place. 'Corrective' in this sense is misapplied in that, unquestionably, the signal being proffered for transfer was *the* signal required for replay.

The problem, however, was how to get the best from a medium with known limitations. Optical film rolls off sharply at, say, 8kHz, whereas tape and 'ether' (broadcast) have noise problems in the higher frequencies. Knowing these limitations, signals were and still are deliberately tailored (pre-emphasised) through equalisation networks to get the best into and subsequently out of (via a de-emphasis network) a medium, avoiding as much of the medium's (audio) drawbacks whilst, as importantly, not wasting electronics on unrecordable (hence irrecoverable) audio data. Times change and technology advances hence today's technology could perhaps get by without yesterday's answers to yesterday's problems—were it not for the fact that in, for example, the broadcast application there are umpteen *million* suitably de-emphasised receivers in use daily, which would sound decidedly 'unbright' at the top end, if pre-emphasis were cancelled overnight. Modern techniques have taken the equaliser forward into the world of purely 'subjective' equalisation where the need is to produce a particular 'sound' where shape, mood or texture may differ at any given moment, certainly from one engineer to another.

To equalisation, as against equalisers

At this point let us consider application of equalisation rather than for equalisers, which are a function of, in some cases, combining filters with compressor/gate technology or band splitting with level control.

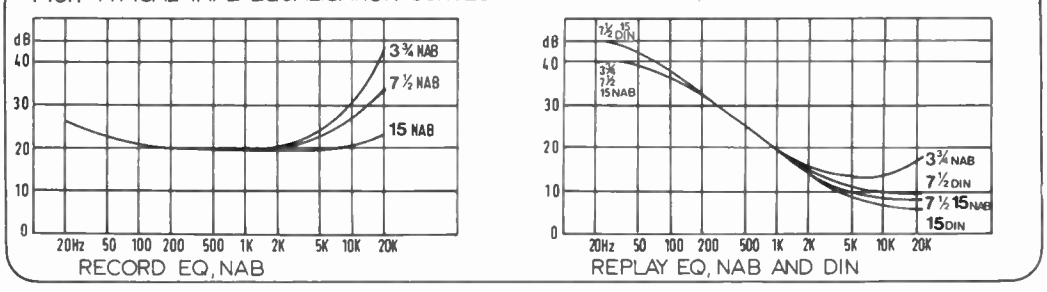
Dynamic equalisation

All pieces of electronic circuitry languishing under the generic title of equalisers are of the static type, ie, when used they introduce some kind of permanent alteration into the frequency response of the audio signal traversing their innards. This serves well the purpose of 'notching out' *continuous* obtrusions (such as hum) and is well serviced by the 'parametric brigade' (more later).

Consider, however, the problem of the close-miked tom-tom. When not actually being beaten it can reasonably be assumed that the tightly stretched skin is resonating in sympathy with the other kit thereabouts. To introduce some kind of static equalisation in the form of a highpass filter or suchlike must permanently degrade the actual sound of the tom-tom when used. However, if you band split the signal at the appropriate frequency and feed the 'process' area (say below 40Hz) to an expander, judicious arrangement of the threshold would ensure attenuation of the resonating skin (always low level) except in the presence of wanted signal (ie tom-tom struck). At this point the signal will be above the expander threshold, causing it to open and no attenuation takes place (whereafter it can be added back to the main audio path). This technique has, in practice, been found to work admirably (and at other frequencies —hiss reduction) and can be so set up as to appear 'static' to the audio engineer. Hence we have equalisation *dynamically*—as and when required, **fig 1.**

This same principle can be applied for dynamic *notching* of any particular frequency too (**fig 2**) if, as the level rises, a limiter is employed instead, finding uses in dynamically equalising a signal with respect to level as, for instance, in de-essing. Here, you have only to arrange the notch centre frequency and bandwidth to optimumly include sibilance and exclude all else in order to achieve de-essing capabilities of a very high order. Bearing in mind that only one area is being treated, this approach to dynamic equalisation can be equally well practised on *finished masters*—cassette duplicators and disc cutters take note—since no modulation of other frequencies takes place. On the subject of finished masters and relative to dynamic equalisation, is the earlier noted broadcaster's problem of umpteen million de-emphasised listeners.

FIG.1 TYPICAL TAPE EQUALISATION CURVES



Variable pre - emphasis — another form of dynamic equalisation

Taking the theme of dynamic equalisation into the realms of broadcasting, it has been possible to create (with the active and much appreciated collaboration of the IBA) a transmitter pre-emphasis equalisation curve whose characteristic varies with respect to level. Nowadays, higher levels of high frequencies abound due to close mic, compressed techniques, aggravating the pre-emphasis problem. Essentially, by band splitting at the 50μs pre-emphasis 3dB point it is possible to progressively limit the actual characteristic, as level rises, to a point where at high level the signal is flat, **fig 3.** Although this gives a loss of 'top' on 'de-emphasised' receivers (for less than 10% of the time and then only discernible on extensive A-B comparison), the benefit is to be able to push up to 6dB more signal into the transmitter configuration than would otherwise be possible, due to 'unnecessary' limiter action occasioned in protecting the transmitter from pre-emphasis. This useful piece of 'audio surgery' counters quite effectively the 'ether' limitations at higher frequencies but allows modern techniques to shine with a compromise for 'in-place' receivers—a good trade off (more details in October 1975 issue of *Wireless World*).

In America this type of 'audio surgery' is taken a step further, for better or worse, by the chopping up of an AM radio signal into several bands each of which is then individually limited to optimum levels and phase enhanced so as to reflect the limitations, technically and authoritatively, imposed on transmitters. This well suits the 'stick it in your ear' or 'loudest is best' approach adopted by broadcasters over recent years, but is it art ? With the advent of FM handling greater dynamic ranges, there are already rumblings for clean sounds, and in the UK you only have to listen to our FM bands to see what can be achieved.

Dynamic filtering

To return to equalisation, another (and less expensive) alternative to the problem of static equaliser's signal degrading qualities is the dynamic filter. This is a special kind of high or lowpass equaliser with, usually, a variety of turnover frequencies. It is possible to tie a filter slope to a threshold (usually using a pre-emphasised feedback loop, or side-chain) in such a way that above a given level the filter has a slope of 0dB/octave, or 'out'. As the level falls below threshold, this filter slope can then progressively become steeper so cutting (or filtering) either in a highpass or lowpass fashion, any noise which may no longer be masked by the programme content. In this way, as with dynamic equalisation, a signal can be tailored differently according to level, **fig 4.**

FIG.2
DYNAMIC EQUALISATION

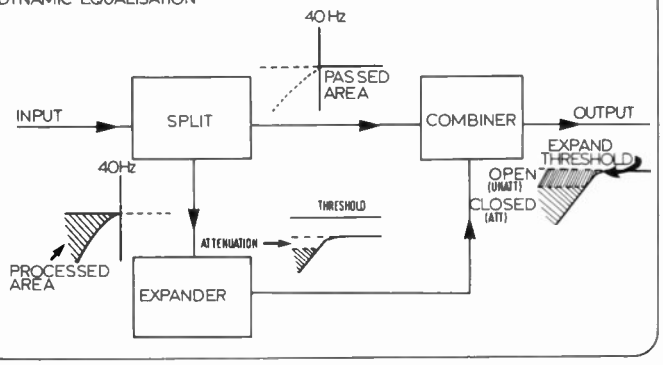


FIG. 3
DE-ESSING

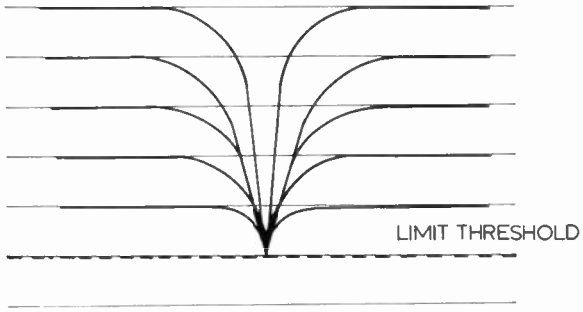


FIG. 4
VARIABLE PRE-EMPHASIS

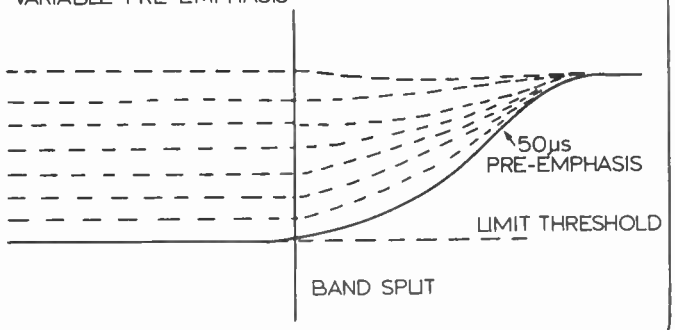
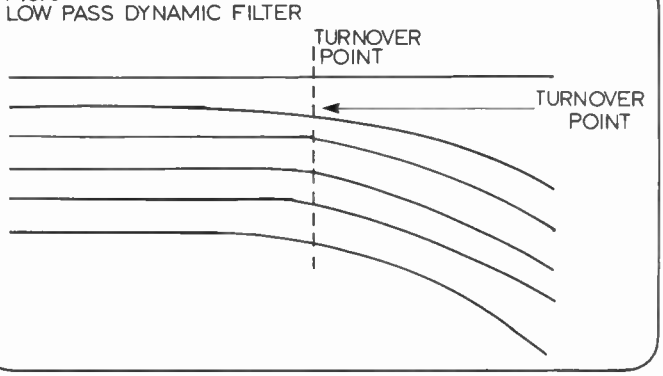


FIG. 5
LOW PASS DYNAMIC FILTER



Back to the plot

To revert back into the mainstream of equalisers, a few notes, and personal opinions, on applications.

There are three variables (or parameters) to be considered when frequency response modification is required:

(1) gain—how much to add or take away.
(2) centre frequency—where.
(3) bandwidth—with how wide an effect.

To simplify matters, assume that equalisers roughly fall into three categories: graphic, sweep and parametric. Whereby:

Graphics alter (1) with (2) and (3) fixed,
Sweeps alter (1) and (2) with (3) fixed,
Parametrics alter all three (hence the term parametric).

Thus it can be seen that each type of equaliser offers a specific level of 'power to change' over the important factors. As with all electronics, ease of use is inversely proportional to the ratio of the number of knobs to twiddle.

Graphic equalisers

These are usually arranged to have xdB boost or cut on standard centre frequencies at typically 1-, ½- and ⅓-octave spacings. Since centre frequencies and bandwidths are fixed and gain is usually modified with slide rather than rotary controls, these units give a good 'graphic' readout of where equalisation is being applied and hence are very good for 'tailoring' the frequency response of a signal to known limitations, ie the 'curve' of a room or loudspeaker or the 'properties' of an auditorium. In creative work, graphics can 'notch' problems quickly or generally enhance frequency areas, ie a little more presence or a little less bass but for more precise work sweeps or parametrics are more appropriate.

Sweep equalisers

These are still relatively simple to use, though typically, do not employ fader controls and hence lose any graphic representation of what's going on. However, for 'troubleshooting' eq they have an advantage in that you can, by ear, speedily select the area that requires attention without compromising on a fixed centre frequency. Speed is, therefore, the primary benefit of sweep equalisation and provided sensible frequency sweeps and bandwidth settings (fixed) are available, a rogue signal can be quickly brought under control. Sweep equalisers are probably the most common type and, in my opinion, deservedly so. With so much going on in a session,

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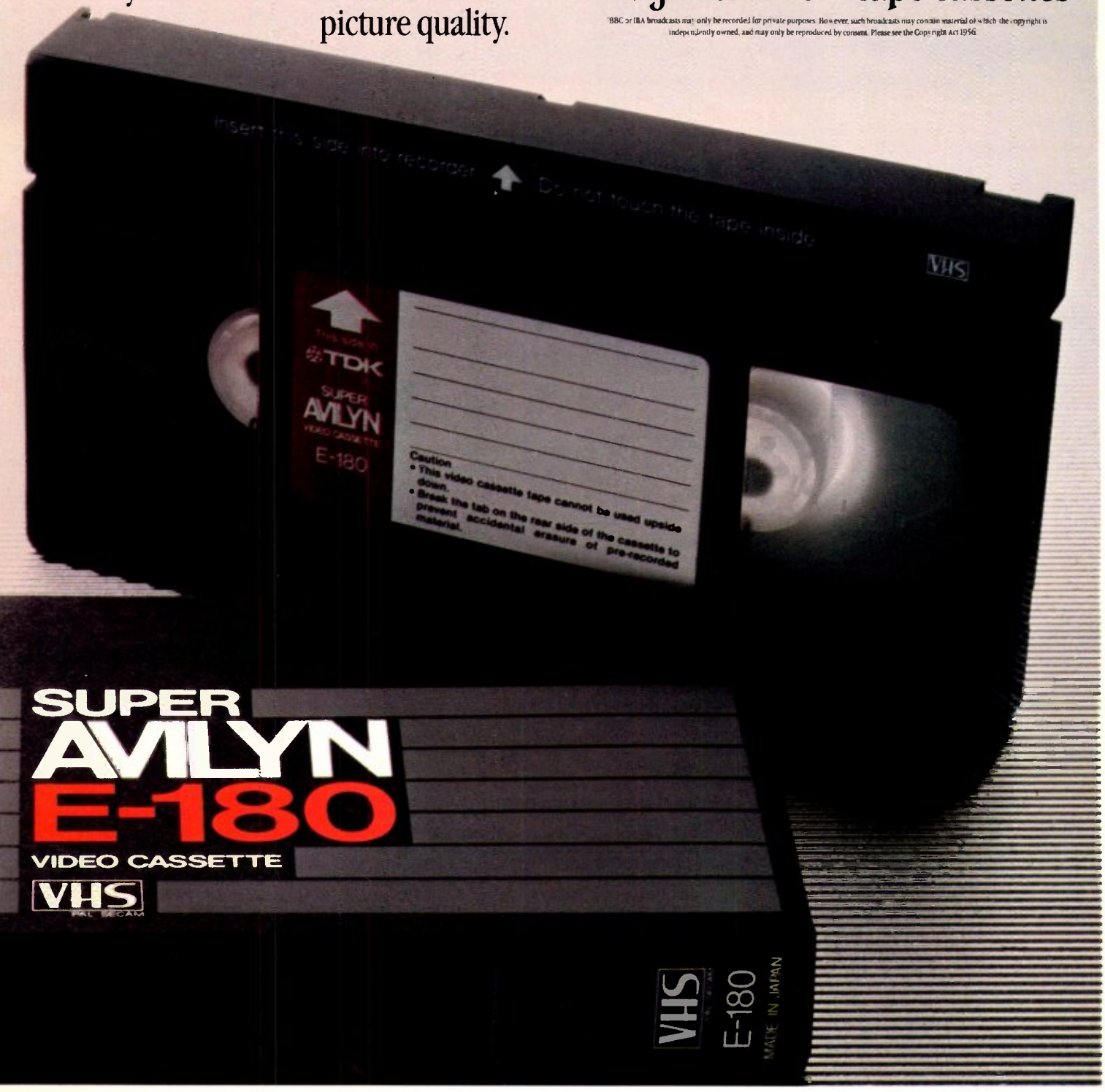
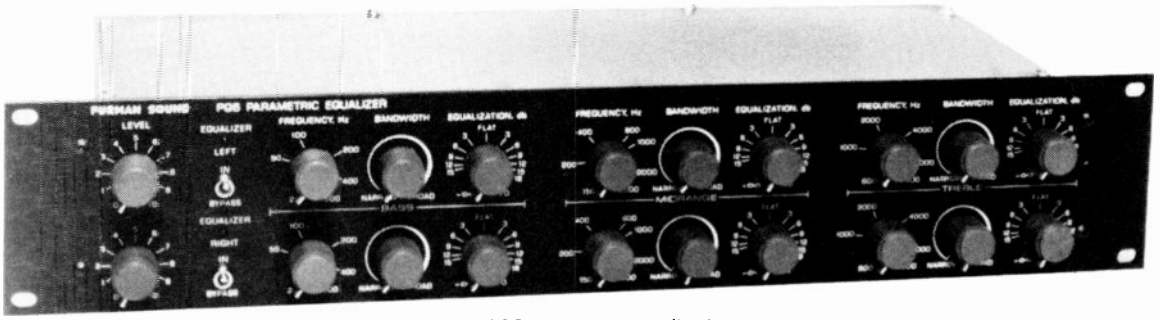


Survey: equalisers



Furman Sound PQ6 parametric equaliser/pre-amp

This survey basically includes graphic and parametric stand-alone equalisers, although a few module types are included. It does not include electronic cross-overs.

APSI (USA)

Audio Processing Systems, Inc, 40 Landsdowne Street, Cambridge, Mass, USA.
Phone: (617) 354-1144.
UK: Scenic Sounds Equipment, 97-99 Dean Street, London W1V 5RA.
Phone: 01-734 2812. Telex: 27939.

Model 559
Type: single-channel equaliser module.
Band centre frequencies: nine $\frac{1}{3}$-decades (35, 75, 160, 350, 750Hz, 1.6, 3.5, 7.5 and 16kHz).
Control range: +15, ±12, ±9, ±6, ±4, ±2 and 0dB, switched.
Noise: —90dBm with eq out; 87dBm with eq in and all switches at zero; —70dBm with eq in and all switches at +15dB setting.
Features: thumbwheel indicators show amount in dB of boost or cut; requires ±15V dc power supply; unit is exchangeable with Aengus, Automated Processes, Modular Audio Products and Melcor equalisers.
Price: $350/£176.

Model 561
Type: 4-band equaliser module.
Price: $250.

Model 562
Type: 4-band equaliser module, parametric.
Price: $350/£156.

ASHLY (USA)

Ashly Audio Inc, 1099 Jay Street, Rochester, NY 14611, USA.
Phone: (716) 328-9560.
UK: Atlantex Music Ltd, 34 Bankcroft, Hitchin, Herts SG5 1LA.
Phone: 0462 31511. Telex: 826967.

SC63
Type: single-channel parametric equaliser.
Band centre frequencies: three bands, 16-800Hz, 160-8,000Hz, 480-24,000Hz, bandwidth variable from $3\frac{1}{3}$ to $\frac{1}{20}$-octave.
Control range: ± 15dB.
Noise: —87dB.
Features: ±15dB overall gain, peak LED.
Price: £246.13.

SC66A
Type: 2-channel parametric equaliser. Basically similar to *SC63*, but two channels and additional band of 48-2,400Hz.
Price: £395.

AUDIO & DESIGN (UK)

Audio & Design Recording Ltd, 84 Oxford Road, Reading, Berks RG1 7LJ, UK.
Phone: 0734 53411. Telex: 847605.
US: Audio & Design Recording Inc, PO Box 786, Bremerton, Washington state, 98310 USA
Phone: (206) 275-5009.

Scamp S03
Type: single-channel parametric equaliser module which plugs into *Scamp* rack, externally powered.
Band centre frequencies: three, continuously variable; 'low' 20-1,000Hz, 'mid' 75-7,500Hz and 'high' 400-20,000Hz.
Control range: ±20dB, continuously variable.
Noise: —88dB, ref +8dBm.
Features: 'Q' values fixed at three for low and high bands and 1.5 for mid band; unit fitted with 3-position attenuator and LED optimum modulation indicator.
Price: £195/$390.

Scamp S04
Type: single-channel parametric/shelving equaliser module which plugs into *Scamp* rack, externally powered.
Band centre frequencies: three, continuously variable; 'low' 20-1,000Hz, 'mid' 75-7,500Hz and 'high' 400-20,000Hz.
Control range: ±20dB, continuously variable.
Noise: less than —88dB, ref +8dBm.
Features: continuously variable 'Q' on all ranges between 0.2 and five octaves; mid band has a symmetrical relationship between peak and dip curves, while both high and low sections have an asymmetrical relationship—in addition high and low sections can be switched between bandpass and bandstop mode to provide high and lowpass variable characteristic shelving filters with >30dB shelving; each range has a LED optimum modulation indicator and an 'in/out' switch.
Price: £280/$560.

Scamp S07
Type: single-channel system or room equaliser module which plugs into *Scamp* rack, externally powered.
Band centre frequencies: ten octaves, 31.25-16,000Hz.
Control range: ±12dB, continuously variable.
Noise: —88dB, ref +8dBm.
Price: £195/$390.

E900RS
Type: single-channel parametric equaliser, self-powered.
Band centre frequencies: four, continuously variable; 40-1,400Hz, 80-1,600Hz, 400-14,000Hz and 800-16,000Hz.
Control range: ±20dB, continuously variable.
Noise: 88dB, ref +8dBm.
Features: 'Q' values fixed at three (approx 15dB/octave) for first section, 1.5 (approx 10dB/octave) for second and third sections, and three for fourth section.
Price: £210/$420 (£495/$990 for stereo model).

E500/560
A 2-channel 'dynamic' equaliser, the range of which 'enables any part of the audio spectrum to be precisely defined, routed externally for processing and added back, in processed form, to the main signal without phase shift under unity gain conditions. Equalisation is only present above certain levels (using a limiter) or below (using an expander); at all normal levels the system response is quite flat. The programme is therefore only momentarily altered or tailored to suit the new recording medium, against fixed attenuation in the troublesome regions which permanently degrades the signal.'
Features include high and lowpass sweep filters over the range 100-10,000Hz at 24dB/octave slope; parametric notch filter of variable 'Q' between 0.3 and 10 over the range 20-20,000Hz; switched threshold control to convert variable input/output limiters or expanders to unity gain; and phasing effects by rotating sweep notch control.
Price: £765/$1,530.

E950
Type: single (ganged 12-band) or 2-channel (6-band) '*Paragraphic*' equaliser.
Band centre frequencies: six bands/channel each covering four octaves (31.25-500Hz, 62.5-1,000Hz, 125-2,000Hz, 250-4,000Hz, 500-8,000Hz and 1-16kHz.
Control range: ±28dB, continuously variable.
Noise: less than —80dB, ref +8dBm.
Features: switchable between stereo 6-band/channel and mono 12-band unit; 'Q' on each band variable between 0.6 and 8.
Price: £750/$1,500.

AUDIO DEVELOPMENTS (UK)

Audio Developments, Hall Lane, Walsall Wood, Walsall WS9 9AU.
Phone: 05433 5351. Telex: 338212.

Prographic
Type: programmable graphic equaliser with 16 bands and 16 stores. Level setting is by a single fader with LED indication of bands and levels.
Price: on application.

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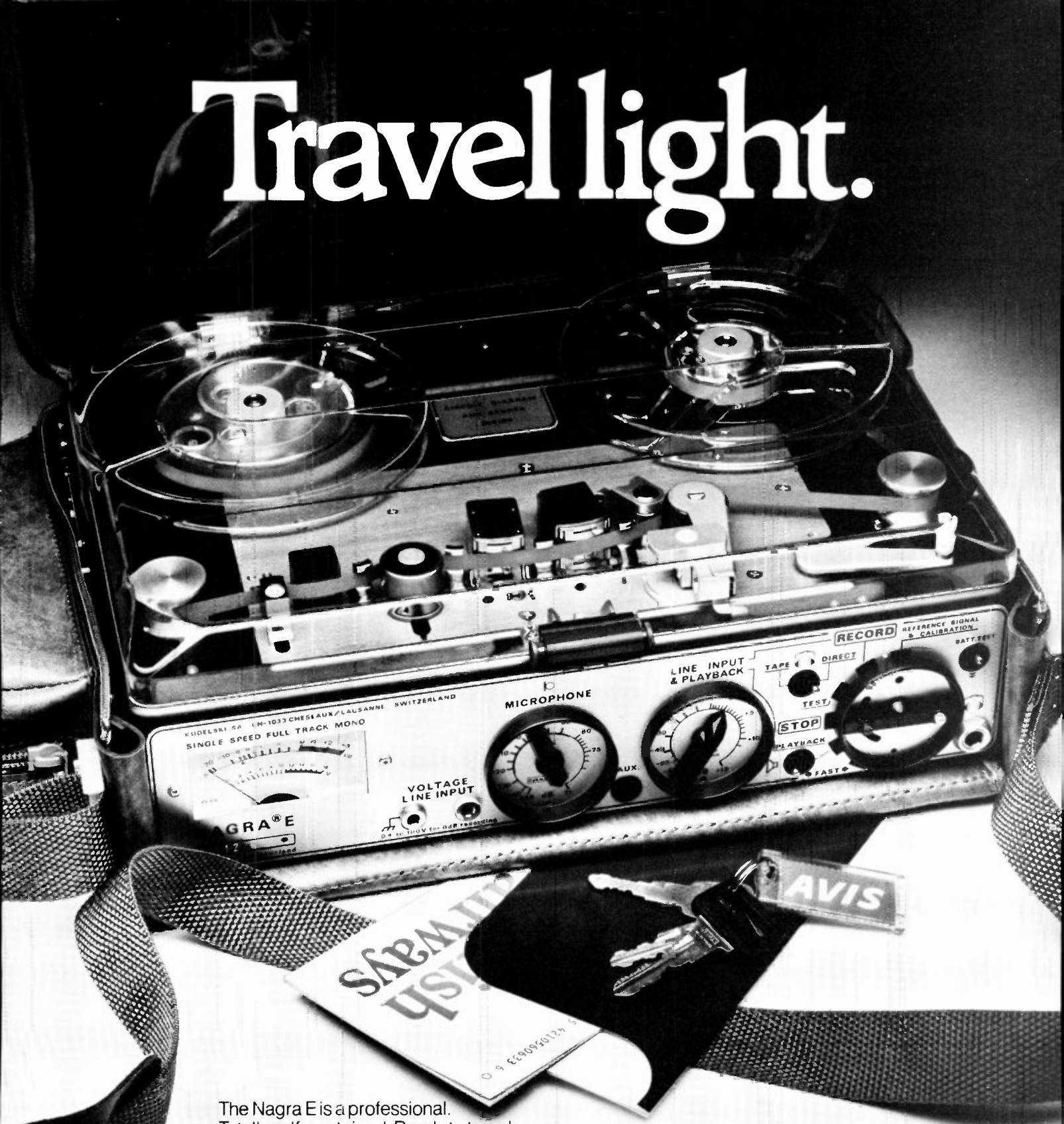
Travel light.



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Chalfont St Peter, Bucks.
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Telex: 849469.

SURVEY: EQUALISERS

AEC (West Germany)

Audio International, Box 560229, 6, Frankfurt 56, West Germany.

C-41
Type: 2-channel graphic equaliser.
Band centre frequencies: 31.5, 63, 125, 250, 500Hz, 1, 2, 4, 8 and 16kHz.
Input impedance: 10kΩ, unbalanced, nominal.
Output impedance: less than 10Ω unbalanced, short circuit protected.
Frequency response: (controls flat) 20Hz-20kHz ±0.5dB.
Price: on application.

AUDIX (UK)

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

Model 902
Type: single-channel graphic equaliser.
Band centre frequencies: 45, 80, 140, 250, 450, 800Hz, 1.4, 2.5, 4.5, 8.0 and 14.0kHz.
Control range: ±12dB, continuously variable.
Noise: —80dBm, unweighted, in bypass mode.
Features: bandpass filter with 3dB down points at 30Hz and 20kHz, roll-off approaching 12dB/octave.
Price: £272.

Model 908
Type: single-channel graphic equaliser.
Band centre frequencies: 27 ⅓-octaves on ISO centres, 45-16kHz.
Control range: ±12dB, continuously variable.
Noise: —80dBm, unweighted, in bypass mode.
Features: bandpass filter as *Model 902*.
Price: £471.

B&B (USA)

Aphex Systems Ltd, 7601 Melrose Avenue, Los Angeles, Cal 90046, USA.
Phone: (213) 655-1411. Telex: 910-321 5762.
UK: Aphex Systems (UK) Ltd, 35 Britannia Row, London N1 8QH.
Phone: 01-359 5275. Telex: 268279.

EQF-2/EQF-3
Type: single-channel parametric equaliser/filter module.
Band frequency ranges: highpass 20-500Hz flat passband, lowpass 1-20kHz flat passband, low frequency eq 25-500Hz, mid frequency eq 250-5,000Hz, high frequency eq 1-20kHz.
Control range: ±12dB, continuously variable.
Noise: high level output —93dBm.
Features: externally powered, tunable peak/shelf eq, constant Q 1.5 octave, available in stepless (EQF-2) and stepped (EQF-3) versions. Retrofits Automated Processes etc, and fits the Aphex auxiliary rack.
Price: £225 unbal/$400.

CATHEDRAL SOUND (UK)

Cathedral Sound, Fourways, Morris Lane, Halsall, Ormskirk, Lancs L39 8SX, UK.
Phone: 0704 840328.
SGE20
Type: 2-channel graphic equaliser.
Band centre frequencies: 10 octaves, 30-16,000Hz.
Control range: ±12dB, continuously variable.
Noise: 82dB, ref 0dB output.
Features: LED indicators illuminated at 2dB below clipping level.
Price: on application.

CERWIN-VEGA (USA)

Cerwin-Vega, 12250 Montague Street, Arleta, Cal 91331, USA.
Phone: (213) 896-0777.
UK: Cambridge Audio Ltd, 105-109 Oyster Lane, Byfleet, Surrey KT14 7JH.
Phone: 09323 51051. Telex: 262525.

GE-2
Type: 2-channel, 13-band graphic equaliser.
Bands: 13 bands, ½-octave below middle C, octave above, min frequency 31.5Hz, max 16kHz.
Control range: ±12dB, continuously variable.
Features: the level sliders for each channel are frequency adjacent rather than separated. The unit also includes overall gain control, tape monitor.
Price: £224.

COURT (UK)

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

GE-30S
Type: 2-channel graphic equaliser.
Band centre frequencies: 30 bands ⅓-octave on ISO centres from 25Hz to 20kHz, slider controls with clip stops.
Control range: +20dB —10dB.
Noise: —85dBm.
Price: £630.

CROWN/AMCRON (USA)

Crown International Inc, Box 1000, Elkhart, Indiana 46514, USA.
Phone: (219) 294-5571. Telex: 2942160.
UK: HHB PA Hire Ltd, Unit F, New Crescent Works, Nicoll Road, London NW10.
Phone: 01-961 3295.

Model EQ-2
Type: 2-channel graphic equaliser.
Band centre frequencies: 11 octaves, 20-20kHz (all centre frequencies adjustable by up to ±0.5 octave).
Control range: ±15dB, continuously variable.
Noise: 90dB below rated output (20-20kHz).
Price: on application.

FORMULA SOUND (UK)

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

S19G
Type: 2-channel graphic equaliser.
Band centre frequencies: 19 ⅓-octave bands from 31Hz to 16kHz.
Control range: ±12dB, equal Q in both cut and boost.
Noise: —90dBm.
Price: £425.

S19GA
Similar to *S19G*, but with added analyser section comprising 19-band ⅓-octave filters with dual LED display.
Price: £795.

FURMAN SOUND (USA)

Furman Sound, 616 Canal Street, San Rafael, Cal 94901, USA.
Phone: (415) 456-6766.

Model PQ-3
Type: single-channel parametric equaliser.
Band centre frequencies: three, continuously variable, bass 25-500Hz, midrange 150Hz-2.5kHz, treble, 600Hz-10kHz.
Control range: 20dB boost to infinite attenuation, continuously variable. Zero point may be calibrated for extreme precision.
Noise: 109dB in bypass mode, 99dB with eq in and set flat; values measured with high level input shorted to ground, dc-80kHz.
Features: bandwidth controls allow a continuously variable Q adjustment from 0.2 to 3.8 (0.1 octave narrowest notch to 4.5 octave broadest boost); inclusion of low level input and output allow use as an instrument pre-amp if desired; total available gain 26dB with low level input, 6dB with high level input; maximum output level is +21dBm (8.3V rms) into 600Ω.
Price: $275.

Model PQ-6
Same as *Model PQ-3* except 2-channel.
Price: $495.

IEM (USA)

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

Model 213
Type: single-channel graphic equaliser.
Band centre frequencies: 10 octaves, 32-16,000Hz.
Control range: ±15dB, continuously variable.
Noise: 100dB below peak output (+24dBm max).
Price: $550.

Model 231
Type: single-channel graphic equaliser.
Band centre frequencies: 31 ⅓-octaves, 20-20,000Hz.
Control range: 12dB, continuously variable.
Noise: 100dB below peak output (+24dBm max).
Price: $750.

K + H (West Germany)

Klein + Hummel, D-7302 Ostfildern 4, Kemnat, Postfach 3102, West Germany.
Phone: 0711 455026. Telex: 723398.
UK: FWO Bauch Ltd, 49 Theobald Street, Boreham-wood, Herts WD6 4RZ.
Phone: 01-953 0091. Telex: 27502.
US: Gotham Audio Corp, 741 Washington Street, New York, NY 10014.
Phone: (212) 741-7411. Telex: 129269.

UE400
Type: 2-channel parametric equaliser.
Band centre frequencies: three, each continuously variable 15-20,000Hz.
Control range: ±12dB, continuously variable.
Noise: 70dB, 20-20,000Hz (no further conditions).
Features: 'Q' on each band continuously variable 5-22dB/octave; highpass (60Hz) and lowpass (10kHz) filters with 6dB/octave slopes.
Price: £919 (mono version, *UE200*, £780).

KLARK-TEKNIK (UK)

Klark-Teknik Research Limited, Walter Nash Road, Kidderminster, Worcs DY11 7RE.
Phone: 0562 64027. Telex 339821.
US: Klark-Teknik, 155 Michael's Drive, Syosset, NY 11791.
Phone: (516) 364-1900. Telex 961396.

DN 27
Type: single-channel graphic equaliser.
Band centre frequencies: 27 ⅓-octave on ISO centres, 40-16,000Hz.
Control range: ±12dB, continuously variable.
Noise: less than —90dBm unweighted equivalent input noise, 20-20kHz.
Price: approx £495.

DN 22
Type: 2-channel graphic equaliser.
Band centre frequencies: 50, 90, 160, 300, 500, 900Hz, 1.6, 3, 5, 9 and 16kHz.
Control range: ±12dB, continuously variable.
Noise: less than —90dBm unweighted equivalent input noise, 20-20kHz.
Features: two filters with 12dB/octave turnovers at 100Hz and 10kHz.
Price: approx £495.

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AND HE COMMANDED THE PEOPLE OF SOUNDCRAFT THUS:

TAKE ALL THE FRUITS OF YOUR LABOURS, ALL THE WISDOM OF YOUR TEACHERS, AND BUILD A TESTAMENT TO YOUR CRAFT.

LET ITS USES BE ABUNDANT.

LET ITS EXCELLENCE BE WITHOUT LIMIT.

LET ITS BEAUTY BE A REVELATION.

AND THE PEOPLE OF SOUNDCRAFT OBEYED HIM.

MANY DAYS AND NIGHTS THEY LABOURED, AND AT LENGTH, LOOKING UPON THEIR WORK AND FINDING IT GOOD, THEY ASKED AGAIN FOR GUIDANCE.

TAKE FORTH YOUR WORK, HE COMMANDED, AND MAKE IT PLENTIFUL TO ALL OF THE PEOPLES OF THE EARTH, THAT THEY MAY LOOK UPON IT AND FIND JOY IN THEIR HEARTS.

AND SO IT CAME TO PASS.

THE NEW SOUNDCRAFT SERIES 400/800 MIXING CONSOLE

SOUNDCRAFT ELECTRONICS LIMITED
5-8 GREAT SUTTON STREET
LONDON ECIV 0BX. ENGLAND
TELEPHONE: 01-251 3631
TELEX: 21198

SOUNDCRAFT INC.
PO BOX 2023
KALAMAZOO
MICHIGAN 49003. USA
TELEPHONE: (616) 382 6300
TELEX: 22-4408 SOUNDCRAFT KMZ

SOUNDCRAFT ELECTRONICS LIMITED

1979

SURVEY: EQUALISERS

LINDSAY (UK)
Lindsay Electronics Ltd, Ifton Hill House, Port Skewett, Newport, Gwent NP6 4TT.
Phone: 0291 420517.
UK: Scenic Sounds Equipment, 97-99 Dean Street, London W1V 5RA.
Phone: 01-734 2812. Telex: 27939.

Model 7607
Type: single-channel graphic equaliser.
Band centre frequencies: 27 ⅓-octave bands on ISO centres, 40Hz to 16kHz.
Control range: ±12dB, continuously variable.
Noise: —85dBm.
Features: output limit with indication at +21dBm.
Price: £385.

METEOR (USA)
USA: Meteor Light and Sound Co, 155 Michael's Drive, Syosset, NY 11791.
Phone: (516) 364-1900. Telex: 961396.
UK: C E Hammond & Co Ltd, 105-109 Oyster Lane, Byfleet, Surrey KT14 7JH.
Phone: 09323 51051. Telex: 262525.

Graphic Equaliser
Type: 2-channel graphic equaliser.
Band centre frequencies: 10 bands, 31, 62, 125, 250, 500, 1,000, 2,000, 4,000, 8,000, 16,000Hz.
Control range: ±12dB.
Price: £244.

M-JAY (UK)
M-Jay Electronics, 90 Kingsdale Gardens, Drighlington, Bradford BD11 1EZ, UK.
Phone: 0532 852075.

GE9-2
Type: 2-channel graphic equaliser.
Band centre frequencies: nine octaves, 50-12.8kHz.
Control range: ±12dB, continuously variable.
Noise: 80dB.
Price: £169.

MM (UK)
MM Electronics, Kneesworth Street, Royston, Herts SG8 5AQ, UK.
Phone: 0763 45214.

EP Series
Type: 2-channel graphic equaliser, *EP127*.
Band centre frequencies: 60, 150, 400Hz; 1, 2.5, 6 and 15kHz.
Control range: ±12dB, continuously variable.
Features: designed primarily for PA installations, including foldback systems.
Price: £72.

MXR (USA)
MXR Innovations Inc, 247 N Goodman Street, Rochester, NY 14607, USA.
Phone: (716) 442-5320. Telex: 978451.
UK: Atlantex Music Ltd, 34 Bankcroft, Hitchin, Herts SG5 1LA.
Phone: 0462 31511. Telex: 826967.

Dual 15-Band Equaliser
Type: 2-channel graphic equaliser.
Band centre frequencies: 15 ⅔-octave bands from 25Hz to 16kHz, ISO alternative ⅓-octave centres.
Control range: ±12dB.
Noise: —95dBm.
Price: £275.67.

31-Band Equaliser
Type: single-channel graphic equaliser.
Band centre frequencies: 31 ⅓-octave bands on ISO centres from 20Hz to 20kHz.
Control range: ±12dB.
Noise: —90dBm.
Price: £293.73.

Stereo 15-Band Equaliser
Type: 2-channel graphic equaliser.
Band centre frequencies: 15-band ⅔-octave from 25Hz to 16kHz.
Control range: ±15dB.
Noise: —95dBV.
Features: tape monitor switch.
Price: £275.67.

⅓-Octave Equaliser
Type: single-channel graphic equaliser.
Band centre frequencies: 31-band, ⅓-octave from 20Hz to 20kHz.
Control range: ±12dB.
Noise: —90dBV.
Price: £293.73.

Stereo Graphic Equaliser
Type: 2-channel graphic equaliser.
Band centre frequencies: 10 bands, octaves 31Hz to 16kHz.
Control range: ±12dB.
Noise: —95dBV.
Price: £212.21.

NEPTUNE (USA)
Neptune Electronics Inc, 934 NE 25th Avenue, Portland, Oregon 97232.
Phone: (503) 232-4445.
UK: Court Acoustics Ltd, 35 Britannia Row, London N1 8QH.
Phone: 01-359 0956. Telex: 268279.

Model 2710
Type: single-channel graphic equaliser.
Band centre frequencies: 12-band ⅓-octave from 40Hz to 16kHz.
Control range: ±12dB.
Price: £212.50.

ORANGE COUNTY (Canada)
Orange County Electronics Corp Ltd, 1125 Empress Street, Winnipeg, Manitoba R3E 3H1, Canada.
Phone: (204) 775-8151.
USA: Parasound Inc, 680 Beach Street, San Francisco, Cal 94109, USA.
Phone: (415) 673-4544.

DEQ
Type: single-channel parametric equaliser module, externally powered.
Band centre frequencies: four bands, 20-640Hz 64-2,000Hz, 200-6,400Hz, 640-20,000Hz, all adjustable 0.15 to three octaves, constant Q 10-0.33.
Control range: 20dB gain, 60dB notch per band.
Noise: 110dB with all sections on 20dB gain.
Price: $555.

PEQ
Type: single-channel parametric equaliser, externally powered. Basically similar to *DEQ* but only ±20dB gain range.
Price: $555.

SEQ
Type: single-channel parametric equaliser, externally powered.
Band centre frequencies: bands, 35-1,400Hz (Q=3), 80-1,800Hz (Q=1.5), 350-14,000Hz (Q=1.5), 800-18,000Hz (Q=3).
Control range: ±20dB.
Price: $555.

ORBAN (USA)
Orban, 645 Bryant Street, San Francisco, Cal 94109, USA.
Phone: (415) 957-1067.

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

Model 622B
Type: 2-channel parametric equaliser.
Band centre frequencies: four, continuously variable; 'lf' 20-500Hz, 'mlf' 68-1.7kHz, 'mhf' 240-5.85kHz and 'hf' 800-20kHz.
Control range: +16dB to infinite attenuation; typical obtainable notch depth is 40dB.
Noise: less than —84dBm at output for unity gain, eq in and controls flat.
Features: 'Q' on each section variable between 0.29 and 3.2.
Price: £498.

672A Paragraphic
Type: 8-band parametric equaliser with 3:1 tuning range.
Band centre frequencies: eight bands, 20-60Hz 40-150Hz, 110-310Hz, 230-750Hz, 480-1,900Hz, 1.1-4.5kHz, 2.8-9kHz, 5.9-21kHz, Q range from 0.5 to 10 for any setting of the tuning control. Also lowpass filter in two ranges, 200-2,000Hz or 2-20kHz (12dB/octave), highpass filter 20-200Hz or 200-2,000Hz (12dB/octave).
Control range: ±16dB.
Noise: —84dBm at output, overall 113dB.
Price: on application.

PEAVEY (USA)

Peavey Electronics Corp, Box 2898, Meridian, Miss 39301, USA.
UK: Peavey Electronics (UK) Ltd, Unit 8, New Road, Ridgewood, Uckfield, Sussex TN22 5SX.
Phone: 0825 5566. Telex: 957098.

EQ-20
Type: 2-channel graphic equaliser.
Band centre frequencies: 50, 100, 200, 320, 500, 800Hz, 1.5, 3, 6 and 12kHz.
Control range: ±12dB, continuously variable.
Noise: 90dB below 2V output, controls flat and input open-circuit (20-20kHz).
Features: designed primarily for PA installations the unit will accept any signal level 'including speaker outputs'.
Price: £205.

PROAUDIO (UK)

ProAudio Ltd, 30 Wolsey Drive, Walton-on-Thames, Surrey KT12 3AZ.
Phone: 0932 21078.

PA27
Type: single-channel graphic equaliser.
Centre band frequencies: 27 ⅓-octaves, 40-16,000Hz.
Control range: 12dB, continuously variable.
Noise: —88dBm (typical) equivalent input noise.
Price: £286/$715.

PULTEC (USA)

Pulse Techniques Inc, 1411 Palisade Avenue, Teaneck, NJ 07666, USA.
Phone: (201) 837-2575.
UK: Jacques Levy, 6 Carlisle Mansions, Carlisle Place, London SW1.
Phone: 01-834 9248.

EQP-1A3
Type: single-channel equaliser.
Band centre frequencies: variable (see below)
Control range: variable (see below).
Noise: 88dB signal-to-noise ratio with input signal of +8dBm.
Features: peak boost 0-18dB at 3, 4, 5, 8, 10, 12 or 16kHz; shelf attenuation 0-16dB at 5, 10 or 20kHz; shelf boost 0-13.5dB at 20, 30, 60 or 100Hz; shelf attenuation 0-17.5dB at 20, 30, 60 or 100Hz; 'Q' variable between 0 and 10.
Price: $685/£440.

MEQ-5
Type: single-channel equaliser.
Band centre frequencies: three; 'band 1' covers 200, 300, 500, 700 or 1,000Hz, 'band 2' covers 1.5, 2.0, 3.0, 4.0 or 5.0kHz, and 'band 3' covers all those listed for bands 1 and 2.
Control range: up to 10dB boost on band 1; up to 8dB boost on band 2; up to 10dB attenuation on band 3.
Noise: 83dB signal-to-noise ratio with input signal of +8dBm.
Price: $680/£380.

QUAD-EIGHT (USA)

Quad-Eight Electronics, 11929 Vose Street, North Hollywood, Cal 91605, USA.
Phone: (213) 764-1516. Telex: 662446.
UK: Audio Kinetics (UK) Ltd, Verulam Road, St Albans AL3 4DH.
Phone: 0727 32191. Telex: 299951.

EQ-333
Type: single-channel parametric equaliser.
Band centre frequencies: three; 'low' offers a choice of 11 frequencies 50-500Hz, 'mid' a choice of 11 frequencies 300-3,000Hz, and 'high' a choice of 11 frequencies 1.5-15kHz. High and low bands are switch selectable between peaking and shelving.
Control range: ±12dB in 2dB steps.
Noise: —89dBm output noise.
Features: 70Hz highpass and 15kHz lowpass filters, 12dB/octave; requires ±28V dc power supply.
Price: £215.

EQ-444
Type: single-channel parametric equaliser.
Band centre frequencies: four; 'low' offers a choice of 11 frequencies 50-500Hz, 'mid 1' a choice of 11 frequencies 180-1,800Hz, 'mid 2' a choice of 11 frequencies 500-5,000Hz and 'high' a choice of 11 frequencies 1.8-18kHz. High and low bands are switch selectable between narrow, wide and shelving; mid bands between narrow and wide.
Control range: ±12dB in 2dB steps.
Noise: —87dBm output noise.
Features: 50 and 100Hz highpass plus 8 and 10kHz lowpass filters, 12dB/octave; requires +28V dc power supply.
Price: £291.

REBIS (UK)

Rebis Audio, Kinver Street, Stourbridge, West Midlands DY8 5AB.
Phone: 0384 71865.
UK: Scenic Sounds Equipment, 97-99 Dean Street, London W1V 5RA.
Phone: 01-734 2812. Telex: 27939.

RA402
Type: 2-channel parametric equaliser.
Band centre frequencies: four, continuously variable; 'section 1' 20-450Hz, 'section 2' 70-1,600Hz, 'section 3' 250-5,600Hz, and 'section 4' 800-18,000Hz.
Control range: ±21dB, continuously variable.
Noise: —80dB signal-to-noise ratio with system in and set for zero gain (20-20kHz).
Features: 'Q' for each section variable between 0.89 and 13 (5.5-36dB/octave).
Price: £420.

RA204
Type: modular parametric equaliser, externally powered.
Band centre frequencies: one switchable band, 20-2,000Hz, 200-20,000Hz, Q=0.89-13.
Control range: ±21dB.
Features: up to 20dB of gain available, overload

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SURVEY: EQUALISERS

Rebis cont'd

LED. Fits Rebis *RA200* rack.
Noise: —80dBm.
Price: £62.

SAE (USA)

Scientific Audio Electronics Inc, PO Box 60271, Terminal Annex, Los Angeles, Cal 90060, USA.
Phone: (213) 489 7600.
UK: C E Hammond & Co Ltd, 105-109 Oyster Lane, Byfleet, Surrey KT14 7JH.
Phone: 09323 51051. Telex: 262525.

1800
Type: 2-channel parametric equaliser.
Band centre frequencies: two, continuously variable; 'low' 40-1,200Hz and 'high' 1.2-20kHz.
Control range: ±16dB, continuously variable.
Noise: <100dB signal-to-noise ratio, ref 2.5V rms.
Features: 'Q' continuously variable on both bands between 0.3 and 3.6 octaves.
Price: £229.

2800
Type: 2-channel parametric equaliser.
Band centre frequencies: four, continuously variable; 'low' 10-320Hz, 'low mid' 40-1,200Hz, 'high mid' 240-1,600Hz, and 'high' 1.2-20kHz.
Control range: ±16dB, continuously variable.
Noise: <100dB signal-to-noise ratio, ref 2.5V rms.
Features: 'Q' continuously variable on all bands between 0.3 and 3.6 octaves.
Price: £387.50.

SOLIDYNE (Argentina)

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

9180
Type: modular single-channel parametric equaliser, with various plug-in sections, to a maximum of nine modules.
Modules: *Type 9181* single-band graphic module; *Type 9182* 2-band graphic (ISO full octave frequencies) ±15dB gain; *Type 9182M* 2-band graphic module (½-octave ISO frequencies); *Type 9183* 3-band (rotary controls) graphic module (⅓-octave ISO frequencies); *Type 9185* parametric module, single-band variable from 32-16,000Hz, bandwidth variable between 2- and ⅛-octave; *Type 9186* cut-off filter module, six and 12dB/octave, continuously variable 32-1,600Hz and 320-16,000Hz.
Price: on application.

SHURE (USA)

Shure Brothers Inc, 222 Hartrey Avenue, Evanston, Ill 60204, USA.
Phone: (312) 328-9000.
UK: Shure Electronics Ltd, Eccleston Road, Maidstone ME15 6AU.
Phone: 0622 59881. Telex: 96121.

SR107-2E
Type: single-channel equaliser.
Band centre frequencies: 10 octaves, 32-16kHz.
Control range: ±15dB, continuously variable.
Noise: 99dB at max output with filter controls flat and unity gain (20-20kHz).
Features: can be used with *M615AS* equalisation analyser system.
Price: on application.

SOUNDCRAFTSMEN (USA)

2200 So Ritchey, Santa Ana, Cal 92705, USA.
Phone: (714) 556-6191. Telex: 910 595-2524.
UK: REW Audio-Visual Company, 10-12 High Street, Colliers Wood, London SW19 2BE.
Phone: 01-540 9684.

AE2420-R
Type: combined analyser/equaliser.
Band centre frequencies: 10-band, 30, 60, 120, 240, 480, 960, 1,920, 3,840, 7,680, 15,360Hz.
Control range: +22dB, —28dB, all controls as maximum.
Features: mic pre-amp, pink noise source, band select switch, LED indicating comparator.
Price: £221/$499.

RF2215-R
Type: 2-channel graphic equaliser.
Band centre frequencies: 10-band, 30Hz to 15.36kHz, as above.
Control range: ±22dB, all other controls as max, ±15dB, all other controls at zero.
Price: £164/$370.

TG3044-R
Type: 2-channel graphic equaliser.
Band centre frequencies: 21-band, ISO ⅓-octave below 1kHz, alternate ½ above.
Control range: ±22dB or ±15dB (as above).
Features: zero gain with LEDs to match input/output levels.
Price: £244/$550.

SPECTRA SONICS (USA)

Spectra Sonics, 3750 Airport Road, Ogden, Utah 84403, USA.
Phone: (801) 392-7531.

Model 500
Type: single - channel 'microphone / program' equaliser.
Band centre frequencies: two, switched; lf range 50, 100, 200 or 300Hz, and hf range 2.5, 5, 10 or 15kHz.
Control range: ±12dB in 2dB steps.
Features: a passive network utilised as an active feedback element in conjunction with the *Model 101* and *110* amplifiers.
Price: $220/£122.

Model 501
Type: single - channel 'microphone / program' equaliser.
Band centre frequencies: two, 100, 7,000Hz.
Control range: lf continuously variable ±10dB, and hf continuously variable ±8dB.
Features: as *Model 500;* unit also contains master in/out switch.
Price: $89/£49.

Model 502
Type: single - channel 'microphone / program' equaliser.
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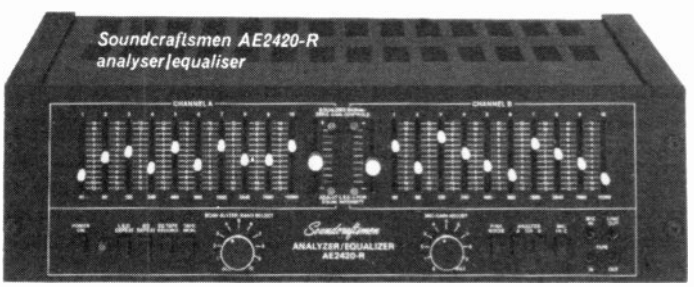
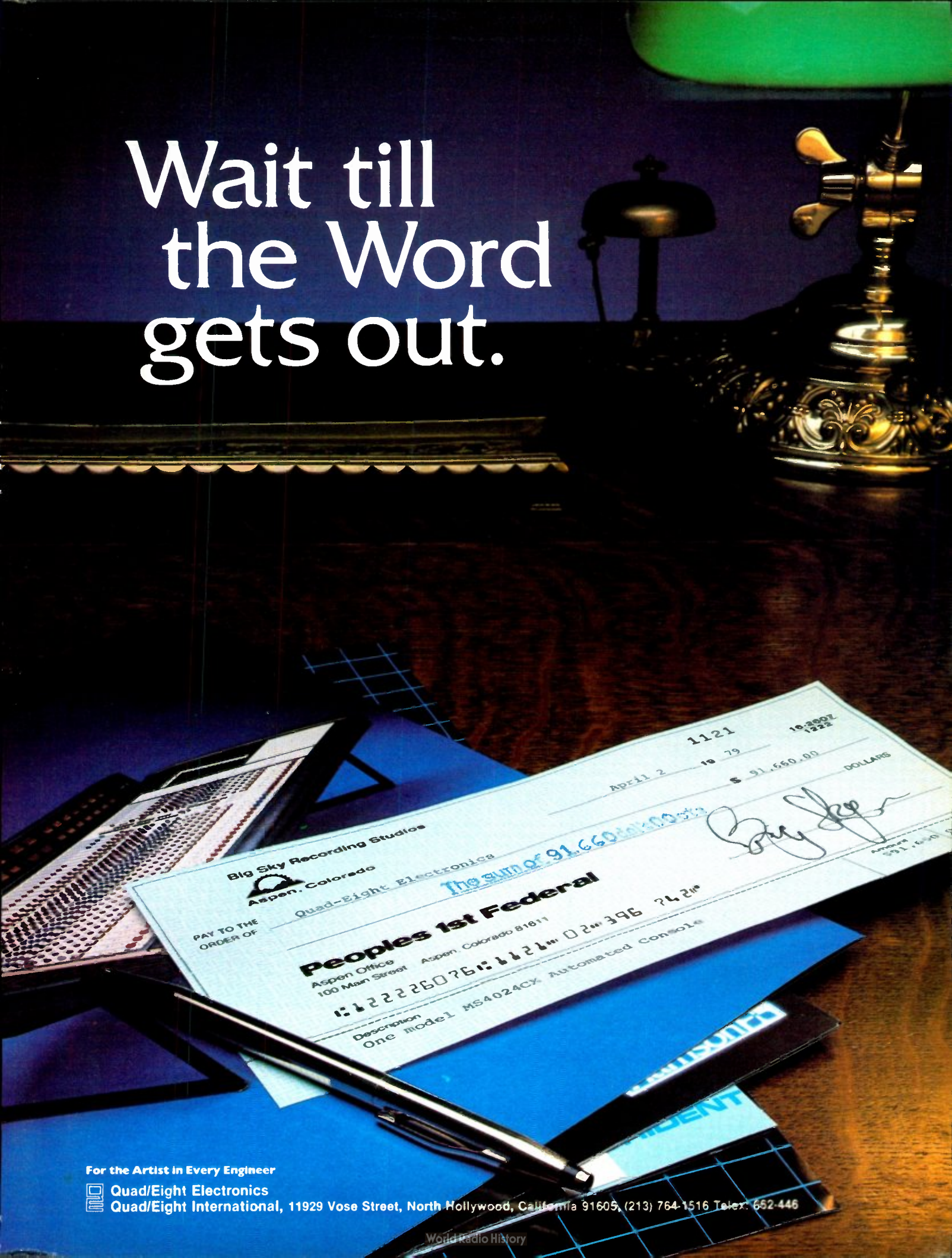




SURVEY: EQUALISERS

Band centre frequencies: three, switched; lf range 50, 100, 200, 300 or 400Hz; mf range 500, 800Hz, 1.2, 1.6 or 2kHz; hf range 2.5, 3.5, 5.0, 7.5 or 10kHz.
Control range: ±12dB in 2dB steps.
Features: as *Model 500;* in addition shelving curves at 50Hz and 10kHz in selectable increments are provided.
Price: $296/£164.

STATIK ACOUSTICS (UK)

Statik Acoustics, Coppice Trading Estate, Kidderminster, Worcs DY11 7HS, UK.
Phone: 0562 741515. Telex: 339821.

SA 10
Type: 2-channel octave equaliser.
Band centre frequencies: 31, 62, 125, 250, 500Hz; 1, 2, 4, 8 and 16kHz.
Filter bandwidth: 1 octave at —3dB points with 7dB boost or cut.
Noise: less than —90dBm A-weighted.
Price: approx £280.

TEAC (Japan)

USA: Teac Corp of America, 7733 Telegraph Road, Montebello, Cal 90640.
Phone: (213) 726-0303.
UK: Harman UK, St John's Road, Tylers Green, High Wycombe, Bucks HP10 8HR.
Phone: 049481 5331.

GE-20
Type: 2-channel graphic equaliser.
Band centre frequencies: 10-band, 31.5, 63, 125, 250, 500, 1,000, 2,000, 4,000, 8,000, 16,000Hz. Also lowpass 16kHz and highpass 31.5Hz filters.
Control range: ±12dB.
Noise: 82dB.
Price: on application.

TECHNICS (Japan)

Matsushita Electric Trading Co Ltd, PO Box 228, Osaka Central, Japan.
Phone: Osaka 204 5111.
UK: Technics, 107-109 Whitby Road, Slough, Berks SL1 3DR.
Phone: 0753 27516. Telex: 848761.
US: Technics by Panasonic, One Panasonic Way, Secaucus, NJ 07094.
Phone: (201) 348-7000. Telex: 710-992 8996.

SH-9010
Type: 2-channel combined parametric / graphic equaliser.
Band centre frequencies: 60, 240Hz, 1, 4 and 15kHz.
Control range: ±12dB, continuously variable.
Noise: 90dB signal-to-noise ratio (1HF, A); 87dB to DIN 45500.
Features: centre frequency of each band can be adjusted ±1.6 octaves; 'Q' on each band variable 0.7-7.
Price: £258.

SH-8010
Type: stereo graphic equaliser.
Band centre frequencies: 5-band, 100Hz, 330Hz, 1kHz, 3.3kHz, 10kHz.
Control range: ±10dB.
Noise: 90dB.
Price: £100.

TRESHAM AUDIO (UK)

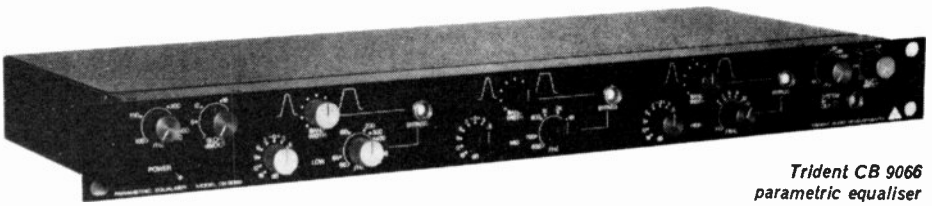
Tresham Audio Ltd, 32 Tresham Road, Orton Industrial Estate, Peterborough.
Phone: 0733 234340.

SR271
Type: single-channel graphic equaliser.
Band centre frequencies: 27-band ⅓-octave, centres from 40Hz to 16kHz.
Control range: ±12dB, continuously variable.
Noise: —80dBm.
Features: in addition to overload indicators on input and output, each band has a variable threshold LED with a range of ±20dB.
Price: £285.

SR112
Type: 2-channel graphic equaliser.
Band centre frequencies: 11 bands, 50, 90, 160, 300, 500, 1,600, 3,000, 5,000, 9,000 and 16,000Hz.
Control range: ±12dB.
Features: in addition to overload indicators on both inputs and outputs, each channel has separate threshold controls for peak monitoring LEDs on each channel.
Price: £285.
Tresham Audio Ltd was previously called PA:CE Studio Equipment Ltd.

TRIDENT (UK)

Trident Audio Developments Ltd, Shepperton Studios, Squires Bridge Road, Shepperton, Middlesex TW17 0QD, UK.
Phone: 09328 60241. Telex: 8813982.
Canada: La Salle Audio Products Ltd, 2500 Butes Road, Montreal H35 1A6, Quebec.
Phone: (514) 342-2511. Telex: 055-60070.
US: Studio Maintenance Service, 12438 Magnolia Blvd, North Hollywood, Cal 91607.
Phone: (213) 877-3311. Telex: 674901.



Trident CB 9066 parametric equaliser

CB 9066
Type: single-channel parametric equaliser.
Band centre frequencies: three, continuously variable; 'low' 60-700Hz, 'mid' 600-7,000Hz, and 'high' 3.5-14kHz.
Control range: ±16dB, continuously variable.
Noise: better than —75dBm with system in and all controls flat.
Features: Q variable 2-18dB/octave for each range; highpass filters continuously variable 100-400Hz and lowpass filter continuously variable 4-15kHz, both with 0-22dB/octave slopes.
Price: £294 for a single unit, £568 for two.

UREI (USA)

United Recording Electronics Industries, 8640 San Fernando Road, Sun Valley, Cal 91352, USA.
Phone: (213) 767-1000. Telex: 651389.
UK: FWO Bauch Ltd, 49 Theobald Street, Boreham-wood, Herts WD6 4RZ.
Phone: 01-953 0091. Telex: 27502.

Model 535
Type: 2-channel graphic equaliser.
Band centre frequencies: 10-band, ISO octaves from 31.5Hz to 16kHz.
Control range: ±12dB, overall gain —10dB to +20dB.
Features: overload LED.
Price: $424/£285.

Model 532
Type: single-channel graphic equaliser.
Band centre frequencies: 9-band, 50, 100, 200, 400, 800, 1,600, 3,150, 6,300, 12,500Hz.
Control range: ±10dB.
Features: overload LED.
Price: $316/£212.

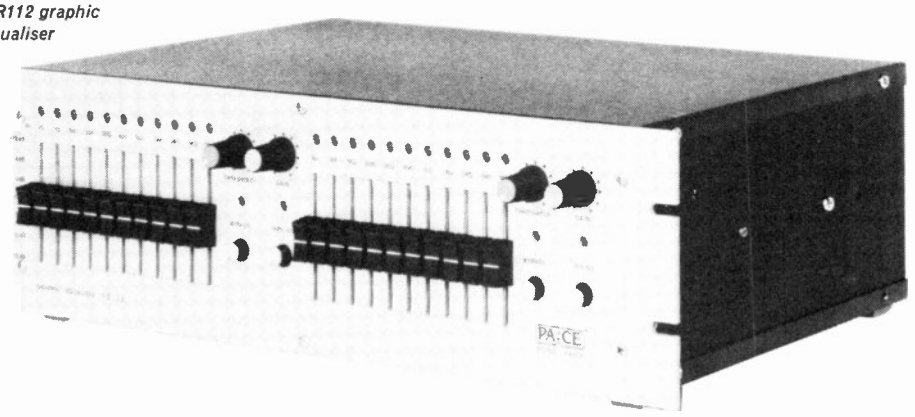
Model 537
Type: single-channel graphic equaliser.
Band centre frequencies: 27-band ⅓-octave on ISO centres from 40Hz to 16kHz.
Control range: ±12dB.
Noise: —94dBm.
Features: overload LED.
Price: $736/£494.

Model 539
Type: single-channel room equalisation filter set.
Band centre frequencies: 27 ⅓-octaves on ISO centres from 40Hz to 16kHz, screwdriver-adjustable highpass 20-250Hz, lowpass 3.5-20kHz (6 or 12dB slope).
Control range: zero to —15dB.
Noise: —90dBm.
Features: overload LED.
Price: $796/£534.

Model 545
Type: single-channel parametric equaliser.
Band centre frequencies: 4-band, low band 24-310Hz, mid band 190-2,240Hz, high band 960-12,500Hz; multi band 15-200Hz/150-2,000Hz/1,500-20,000Hz, bandwidth adjustable ¼ to two octaves, low cut 16Hz to 800Hz, high cut 500Hz to 25kHz.
Control range: ±15dB.
Noise: 85dBm.
Features: overload LED.
Price: $468/£314.

65 ▶

Tresham Audio SR112 graphic equaliser



The Technology Must Serve The Music

This one thought is reflected in every facet of Solid State Logic's Master Recording Consoles. From the beginning, we wanted to offer the artists in our industry a truly exceptional instrument which would not limit their expression in any way. After years of quiet and deliberate work, we have created an unprecedented marriage of hardware, firmware and software with advantages and potentials years ahead of any other studio system.

SSL's ULTRA-LOCATOR, for example, brings automation to **recording** as well as mixing. The multi-track transport is directed to unlimited cue points which may be requested by songtitle, verse or other words, as well as sequential numbers and timecodes. All session data, such as track assignments and comments on takes, can be stored on floppy disc for video display or hardcopy printout. The proprietary SUPERCUE system enables unerringly accurate programmable drop-ins with tandem multi-track, monitor, and foldback switching.

SSL's SOFTWARE ASSISTED MIXING (SAM) is easily the most useful and easy to use mixing automation ever. SAM automatically selects the appropriate fader status, displays VCA levels on a built-in video screen, stores unlimited mixes, and enables extensive off-line manipulation of those mixes. Best of all, SAM is software based, which means he easily learns lots of new tricks to keep you ahead of the pack.

SSL's SIGNAL PROCESSING includes a full-feature compressor/limiter/expander/gate in each module. Front panel "Link" buttons enable an unlimited number of strapped stereo or quad units to be freely configured across the board. The module's four band parametric equaliser has continuously variable Q in each of the overlapping mid-bands, selectable peaking or shelving in the high and low bands, and separate variable HP and LP filters. Pushbutton switching enables the equaliser to be placed at the channel input, the channel output, in the dynamics unit sidechain, or in the monitor mixer. The dynamics unit can also be switched to the monitor mixer.

SSL has developed these and many other innovations to free the production team from the tedious, purely mechanical aspects of multi-track work, so that they may apply their full skills and judgment towards perfecting the artist's performance. If that sounds like music to your ears, contact us for additional notes. Or visit us at the Brussels or Los Angeles AES shows.

Solid State Logic
—at the leading edge of recording technology

Solid State Logic

Stonesfield • Oxford, England
099 389 324 • TLX 837400

Milan, Michigan • USA
313 663-6444 • TLX 230504

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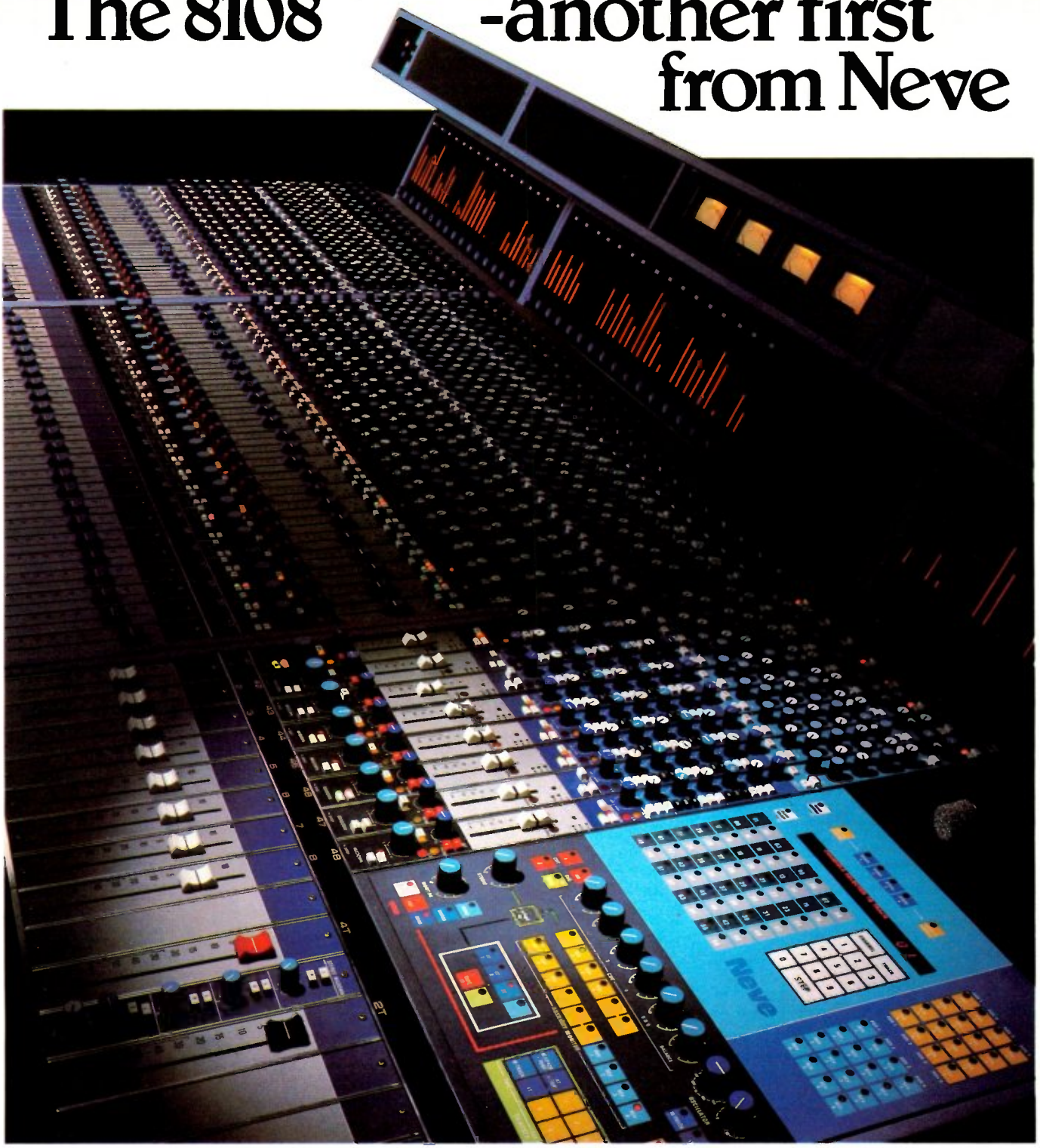
TLX 4187300

The 8108 -another first from Neve



Our new 8108 console provides the optimum in Neve sound together with enhanced operational versatility using advanced signal routing techniques aided by a centralised control system.

- New Neve electronics throughout.
- New Sweep frequency 4 stage equiliser + 2 filters.
- Versatile mode switching with direct-to-mixdown facility.
- Logic display monitor panel.
- Assignment switcher with microprocessor central control.
- Switched insertion points.
- Unique interrogation system.
- Circuits in sub assemblies plug for efficient maintenance.
- 56 input 48 track or 48 input 32 track or 32 input 24 track—Sub fitted options.
- Optional output transformers, electrically balanced line inputs.
- VU, PPM, or Both at once.
- Audio track, VCA Sub Group or NECAM faders.

Neve Electronics International Ltd. Cambridge House, Melbourn, Royston, Herts. SG8 6AU, England. Tel: (0763) 60776 (24 hr. Ansaphone facility) Telex: 81381, Cables; Neve Cambridge. **Rupert Neve Incorporated,** Berkshire Industrial Park, Bethel, Connecticut 06801, USA. Tel: (203) 744 6230. Telex; 969638 **Rupert Neve Incorporated,** Suite 609, 6255 Sunset Boulevard, Hollywood, California 90028, USA. Tel: (213) 465-4822. **Rupert Neve GmbH** D-6100 Darmstadt, Bismarckstrasse 114, W. Germany. Tel: 6151-87038. Telex; 419581. **Rupert Neve of Canada Limited,** 2721 Rena Road, Malton, Ontario L4T 3K1. Canada. Tel: (416) 6677-611. Telex; 21 06 9835 02.

Neve

SURVEY: EQUALISERS

Urei cont'd

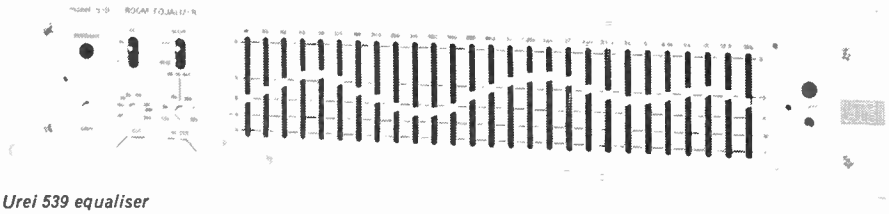
Model 560
Type: feedback suppressor comprising four active narrow band notch filters with two ranges covering 60Hz to 6kHz, notch adjustable from 0 to —20dB.
Price: $424/£285.

Model 562
Type: feedback suppressor comprising five active narrow band notch filters with two ranges covering 60Hz to 6kHz, notch adjustable from 0 to —20dB, low cut 20-200Hz, high cut 2-20kHz, overall gain —10dB to +20dB.
Price: on application. Replaces *Model 560*

Model 565T
Type: filter set with four separate, cascaded continuously tunable filters.
Band centre frequencies: low cut 20-200Hz (18dB/octave), 2-band reject (dip) filters 20Hz to 20kHz continuously tunable variable notch width, 50dB minimum rejection, high cut filter tunable 2-20kHz (18dB/octave).
Noise: —90dBm.
Price: $668/£448.

Model 567
Type: PA processing system with 10-band graphic equaliser, on octave centres from 31.5Hz to 16kHz (±10dB), feedback suppressor (similar to *Model 560)* and screwdriver-adjustable electronic crossover with two outputs.
Price: $696/£467.

WESTREX (USA)
Westrex Company, 2629 West Olive Avenue, Burbank, Cal 91505, USA.
Phone: (213) 846-3394. Telex: 698254.
UK: Westrex Co Ltd, 152 Coles Green Road, Cricklewood, London NW2 7HE.
Phone: 01-452 5401. Telex: 923003.



Urei 539 equaliser

ST3015
Type: single-channel equaliser.
Band centre frequencies: 50, 75, 110, 160, 240 360, 540, 760Hz; 1.2, 1.7, 2.5, 3.8, 5.5, 8.0 and 12.0kHz.
Control range: ±14dB, continuously variable.
Price: approx £465 or $837.

WHITE (USA)
White Instruments Inc, PO Box 698, Austin, Texas 78767, USA.
Phone: (512) 892-0752.
UK: Scenic Sounds Equipment, 97-99 Dean Street London W1V 5RA.
Phone: 01-734 2812. Telex: 27939.

Series 4000
Type: single-channel active equalisers.
Band centre frequencies: 27 ⅓-octaves on ISO centres, 40-16,000Hz.
Control range: ±10dB, continuously variable.
Noise: less than —90dBm (20kHz bandwidth).
Features: 12dB/octave highpass filter continuously variable 20-160Hz; available in three options—*Model 4001* for sound reinforcement applications; *Model 4002* for music reproduction applications; *Model 4003* which is identical to *4001* apart from transformer-coupled outputs.
Price: *Model 4001* £440, *Model 4003* £470.

Model 4004
Type: single-channel passive 'cut-only' equaliser/filter.
Band centre frequencies: 24 ⅓-octave filters on ISO centres, 63-12,500Hz.
Control range: 0-15dB attenuation, continuously variable.
Features: up to 15dB/octave highpass filter continuously variable from 'flat' to 40Hz through 160Hz, and up to 18dB/octave lowpass filter continuously variable from 'flat' to 16kHz through 10kHz.
Price: £482.

Model 4100
Type: 2-channel active equaliser.
Band centre frequencies: 10 octaves on ISO centres, 31.5-16,000Hz.
Control range: ±10dB, continuously variable.
Noise: —92dBm signal-to-noise ratio at +18dBm (maximum) output.
Features: 12dB/octave highpass filter continuously variable 20-160Hz.
Price: £390.

Series 4300
Type: single-channel active monitor equaliser.
Band centre frequencies: 41 bands in total, comprising 28 ⅙-octave bands between 40Hz and 894Hz on and between ISO centres, 13 ⅓-octave bands from 1kHz to 16kHz on ISO centres. Equal Q in boost and cut.
Control range: ±10dB.
Features: accessory socket for 12dB or 18dB/octave crossover networks.
Price: *Model 4301* £720. ■

Doing It For Effect... Equalisation

engineers too often have little time for tinkering and are better advised to accept, say, a 90% solution to equalisation (or none at all) so that more attention can be given to overall factors like balance and 'texture'.

Parametric equalisers
The other 10% of a solution could, when necessary, only be properly achieved with a parametric equaliser. All aspects of frequency alteration fall within the parametrics' domain hence no 'stone' need be left unturned in the quest for the right sound. Certainly selection of odd harmonics for accentuation or attenuation can dramatically alter the 'voice' characteristic of an instrument. Parametrics also usually offer infinite notch capabilities and can be employed usefully in accurately defining troublespots (eg hum) by centre frequency *and* width for 'knocking-out'.

Stirring the grey matter
So much for basics, a few thought provokers. There are drawbacks to liberally dosing programme material with equalisation. Here is a sobering point to remember—if you have a signal at 2k boosted by say 10-15dB, then you are also boosting the 2nd harmonic distortion of a signal present at 1k in the same audio signal by the same amount. The same goes for 3rd and 4th harmonic distortion as you go up the frequency band and one should be wary of this side effect, particularly on odd harmonics.

With parametric equalisers, there are purely ergonomic considerations. If a mixing console has a 4-band parametric, each band with variable Q, centre frequency and amplitude, that makes 12 extra knobs per channel or, in the case of 24-channel, 288 extra knobs per console—a slight case of overkill. Remember, for purely 'trouble-shooting' equalisation a patchable graphic or sweep equaliser would probably get the job done faster and eliminate some of the spurious phase and transient distortion, not normally quantifiable, where too much equalisation is being used. This is not to consider that one section could, albeit unknowingly to the engineer, be effectively cancelling - out another section somewhere else in the 'chain'.

Room equalisation
Does this also call into question the popular idea of room equalisation. There is much on the subject, both talk and equipment-wise, notably George Augspurger's very erudite dissertation on the subject (*Studio Sound* Feb 77). Surely though (personal opinion again), room equalisation need not always be the answer. What alters frequency response is time and delay characteristics. As such, the frequency response of 'an area' is a product of mechanics, not electronics. If you know the limitations of your monitor system and can (subconsciously) account for them, you can still make hit records (who mentioned the Beatles?). The answer may be to have a very sophisticated area of equalisation to hand thus enabling you to use only as much as is necessary in a given situation.

This argument could carry through into sound reinforcement where a multi-band parametric may be more desirable than a ⅓-octave 27-band graphic. Since feedback modes probably number about six or so and Murphy's law dictates that they'll be between bands on a normal graphic—again, a little very precise equalisation could well do the trick.

In conclusion
As I said, a few thought provokers on what must already be an extremely well covered subject. Equalisers are, undeniably, essential audio 'furniture' in all aspects of audio processing and do, definitely, contribute much to modern techniques. However, I do like the comment Chris Coffin of Express Sound made in his article on the subject (*Sound Arts*, Vol 2 No 5, June 79) sic: "They (equalisers) are like a spice, just the right amount and you've achieved perfection, too much and you've spoiled your creation."—bon appetit! ■

letters

British exhibitions I

Dear Sir, At the recent Exhibition of the Association of Professional Recording Studios held at the Connaught Rooms, there was considerable dissension amongst the manufacturers and distributors exhibiting. Despite the excellent work of the organisers, the industry has literally outgrown the venue. As a result, the show is spread over numerous floors which reduces effective promotion, together with the fact that, as with so many exhibitions, there are no parking facilities, extremely poor loading facilities and—most ironically of all—there are no facilities for sound demonstrations . . . quite ridiculous, when you come to think of it. This show is just one of at least 14, I repeat, 14, separate audio shows in the UK in just one year. That is, on average, an exhibition every 3½ weeks, forgetting the four American shows, Midem, Frankfurt, and the rest which brings it down to a sound exhibition every eight days—a totally ludicrous situation.

With each show costing anything from £4,000 to £15,000 in total, and requiring many, many man hours of organisation, it is not surprising that each show is pathetically small in its own right, and even the most successful companies can only afford to select two or so each year.

More to the point is that since each show is small, and there are so many, they attract few overseas exhibitors, and most British manufacturers will agree that without export sales, business can be hardly worth the effort.

When you consider the smaller companies, they simply haven't the money or man power to exhibit, and the larger companies cannot possibly justify such a ridiculous number of shows in the UK, not mentioning the others in America and Europe.

Companies such as JBL, AKG and BGW are large and successful concerns, but since their products range from hi-fi, musical instruments, recording studios, public address, live music, discotheques and so on, the actual amount of shows, say 14 at the present count in any one year, would take something like two years of organisation—a mathematical impossibility.

As far as I see it, professional bodies such as the APRS offer the exhibition as a service to the recording industry and a very valuable one, so the only bodies who would object to one annual central exhibition would be those entrepreneurs making a very tidy profit from exhibitions—with the only result that the equipment costs more to the customer.

We have just outside Birmingham, for example, a custom-built exhibition centre which is equally accessible from most points in the UK, and which could hold one sensibly-sized show to cover the 'Sound Industry'.

It would save most manufacturers many thousands of pounds a year, provide a really worthwhile show that would attract people from all over the world. The one and only show for TV and Broadcasting—the IBC—is an excellent example of this.

For those who say the intimacy is lost with a large exhibition, there is no reason why each section, ie PA, discotheque, hi-fi etc, cannot be run under the auspices of each governing body. Trade and public could buy tickets for the whole exhibition or just the relevant sections.

It seems incredible that the British industry, renowned for its product quality, cannot reflect that in an exhibition which would not only save many thousands of pounds, would also, in all probability, give a considerable increase in sales.

I am grateful for the backing of the UK press in this matter, which is nothing short of a scandal, and I would appreciate comments from other companies in this country.

Yours faithfully, Stephen Court, Managing Director, Court Acoustics Ltd, 35/39 Britannia Row, London N1 8QH.

British exhibitions II

Dear Sir, As a manufacturer it is becoming increasingly difficult to plan our promotion in the jungle which has developed about exhibitions in the sound industry in the UK. Every small organisation, trade association and breakaway group seems to want to run its own exhibition, not only for the monetary gain but to keep their own flag flying. Surely the sound industry must get together and run a festival of sound at a venue which is acceptable to manufacturers in this country, trade visitors from the UK and overseas visitors.

We had a situation in APRS in June when an exhibition took place at the Connaught Rooms which was described as 'intimate' but I would respectfully suggest that it was more like a rabbit warren. The public address industry now runs an exhibition at the Cunard Hotel in March and we now have the situation where the Audio Engineering Society, in their wisdom, have decided to hold their exhibition in London early next year as well.

A few years ago the hi-fi industry had the same problem with breakaway groups and in my opinion it has never been the same since. Surely the time has come when the industry must run an exhibition for the benefit of manufacturers and its customers and not for the numerous committees which operate in all good faith.

Has anybody ever considered the amount of times that an importer in a country such as South America, the Far East and even Europe has come to London, sometimes two or three times a month, and it has now got to the point when people will only attend an exhibition every 2-3 years, which fragments all the effort which has gone into making an exhibition attractive.

Yours faithfully, T. K. Monks, Director, Keith Monks (Audio) Ltd, 26-28 Reading Road South, Fleet, Aldershot, Hampshire, UK.

I believe the views aired in the two above letters are representative of a large proportion of the audio industry, and our own as a magazine covering that industry. Although many companies have made their frustrations apparent to the AES and APRS organisations, each organisation has its own interests to protect, and so perhaps a third party such as *Studio Sound* could obtain a general consensus of the industry, with a view to a single exhibition being organised during spring 1980. In the end, it will be for exhibitors to decide which exhibition to support with their presence, but obviously guidance will be required for all concerned. So could any companies with views on this subject please contact us, and we will attempt to produce an overall industry opinion.—**Ed.**

AES

Dear Sir, On July 1 my contract with the Audio Engineering Society came to an end, and the AES has not offered to renew it on the same basis.

This development, of which I was aware only a few weeks ago, terminates my 23-year association with the AES. During that time, as you know, I have been instrumental in bringing the Society to its present stage in the growth of both its publications and technical meetings. I was astonished.

Twenty-three years may be a difficult habit to break. But rather than continue on a consultancy basis in only one of my areas of responsibility for the AES, I feel that an immediate launching into new projects with new and/or established relationships is far better all round.

I shall deeply miss my pleasant and rewarding association with you, but hope that the work ahead will allow for continuing communication, and before too long.

Yours faithfully, Jacqueline Harvey, Harvey Associates Communications, Seven Lexington Avenue, New York City, NY 10010, USA.

Values

Dear Sir, I refer to your article by Arthur Garratt in the August edition of **Studio Sound,** *which I feel needs comment.*

If Mr Garratt is to measure and to quote absolute values of speed for tape machines to 0.1% he must, as he suggests, be certain that the accuracy of his test equipment is an order of magnitude better, ie 0.01%. Whilst I agree that oscillators and frequency counters of this accuracy are readily available it is not, as he states, possible to measure the length of a piece of tape to an accuracy of 0.01% (0.05mm in 5 metres). Indeed, his statement that tensioning the tape is a 'refinement' would appear to be rubbish, as a small change of tension (60g to 80g) may well change the apparent length by 0.1% (using Scotch 262).

Mr Garratt quite rightly dismisses the two other techniques he mentioned—those of stroboscopic tape and interval timing and I think that if we are not to appear amateurish we must also dismiss the measured tape technique as described.

I welcome the return of technical articles aimed specifically at the recording and broadcasting engineers—but **please** *let them be professional!*

Yours faithfully, R. F. Varley, Chestnut Cottage, 29 Napleton Lane, Kempsey, Worcester.

And now... the new improved Eventide Harmonizer*: Model H949

Eventide's new Model H949 starts where the H910 left off... with outstanding new features like time reversal, randomised delay, flanging and repeat. New digital circuitry and random access memories now actually transpose input signals by one full octave up and no less than two full octaves down.

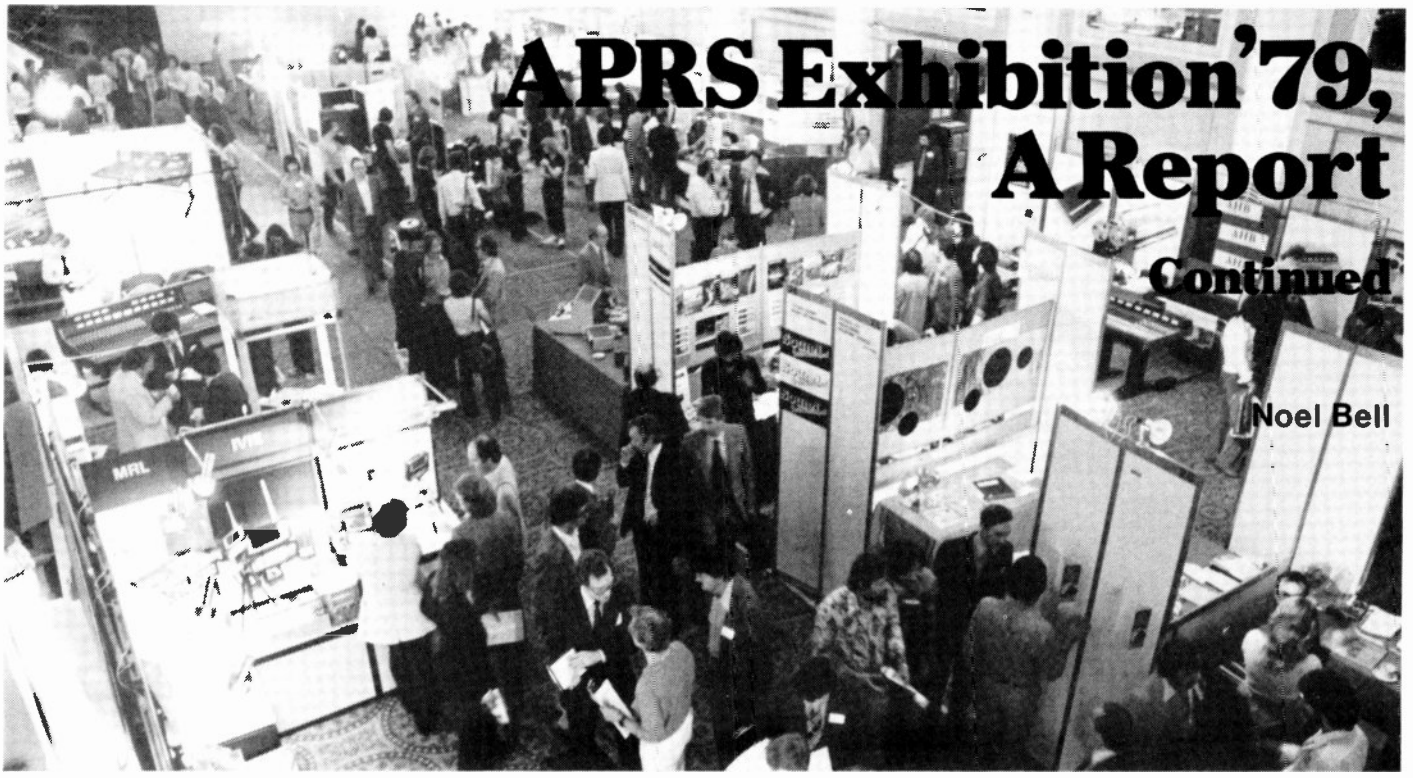
* Two outputs, each with up to 400 ms of delay.
* Two selectable algorithms to optimize pitch change performance.
* Micro pitch change ensures extremely precise, stable settings.
* Long delay permits simulated reverb.
* High and low feedback equalization, coupled with the use of delay and pitch change makes possible a range of special effects hitherto unobtainable.
* 15 kHz band width.
* 96 dB dynamic range.
* Dual colour LEDs give markedly improved front panel readability.
* Switchable 115/240 volts.

* Harmonizer is a trade mark of Eventide Clockworks Inc.

UK Distributors

Feldon Audio Ltd.,

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



APRS Exhibition '79, A Report

Continued

Noel Bell

Part One (September) covered consoles and tape machines. Part Two continues with effects, etc.

Effects

Scenic Sounds Equipment introduced a number of new units at APRS. One of the most interesting was the *Master Room XL-305* reverberation chamber from MicMix. This is a compact rack mount stereo unit which features stereo imaging of a mono signal, reverberation/dry signal mixing controls, LED peak signal indicators, and 4-band peak/dip eq on each channel. The unit has an 8kHz reverb bandwidth, offers a decay of 3.25s at 1kHz, has adjustable input level and output gain, auxiliary front panel input/output connections, and mono mix switching of reverb inputs or outputs. Also on display were the new dbx *165* and *163* 'over-easy' comp/limiters, the Marshall Electronics *Minimodulator*, and DeltaLab *DL2 Acousticomputer*.

Audio & Design added a new unit to their range, the *Express Limiter*. This is a compressor, limiter, expander which uses digital logic switching. Four pots control input, output, attack and release, while all other functions are controlled by six gold-plated leaf spring momentary buttons including compressor ratio (ratios provided are 1.5:1, 2:1, 5:1 and limit 20:1), expander and selection of meter functions to read output or gain reduction on either left or right channel or the sum of both. LEDs indicate the mode of operation and a memory system retains previous settings when switched off. The unit has stereo input/output attenuator, variable attack and release times and an auto release network. Price of the *Express Limiter* is £525.

EMS introduced a baby brother to their present range of vocoders, the *Vocoder 1000*, which is a compact low cost speech synthesiser. Designed by Tim Orr, the *Vocoder 1000* uses 32 filters to analyse and re-synthesise the frequency and amplitude pattern of a speech input, additionally having 16 envelope followers and modulators plus an oscillator and white noise generator. Outputs can be a mix of outputs from either the vocoder, excitation or voice and a 'pause-stuffing' function can be switched in to fill silences in the excitation or voice inputs.

Klark - Teknik's sister company **Statik Acoustics** introduced a brand new range of units to the market. Although designed and priced with the lower end of the market in mind they offer good value. First unit is the *SA 10* octave equaliser priced at £280 approx. This is a dual channel 10-band graphic eq allowing ±12dB of boost or attenuation per channel at ISO centre frequencies. The unit features electronic bypass allowing silent eq in/out switching, input level control and gain stage on each channel, and complete system bypass during supply interruption. The second unit is the *SA 20* stereo or dual channel reverb system priced at £350 approx. This uses a multiple spring design, and has an input limiter plus input and output level controls, variable high and low frequency eq controls, a dry/reverb mix control, and electronically balanced inputs fitted as standard. Bandwidth is 8kHz with a decay time of 2s and an initial delay of 35ms. Next is the *SA 30* electronic loudspeaker crossover unit priced at £260 approx. This is a three-way (switchable two-way high/low) stereo design using 18dB per octave Butterworth filters. The unit has comprehensive facilities including a subsonic 30dB per octave slope filter and four switchable turnover frequencies at each crossover point allowing almost any combination of drivers to be used. Finally there is the *SA 100* dynamic delay/flanger priced at £490 approx. This is a very versatile unit offering not only the usual delay-based effects such as flanging, Doppler shifts and ADT, but also long single delays up to 160ms for echo or repeat effects together with a mix of a number of offset delays in the reverb mode. Unlike all digital delays the *SA 100* can achieve a wide sweep range enabling deep flanging effects to be created. The waveform of this sweep is selectable from either triangle, square or dynamic, the first two waveforms creating repetitive sweeps while dynamic gives a sweep waveform that is a complex function of the input signal. The unit has an internal limiter, variable bandwidth and delay range, and the capability of delay extension with additional delay cards. The unit also has an inverted comb output allowing stereo flanging effects or alternatively two *SA 100*'s may be linked to give complete stereo capability.

On the **Feldon Audio** stand could be seen the new Eventide *Monstermat RD770* mono/stereo matrix unit for broadcast use. The *Monstermat* solves the problem of broadcasting in stereo to a predominantly mono audience by converting the signal into left + right and

70 ▶

Left: new range of Statik equipment. And here Audio & Design's Express Limiter.

APRS REPORT

left — right signals on cartridge machines. These are then replayed and full stereo is restored on playback and dematrixing. The unit incorporates dbx noise reduction which can be automatically switched and it is available in two formats, record/play or play/play, the latter being able to handle two cart machines in the play mode. Price of the unit is $995.

Also in the broadcast field is the Orban *Omtimod-AM* which was shown by **Lee Engineering.** Designed to replace a conventional compressor, programme equaliser, and peak limiter in the AM audio chain, the *Optimod-AM* provides increased high frequency eq without distortion, pumping, hole-punching and loudness losses. The unit uses a 6-band frequency selective limiter with 'Smart Clipping', a new technique for peak limiting, and includes a broadband gain-riding compressor and a programme equaliser to compensate for typical AM receiver response. Although designed for mono use the unit is equipped with a rear panel connector to accept an AM stereo adaptor chassis, if and when such a system is approved.

Atlantex Music were showing the Ashly and MXR ranges. From Ashly there were a wide range of units including electronic crossovers, parametric equalisers, peak limiter/compressors, and their musical instrument preamp and keyboard input processor. In the MXR range the auto phaser, flanger, *Digital Delay Flanger/Doubler* and *Pitch Transposer* were shown. The MXR *Pitch Transposer* is the most recently introduced unit and shifts pitch in real time by any desired interval from one octave lower to one octave higher. While operating primarily as a harmonising unit, it will also provide doubling, pitch correction and choral effects, and with the addition of an external delay will also perform arpeggios and delayed harmony. The *Pitch Transposer* has four front panel presets, LED indication of the selected preset or the bypass condition, mix control, regeneration control, and a level matching switch with an associated LED overload indicator. Separate connections are provided for both instrument and line levels and rear panel jacks are provided for external preset selection, external delay, external voltage control of preset 1, and an external display option. The display option provides a readout of the amount of pitch shift displayed as either pitch ratio or semitone shift. Price of the *Pitch Transposer* is £699, while the display option costs £200.

Line up of AKG mics part of their stand

Aphex Systems, who are well known for their *Aural Exciter*, showed two new B&B Audio products. The first of these was the *1537A* voltage controlled attenuator suitable for use in a wide range of professional audio applications. Available as a 14-pin ceramic ic or as a module, it features low distortion, low noise, high stability and wide dynamic range. A control voltage varies the output from unity gain to over 100dB and it is usable from dc to 50MHz. Also new were the *EQF-2* and *EQF-3* modular parametric equaliser/filters. These have tunable peak/shelf eq, tunable high/low pass filter, reciprocal cut and boost, and differ in that the *EQF-2* is stepless while the *EQF-3* is stepped.

Music Laboratory showed three reverb units featuring full equalisation controls. The three units were a medium-priced stereo plate reverb, a spring reverb with rack-mounting or portable option, and a digital unit. Also shown was their range of DI boxes and a purpose-built headphone amplifier. Music Laboratory have also just been appointed agents for the American manufactured Quatre amplifiers and their 250W and 500W 'gain cell' amplifiers are now available in Europe for the first time.

Microphones

Two new series of microphones were introduced by **Beyer.** The first, designated the *M400 Series*, saw the introduction of the *M400N (C)* priced at £67.50. This is a dynamic supercardioid mic with a frequency response of 50-15kHz, output level of 2mV/Pa, and an impedance of 200Ω. The second range, called the MCM system, is designated the *700 Series* and comprises a modular condenser mic system. This is available as two preamplifier modules with 48V or 12V phantom powering, plus a range of four mic capsules together with long and short shotgun capsules.

AKG introduced two mics, the *C535EB*, a condenser mic with a cardioid response, and the *D130E* omnidirectional dynamic mic. The *C535EB* has an integral pre-attenuator and filter switch with built-in pop filter and the capsule is elastically suspended. Recommended for interview and PA applications, the *D130E*, is also elastically suspended and is protected by a sintered windscreen. Prices of the new mics are £118 for the *C535EB* and £45 for the *D130E*. AKG also had advance information on two forthcoming FET stereo condenser mics using capsules based on the *CK1*. These mics will feature two pairs of capsules with the upper capsule rotatable through 180° and will come complete with the *S42E* remote control unit which enables each channel's polar response to be adjusted from omnidirectional through cardioid, hyper cardioid, to figure of eight. Both mics will be capable of phantom powering and they are to be designated the *C34* and *C422*.

Electro-Voice were highlighting two mics on their stand the *Model DO56* omnidirectional dynamic mic which is designed to be shock-isolated for vocalist and commentary usage; and the *Model RE18* super-cardioid dynamic mic based on the *RE16* but with the addition

72 ▶

B&B EQF2 Parametric Equaliser

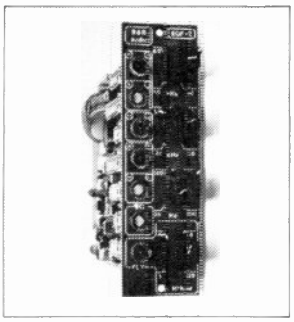
A very versatile instrument for getting sounds just right. It's modular and directly retrofits APSI 550.

EQ is peak or shelf.

Filter is high or low pass, tunable.

Bandwidth is 20Hz to 20kHz.

Reciprocal cut or boost on EQ.



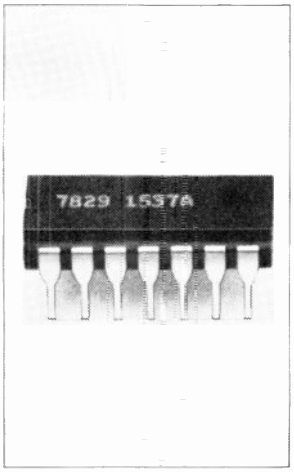
Input	High level	+ 30dBm (max) at 34KΩ
	Low level	+ 20dBm (max) at 11KΩ
Output	High level	+ 30dBm with − 93dBm noise
	Low level	+ 20dBm with − 103dBm noise
Frequency response	EQ & filters out	10Hz to 20kHz, ± 0.1dB
	EQ & filters in	20 Hz to 20kHz, − 1dB
Distortion	Harmonic & IM	< 0.1%
Transient response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

B&B 1537A Voltage Controlled Attenuator

The first high quality VCA in the professional audio market.

It's available in chip form for OEM, or as a purpose built package to retrofit MCI.

However, we can design a VCA package to fit any other manufacture.



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

B&B OAS24 Grouping and Automation System

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

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

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

For MCI equipment, a compatible automation package is available.

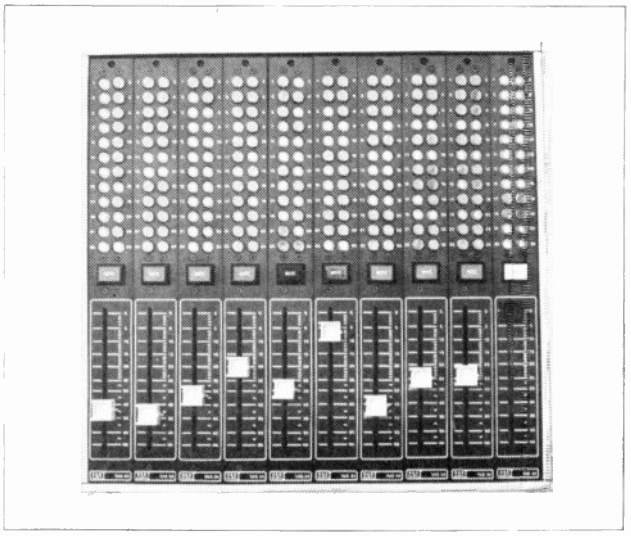
Our own Voltage Controlled Attenuators (VCA) are used throughout, whose high quality assure minimal sound degradation.

Maximum output is + 24dBm.

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

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

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



Aphex

The Aphex Aural Exciter

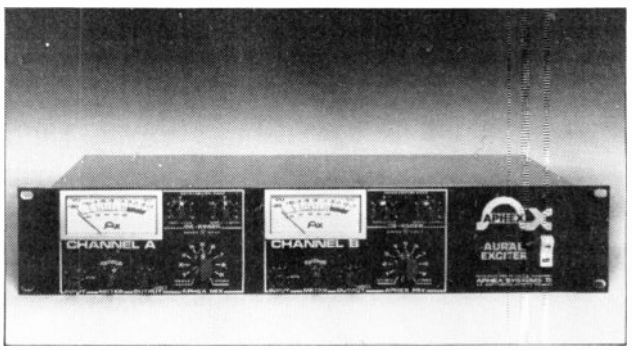
One of the most exciting signal processors to have been invented.

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

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

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

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



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

APHEX

of an internal shock mount and a smaller integral blast filter.

Loudspeakers

Tannoy were showing a number of new products for the first time in the UK. These included the recently introduced *Buckingham* monitor, *Classic Dual* monitor, and the *Super Red* monitor. Also on display was Tannoy's active dividing network and low frequency parametric equaliser which has had a number of alterations made to it since AES Brussels. The unit is a stereo rack-mounted unit incorporating a parametric equaliser operating over the frequency range 20Hz to 200Hz, and a two-channel crossover unit with variable time delay operational in either the high or low pass channel. The characteristics of this dividing network are determined by plug-in modules which define the crossover parameters for all Tannoy professional monitors, and it is intended that modules will also be made available for most studio and PA monitors. Additional features include switchable 20Hz, 31.5Hz and 63Hz high pass filters, linear phase Bessell input filter, high pass channel inversion facility, XLR connectors and optional fully balanced input/output configurations. The parametric equaliser has individual channel control, and the characteristics of the crossover point (slope, frequencies and band pass level parameters) are specified together with either present or variable time delay on a plug-in card. Bandwidth is variable between 0.3 and 3 octaves, level is variable by ±12dB, and frequency is variable between 20Hz and 200Hz. All filtering at the crossover point is carried out using passive networks to increase the flexibility, reduce noise and to prevent degradation of the highpass slew rate.

Parallel to the Tannoy loudspeakers, **Lockwood** announced the introduction of their *Universal* enclosure which will accept either of the new Tannoy *Super Red* or *Classic Dual* drive units. The enclosure is 41 x 30 x 17¾in (hxwxd), has a laminated finish and alternative grille materials in a choice of colours. Several versions of the *Universal* are being produced including versions for ceiling mounting, wall mounting, floor standing (with or without castors), or with stands to the required height. Disco and stage versions will be available at a later date. Lockwood offer a retrofit service for fitting existing Lockwood enclosures with the new Tannoy drive units and will loan or hire enclosures to users whilst refurbishment is being carried out.

Harman (Audio) displayed a selection of models from the JBL range and showed the *Model 4313* compact monitor for the first time in the UK. This model has a frequency response of 40Hz to 18kHz, an impedance of 8Ω, and a sensitivity of 89dB SPL at 1W at 1m.

H/H's range of MOS-FET amps

Others

One of the most interesting items on display was the recently introduced *ADD-1* two channel audio digital delay for disc mastering preview operations, from **Ampex**. Demonstrated as part of the new Ampex mastering system (in conjunction with an Ampex *ATR-100* fitted with a new ½in 2-track head assembly), the *ADD-1* has a dynamic range of 90dB, variable delay of up to 5.12s in 5ms increments, 16-bit digital or balanced line analogue inputs, allows up to 30in/s mastering speed, provides high quality signal output during the final disc mastering step, and is totally compatible with normal or half speed cutting. The unit obviates the requirement of a special preview machine for disc mastering and eliminates the need for rethreading or special techniques for changing tape speed, as the same delay settings may be used for any tape speed. Full details of the Ampex system can be found in our AES report in the August issue of *Studio Sound*. Details of the Cybersonics *DM2002* disc mastering lathe which was shown by UK distributor **Feldon Audio** can also be found in this AES report.

Turning to amplifiers, **H/H Electronic** introduced a range of MOS-FET professional power amplifiers. Four models are available, the *V150-L* single channel power amp, and the *V200*, *V500* and *V800* two-channel power amps. The *V150-L* offers 105W rms into 8Ω at 1kHz; while the *V200* offers 65W per channel, the *V500* 150W per channel and the *V800* 260W per channel under the same conditions. The amplifiers have a quoted total harmonic distortion of less than 0.02% with intermodulation distortion of less than 0.03%. The amplifiers are 19in rack-mount units, have calibrated detented input attenuators, plug-in optional input transformers, XLR and jack connectors, and LED peak indicators, the *V800* having a more comprehensive LED

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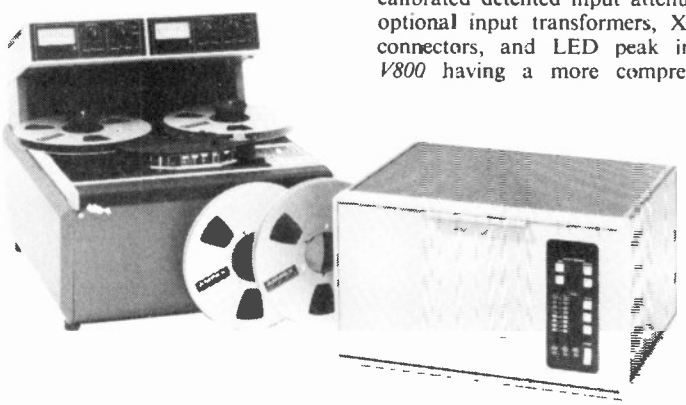

Ampex ADD-1 audio digital delay

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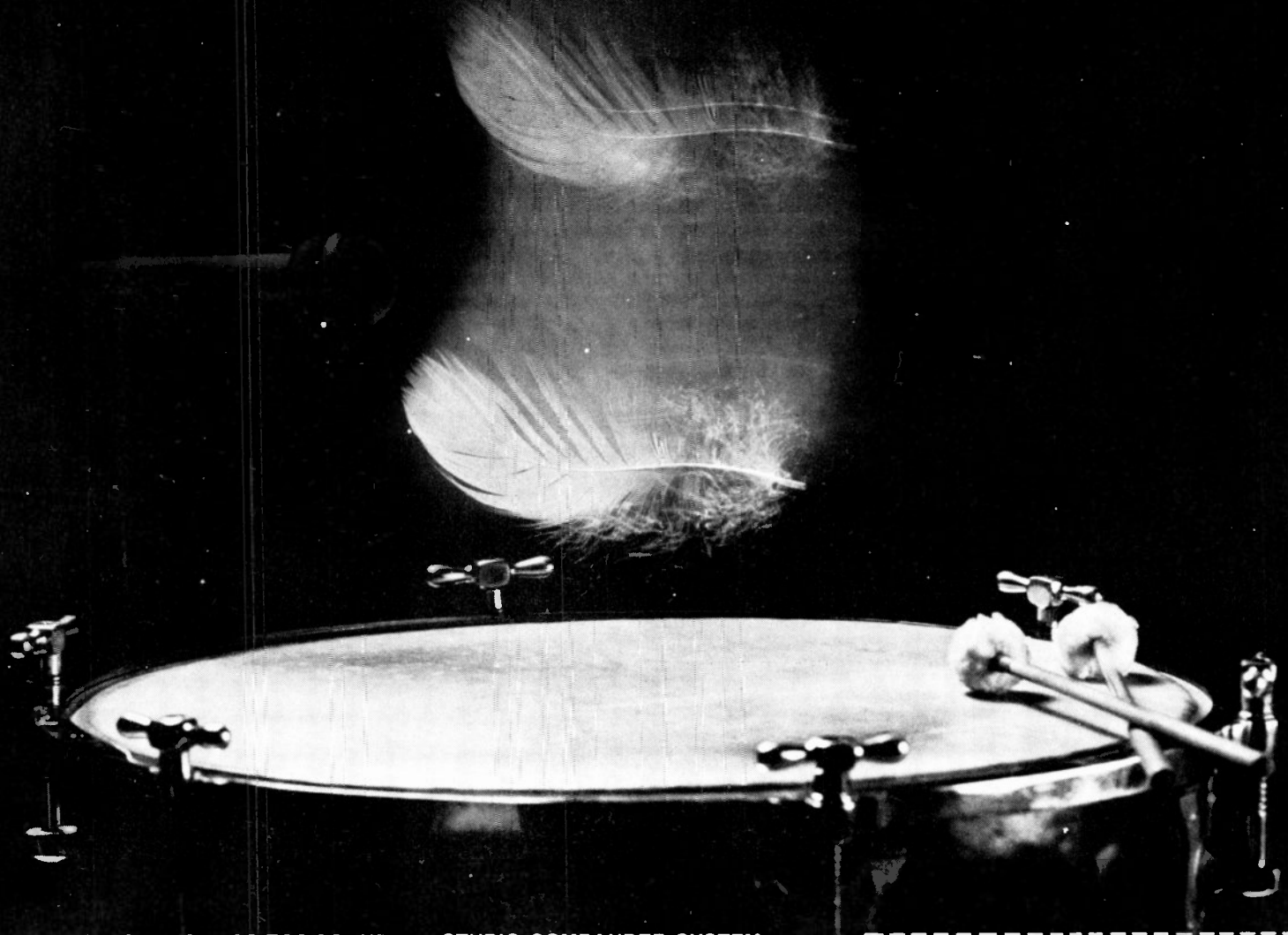

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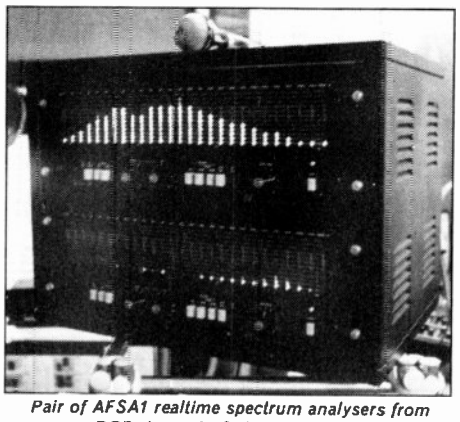
WAK 1090 E

metering system arranged in a VU meter style display. Both the *V500* and *V800* are fitted with thermostatically controlled quiet running fans. The amplifiers are of rugged mechanical construction, are virtually immune from thermal runaway and because no thermal tracking is necessary give optimum performance from switch on. Prices are *V150-L* £210, *V200* £264, *V500* £369 and *V800* £487.

In the broadcast field **Philip Drake Electronics** introduced a new range of amplifier equipment for line level signal distribution. Manufactured under licence from the BBC, the amplifiers are 19in rack-mount units. Included in the range are a distribution amplifier, a line sending amplifier, a high gain amplifier, a remote controlled amplifier, and a line-up oscillator. Future products in the range are to include a 25W loudspeaker amplifier and a microphone amplifier.

Bulgin Electronics were showing their comprehensive range of PPMs and introduced a number of new products. These included the *PPM 100 Series* conforming to BS 5428 Type 2A, the *PPM 200 Series* conforming to the requirements of CCIR 468-2 for the unweighted measurement of noise in audio circuits, and the *PPM 400 Series*, an economy PPM which closely resembles the characteristics of the *PPM 100 Series*. Other new items were an attractive instrument casing for 'head-up display' which can be desk or wall mounted and is adjustable for display angle, and the stereo monitor *PPM 106* using a single movement system having LED indication of the channel giving the higher peaks. Hidden away almost on the Bulgin stand was the *Sound Source* acoustics analyser from **IMA Measurement Services Ltd.** Designed to be used with a sound level meter, a dual beam oscilloscope, and a loudspeaker system, the *Sound Source* is a complete source of filtered noise pulses for use in the measurement of reverberation time and room frequency response. It is self-powered and has a 10W amplifier fitted as standard. Push-button switches are provided to select octave frequency bands of noise having centre frequencies at 125, 250 and 500Hz, and 1k, 2k, 4k and 8kHz, and a manual filter position is also available so that spectral bands can be set at whatever frequency and bandwidth is required. Price of the *Sound Source* is approximately £430.

Another new measurement unit was introduced by **Scenic Sounds Equipment.** This was the modular *System 200* microprocessor controlled real-time analysis system from White Instruments. Features, functions and expandability of the system are software dependent, with all analysing and display functions being controlled by the microprocessor which may be reprogrammed at any time in the future by changing the circuit card containing the PROMs. The system features switched full octave (31.5Hz to 16kHz) and ⅓-octave (25Hz to 20kHz) filters, and the facility to include optional ⅓-octave (40Hz to 1,120Hz) filters, a LED matrix 15 x 30, 46dB of dynamic range over a total range of −69.5 to +46.5dBm with a resolution of 0.5dB, simultaneous analysis in both peak and average modes, storage in eight memories, simultaneous display of up to three curves, and numerous options. The basic *Model 200* mainframe will include an RT-60 and reverberation time analysis feature although details of this feature are not yet available. Price of the *System 200* with eight memories and RT-60 analysis is £2,695.

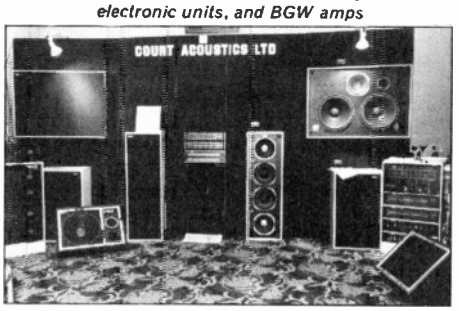


Pair of AFSA1 realtime spectrum analysers from RCF shown by UK distributors— Covemain Ltd

Covemain Ltd were showing the imported RCF *AFSA1* real-time spectrum analyser available as a 19in rack-mount unit or as a free standing unit. Featuring ⅓-octave operation from 40Hz to 16kHz in 27 ISO bands, the analyser has a 12 x 27 LED matrix using a three colour display, red (+1dB to +3dB), amber (−3dB to 0dB) and green (−20dB to −4dB). Other features include a digital pink noise generator with level control, pre-amplifier with balanced line input and 12V dc phantom power supply, stereo line inputs with volume control and push-button attenuators, and an internal test and calibration facility. Price of the *AFSA1* is approximately £800.

Court Acoustics also had a real-time analyser on display, the *Model 2709* from Neptune Electronics. This is a 27-band ⅓-octave analyser and costs £599.50. Other Neptune units available are the *Model 2710* ⅓-octave graphic equaliser (£212.50), the *Model 611* 6-channel mixer (£199.50), the *Model 820* 8-channel stereo mixer (£289.50) plus the *Model 909* 9-band full octave real-time analyser (£249.50) and the *Model 910* 9-band graphic equaliser (£102.50). Court Acoustics also distribute the *Q-Aid* 'in the ear' wireless receiver/earphone. This is available in two formats the *Q1* which includes a volume control and the *Q2* which fits entirely in the ear. The *Q-Aid* works on the induction principle. A loop of plain wire is placed around the desired area of coverage and the ends of the loop are connected to the loudspeaker output of a small audio amplifier. The voltage produced by the amplifier creates an electro-magnetic field which is picked up by the *Q-Aid* and then amplified in its 3-stage integrated circuit. The *Q-Aid* has a maximum acoustic output of 120dB SPL at 1kHz into a 2cc cavity and a signal-to-noise ratio of 40dB at 1kHz.

Court Acoustics stand showing a wide range of equipment including Court loudspeakers and ancillary electronic units, and BGW amps



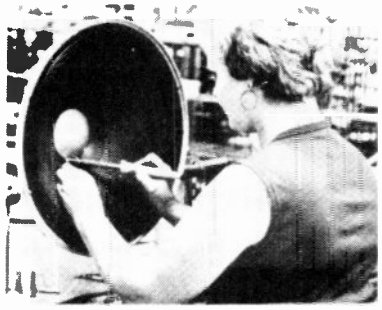
Turning to more miscellaneous items, **Canford Audio** displayed a number of French manufactured *Rondson* loudspeaker units for which they are the UK distributors. These units are suitable for broadcasting editing cubicles, newsrooms etc. The units are housed in polyethylene or ABS spherical or cylindrical housings fitted with mounting yokes or brackets and most of them are silicon treated for outdoor or humid conditions. Several of the units are wall or ceiling mount versions and a large proportion of the range have built-in 50/100V transformers. Canford Audio also displayed their cartridge labels for NAB broadcast cartridges a hexagonal studio 'acoustic' table which can be fitted with PO jack sockets and their automatic cable tester for testing XLR and PO cables.

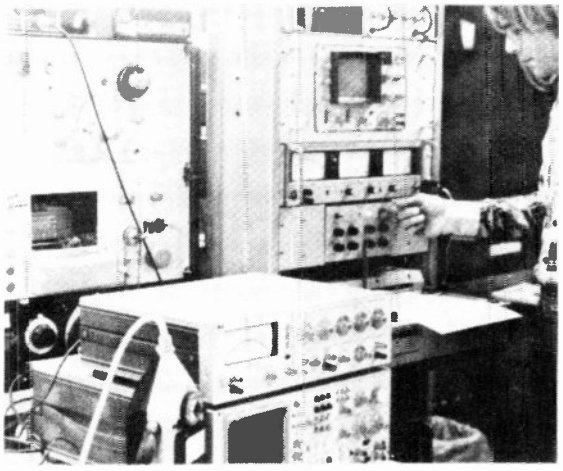
In an attractive mock-up studio corner arrangement **Shone Sound** displayed its range of studio fittings including acoustic doors, observation windows, acoustic modules, and a full range of signal lights, cue lights and illuminated signs plus mic stands and acoustic tables. Although designed primarily for broadcast use these units are also applicable to normal studio usage.

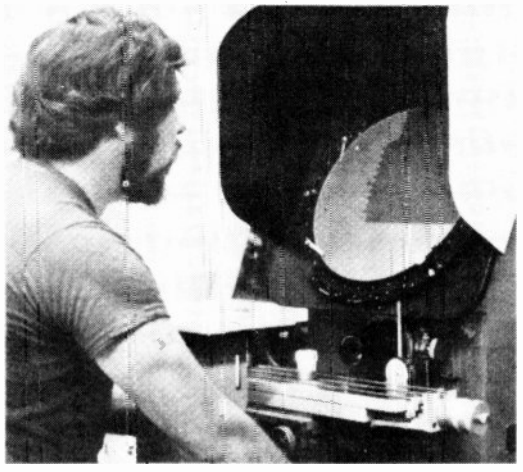
Finally, **Keith Monks Audio** showed their range of mic stands and other ancillary equipment including a new tripod stand, the *MT/1*. This is a portable folding design and can be supplied with fittings to take a boom arm, or cabinet or column loudspeakers. ■

PEAVEY

BLACK WIDOW







A NEW STANDARD OF EXCELLENCE
FOR PREMIUM TRANSDUCERS

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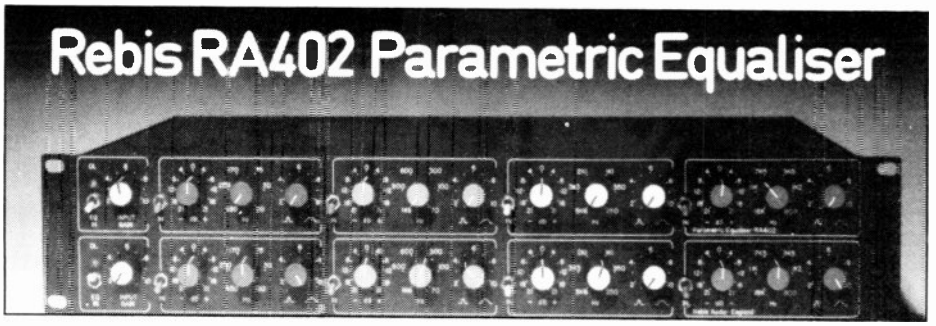
Rebis RA402 Parametric Equaliser



MANUFACTURER'S SPECIFICATION

Input gain controls: continuously variable up to 20dB boost.
Equalisation controls: continuously variable boost or cut up to 21dB.
Bandwidth controls: continuously variable from 5.5dB/octave to 36dB/octave (Q from 0.89 to 13).
Frequency controls: continuously variable over a 4.5 octave range. Section 1—20Hz to 450Hz. Section 270—Hz to 1.6kHz. Section 3—250Hz to 5.6kHz. Section 4—800Hz to 18kHz.
Section overlap: 2.7 octaves.
Bypass: each section has an in/out switch. Each channel has an in/out switch.
Overload indicator: the LED will light and stay on for 100ms if the peak positive or negative level anywhere in the system exceeds +22.5dBm.
Frequency response: ±1dB from 20Hz to 20kHz.
Input impedance: unbalanced 100kΩ. Balanced 10kΩ.
Maximum output: +23dBm into 600Ω.
Noise: with equalisation controls flat, frequency controls mid-range, bandwidth controls on broad. Better than —80dBm 20Hz to 20kHz.
Distortion: below 0.05% THD at 1kHz and +12dBm.
Power requirements: 110-240V, 50/60Hz.
Dimensions (whd): 19 x 3½ x 9¾in (behind front panel).
Weight: 10¼lb.
Price: £420.
Manufacturer: Rebis Audio, Kinver Street, Stourbridge, West Midlands, England.

THE Rebis *RA402* parametric equaliser is a twin-channel equaliser, with each channel split into four independent frequency bands having individual controls for frequency, degree of cut or boost, and bandwidth, or Q. In addition each band may be switched in and out of circuit.

Each band has a continuously variable frequency control covering the frequencies 20 to 450Hz, 70Hz to 1.6kHz, 250Hz to 5.6kHz and 800Hz to 18kHz in terms of centre frequencies with the cut/boost control providing continuously variable cut or boost over a nominal range of ±21dB. The bandwidth control is also continuously variable providing a range of initial slopes between 6dB per octave and 36dB per octave.

The unit is intended for mounting into a standard 19in rack and is solidly constructed from 3mm thick alloy plate. All front panel controls, including the toggle switches, have colour coded knobs.

The input controls consist of: an equaliser in/out toggle switch, which turns the complete equaliser in or out of circuit but retains the input and output buffering circuits; an input gain control, only operational with the equaliser in circuit; and a yellow overload LED indicator which is continuously illuminated at a low brilliance, but becomes brightly illuminated if any section of the unit is overloaded. (This is achieved by sensing the outputs of seven operational amplifiers in the signal path and illuminating the overload LED brightly, if any output rises to within 1.5V of either power supply rail—an excellent idea).

Each frequency band of the equalisers has four controls, ie a frequency control for each band with six appropriate calibration points and identical cut/boost and bandwidth controls for all bands. The cut/boost potentiometers are calibrated in decibels with calibration points at ±4dB, ±8dB, ±12dB, ±18dB and ±21dB whilst the bandwidth controls have calibration marks identified as zero to 12 purely for reference. The fourth and final control for each band is for switching a single band in or out of circuit.

The audio signal inputs and outputs, at the back of the unit, are in the form of a 12-way barrier strip with a separate chassis earth, the signal earth being isolated from the chassis earth—a sensible and not too usual feature. Personally I do not like barrier strip connections, but there is plenty of space to fit XLR connectors if desired.

Mains power is supplied via an IEC standard connector with an adjacent voltage selector covering 240/120V and a properly identified metric size mains fuse. Surprisingly no power on/off switch is fitted.

The dc power supply is derived from a toroidal transformer and a small printed circuit board housing the rectifier and power stabiliser at the rear panel. Each equaliser channel comprises a fibre glass printed circuit board extending the full width of the unit. Although the components are not identified they are very accessible and the instruction manual does include a layout diagram and a full circuit.

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FIG.1 REBIS RA402 OVERALL FREQUENCY RESPONSE

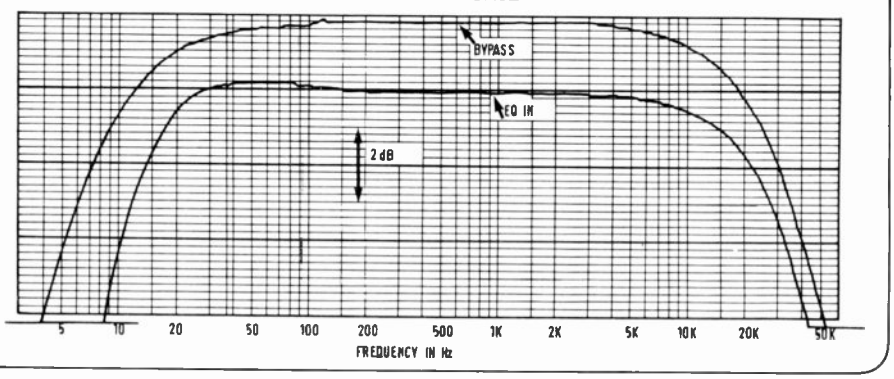
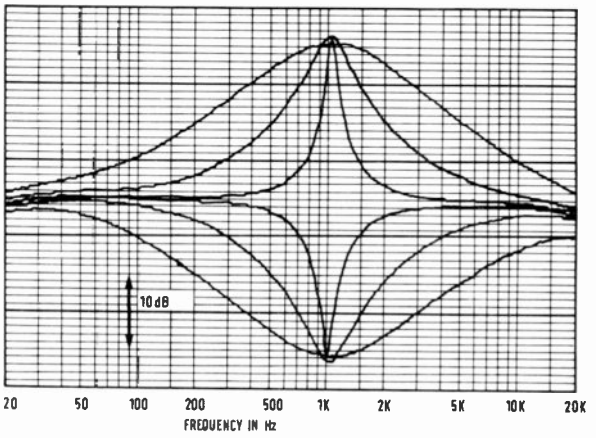


FIG. 2
REBIS RA402 RANGE OF BANDWIDTH CONTROLS FOR MID



...here is the new dynamic range

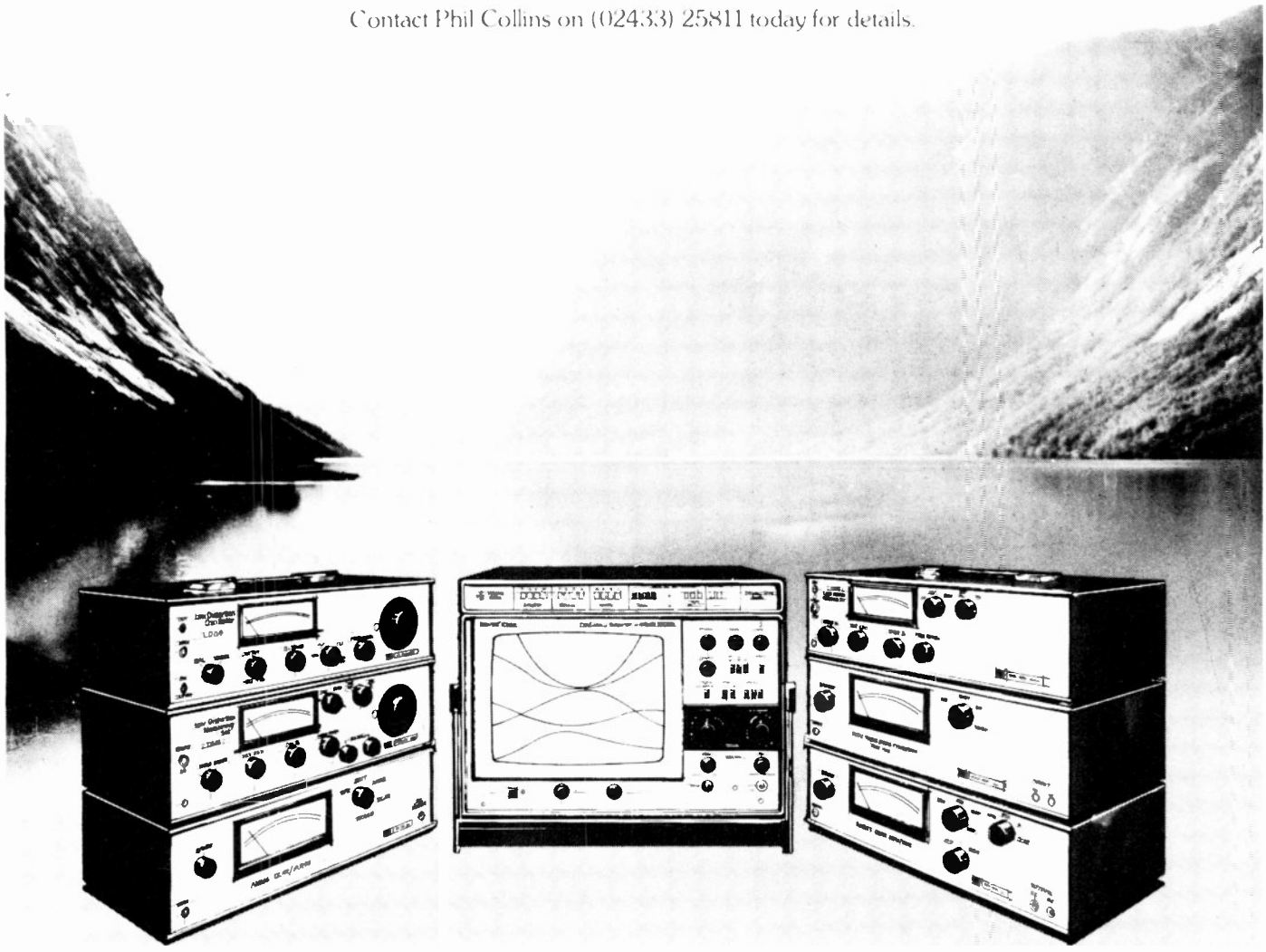
Two leading names in electronics Wayne Kerr and Radford have merged their expertise to provide a comprehensive new range of Audio Test Instruments.

The Wayne Kerr Radford range includes distortion measuring sets, frequency response analysers, digital display stores, low distortion oscillators, audio noise meters and high sensitivity voltmeters.

This is good news for all professional audio users, . . . for recording studios, radio & TV broadcast stations, laboratories, service workshops, film sound & audio visual engineers, musicians & producers and audio equipment manufacturers.

Wherever rapid, accurate and high sensitivity audio measurements are vital this new combination is without equal.

Contact Phil Collins on (02433) 25811 today for details.



Wayne Kerr Radford **The dynamic range**

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Frequency response

The overall frequency response in the bypass mode, with all equalisers in circuit and set to 0dB cut/boost setting, is shown in **fig 1**. From this you can see that the bandwidth has been intentionally limited with the frequency response in both cases approximating to: +0dB, -2dB from 15Hz to 20kHz above which there is a rapid fall.

The basic shape of the responses of all equalisers was the same when allowance was given for the overall frequency response with the range of the bandwidth control shown in **fig 2** for mid frequencies, and **fig 3** when set for 100Hz. Bearing in mind that the frequency range of the equaliser sections overlap, an enormous degree of boost or cut is possible at discrete frequencies—64dB cut at 1kHz measured using three sections or 80dB using four sections. Such a facility is useful for instance for eliminating howlround in PA systems.

Checking the calibrations of the boost/cut potentiometers in the four frequency bands using 100Hz, 1kHz, 1kHz again and 10kHz respectively for the bands showed that the calibrations were remarkably accurate with a worst case error of 0.5dB at the 4dB and 8dB points and 1.2dB at any other point in any frequency band.

Accuracy of the frequency calibrations was checked for all six calibration marks on each equaliser section with the calibration accuracy generally within 10%—which is excellent. But in both channels the 300Hz and 1.1kHz points were 25% in error, however this represents only a small mechanical movement of the controls.

Distortion

Both harmonic and intermodulation distortion were measured with the channels set to unity gain and all equalisers in circuit set for 0dB cut/boost and the output loaded into 600Ω. As can be seen from **fig 4** the third harmonic distortion at +10dBm (or below) is at a remarkably low level and only at +20dBm operating level and at high frequencies is the distortion significant. The same pattern, but at a lower level, was followed by the less objectionable second harmonic.

As is to be seen from **fig 5**, which is a plot of the difference frequency distortion with two swept tones separated by 70Hz, a similar pattern is followed to that of the harmonic distortion giving an excellent overall distortion performance.

Noise

Noise in the output was measured with all four equalisers in circuit with their cut/boost controls set at 0dB, the frequency controls at mid position and the bandwidth controls at maximum. Measurements were made at unity and maximum gain and also in the bypass mode.

Table 1 shows output noise in dBm to which must be added the maximum output drive capability of +21.5dB to give the dynamic range.

Both channels exhibited similar noise performance, the noise varying widely with control settings in a rather unpredictable manner. For instance, with equalisers set to 0dB cut/boost the frequency control effected the noise as did the bandwidth control to the extent that the CCIR-weighted rms noise rose to -60dBm irrespective of the gain setting—in the worst case condition without any cut or boost in action.

Clearly this is not a very good performance and if the optimum noise performance is to be achieved care must be taken over the control settings not logically in use.

TABLE 1 NOISE AT THE OUTPUT

	BY-PASS	UNITY GAIN	MAXIMUM GAIN
Band limited 20Hz to 20kHz rms	-95.0dBm	-81.5dBm	-73.5dBm
A-weighted rms	-96.5dBm	-83.0dBm	-75.5dBm
CCIR-weighted rms	-87.0dBm	-73.5dBm	-66.0dBm
CCIR-weighted quasi-peak	-83.0dBm	-71.0dBm	-62.0dBm

Inputs, outputs and overload

The review unit which had unbalanced inputs and outputs had a maximum input capability of in excess of +22dBm with an input impedance of 98kΩ constant irrespective of any control settings.

The output impedance was extremely low, in the order of 0.5Ω with a maximum drive capability of +21.5dBm loaded into 600Ω. In the bypass mode both the inputs and outputs are buffered so there is no change in loading with the gain being +0.2dB at 1kHz.

With the equalisers in circuit and set 'flat' the maximum available gain from the input to the output was 21dB with an input level of +2dBm being required to reach the input overload point.

Performance of the overload indicators was excellent, a visible indication of overload occurred with less than 50μs of overload time, but before the onset of any serious distortion the indicators illuminate.

Testing with tone bursts produced predictable results without any undesirable effects and the phase shift behaved much as expected of a parametric equaliser.

Power frequency components were at all times below -90dBm in the output and the unit was not prone to hum pick-up from adjacent equipment.

Summary

With the exception of the unpredictable noise performance, the measured results on the Rebis *RA402* parametric equaliser were first class and distortion performance was particularly good.

Operationally the controls are very clearly and logically arranged and the general standard of construction was satisfactory, though not to the highest standards. **Hugh Ford**

FIG. 3 REBIS RA402 RANGE OF BANDWIDTH CONTROLS AT 100Hz

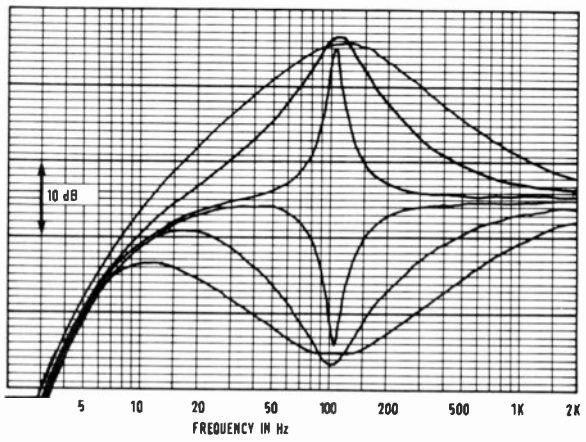


FIG. 4 REBIS RA402 THIRD HARMONIC (2nd SIMILAR)

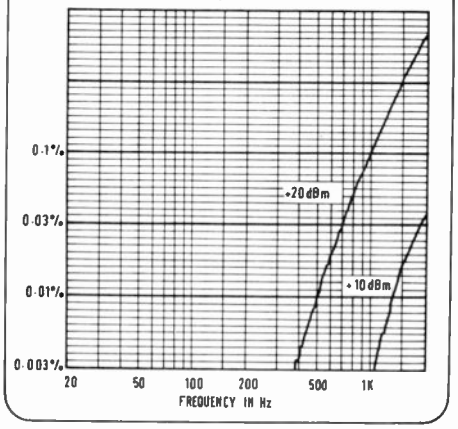
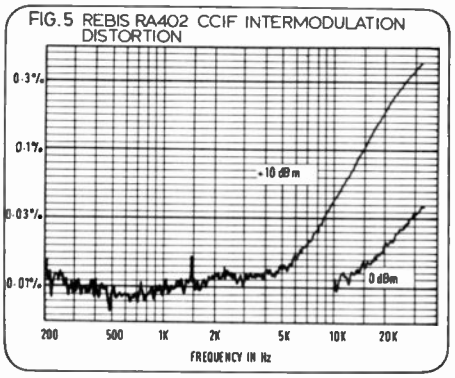


FIG. 5 REBIS RA402 CCIF INTERMODULATION DISTORTION



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MANUFACTURER'S SPECIFICATION

Inputs: left/right/mono at 0dBm. Universal at 3mV and 'Dynacord' at 30mV.

Outputs: left/right/mono original at +6dBm. Left/right/mono mixed at +6dBm. Left/right/mono delay at +6dBm. Universal at 300mV and 'Dynacord' at 1.3V.

Delay time: echo 6ms to 320ms. Reverberation 30ms to 10ms. Delay (between original and reverberation) 0, 25, 50, 75ms.

Signal-to-noise ratio: original greater than 75dB, effects greater than 70dB.

Frequency response: original 20Hz to 20kHz, effects 20Hz to 8kHz.

Distortion: original less than 0.2%, effects less than 1%.

Operating voltage: 220/110V, 50/60Hz.

Dimensions whd: 19x5x12in (483x132.5x300mm) (designed for 19in rack mounting).

Weight: 24lb (11kg).

Price: £1,110.33.

Manufacturer: Dynacord Electronik und Geratebau, Postbox 68, D-8440, Straubing, West Germany.

UK: Beyer Dynamic (GB) Ltd, 1 Clair Road, Haywards Heath, Sussex.

THE Dynacord *DRS 78* digital reverberation unit is in fact more than a pure reverberation unit as it also includes an echo facility with variable time delay up to 320ms. Whilst the unit may be used to generate effects in the studio it has been designed for stage use and thus incorporates several remote control facilities, which can be actuated by either footswitches or footpedals.

The black front panel is divided into three horizontal sections which separate the clearly marked functions. Working left to right and bottom section first: is an unbalanced low level input with its nearby input level control and bass and treble equalisation potentiometers. Then a further unbalanced jack socket which provides an output of the mixed input signal and the echo or reverberation signal, as desired. Next an array of nine LED indicators to form the level indicator, which is a fast peak sensing type with calibration points at +3dB, 0dB, −15dB, −27dB and −39dB in addition to a percentage scale at the same points. And further to the right is a ¼in jack socket for remote selection which is next to a pushbutton, for selecting either the echo or the reverberation mode. These are followed by a miniature toggle switch, allowing the unit to hold and repeat the contents of its digital store, and finally a ¼in jack socket for remote control of the effects on or off.

The middle section mainly controls the echo or delay effect. Left to right: a ¼in jack socket for remote control of the echo return level with an adjacent potentiometer for local control of the echo return level. Then an echo duration potentiometer, which in practice is a feedback level control around the echo delay and controls the duration of the echo up to 100% feedback when the unit becomes unstable. Three delay time potentiometers follow with an LED indicator above each—a ¼in jack socket and a pushbutton to the right and a 3-digit delay time indicator. Sequentially depressing the pushbutton selects the LED indicator above each of the delay time controls and indicates the selected delay time in the digital display. Thus three different delay times may be preset and the unit switched from one time to the next by depressing the pushbutton—this function is capable of remote control via the adjacent jack socket. Finally, the bass and treble equaliser potentiometers which are located in the echo return path.

The top section which controls reverberation is similar to the middle section in that it has a return level potentiometer which can be remote controlled via a ¼in jack socket connected to a footpedal or similar device. Also similar is the reverberation duration control which controls the feedback level around the digital echo section. And finally two 4-position rotary switches, one of which provides for a selection of four different decay or reverberation times, the other providing a prereverberation delay of 0, 25, 50 or 75ms. Other than a red LED indicator which indicates that reverberation is in action and echo out of action, this completes this section and the front panel facilities.

At the back of the unit is a mass of unbalanced ¼in jack socket connections. Whilst the input to the unit is monophonic the effects output is quasi-stereophonic, as the phase of the right channel is shifted 180° to produce a stereophonic effect. In practice, left, right and mono input sockets are provided so that stereo inputs can be handled with all the input at the rear panel, at a fixed level. Three sets of fixed level outputs are provided in the form of the original output. the pure delayed or reverberated output and the mixture of the original and delayed or reverberated signals. All these outputs have mono, left and right connections.

A 5-pin DIN socket allows connection to other Dynacord units providing a mono input and mixed output to the ancillary units. Finally the IEC mains power connection, a 110/220V selector switch and the power on/off switch which is peculiarly located at the rear of the unit.

Inside the unit all front panel controls are mounted directly onto a pair of printed circuit boards which also house a number of active components. The majority of the circuits are contained on four further plug-in printed circuit boards which connect with a mother board in the base of the unit, there being a small further board containing the D/A converter, a power supply board and a board at the rear panel which houses the multitude of rear panel jack connectors. The quality of the printed circuit boards gave me the impression that the review sample was a prototype as the board quality varied and there were a number of handwired modifications. However, component identifications for servicing were provided in most cases and the connections between boards were ribbon cables and connectors.

Inputs and outputs

As mentioned earlier all inputs and outputs are unbalanced; however, an optional accessory buffering and balancing unit is available to provide 'professional' input/output impedances, and levels. As the unit stands, the front panel jack input has a sensitivity of 1.5mV for 0dB indication on the level indicator with an input impedance in the order of 100kΩ. This input impedance was relatively constant with input gain setting but the input capacitance varied from 350pF at minimum gain up to 600pF at maximum. The impedance and sensitivity of this input make it suitable for direct connection to dynamic microphones or stage instruments.

The rear inputs for left, right and mono all had an input sensitivity of −6dBV (0.5V) without any gain control, the input impedance of the left and right inputs was 18kΩ and that of the mono input 88kΩ. These inputs are intended for connection to other Dynacord equipment but are also capable of interfacing with mixers of alternative manufacture. Finally the DIN connectors, which provide an input sensitivity of −40dBV (10mV) into 12kΩ in parallel with 100pF in addition to the left and right outputs of +8dBV (2.5V) for 0dB level indication from a source impedance of 7,300Ω. Whilst this connection is specifically intended for connection to other Dynacord equipment the input configuration happens to be DIN compatible.

The 'original', 'mixed' and 'delay' outputs all had a source impedance approximating 1kΩ but with the output levels for 0dB level indication varying as **Table 1.**

The front panel headphone jack is the remaining output providing the mixed output at 1.3V from a source impedance of 3,120Ω. It is perhaps unfortunate that this is a fixed level output only suitable for high impedance

82 ▶

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TABLE 1

Original output left and right	—6dBV
Original output mono	0dBV (1.0V)
Mixed output left and right	+3.5dBV (1.5V)
Mixed output mono	+6dBV (2.0V)
Delay output left, right and mono	0dBV (1.0V)

headphones and then only providing a low listening level.

Frequency response and distortion

The frequency response from the front panel input via the input equalisers to the 'original' output is shown in **fig 1**; this also shows the full range of the treble and bass equalisers which have a well-chosen performance.

The overall frequency response of the unit with the equalisers 'flat' for the echo (delay) mode and the reverberation mode, is shown in **fig 2**, the latter being measured by means of spectrum analysis of white noise. It is to be seen that whilst the frequency response in the echo (delay) mode extends towards the specified 8kHz this upper limit is halved in the reverberation mode where the limited high frequency performance leads to a rather dull reverberation. In both cases the overall frequency response was unaffected by the delay time setting or reverberation time. It is also to be noted from fig 2 that the roll-off at high frequencies is not particularly sharp, with the result that the anti-aliasing is not as effective as it might be.

As far as the echo return equalisers are concerned their characteristics show that whilst the bass equaliser is effective and identical to the input equaliser, the treble equaliser has a limited range (see **fig 3**).

Harmonic distortion was measured in the echo (delay) mode and found to be satisfactory at all operating levels, a typical distortion plot at −10dB input level is shown in **fig 4**—this indicates that both the second and third harmonic levels are consistently below 0.1%. Similarly the intermodulation distortion to the CCIF twintone method at the same operating level remains satisfactorily low as **fig 5.**

However, some peculiarities were noted in the reverberation mode where the distortion performance depended upon the decay time setting. In the decay time settings two and four, the performance was subjectively free from distortion up to the full operating level indication, but in the decay time settings one and three, distortion could be severe at levels higher than −15dB indicated operating level. Furthermore it was possible to have control settings which led to output clipping without any overload indication and it is felt that this is a serious shortcoming of the unit which should be rectified by the manufacturer.

Level display

It was found that the LED level display was accurate in calibration with the top +3dB LED illuminated at the onset of clipping. Other than the top three LED indicators, which are arranged at 3dB intervals, the lower indicators down to −39dB are arranged at 6dB intervals.

Being a peak detecting display with a very fast and satisfactory attack time it is suspected that the level is derived from the digitised signal—which is ideal as far as the digital processing is concerned. However, it is unfortunate that the audio output from the unit is derived from the analogue addition of the input and processed signal which may also have been boosted by the echo return equaliser. The result of this addition is that the output has inadequate headroom in some circumstances and can be driven into clipping without overload indication. ▶

FIG.1
DYNACORD DRS 78
ORIGINAL FREQUENCY
RESPONSE WITH
INPUT EQUALISER

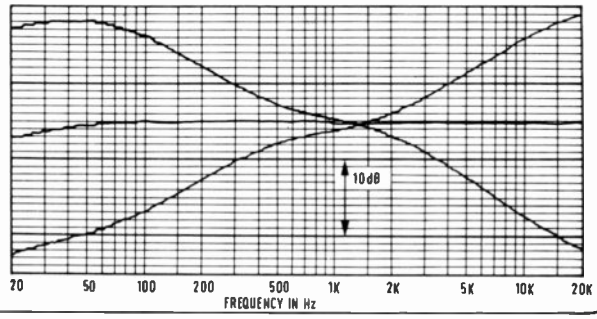

FIG.2
DYNACORD DRS 78
OVERALL FREQUENCY
RESPONSE

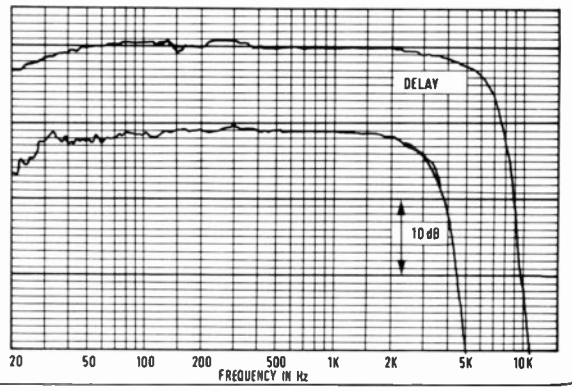

FIG.3
DYNACORD DRS 78
ECHO EQUALISER

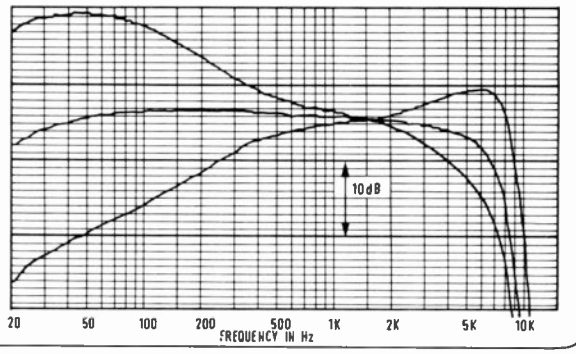

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FIG. 4
DYNACORD DRS 78
HARMONIC DISTORTION
AT -10 dB

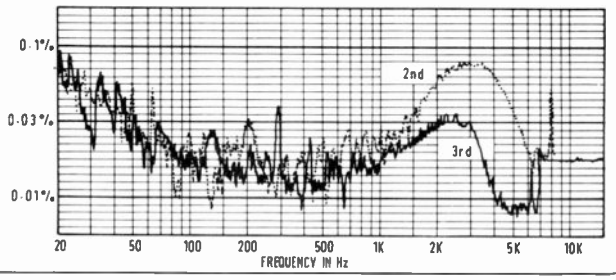


FIG. 5
DYNACORD DRS 78 CCIF IM
DISTORTION AT -10dB

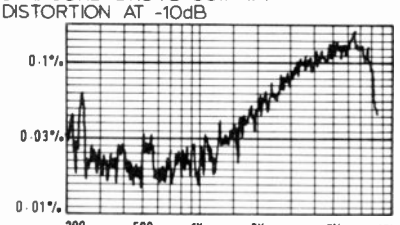


TABLE 2

Measurement method	Original	Delay echo	Delay reverberation
Band limited 22Hz to 22kHz rms	78dB	67dB	72dB
A-weighted rms	81.5dB	67dB	72dB
CCIR-weighted rms ref 1kHz	73dB	64dB	65.5dB
CCIR-weighted quasi-peak ref 1kHz	69dB	60dB	60dB

Noise

Without an input signal the effects outputs of the unit are remarkably silent, but with an input signal and the dynamic range in the 80 to 90dB order, there is an abrupt increase in noise. Unfortunately the method of digital coding is not known but it appears that no dither is used in what is known to be a 12-bit system with a potential dynamic range of 72dB, which correlates with the measured dynamic range under signal conditions.

Table 2 shows the dynamic range of the direct outputs and that of the delay output in both the reverberation and the echo mode in the presence of an input signal, the results being independent of the signal level once above the threshold of noise generation.

While these results are respectable it was found that the front panel input was noisy at maximum gain with the noise referred to the input being -119dBm or -121.5dBm A-weighted with the input shunted with 200Ω.

Delay (echo) and reverberation

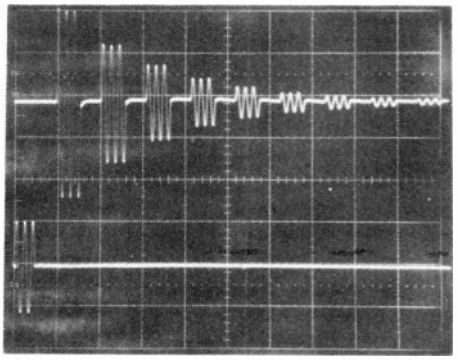
The accuracy of the delay time setting was generally found to be such that the indicated delay was 10% longer than the actual delay with the measured range from 5.6ms up to a maximum of 288.3ms and the display showing 320ms.

Apart from the above the performance of the delay controls was good but slight clicks were introduced when sweeping the delay time. However it is thought unlikely that these would be audible on programme material. The range of the decay control was wide such that instability could be produced by applying excessive feedback, but this feature can be put to use and the repeat control recycles a full 320ms nominal storage capacity.

Fig 6 shows an input toneburst and the echo (delay) output—and the unit produces a pure repeat of the input with decreasing amplitude according to the setting of the decay control.

In the reverberation section it was found that the prereverberation delay was 10% longer than the nominal setting, but this error is of little consequence and it is nice to find this feature in a reverberation unit.

Fig. 6



With the exception of the distortion at some decay time settings, the reverberation characteristic was realistic, but as previously mentioned the frequency response makes the sound rather dry. It was found that the four reverberation time settings offered by the 'decay' control approximated to 0.5s, 1.5s, 2s and 2.5s covering the more common range of requirements.

Summary

This Dynacord reverberation unit is certainly versatile for stage use and it could well find a place in studios in view of its low price when compared with digital studio equivalents.

As has been seen there are a few snags, particular shortcomings being the possibility of output clipping without indication and also distortion in the reverberation section at certain decay settings, but the latter could be a fault peculiar to the review sample. In other respects the measured performance was satisfactory but the addition of dither to the digital section would improve the subjective noise performance.

Hugh Ford

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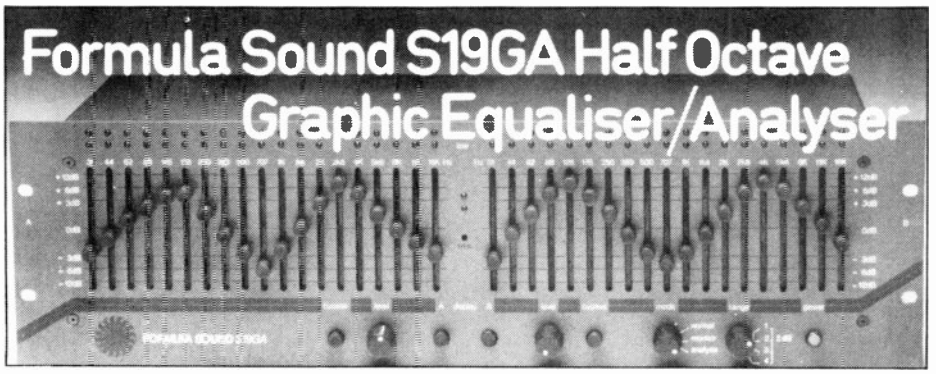


MANUFACTURER'S SPECIFICATION
EQUALISER
Filters: 19 equaliser filters per channel with centres at 31, 44, 62, 88, 125, 176, 250, 353, 500, 707, 1k, 1·4k, 2k, 2·8k, 4k, 5·6k, 11k and 16kHz.
Filter type: simulated inductor. Equal Q in both cut and boost.
Frequency response: equaliser in, controls set flat 10Hz to 30kHz ±0.5dB.
Gain: unity—all controls set flat or in bypass. Optional internal link provides 10dB gain.
Output: maximum level before clipping into 600Ω +20dBV (+22dBm). Source impedance 50Ω, 'oad 600Ω or greater, unbalanced (transformer option available).
Input: input impedance 47kΩ, balanced bridging, differential amplifier.
Distortion: frequency 1kHz, output level +20dBm, equaliser flat, better than 0.01% typically 0.005%. Worst case—all controls at maximum boost 0.02% total.
Equivalent input noise: equalisers in and set flat, less than —90dBV bandwidth 20Hz to 20kHz, equaliser bypass —96dBV, bandwidth 20Hz to 20kHz.
Channel separation: 1kHz —90dB. 10kHz —80dB.
Front panel controls: power on/off pushbutton (illuminated), each channel has 19 sliders with 58mm travel and ±12dB range, rotary channel level control and equaliser bypass pushbutton.

ADDITIONAL FEATURES — EQUALISER/ ANALYSER
Analyser section: 19-band ⅓-octave filter set with frequencies as the equaliser, dual LED display, LED indicators for accurate adjustment of the input level, precision digital pink noise source providing equal energy per octave, microphone pre-amplifier, transformer balanced input, gain trim provided via front panel, Phantom power for AKG *451* microphone.
Measurement microphone: most laboratory quality non-directional low impedance microphone. For general purposes use AKG *451* with *CK2* omnidirectional capsule which is suitable.
Front panel controls: display A or B, two interlocked pushbuttons switching analyser functions to channel A or B.
Mode: 3-position switch, 1) Normal: Analyser section off, graphic equaliser functions normally; 2) Monitor: Analyser section monitors output of channel A or B; 3) Analyse: Switches pink noise output via level control into selected channel. Display monitors microphone output.
Range switch: a 4-position switch to set limits of display between ±1dB and ±4dB.
Calibration: analyser supplied to provide hf roll-off referred to pink noise, flat response available with internal link, 19 internal channel presets for calibration of analyser.
Power requirements: 200-240V ac (100-120V internal adjustment) 50-60Hz at 17VA.
Connectors: IEC power connector. 3-pin XLR audio connectors.
Dimensions whd: 19 x 5¼ x 7in (482 x 133 x 177mm) excluding connectors.
Weight: approximately 12½lb (5.7kg).
Finish: bronze anodised aluminium.
Price: £795. S19G equaliser only £425.
Manufacturer: Formula Sound Ltd, 3 Waterloo Road, Stockport, England.

THE Formula Sound *S19G* graphic equaliser forms part of the *S19GA* graphic equaliser/analyser and is available as a separate item as a straightforward graphic equaliser without the pink noise source and analysing features of the *S19GA* reviewed here.

In either case the *S19G* graphic is a ⅓-octave equaliser covering centre frequencies from 31Hz to 16kHz in 19 sections, each of which has a cut/boost range of up to ±12dB. Very sensibly the first half of the movement of the slider controls covers only the first ±3dB thus allowing the accurate and positive setting of small amounts of equalisation. As the unit is a 2-channel device it has 38 slider controls on the standard 19in rack-mounting front panel, thus the controls are rather crowded and require some delicacy in operation. In addition, and a feature I favour, is a switch for bypassing the equalisers but not the input and output stages and a level control—which are duplicated for each channel.

The *S19GA* equaliser/analyser is an unusual instrument as it not only contains the twin-channel ⅓-octave graphic equalisers but also a pink noise source, a ⅓-octave analyser and also a microphone input facility so that the analyser can be driven from a measuring microphone.

The front panel layout of this instrument is such that the equaliser controls are clearly identified in frequency at the top and in cut/boost by lines at ±3dB, ±6dB and at ±12dB. Above each of the equaliser controls are two red high and low LED indicators showing whether the input is above or below a preselected level in each ⅓-octave band. Also two further LEDs between the equaliser channels indicate the level of the wideband signal with an adjacent screwdriver-operated 'trim' control setting the overall operating level of the analyser.

Under each section is a bypass locking pushbutton and an operating level potentiometer of the full range type. Two interlocked pushbuttons, under each section, 'display' A or B, switch the analyser section to activate the LED display above either section. A 4-position rotary switch controls display range such that the high or low LED indicators are illuminated at ±1dB, ±2dB, ±3dB or ±4dB above or below the preselected levels for each ⅓-octave band. The instrument has been designed so that each ⅓-octave analyser has its own control for setting the operating level of each ⅓-octave display and so that the overall display can be preset to any required frequency response curve by means of potentiometers within the unit.

A 3-position rotary switch on the front panel selects 'normal', 'monitor' or 'analyse'. 'Normal' for when the unit is required simply to act as a ⅓-octave equaliser; 'monitor' where the analyser section monitors the output of either equaliser section according to the display A or B pushbutton's setting, and the normal graphic equaliser function remaining in action; or 'analyse' when the level display is fed from the microphone input, so that it functions as a ⅓-octave analyser with pink noise fed via either equaliser section (in accordance with the 'display' A or B pushbutton settings). The illuminated power on/off pushbutton is powered via an IEC connector on the rear panel with an adjacent fuse properly identified for either 230V or 113V operation.

Recessed behind the rear panel is a pink noise 'trim' potentiometer for setting the level of the pink noise output in the 'analyse' mode —this potentiometer is screwdriver operated. And finally the input and output connectors for the two equaliser sections and the microphone input for use in the 'analyse' mode, all these are XLR connectors.

The unit's construction is solid—the basis of which are four moderately thick alloy plates. Two 'U'-shaped covers screw onto the sides to form the top and bottom and the power supplies and pink noise generator are located in the base (which is screened from the remainder of the circuits). One large printed circuit board covering the complete area of the unit contains the equaliser sections with a second similar printed circuit board at the top of the unit housing the analyser section complete with the display LEDs which poke through the front panel.

Both mechanically and electrically the standard of construction and finish is excellent with very simple access to all components clearly and logically laid out. All interconnection between boards is by means of connectors and there is no wiring to the controls which are all mounted onto the good quality printed circuit boards.

Inputs and outputs
The audio signal inputs are electronically balanced and buffered before the gain control which results in an input impedance constant with gain measured at 93,900Ω in the balanced

88 ▶

FIG.1
FORMULA SOUND S19GA OVERALL FREQUENCY RESPONSE

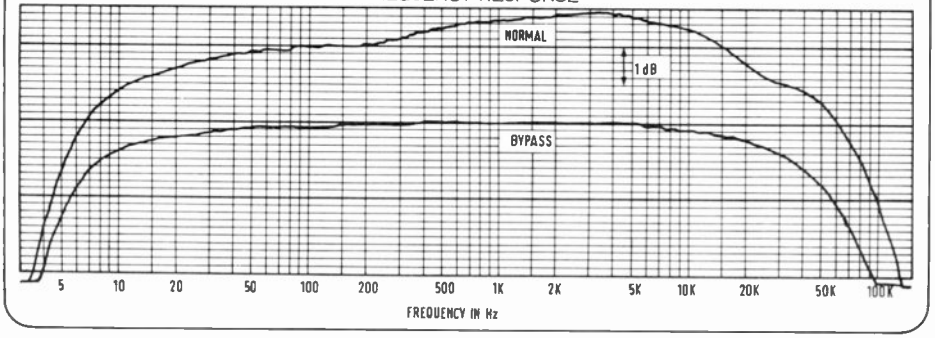


FIG.2
FORMULA SOUND S19GA EQUALISER FREQUENCY RESPONSE

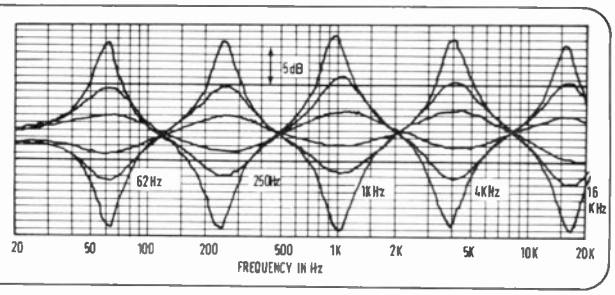


FIG.3
FORMULA SOUND S19GA 1/3-OCTAVE ANALYSIS OF NOISE OUTPUT

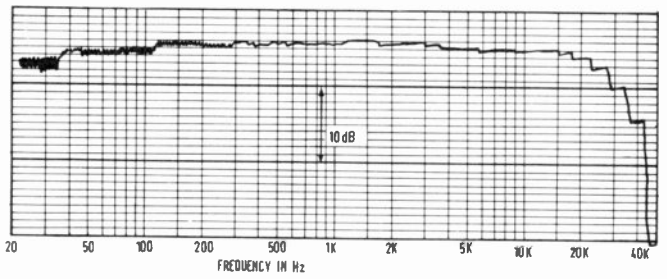


FIG.4
FORMULA SOUND S19GA THIRD HARMONIC DISTORTION, -10dBm OUT

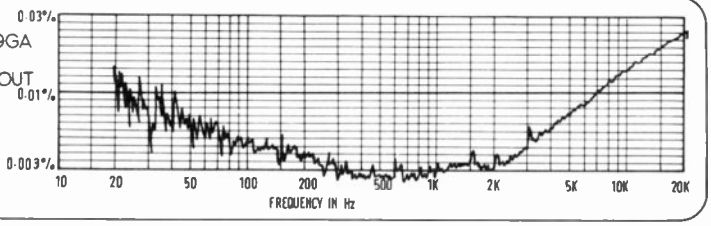
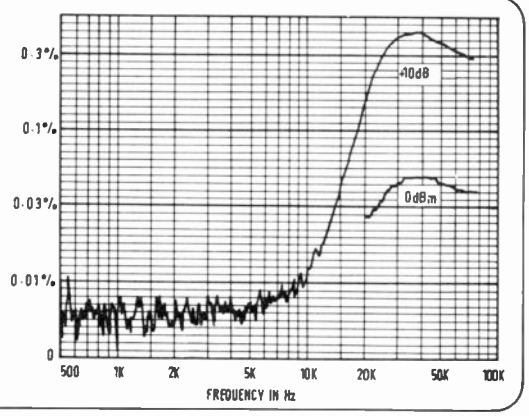


FIG.5
FORMULA SOUND S19GA CCIF IM DISTORTION, EQ FLAT



mode or 90,900Ω when used in the single-ended mode. Common mode rejection was excellent at greater than 70dB below 2kHz reducing to 60dB at 15kHz with the maximum input signal level handling capability being adequate at +21dBV.

The phantom-powered connect microphone input has an input impedance of 1.12kΩ and a measured 17.7V powering; this is suitable for the recommended AKG *C451* microphone with the omnidirectional type *CK2* capsule. The sensitivity of the microphone input for the lower level LED to be illuminated on the ±1dB range was found to be variable, from −70dBV to −33dBV according to the setting of the front panel 'trim' control which sets the overall display sensitivity.

The output impedance was adequately low—measured as 49Ω with a maximum drive capability of +20.5dBm into a load of 600Ω in either the bypass or equalisation modes. When in the analyse mode the level of pink noise at the output can be varied from zero to 0dBm by means of the pink noise trim control behind the rear panel.

Frequency response and noise

The overall frequency response in the normal and bypass modes with all equalisers set to their mechanical flat position is shown in **fig 1** depicting a response from 20Hz to 20kHz of +0, −0.4dB in the bypass mode and remarkably +0.9, −0.6dB in the equalise mode.

As far as the equalisers are concerned, their frequency response (for a few samples) is shown in **fig 2** with the equalisers set to ±3dB, ±6dB and ±12dB. Whilst their performance is not identical, the matching is certainly adequate as is the shape of the curves.

The accuracy of the centre frequencies of all equalisers was checked and found to be remarkably good at generally within 1% of nominal. A ½-octave analysis of the pink noise output is shown in **fig 3** from which it can be seen that over the analyser's frequency range, from 31Hz to 16kHz, the noise is within ±1dB of the ideal spectrum. However listening to the pink noise showed that it had a cyclic pattern with a low frequency jump about every 2s: it is this that produced the ripples in the low frequency part of **fig 3** and a narrow band spectrum analysis gave peculiar results.

Noise in the output was measured in the bypass mode and also in the equalising mode with all equalisers in the flat position, the gain control at maximum (unity gain from input to output) with the following results which are very good (**Table 1**).

Very sensibly the manufacturer has isolated the signal earth from the chassis earth and in view of the use of a toroidal mains transformer and proper screening, no hum problems were found.

Distortion

In the flat condition with the equalisers in circuit, the harmonic distortion relative to frequency is shown in **fig 4** in terms of the predominating third harmonic at −10dBm working level. Whilst this remains low, the CCIF twin tone intermodulation distortion is at the same level, as shown in **fig 5**, remaining

91 ▶

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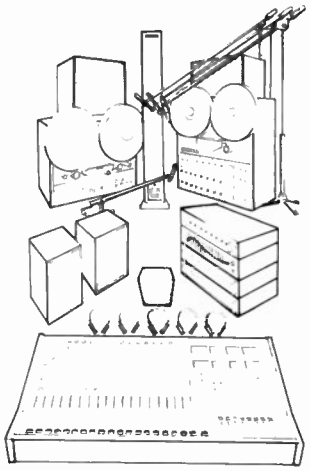

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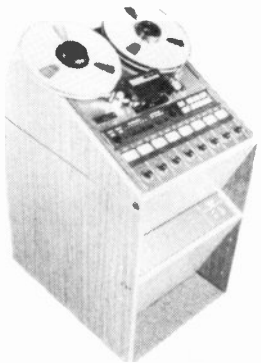

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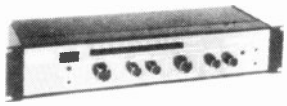

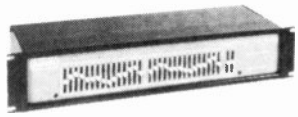

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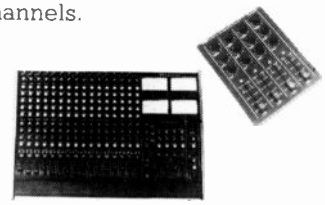

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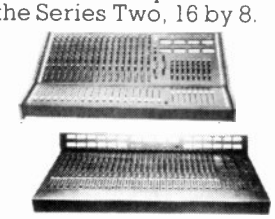

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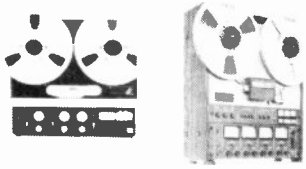

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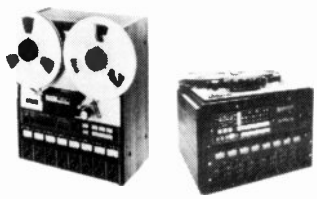

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low up to a frequency of 10kHz above which it rises rapidly particularly at higher working levels. This feature could be indicative of transient intermodulation problems.

Similarly, investigations into the total harmonic distortion and noise showed a significant increase in distortion products at high frequencies and revealed that the distortion was highly dependent upon the setting of the equalisers increasing at either extreme setting and changing in characteristic.

Feeding squarewaves or tone bursts through the equaliser produced the normally predicted results without any instability or other defects and in this respect everything was in order.

The analyser

The frequency response of the analyser may be trimmed to match the user's desires, as previously mentioned, and is normally supplied with a degree of high frequency cut, the measured response as supplied is shown in fig 6. In practice each ½-octave band has a potentiometer trimmer which can adjust individual channels by up to 10dB, thus permitting the insertion of any practical curve into the analyser.

Level ranges of ±1dB, ±2dB, ±3dB and ±4dB for the LED indicators were found to be extremely accurate in all cases with less than 0.1dB error for the illumination of the LED indicators. As is necessary, the averaging times of each frequency band is different and this seemed to be fairly well arranged for pink noise analysis with the display appearing to have something close to an rms rectifier.

In the monitor mode the display sensitivity for the lower LED indicator, to be just illuminated in the ±1dB range, could be varied between +2dBV and −35.5dBV by a front panel control providing a more than adequate range.

The crosstalk between the two sections was generally low as fig 7, but I was not able to meet the manufacturer's specification of 80dB at 10kHz, which is unnecessarily good anyway.

Crosstalk between the audio signal input and the pink noise output in the analyse mode was audible, but the level was such that it did not interfere in any way with measurements.

Summary

This Formula Sound equaliser/analyser is an unusual and versatile device for equalising rooms and generally checking the performance of audio systems.

Naturally its accuracy depends largely upon the microphone used, but such mics as the recommended AKG *C451* with the omnidirectional capsule are adequate for most purposes where an expensive measuring mic cannot be justified.

The analyser section gave accurate results and it was found that the four level ranges were a most practical feature; however it may be disputed if the instrument should be supplied with a high frequency roll-off in the analyser, when in practice it may well be used for purposes other than the acoustic alignment of rooms.

Regarding the equaliser performance it was generally very good but I do have some reservations about distortion at high frequencies, particularly when large degrees of equalisation are used. **Hugh Ford**

Table 1

MEASUREMENT METHOD	BYPASS CHANNEL 1	BYPASS CHANNEL 2	EQUALISE CHANNEL 1	EQUALISE CHANNEL 2
Band limited 20Hz to 20kHz rms	—96dBm	—96dBm	—87dBm	—86dBm
A-weighted rms	—99dBmA	—99dBmA	—90dBmA	—90.5dBmA
CCIR-weighted rms ref 1kHz	—90dBm	—90dBm	—81.5dBm	—83dBm
CCIR-weighted quasi-peak ref 1kHz	—85dBm	—85dBm	—76dBm	—79dBm

FIG.6
FORMULA SOUND S19GA
MONITOR FREQUENCY
RESPONSE

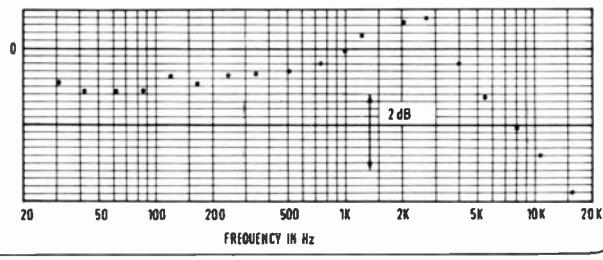
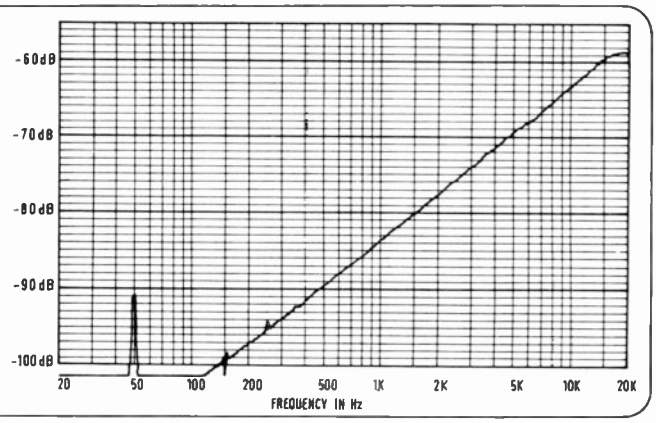


FIG.7
FORMULA SOUND S19GA
CHANNEL SEPARATION



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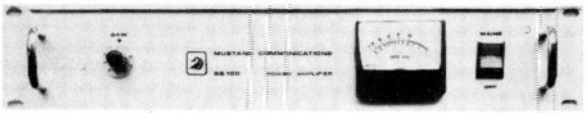

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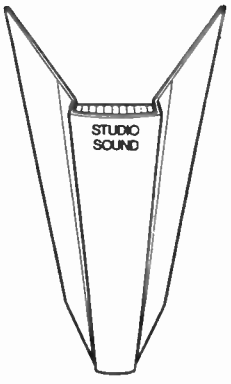

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Note: Advertisement copy must be clearly printed in block capitals or typewritten.
Replies to Box Nos. should be addressed to the Advertisement Manager, Studio Sound, Link House, Dingwall Avenue, Croydon CR9 2TA, and the Box No. quoted on the outside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

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

STUDIO FACILITIES

★**Disc Cutting** Masters and Demos, Pressings, Cassettes, Mobile Recording Studio. Free brochure. TAM Studio, 13a Hamilton Way, London N.3. Tel. 01-346 0033. K

★**Radio Production Studios** for Commercials, Voice-Overs, A.V. Soundtracks, Audio Promotions. D.I.Y. or complete service. Mark Stevens Productions Limited. 01-485 8087. L

★**Vinyl pressings** from your tapes. Labels. S.A.E. for list. Deroy Records, P.O. Box 2, Morecambe, Lancs. X

IF YOU NEED . . .

Cassette Duplication	Empty Tape Spools
Blank Cassettes	White Tape Boxes
¼" Tape	8T Cartridge Bodies
Leader Tape	Lubricated Tape
Splicing Tape	Head Cleaner Tape

Why not ring us on 01-399 2476/7 and let us quote you for your next requirements.

MEDIATAPE LIMITED, 29a Tolworth Park Road, Surbiton, Surrey.
01-399 2476/7

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

CHERRY RECORDING STUDIOS
41 Leslie Park Road, Croydon, Surrey
MASTER Quality at Demo. prices: Ampex 16 and 8 Track; Alice ACM 20-16; A and D Compressor Limiters; Digital ADT Sennheiser AKG Neumann. Friendly service.
Grand Opening Offer
16 Track £12.50 per hour; 8 Track £7.50 per hour; Long Runs, Cassette Copying, Tape Duplicating, Record Pressing. **Call us now: 01-654 1197**

SERVICES

★**Studio Design.** Complete acoustic design and measurement services for new studios and studio expansions. Monitor system equalisation service. Acoustic Technology Ltd., 58 The Avenue, Southampton SO1 2TA. Phone (0703) 37811. US Office: 320 Dresser Tower, 601 Jefferson, Houston, Texas 77002. Tel. 713/759-9768. X

TAPE COPYING SERVICES
We specialise in short run cassette duplication.
NO JOB TOO SMALL
Fast turnround, reliable service
LOW COST
STEREO—MONO—PULSED
01-723 6301 (Baker Street)

★**Pressings of classical quality** (colour also) promptly manufactured from your Master tapes. Sleeve printing, mailing service. Studio or mobile units for Master recording. Specify requirements to Mike Bull, Sound News Studios, 18 Blenheim Road, London W4 1ES. Tel. 01-995 1661. M

METROTONE STUDIO INSTALLATIONS LTD.
WIRING SPECIALISTS
MAINTENANCE
ACOUSTIC DESIGN
All recording studio wiring undertaken: free estimates.
Tel. 01-391 1228
or BYFLEET 47854
(24-hour SERVICE) REFERENCES AVAILABLE

CASSETTE	DUPLICATION		PRICE	LIST
	20+	100+	250+	500+	1000+
C10	·58	·54	·50	·47	·44
C20	·60	·56	·52	·49	·46
C30	·62	·58	·54	·51	·48
C40	·69	·65	·61	·57	·53
C50	·74	·70	·66	·62	·58
C60	·85	·81	·77	·72	·67
C90	1·09	1·04	·99	·92	·85

01-360 1200 **DUPLICASSETTES** 01-903 0827
□ 67 COMPTON RD □
LONDON N21

HIGH SPEED CASSETTE COPYING IN MONO OR STEREO AT COMPETITIVE PRICES
Long or short runs.
Blank cassettes supplied in bulk.
A growing reputation for reliability.
MORARD SOUND PRODUCTIONS
THORNTON HEATH, SURREY
Telephone 01-689 7424

★**Pentagon spares,** most parts, ex-stock, service nationwide, prompt personal engineer, ten years high speed experience. Other makes also. Phone 24 hours 0628-33011. A

COUNTY RECORDING SERVICE
From your tapes we cut master discs, demo discs, using our Scully lathe fitted with the latest ME/76 UK stereo disc-cutting system.
Dolby 'A', Dolby 'B' and DBX Noise Reduction.
Telephone Bracknell (0344) 54935.
London Road, Binfield, Bracknell, Berks, England

audio & design (recording) ltd
announces a series of free
U K SEMINARS

A demonstration of Audio Visual presentation of Signal Processing Equipment and its application in Recording, Broadcasting and allied fields.

Sept.: Glasgow/Edinburgh/Tyne & Wear
Oct.: Swansea/Birmingham/Liverpool/Manchester
Dec.: Leeds/Nottingham/Ipswich

Write for FREE details and information to:
Audio and Design Recording Ltd.
Freepost
84 Oxford Road
Reading
Berks RG1 1BR
SCAMP

SPR
SPEECH RECORDING
CASSETTE DUPLICATING
OPEN-REEL DUPLICATING
LANGUAGES/AUDIO-VISUAL
SPEECH-PLUS RECORDINGS LTD
32, PAGES WALK, SOUTHWARK, LONDON SE1 4SB. 01-231 0961/2

FOR SALE—TRADE

★**The Astounding** new four track Teac 3440 is available now from C.A.V.S. Ltd., anticipated list price £900 plus V.A.T. Phone Geoff Yates, 01-363 6125. K

★**Endless cassettes** from 10 seconds to 20 minutes, exact length blanks from 13p, cassette duplication; opsis sound. Freepost, Romford RM2 1BR (04024) 53424. L

★**Telefunken M251** condenser microphone. Made by AKG. Omni-directional, cardiod, figure eight. Power supply. Little used, immaculate, £55. Twickenham 01-892 9238 K

★**Ampex-Sound** techniques 440 4-track console in excellent condition, balanced 1/0 sync outputs, £900 o.n.o. Mr. Smith, 01-388 7164 office hours. K

★**Nagra III** full track recorder, ATN crystal sync pre-amp mixer plus converter for IV. Sennheiser mics, accessories. 891-2993. K

★**Two Electrosund** cassette/cartridge loading machines, fitted into workbench and complete with splicers, control boxes and other spares/extras. £1650 plus V.A.T. Also one Brennell made cassette loading machine with footage counter—£300 plus V.A.T. 01-399 2476/7. L

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

★**Discount recording tape.** Limited quantity top quality ½ inch EMI £11 per roll; 2 inch Ampex £40 per roll; used 2 inch Ampex £12 per roll. 01-722 2678. K

★**Add accurate level** control to your mixer with the Cathedral LA3 comp/limiter module. Excellent performance at moderate cost. Build your own mixer with Cathedral low noise channel modules dispatched post free to any part of the world. Cathedral Sound Ltd., Fourways, Morris Lane, Halsall, Lancs L39. Tel. Halsall (0704) 840328. X

HELIOS CONSOLE

32 input, 24 output automated mixing console — 8 VCA groupers, quadraphonic sub-grouping system with 8 joy-sticks — full main group to sub-group routing, 4 band parametric equalisation on all channels. Huge patchfield — echo and foldback systems — 4 A & D companders — oscillator, phase display and full VU metering — available December 1979. **£33,000**

Call:
THE MANOR, Kidlington (08675) 2128

★**Bose 802** speakers with equalisation £475 per pair or £432 without equalisation. Amcron DC 300 £498 and D150A at £310. All prices plus VAT. Contact Geoff Yates, C.A.V.S. Ltd., 01-363 6125. A

EAST LONDON
REGISTERED FULLY OPERATIONAL 8 TRACK RECORDING STUDIO AND REHEARSAL ROOMS. OFFERS AROUND
£16,500
Write for details to
Box No. 813

FOR SALE—PRIVATE

★**Studer A80 16-track** 30/15, line input modification, recently re-lapped heads, complete with spares and manual. £11,500. Apply (060 885) (Brailes) 269, private and well cared for. K

★**1in 8-track 284 Scully,** excellent condition, £3,500. A & H 14 x 8 x 8 mixer, noise gate, stereo compressor, £1,250. Other equipment also available. Tel. 01-534 5472 (24 hours). K

SITUATIONS WANTED

★**Film Dubbing Mixer,** fully experienced, available on freelance basis. Will travel at home or abroad. Also available for recording equipment installation consultancy or film location recording service with equipment. Lionel Strutt. Tel. 01-953 9214. Telex 912881. K

★**After six years** at a major London studio and 18 months with a disappointing Merseyside project, experienced 24 track engineer seeks enjoyable freelance sessions. Fees negotiable. Phone Phil on Formby 76137. K

★**Energetic** 25 year old seeks employment in recording studio as trainee/assistant, experience in c.c.t.v. studio, electronic maintenance and some mixing work. Box 817 c/o Studio Sound. R

★**Very experienced** recording engineer, returning to work full-time after three years taking degree, seeks post with major studio. Eleven years experience of every kind of session and equipment. Box No. 815. K

★**Recording engineer** (23) presently employed with B.B.C. seeks position as assistant/trainee engineer in London multitrack studio. Technical and musical qualifications. Box 816 c/o Studio Sound. K

WANTED

★**Wanted. Revox and Teac** Tape Recorders. Best prices paid. R.E.W. Professional Audio. 01-836 2372. X

SITUATIONS VACANT

Sound Advice

—join us! If you are an experienced television sound technician or would like to train as one, you could take a progressive step in your career by joining ATV.

We are recruiting a range of sound staff for our studio centre in Birmingham, at all levels from Trainee to Substantive.

We'd like to hear from you if you are an established sound technician with good practical experience of TV studio work and a desire to improve your position.

We'd also be interested in you if you have the necessary qualifications for a trainee—a genuine interest in sound, a basic knowledge of electronics, 5 'O' levels (including maths and physics), and aged between 18 and 22.

We can offer you a rewarding position (at rates well above the national level)—so for a more satisfying future, contact us now. That's sound advice.

(Experienced applicants please quote Vacancy Number 67: applicants for trainee positions please quote Vacancy Number 68).

Application forms are available from:-

The Head of Staff Relations,
ATV Network Limited
ATV Centre, Birmingham. B1 2JP 021 643 9898 Ext. 369
Open to male/female applicants.

TECHNICAL LIAISON EXECUTIVE

Dusseldorf

Maxell Europe are International leaders in the field of quality magnetic tapes which include audio and video cassettes. As a result of their European expansion programme they require a young and energetic person, ideally aged 25-35 to work closely with their European distributors and dealers and to supervise the Maxell tape clinics.

Based in Dusseldorf but with extensive European travel, a working knowledge of German would be useful, though not essential. Salary will be negotiable, commensurate with the position.

Please write to the address below.

CHR Recruitment
11 Hanover Street, London W1R 9HF.
Telephone: 01-629 3727. Telex: 261254 CHRINT

SAMUELSON SIGHT AND SOUND LIMITED

WE NEED AN
AUDIO-VISUAL SOUND OP

who is enthusiastic, versatile, congenial, responsible and reasonably if not fully conversant with large amplification equipment, multi-channel mixing for P.A.; and who is willing to learn about projection, tape slide equipment etc. etc. ARE YOU? – if so, give us a ring on 01-452 8090 and ask for Charlie Beddow.

GOOD WORKING CONDITIONS
AND SALARY.

GO WITH A PROGRESSIVE COMPANY

MCI UK

REQUIRE

A field engineer, extensive experience in trouble-shooting digital and micro-processor based studio equipment absolutely essential. Must be prepared to travel. Second language would be an advantage.

Apply in writing to:

D. FELLNER
MCI HOUSE
54/56 Stanhope Street,
London NW1 3EX

TRIDENT RECORDING STUDIO LTD

Due to expansion Trident have vacancies for a Balance Engineer and Audio Maintenance Engineer. The balance engineer must be fully conversant with modern-day multitrack recording techniques and have an excellent track record. The applicant for the maintenance position should have Studio experience, together with a sound knowledge of electronics. Salaries are negotiable.

Please ring **Peter Booth 01-734 9901.**

UTOPIA

Trainee Disc Cutting/Tape Copying Engineer required for one of London's most successful independent Recording Studios.

Duties will be interesting and varied.

A great opportunity for a young person interested in a career with a company with a proven track record.

Applications in writing please to:

Derek Sticklen

Utopia Studios, Spencer Court,
7 Chalcot Road, London NW1

AUDIO TEST ENGINEER

wanted. Work includes testing hi-fi equipment with superb test gear. Age immaterial, but some experience required. £4,000-£6,000 p.a. Apply in writing to

ANGUS McKENZIE FACILITIES LTD.
57 Fitzalan Road, London, N.3.

All enquiries treated in confidence

SOUTHERN ✳ TELEVISION

requires a

SOUND TECHNICHAN

based at their Southampton Studios

Salary dependent upon applicant's degree of experience in Studio Sound Operations. Additionally there is a Productivity Supplement.

Conditions of employment are excellent and include a five day working week, four weeks and one day annual holiday, Pension, Life and Accident Insurance Schemes, and staff restaurant.

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The Personnel Administrator,
Southern Television Limited, Northam, Southampton SO9 4YQ.

THE POLYTECHNIC OF CENTRAL LONDON

SCHOOL OF COMMUNICATION

Senior Sound Engineer £5843 – £6203
Sound Engineer £4379 – £4967
Salaries currently under review

The Media Unit of the School requires two audio engineers to work in its Broadcast quality radio studios. The senior post will involve demonstrations to students of current radio practice.

Application form and job description from The Establishment Officer, PCL, 309 Regent Street, London W1R 8AL (01-580 2020 Ext. 212)

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THE ADVERTISERS INDEX FOR THIS ISSUE APPEARS ON PAGE 97

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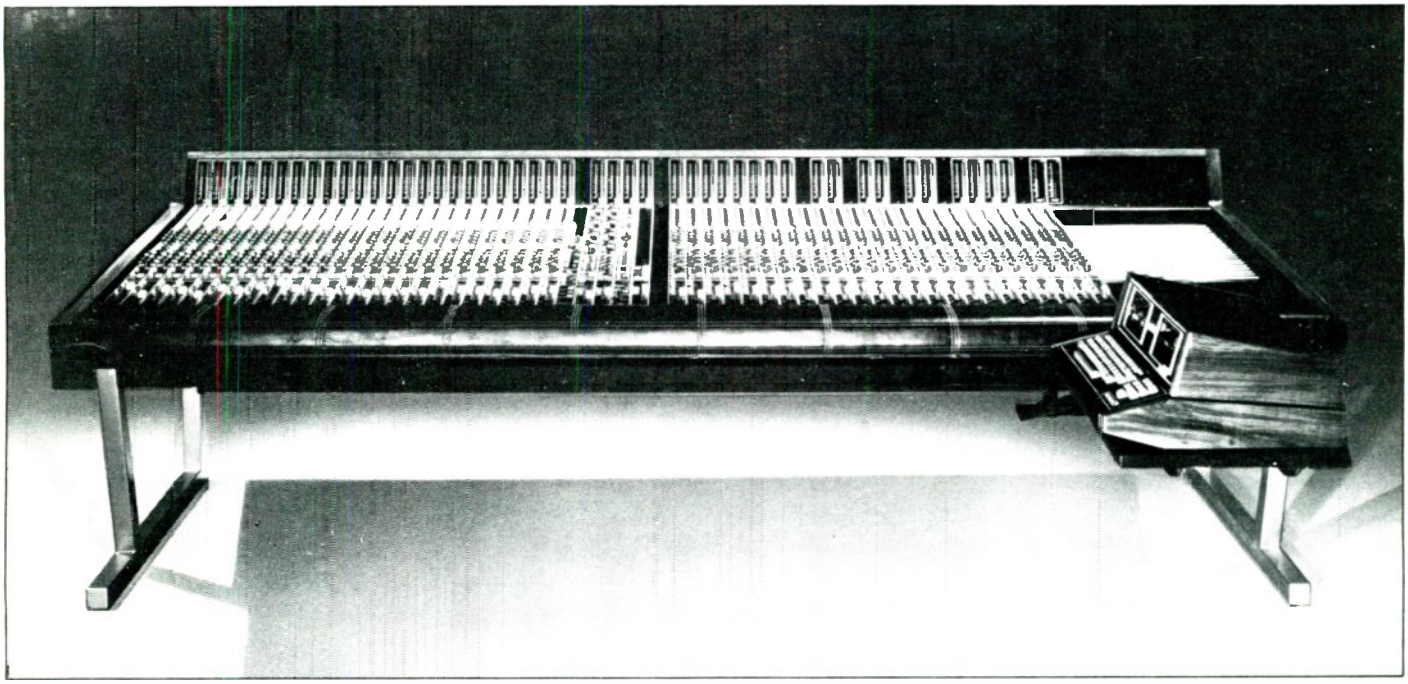
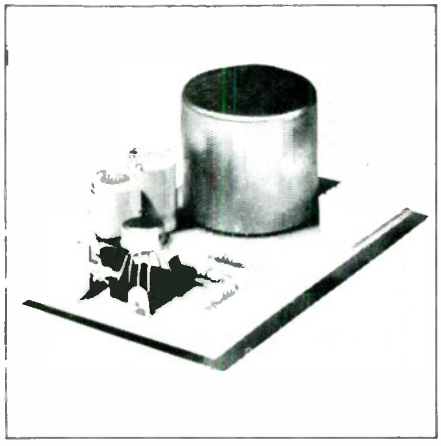
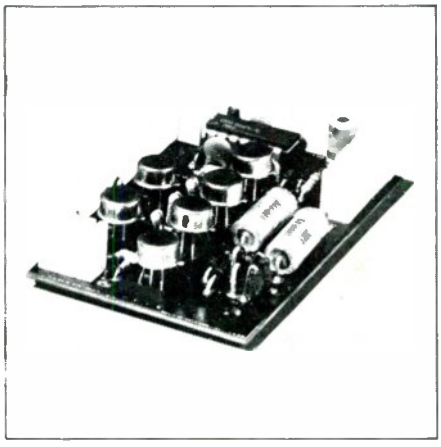
SOME COMPANIES GIVE YOU A PRICE THAT SOUNDS GOOD. HARRISON GIVES YOU A CONSOLE THAT SOUNDS GOOD!

And "good sound" is what our business is all about. That's why we build consoles with *you*, the engineer and studio owner, in mind. We use the highest quality components and circuit designs in our consoles. These give you maximum reliability and the cleanest and quietest possible sound. The almost unlimited flexibility of a Harrison console gives the recording and balance engineers the opportunity to be truly creative. Quality, reliability and flexibility. Others talk about these features... Harrison delivers them in every console. Harrison consoles, a sound investment.







HARRISON Model 4832, 48 input channels, 32 output channels, with Harrison AUTOSET automation programmer

Now, Harrison also gives you a choice. Console Models 4832, 4432, 4032 and 3232 are available with your choice of microphone preamplifiers: with or without input transformers.

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EXPORT AGENT:

Audio Systems International
128 North Highland Avenue
Los Angeles, California 90036
Tel: (213) 933-2210 • Telex. 686101

FACTORY:

Harrison International Corp.
Post Office Box 22964
Nashville, Tennessee 37202
Tel: (615) 834-1184 • Telex: 555133

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