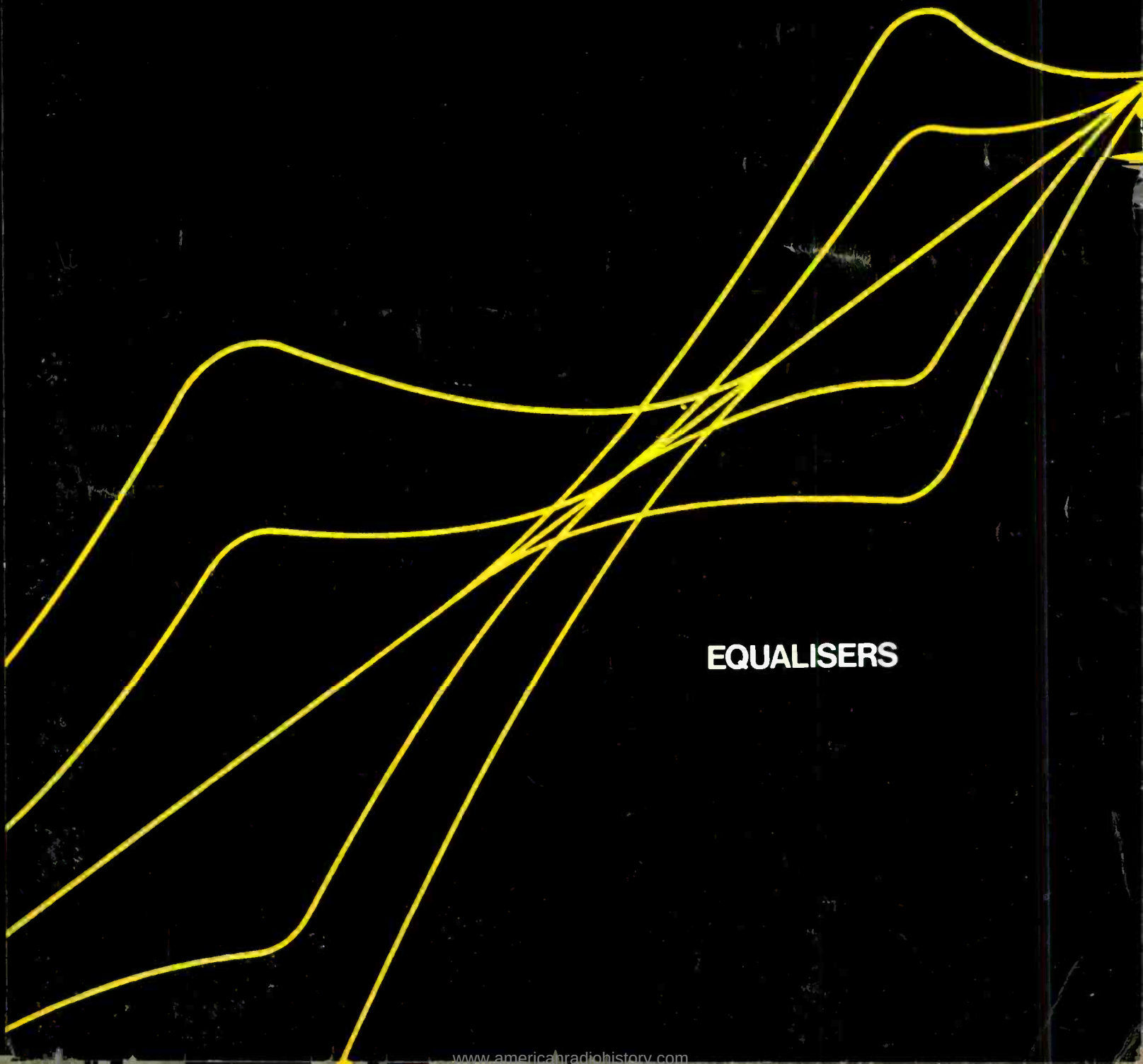
February 1978 50p

studio sound

AND BROADCAST ENGINEERING



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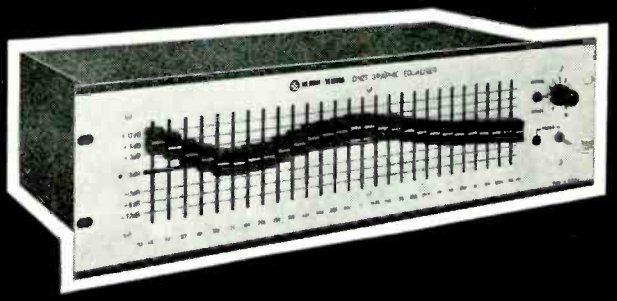

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AND BROADCAST ENGINEERING

HAPPY NEW YEAR

As we go to press with the final copy for this issue we leave behind the Centenary year of 'recorded' sound. It may seem surprising that in a fast moving technology-based society we are still using the same basic record/replay system that was invented 100 years ago, albeit in a relatively refined form. A very close parallel to the modern lp must be the internal combustion engine—the same basic principles apply as they did last century but with present day outputs of up to 130 bhp/litre, refinement has certainly altered the practical realisation of the principles. And in the case of a record for power read quality.

Even though the existing methods are 'adequate' for today's average consumer it may be the case that we will soom see a change in the field of sound reproduction. Whether the impetus comes from the consumer demanding more quality or from the manufacturers trying to justify their r&d costs—who knows? But digital seems to be the universal panacea and has not only been applied to tape machines in electronic form, but has also led to the use of lasers for disc recording and replay (see p 36 . . . wasn't that subtle?).

And long term? Science and technology is moving at a frightening exponential pace so consequently one must question the lifetime of digital techniques. For example, both the US and USSR (originally in co-operation) are working on esp, so in 100 years time, or even less, it could well be the main form of communication—but what about the musicians, arrangers and producers? It's very probable that science will have 'sorted out' most things about the brain and consequently offer us musical pleasure in terms of esp or a pill. A composer 'thinks' a hit record and records it in some form or another. A dj sits in a studio (or maybe at home in front of a log fire) with a selection of these recordings and thinks his programme. Listeners tune in (they learnt how at school) and receive the ultimate in quality by esp.

For your own choice in music you have to be a little more basic and work biochemically. You go to a music shop and buy a pill, instead of an album. It lasts for 20 plays but as you use up each play the diameter decreases and the quality suffers. Track selection could also be a problem here, so no doubt they're working on it.

All very laughable, but what would Edison have made of an a-d convertor, let alone a laser.

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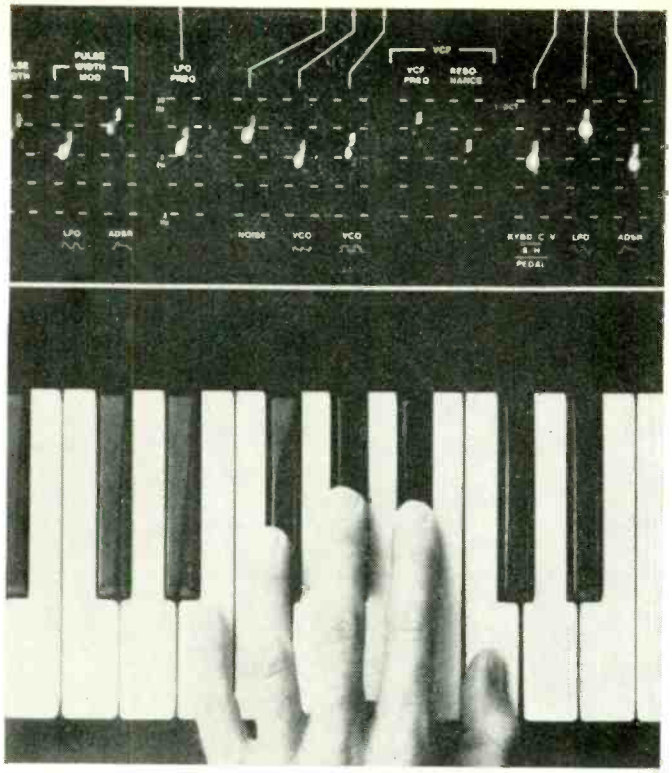
FEBRUARY 1978 VOLUME 20 NUMBER 2



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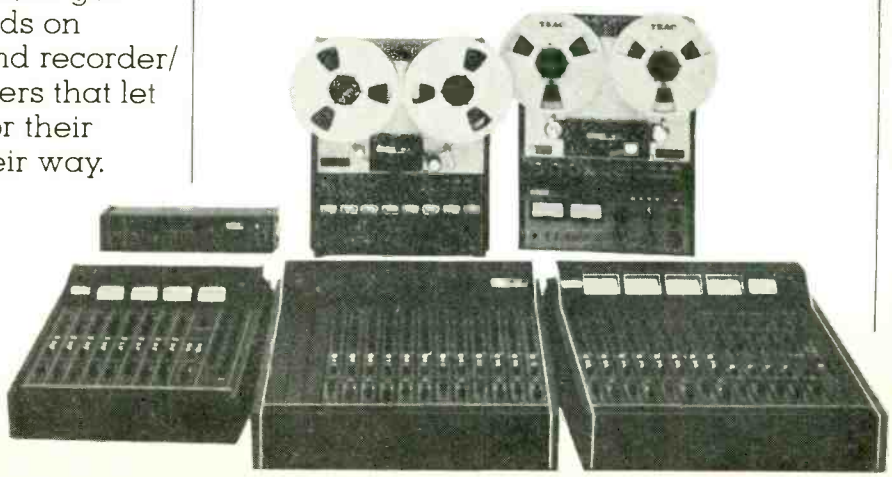

The Model 5-EX shown with four optional 201 input modules. Model 5 shown with optional 204 talk back/slate module.

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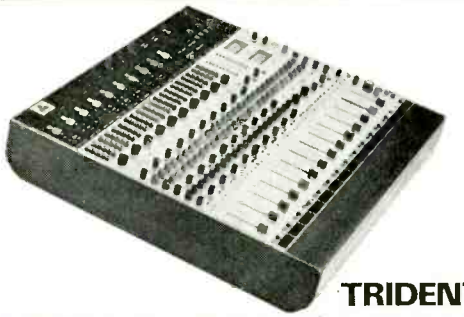

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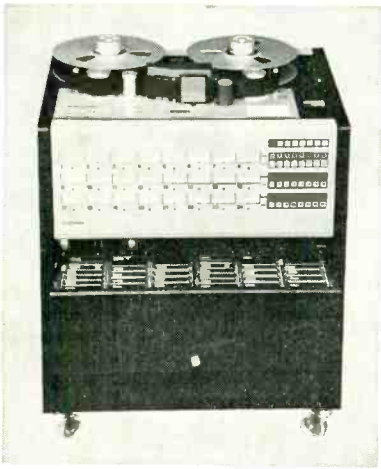

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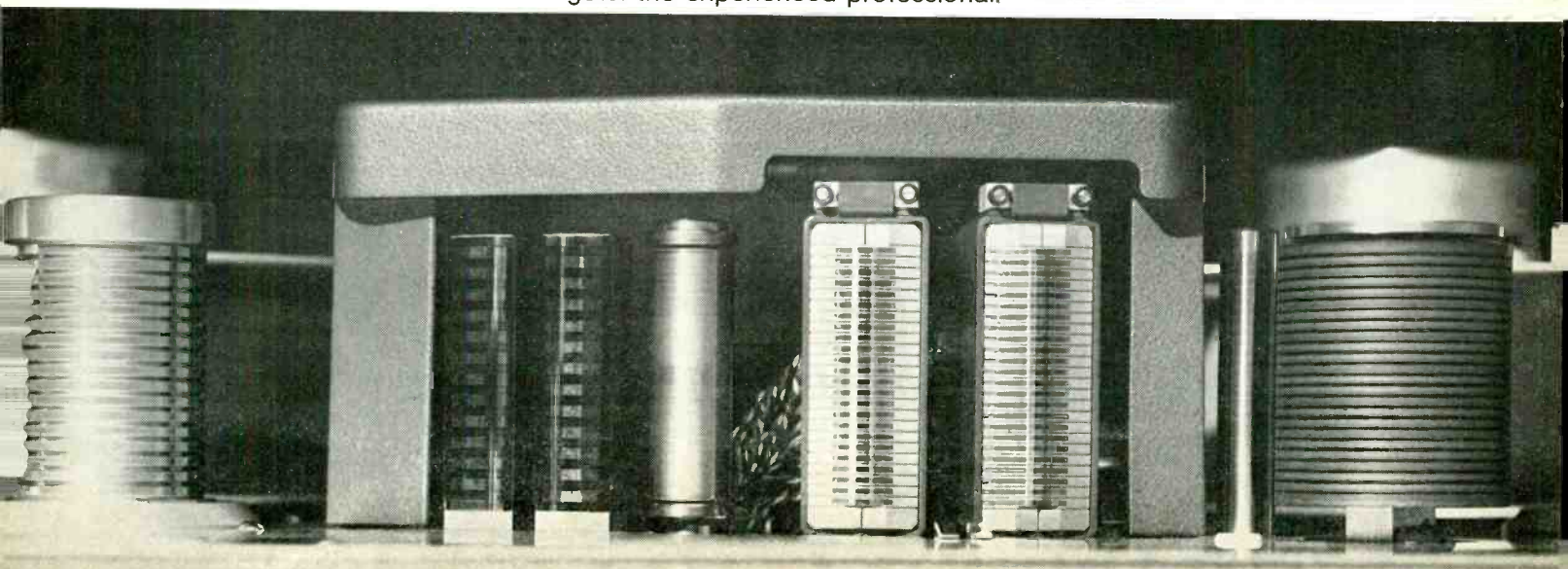

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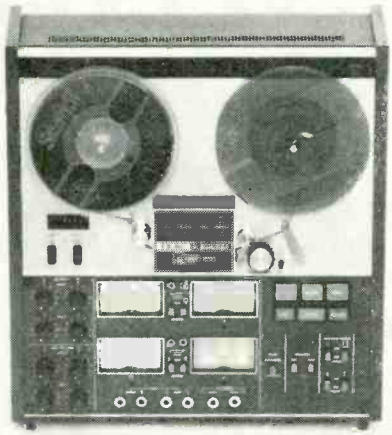

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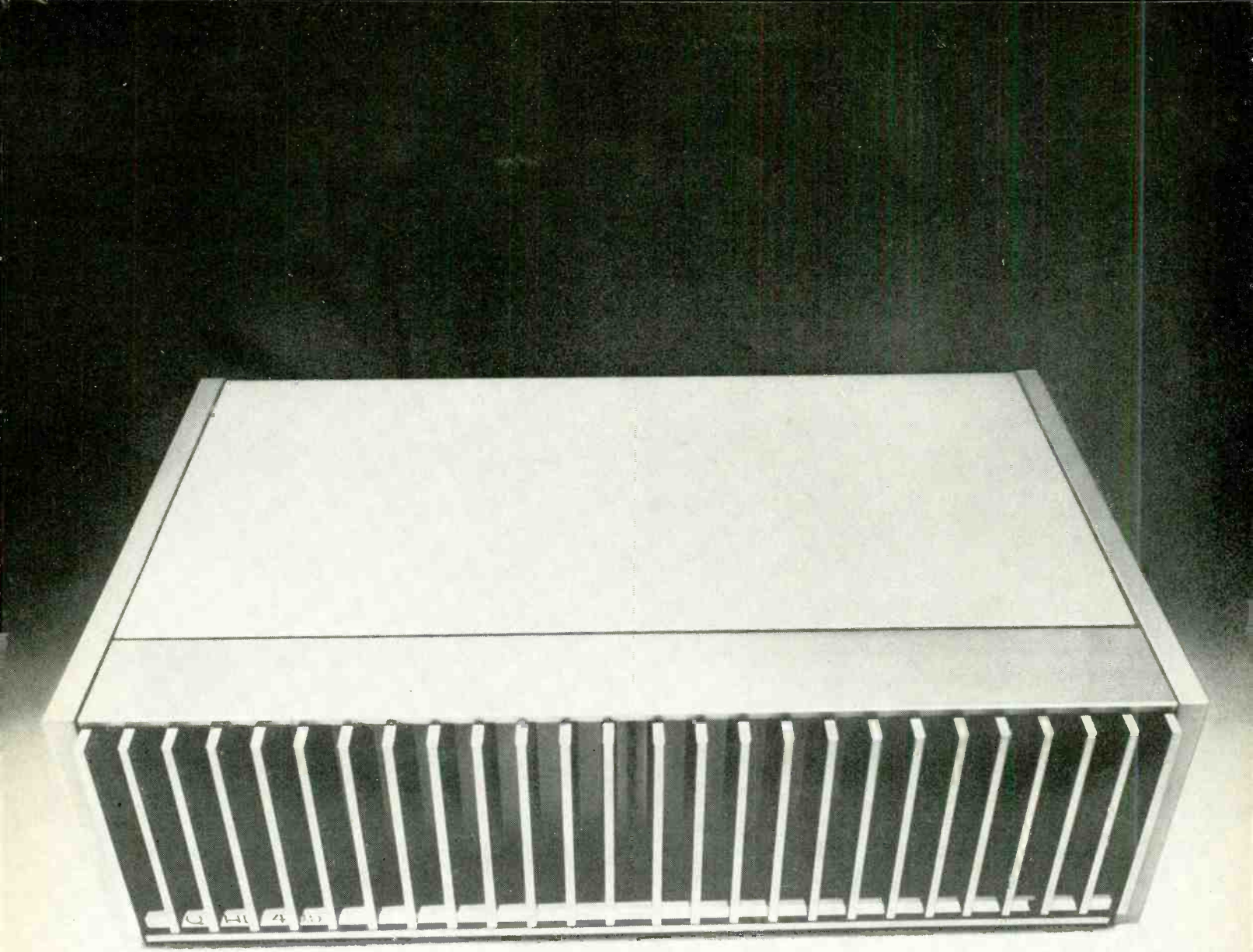

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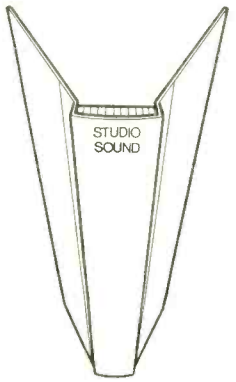

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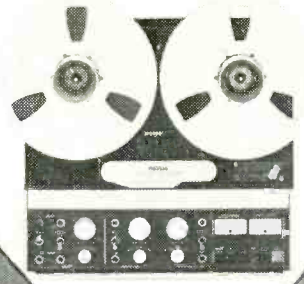

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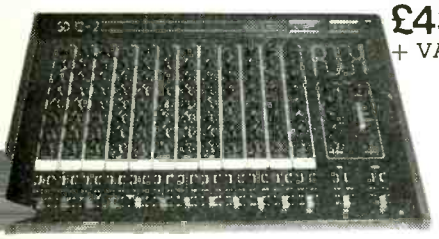

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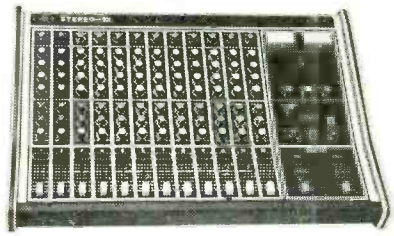

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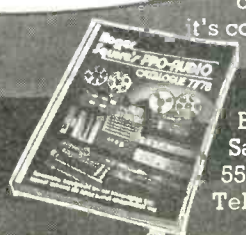

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news

BBC/NRDC System HJ

Earlier this year, the BBC and NRDC announced their intention to exchange information and experience with a view to moving towards a joint specification for surround-sound (or quadraphonic) encoding in a 2-channel system. Mainly as a result of Matrix H broadcasting experience gained by the BBC during the 1977 Promenade Concert season, the BBC and NRDC jointly decided that it would be advantageous to make minor alterations to their respective systems, BBC Matrix H and NRDC System 45J. The change primarily affects the phase of signals related to a centre-front source, which improves stereo compatibility with very little effect upon either mono or surround-sound reproduction. Thus existing decoders do not require any alteration.

As a result of these changes the two systems moved even closer together, and it has become possible to agree upon a unified specification that takes the form of tolerance zones on the Scheiber Sphere in which the encoding points will lie. The agreed changes have also been noted by Nippon-Columbia, with whom NRDC has a working agreement.

The joint BBC and NRDC system will be known as BBC/NRDC System HJ, and future BBC surround-sound broadcasts will use this system. Collaboration between the BBC and NRDC in the fields of production and microphone techniques and decoder technology will continue.

■But what do the IBA feel about the new system?—after all, they organised the world's first broadcast using the NRDC 45J system from Radio City last June (see October '77 issue, pp58-60). In a press statement, they say they welcome the emergence of System HJ and that it is their firm intention to continue investigations into surround-sound systems. In particular, the IBA feels that the merits of 45J or System HJ when used in the so-called '2½' mode of transmission warrant careful consideration. Their studies will be concentrated initially into four areas: modulation systems, receiver design for 2/2½/3-channel operation recording characteristics, and microphone techniques.

Listening tests conducted by the IBA 'have already shown convincingly that image location is improved significantly when using the 2½ or 3-channel techniques, rather than the simpler 2-channel matrix techniques, even when variable-matrix decoders are used for 2-channel system'.

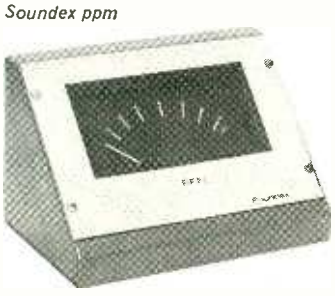
Theoretical studies carried out by IBA engineers suggest that a 2½-channel system is unlikely to result in any significant reduction of service coverage of fm transmitting stations. If the narrowband '½-channel' is transmitted at −10 dB the signal-to-noise ratio for existing listeners would be minimally degraded. These calculations have yet to be confirmed by field trials, now being considered, but would appear to support the IBA's view that it is worth continuing investigations into 2½-channel systems before committing ilr to a particular surround-sound system.

Peak programme meter

Soundex has introduced a new range of ppms conforming fully with BS 429 and BBC specifications. The large, illuminated scale is available calibrated in dBs or ppm scale 1-7. Operating from a 24V dc supply, the meter consumes approximately 150 mA, including scale illumination. Frequency range is 15-35k Hz. Power and signal inputs are via single screened cable. Each meter costs approximately £75.

Soundex Ltd, 91 Farmer Road, Leyton, London E10 5DJ, UK.
Phone: (01) 539 3385.

Soundex ppm



Scotch quiz results

The prizes offered in the 'Professional Challenge' competition organised by 3M United Kingdom were, appropriately, ten cases of Scotch whisky. The competition called for entrants to identify a series of 'diverse and unusual' sounds recorded on 3M *Scotch* tape. These varied from the voices of Shirley Bassey to General Montgomery, and included the sounds of a kookaburra, 'ma-ma' doll, humming top and roulette wheel; quite a mixed bag.

The winners were Peter Townsend and Ian Hunter of the RN1B; Dick Allot from Trilion Video; Simon Dass from RCA; John Gibbons from the University of Southampton; Frank Jeffs from Ewarts Television; Tom Hepel and John Sergent from the Building Research Station; Wally Fisher and Mick Hinton from Decca Studios; John Frame from Scottish Television; Martin Compton from Saga Records; and Jeff Jones from Morgan Studios.

Electronic turntable crossover

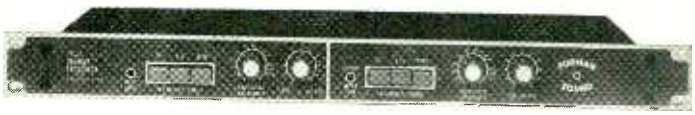
A new 'low-cost' electronic turntable crossover unit has been announced by Furman Sound. It can be used as a variable-frequency splitter for pa, reinforcement and studio monitor systems, or as a conventional bandpass filter.

The *TX-2* is tunable over a range 20-20k Hz and can be switched for either stereo bi-amp or mono tri-amp configurations. Active Butterworth filters with 12 dB/octave roll-off are claimed to ensure smooth frequency handling and minimal phase displacement. The high and lowpass outputs of each crossover point track each other automatically as the frequency is changed.

The unit occupies only 44 mm of 483 mm rack space, and costs about $250.

Furman Sound products are distributed worldwide by Rothchild Musical Instruments, 300 Windsor Road, Englewood, NJ 07631, USA.
Phone: (201) 871 3366.

Furman Sound TX-2 electronic tunable crossover



Syn-Aud-Con representatives

Synergetic Audio Concepts (Syn-Aud-Con) has appointed Theodore Pappas & Associates as a representative for their 3-day sound engineering seminars for Eastern Wisconsin, Illinois, Indiana and Kentucky. Other representatives for the seminars, now in their fifth year, are Bidwell Sales Associates, Carson, Ca; Moulthrop Sales Inc, Oakland, Ca; Fleehart & Sullivan Inc, Seattle, Wa; Dobbs-Stanford Corp, Irving, Texas; Forristal-Young Sales Co, Kansas City, Mo; Jamieson & Associates Inc, Minneapolis, Mn; Diversified Concepts Inc, Marcellus, NY; Irv Brown Company Inc, Brooklyn, NY; Ballou & Associates, Southington, Ct; Lienau Associates Inc, Rockville, Md; and Forti-Austin Associates, Willingboro, NJ.

For further information contact Synergetic Audio Concepts, PO Box 1134, Tustin, Ca 92680.
Phone: (714) 838 2288.

Scotch 256

3M United Kingdom has announced a new tape designed specifically for the UK/European broadcast and recording market. *Scotch 256* has been evolved to provide a wider dynamic range, reduced print level, higher maximum output level and low distortion. A newly-developed black back-coating is said to improve the wind characteristics.

Signal-to-print level after storage at 20°C for 24 hours is a claimed 59 dB (about 9 dB better than *Scotch 250*). The improved signal-to-print figure also helps increase the signal-to-noise level to an impressive 77 dB (DIN measurement).

If you are already using *Scotch 206* the change to *256* is pretty simple: bias is increased by 1.5 dB to give a 2 dB overdrop at 10 kHz; record level is increased by 0.5 dB; and hf equalisation raised by 2 dB.

At present *256* is available in 6.35, 12.7, 25.4 and 50.8 mm widths on 26.7 cm NAB reels holding 731m of tape or, for European users, on open hubs holding 1 km. There are no plans at present to market 6.35 mm wide tape on 17.8 cm reels, but 3M may change its mind if there is sufficient demand.

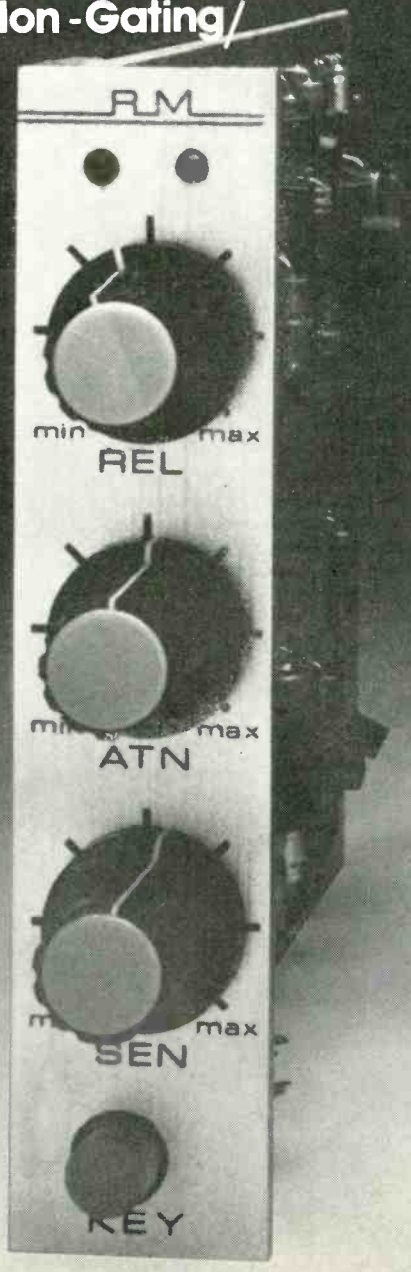
The handling characteristics and specifications also make *256* suitable for use in high-speed tape duplicating loop bins.

Magnetic AV Division, 3M United Kingdom Limited, 3M House, PO Box 1, Bracknell, Berks RG12 1JU.
Phone: Bracknell (0344) 26726.

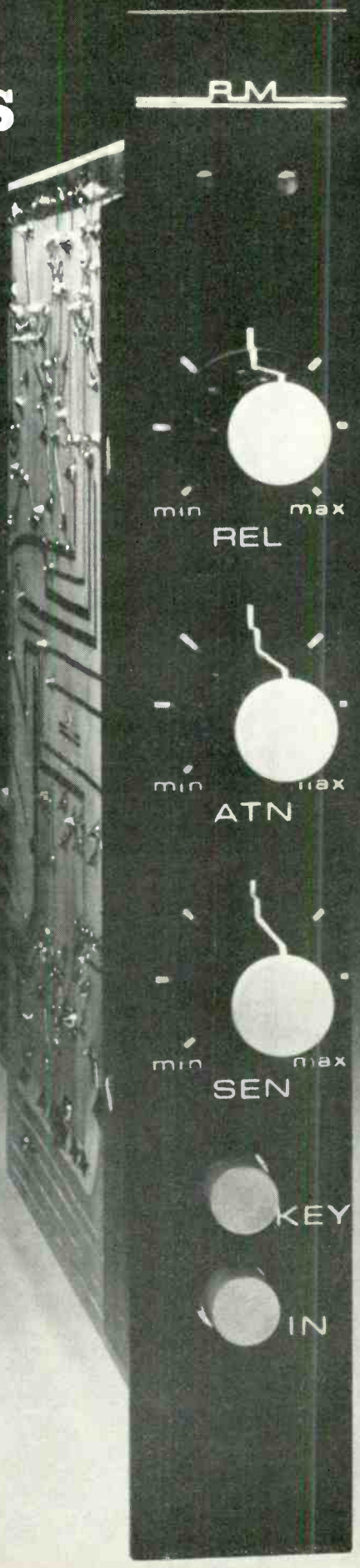
20 ▶

Noise Gates from Roger Mayer Electronics

- 150 nano second Attack Time
- -96 Dbm Output Noise
- ·05% Distortion
- -56 Dbm Maximum Input Sensitivity
- Keying Input
- 2 LED'S Red (Gating)
  Green (Non Gating)
- LED Indication of Non-Gating/
  Gating Operation



Model RM68



Model RM68X
(Retrofits into Kepex Rack)

Sole UK Distributors:

SSE

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

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

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

Mike Llewelyn-Jones,
AP Postal 8178,
Madrid 8, Spain
Telephone: 415 6350

Peter Bollen Geluidstechnik,
Hastelweg 6, Eindhoven,
Holland
Telephone: 512 777

Kuam Audio,
Tollbugt 7,
Oslo 1, Norway
Telephone: 41 7855

NEWS

Electronic design and marketing service

Rupert Neve, founder of that well-known company making broadcast and recording consoles (whose name escapes us for the moment), recently launched an independent venture into consultancy. Known as Nevenco Ltd, the new company is based in Cambridge and includes two well-known former members of the Neve management team, Peter Moody and Geoff Watts. The fourth member, Chris Heath, was employed for a number of years by Cambridge Consultants.

The *raison d'etre* of the company will be 'creative design in the electronics field', including product design, manufacturing and marketing consultancy. It has available skills in a wide range of disciplines, and expects to specialise in establishing new product lines.

If you want to find out how Nevenco could be of service to your company or studio contact Peter Moody, Nevenco Ltd, 2 Hills Road, Cambridge CB2 1JP, UK.
Phone: Cambridge (0223) 62392.

Out, damn click

'It's the second generation in tick, pop and click elimination', is how Michael D Brown describes the new Burwen transient noise eliminator. And seeing how he's the President of Burwen Research, who are we to disagree.

The *TNE 7000* is another of those units designed to eliminate horrible noises caused by scratches, dirt and imperfections in record vinyl. It is obviously aimed at the domestic market to clean up the lousy quality of modern pressings, but (as we've said before) the beastie could prove useful for tarting up old 78s for re-issue where no master tape exists.

Although the principle of action of most of these gadgets is the same—a click, pop or fart is detected and replaced by audio information immediately preceding the disturbance—Burwen claims that theirs differs in four ways:

It is the first device to filter out medium and small ticks and pops because it can make the finest discriminations between transient (impulse) noise and music.

It has the shortest off-time of any such device (80-600 μs) which minimises signal disturbance.

The signal processing stage includes switch-spike cancellation, which cancels out any noise introduced by the filtering action (thereby eliminating the rumble present in other processes).

It uses a time delay of only 40 μs to avoid psycho-acoustic side effects.

Burwen Research Inc, 30 Cross Street, Cambridge, Mass 02139, USA.
Phone: (617) 491 5060.

SES move

Studio Equipment Services' new address is The Shop, Oxgate Farm, Coles Green Road, London NW2.
Phone: (01) 452 1979.

Wider 888

Racal-Zonal has introduced a 50.8 mm version of its *888* tape. Available in standard play, the polyester-based tape is said to offer a very wide dynamic range with excellent noise, distortion and harmonic characteristics. Signal-to-print ratio (at 1 kHz) after storage for 72 hours at 20°C is a claimed 54 dB, and output uniformity over a reel (at 1 kHz) is less than ±0.25 dB. A 'unique' blue backing ensures minimum layer-to-layer adhesion, vastly improving fast winding properties.

Racal-Zonal Ltd, Holmethorpe Avenue, Redhill, Surrey RM1 2NX UK.
Phone: Redhill 67171.
Telex: 946420.

■Stanley Productions, London distributor of Racal-Zonal tape, cassettes and other audio-visual products, has opened a new showroom and trade counter at 147 Wardour Street, London W1. They are said to offer a rapid delivery service to customers, with orders placed before 10.30 am being delivered the same day; orders placed after that time are delivered the next day. Their phone number is (01) 439 0311.

Above: *IEM 1000*
Left: *IEM 1100B*

Tape machine survey omission

Because the information arrived after our copy deadline, we were unable to include the following details of IEM's tape machines in last month's survey:

IEM

International Electro-Magnetics Inc, Eric Drive and Cornell Avenue, Palatine, Ill 60067, USA.
Phone: (312) 358 4622.
Australia and SE Asia: Optro Pty Ltd, PO Box 257C, Melbourne, Victoria 3001, Australia.
All the machines described here feature a built-in line-up oscillator, remote control and Dolby interface.

1100 SERIES
Tracks/speeds: 1 or 2 on 6.35 mm, 4 on 12.7 mm, or 8 on 25.4 mm; 19, 38 and 76 cm/s.
Frequency response: ±2 dB, 30-15k Hz, overall at 38 cm/s.
Noise: >70 dB below peak record level.
Wow and flutter: <0.05% rms in the band 0.5-250 Hz.
Features: full logic control and motion sensing; crystal-controlled servo capstan with 19-76 cm/s varispeed; servo-controlled spool motors; plug-in headblocks; console or portable construction.

1000 SERIES
Tracks/speeds: 8 on 25.4 mm, or 16 or 24 on 50.8 mm; 19, 38 and 76 cm/s.
Frequency response: ±2 dB, 30-15k Hz, overall at 38 cm/s.
Noise: >70 dB below peak record level.
Wow and flutter: <0.05% rms in the band 0.5-250 Hz.
Features: as *1100 Series*, plus 35.5 reel handling.

Glasgow 8-track

Ca Va Studios claim to be the first fully professional 8-track facility to be set up in Glasgow. Its prime objective is to provide 'a relaxed atmosphere in which musicians, producers and engineers can successfully create their music and technique with no pressure, and to within a reasonable budget'. In addition, it hopes to assist and hang onto Scotland's nomadic home-grown talent who, through necessity, have in the past had to go south or even to the US to create their music.

The control room of Studio-1 sports a Tweed Audio 12/8 desk linked to Ampex 8-track and 2-track mastering machines. Monitoring is on Tannoys driven by Tweed power amps. The studio floor can accommodate up to 25 musicians, while the control room will take up to a dozen 'comfortably'. Studio-2 will feature a complete dubbing suite with 4-track facilities and high-speed tape duplication of both 6.35 mm tape and cassettes. It also houses a library of pre-recorded tapes and albums for Ca Va's radio and tv commercial productions.

Studio-1 has recently been used to master various Scottish New Wave maxi-singles and ep releases, and also for filming and mastering a programme in BBC's new 'Spectrum' series. However, the backbone of the studio's work is in demos. These have included recent sessions for albums by ex-String Driven Thing vocalist Kim Beacon and his band, The Serenaders, and Rob Spensley. Boyz, Cafe Jacques and Dead End Kids have also been in, as have Cado Belle and ex-Chico vocalist Sandy McLelland.

Ca Va plan to go 24-track and be 'fully equipped in "state-of-the-art" audio hardware' by the end of this year, and also to introduce video recording facilities in the near future.

Ca Va Studios are located at 201 St Vincent Street, Glasgow City Centre, Scotland.

IGM in UK

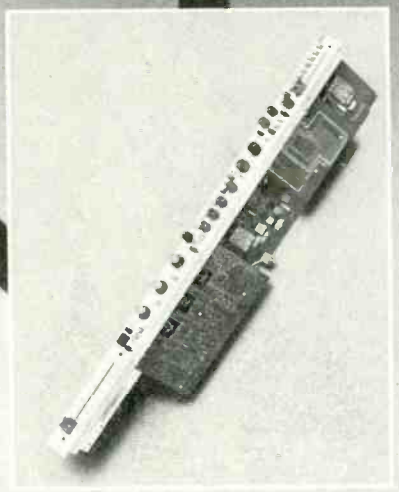
IGM has appointed Lee Engineering as sole UK agents for its range of *Go-Cart* and *Instacart* NAB cartridge machines. They come in a variety of formats, and the use of a built-in microprocessor is said to ensure complete integration with any automation system. The *Instacart* is available in units of 12 replay decks.

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

22 ▶

Are you really serious about a new console?

Model Pacifica 28 Input/16 output



7200M Input/Master Mix Module

We know that buying a large multi-track console is no small decision. For most professionals, it's one of the largest investments you'll make — a decision that you'll have to live with for years.

There are a lot of companies making consoles. Many perform adequately. Others are compromises. Few have all of the features and performance at a reasonable price. So, what are we leading up to? A simple statement of fact that you should consider seriously if you're really interested in an outstanding console system: Quad/Eight has an enviable reputation for quality and reliability. It's something we've worked at for over 10 years. We've also had a reputation for building the industry's most expensive systems too. Now, relax. Our new modular series consoles look expensive. Truth is, they're priced right in the same category as our best competition. In addition to having the best human engineering for operational ease, they're loaded with more features and performance:

- 3 band, 33 overlapping frequency equalization
- Peak Indication common to Mic & Line
- Six auxiliary mixing busses from each input
- Two solo mixes, monitor & positional
- Discrete amplifiers used in the primary signal paths
- High-quality conductive plastic rotary controls
- Penny & Giles Faders
- Color-Coded aluminum knobs
- Individual phantom power switching
- Four fully equalized echo returns
- + 28dBm output level
- Noise: —129dBm E.I.N,
  I.M. Distortion: 0.1% max.

If you're really serious about a new console and the quality of your work, then do yourself a favor and contact us for full information on a new outstanding line of modular consoles.

*The Coronado, 40 Input/24 Output equipped with Compumix III available in October, 1977.

For the Artist
in Every Engineer

Quad/Eight International
Quad/Eight Electronics
11929 Vose St., No. Hollywood, CA 91605
(213) 764-1516 Telex: 662-446

NEWS

Video Yearbook 1978

Although aimed primarily at the industrial and broadcast video industry, the Video Yearbook 1978 also contains considerable content of interest to the audio side, including directories covering tape machines, microphones, mixers, loudspeakers and amplifiers. Almost every range of video equipment is extensively surveyed, many with photographs and complete with prices. Other sections include television production facilities, sales and service companies, international television standards in 179 countries, surveillance equipment and video tape recorders. The 440-page Video Yearbook 1978 (50% up on 1977) has over 1400 separate entries with 334 photographs and illustrations, and the complete addresses, phone numbers and contacts for 1800 companies in the video, audio-visual, audio and related industries.

Costing only £7.95 (tax deductible) the Video Yearbook 1978 is available through bookshops or for £8.65, including carriage, direct from the publishers: Blandford Press Ltd, Link House, West Street, Poole, Dorset BH15 1LL, U.K. Eor those in central London Book City, an excellent technical bookshop in Broadwick Street, has copies off-the-shelf.

Crown/Amcron modification

Macinnes Labs, UK agent for Crown/Amcron equipment, tells us that all *DC300A* and *D150A* power amps are now fitted with a front-panel led on each channel which indicates the onset of distortion. The *IOC System*, as it is called, analyses the input and output waveforms, notes the difference and when distortion levels of 0.05% are approached illuminates the led.

Several advantages are claimed for the *IOC* over a traditional led clip indicator which, being sensitive only to the output voltage, cannot respond to the activation of a protection circuit or the presence of transient intermodulation distortion (tid), and may not even report clipping if it is brief. The *IOC*, by contrast, is said to report any and all forms of amplifier non-linearity, including tid, activation of protection circuits, and all clipping no matter how brief.

Furthermore, all *DC300A* and *D150A* amps equipped with *IOC* are reported to have an improved signal-to-noise specification of 115 dB referred to the rated output.

Crown International, Box 1000, Elkhart, Indiana 46514, USA. Phone: (219) 294 5571.
Telex: 2942160.
Macinnes Laboratories Ltd, Carlton Park Industrial Estate, Saxmundham, Suffolk IP17 2NL, UK. Phone: Saxmundham (0728) 2262/2615.

New IBA engineering director

The IBA has appointed Thomas Robson, at present its deputy director of engineering, to succeed Howard Steele as director of engineering from the beginning of this month. Tom joined the Authority's staff in 1957 after ten years at EMI working on television transmitter development. Previously he had been with the BBC for two years on transmitting stations.

During the Second World War he worked on radar in the signals branch of the RAF. He started with the Authority as engineer-in-charge of its Black Hill transmitting station near Glasgow, and 18 months later moved to headquarters as a senior planning engineer dealing with transmitter equipment, masts and aerial systems. In 1967 he was appointed head of the Station Design and Construction Department, where he was closely involved in the building of the UHF network equipped for colour transmissions. In 1969 he became assistant director of engineering and in 1973 deputy director of engineering.

The vacancy for director of engineering arose from Howard Steele's decision to resign and take up the post of managing director of Sony Broadcast.

The Cadac Compact console recently installed at Morgan Studios, London, is fitted with 32 input/output modules, but has been wired for 40 inputs and 32 outputs to allow for later expansion. The 32 mix-buss outputs appear on the jackfield, with the first 24 being provided with meters. Separate 4-track mixdown busses with output metering are also incorporated. Each module has a V-cat fader that can be used conventionally, or linked by dc-ganging to any of seven sub-group faders. The seventh fader can be assigned as a gang master to control all console faders. Isometric, continuously-variable frequency eq in five overlapping ranges is fitted to each module, plus a highpass variable-frequency filter. The four echo return and send modules each have a mic input and eq section. Outputs to two monitor systems, each with a separate level control, are provided. Both systems and the studio playback outputs have protection circuits to delay connection to monitor amps when the console power supplies are switched on.

Ancillary control room gear includes an Eventide Instant Flanger, Harmonizer and ddl; four Urei 1176LN limiting amps; three Allison Gain Brains and three Kepex gates; an EMT 156 stereo compressor-limiter; and two Astronic graphic equalisers. Tape machines are all Studer: a 24-track and two 2-tracks. Noise reduction is handled by 24 Dolby 361 modules. Control room monitoring is by a pair of the new Tannoy Buckinghams (see last month's issue, p30).

As it says on the front, the model 1400 In-line microphone pre-amplifier from RTS Systems

Mic pre-amp/limiter

The gain of the new RTS *model 1400* is continuously variable from 23-56 dB, allowing it to be used to boost low-output microphones for driving low-gain mixers, to boost mic outputs to line level, or to buffer medium-level lines. In addition, a built-in limiter prevents overload of individual mic or line inputs while maintaining high average levels.

The module is claimed to have a fast rise-time with absolutely no overshoot, even with 20 dB of limiting applied. Circuit stability is such that it will not oscillate or ring, despite capacitive loads.

An output impedance of 50 ohm allows the unit to drive mic cables of 300 m or longer with no significant loss of high frequencies. To enhance common-mode rejection and further improve the signal-to-noise ratio, input and outputs are Jensen transformer isolated with 2-way Faraday shielding. Potential hum and earth loops are avoided by battery operation. Two 9V batteries provide an operating life of approximately 100 hours.

Extract from manufacturer's specification:

Frequency response: −0.5 dB at 20 Hz; −0.25 dB at 20 kHz.
Equivalent input noise: −127 dB (ref 0.775 V).
Distortion: ≦0.05% total harmonic.
Limiting: 2.5 : 1 compression ratio; 100 ms attack time.
Dimensions (w×h×d): 100×125×50 mm.
Weight: 900 g.
Price: $185.
RTS Systems, 4167 Fair Avenue, North Hollywood, Ca 91602, USA. Phone: (213) 980 0511.

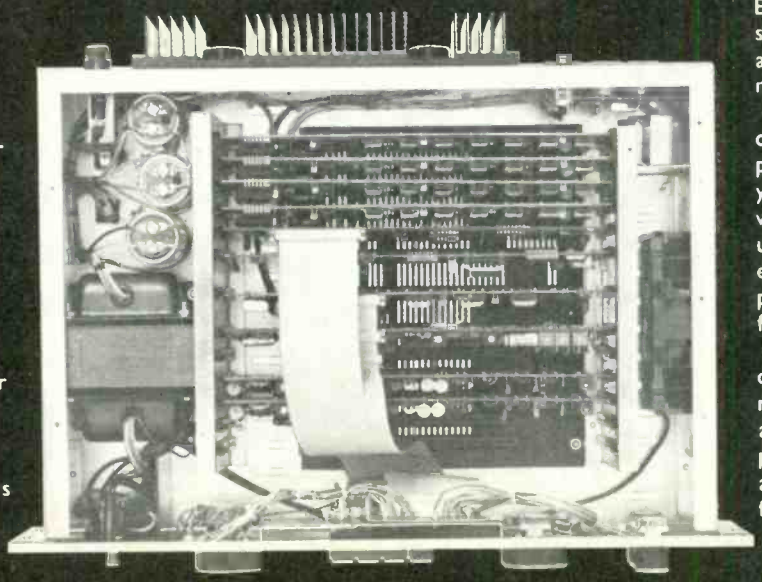
The CPR-16
Computer Programmed Reverberation

The Quad Eight CPR-16 represents a revolutionary breakthrough in the application of advanced computer technology for the professional audio marketplace.

Two years in development, the CPR-16 is the first product to embody advanced digital technology in a configuration which will allow an unprecedented degree of control over the reverberant field by signal processing.

It offers the user a flexibility beyond the now ordinary mechanical methods; every possible aspect of the reverberant field is capable of alteration by the engineer. Reverberation time can be changed from zero to twenty seconds in sixteen steps, even during operation, without signal degradation. High and low frequency damping rates can be controlled over a wide range which previously was only achieved by time-consuming and clumsy rearrangements of complex arrays of absorption splays in live chambers or rooms. The simulation of "room size" can be modified with a single control which adds a variable delay before the first echo or reflection signal.

And, most importantly, the CPR-16 allows the prominence and density of resonant modes to be altered. Thus, the density and diffusion rate of echoes can be tailored to match any room, electromechanical device, or whim.



The CPR contains two individual reverb programs and one "open" program provision for future custom sound processing effects. Program 1 is analogous to a live acoustical chamber, and Program 2 creates a simulation of an artificial plate. Program 3 switching facility is pre-wired for a plug-in programming module and Program 4, ECHO allows a "Tape-Echo" simulation that is unobtainable by present mechanical methods.

The CPR-16 incorporates control over every critical aspect of the reverberant field. If you have a special application which requires a previously unavailable sound processing effect, information on custom programs is available from the factory.

Write us or call for a detailed brochure on the revolutionary CPR-16. The age of affordable digital processing for audio has arrived. If you've been waiting for technology to catch up with your imagination, your time has come.

Quad/Eight Electronics • Quad/Eight International 11929 Vose St., No. Hollywood, Ca. 91605 • (213) 764-1516 • Telex: 662-446

NEWS

MCI broadcast tape machine

The latest issue of MCI's 'News and Views' (volume 1, number 7) contains an interesting article on the new *JH-110A* broadcast tape machine. It is the first stereo model from the *JH-110A Series* to incorporate a new generation of electronics, which includes a more flexible and accurate eq network claimed to allow a flatter frequency response, and switching between CCIR and NAB curves without readjustment. High - frequency phase compensation has also been added, plus a meter buffer to reduce electronics distortion. The improved electronics package is not the only new thing about the broadcast machine—it is said to be the first tape machine that a US manufacturer has designed specifically for the European market.

The external controls of the broadcast machine have been minimised to simplify operation by station personnel. The machine's output is fed permanently from the replay head and the 'record ready' condition always exists, there being no need to deactivate a 'safe button' (à la multitrack practice). Accidental erasure of tape is prevented by the need to press simultaneously the record and play button. A built-in loudspeaker, amplifier and headphone jack are provided for editing and cueing.

An editing kit is also included. This comprises a mechanical marker arm positioned in front of the replay head, a set of scissors stationed along the tape path, and additional edit-mode logic in the transport control circuits (sounds rather Studer-like). For electronic editing the broadcast machine is fitted with *QUIOR*, a new bias timing circuit to reduce drop in/out noise and compensate for the time lag between the record and erase heads.

Other articles in 'News and Views' describe the new 8-track *JH-110A/8* machine, the *JH-500* and *JH-400B Series* of consoles, the *JH-50* automation system, and the new *JH-45* tape synchronisation system using an SMPTE time code.

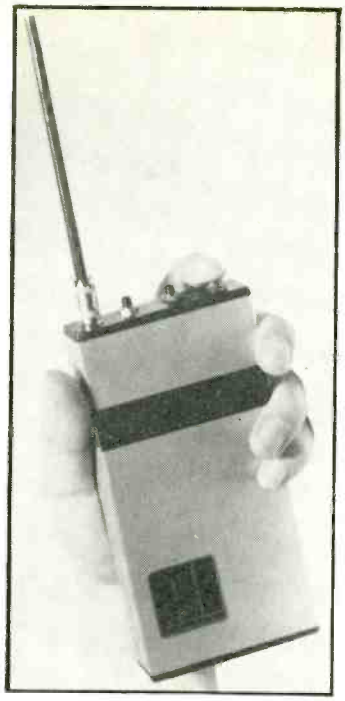
For copies of the newsletter write to: MCI News and Views, 4007 NE 6th Avenue, Ft Lauderdale, Florida 33334, USA.

Noise meter ▶

A pocket-sized, digital sound level meter manufactured by Metrosonics Inc is now available in the UK from Dawe Instruments. The *Type 26-306 Metrologger* automatically measures and displays A-weighted sound level over a selected 64 dB range, Leq (equivalent sound level), Lmax (maximum sound level sampled), and the time duration of the measuring period. Levels are displayed in 1 dB increments and updated every 0.25s.

The meter is normally supplied with a miniature ceramic microphone that can be mounted directly or positioned up to 30m away. Battery operating life is approximately 72 hours.

Metrosonics Inc, Box 18090 Rochester, NY 14618, USA.
Phone: (716) 442 0760.
UK: Dawe Instruments Ltd, Concord Road, Western Avenue, London W3 0SD.
Phone: (01) 992 6751.
Telex: 934848.



Microphone catalogue

A new 6-page catalogue and price list from Calrec describes the *1000*, *2000* and *2100 Series* of recording and broadcast microphones. The *1000 Series* are 48V phantom-powered and have fixed capsules; the *2000 Series* are similarly powered but have detachable capsules. The *2100 Series* are designed for phantom-powering from 7.5-50V supplies and use the same detachable capsules as the *2000 Series*.

Copies of the catalogue are available from Calrec Audio Ltd, Hangingroyd Lane, Hebden Bridge Yorkshire HX7 7DD, UK.
Phone: Hebden Bridge (042 284) 2159.

aes news

This section is devoted to some of the items that we didn't have space for in last month's AES Report.

The original **Amber** *4400* multifunction test set lacked little in the way of performance when reviewed in this magazine (February '77 issue, p58), yet the Canadian manufacturer states that a new, improved model is available. The *4400A* is quoted as delivering much higher output power (some 30 dBm into 600 ohm); improved bandwidth and accuracy of the receiver section; improved detector circuit; better gate performance; and more accurate spectral output from the pink noise generator—to mention but a few.

Amber has also added some extra facilities: repetitive gating bursts; autostart function for external recorder; dB plot of differential between two inputs; phase plotting windows; x5 magnification facility; 0.01 dB resolution; and peak and average response detectors in addition to the true rms original.

Ampex has introduced a new search - to - cue facility for the *MM 1200* and *ATR 100* tape machines. The main feature of the device is that it will store up to 20 cue points. Although the numeric keyboard only extends from 1 to 10, an upper-case function key shifts the keyboard into the 11-20 mode. In common with other search-to-cues, the new model can be set with an arbitrary zero point anywhere on the tape. The unit costs just under $2000.

The new **Electro-Voice** microphone *System C* comprises four interchangeable heads—omni, cardioid, hypercardioid and rifle—and two pre-amplifiers. One type of pre-amp is for handheld operation while the other is intended for boom use. All parts of the microphone system are designed to interface with each other. Electro-Voice states that a new diaphragm charging process has been used in the manufacture of this electret range that keeps output levels 'constant for years'. The company gives an unconditional guarantee of two years with the microphones.

Court Acoustics are offering a range of 2-channel electronic crossovers for either 2, 3 or 4-way

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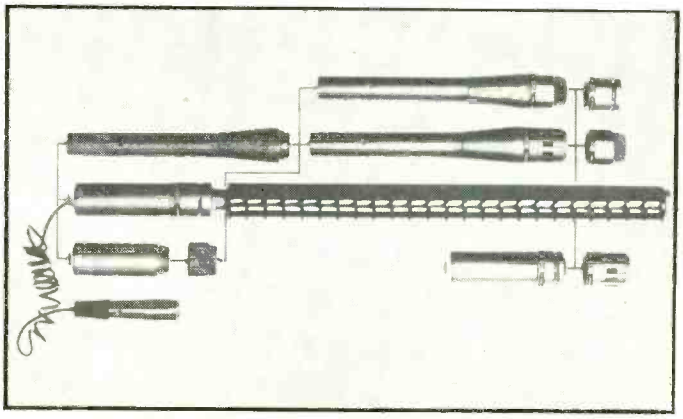
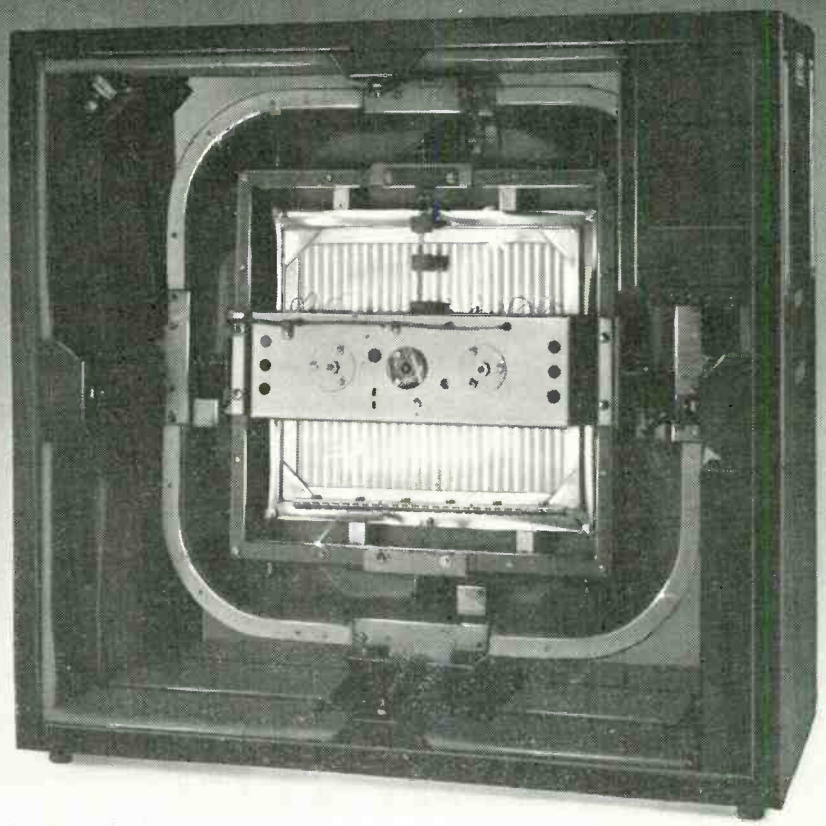
The Comprehensive Electro-Voice System C microphones



The EMT 240 Reverb Foil



has a heart of gold

Synonymous with the world's finest reverberation system is the name EMT and their model 240 has the Midas touch.

An electrolytically produced gold foil only 12 inches square lies at the heart of this unit which ensures constant resonance density through the audible range, no flutter echo repeats, minimum dispersion and smooth decay.

Easily transportable the 240 weighs a mere 67kg and is isolated against shock, vibration, ambient noise; it is ideally suited to O.B. use with no need for recalibration.

DATA:

Reverberation time at 500 Hz	min. 0.8s ±0.2s
Variation of reverb time is effected by a damping plate which is varied in its distance from the reverb foil.	max. 5s ±0.5s
Density of resonances	>3/Hz
Maximum ambient noise level:	≤80 phon
Frequency response from 40 Hz . . . 15 kHz relative to standard curve:	±2 dB
Total harmonic distortion at 1 kHz and max. output	≤0.5%
Signal to noise ratio (unweighted):	≥65 dB

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speaker systems. The filter response is second-order Butterworth; this is a minimum phase network with 12 dB/octave roll-off. Each crossover point has four switchable frequencies which are claimed to be generally suitable for most cone, dome and horn transducers. The series, designated *EC-2*, *3* or *4* (depending on output ports), fits in a standard 483 mm rack and weighs 5 kg.

A new acoustic analyser from **Inovonics** offers 30 ISO ⅓-octave bands and a wideband reference. Readout is by a column of 13 leds/band. A special feature of the *500* is a decay time analysis function. In this mode, each display column acts as a wideband sound level meter which measures and holds a given spl value. Each is stepped in turn to take readings at a rate switchable between 7.5 and 60 ms per step. A logarithmic oscilloscope output is also provided. The instrument also has a built-in pink noise source yielding either wideband or octave noise, the latter intended for RT_{60} room analysis. The US ex-works price is $2500.

Marshall ('the time has come . . .') gave details of two new delay lines, the *P250* and *P500*. These units are intended to head the input to a conventional plate or spring, thus offering a pre-reverb delay variable between 10 and 250 (*P250*) or 500 (*P500*) ms. The design philosophy concludes that there is no point in providing a frequency response or dynamic range far in excess of mechanical plates (with which most straight delay lines are inevitably used) because that costs money without providing any other return. Thus, these units limit the frequency response to 8 kHz and offer dynamic range just slightly ahead of mechanical plates.

The trade off? Price, although that isn't quoted yet.

The California-based company of **Quantum Audio Labs** is selling a new desk, the *QA-3000*, which is fully equipped without being terrifying in complexity. The basic format is between eight and 40 input with up to 16 principal output busses; however, all models are fitted with an independent quad buss interfacing with x-y pan on each input/output module. Other features include four echo busses, two cue sends and 4-band eq. A basic 20/16 desk without patchbay costs $17 750.

Custom Audio Electronics offer a range of pa consoles, the principal feature of which is the total absence of mainframe, mother board or any other oversystem. Both the channel and output modules simply plug into each other to enable quick and easy expansion to the desired system size.

The mixer facilities are interesting and deserve mention in their own right. Each channel can be specified from a simple input unit with eight buss outputs, to parametric eq, individual limiting, etc. Similarly, the output modules can be supplied with differing arrangements to tailor the system organisation to specific need. For instance, the output side of the mixer may feature metering on each buss, a simple a/b or a/b/c output channelling, or any variation inbetween. The power supply fits into the end pieces. Naturally, the price depends on specification; whatever the variety of modules chosen, they all plug together without any hard wiring.

Quad/Eight has entered the off-the-peg console market with the *Pacifica* range of input/output module mixers. Basically, the company quotes mixer size (there are three) as the total number of available channels. For instance, the architecture of a 24-input desk breaks down like this: eight input/output modules; 16 conventional input modules; four echo send/return modules; a control room module; a stereo module; and a communications module.

The idea behind the desk design is to reduce redundancy of output/monitoring channels found in conventional consoles by recognising that engineers hardly ever need more than eight output groups going at the same time. It saves money over the complete input/output desk—such as an MCI or Specta Sonics console—by giving i/o status to the first eight channels only. The rest are totally conventional.

Within this framework, there are no other surprises. The basic channel has four foldback sends, 3-section eq, two cue busses and 8-way routing.

Tangent is offering a desk, *model 3216*, for the musician/semipro recording market. From reading the specification, it is fairly difficult to locate the design departure from the recording industry standard. Available with either 16, 24 or 32 input/output modules, the input stages are fully balanced with the usual *XLR* connectors. The quoted technical specification is as high as any other desk on the market, and the standard model comes with all the regular features found on upmarket competitors. If the price—which isn't quoted on the literature—is lower than the average, then the *model 3216* has to be a good proposition for anyone buying a recording desk.

The publicity handout from **Allen and Heath** says that the *SD12-2* is 'a high-quality stereo mixing console probably for less than your guitar costs'. That says it all. This new desk is purely for pa applications, has a very straightforward 12/2 format, and costs only $950. Each channel incorporates an input pad, four consumer-style tone controls, one foldback send, one echo send, pan, pfl and channel fader. The output section provides the simple complement to the input channels. Inputs are balanced; the standard mixer is equipped with *XLR* sockets.

In the new *TSM Series* of mixing consoles, **Trident** seems to have opted for a traditional design approach—at least from outward appearances. This range is built to the input-channel/output-group concept rather than the American i/o system. Strangely, buss metering is physically offset to the extreme right-hand side of the console, with channel routing buttons where one would normally expect the meters.

Each input channel has 4-band parametric eq with variable high and lowpass shelves; the graphic sections are fitted with bypass switches so that both sections may be used independently. Very usefully, the output features separate quad and stereo busses independent of the main multitrack monitor section, thus giving the engineer plenty of opportunity to play about with the mix during mixdown without disturbing a given combination on the monitors.

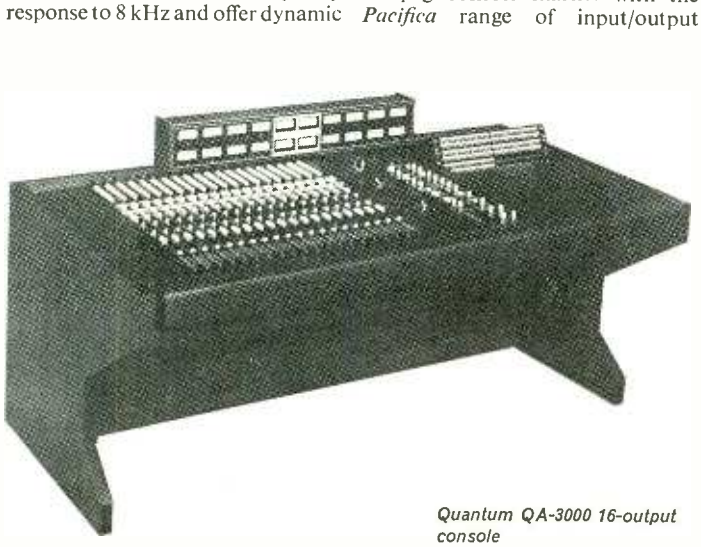
Ivie is offering an astonishingly compact (203 x 98 x 54 mm) audio analysis set which sells for $2800. The manufacturer's specification for the *IE30A* combined real time analyser, sound level meter, precision pre-amp/attenuator and measuring microphone claims an accuracy equal to normal full size equipment. For instance, the spectrum analyser comprises 30 bands on ISO centres with readout from a 480 led matrix giving a resolution of 1, 2 or 3 dB/step. The filter skirt selectivity fully complies with the usual international standards.

The sound level meter covers the range 30-149 dB spl. The detector has switchable rms or peak characteristics; the weighting can be switched to either A, B or C response. Like the analyser, it complies fully with the relevant international standards.

A black box called *Vidigraf* will turn any NTSC video monitor into a black and white 16 or 32-channel vu display. Manufactured by **UREI**, an internal character generator enables each of the columns to be numerically labelled, and also provides the appropriate *y*-axis scale at the side of the display.

The actual scale and bar organisation can be modified from unit to unit to customise the box for a particular application. For instance, the scale can be supplied to log or linear response; naturally, the log scale would be used in audio signal measurement. This flexibility can be used to provide a very useful monitoring facility. The manufacturer suggests uses in spectrum analysis, vu measurement or a combination of both.

The black and white model costs just under $1000; UREI hopes to have a colour version at the LA AES that will be about $200 more. ■



Quantum QA-3000 16-output console

The IE-30A Audio Analysis System from IVIE

- **1/3-octave Spectrum Analyzer**
- **Full-octave Spectrum Analyzer**
- **Precision Sound Level Meter**
- **True RMS AC Voltmeter**
- **RT_{60} (Reverberation)***
- **THD (Harmonic Distortion)***

For the first time, a real time analyzer and precision sound level meter have been combined into a portable audio analyzer "system" with features and accuracies rivaling the best laboratory instruments available.

The fully digital IE-30A comes standard with a precision laboratory microphone calibrated in dB-SPL and remoteable up to several hundred feet, a test probe with three precision attenuator settings for calibrated dBμV measurements (true rms, average or peak), nickel cadmium batteries with charger, and a hard shell, foam lined travel case.

*Using optional accessories

Other features include selectable detector responses, gated mode operation for measurement of reflections and time delay events, dual involatile memories that store or accumulate data that can be recalled to the IE-30A display up to weeks later.

The IE-30A was designed to accommodate an inexpensive new family of optional accessories. The IE-17A measures RT_{60} (reverberation time) in 1/3-octave bands up to 99.99 seconds with 10 millisecond resolution. The IE-15A measures total harmonic distortion (THD) to less than .01%.

SPEC BRIEFS

- 1/3 octave or full octave bands 30 filters on ISO centers 25Hz to 20KHz.
- Highly selective three pole-pair filters exceed ANSI S1.11-1966 Class III, B.S. 2475-1964, DIN 45652, and IEC255-1966.
- 1/3 octave display weighted A, C or Flat.
- LED array 30 x 16. Resolutions of 1, 2 or 3 dB for display ranges up to 45dB.
- Precision SLM has *Fast, Slow, Impulse* or *Peak* responses with A, C or Flat filter weightings.
- 4 digit/0.1dB resolution readout with display hold mode.
- Meets requirements of:
  ANSI S1.4-1971 TYPE S1A, S1C,BS 4197-1967
  DIN 45633 B1.1, B1.2 (Impulse) IEC 179-1973.
- 30 to 149 dB SPL re 20μN/M².
- Microphone is omnidirectional condenser Type 1 (Precision). Flat 10Hz to 20KHz.
- Signal outputs for recorders, oscilloscope displays and voice prints.

IVIE ELECTRONICS, INC.
500 West 1200 South
Orem, Utah 84057 U.S.A.
(801) 224-1800
TELEX or TWX 910-971-5884

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Equalisers: their uses and abuses

Terry Clarke

From the beginning of recorded sound, equalisation has shown itself to be an important factor in the design and fabrication of audio equipment. Much progress has since been made. With the aid of modern technology, there now exists such a degree of control over equalisation that it has become a major design criterion in any audio installation.

THE FILTER is the basic building block of all equalisers. In its simplest form, as an 'RC network' (shown in fig. 1), it will perform a lowpass or highpass filter function. Using operational amplifiers, it is possible to build filters, both inexpensively and effectively, that will perform complex functions and, at the same time, have control over their main parameters.

Parameters of high and lowpass filters are the frequency at which the filter starts to attenuate (this is measured at the 3 dB down [turnover] point); and the rate of attenuation, ie the slope of the response curve (this is usually measured in dB/octave). The turnover point is determined by the values of the components in the filter and the slope is controlled by the 'order' of the filter, this 'order' being dependent on the number of reactive components (ie capacitors and inductors) in the filter.

The simple RC filter is defined as a first order filter (only one capacitor or inductor). The maximum rate at which the voltage gain can change is to double (or halve) every time the frequency doubles—a 6 dB/octave slope. Higher order networks (containing more than one capacitor or inductor) can produce steeper slopes, and more complicated curves.

First order filters can be arranged to produce a shelving filter (see fig. 2), and here the response falls (or rises) to a fixed value, at which point it ceases to change. A filter can be arranged to boost or cut, by incorporating it in an amplification circuit.

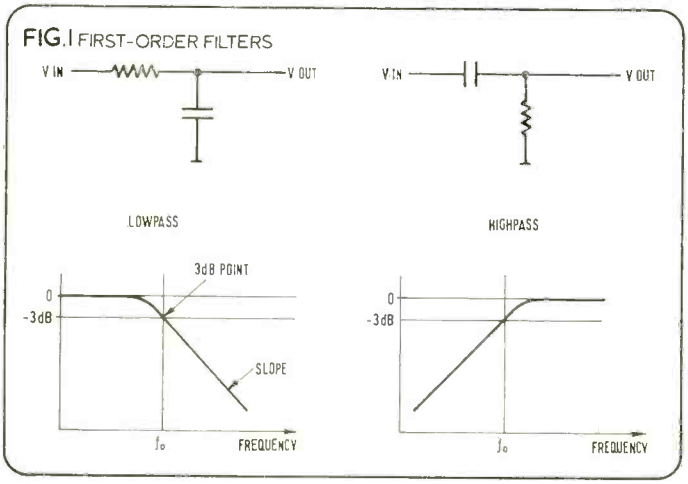
In a bandpass filter, the frequencies at both the high and low end of the audio spectrum are attenuated, thus leaving a peak at the centre frequency, as in fig. 3. Here, one finds another parameter of a filter—the 'Q' factor. The 'Q' is the degree of sharpness of the filter—the higher the 'Q' the sharper the filter. The mathematical definition is: $Q = fo/2\,\Delta f$ (where fo is the centre frequency and $2\,\Delta f$ is the bandwidth at the 3 dB points).

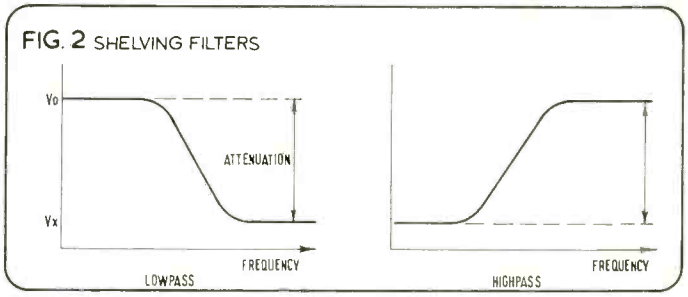
In a bandstop (notch) filter, the high and low frequencies are passed, leaving a maximum attenuation at the centre frequency (see fig. 4) and, ideally, the notch should have infinite attenuation at the centre frequency.

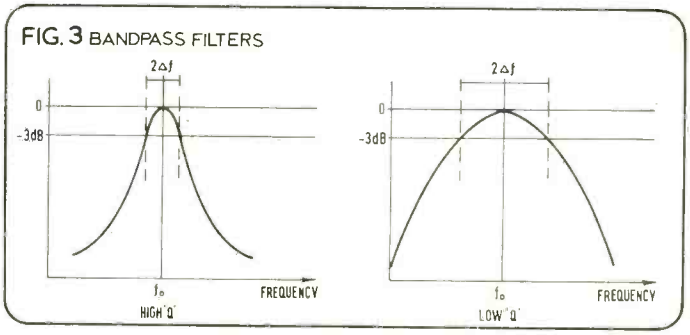
With both bandpass and bandstop filters it is possible, using complex design, to alter all their parameters independently; hence the centre frequency can be altered without changing the 'Q' or the gain of the filter, and vice-versa. This type of filter is often referred to as a parametric filter.

As with the low and highpass filter, the bandpass and bandstop filter can be placed around an amplifier, enabling them, by adding or subtracting from the original signal, to both boost and cut.

One problem, however, with high order filters is their inability to handle transients, so putting a squarewave through a high order filter will produce ringing (see fig. 5). The amount of ringing depends on the frequency response of the filter and not, as many people believe, on the type of components used in the filter. With a 'Q' factor of less than 0.5, it is impossible to produce ringing, since at this point, the circuit is said to be critically damped, but increasing the 'Q' above 0.5 will produce ringing—the higher the 'Q' the greater the ringing. It must be pointed out that the amount of ringing can also be affected by the frequency response of the filter outside the audio spectrum, and that ringing will be more severe if the filter is not of the minimum-phase type.







Equalisers

An equaliser is a unit containing one or more filters arranged so that adjustment can be made to either the gain (level of boost and cut) and/or a combination of their parameters. The range of equalisers used spans from a basic treble and bass tone control on a low-cost hi-fi system, to the complex parametric and ⅓-octave graphic equalisers used in professional studios and laboratories. The type and complexity of the equaliser needed is determined by the application and by the amount of control required. Basic devices have a very limited range of control and are relatively simple to use, whereas complex devices are more versatile, but require much more expertise from the operator.

Fig. 6 shows a plot of the frequency response curves, at various control positions, of a basic treble and bass tone control found in pre-amplifiers and small mixing consoles. These equalisers are usually first order networks (6 dB/octave slope) with a fixed turnover point using a continuously variable control to adjust the level of boost or cut. Typically, a single potentiometer per section would be used, giving 15 dB maximum boost and cut at the extreme ends of the control, with a flat response at the mid position. More complex equalisers incorporate second order networks, and are provided with adjustable slope and turnover points. These can be extended to include peaking control with selectable centre frequencies, as shown in **fig. 7**. Some of the more sophisticated mixers, however, use a simple parametric equaliser on each channel.

The word 'parametric' does not have a specific definition when used in this context and, consequently, manufacturers tend to use their own interpretation (one which brings their product into this category). The normally accepted meaning describes an equaliser which is comprised of a number of filter sections, each having continuously adjustable, non-interactive control over the centre frequency, the level of boost and cut, and either the bandwidth or 'Q'. A typical unit would have, perhaps, four sections connected in series, and the limits of the centre frequency control of each section would be arranged to overlap the adjacent sections by 50%, so that separate adjustment can be made to any two close frequencies within the audio bandwidth. In the boost position, a maximum gain of 15 dB is normally provided—more than this is considered unnecessary. In the cut position, however, when the unit is being used to remove unwanted noise, an infinite cut or 'notch' may be required. Bandwidth limits are a matter of personal preference, but a minimum 'Q' factor of 0.3 would provide a gentle slope similar to that of a simple first order tone control, and a maximum 'Q' factor of 7 would provide a steep or sharp response.

The majority of parametric equalisers on the market utilise the reciprocal form of filter, in which the cut and boost curves approximate to a mirror image. **Fig. 9** (a set of 'reciprocal' frequency response curves) shows that this type of equaliser is unable to produce a deep notch response. **Fig. 8** (a set of constant 'Q' frequency response curves) shows the curves made by a unit using a constant 'Q' design and here an infinite (or deep) notch is easily provided.

Because of the high degree of control, precise frequency responses can be attained, but since most parametric equalisers use rotary controls which give relatively no visual feedback of their frequency response, it is important that the engineer is fully conversant with the equipment, otherwise results can be disastrous! They are ideally suited for precise control over a particular frequency, such as removing constant pitch interference (eg hum).

A graphic equaliser consists of a number of bandpass filters, whose centre frequencies are usually fixed and are equally spaced according to musical intervals, ie a log scale. An 'octave' band equaliser could have ten controls spaced at octave intervals: for example at 40 Hz, 80 Hz, 160 Hz, 320 Hz, 640 Hz, 1.25 kHz, 2.5 kHz, 5 kHz, 10 kHz and 20 kHz. The controls are normally linear slide potentiometers, arranged in a side-by-side configuration, thus giving a graphical representation of the frequency response of the equalisers—hence the name 'graphic equaliser'. The 'Q' of each individual filter is usually a fixed value, selected to overlap the adjacent centre frequencies when its control is set to the maximum boost or cut position. This provides minimal interaction between sections and a smooth frequency response curve when two adjacent controls are set at the same position (thus providing a broader bandwidth). As a rule the maximum level of boost and cut provided is between 10 and 15 dB. Graphic equalisers now available have

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FIG. 4 NOTCH FILTER

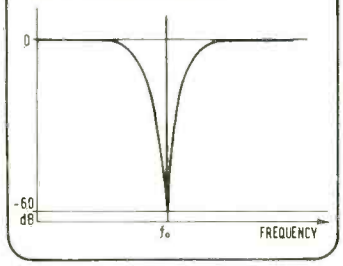


FIG. 5 RINGING ON A SQUAREWAVE

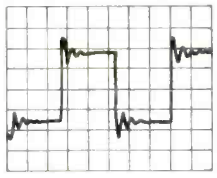


FIG. 6 TREBLE AND BASS TONE CONTROLS

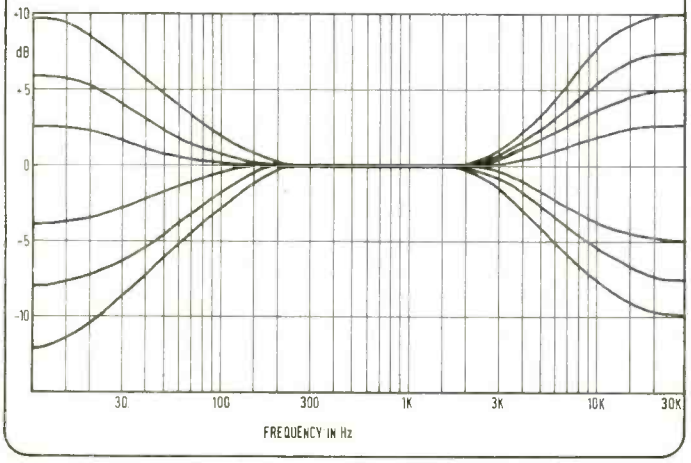


FIG. 7 TREBLE, BASS AND MIDDLE TONE CONTROLS

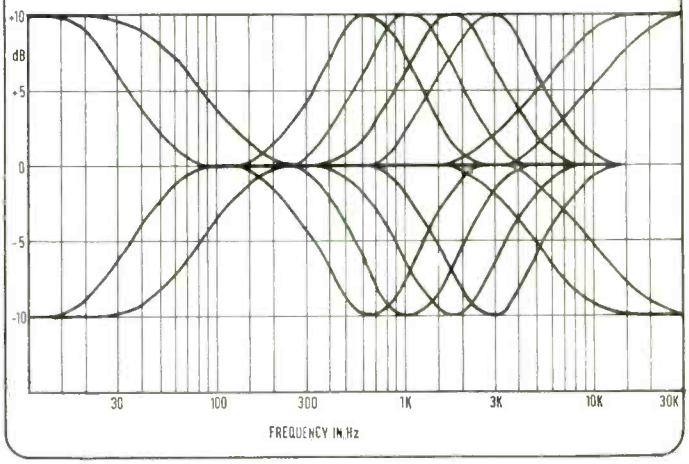


FIG. 8 CONSTANT 'Q' CURVES

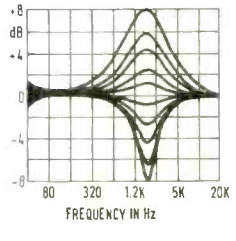
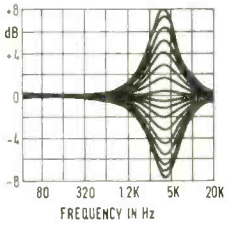


FIG. 9 'RECIPROCAL' CURVES



between six and 27 controls per channel, fulfilling a wide range of requirements. Obviously, the bandwidth on each section of a 6-band unit will be much broader than that on a unit with 27 sections.

Graphic equalisers are ideal for equalising general frequency deficiencies over the whole audio spectrum and the visual feedback is an obvious advantage when a quick and precise adjustment is required, such as for flattening the frequency response of an entire sound reinforcement system.

Recently, several parametric equalisers have come onto the market which utilise the linear boost and cut controls that one would find on a graphic equaliser. These so-called parametric-graphic equalisers usually have more sections per channel (typically 6-10) than a parametric equaliser, and provide a degree of visual feedback. However, by adding bandwidth and centre frequency controls to a 'graphic' layout does mean that at some settings the visual information is misleading. Here, as with the parametric equaliser, the engineer must have a good understanding of the piece of equipment to achieve good results.

Application

Equalisers have extensive application in the field of modern audio engineering. The general philosophy that persisted for many years in the broadcasting and, to a lesser extent, recording industries was that equalisation, if any, should be used only to correct deficiencies in the frequency response of the equipment or listening environment rather than to actually modify the programme source in any way. Equalisers are still widely used to achieve these same requirements and also for room equalisation in studios, concert halls, and in the home, and to restore correct tonal balance to programme material. Applications here include restoring old or badly-made recordings and compensating for deficiencies in equipment having a poor frequency response—for example, mechanical reverberation devices.

With the move towards closely-positioned microphone techniques came the ability to add equalisation to an individual instrument without disturbing the overall tonal balance. This has led to the development of the equaliser as a creative tool, which explains the sophistication of the equalisation facilities provided on modern mixing consoles. Equalisers are most commonly used as integral parts of other equipment, such as crossover networks, tape recorders, reverberation plates, microphones and magnetic cartridge pre-amplifiers.

Equalisation facilities provided on modern studio mixing consoles vary in detail quite considerably, but each equaliser section falls into one of two main categories. The more common of the two uses either a three or four 'knob' equaliser as previously described, while the alternative is a three or four section parametric equaliser. There are obvious advantages and disadvantages with both these types of equaliser, but the parametric equaliser gives the engineer much greater flexibility. However, to obtain any real benefit, he should know what equalisation he wants to add, and understand the means of achieving it. Playing it purely 'by ear' may be possible with one parametric section but with a complete equaliser having, for example, four sections (two of which may have shelving responses) the problem is considerably worse. Trying to return to a given equalisation setting under these conditions can be very difficult.

Using the more usual system of switchable centre frequency controls and fixed 'Q', the engineer can rapidly set a known equalisation setting. The disadvantages of not being able to alter the 'Q' of the filter and being limited to a finite number of centre frequencies are often not apparent and, in the event of a signal requiring more extensive equalisation, a graphic or parametric equaliser can be patched-in. There may well be a case, especially for the budget-conscious studio, to opt for a desk with less equalisation than currently found on the most expensive units, and to patch-in a graphic equaliser when a difficult situation arises. Even using a desk with extensive equalisation facilities, an external equaliser is usually faster and easier to use when an abnormal equalisation problem is encountered. Parametric equalisers may be used in the same manner but will generally take longer to set up—they are better used for sound effects or for tuning out spurious noises.

Equalisation can be used on most instruments to advantage and in many cases a minimal degree of eq will be required. Conversely, some instruments can require substantial adjustment; for example, the drumkit. Low and highpass filters are useful here—the highpass filter for reducing bass drum spill onto the cymbal microphones and the lowpass filter for reducing cymbal spill onto the bass drum microphone. However there is little point in specifics here, since the use of equalisers on programme material is very subjective and constitutes much of the 'art' of recording.

Equalisation should obviously be added before the sound is committed to tape where possible. Since some further equalisation will usually be required in the final mixing stages, one can add some extra 'top' initially, which can always be turned down later, thus ensuring a minimum of tape noise.

Mechanical reverberation devices usually have an uneven frequency response and professional models will normally have equalisation circuits as an integral part of the unit, so they may not require further equalisation (unless it is added as an effect). Some of the less expensive spring devices, however, may well be improved by using external equalisation.

The need for a flat frequency response in the control room for monitoring purposes is, of course, essential, and using a calibrated microphone and spectrum analyser or pulse system, the frequency response of the listening environment/monitor combination is easily determined. Equalisation is then used to make the response flat. Although fixed value equalisers can be used for this application, this is not advisable since a change of monitor or any change in the acoustics of the control room necessitates retaking the measurements, and probably resetting the equalisation. For this application, one normally uses a 27-band ⅓-octave graphic equaliser, and after it has been set a tamper-proof cover is fitted over the equaliser controls to avoid the equalisation being inadvertently altered. In a well-designed control room, this is all that is necessary to ensure correct monitor acoustics. However, in the case of extreme peaks or troughs being found, the control room acoustics must be adjusted, possibly by means of structural changes, before correct calibration can take place.

Stage

Some applications here are obviously the same as for the studio. As far as most facilities go, mixing consoles for live work have almost reached the same level as those found in the studio; and this applies to the equalisation section in particular. Highpass filters will be useful in reducing mechanical vibrations transmitted through microphone stands. Again, anything requiring more equalisation can be routed to an external graphic or parametric equaliser.

Room equalisation is of great importance for a live performance and the procedure used is the same as that for equalising a studio control room, except that a minimum of three calibrated microphones are used. These are spaced around the listening area and the signals from them are then multiplexed, which helps to overcome misleading results caused by standing wave effects in the hall. However, multiplexers are expensive so these measurements are sometimes taken using one microphone only. Measurements are taken with the microphone in several different positions around the listening area, and the results are then averaged. But the first method is preferable. The equaliser used for this application is again the 27-band ⅓-octave graphic equaliser. Stage monitors are usually equalised with their own equaliser, and there the resonant frequencies are cut in order to increase the monitor levels attainable before acoustic feedback occurs. A parametric equaliser with a 'notch' facility is beneficial in cases where a specific frequency is causing trouble, especially when this frequency falls midway between two filters on the graphic equaliser.

Conclusion

As in all aspects of the audio field, equalisers are becoming more comprehensive year by year. Although the intention is to improve sound reproduction, very often the reverse is the case. Acoustic problems should be cured as far as possible by improving the acoustics, using the equaliser as an aid and a creative tool.

Because of its comprehensive facilities an equaliser can be an extremely creative tool on programme material. However, it should be used very carefully when flattening a room; those controls are saying a lot about the acoustics. ■

My thanks to the development staff of Klark-Teknik for their assistance in compiling this article.

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STUDER REVOX

business

ADRIAN HOPE

Quality pressings

SUDDENLY, direct-cut is all the hi-fi rage. And it's easy to see why. Enthusiasts who have spent thousands of pounds on their disc-playing systems are, not surprisingly, generally disillusioned by the overall quality of discs in the shops. Even a perfect pressing (which many people would say is so rare as to be worth its weight in gold) may well have been cut from a master tape with a fairly high level of distortion, or noise, or both. Likewise, manufacturers and shops are always looking for the best possible programme source with which to demonstrate their wares.

So enthusiasts and trade alike have alighted on direct-cut discs, of which by far the most favourite to date are those made by Sheffield in California. But in addition to Sheffield there are now literally dozens of other direct-cut labels on the market in the USA, some decidedly better than others. Inevitably some small record companies have jumped on the bandwagon, in the hope that the magic words 'direct-cut' will sell rubbish; and so far, it will. But the bubble will burst and some people will get their fingers burnt—and deservedly so.

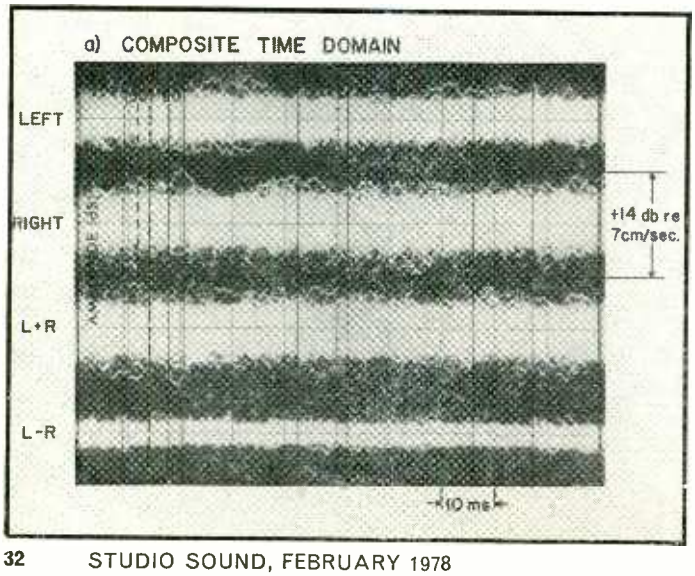
In France direct-cut records are sold in ordinary record shops, along with ordinary records—but at the extraordinary price of over £15 a time. In England, Jon Soyka left his job with JVC to start Quadramail, originally to sell hard-to-obtain quad discs to owners of CD-4 equipment. But the paucity of new CD-4 releases and the poor pressing quality of many of those that are available led Quadramail to drop CD-4 from its UK mail-order catalogue. The company is now going great guns on the sale of imported direct-cut records, mainly the Sheffield discs and those on the new Canadian label, Umbrella. Prices average around £7 or £8 a time, and it's astonishing that at the time of writing the first British direct-cut disc has only just happened (see Work item, p56).

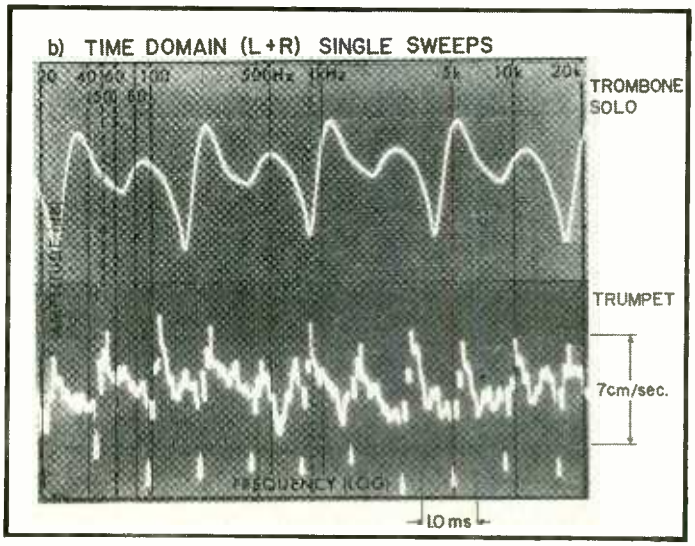
When I wrote about EMI's Abbey Road Studios a couple of years ago I reported on how they were interested in direct cutting. I also mentioned the possibility of ganging all the Abbey Road disc-cutting rooms together, to produce several lacquers at the same time and so overcome the main problem with direct cutting, namely that it produces only one, irreplaceable lacquer and consequently a limited pressing run. But nothing has ever happened. A while back I took a trip to The Manor and sought out Richard Branson. He, too, was interested, and for a while it seemed that there might be a Virgin direct-cut before long; but nothing as yet seems to have happened there either. This is surprising, because Virgin have always been an enterprising bunch: putting out Mike Oldfield in several quad formats; getting at least as far as a test pressing for a dBx-encoded Oldfield album; and now releasing a David Bedford lp encoded in BBC Matrix H quad format. (Memo to Virgin re the current adverts for this album: actually it isn't the first album ever to be released in Matrix H; BBC Records put out a Norrie Paramor stereo light music album a year ago which, although few people realised it, was in fact made from a tape recorded in Matrix H!)

Surely the absence of a British direct-cut record hasn't been the result of inadequacy on the part of British cutting engineers? Even though cutting direct is a darned sight more difficult than anybody realises until they've tried it, we have some of the best cutters in the world, and I bet they'd rise to the challenge if someone gave them the opportunity. Meanwhile, interesting points on the American direct-cuts are continually coming to light.

Sheffield, on a recent direct-cut album, suggested that the listener should try reversing the phase to *both* loudspeakers. At first this sounds ridiculous, because if you reverse the phase to both loudspeakers you leave the relative phase as it is. But Sheffield are talking here about *absolute* phase, and have realised that the console on which all their recordings were made, up to the Harry James album, had a summing junction that inverted phase. Many instruments and voices produce asymmetrical waveforms (see 'Tower of Power', J Fred Riley, STUDIO SOUND, August 1977, p40). They have large spikes or pulses that move in a positive-leading fashion. There is now some evidence to suggest that if overall audio quality is very good but these pulses are reproduced in negative fashion (that is to say with the speakers pulling rather than pushing the air at the beginning of the transient) there is a subtle, unnatural audio effect. This is corrected by reversing the phase of both speakers to reconstitute absolute phasing.

Some people are more sensitive to absolute phase than others, and very little work has been done on how important it really is. But it might be an idea for engineers to check out their desks and see whether a positive pulse at the input comes out as a positive pulse at the output. If it doesn't, it might well be worth rectifying the matter now, rather than later when more work has been done on the relevance of absolute phase and you find you have been turning out inverted-phase recordings for donkey's years. In the meantime it would probably be best for labels such as Sheffield to suggest that the listener reverses the phase of both loudspeakers *and then listens to see if it sounds any better*. Simply to tell people to reverse the phase of both loudspeakers will confuse them and give





many listeners the impression that whoever wrote the instructions has made a mistake.

Talking to Peter Clayton of Umbrella Records recently, I learned some interesting snippets on direct-cutting. Umbrella reckon it's necessary to plate the freshly-cut lacquers within a couple of hours, to preserve all the advantages of cutting direct. After a couple of hours the 'memory' of the plastic tends to pull the groove a fraction out of its cut shape, causing a slight degradation of quality. The story goes that one American record company found this out the hard way, when they moved their cutting rooms away from the building which housed the plating baths. An inevitable delay of several hours, sometimes days, between cutting and plating was introduced, and quality fell off. Also, Umbrella and Sheffield have their pressing done in Germany by Teldec. This seems sad comment. Incidentally, one tiny click you hear on the Thelma Houston Sheffield album isn't a pressing fault or speck of dust—it's all that remains of a microscopic repair on the original master carried out by Teldec engineers to save the lacquer after one groove had run into the other. Although some direct-cut recordings are now being made on location, with music lines run back to a studio lathe, most have so far been studio jobs. Umbrella have plans to use a mobile lathe, but in the meantime aim to use a microwave link to beam signals back to the studio across a Canadian lake. This will present some fairly substantial problems. For a start, Umbrella will need a 25 kHz bandwidth on the stereo pcm link, because analysis has shown that there is this kind of frequency information on the best direct-cut discs. (Current radio links have a more limited bandwidth). Also birds fly over lakes and there will be the problem of loss of signal and 'dropout' if a bird flies through the microwave beam; so there will have to be several back-up beams, spaced side by side. So what happens if a helicopter or a flock of birds fly through the bunch of beams? You junk the lacquer and start again, that's what.

An indication of how seriously Umbrella take the business of direct-cutting and how many pitfalls there are for the unwary is to be had from some oscillograms they have made of side 4 (the *Porgy & Bess* Suite) of the Umbrella *Big Band Jazz* lp (UMB DD-4). A pressing was replayed on the Neumann *VMS 70* lathe turntable, using an SME arm and Stanton *681EE* pickup. A Tektronix storage scope was used to display left, right, sum and difference information and photos taken direct from the screen. These photos reveal some interesting facts. For instance, **fig. a**, an accumulated display of all four signals, with the scope sweep running for the entire side of the disc, shows how some instantaneous peaks rise to +13-14 dB above the average. These are mostly kick drum transients, and although they show up on the left, right and sum (l + r) sweeps they are almost totally absent from the difference (l – r) sweep. This graphically shows the absolute need to keep low-frequency, out-of-phase signals at a minimum for an unlimited recording. In fact the difference signal is always about 10 dB down on the left, right and sum channels. If it weren't, the stylus would bounce and skip the grooves on replay and the disc would wear out far too fast. So, for direct-cut recordings, engineers need to mix, place and phase microphones very carefully indeed.

Some single shot waveforms of the sum signal (lower trace on **fig. b**) show up curious discontinuities when a trumpet is played. The reason is very simple: the steep sides of the trumpet fundamental-pitch transients exceed the writing rate of the Tektronix scope! It's that fast rise-time that gives the brass its characteristic bite—so hard normally to capture on disc.

Other traces photographed by Umbrella show that the mid-range signal dynamics average about 40 dB, but rise to over 60 dB at high frequencies. By direct-cutting, and hence avoiding the tape stage, the overall signal-to-noise ratio is around 50-60 dB through the mid-range, to better than 70 dB above 5 kHz. And these figures are based on the studio noise-floor, that's to say, room ambience, outside traffic, and so on; if the system noise, that is to say the desk and Pyral lacquer, is taken as the baseline, the s/n ratio can approach 80 or 90 dB at the high end.

All this just helps to show how cutting a direct-cut disc requires a great deal of care from all concerned. This, coupled with the fact that only a limited edition of between 10-30 000 can be pressed from a single master, accounts for the high price.

Finally, it's interesting to note the activities of another firm in the direct-cut field—Crystal Clear, of California. Although imported Crystal records have so far been musically rather less exciting than the Sheffield and Umbrella offerings, Crystal adopts the interesting approach of cutting onto standard lp-sized lacquers, but running at 45 rather than 33⅓ rpm. In theory, this makes it possible to improve signal-to-noise ratios even further, and cut at higher level or with less distortion. ■

agony

On reflection

letters

Bootlegging

Dear Sir, In reference to your 'agony' column of October 1977 re: the bootleg album, I must tell you that this situation is all too common an occurrence here in the US. Some years back we were glutted with a wide assortment of rock bootlegs, ranging from pirated concert recordings, either live or air-checked, on 4 and 8-track cartridge tapes and discs; the problem of the discs being one of the more clever, but still poorly counterfeit. Fortunately, the American record industry, seeing this as a plague of cancerous proportions, set out to enact all kinds of federal legislation, and with the help of the FBI managed to stifle the multimillion dollar industry bent on burning customers.

This, however, was successful only with rock recordings: since these garnish the most in potential sales they stood to lose the most. Symphonic and operatic recordings took the usual back seat and their piracy has raged to epidemic proportions. The twist to this type of bootlegging, as opposed to the rock items, is that the sources of such material are of a considerably wider nature and therefore harder to trace. For example, there has been a tremendous number of historical recordings issued in this country, mostly culled from either transcriptions made in the 1930s and forties, or from 78s.

Due to the grossly inferior sound of these recordings, it is hardly feasible that any sort of permission was granted, or intentions presented to the parent companies holding these masters —in particular the catalogues of EMI and Polydor from whom American collector pirates have pillaged at an inestimable rate. These recordings, as one would quickly notice by merely playing them, are usually transferred directly from well-worn 78s, quite often with little or no eq, and invariably suffer from wow and pitch problems as well as a total lack of musical continuity in respect to side joining.

Because most of these recordings go under the heading of 'Private Issue' one has the feeling of some sort of immunity from prosecution. But the title is of little or no value as all of these recordings are readily available at most every record store that offers more than the meat-and-potatoes fare of classical recordings.

Because union problems are so widespread and stifling with regard to musicians and the expenses of recording opera in this country are so high, most companies go unrecorded, with the exclusion of the Metropolitan which maintains a weekly radio programme broadcast nationwide. Aside from that nothing much is recorded or broadcast; and this is where the bootlegger comes in with guns blazing. Recently Tower Records, one of LA's largest record store chains, offered a monstrous array of curious opera recordings. Encased in dubious packaging and offering everything from 1937 Salzburg to 1947 Met the discs were from pirate sources. The quality was, at best, rough, the prices extortionate and the royalties for performances non-existent.

Some attempts at thwarting the illegal recording of a live-performance have only been sporadic and subsequently left to go unheeded. One of the more glowing stories of this type of recording was the case of a well-known movie & tv actor who, when stopped by the management of the theatre, was discovered to be wired for sound with microphones coming out of each arm and a portable cassette machine under his jacket. His is not an uncommon occurrence. Although I am in no way implying that this actor is a potential bootlegger, I am saying that it is common to have a situation such as this take place.

The other situation has been presented that classical pirating is not merely confined to disc. The past few years has seen an unprecedented growth of reel-to-reel and cassette duplication firms specialising in live performances on tape procured primarily from live performances broadcast in Europe. Strange as it seems, none of these recordings has the 'fm sound' of tapes made from air-checks, but instead sound more like master recordings. The range of recordings is far reaching, with the usual myriad of operas leading the way, and all come from either the BBC or Deutsche Welle and ORTF. For the most part these recordings are of superior quality, and the prices go according to quality. One case in point was my own experience in beefing up my Jascha Horenstein collection, when I came across a broadcast of Brahms Second Symphony. I paid $25.00 for it, only to discover that the same recording was issued a year later by Unicorn Records. I was happy the recording was now out legitimately, but was also out $25.00.

The problem of pirating and bootlegging of classical recordings will always be in our midst as long as there is a lack of willingness on the part of record labels to deal with the problem. The problem in this case is the total lack of interest on the part of American record companies in satisfying this need, which is surprisingly great. I know the extent of historical re-issuing done by the EMI group of companies worldwide, and find that almost all of these recordings are refused issuance by Capitol here in the States —leaving many of these recordings to never see the light of day in America.

'High Fidelity Magazine' devoted an entire issue four years ago to the problem of bootlegging of classical recordings, and the virtual storehouse of historical broadcasts in the archives of most European radio networks. To me, it would seem easy to restore and issue these recordings, as Cetra in Italy has started to do with live opera recordings; I am sure it would be as easy for Polydor and EMI to do likewise. I have always heard rumours about the inestimable amount of live broadcast recordings the BBC has hidden away, and what a truly invaluable service it would be to provide these recordings to the collector — satisfying not only the public but the artists and the estates of the artists as well.

As it stands now the record companies have potentially lost millions of dollars because of the unauthorised issue of recordings. This situation will never be fully stifled, but a partial recovery of losses could be at hand if the powers that be— the EMIs, Polydors, Columbias and RCAs— would take a second look at that immense pile of tapes and metal masters and realise that there was a lot of potential sitting there. Likewise with the BBC, DW and ORTF.

You've no idea what a pain it is to listen to an inferior pressing of a Mengleberg bootleg and know damn well that originally the 78s must *have sounded better.*

Yours faithfully, Gordon D Skene, West Coast Contributor, Studio Sound.

Rock music and hearing damage

Dear Sir, 'When I'd seen Kiss at the Chicago Stadium back in January, they were putting out a measured 140-plus decibels to the first 20 rows or so. It's an effect you can reproduce almost exactly by sticking your head inside a jet engine. If you are under 15, it's very exciting.'— Playboy, December 1977.

*'Black Sabbath perform at outrageously high levels, and the sound reinforcement company had installed a system that ensured the audience's satisfaction at staggering levels.'—*STUDIO SOUND, *December 1977.*

Since a 37.5 kW Lou Reed concert in Copenhagen I have had an at first constant and now (three or four years after) intermediate chiming sound in both ears. At a David Bowie concert some time ago the noise level was occasionally so loud that I felt the need for supplementing my 'bilsom' earplugs with my gun shooting earmuffs. I sat in the 27th row.

Even though the Leeds noise limits seem somewhat excessive, the rock industry shows a truly remarkable lack of concern for the hearing damage it inflicts on its consumers, and overamplification seems to be the rule rather than the exception.

I would be very interested to hear if any of the people arranging these shows can come up with some kind of evidence for the irresistible craving from the audience to have the sense of hearing impaired and eardrums occasionally ruptured.

Of course you want it loud and clear—it must be a part of the show you sell that the sound is as good as the lighting and the stage show—but if you come from a 60-80 dB environment (the street) 100 dB certainly is loud. *This average sound pressure still leaves 15 dB for peaks and short fortissimos within easy reach for a relatively small, well-designed sound system.*

If the band really needs zero dynamic range, let them have it at 100 dB—no one will ever notice it, except perhaps the live sound engineer whose hearing is already severely damaged. Anyway, the show isn't for him, it's for the kids who still can hear 20 kHz, and who just might like to do it after the show as well.

Yours faithfully, Peter Larsen, LM Recording, Platanvej 32, DK-1810 Kobenhavn V, Denmark.

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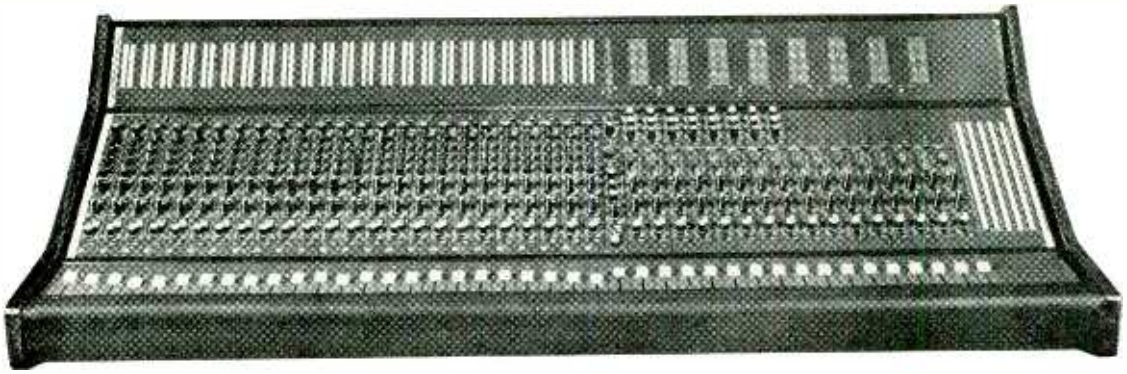

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Cutting sound with light

Paul Messenger

The conventional analogue disc has been around for a long time now and consequently is firmly established; it is easy to use, fairly robust and provides 'adequate' quality. Its days may be numbered though, with the development of a pcm-encoded disc by a consortium of three Japanese companies. This uses laser light to 'cut' the bits of data onto a nickel master, thus offering the potential of large scale duplication with no loss of quality.

THE 1977 Tokyo Audio Show in the autumn saw the announcement of a revolutionary disc sound recording system, using digital pcm encoded signals, with the recording and scanning by means of lasers. The system is the result of joint research work by three companies, Teac, Mitsubishi and Tokyo Denka. Attempts are obviously being made to create an international standard with this otherwise incompatible system, and both Sony and Pioneer are reported to be producing software.

The report which follows is based on a translation* of details put out by one of the manufacturers, and is therefore essentially non-critical and may tend to exaggerate the benefits and minimise the drawbacks. As far as we are aware, no demonstrations have been given in Europe yet.

Whether the system will catch on must remain very much a moot point at present. To change the whole direction of one hundred years of analogue developments may well prove to be an impossible task, because of the enormous manufacturer and consumer investment in capital equipment. Although the digital system offers theoretical advantages in quite a number of areas, it also raises problems of its own, notably in the initial a-d conversion and the final d-a reconversion for playback.

There is also the thorny question of standardisation of the recording medium. A digital signal may offer rather more flexibility in choice of storage medium than an analogue, and could well ride on the back of the computer industry in developing storage mechanisms. One wonders therefore whether a laser-scanned rotating disc is the optimum method or merely chosen in order to avoid consumer distrust through unfamiliarity. It is possible that developments in holography and bubble memory systems, which could be scanned once and controlled by a clocking mechanism, might be a more logical way to approach a digital medium; key factors which we have not been able to investigate yet will of course revolve around capital costs of equipment required by both the manufacturers and consumer, and the unit cost and consistency of the software product.

So while there must remain considerable doubts over the viability of the system, and whether in practice it is capable of producing better results than the best analogue systems, at least a standard has been set. The considerable commercial 'muscle' behind it may be sufficient to win acceptance, but only time will tell whether it becomes a Compact Cassette or an Elcaset!

The laser method provides a very high density recording medium. As a laser beam is very narrow in width and consists of a perfect plane-wave ray, it can be focused into a very small spot using a condensing lens. This characteristic gives a high recording capacity per unit area, and allows the use of the new system of pcm recording/reproduction which needs a frequency range as wide as a vtr. All the recording equipment is installed in a clean room to avoid contamination.

The high output power of an argon laser beam in the recording equipment is fed to a light-modulator where it is converted into a blinking beam synchronised with the recording signal (frequency modulation). This beam is focused into a microscopic spot, with a diameter of less than 1 μm, using a condenser lens, and is then applied to a very flat glass master disc on which a special metal coating layer has been deposited (the master rotates at 1800 rpm and is 350 mm in diameter).

By focusing the laser onto the metal layer on the master and moving the beam towards the centre of the disc constantly using a radial pitch servo, a series of oval-shaped holes (called pits) are made in a spiral formation; and this master is used for mass production.

The recording equipment, which corresponds to a cutting machine in a conventional system, has many servo circuits in order to ensure precise operation. For example, a focus servo is used to maintain the diameter of the laser spot to unify the size of pits and the distance between them.

A pcm (pulse code modulation) signal is a 'discontinuous' digital signal, while a normal audio signal is a successive or 'continuous' analogue signal. Therefore, in order to convert analogue to digital, the audio signal is first fed to a sampling processor where it is sampled periodically (pulse amplitude modulation). This sample interval determines the upper limit of the transfer frequency of the system.

The sampled signal is then fed to a quantisation process which converts it into a digital signal. The number of pulses used in this stage determines the dynamic range of the system. In reality an expensive analogue-digital converter is necessary for the quantisation of many pulses, and a practical system uses a compression and expansion method for the quantisation, which in turn uses comparatively less pulses, but enables a wide dynamic range to be obtained at reasonable cost. In addition to the above-mentioned basic functions of pcm conversion, several other functions are necessary such as a time-sharing circuit which converts a (parallel) stereo signal into a serial signal, and a drop-out compensation circuit to prevent the introduction of noise under such conditions.

* *Translation by Kawamura Labs of Japan.*

A pcm Laser Sound Player has been demonstrated using a small-power He-Ne laser; the group, however, is developing the application of a semiconductor laser for the player, to achieve compactness, light weight and easy handling.

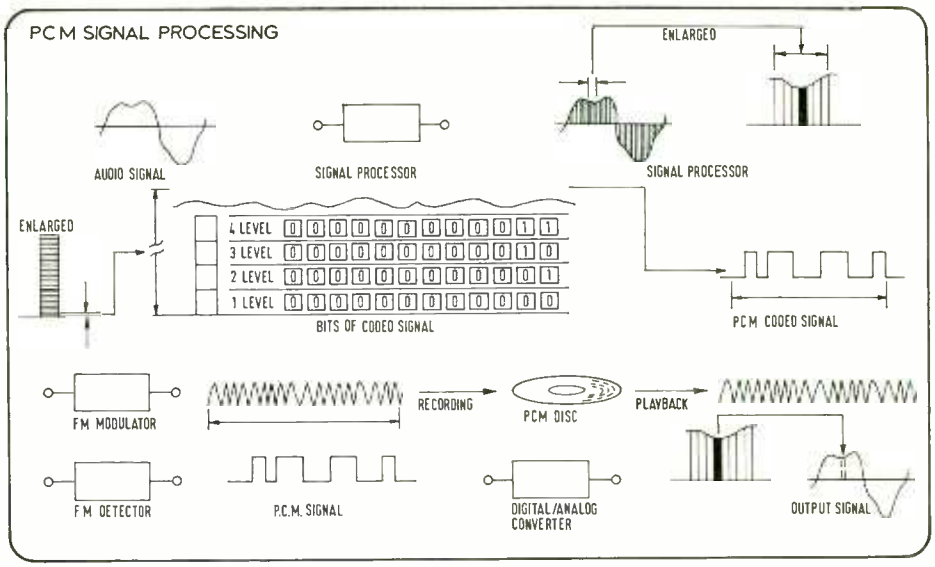
In the player, a 2 μm spot from the laser beam is focused onto the recorded pits on the disc. Even though the reflection factors of the pits and the peripheral region are the same, discrimination of pits is possible since the reflected beams will interfere with each other and reduce the luminous intensity at a beam detector if the depth of pits is adjusted to one quarter the wavelength of the laser beam.

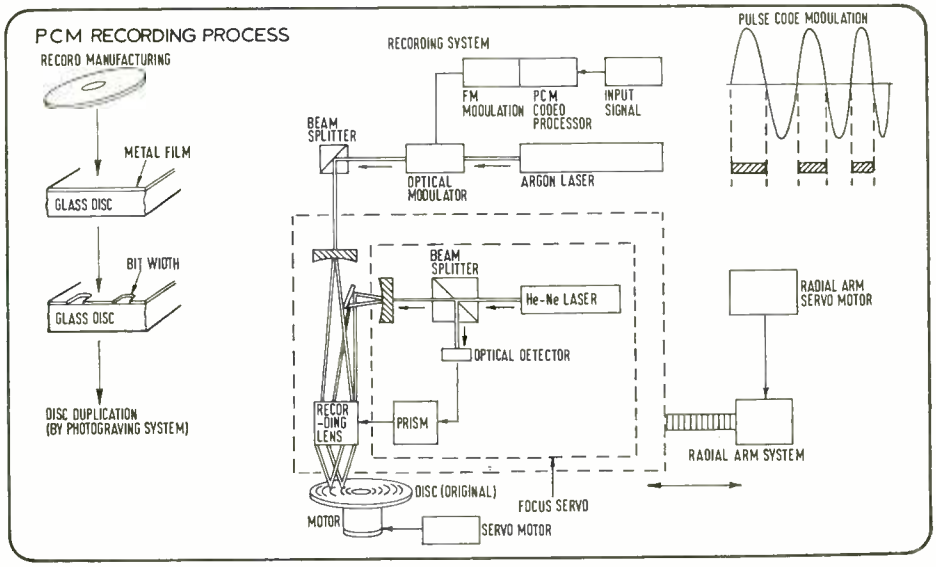
The disc revolves at 1800 rpm anticlockwise (using quartz-locked direct drive); the frequency modulated pcm signal is picked up by the beam detector, passed through an fm discriminator and restored as a pcm signal. Following that, the signal is separated into two stereo channels and the errors of code caused by dropout or other factors are checked and corrected. After a jitter-correction circuit, where all wow and flutter components are eliminated to the accuracy of a crystal generator, the signal is finally fed into a digital/analogue converter, where the audio signal is decoded.

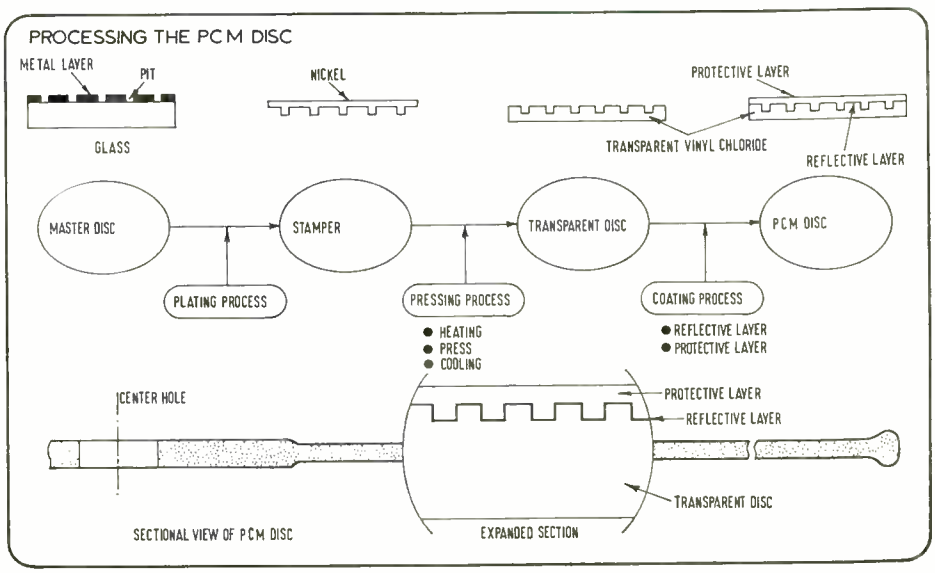
The general specifications of the system are as follows:
Number of channels: two (multichannel applications are also possible).
Dynamic range: >98 dB.
Frequency response: 10-20k Hz, +0.1, -0.5 dB.
Noise and harmonic distortion: less than 0.1%.
Wow and flutter: the same accuracy as a crystal generator.
Dimensions of disc: diameter 301 mm, thickness 1.1 mm.
Max playing time: 30 minutes.

The implications of the system for the engineer working in recording are enormous. Digital signals are naturally easier to handle and process than analogue signals, as the processing machinery only has two unambiguous options for each bit of the signal. Provided reasonable precautions are taken against significant dropout, the signal should be completely controllable and lose nothing between the original a-d converter and the final d-a converter in the consumer's system. Signal processing will probably be done by a computer rather than merely with the assistance of a computer.

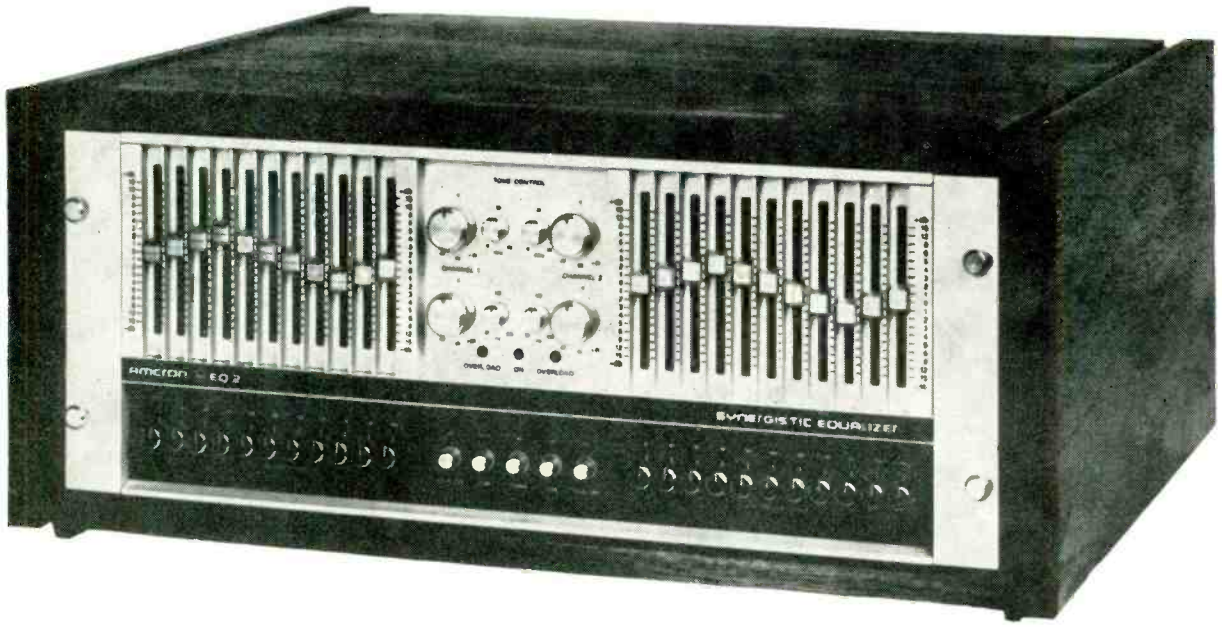
The implications for disc cutting are even more revolutionary. All that will be necessary is to oversee the operating of the machine in a pollution-free environment. The skills needed to avoid distortion, to cut accurate peaks and to maximise playing time will no longer be needed. And a 98 dB signal-to-noise ratio should make headroom considerations and noise reduction systems unnecessary. But the ultimate question will be whether it is possible to take those nasty spikey analogue signals and squeeze them into little boxes without turning the music into Muzak! ■







NOW AMCRON INTRODUCE THE EQ-2 Equalizer



The AMCRON EQ-2 is a stereo equaliser designed for professional use, and offering eleven bands per channel of full equalisation from 20 Hz to 20 kHz. The filters are half octave set on octave centres, and each has a control permitting the centre frequency to be varied by ± 0.5 octave. The two channels can be cascaded to provide a full range half octave equaliser, and shelving type tone controls are provided allowing adjustment of the Bass and Treble.

The EQ-2 has been designed, and built to the usual high AMCRON standard, and is supported by the normal 3 year warranty on parts, and labour.
Leaflets are available on request.

MACINNES LABORATORIES LTD.
MACINNES HOUSE, CARLTON PARK INDUSTRIAL ESTATE, SAXMUNDHAM, SUFFOLK IP17 2NL TEL: (0728) 2262 2615

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Tel. 206 60 80 et 206 83 61

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For further information and a full colour brochure contact Andrew Stirling or Andy Munro at:

Allen and Heath/Brenell Limited, Pembroke House, Campsbourne Road, Hornsey, London, N.8. Tel: 01-340 3291 Telex: 267727 BATGRP G

Survey: equalisers

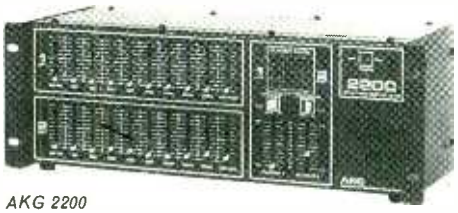
Forthcoming surveys include cartridge machines, turntables and pickups (April), noise reduction (May) and test equipment (July). Manufacturers and agents are invited to submit product details for publication to reach the editorial offices (address p3) at least six weeks before the issue publication date (preferably a lot earlier).

ADI

Audio Developments International Corp, 530 Ramona Street, Palo Alto, Ca 94301, USA.
Phone: (415) 321 3035. Telex: 470464.

1500
Type: 2-channel 'automatic' graphic equaliser with built-in pink noise generator.
Band centre frequencies: 10 octaves, 31.5-16k Hz to ANSI S1.11-1966, DIN 45651.
Control range: ±12 dB, continuously variable.
Noise: —82 dB, ref 0 dBm output.
Features: a self-contained system for setting control room eq, eliminating feedback, frequency optimisation etc. Equalisation can be set to ±0.75 dB using red and green led indicators.
Price: $795.

TYPE 1503
Type: single-channel graphic equaliser.
Band centre frequencies: 31⅓-octaves, 20-20k Hz, to ANSI S1.11-1966, DIN 45651.
Control range: ±10 dB, continuously variable.
Noise: —81 dB, ref 0 dBm output.
Features: five selectable, infinitely-variable lowpass filters.
The unit can be used with the *System 1003* digital spectrum analyser (see last month's issue, p50).
Price: $850.



AKG 2200

AKG

AKG Akustische und Kinogerate Ges mbH, Brunhildengasse 1, A-1150 Vienna, Austria.
Phone: (222) 921647. Telex: 118390.
UK: AKG Equipment Ltd, 182-4 Campden Hill Road, London W8 7AS.
Phone: (01) 727 0788/229 3695. Telex: 28938.
US: Philips Audio Video Systems Corp, 91 McKee Drive, Mahwah, NJ 07430.
Phone: (201) 529 5900. Telex: 138022.

2200
Type: 2-channel graphic equaliser.
Band centre frequencies: ten octaves, 30-16k Hz.
Control range: ±15 dB, continuously variable.
Noise: <80 dB (no conditions).
Features: balanced and unbalanced (HiZ) inputs and outputs for interfacing with semi-pro and professional equipment; built-in vu meters and output faders.
Price: £290.

APSI

Audio Processing Systems Inc, 104 Turnpike Road, Fayville, Ma 01745, USA.
Phone: (617) 481 6656.
UK: Scenic Sounds Equipment, 97-99 Dean Street, London W1V 5RA.
Phone: (01) 734 2812. Telex: 27939.
For addresses and phone numbers of APSI agents in Belgium, Denmark, France, Netherlands, Norway and Sweden, see entry for REBIS in the survey of compressor-limiters, October '77 issue p42; both companies have common agents.

MODEL 559
Type: single-channel equaliser module.
Band centre frequencies: nine ⅓-decades (35, 75, 160, 350, 750 Hz, 1.6, 3.5, 7.5 and 16 kHz).
Control range: +15, ±12, ±9, ±6, ±4, ±2 and 0 dB, switched.
Noise: —90 dBm signal-to-noise ratio with eq out; —87 dBm with eq in and all switches at zero; —70 dBm with eq in and all switches at +15 dB setting.
Features: thumbwheel-type 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: $300; £182.

AUDIO & DESIGN

Audio and Design Recording Ltd, St Michaels, Shinfield Road, Reading, Berks RG2 9BE, UK.
Phone: Reading (0734) 53411. Telex: 847605.
US: Audio and Design Recording Inc, PO Box 23047, Honolulu, Hawaii 96822.
Phone: (808) 845 7226.
Agents in Australia, Austria, Belgium, Brazil, Canada, Caribbean, Denmark, Finland, France, Greece, Holland, Italy, Japan, New Zealand, Norway, South Africa, South East Asia, Sweden, Switzerland and West Germany.

SCAMP S03
Type: single-channel parametric equaliser module.
Band centre frequencies: three, continuously variable; 'low' 20-1k Hz, 'mid' 75-7.5k Hz and 'high' 400-20k Hz.
Control range: ±20 dB, continuously variable.
Noise: —88 dB, ref +8 dBm.
Features: 'Q' values fixed at 3 for low and high bands, and 1.5 for mid band; unit fitted with 3-position attenuator and led optimum modulation indicator
Price: $325.

SCAMP S04
Type: single-channel parametric/shelving equaliser module.
Band centre frequencies: three, continuously variable; 'low' 20-1k Hz, 'mid' 75-7.5k Hz and 'high' 400-20k Hz.
Control range: ±20 dB, continuously variable.
Noise: less than —88 dB, ref +8 dBm.
Features: continuously variable 'Q' on all ranges between 0.2 and 5 octaves; mid band has a symmetrical relationship between peak and dip curves, while both high and low sections have an asym-

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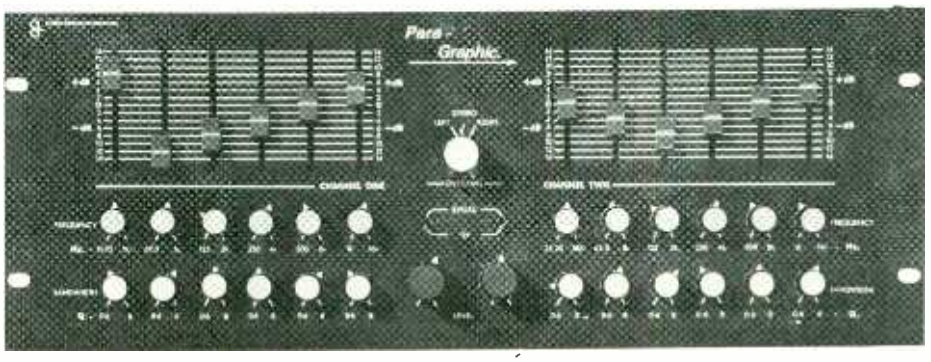
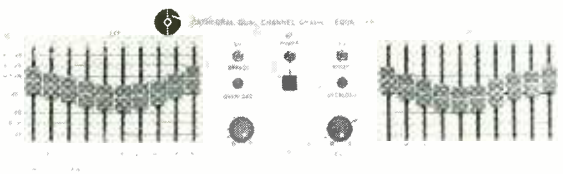
Audio & Design E950



A BRAND NEW DUAL CHANNEL GRAPHIC EQUALISER

from **CATHEDRAL**



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Low Noise—Low Distortion
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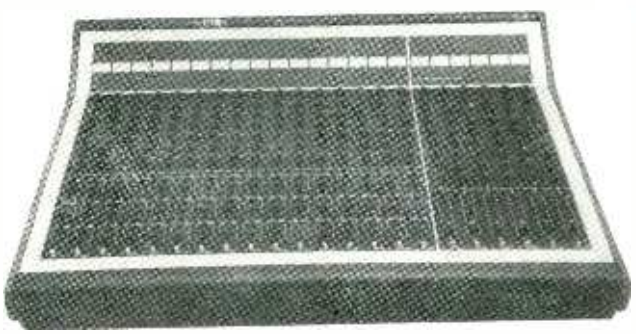
MONITOR MIXER 16/6

The 16 in, 6 out mixer has been developed purely as a monitor mixing console, giving the availability of 16 inputs to any one or more of the 6 outputs, thus providing 6 independent mixers.



please note new Address

elf

ELECTRONICS LIMITED
have moved to: **5 MOUNT AVENUE, BLETCHLEY, MILTON KEYNES MK3 6JE**
Telephone: Milton Keynes (0908) 77503/647262

Accoustical and Programme Analysers and Corrective Equalisers

Model 140 Acoustical Analyser with inbuilt pink noise source and 10db or 20db display range on 27, 1/3 octave frequency centres. For rapid and accurate diagnosis of complete monitor system or transducer response.

Model 142A Programme Analyser with two digital memories, an inbuilt pink noise source and 10db or 30db display range on 27, 1/3 octave centres. Fast peak sensing and twin digital memories allows storage of either 'snapshot' samples or overall 'highest peak' levels of a programme segment.

Model 4001 27 Band Equaliser provides accurate and repeatable equalisation especially of monitor programme feed. Features a plug-in accessory electronic crossover which allows signal splitting for bi-amplified systems. A complete range of crossovers is available.

U.K.
Scenic Sounds Equipment,
97–99 Dean Street,
London W1V 5RA
Tel: 01-734 2812

White Instruments Inc.,
Austin, Texas 78767

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

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

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

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

Norway
Kvam Audio,
Tollbugt 7,
Oslo 1,
Tel: 412 996

SURVEY: EQUALISERS

metrical 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 >30 dB shelving; each range has a led optimum modulation indicator and an 'in/out' switch.
Price: $450.

SCAMP S07
Type: single-channel system or room equaliser module.
Band centre frequencies: ten octaves, 31.25-16k Hz.
Control range: ±12 dB, continuously variable.
Noise: —88 dB, ref +8 dBm.
Price: $325.

E900
Type: single-channel parametric equaliser.
Band centre frequencies: four, continuously variable; 40-1.4k Hz, 80-1.6k Hz, 400-14k Hz and 800-16k Hz.
Control range: ±20 dB, continuously variable.
Noise: —88 dB, ref +8 dBm.
Features: 'Q' values fixed at 3 (approx 15 dB/octave) for first section, 1.5 (approx 10 dB/octave) for second and third sections, and 3 for fourth section.
Price: $425 ($920 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 100-10k Hz at 24 dB/octave slope; parametric notch filter of variable 'Q' between 0.3 and 10 over the range 20-20k Hz; switched threshold control to convert variable input/output limiters or expanders to unity gain; and phasing effects by rotating sweep notch control.
Price: $1250.

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

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

MODEL 902
Type: single-channel graphic equaliser.
Band centre frequencies: 45, 80, 140, 250, 450, 800 Hz, 1.4, 2.5, 4.5, 8.0 and 14.0 kHz.
Control range: ±12 dB, continuously variable.
Noise: —80 dBm, unweighted, in bypass mode.
Features: bandpass filter with 3 dB down points at 30 and 20k Hz, roll-off approaching 12 dB/octave.
Price: £228.

MODEL 908
Type: single-channel graphic equaliser.
Band centre frequencies: 27 $\frac{1}{3}$-octaves on ISO centres, 45-16k Hz.
Control range: ±12 dB, continuously variable.
Noise: —80 dBm, unweighted, in bypass mode.
Features: bandpass filter as *Model 902*.
Price £389.

B & B
Baskind, Bissot & Associates, Electrical Acoustical Designers, 7601 Melrose Avenue, Los Angeles, Ca 90046, USA.
Phone: (213) 653 9200.
UK: Scenic Sounds Equipment, 97-99 Dean Street, London W1V 5RA.
Phone: (01) 734 2812. Telex: 27939.
For addresses and phone numbers of B & B agents in Belgium, Denmark, France, Netherlands, Norway and Sweden, see entry for REBIS in the survey of compressor-limiters, October '77 issue p42; both companies have common agents.

EQF-1
Type: single-channel equaliser/filter module.
Band centre frequencies: three, continuously variable, with a fixed 'Q' of 1.4 octaves; 'low' 22-500 Hz, 'mid' 220-5k Hz, and 'high' 1-20 kHz.
Control range: ±12 dB, continuously variable.
Features: lowpass filter 1-20 kHz flat passband, and highpass filter 15-500 Hz flat passband (both filters are 2-pole Butterworth); requires ±12 to ±18V dc power supply; unit it exchangeable with Aengus, Automated Processes, Modular Audio Products and Melcor equalisers.
Price: $400; £272.

CATHEDRAL SOUND
Cathedral Sound, Fourways, Morris Lane, Halsall, Ormskirk, Lancs L39 8SX, UK.
Phone: Halsall (0704) 840328.

SGE20
Type: 2-channel graphic equaliser.
Band centre frequencies: 10 octaves, 30-16k Hz.
Control range: ±12 dB, continuously variable.
Noise: 82 dB, ref 0 dB output.
Features: led indicators illuminated at 2 dB below clipping level.
Price: on application.

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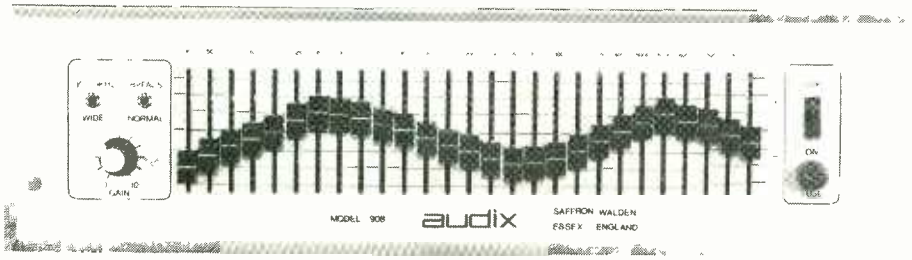
Audix model 908



THE 19" PARKING SPACE

S 03 Sweep Equaliser
A 3-band sweep equaliser offering 40dB control range switchable on each section. Input attenuator and optimum modulation indicator.

S 04 Parametric Equaliser
A 3-band fully parametric equaliser with 40dB range; shelf option with variable slope on Hi and Lo sections. Each section switchable with optimum modulation indicators.

S 23 Auto-PAN effects module
offers different *pan* patterns with *trigger*, *speed* and *envelope* following functions.

S 27 Dual Electronic Crossover
Provides *stereo* dual crossover, or *mono* **triple** crossover networks at 18dB/oct.

S 05 Dynamic Noise Filter
This programme controlled high-pass filter automatically attenuates hum and rumble. It has variable slope (0-18dB/oct) and three t/o frequencies. Can also be used as a 20/40dB noise gate.

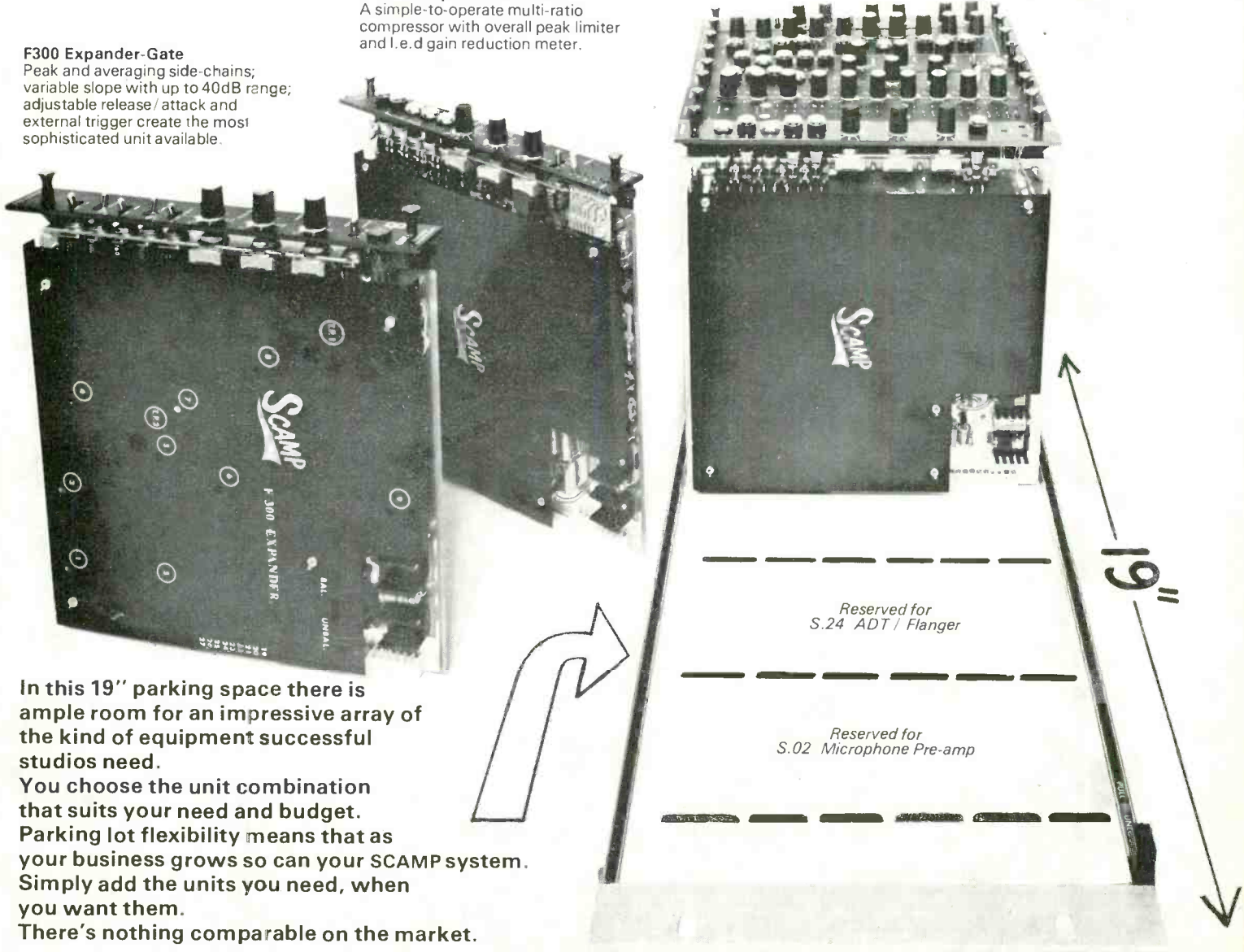
S 06 Dynamic Noise Filter
Similar to S 05 but being the low pass version, cleans up hiss and HF splash without affecting wanted HF transients. Alternatively acts as a wide-band noise gate.

S 07 Octave Equaliser
Ten-band octave equaliser set on standard ISO centre frequecies from 31.25Hz — 16kHz. Optimum modulation indicator.

S 14 Quad PPM l.e.d column
has brightness control and can be ganged with other S 14 modules.

S 01 Compressor-Limiter
A simple-to-operate multi-ratio compressor with overall peak limiter and l.e.d gain reduction meter.

F300 Expander-Gate
Peak and averaging side-chains; variable slope with up to 40dB range; adjustable release/attack and external trigger create the most sophisticated unit available.



In this 19" parking space there is ample room for an impressive array of the kind of equipment successful studios need.
You choose the unit combination that suits your need and budget.
Parking lot flexibility means that as your business grows so can your SCAMP system.
Simply add the units you need, when you want them.
There's nothing comparable on the market.

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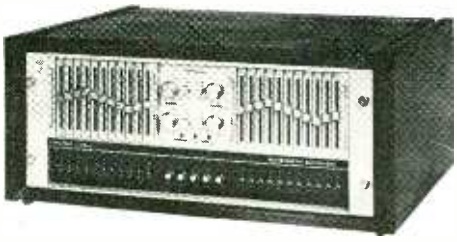
SURVEY: EQUALISERS

CROWN/AMCRON

Crown International, Box 1000, Elkhart, Indiana 46514, USA.
Phone: (219) 294 5571. Telex: 2942160.
France: Macinnes France SARL, 18 Rue Botzaris, Paris 75019.
Phone: 206 6080/8361.
UK: Macinnes Laboratories Ltd, Macinnes House, Carlton Park Industrial Estate, Saxmundham, Suffolk IP17 2NL.
Phone: Saxmundham (0728) 2262/2615.

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

Crown model EQ-2



FURMAN

Furman Sound, 616 Canal Street, San Rafael, Ca 94901, USA.
Phone: (415) 456 6766.
US and Worldwide: Rothchild Musical Instruments, 300 Windsor Road, Englewood, NJ 07631, USA.
Phone: (201) 871 3366.

PQ-3
Type: single-channel parametric equaliser/preamp.
Band centre frequencies: three, continuously variable; 'bass' 25-500 Hz, 'midrange' 150-2.5k Hz and 'treble' 600-10k Hz.
Control range: 20 dB boost to infinite attenuation, continuously variable.
Noise: 109 dB in bypass mode, 99 dB with eq in and set flat; values measured with high-level input shorted to ground, dc-80k Hz.
Features: 'Q' continuously variable between 0.2 and 3.8; pre-amp gain up to 26 dB with low-level input or 6 dB (eq set flat) with high-level input.
Price: on application.

HELIOS

Helios Electronics Ltd, Browells Lane, Feltham, Middlesex TW13 7ER, UK.
Phone: (01) 890 0087.
Canada: Radio Services Inc, 2500 Bates Road, Montreal H3S 1A6.
Phone: (514) 342 4503. Telex: 60070.
Norway: Siv Ing Benum A/S, Boks 2493, Solli, Oslo 2.
Phone: (02) 565753.
US: Everything Audio, 7037 Laurel Canyon Boulevard, North Hollywood, Ca 91605.
Phone: (213) 982 6200. Telex: 651485.

RE24
Type: two-channel parametric equaliser.
Band centre frequencies: four, continuously variable (40-700 Hz, 500-5k Hz, 700-7k Hz and 7-17 kHz).
Control range: ±14 dB symmetrical peak-trough, continuously variable.
Noise: <99 dB, ref +8 dBu, with eq in and set flat; <88 dB, ref +8 dBu, with eq in and maximum boost on all bands (measured rms, 20-20k Hz).
Features: available in external (+36V stabilised) or self-powered versions; optional led overload indicators with peak hold and/or high 'Q' upper mid section; other frequency ranges or special 'Q' values to order.
Price: on application.

HOLLAND

Holland Electronics Inc, 970 East 92nd Street, Brooklyn, NY 11236, USA.
Phone: (212) 649 7330.

MODEL 186
Type: single-channel graphic equaliser.
Band centre frequencies: three (switched); lf range 50, 100, 200, 300 or 400 Hz; mf range 400, 800 Hz, 1.5, 3 or 5 kHz; hf range 5, 7, 10, 12.5 or 15 kHz.
Control range: ±12 dB in 11 steps.
Noise: below —90 dBm (unequalised), 20-20k Hz.
Features: modular 3-band equaliser with a choice of five frequencies per band, plus choice of peak or shelf characteristics on hf and lf band; powered from ±15 to ±18V dc rails.
Price: $300.

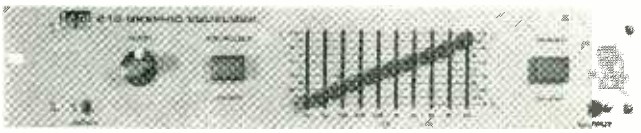
MODEL 176
Type: single-channel equaliser.
Band centre frequencies: three; hf, mf ('centered around 3 kHz') and lf.
Control range: ±12 dB in 11 steps.
Noise: better than —90 dBm, 20-20k Hz (all controls flat).
Features: designed specifically for film soundtrack mixing, but 'equally useful in broadcast, recording and sound reinforcement'; power requirements identical to *model 186*.
Price: $160.

IEM

International Electro-Magnetics Inc, Eric Drive and Cornell Avenue, Palatine, Ill 60067, USA.
Phone: (312) 358 4622.
Australia and SE Asia: Optro Pty Ltd, PO Box 257C, Melbourne, Victoria 3001, Australia.

MODEL 213
Type: single-channel graphic equaliser.
Band centre frequencies: 10 octaves, 32-16k Hz.

46 ▶



◀ *IEM 213 equaliser*

IEM ▶ *231 equaliser*

NAGRA

complete the picture...

...with their new NAGRA E

A dilemma Nagra were suffering for some time, was how to produce a self-contained Professional Tape Recorder which incorporated all the qualities of their highly acclaimed Nagra 4.2, but could be marketed in the lower price range. Almost anyone can manufacture a cheaper version of a successful product but Nagra were determined not to sacrifice standards for economy. Well, we are happy to announce they have achieved the perfect solution with the new Nagra E.

The astounding saving of around 50% has been principally achieved by the simplification of the speed stabiliser—a single operating speed of 7½ ips is provided. The tape deck and transport mechanism are closely similar to that used on the Nagra 4 Series, which has become renowned worldwide for its reliability and performance.

Good news, for the operator in the field, is that the new model is slimmer and lighter than the 4.2 and comes complete with a measuring probe, circuit diagram and some essential spares. This means that bias adjustment resulting from tape type change can be easily carried out away from base. A single microphone input is provided which can be switched to accept dynamic or condenser types.

TECHNICAL DATA

Dimensions: 13.8 x 9.3 x 4in (351 x 336 x 104 mm)
Weight: 12.6 lbs (5.75 kg) with tape and batteries
Wow and flutter: ± 0.1%

Reels: 7 in cover open, 5 in cover closed.
Loudspeaker: 1.0W
Headphones output } both switchable Tape/Direct
Frequency response recorded at —20 dB: 30—15.000 Hz ± 2 dB
S/N ratio, ASA "A": better than 66dB
Temperature range: 4°—158°F(—30 to + 70°C)

Please send me further details of the new NAGRA E and other models in the range.

Name _____

Address _____

_____

HAYDEN

HAYDEN LABORATORIES LTD
Hayden House, Churchfield Road, Chalfont St. Peter, Bucks, SL9 9EW Tel: Gerrards Cross 88447

SS2/NAG

SURVEY: EQUALISERS

Control range: ±15 dB, continuously variable.
Noise: 100 dB below peak output (+24 dBm max).
Price: $650.

MODEL 231
Type: single-channel graphic equaliser.
Band centre frequencies: 31⅓-octaves, 20-20k Hz.
Control range: ±12 dB, continuously variable.
Noise: 100 dB below peak output (+24 dBm max).
Price: $950.

K + H

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 15-20k Hz.
Control range: ±12 dB, continuously variable.
Noise: 70 dB, 20-20k Hz (no further conditions).
Features: 'Q' on each band continuously variable 5-22 dB/octave; highpass (60 Hz) and lowpass (10 kHz) filters with 6 dB/octave slopes.
Price: £851 (mono version, *UE200*, £722).

KLARK-TEKNIK

Klark-Teknik Research Ltd, MOS Industrial Site, Summerfield, Kidderminster, Worcs DY11 7ER, UK.
Phone: Kidderminster (0562) 64027/63467. Telex: 339821.
US: Klark-Teknik, 155 Michael Drive, Syosset, NY 11791.
Phone: (516) 364 1900. Telex: 961396.
Agents in most countries.

DN27
Type: single-channel graphic equaliser.
Band centre frequencies: 27 ⅓-octave on ISO centres, 40-16k Hz.
Control range: ±12 dB, continuously variable.

MM Electronics EP series

Noise: less than —90 dBm unweighted equivalent input noise, 20-20k Hz.
Price: approx £450-500; $749.

DN22
Type: 2-channel graphic equaliser.
Band centre frequencies: 50, 90, 160, 300, 500, 900 Hz, 1.6, 3, 5, 9 and 16 kHz.
Control range: ±12 dB, continuously variable.
Noise: less than —90 dBm unweighted equivalent input noise, 20-20k Hz.
Features: two filters with 12 dB/octave turnovers at 100 Hz and 10 kHz. The *DN15* is a domestic/semi-pro version with a built-in pre-amplifier and input switching.
Price: *DN22* approx £450-500; $799. *DN15* approx £550-60; $1100.

M-JAY

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

GE9-2
Type: 2-channel graphic equaliser
Band centre frequencies: nine octaves, 50-12.8k Hz.
Control range: ±12 dB, continuously variable.
Noise: 80 dB (no conditions given).
Price: £169.

MM

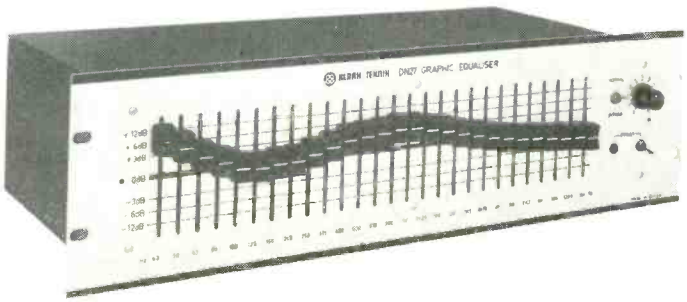
MM Electronics, Kneesworth Street, Royston, Herts SG8 5AQ, UK.
Phone: Royston (0763) 45214.

EP SERIES
Type: two-channel graphic equaliser.
Band centre frequencies: 60, 150, 400 Hz; 1, 2.5, 6 and 15 kHz.
Control range: ±12 dB, continuously variable.
Features: designed primarily for pa installations, including foldback systems.
Price: £65.

48 ▶

◀ *K & H UE400*

Klark-Teknik ▶ *DN27*



Presenting plug-in 46 track capability.

Featuring Studer TLS 2000 flexibility.

The difference between a 32 Track Machine and the Studer 46 Track system may only appear to have the obvious advantage of 14 additional tracks and yet it offers unrivalled flexibility.

The principle is simple as is the installation. Merely plug-in two 24 track A80's with the Studer Tape Lock System and 46 Track facility is attained.

And you can go to almost any lengths to install the system, quite literally. Machines can be positioned side by side or on separate floors, interconnection being by means of a standard 3-pole audio line. Updating existing A80 systems is simplicity itself.

As for flexibility you have the advantage of 46 track capability synchronously locked between the two tape transports for recording and mix down, or the independent use of two 24 track machines.

Installed and working at TRIDENT STUDIOS since September 1977.

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49 Theobald Street, Boreham Wood, Hertfordshire, WD6 4RZ Tel: 01-953 0091

STUDER INTERNATIONAL AG

CH-8105 Regensdorf, Phone (01) 840 29 60, Telex 58489

STUDER REVOX AMERICA INC., Nashville, Phone (615) 329-9576, Telex 55-4453
STUDER REVOX CANADA LTD., Toronto, Phone (416) 423-2831, Telex 06-23310
STUDER FRANCE S.à r.l., Paris, Phone 533 58 58, Telex 24-744

SURVEY: EQUALISERS

MXR

MXR Innovations Inc, 277 N Goodman Street, Rochester, NY 14607 USA.
Phone: (716) 442 5320.
UK: Rose-Morris & Co Ltd, 32-34 Gordon House Road, London NW5 1NE.
Phone: (01) 267 5151. Telex: 23170.

TWO-CHANNEL GRAPHIC EQUALISER
Designed primarily for pa use to compensate for room acoustics, speaker aberrations and program material.
Band centre frequencies: 10 octaves, 31-16k Hz.
Control range: ±12 dB, continuously variable.
Noise: —95 dBm equivalent noise input (typical).
Price: £178.

MXR graphic equaliser

NEVE

Rupert Neve & Co Ltd, Cambridge House, Melbourn, Royston, Herts SG8 6AU, UK.
Phone: Royston (0763) 60776. Telex: 81381.
Canada: Rupert Neve of Canada Ltd, 2717 Rena Road, Matton, Ontario L4T 3K1.
Phone: (416) 677 6611.
US: Rupert Neve Inc, Berkshire Industrial Park, Bethel, Conn 06801.
Phone: (312) 252 8144.

The company manufactures a wide range of channel amps, equalisers and effects units either for incorporation within consoles or in 483 mm racks. The format can vary from simple units with lf and hf shelf with switchable highpass filter, to complex units with lf and hf shelves switchable to bell characteristics, two midrange bells and fully variable low and highpass filters. The associated channel pre-amps offer typical input range between —80 and —20 dB (mic) and ±20 dB (line). Additional controls provide adjustment of the midrange bandwidth. The following is an example from the company's range:

2074 CORRECTION UNIT
Type: single-channel equaliser.
Band centre frequencies: various; hf band centred at 12 kHz; 'prescence' switchable to 350, 700 Hz, 1.6, 3.2, 4.8 or 7.2 kHz; lf switchable to 35, 60, 110 or 220 Hz; plus highpass filter switchable to 50, 80, 160 or 300 Hz with 18 dB/octave slope.
Control range: ±18 dB, continuously variable.
Price: on application.

ORANGE COUNTY

Orange County Electronics Corporation Ltd, 1125 Empress Street, Winnipeg, Manitoba R3E 3HI, Canada.
Phone: (204) 775 8151.
For a full list of overseas agents see October '77 issue, p40.

OCASEQ
Type: single-channel parametric equaliser.
Band centre frequencies: four, continuously variable (35-1.4k Hz, 80-1.8k Hz, 350-14k Hz, 800-18k Hz).
Control range: ±20 dB, continuously variable.
Noise: —89 dB with all sections at maximum boost (—109 dB equivalent input noise).
Price: stereo rack-mounting version $996 (mono $686); module $496.

Orban/Parasound model 622B

OCAGEQ
Type: single-channel graphic equaliser.
Band centre frequencies: ten octaves, 32-16k Hz.
Control range: ±12 dB, continuously variable.
Noise: —97 dB with all sections at maximum boost (—109 dB equivalent input noise)
Features: selectable outer bands for peaking/shelving amplitude characteristics (said to be suitable for noise elimination or 'loudness/hum' filtering); in shelving mode centre frequencies of two outer bands are continuously tunable from 20-1.4k Hz (highpass) or 350-20k Hz (lowpass).
Price: on application.

ORBAN/PARASOUND

Orban/Parasound, 680 Beach Street, San Francisco, Ca 94109, USA.
Phone: (415) 673 4544.
UK: Scenic Sounds Equipment, 97-99 Dean Street, London W1V 5RA.
Phone: (01) 734 2812. Telex: 27939.

MODEL 622B
Type: two-channel parametric equaliser.
Band centre frequencies: four, continuously variable; 'lf' 20-500 Hz, 'mlf' 68-1.7k Hz, 'mhf' 240-5.85k Hz, and 'hf' 800-20k Hz.
Control range: +16 dB to infinite attenuation; typical obtainable notch depth is 40 dB.
Noise: less than —84 dBm at output for unity gain, eq in and controls flat.
Features: 'Q' on each section variable between 0.29 and 3.2.
Price: $695; £471.

PA:CE

Parmee Acoustics: Collins Electromagnetics Ltd, Kneesworth Street, Royston, Herts SG8 5AQ, UK.
Phone: Royston (0763) 45214.

STUDIO RANGE
Type: single-channel graphic equaliser.
Band centre frequencies: 27 $\frac{1}{3}$-octaves, 40-16k Hz.
Control range: ±20 dB, continuously variable
Noise: less than —80 dBm, ref input.
Price: £200.

PEAVEY

Peavey Electronics Corp, Box 2898, Meridian, Miss 39301, USA.
UK: Peavey Electronics (UK) Ltd, 49 The Broadway, Haywards Heath, Sussex RH16 3AS.
Phone: Haywards Heath (0444) 58301. Telex: 87265.

EQ-10
Type: single-channel graphic equaliser.
Band centre frequencies: 50, 100, 200, 320, 500, 800 Hz, 1.5, 3, 6 and 12 kHz.
Control range: ±12 dB, continuously variable.
Noise: 90 dB below 2V output, controls flat and input open-circuit (20-20k Hz).
Features: designed primarily for pa installations, the unit will accept any signal level 'including speaker outputs'.
Price: $200; £147.

PROAUDIO

ProAudio, Unit F, New Crescent Works, Nicoll Road, London NW10 9AX, UK.
Phone: (01) 961 1425.

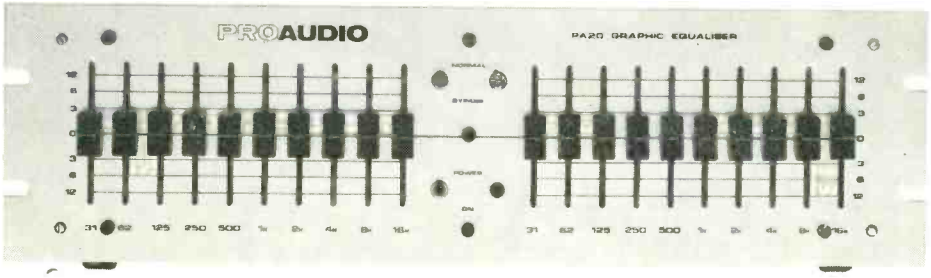
PA20
Type: two-channel graphic equaliser.
Centre band frequencies: ten octaves, 31-16k Hz.
Control range: ±12 dB, continuously variable.
Noise: —95 dBm (typical) equivalent input noise.
Price: £260.

PULTEC

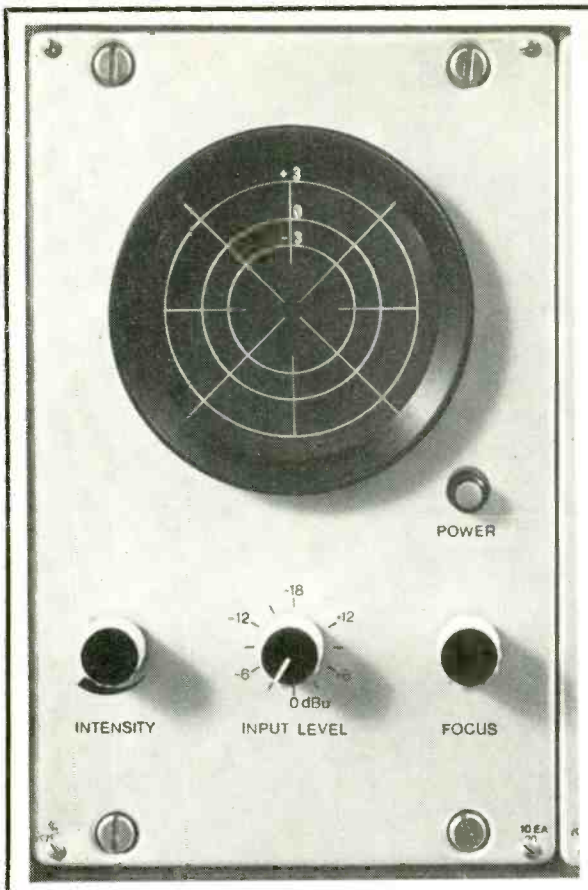
Pulse Techniques Inc, 1411 Palisade Avenue, Teaneck, NJ 07666, USA.
Phone: (201) 837 2575.
UK: Jacques Levy, 6 Carlisle Mansions, Carlisle Place, London SW1.
Phone: (01) 834 9248.

EQP-1A3
Type: single-channel parametric equaliser.
Band centre frequencies: variable (see below).
Control range: variable (see below).
Noise: less than —88 dB signal-to-noise ratio with input signal of +8 dBm.
Features: peak boost 0-18 dB at 3, 4, 5, 8, 10, 12 or 16 kHz; shelf attenuation 0-16 dB at 5, 10 or 20 kHz; shelf boost 0-13.5 dB at 20, 30, 60 or 100 Hz; shelf attenuation 0-17.5 dB at 20, 30, 60 or 100 Hz; 'Q' variable between 0 and 10.
Price: $584.

MEQ-5
Type: single-channel equaliser. 50 ▶



Pro Audio PA 20 2-channel graphic equaliser



GONIOMETER

Stereo Phase Oscilloscope For Broadcasting and Recording

- Relative phase and level indication
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- Large 68mm diameter screen
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Finland

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PEAVEY

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CS-800

The CS-800 Stereo Power Amplifier has been designed to be the most durable and reliable available for commercial sound applications. We have used 24 of the best high voltage, high speed power devices that money can buy. Designed to withstand the demanding and strenuous requirements of any "on the road" use, reliability is this units MAIN BAG. Octal sockets on the back panel provide for a range of balance transformer and electronic crossover accessories. Fully load protected and built to the highest specifications, CS-800 provides 400W rms per channel into 4 ohms (5Hz to 60kHz response +0-1dB).

For full specifications of all Peavey Professional Products. Write to:

PEAVEY ELECTRONICS (U.K.) LTD., **49 THE BROADWAY, HAYWARDS HEATH, SUSSEX.**

SURVEY: EQUALISERS

Band centre frequencies: three; 'band 1' covers 200, 300, 500, 700 or 1k Hz, 'band 2' covers 1.5, 2.0, 3.0, 4.0 or 5.0 kHz, and 'band 3' covers all those listed for bands 1 and 2.
Control range: up to 10 dB boost on band 1; up to 8 dB boost on band 2; up to 10 dB attenuation on band 3.
Noise: less than —83 dB signal-to-noise ratio with input signal of +8 dBm.
Price: $560.

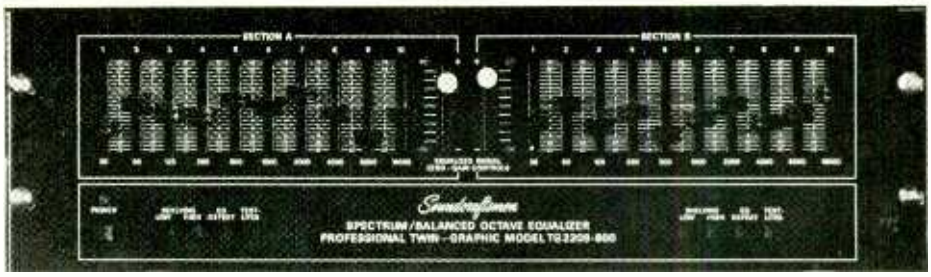
QUAD-EIGHT

Quad-Eight Electronics, 11929 Vose Street, North Hollywood, Ca 91605, USA.
Phone: (213) 764 1516. Telex: 662446.
UK: Cinesound International Ltd, Imperial Studios, Maxwell Road, Borehamwood, Herts.
Phone: (01) 953 5545. Telex: 923274.
Agents in most countries.

EQ-712
Type: single-channel graphic equaliser.
Band centre frequencies: 65, 160, 400 Hz, 1.0, 2.2, 4.5 and 8.2 kHz.
Control range: ±12 dB, continuously variable.
Noise: —106 dBm output noise.
Features: requires ±28V dc regulated power supply.
Price: $688.

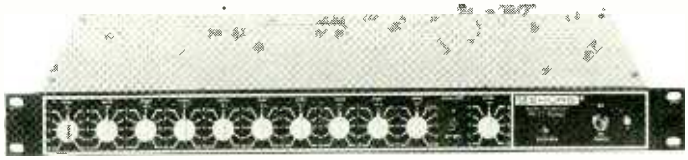
EQ-333
Type: single-channel parametric equaliser.
Band centre frequencies: three; 'low' offers a choice of 11 frequencies 50-500 Hz, 'mid' a choice of 11 frequencies 300-3k Hz, and 'high' a choice of 11 frequencies 1.5-15 kHz. High and low bands are switch selectable between peaking and shelving.
Control range: ±12 dB in 2 dB steps.
Noise: —89 dBm output noise.
Features: 70 Hz highpass and 15 kHz lowpass filters, 12 dB/octave; requires ±28V dc power supply.
Price: $360.

EQ-444
Type: single-channel parametric equaliser.
Band centre frequencies: four; 'low' offers a choice of 11 frequencies 50-500 Hz, 'mid 1' a choice of 11 frequencies 180-1.8k Hz, 'mid 2' a choice of 11 frequencies 500-5k Hz and 'high' a choice of 11 frequencies 1.8-18 kHz. High and low bands are switch selectable between narrow, wide and shelving; mid bands between narrow and wide.
Control range: ±12 dB in 2 dB steps.
Noise: —87 dBm output noise.
Features: 50 and 100 Hz highpass plus 8 and 10 kHz lowpass filters, 12 dB/octave; requires ±28V dc power supply. *EQ-444W* is a 'write data only' and *EQ-444A* an 'automated-write/read' version of the *EQ-444*.
Price: $475.



Above: *Soundcraftsman TG2209-600*

Right: *Shure SR107*



REBIS

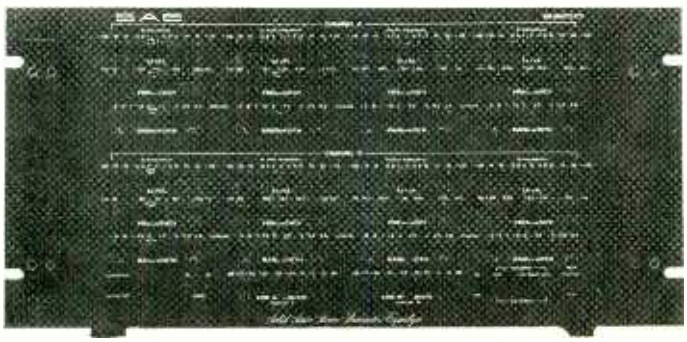
Rebis Audio, 127 Soho Hill, Handsworth, Birmingham, UK.
Phone: (021) 523 3509.
UK: Scenic Sounds Equipment 97-99 Dean Street, London W1V 5RA.
Phone: (01) 734 2812. Telex: 27939.
For a list of overseas agents see October '77 issue, p42.

RA402
Type: two-channel parametric equaliser.
Band centre frequencies: four, continuously variable; 'section 1' 20-450 Hz, 'section 2' 70-1.6k Hz, 'section 3' 250-5.6k Hz, and 'section 4' 800-18k Hz
Control range: ±21 dB, continuously variable
Noise: —80 dB signal-to-noise ratio with system in and set for zero gain (20-20k Hz)
Features: 'Q' for each section variable between 0.89 and 13 (5.5-36 dB/octave)
Price: £400.

SAE

Scientific Audio Electronics Inc, PO Box 60271, Terminal Annex, Los Angeles, Ca 90060, USA.
Phone: (213) 489 7600.
UK: REW Audio-Visual Company, 10-12 High Street, Colliers Wood, London SW19 2BE.
Phone: (01) 540 9684.

1800
Type: two-channel parametric equaliser.
Band centre frequencies: two, continuously variable; 'low' 40-1.2k Hz and 'high' 1.2-20 kHz.
Control range: ±16 dB, continuously variable.
Noise: <100 dB signal-to-noise ratio, ref 2.5V rms.
Features: 'Q' continuously variable on both bands between 0.3 and 3.6 octaves.
Price: £240.



SAE 2800 2-channel, 4-band parametric equaliser

2800
Type: two-channel parametric equaliser.
Band centre frequencies: four, continuously variable; 'low' 10-320 Hz, 'low mid' 40-1.2k Hz, 'high mid' 240-7.6k Hz, and 'high' 1.2-20 kHz.
Control range: ±16 dB, continuously variable.
Noise: <100 dB signal-to-noise ratio, ref 2.5V rms.
Features: 'Q' continuously variable on all bands between 0.3 and 3.6 octaves.
Price: £408.

SHURE

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

SR107
Type: single-channel equaliser.
Band centre frequencies: ten octaves, 32-16k Hz.
Control range: ±15 dB, continuously variable.
Noise: 99 dB at max output with filter controls flat and unity gain (20-20k Hz).
Features: can be used with *M615AS* equalisation analyser system (see review 70).
Price: £204.

SOUNDCRAFTSMEN

1721 Newport Circle, Santa Ana, Ca 92705, USA.
Phone: (714) 556 0371.
UK: REW Audio-Visual Company, 10-12 High Street, Colliers Wood, London SW19 2BE.
Phone: (01) 540 9684.

TG2209-600
Type: 2-channel graphic equaliser.
Band centre frequencies: ten octaves, 30-15.36k Hz.
Control range: ±12 dB, continuously variable.
Noise: 90 dBm equivalent input noise, 110 dB below maximum output.
Features: 'zero-gain' controls (18 dB range) and associated leds to match input/output levels; highpass (100 Hz) and lowpass (10 kHz) filters with 12 dB/octave rolloff; switched balanced/unbalanced inputs and outputs, plus low/high input impedance.
Price: £515.

SG2205-600
Type: 2-channel graphic equaliser.

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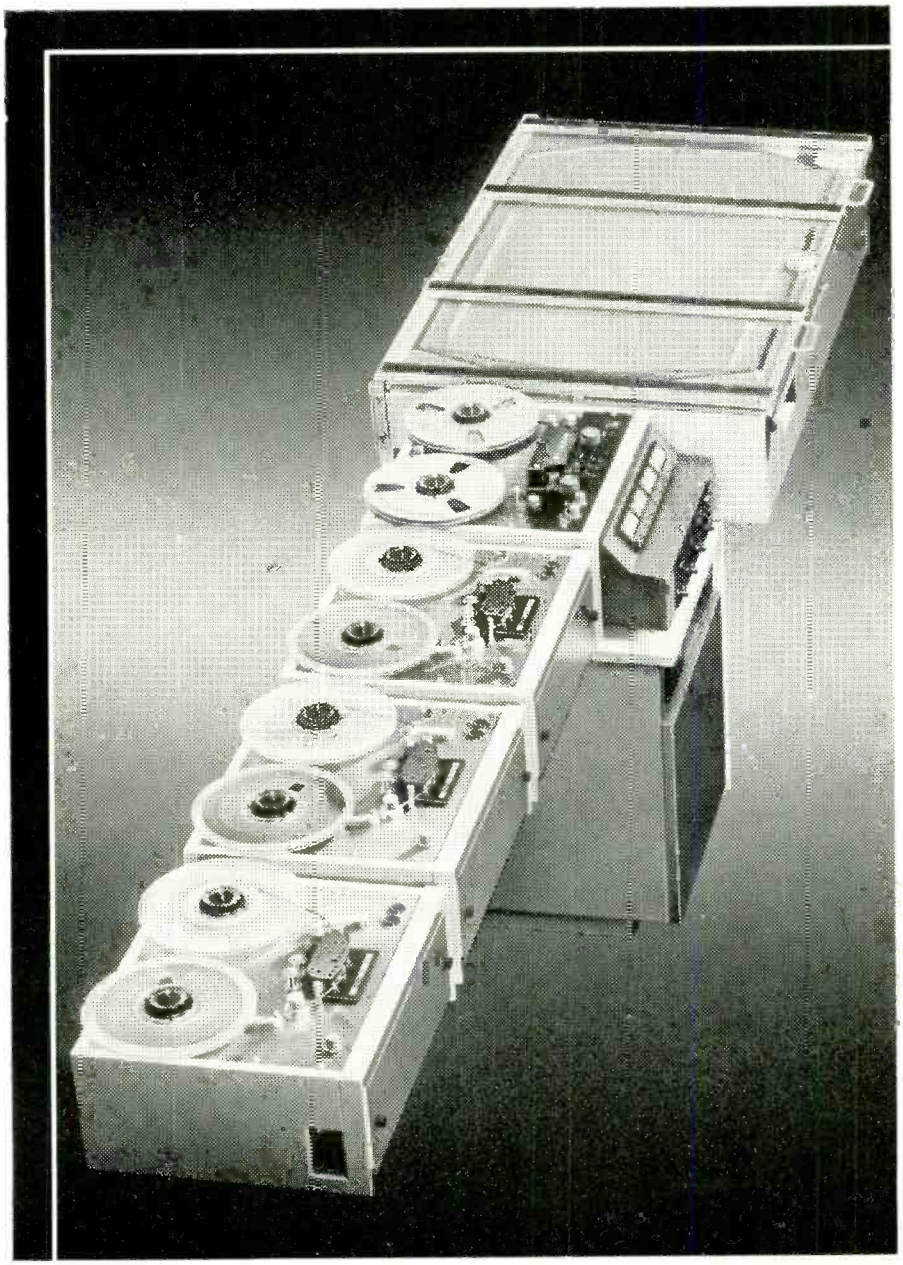
OTARI

Otari DP-1010 for top quality duplications at 16:1. For those who don't need the largest system.



If you are looking for a medium scale system with a capacity of 150-250 C60 copies an hour, the DP-1010 is the perfect choice. The latest modular concept and the state-of-the-art design enable you to own the system which exactly meets your specifications. In performance, scale and price. Your masters can be 1/2- or 1/4-inch bin-loop up to 1,800 ft, or 1/2- or 1/4-inch open reel, at 3-3/4 or 7-1/2 ips. It can be equipped with 3 — 5 slaves for cassette or open-reel copies, two- or four-track.

Performance-wise the system might exceed your requirements: master reproducer and slaves with less than 0.1% flutter, greater than 55dB S/N and crosstalk; undisputable reliability and durability proven in hundreds of critical applications. For the full story about this unique and compact duplicating system, get in contact with your nearest Otari.

Japan: Otari Electric Co., Ltd., 4-29-18 Minami Ogikubo, Suginami-ku, Tokyo 167, Japan
U.K.: Industrial Tape Applications, 1-7 Harewood Avenue, Marylebone Road, London NW1
France: Reditec, 62-66, Rue Louis Ampère, Zone Industrielle des Chanoux, 93330 Neuilly-s/Marne
Belgium: Trans European Music S.A., Koeivijverstraat 105, 1710 Dilbeek, Brussels

Please send me details on
DP-1010
Name
Company
Address
SS

SURVEY: EQUALISERS

Band centre frequencies: ten octaves, 30-15.36k Hz.
Control range: ±12 dB, continuously variable.
Noise: 96 dB at 2V rms output.
Features: basically a domestic/semi-pro version of *TG2209-600* equaliser; unbalanced inputs and outputs on phono (RCA) sockets; no filters.
Price: £295.

SPECTRA SONICS

Spectra Sonics, 770 Wall Avenue, Ogden, Utah 84404, USA.
Phone: (801) 392 7531.

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

MODEL 502
Type: single-channel 'microphone/program' equaliser.
Band centre frequencies: three, switched; lf range 50, 100, 200, 300 or 400 Hz; mf range 500, 800 Hz, 1.2, 1.6 or 2.0 kHz; hf range 2.5, 3.5, 5.0, 7.5 or 10 kHz.
Control range: ±12 dB in 2 dB steps.
Features: as *Model 500*; in addition shelving curves at 50 Hz and 10 kHz in selectable increments are provided.
Price: $296; £164.

SUSAN BLUE

Sun Recording Services Ltd, 34-36 Crown Street, Berks RG1 2SN, UK.
Phone: Reading (0734) 595647.

ARE
Type: 2-channel room equaliser.
Band centre frequencies: 10 octaves, 31-16k Hz.
Control range: ±15 dB, continuously variable.
Features: two leds per band for adjustment of room eq to within ±2 dB.
Price: about £450.

TECHNICS

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: Slough 27516. Telex: 848761.
US: Technics by Panasonic, One Panasonic Way, Secaucus, NY 07094.

SH-9090
Type: single-channel combined parametric/graphic equaliser.
Band centre frequencies: 11 octaves, 30-32k Hz, plus 10 Hz band.
Control range: ±12 dB, continuously variable.
Noise: 90 dB signal-to-noise ratio (1HF, A), 1V signal.
Features: centre frequency of each band can be adjusted ±1 octave; 'Q' on each band variable 0.7-7.
Price: £422.

SH-9010
Type: two-channel combined parametric/graphic equaliser.
Band centre frequencies: 60, 240 Hz, 1, 4 and 16 kHz.
Control range: ±12 dB, continuously variable.
Noise: 90 dB signal-to-noise ratio (1HF, A); 87 dB 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.

TRIDENT

Trident Audio Developments Ltd, Shepperton Studios, Squires Bridge Road, Shepperton, Middlesex TW17 0QD, UK.
Phone: Chertsey 60241.
Canada: Audio Analysts Inc, 2401A St Catherine's Street East, Montreal H2K 2J7, Quebec.
Phone: (514) 525 2666.
US: Studio Maintenance Service, 2444 Wiltshire Boulevard, Suite 214, Santa Monica, Ca 90403.
Phone: (213) 990 5855.

CB 9066
Type: single-channel parametric equaliser.
Band centre frequencies: three, continuously variable; 'low' 60-700 Hz, 'mid' 600-7k Hz, and 'high' 3.5-14 kHz.
Control range: ±16 dB, continuously variable.
Noise: better than —75 dBm with system in and all controls flat.
Features: 'Q' variable 2-18 dB/octave for each range; highpass filters continuously variable 100-400 Hz and lowpass filter continuously variable 4-15 kHz, both with 0-22 dB/octave slopes.
Price: £285 for a single unit, £550 for two.

UREI

United Recording Electronics Industries, 11922 Valerio Street, North Hollywood, Ca 91605, USA.
Phone: (213) 764 1500. Telex: 651389.
Export: Gotham Export Corp, 741 Washington Street, New York, NY 10014, USA.
Phone: (212) 741 7411. Telex: 129269.
UK: FWO Bauch Ltd, 49 Theobald Street, Boreham-wood, Herts WD6 4RZ.
Phone: (01) 953 0091. Telex: 27502.

MODEL 527A
Type: single-channel graphic equaliser.
Band centre frequencies: 27 ⅓-octaves, 40-16k Hz.
Control range: ±10 dB, continuously variable.
Noise: less than —90 dBm equivalent input noise for 0 dBm input setting.
Price: £467.

MODEL 529
Type: single-channel 'cut-only' room equaliser.
Band centre frequencies: 27 ⅓-octaves, 40-16k Hz
Control range: up to 15 dB of attenuation, continuously variable.
Noise: less than —90 dBm equivalent input noise for 0 dBm input setting.
Features: tunable highpass (30-240 Hz) and lowpass (3.5-20 kHz) filters with 18 dB/octave slopes.
Price: on application.
Price: £517.

MODEL 530
Type: 2-channel graphic equaliser (*Model 531* is a single-channel version).
Band centre frequencies: nine octaves, 50-12.5k Hz.
Control range: ±10 dB, continuously variable.
Noise: less than —90 dBm equivalent input noise, 15.7 kHz bandwidth.
Price: £300.

MODEL 545
A new single-channel parametric equaliser. Other details unavailable at time of publication.
Price: £281.

WESTREX

Westrex Company, PO Box 989, Beverly Hills, Ca 90213, USA.
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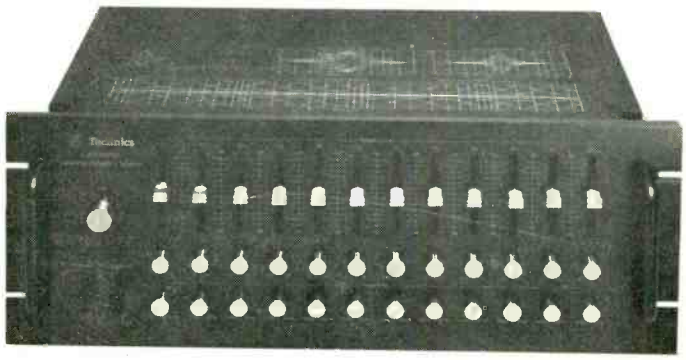
ST3015
Type: single-channel equaliser.
Band centre frequencies: 50, 75, 110, 160, 240, 360, 540, 760 Hz, 1.2, 1.7, 2.5, 3.8, 5.5, 8.0 and 12.0 kHz.
Control range: ±14 dB, continuously variable.
Price: approx £465 or $837.

54 ▶

Above: *Trident CB 9066 parametric equaliser*



Right: *Technics SH-9090 combined parametric graphic*

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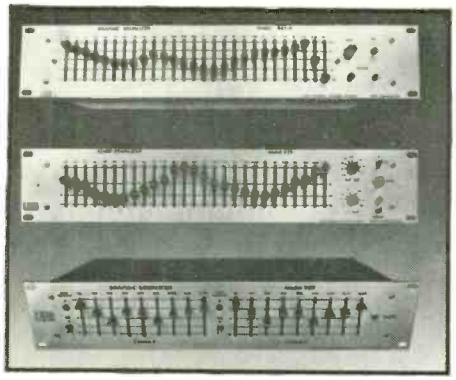

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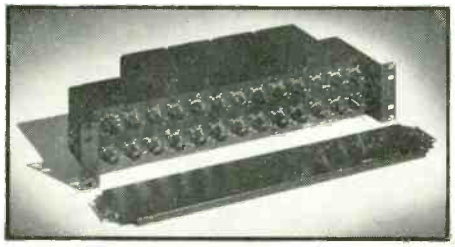
SERIES 4000
Type: single-channel equalisers.
Band centre frequencies: 27 $\frac{1}{3}$-octaves on ISO centres, 40-16k Hz.
Control range: ±10 dB, continuously variable.
Noise: less than —90 dBm (20 kHz bandwidth).
Features: 12 dB/octave highpass filter continuously variable 20-160 Hz; available in three options—*model 4001* for sound reinforcement applications, *model 4003* which is identical to *4001* apart from transformer-coupled outputs, and *model 4002* which features single-ended input and phono connectors and is described as a 'music reproduction model'.
Price: $690 or £428 for *model 4001*; $740 or £458 for *model 4003*.

SERIES 4200
Type: single-channel 'cut-only' equalisers.
Band centre frequencies: 27 $\frac{1}{3}$-octaves on ISO centres, 40-16k Hz.
Control range: 0-15 dB attenuation, continuously variable.
Noise: less than —92 dBm (no conditions).
Features: active equalisers derived from *Series 4000*—*models 4201* and *4203* are similar to *4001* and *4003*, apart from the 'cut-only' facility.
Price: on application.

MODEL 4004
Type: single-channel passive 'cut-only' equaliser/filter.
Band centre frequencies: 24 $\frac{1}{3}$-octave filters on ISO centres, 63-12.5k Hz.
Control range: 0-15 dB attenuation, continuously variable.

White series 4000



Features: up to 15 dB/octave highpass filter continuously variable from 'flat' to 40 Hz through 160 Hz, and up to 18 dB/octave lowpass filter continuously variable from 'flat' to 16 kHz through 10 kHz.
Price: $795; £469.

MODEL 4100
Type: two-channel equaliser.
Band centre frequencies: ten octaves on ISO centres, 31.5-16k Hz.
Control range: ±10 dB, continuously variable.
Noise: —92 dBm signal-to-noise ratio at +18 dBm (maximum) output.
Features: 12 dB/octave highpass filter continuously variable 20-160 Hz.
Price: $599; £379.

agony

Among the tapes arriving in the copying suite one day was a master reel from the music publishers around the corner, with a note requesting two 19 cm/s copies on 12.7 cm spools. The tape was duly copied, and the three reels returned to their owner, the head of publishing. The copyist thought no more of it—until the following morning when the phone rang.

'Those copies you did for me yesterday,' asked the caller, 'you only copied two of the tracks. What about the third?'

The worried copyist scratched his head. 'But surely there were only two tracks on the master reel, weren't there?'

'No,' replied the caller. 'You copied the first two tracks, but you left out the third, the one called "non-Dolby" . . .'

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High-Frequency Noise	A15LP	**Low Pass Filter** provides high-frequency cutoff to reduce objectionable high-frequency noises.
Lack of Presence	A15PA	**Presence Adapter** adds voice-range intelligibility and extra brilliance.
Sibilance	A15RS	**Response Shaper** provides excellent sibilance filtering; flattens microphone response.
Line Level to Mic Input	A15LA	**Line Input Adapter** converts balanced low-impedance microphone input to line level input.
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work

Trident direct-cut and 46-track sessions

As we mentioned in last month's editorial, the first direct-to-disc recording in the UK took place on November 27 at Trident Studios, London. And as if that wasn't enough to put them in the record books, at the same time Alec Kostandinos was using the mix-down suite to put the finishing touches to a 46-track session recorded earlier in the month.

The sequence of events culminating in the direct-cut ran as follows:

■ Warsaw Pakt came straight from a gig on Friday night and spent a couple of hours setting up their pa gear on the studio floor. They then returned early Saturday morning to start rehearsing their two sets—one for each side of the album.

■ Meanwhile Trident engineers had taken a parallel feed from the pa mics up to the control room. Thus two separate mixes were established—one from a small Neve mixer positioned behind screens on the studio floor to provide a stereo mix for the band's foldback bins and pa stacks; and the other for the stereo direct-cut.

■ In the control room a stereo mix was established on the *Series A* desk and fed to two destinations: the cutting room and a tape transfer room where two non-Dolbied 38 cm/s copies of the session were made. As a back-up a 24-track Studer *A80* was used to record the output of the desk's mixing busses to which were assigned individual instruments and vocals. Because the stereo mix assumed priority the levels on the 24-track were rather rough and ready, but sufficient for remix purposes (should it be needed at a later date).

■ Little or no eq was used on the vocals because of spill-over from the pa system, but the drums and bass were tweaked to give the desired sound. A touch of compression was applied to the vocals and guitars, but the overall output left alone. Tape loop echo and a trace of ddl were used on the lead guitar.

■ The resultant 3-4 dB dynamic range, without limiting, caused few problems in the cutting room. The groove spacing and depth were estimated, and a couple of rough cuts showed that all was well. At just after 7.00 pm on Saturday evening the cutting stylus was dropped onto the acetate for the first take of side one, and little adjustment was needed in the cutting room during the 16-minute session. But swarf problems and over-modulation on the left-hand channel caused wall break-up and the acetate had to be rejected. Nevertheless it wasn't all bad news because the band, producer, engineers and everyone else involved were treated to a replay of the acetate. The assembled throng was suitably impressed and recording began on take 2 in front of an invited audience.

■ Both sides were completed by late Saturday evening and a fast car had been laid on to rush the acetates to Gedmel Galvanics in Leicester, where the stampers were grown. These were then taken to Island's pressing plant in Middlesex. After packaging and labelling, the album entitled 'Needletime' was on sale in Virgin Records at Marble Arch by 5.00 pm on Sunday evening. Price: a very reasonable £2.99.

Congratulations then to all involved for taking the UK plunge: producer Mim Scala; the members of Warsaw Pakt, lead guitarist Andy Colquhoun, rhythm guitarist John Walker, vocalist Jimmy Coull, bass guitarist Chris Underhill and drummer Lucas Fox; band engineers Terry Barham and Hutch; balance engineer Steve Tayler; cutting engineers Ray Staff and John Dent; and last, but by no means least, studio manager Peter Booth.

But November's session was by no means a one-off affair. We have since heard that Trident has been inundated with enquiries and another six or so bookings 'are taking shape'. Of special interest is the fact that several enquiries have come from producers wanting to do direct-cuts of classical ensembles and jazz musicians. However, because of the extensive rebuilding that will be taking place during January and February (more details below), Trident has had to put off prospective clients until late February/early March. Meanwhile the engineers are sorting out a couple of problems that came to light during the Warsaw Pakt gig. The swarf extraction tube on the cutting room's Neumann lathe has been modified from a curved to a straight pattern. Cue and talkback facilities between the studio control room and the cutting room will also be improved to reduce confusion.

John Dent at the controls of the Trident cutting desk

Ray Staff and one of his best friends, the Neumann lathe

Two times 24-track is 46

Although the direct-cut was potentially stealing all the glory, work was continuing apace in the remix suite at Trident with a 46-track session under the direction of Alec Kostandinos assisted by engineer Peter Kelsey. No, the studio hasn't built its own transport using 10-cm tape; it has taken the easier route and is the proud owner of a pair of the first Studer *TLS 2000* synchronisation systems to be installed in the UK. One system is installed in the remix suite, and the other in the control room attached to the recording studio. Because at the time of writing Trident only has three Studer 24-track *A80*s, one machine has been designated a 'slave' and serves both studios, but more of this later.

Before a session begins a *Mellotron* or similar device is recorded on one track of an *A80* (usually track 23) to act as a reference guide-track. Up to 22 musical tracks (leaving one for the subsequent addition of the SMPTE code for synchronisation) can now be recorded in the normal manner. When complete the tape is taken to the remix suite where the two *A80*s are run together and a rough stereo mix of the previous tracks recorded on the slave machine. At the same time an SMPTE time code is put onto track 24 of both tapes. Occasionally other tracks are transferred onto the second tape, including the *Mellotron* and/or drums, if the producer feels he may need them. Additional tracks are then recorded on the second tape, with the rough stereo mix and guide tracks being available for foldback and monitoring as the new tracks are laid down. When the second session is complete both tapes are taken back to the remix suite, laced up and the SMPTE locks the two *A80*s in per-

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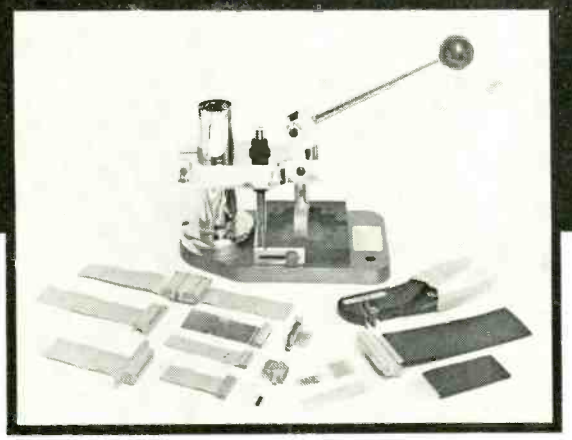

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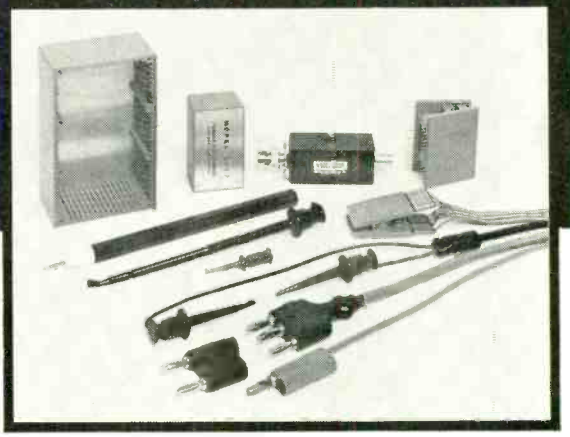

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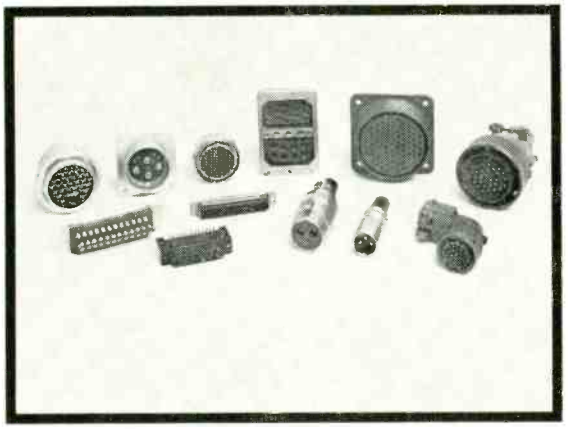

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fect synchronisation (well, according to Studer, to within 100 μs).

At present the 40-in/8-out *Series A* desk in the remix suite hasn't sufficient input channels to handle all 46 tracks from the two *A80*s, so a 20-input *Fleximix* mixer is used to provide the extra capacity.

In its present format the synchronisation system does have a couple of funnies. For example, the slave *A80* takes about 10 seconds to lock up with the master machine, and the slave's audio output is muted until synchronisation is established. It is rather uncanny when backing tracks suddenly surge out of the monitors as the slave finally locks into sync. At present it is also not possible to disable one of the machines, so that both have to run back and forth as a balanced mix is set up. It is hoped that a modification to the *A80*'s remote control will allow either or both machines to be run at any one time.

Apart from the extra available tracks, what other advantages are offered by 46-track? According to Trident's studio manager, Peter Booth, it does away with the need for track bumping and, as a result helps to retain the 'brilliance' of the original instrument or vocal. From a producer's point of view, the extra tracks allow more mics to be used, for instance, on a string or vocal section. By way of an example, Alec Kostandinos, who had been spending several weeks recording a 'Eurodisco' album entitled *Love and Kisses II*, was able to put out four mics on a 5-piece string section and leave the decision on a final balance until the mixdown stage. Greater musical separation of instruments is thus possible, and spot solos can be pulled out as necessary.

With an ever-growing demand for 46-track sessions, Trident are at present rebuilding the recording studios to be totally compatible with this format. A modified *Series A* console with 28 input channels, 48 output groups and 48-track monitoring is to be installed during January and February. The control room is being enlarged to house the larger desk, and will extend several more metres out and over the studio floor. Since it will only be used for recording, the desk will not be fader-automated but may at a later date have automation added to the monitor section.

There are also plans to convert the now-closed preview theatre at Trident into a new remix suite, but this will not start until the recording studio re-opens in late February. The new 60-input/12-output remix desk will be one of the recently-announced Trident *TSM* series consoles with voltage-controlled faders linked to either a Harrison or Allison automation system.

Mel Lambert

IRCAM, or Won't you come home, Pierre Boulez....

In 1969 President Pompidou of France announced plans to erect a cultural centre near the old Les Halles market and Boulevard de Sebastopol, on the Plateau Beaubourg. It was to be a building of grand design (in the heart of Paris) which would serve as a centre for contemporary art of all forms. To decide what form the new building should take a competition was opened to architects all round the world. In all, 681 designs were entered and in July 1971 an international jury, under J Prouve, awarded the prize to three architects; Renzo Piano, Gianfranco Franchini (both Italians) and an Englishman, Richard Rogers. That the task of building a new French monument should go to the foreign firm of Piano & Rogers and to the equally foreign firm of engineering consultants Ove Arup & Partners was not exactly welcomed in France. It seems that it had never seriously entered anyone's mind that the competition might be won by foreigners.

Almost immediately, the architects and judges were involved in no less than seven legal actions, seeking to overturn the prize decision for a variety of reasons. It emerged, for instance, that the old and highly respected Chairman of the jury had earned his deserved respect through brilliant work, rather than the usual collection of diplomas. So someone sued that his lack of paper qualifications left him unfit to judge such a competition. Another suitor managed to find room to dispute the ownership of a metre or two of essential ground, and thereby nearly scotched the project. The project was also nearly scotched by the death of Pompidou, whose replacement, Giscard D'Estaing, almost killed off the Beaubourg Centre once and for all. Pompidou had admired modern architecture and proved remarkably adept at removing all the red tape blocks to progress of his Beaubourg Centre, almost before they were created by underling bureaucrats. Giscard, however, being an economist with different attitudes to modern building proved far less enthusiastic.

For a while it was a case of touch and go whether there would ever be a Pompidou Centre at Beaubourg under Giscard. In the event agreement was finally reached, but only after two years of plans had gone into the waste-paper basket because the decree came down that £1.2 million had to be lopped off the price. The foundation hole had already been dug, and when you dig a foundation hole out of compacted earth, you can't just fill up part of the hole again with loose earth. The French attitude to the foreign architects was typically chauvinistic. From the moment the competition result was announced and the architects moved to France, no one would speak a word of English to them—even one Government official who had spent three years at Oxford.

As anyone who has visited the new Beaubourg Centre will well know, it's an extraordinary looking building. For a start it's 'inside out', in that all the pipes, services and escalators are on the outside, leaving the inside as open and adaptable as a football pitch. Legend has it that at one time the architects overcame one bureaucratic problem by offering to box in the whole structure with an outside shell of concrete, to make the inside-out structure look like an ordinary, outside-out tower block. Utterly impossible and quite ridiculous, of course, but sufficient to keep someone somewhere in the French hierarchy of bureaucracy happy.

The original competition brief and the original architects' plans put the public library, an industrial design department, and a series of art galleries all under one roof, with an institute for research and co-ordination of acoustics and music (IRCAM for short) in a few rooms buried in the Beaubourg basement. The idea behind IRCAM was to associate musicians and scientists in a new mixed discipline research. For the first time, it was claimed, research facilities on electroacoustics, musical instruments and the human voice would be housed under the same roof, rather than separately as has been traditional. Theoreticians, practical research workers, composers, instrumentalists, acousticians and scientists will all collaborate on mixed research projects with both a theoretical and practical basis. The avowed aim was that this research would bring about a better understanding of musical and acoustic phenomena. All are impressive aims that, in the long term, could well involve, influence and provide useful spin-offs for the studio and broadcasting world.

The Beaubourg Centre opened early in 1977, and despite distinctly varied opinions over its appearance (either you love or hate the yellow submarine/gasometer-style architecture) it has proved a massive public attraction. In the first ten months it was open, five-and-a-half million people went through its doors, using the library facilities, looking at the art exhibitions, and just generally looking. This is more than twice the number of people who visited the Eiffel Tower in the same period. It's so crowded that not everyone who tries to get in succeeds. But on a good day, you can watch fire-eaters eat fire, a philosopher discuss life with a pair of chickens, a bare-footed man walk on glass, an escapologist play amateur Houdini in chains and several political activists arrested by heavily armed police.

But you won't yet see inside the IRCAM facility, because somewhere along the way IRCAM moved out of the main Beaubourg Centre and went deep down underground alongside the nearby Saint Merri Church. IRCAM is now functioning, staffed by 54 people, although the Espace de Projection, or public concert hall, has not yet been opened to the public—this is due in the summer of 1978.

It is now clear that it was a political decision which moved IRCAM out of the few rooms dotted around the main Beaubourg Centre and into the current subterranean complex of offices, studios, halls and computer facilities. Pierre Boulez had been spending more and more time out of France, and in offering Boulez the directorship of IRCAM and a virtually free hand over design, in return for active participation, the French Government were adopting the carrot approach. He bit, and the IRCAM project was redesigned from scratch by Boulez in close co-operation with the architects, Piano & Rogers.

Mike Davies of P & R was the architect mainly responsible for the IRCAM work. The object was to hollow out a vast underground cavern and construct a warren of underground offices and studios, with the former leading directly off the main entrance corridor and the latter as remote as possible and thus best isolated acoustically.

The lowest point of the warren is the vast Espace de Projection, which is an astonishing, gymnasium-like structure of 400 m^2 floor area and 12 m height, making a total volume of around 5000 m^3.

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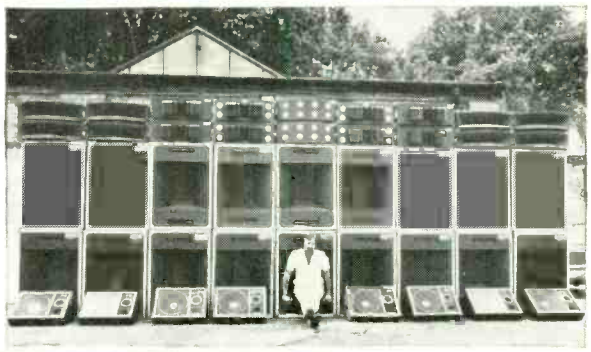

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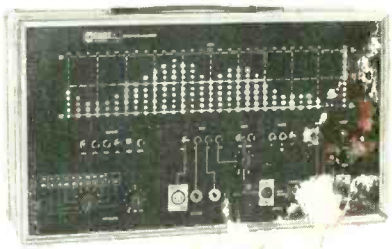

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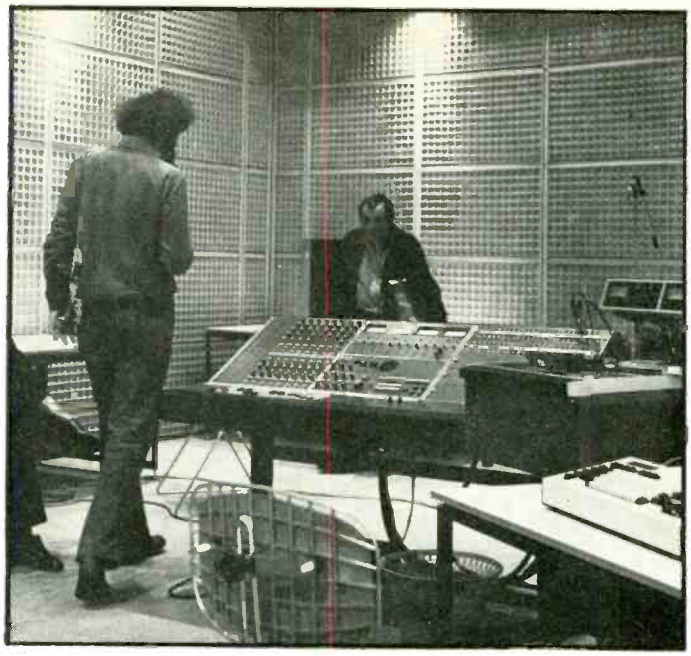

Architect Mike Davis paces up and down his handiwork in one of IRCAM's studios

But this volume is adjustable, because the whole ceiling can be lowered from its 12m maximum to a minimum of 'domestic room' level. Likewise, the side walls are all acoustically adjustable, being built from triangular members which are independently rotatable and with each face having a different acoustic characteristic. On each triangular panel there is one reflecting surface, one absorbent and one diffusing, with the turning panels only raising the ambient noise level to 40 dB. Thus by turning the triangles as required the overall acoustic can be altered.

The walls are also lined with ladder-like structures, which can move across the hall to support instruments or transducers dotted in lattice fashion over the overall hall volume. Although economy cuts have left the floor currently flat and non-adjustable, space has been left below the floor to enable the original intention to be carried out when funds permit: this is so that areas of the floor will be lowered and raised in draughtboard fashion.

Therefore, the Espace de Projection has an almost infinitely variable appearance, volume and acoustic. All the movements can be pre-programmed from a console in the studio control room overlooking the main hall, and pre-recorded or live sounds can be either generated in the hall or relayed from any of the other studios in the IRCAM complex.

Boulez's desire was to create a concert space with changing visual and acoustic specifications. Because the room volume and panel movement can be controlled direct from a computer, the room acoustic can be written into the music—the room itself becomes 'an instrument'.

When the Espace de Projection is opened to the public, it will hold 400 people at a time for concerts—the first is scheduled for next July. As the whole complex is underground, it is isolated from problems of sound leakage from either the sides or below. Leakage from above, eg from pedestrians or low flying aircraft, is reduced to a minimum by a cladding of paving stones mounted on resilient supports. The noise level in the Espace de Projection is as low as 15 dBA.

Comparably low ambient noise level is also found in all the studios. In fact, one studio has a 13 dBA ambient level, even with the air conditioning running. All the studios, along with the Espace de Projection, are constructed according to an interesting design philosophy. This clearly stems from the fresh approach taken by the architects in close working with Boulez, as opposed to routine adoption of standard-practice ideas. Every studio in its *natural* state is acoustically very *dead*. The walls, although appearing to incorporate only routine acoustic treatment, are in fact highly absorbent with a flat response down to 250 Hz and a reverb time of 0.3s. There is isolation of 80 dB between studios over most of the frequency range, and isolation of 50 dB down to 50 Hz. This latter, low-frequency isolation is courtesy of a laminar wall construction, a type of flapping baffle forming an integral part of the studio walls. Although this very dead acoustic with low ambient noise may be ideal for much of the IRCAM work (synthetically generated electronic sound) for music, speech or other purposes, it is far from ideal. In accordance with the IRCAM design philosophy the dead studio acoustic is 'tuned' up to the required 'liveness' by adding reverberation panels to cover the normally absorbent walls. Because the walls of the underground studios were constructed in a rather special way, each is electrically, as well as acoustically, isolated. When the original excavation was carried out, great care had to be taken not to cause any subsidence which would damage the Saint Merri Church nearby. First of all, a deep ditch was dug and then filled with clinker to stop it subsiding. Liquid concrete was then poured into the clinker-filled ditch, and as the heavy concrete filled the ditch, from the bottom up, the clinker gradually floated up and out of the ditch. The concrete then hardened, to provide an underground wall, so that it was possible to excavate either side of the wall without fear of subsidence. But the poured walls have metal reinforcements which are electrically linked, so the result of four walls, a roof and ceiling is in fact, a Faraday cage—hence the electrical isolation.

The array of electronic hardware in the IRCAM studios is daunting. The staff of 54, headed by Boulez and with the likes of Luciano Berio and Vinko Globokar responsible for individual departments, work in eight studios. All are equipped with Neve desks, Studer or Ampex multitrack and stereo machines, and mostly JBL *4331* and *4311* monitors. Money, one could safely say, has been no real object.

There is also extensive computer facility and even a new gadget which enables an operator with a light pen and visual display unit to create sound by moving the pen over the screen surface, in a manner comparable to the technique used to digitally encode analogue graphics.

Without doubt, then, the IRCAM Centre has unrivalled facilities. Funded largely by the French Government, but willing to receive funds from outside bodies seeking to use the Centre's facilities for independent research, IRCAM surely offers the most up-to-date electroacoustic complex in Europe —if not the world. Of that there can be no doubt. But what exactly is going on there? What exactly is likely to emerge in the way of research results? And what kind of sounds will be heard, either off tape or issued disc or in the underground Espace de Projection? On this there seems to be some doubt. Certainly, everyone concerned is beavering away and making new sounds which even those involved are reluctant to call music. Whereas a couple of the studios are intended as music studios, it seems unlikely that there will be any straightforward music recordings made in conventional (for want of a better word) 'classical' style. It is unlikely, too, that there will be any good old rock 'n' roll recorded at IRCAM. One aim is to record music, analyse it using the computer facility, doctor it (for instance by removing some tonal qualities) and then reproduce the doctored product, to transmute musical sounds as we know them and create new sounds, like new colours. Others are creating electronic music in real time, and there is work in progress on psycho-acoustics and the mechanism of hearing.

It remains to be seen whether valuable data and rewarding sounds come out of IRCAM. There is a school of thought (to which I happen to subscribe) which believes that musical ideas stem from fertile minds, irrespective of surroundings. An infertile mind will produce nothing of value, even when surrounded by the most exotic electroacoustic equipment in Europe. A fertile mind in a garret over the road will produce more of value. There is also an old adage about computers: feed junk in, and you get junk out. The results of IRCAM's research into psychoacoustics and the timbre or quality of sound will only interest and awaken engineers (for instance in the field of surround-sound and high fidelity reproduction) if the computers have been fed with meaningful programs based on relevant questions. I shall certainly watch out with special interest, for any research papers in these areas which are published by IRCAM. I also look forward to the chance of attending a public audition of what IRCAM has to offer, for instance when the Espace de Projection opens in July. To quote the official IRCAM booklet: 'To sum up, IRCAM will be a creative laboratory and also a place open to the public, who will be welcome to form their own judgment and to participate'. My personal fear is that to participate at IRCAM may be the audio equivalent of viewing a pile of bricks at the Tate, but until the opportunity to participate first-hand arises, it is only fair to reserve judgement.

Adrian Hope

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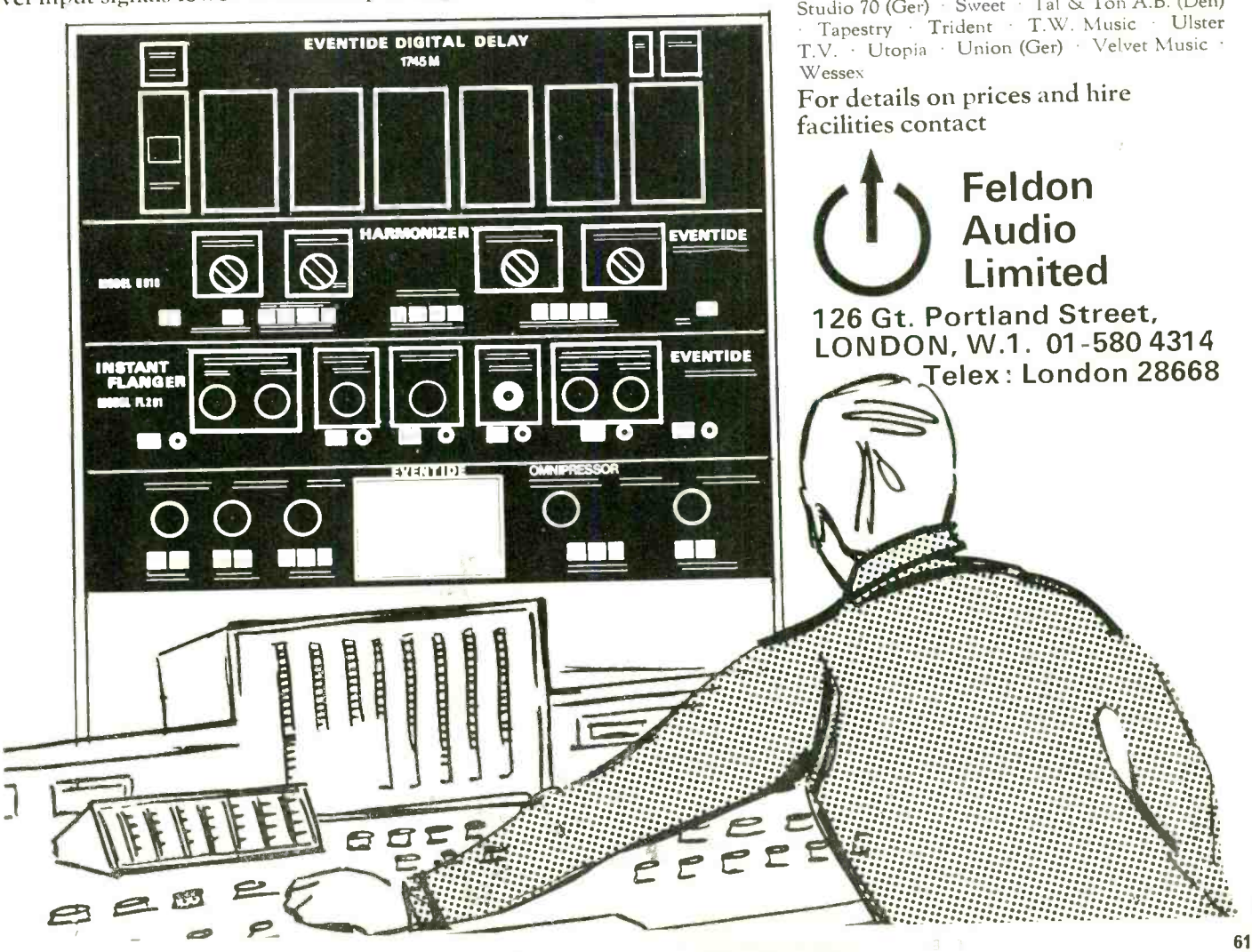


reviews

Telefunken MI5A tape machine

Hugh Ford

MANUFACTURER'S SPECIFICATION

Tape transport: one brushless dc servo motor with quartz oscillator reference; two special reel motors.

Tape speeds: 38 and 19 cm/s; optional 76 and 38 cm/s.

Deviation of average speed from nominal speed: 0.1% maximum.

Wow and flutter (peak-weighted (IEC 386 or DIN 45507) measured with EMT *420*): 76 and 38 cm/s max 0.04%; 19 cm/s max 0.06%.

Tape tracks and width: 8 on 25.4 mm; 16, 24 or 32 on 50.8 mm.

Tape thickness: standard or long play.

Reel size: NAB reels with maximum diameter of 31.8 cm.

Start time: rated speed within 0.5s (1s for 76 cm/s); time to 0.1% wow and flutter 1s (2s for 76 cm/s).

Fast wind time: 120s max for 730m of standard-play tape.

Stopping time: 5s max from fast wind (6s for 31.8 cm reel).

Electronic tape timer: 4-digit display indicating minutes and seconds for both tape speeds; In reverse mot on beyond zero indicating ascending time with negative sign.

Tape timer error: maximum 0.2%.

Remote control facilities: remote control unit *FS15A* offers remote control of all transport modes, remote only or parallel control and switch for mono-stereo or NAB/CCIR; autolocator unit *AL15A* offers automatic location of a tape position, repeated replay of a tape portion and remote control of all transport modes; varispeed unit *SZ15A* facilitates stepless variation of tape speed within +50% of nominal speed and 'highly accurate repeatability'; remote track selector *SF15A* or *SF15AT* remote control of ready and sync for all tracks.

AMPLIFIER ELECTRONICS

Equalisation: 76 cm/s 17.5 µs; 38 cm/s CCIR 35 µs; 19 and 38 cm/s NAB 3180+50 µs; 19 cm/s CCIR 70 µs.

Input: balanced and floating.

Input level: +4 dBm for operating level of 200 nWb/m and 0 vu; indication max input level +24 dBm. (In this standard level setting an input level of +12 dBm will record a level of 510 nWb/m.)

Input impedance: minimum of 5k ohm, 30-16k Hz.

Output: balanced and floating.

Output level: +24 dBm maximum undistorted level.

Output impedance: maximum of 40 ohm, 30-16k Hz; minimum load 150 ohm up to +18 dBm (200 ohm up to +24 dBm).

Erase and bias frequency: 131 kHz with quartz reference.

OVERALL PERFORMANCE

These data refer to the 17.5 µs NAB equalisation for the tape speeds 76/38 cm/s, 19 cm/s and modern tapes (for example, 3M *250* or equivalent).

Frequence response:

	Record/reproduce	Record/sync
76 cm/s	60-20k Hz +1/—2 dB 80-18k Hz ±1 dB	80-15k Hz ±2 dB
38 cm/s	30-18k Hz +1/—2 dB 60-15k Hz ±1 dB	40-15k Hz ±2 dB
19 cm/s	30-15k Hz +1/—2 dB 60-12k Hz ±1 dB	40-10k Hz ±2 dB

Signal to noise ratio:
A-weighted (IEC 179) rms value referring to 510 nWb/m.

Record-reproduce	8/16	24	32-track
76 cm/s	67	65	63 dB
38 cm/s	66	64	62 dB
19 cm/s	65	63	61 dB
Record-sync			
76 cm/s	66	64	62 dB
38 cm/s	65	63	61 dB
19 cm/s	64	62	60 dB

Crosstalk rejection between adjacent tracks:	8/16	24	32-track
Record/reproduce	58	50	45 dB
Record and adjacent sync	30	26	16 dB
10 kHz at 38 cm/s	20	16	6 dB
10 kHz at 76 cm/s	24	20	10 dB

Erasure: minimum of 80 dB at 1 kHz.

Distortion: 1% at 1 kHz, 510 nWb/m, 76 and 38 cm/s; 2% at 19 cm/s.

Power: 110/120/220 or 240V ac (+5, —10%); 50 or 60 Hz.

Ambient temperature: +5 to +35 °C.

Weight: 8-track approx 180 kg; 16-track approx 200 kg; 24-track approx 225 kg; 32-track approx 250 kg.

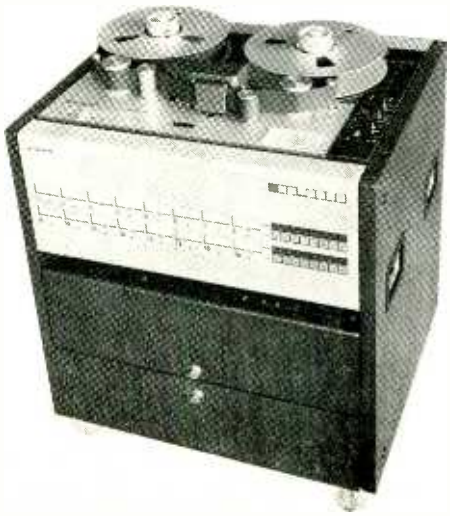
PERFORMANCE WITH TELCOM C4 NOISE REDUCTION

When equipped with the Telefunken *Telcom c4* noise reduction system the following data will be obtained (all other conditions unchanged).

Input and output: the nominal level of the *Telcom c4* system is adjusted to +4 dBm (operating level) giving identical gain between the system switched i..to compression and expansion mode and switched out. Then compressor input level respectively and expander output level corresponds to a tape level of 510 nWb/m.

Input impedance: 10k ohm balanced to ground; maximum input level +22 dBm.

Output impedance: 2 ohm + 500 µF balanced to ground; maximum output level +22 dBm into 300 ohm.



Signal-to-noise ratio:
A-weighted (IEC 179) rms value referring to 510 nWb/m (corresponding to +16 dBm).

Record-produce	8/16	24	32-track
76 cm/s	96	93	90 dB
38 cm/s	95	92	89 dB
19 cm/s	93	91	88 dB
Record-sync			
76 cm/s	94	91	88 dB
38 cm/s	93	90	87 dB
19 cm/s	91	89	86 dB

Crosstalk rejection between adjacent tracks:	8/16	24	32-track
Record/reproduce at 1 kHz	86	74	66 dB
Record/sync at 1 kHz	45	39	24 dB
10 kHz at 38 cm/s	30	24	9 dB
10 kHz at 76 cm/s	36	30	15 dB

Erasure: minimum 110 dB at 1 kHz.

Price: 24-track without *Telcom c4* £22.5k; 32-track without *Telcom c4* £29.5k. (24 tracks of *c4*—maximum to fit electronics drawer—costs an extra £12k.)

Manufacturer: AEG-Telefunken, Postfach 2154 D-7750 Konstanz, West Germany.

UK Agent: Hayden Laboratories Ltd, Churchfield Road, Chalfont St Peter, Bucks.

THE TELEFUNKEN *M15A* multitrack is in many ways similar to the Telefunken *M15* 6.35 mm machine, but it has many novel features that are not to be found in the smaller machine or in competitive products. Probably the most important of these is the possibility of including the *Telcom c4* noise reduction system within the machine itself. The *Telcom* system will be reviewed in next month's issue, but briefly it has the 1.5:1 compression/expansion ratio with the addition of a frequency-band splitting arrangement as found in the professional Dolby *A* systems. It therefore offers almost the extra noise reduction of dbx when compared with Dolby, without the noise 'breathing' associated with wide-band systems.

The *M15A* is available in a large variety of versions, covering eight tracks on 25.4 mm tape and 16, 24 or 32 tracks on 50.8 mm tape. All machines use the same basic tape transport, which can be associated with a wide selection of electronics. The latter not only includes such facilities as separate sync outputs, equalisation switching, remote track selection etc, but there are also a variety of remote options available. These include an autolocator, tape-speed control, remote control unit for the tape transport, remote control for the noise reduction system and a time code synchronisation unit for locking separate machines, or locking the *M15A* to other devices such as video tape recorders.

A very heavy alloy casting forms the basis of the tape transport itself, the casting being of ribbed form with machined reference faces for the major tape transport components, such as the reel motors, tape guides and the plug-in headstack. This can be readily changed without the use of any tools, the individual heads being mounted solidly onto a substantial headblock casting that has three steel reference pins which locate on to a reference face in the main transport casting.

Tape reels are mounted directly onto the spool motors by a simple clamp mechanism that was quick and simple to use. Despite the direct mounting there was negligible temperature rise of the hubs, which could otherwise cause tape damage. Like most modern machines there is sufficient clearance around

the hubs to use 31.8 cm diameter NAB spools, giving useful extra time when running at 76 cm/s tape speed.

All versions of the machine are fitted with two speeds—either 76/38 or 38/19 cm/s—with the tape speed being controlled by a crystal reference oscillator in conjunction with a special brushless dc servo motor that provides a belt drive to the capstan. The capstan is a steel shaft mounted in a very long housing to provide mechanical stability. As in traditional machines, a large diameter flywheel is fitted to the capstan shaft.

From the pay-off spool the tape passes to a mechanical tension sensing arm which controls the mechanical brakes on the pay-off motor. From there the tape passes over a large-diameter covered roller, which drives a photo-electric tachometer disc for the tape timer, and thence over a smaller-diameter roller guide before reaching the head stack. Two staggered 12-track ferrite erase heads are fitted to the 24-track machine, followed by the metal record and replay heads. These are protected by a removable hum shield that is driven in and out of position mechanically during normal operation, as is the tape lifter roller located between the erase and record heads. The replay head is followed by the capstan/pinch-roller system, a large-diameter covered roller guide and the take-up spool with its associated tension arm.

Local tape motion control is effected by the normal play, record, stop and rewind buttons that feed the solid-state logic control underneath the tape transport. It was nice, however, to find variable-speed spooling controlled by a small lever next to the illuminated control buttons. A further button is used to reset the local tape timer, which indicates elapsed time in minutes and seconds as well as half-seconds by means of a flashing decimal point; of course the timer is corrected for tape speed.

The only other tape transport controls comprise the edit control and three pushbutton switches beneath a hinged panel that also secretes a capstan running time meter. The three buttons provide local/remote tape transport control; tape speed selection; and power on/off for the tape transport only. Editing can be done in a number of ways using the edit switch, which always applies the replay signal to the audio outputs. Thus, once this control is operated the sync and the record functions are inhibited and rock-and-roll editing can be carried out. If the tape is then put into replay the replay process will be normal, unless the right-hand tape tension arm is moved outwards to its extremity when the take-up spool motor will be inhibited and a dump-edit mode entered.

Access to the tape for editing is excellent once the moving headshield has been removed by simply pulling it out of its socket. It was found essential, however, to have the headshield in position in normal use to reduce the effect of stray hum fields. While the tape is always lifted from the heads in the fast wind modes of operation, setting the edit control partially inserts the capstan pinch-roller, thus providing a replay signal in the fast mode when this is desired for locating takes etc.

All the logic and other electronics associated with the tape transport are contained within a screened box on the tape transport, and the transport has its own separate power supply unit. The audio electronics are located in two sliding drawers in the base cabinet, which houses a separate power supply unit for the audio electronics and other items.

As with the tape transport, access to all parts is really excellent and all fuses, connectors, printed-circuit boards and individual components are very well identified—thus servicing should not present any problem if the instruction book for the 6.35 mm machines is anything to go by!

In the 24-track review machine the upper electronics drawer contained the audio electronics for record, replay and sync for 16 channels (plus a few special boards), and the lower drawer the electronics for the remaining eight channels plus space for 24 channels of *Telcom c4* noise reduction (only four of which were fitted). All printed-circuit boards are mounted in vertical array with their locations clearly identified by printed markings, such that the electronics for any particular channel can be readily found. The pcbs have plug and socket connections to the mother boards mounted on the bottom of the drawer.

Preset controls, which normally take the form of single-turn potentiometers, are at the ends of the boards and are therefore readily accessible with a screwdriver. It was pleasing to find that in spite of the use of single-turn controls the adjustment ranges had been well chosen. Each record amplifier has a bias control, a record level control and two high-frequency equalisation controls, while the replay amplifiers have a replay level control, two-high frequency equalisation controls and a bass equalisation control.

To the front of the cabinet, which is mounted on castors and has four good carrying handles, are the 32 illuminated vu meters. To the right of these is a collection of pushbuttons and indicator lamps. Each channel has a record and a sync button, the former being associated with master record buttons and the sync mode with other functions. Since all these buttons are illuminated either steadily when the function is in action or flashing when selected but not in action, it is very easy to quickly see the status of each channel. The other illuminated buttons comprise a red 'master record ready' button; two buttons for selecting the source of the audio output signal; two buttons for altering the vu meter sensitivity; a test button; and an edit lamp.

Subject to the edit function not being selected, in which case the edit lamp is illuminated and the audio output is always the replay output, an 'input' button fixes the audio output to the input signal, or automatic a/b switching can be used with full interlocking of the sync signal.

Very sensibly the sensitivity of the vu meters can be altered for aligning the machine, such that the sensitivity can be decreased by 8 dB for maximum level alignment, or increased by 12 dB for frequency response alignment—it's really about time that some other manufacturers did something in this direction!

A further very good idea is a test facility that works in association with the test button. The top drawer of the electronics contains a test oscillator activated by a slide switch on the oscillator's board, and which also illuminates the front-panel test button. Actuating the

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test button changes the oscillator frequency between 1 and 10 kHz, the test button lamp's flashing frequency being slow for 1 kHz or fast when 10 kHz is selected.

Turning now to the rear of the cabinet, six multipole connectors provide the audio inputs and outputs—three interlocked connectors for each, with eight channels per connector (more connectors being necessary for 32-track machines). Perhaps the use of multipole connectors is inconvenient, but *XLR* connectors take up a lot more space and are also very expensive. Further connectors are provided for remote track selection, and various options require other connectors in addition to the remaining IEC-type power connector. The wiring to all connectors is in the form of flat ribbon cabling, making tidy but crowded bunches.

TABLE 1

Condition	Reference level (320 nWb/m) to noise ratio			
	Band-limited rms 20-20k Hz	A-weighted rms	CCIR-weighted (ref 1 kHz)	
			quasi-peak	rms
76 cm/s AES equalisation				
machine-erased tape	55.0 dB	62.3 dB	49.1 dB	53.6 dB
no tape	63.5 dB	74.5 dB	63.0 dB	67.8 dB
38 cm/s CCIR equalisation				
machine-erased tape	57.0 dB	61.6 dB	48.4 dB	52.8 dB
no tape	63.5 dB	73.5 dB	61.7 dB	66.4 dB
38 cm/s NAB equalisation				
machine-erased tape	55.8 dB	59.6 dB	46.0 dB	51.0 dB
no tape	63.8 dB	71.8 dB	59.9 dB	63.5 dB
Sync mode				
no tape	58.0 dB	71.0 dB	60.5 dB	65.2 dB

Replay performance

Investigations into the replay equalisation showed that the machine could be set extremely flat in view of the wide range of available equalisation in both the treble and bass. A typical replay frequency response of one track for AES equalisation at 76 cm/s and CCIR equalisation at 38 cm/s using a flux loop is shown in **fig. 1**, which was plotted without touching the factory equalisation adjustment.

The available range of adjustment, again using a flux loop to make the plot, is shown in **fig. 2**, which shows the effects of the two high-frequency equalisers marked 'H1' and 'H2' and the low-frequency equaliser marked 'T'. Clearly the available range is more than adequate for compensating any normal replay heads.

An output level of +4 dBm for a tape fluxivity of 200 nWb/m is the normal adjustment recommended for this machine (equivalent to +8 dBm for 320 nWb/m). In these circumstances the output can be driven to +30 dBm before the onset of serious distortion, thus giving a more than adequate output capability margin for any present or foreseeable tape types.

On the noise front all channels tested gave closely-related results, the measurements in **table** 1 being made using 3M *250* tape as a reference; it will be seen, however, that the machine noise is well clear of tape noise.

Investigations into any discrete tones in the audio output did not reveal anything but the bias output when in the record mode, and this 131.08 kHz signal was well down at 76 dB below the reference level of 320 nWb/m. Naturally some mains hum was present, but in the replay mode the level was well down and only in the sync mode was hum significant. Curiously, the presence of the head shield raised the hum level in the sync mode and reduced it in the replay mode.

Record/replay performance

In view of the wide range of record equalisation available, as shown in **fig. 3**, the machine can be readily adjusted for any current tape types. As can be seen the two high-frequency equalisers marked '1' and '2' offer different characteristics, with the latter control effecting peaking at the highest frequencies.

The possible flatness of the overall record/replay frequency response for both tape speeds is shown in **fig. 4**, which exhibits a remarkably smooth response with a distinct lack of cyclic deviations at low frequencies—thus demonstrating that great care has been taken about tape

TELEFUNKEN M15A TAPE MACHINE

FIG.1 REPLAY FREQUENCY RESPONSE WITH FLUX LOOP

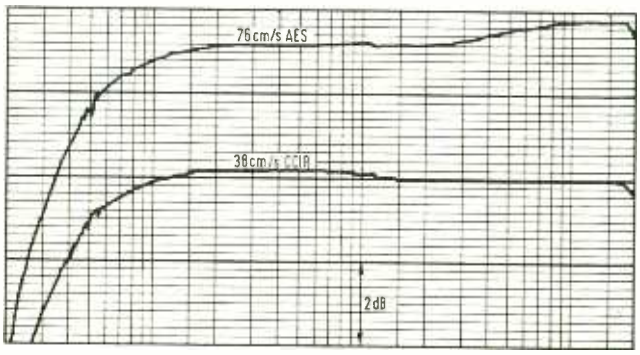


FIG. 2 REPLAY FREQUENCY RESPONSE OF HF AND IF EQUALISERS AT 38 cm/s

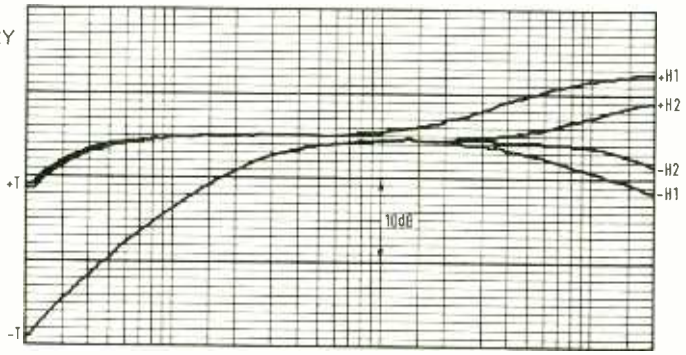
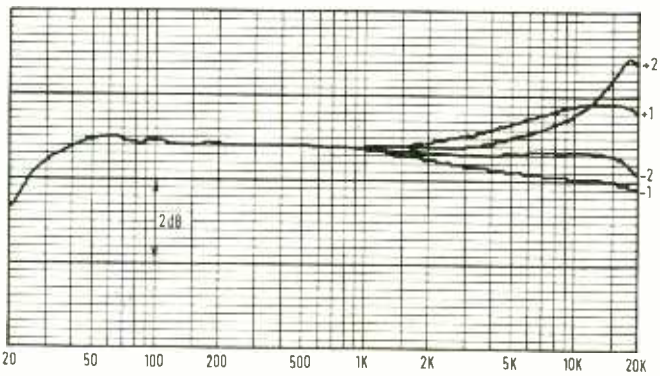
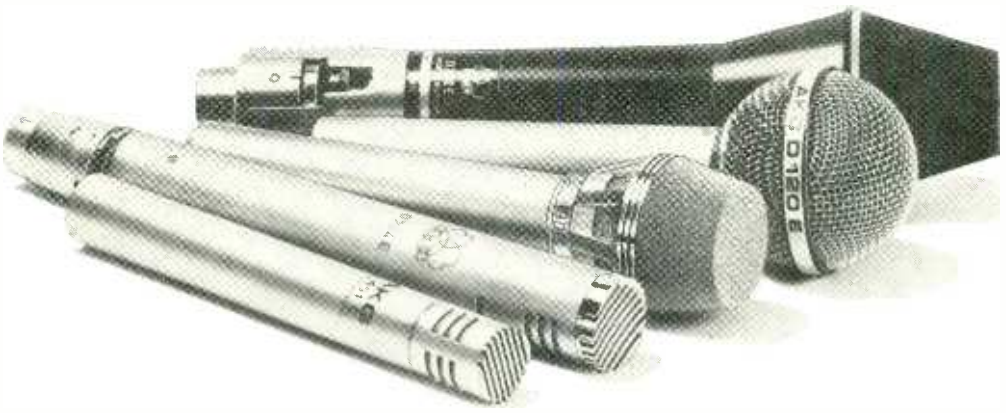


FIG. 3 RECORD EQUALISATION AT 38 cm/s





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wrap angles at the heads and the head design.

The replay frequency response in the sync mode was almost as good as the normal record/replay, but with a slight fall off at the highest audio frequencies as shown in **fig. 5.** Squarewave record/replay performance was also unusually good with little ringing on the edges, as can be seen for a 1 kHz squarewave in **fig. 6.**

Investigations into the distortion performance showed that at both tape speeds the 3% third harmonic point occurred at +10 dB with reference to a recorded fluxivity of 320 nWb/m; at this level the second harmonic was remarkably low at 0.11%. The maximum drive capability of the record amplifiers was found to be sufficient to record a fluxivity +14 dB above 320 nWb/m on 3M *250* tape—an adequate margin for current tape types, but perhaps more might be desirable. Harmonic distortion at lower recorded levels was remarkably low, with the third harmonic levels being given in **table 2.**

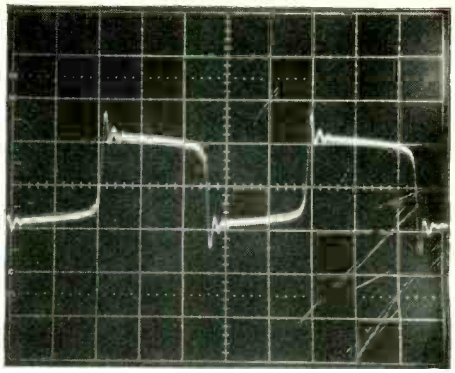


FIG. 6

TABLE 2

Recorded level	76 cm/s	38 cm/s
320 nWb/m 1 kHz	0.11%	0.16%
200 nWb/m 1 kHz (0 vu)	0.03%	0.06%

Apparent intermodulation distortion to the SMPTE method using 50 Hz and 7 kHz tones in a 4:1 amplitude ratio was found to be 1.1% at 38 cm/s or 0.5% at 76 cm/s at a recording level of 0 vu (corresponding to 200 nWb/m) on 3M *250* tape—a creditable performance that was tape limited at the lower tape speed.

Inputs and outputs

In the standard machine without *Telcom* noise reduction the inputs are normally adjusted for +4 dBm to correspond to a tape fluxivity of 200 nWb/m, also corresponding to 0 vu on the meters. Similarly, the output level is set for +4 dBm to correspond to the same conditions, but both levels may be adjusted over a wide range by preset potentiometers on the amplifier boards.

The inputs and the outputs are both floating transformer-coupled connections, with an input impedance of 23k ohm and an output impedance of about 32 ohm at 1592 Hz—both very sensible impedances.

Input and output levels can both be metered by the front-panel vu meters, with various automatic switching arrangements for before and after-tape monitoring. Calibration of the genuine vu meters was found to be correct—such that 0 vu corresponded exactly to +4 dBm at 1 kHz—but the frequency response of the metering was not impressive with errors of +0.8, −1.2 dB over the frequency range 30-10k Hz. Maybe this is sufficient for record/replay alignment, but it's certainly not good enough for replay alignment with calibration tapes.

Wow and flutter

Measuring wow and flutter to the IEC quasi-peak weighted method revealed the most excellent performance when the tape tensions had been properly adjusted. As delivered, however, the machine was out of adjustment with a higher than correct wow and flutter, and also tape skew problems. The UK agents and Telefunken from Germany immediately went to town on this problem, and also an intermittent fault that appeared in the control logic. Congratulations to them for their prompt and efficient action.

The resulting wow and flutter figures as measured at the beginning, middle and end of a 26.7 cm diameter NAB reel of tape were

68 ▶

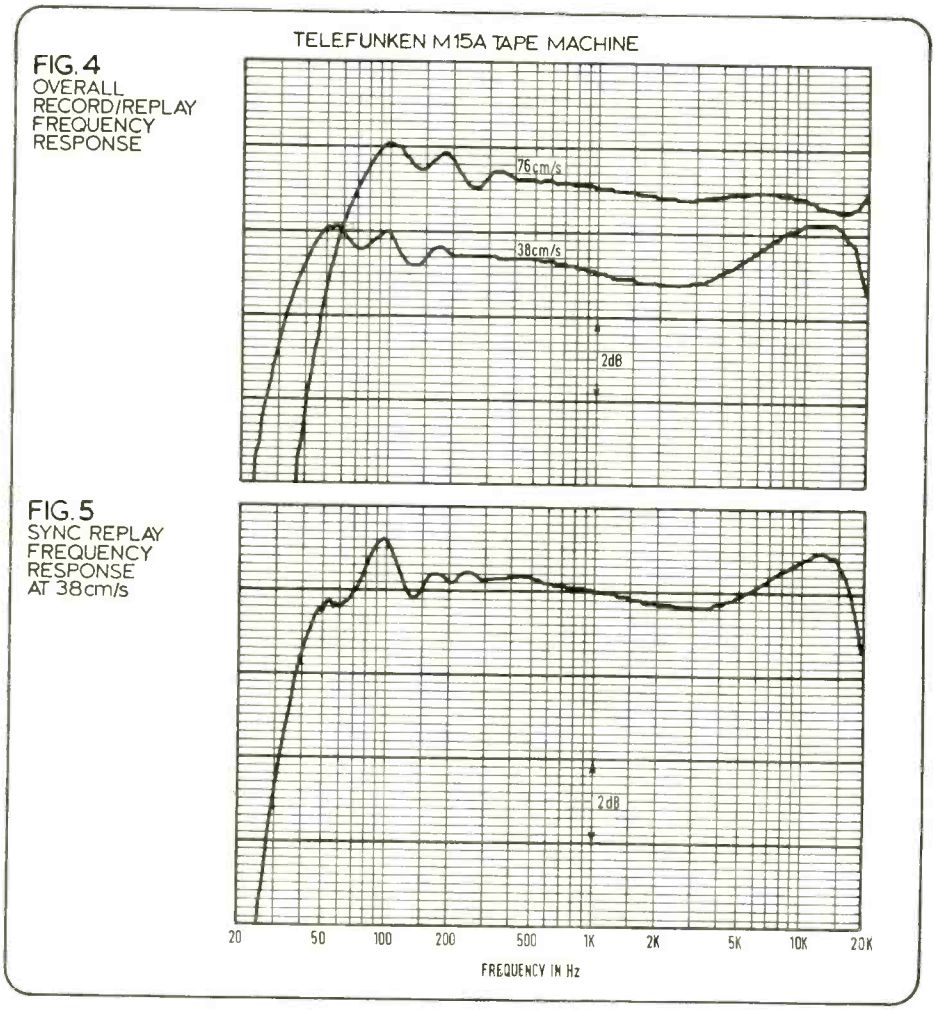
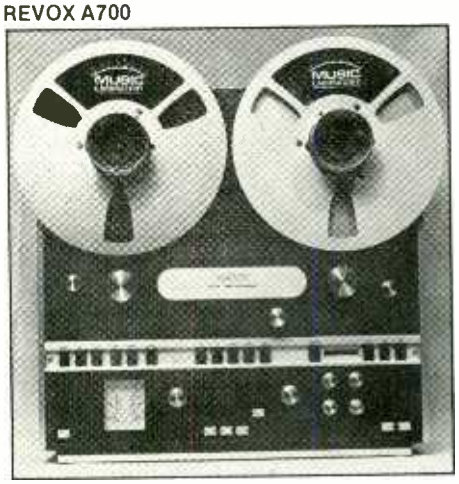


FIG. 4 OVERALL RECORD/REPLAY FREQUENCY RESPONSE

FIG. 5 SYNC REPLAY FREQUENCY RESPONSE AT 38cm/s

Reliability— before and after

REVOX A700



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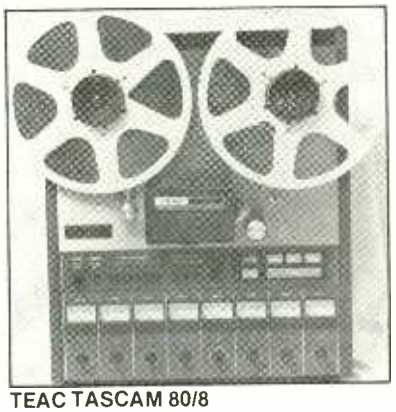


TEAC TASCAM 80/8

40 30 20 10 5 0 3 5

MUSIC LABORATORY

76 LYNDHURST GARDENS, LONDON N3. 01 349 1975-6

quite incredibly good as can be seen from **table 3.** But not so good were the sidebands

TABLE 3

Tape speed	beginning	middle	end of reel
76 cm/s	0.012%	0.01%	0.011%
38 cm/s	0.008%	0.01%	0.01%

created by flutter as shown in **fig. 7,** which is a narrow-band spectrum analysis of a 10.05 kHz tone. While such a figure is typical of many recorders, the sidebands shown at 50 Hz from the carrier could be lower. They are probably caused by ac reel motors that transfer variations in torque from the 50 Hz mains to the tape.

Another matter that can come under the heading of flutter is the phase jitter between the outer tracks. This is shown in **fig. 8,** which represents the jitter of a 10 kHz signal recorded and replayed from tracks 1 and 24, the peak-to-peak jitter at 38 cm/s being in the order of ±15°—a respectable performance.

FIG. 7 TELEFUNKEN M15A FLUTTER ANALYSIS AT 76cm/s WITH A 10.05kHz TONE AND 3.15Hz BANDWIDTH

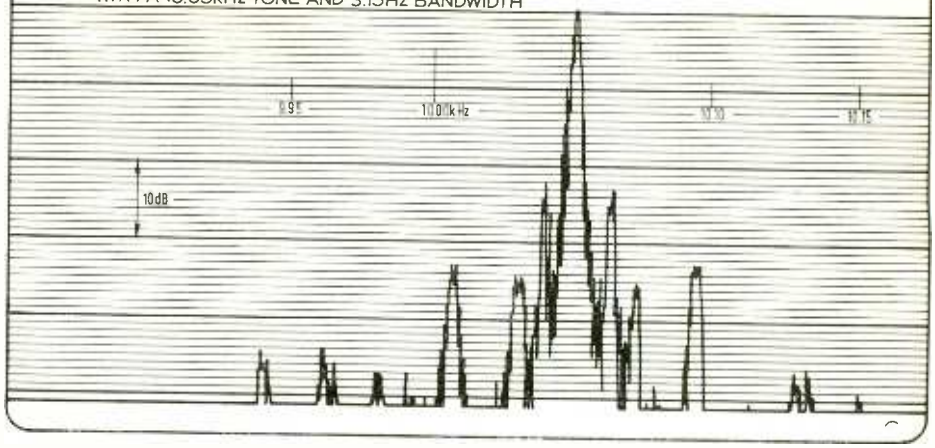
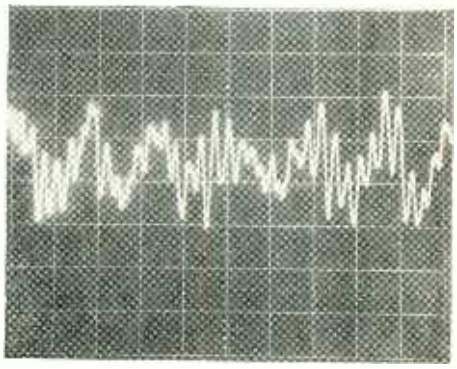


FIG. 8



Other matters

Erasure of a 1 kHz tone recorded at 76 cm/s (a worse condition than 38 cm/s) was really first class, with the erasure being in excess of 100 dB, and clicks when entering the record mode or returning to the replay mode were at a very low level thanks to the bias and erase timing.

At all times the tape handling was beyond reproach—even in the fast wind modes where it took only 105s for a full 26.7 cm reel of tape —and no operation of the transport (even power failure) did anything unkind to the tape.

Type SZ15A varispeed unit

This optional accessory allows the tape speed to be varied continuously over the range ±50% by means of a knurled knob, crystal-lock being provided for any selected speed. A 3-digit display shows the selected speed as a percentage of the nominal speed in use, and it was found that the display was always accurate to the nearest digit. In addition to the speed control knob and the display, the front panel of the unit includes two indicator lamps and a 2-position toggle switch that selects either variable speed or the internal quartz reference for the constant selected speed. A red lamp is illuminated when the variable speed is selected, the second lamp being a green lamp which is illuminated once the transport is synchronised at the selected speed; a table of percentage variation in terms of half tones is engraved on the front panel.

Normally the variable speed can only be operated in the replay mode, but an internal link allows variable speed recording. However, when this is not desired the interlocking is such that it is possible to enter the record mode with variable speed selected if in synchronism. The tape then starts and changes to the nominal speed in use—a rather dangerous habit.

In other respects the varispeed unit was simple to use and offers a very valuable facility for pitch correction.

Type AL15A autolocator

This is a small and very powerful autolocator that can be only briefly described here because of its many possibilities. The normal transport controls of play, stop, record and fast wind are duplicated on the autolocator, in addition to a 'parallel' button that disables the controls on the tape transport. While it is possible to drop in or out with the transport controls, this cannot be done with the controls on the autolocator without stopping the tape when dropping out of record; this would appear to be a considerable inconvenience.

Two 4-digit displays are provided, one of which indicates current tape position in minutes and seconds, and the other into which can be entered directly in minutes and seconds from ten pushbuttons. Either display can be transferred to the other and either can be cleared, as can nine of the ten location memories in the autolocator. These memories can be entered with the current tape position by pushing a button, such that any instantaneous tape position can be memorised. When desired any memory can be transferred to either time display, and the tape made to automatically locate any memorised position by pressing a 'locate' button. In addition, the tape can be made to shuttle continuously between any two positions by means of a 'repeat' button, which selects a play and rewind sequence.

A further feature is that a given amount of time can be added to or subtracted from memories such that, for instance, a starting time can be corrected in memory. Finally there is a stopwatch mode, whereby the time between two events can be determined without interfering with the memories or with the current tape position, which continues to be updated while the stopwatch mode is in use.

Although it takes a little time to get used to its operation, this is a very powerful unit that incorporates a microprocessor to locate the tape at wanted positions. The benefit to be had from this system is that the tape speed is computed in relation to the time before the tape is required to stop. The tape speed is controlled appropriately, such that the tape arrives promptly at the desired location without either violent braking or shuttling about the desired location before stopping.

Once the monitoring switching had been mastered, the operation of the machine was very straightforward and the noise level generated by the machine in operation unusually low.

From a maintenance point of view all parts of the mechanics and the electronics are readily accessible and, in spite of the rather complex reel braking system, there are few operational adjustments on the tape transport.

Summary

I have always been a great admirer of recent Telefunken machines and regard the *M12* and *M15* as amongst the best available 6.35 mm machines; the new 50.8 mm *M15A* is no exception to this tradition of first-class machines.

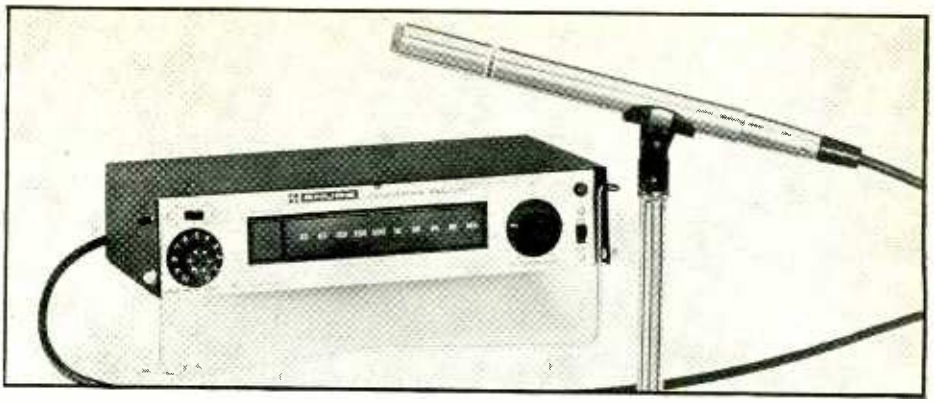
While some engineers will regard the mechanical construction as old-fashioned and traditional, there is a lot to be said for solid engineering and the use of well-known methods. This opinion is well supported by the most excellent wow and flutter performance and the overall standard of tape handling.

From the electronics point of view this is also an outstanding machine—it gives a very good performance without the *Telcom c4* noise reduction units to be reviewed next month. However, it is quite an asset to be able to have a 24-track machine complete with noise reduction in a single cabinet.

So far as the standard of construction is concerned, the quality of both the mechanical and the electronics sections is really beyond reproach, with servicing having clearly been borne in mind and great emphasis having been put upon quality control.

Shure M615AS Equalization Analyzer

Hugh Ford



MANUFACTURER'S SPECIFICATION

	Impedance	Level	Connector
Inputs:	high or low	'mic'	3-pin female *XLR*
	high	'aux'	phone and jack
	Pink noise generator		
Outputs:	high or low	'mic'	3-pin male *XLR*
	high	'aux'	phone and jack
	Analyser		
	high	'aux'	jack

PINK NOISE GENERATOR

Output level: 'aux' —1 dBV (625 mV); 'hi-z mic' —29 dBV (33 mV); 'lo-z mic' —49 dBV (3.3 mV).
Spectrum: equal energy per octave pink noise; flat ±1 dB, 32-16k Hz.
Output impedance: 'lo-z mic' 110 ohm balanced; 'hi-z mic' 2.3k ohm unbalanced; 'aux' 1.5k ohm unbalanced.

ANALYSER

Sensitivity (pink noise levels to turn off 'lo' leds; input level fully clockwise):

Input	15 dB Attenuator	Input voltage	SPL*
lo-z mic	out	—117 dBV (1.8 μV)	45 dB
	In	—100 dBV (10 μV)	62 dB
hi-z mic	out	—92 dBV (25 μV)	
	in	—77 dBV (0.14 mV)	
aux	—	—62 dBV (0.79 mV)	

*Using Shure *ES615* microphone.
'Flat/ES615' switch: complements low-frequency roll-off of *ES615* microphone.
'Above 1 kHz' switch: 'flat' used for near field measurements (produces flat resultant frequency response); 'roll-off' used for reverberant and far field measurements (produces resultant frequency response rolled off at 3 dB per octave above 1 kHz).

Mic overload (pink noise levels to turn on mic overload led):

Input	15 dB Attenuator	Input voltage	SPL*
lo-z mic	out	—40 dBV (10 mV)	122 dB
	In	—25 dBV (56 mV)	137 dB
hi-z mic	out	—17 dBV (0.14V)	—
	in	—2 dBV (0.79V)	—

*Using Shure *ES615* microphone.
Input overload: —25 dBV or 56 mV for pink noise aux input level to turn on 'input overload' led (input level control fully clockwise).
Hi/lo envelope: 2-12 dB (±1 to ±6 dB) adjustable.
Aux output voltage gain:

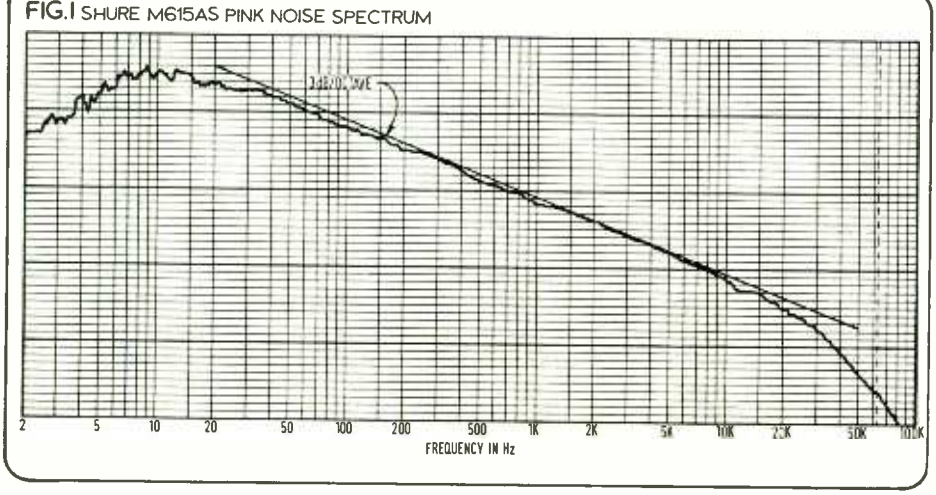
Input	Gain
Lo-z mic	+54 dB**
Hi-z mic	+31 dB**
Aux	—4 dB

**Input attenuator out.
Input impedance: lo-z mic designed for use with 25-600 ohm mics (Actual impedance 950 ohm balanced); hi-z mic 33 kohm microphones (140 kohm unbalanced); aux 100-10k ohm high-level sources (42 kohm unbalanced).
Output impedance: aux designed for use with high-impedance (10k or more) unbalanced circuits (Actual impedance 4.7 kohm unbalanced).

GENERAL

Operating voltage: *M615* 108-132V ac, 50/60 Hz, 5W; *M615-2E* 90-125V or 180-250V ac, 50/60 Hz, 5W.
Temperature range: operating —7° C to 57° C; storage —29°C to 71°C.
Dimensions (whd): 289 x 63.5 x 78 mm.
Weight: 2.2 kg net.
Manufacturer: Shure Brothers Inc, 222 Hartre Avenue Evanston, Ill 60204, USA.
UK agent: Shure Electronics Ltd, Eccleston Road, Maidstone, Kent.

FIG.1 SHURE M615AS PINK NOISE SPECTRUM



THE SHURE *M615AS* equalisation analyser system is one of several spectrum analysers that have recently appeared on the market for equalising sound reproduction systems, and like some others consists of a pink noise generator and a separate analyser system. The unit is supplied in a rigid plastic carrying case, which also contains the Shure *ES615* dynamic analyser microphone, a long microphone cable and also various leads and connectors. The analyser itself is of lightweight sheet-metal construction, with the led display and the main controls at the front and the connectors and subsidiary controls at the rear. The complete unit is supplied with a tilting foot to aid visibility of the display in use.

Each octave band from 32 Hz to 16 kHz is associated with two red led indicators in the display; the lower indicator is illuminated until a specified input level is reached, and the upper led remains out until a higher adjustable level is reached. The difference between these two levels can be adjusted by a calibrated front-panel control over the range 2–12 dB. It follows that the input level range over which all indicators are out can be adjusted between 2 and 12 dB, representing a frequency response tolerance between ±1 dB and ±6 dB over the analyser's range.

Two further led indicators are used to indicate overload of the microphone pre-amplifier or of the input amplifier. The input level is controlled by a front panel potentiometer that is concentric with the pink noise output level control. The final front panel controls consist of the mains power on/off switch and a slide switch that introduces a 3 dB/octave roll-off above 1 kHz, which is sometimes considered to be a desirable characteristic for listening areas.

At the rear panel there is the IEC-type power connector and its associated voltage selector, which provides for European and United States power line voltages; it was noted, however, that no protective fuses are fitted to any part of the power supplies! Three pink noise output connectors are provided: a 6.35 mm unbalanced jack socket in parallel with a phono socket giving a high-level output; and a 3-pole *XLR* socket giving a low-level floating output for feeding dynamic microphone inputs or a higher level unbalanced output for high impedance microphone connections. The selection of the latter outputs is by a slide switch.

Similarly, the analyser section can accept inputs from high or low-impedance microphones via a *XLR* socket, or high-level unbalanced inputs via a 6.35 mm jack socket in parallel with a phono socket. In addition to the high/low-impedance microphone selector switch

there are two further slide switches: one inserts a nominal 15 dB attenuator into the microphone inputs; and the other introduces low-frequency compensation for the characteristics of the Shure *ES615* omnidirectional dynamic analyser microphone. The final feature of the rear panel is an auxiliary output connector in the form of a phono socket connected to the output of the microphone pre-amplifier; this allows the microphone's output to be fed to auxiliary meters or analysers.

Internally the unit is based mainly on a mother-board, which is provided with sockets for the five analysing filters (two on each board), and the overload indicator board. Subsidiary boards are used for the pink-noise generator and the power supplies. Although the boards are tidy and complete with component identifications, the standard of wiring is rather untidy; however, an excellent instruction manual is provided and includes full circuits and parts lists in addition to very clear operating instructions.

Pink Noise Generator

By definition pink noise is random noise that has equal energy per octave bandwidth. Thus, when using a series of octave filters the noise output from the filters has equal rms voltage. Alternatively, it happens that if a constant bandwidth filter is used the noise output voltage falls with frequency at a rate of 3 dB/octave change in centre frequency.

Fig. 1 shows a constant bandwidth analysis of the output from the pink-noise generator section of the Shure analyser. The noise spectrum is within 1 dB of the 'flat' condition over the frequency range 30–20k Hz—substantially better than the manufacturer's specification.

The pink-noise output voltage is controlled by a front-panel potentiometer that offers a full range control; the maximum levels from the various outputs and their associated impedances are shown in table 1. These output levels and impedances are generally sensible for feeding any type of audio equipment, it being borne in mind that it is always important to work at relatively low acoustic levels when equalising listening areas in order to avoid system saturation at high frequencies.

TABLE 1

Output	rms output voltage (20-20k Hz band)	Output impedance
Microphone high	44 mV	1900 ohm
Microphone low	3.4 mV	110 ohm
Auxiliary	1V	1500 ohm

Analyser inputs

The sensitivity of the inputs to just turn off the low-level led indicators in the analyser display and the maximum input levels for input overload are shown in **table 2**, together with the measured impedance of the various inputs,with or without the use of the 15 dB (nominal) attenuator in the microphone pre-amplifier. As is to be seen from **table 2** the insertion of the 15 dB (nominal) attenuator has a substantial effect upon the microphone input impedance. It is felt that this could lead to substantial errors when some low-impedance dynamic microphones are in use. Generally dynamic microphones like to look into something like five times their rated impedance, and in this respect the input impedance with the input attenuator inserted is undesirably low. Although the setting of the input-level

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control didn't affect the mic input impedances, it had a small effect upon the input impedance of the auxiliary input, to the extent that the impedance at maximum input gain fell to 46.5k ohm. However, this fall is insignificant.

When using the Shure *ES615* microphone at maximum gain setting the analyser is usable as a sound level meter for fixed (specified) sound pressure levels of 45 dB spl without the input attenuator, or 62 dB spl with the input attenuator. Our measurements agreed precisely with the 62 dB spl level of pink-noise, and was very close to the nominal 45 dB spl with a measured 44.5 dB spl. All these figures correspond to the extinction of the lower level led indicator in the analyser.

TABLE 2

Input condition	Input sensitivity	Input overload	Input impedance
Microphone low impedance no attenuator	—117 dBV 1.4 μV	—42 dBV 0.8 mV	1060 ohm
Microphone low impedance 15 dB attenuator in	—100 dBV 10.0 μV	—28 dBV 39.8 mV	417 ohm
Microphone high impedance no attenuator	—92 dBV 25.1 μV	—19 dBV 112 mV	150k ohm
Microphone high impedance 15 dB attenuator in	—78 dBV 126 μV	—8 dBV 398 mV	56k ohm
Auxillary	—61.5 dBV 615 μV	—27 dBV 44.7 mV	49k ohm

SHURE M615AS EQUALISATION ANALYSER SYSTEM

FIG. 2
FREQUENCY RESPONSE OF PRE-AMPLIFIER AND ES615 MICROPHONE

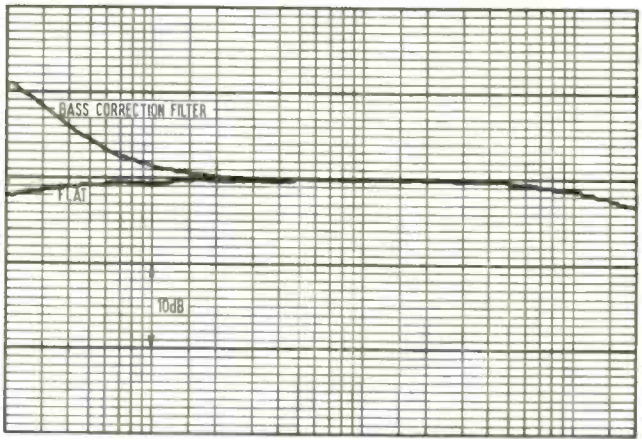


FIG. 3
FREQUENCY RESPONSE OF ES615 MICROPHONE

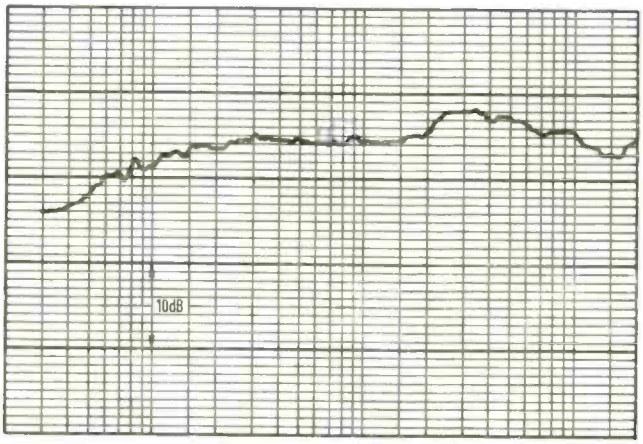
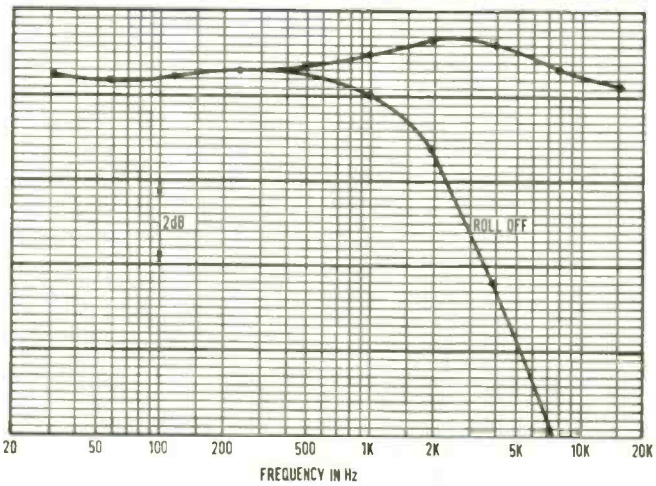


FIG. 4
FREQUENCY RESPONSE OF M615 ANALYSER



Analyser performance

The frequency response of the microphone preamplifier under maximum gain conditions, together with the frequency response of the bass correction filter for the Shure *ES615* microphone is shown in **fig. 2.** It is to be seen that in the 'flat' position there is a mild bass loss and a more significant high-frequency loss, but this is not serious. So far as the bass correction is concerned the frequency response of the *ES615* microphone is shown in **fig. 3.** Sensibly, this is a mirror image of the low-frequency correction curve, but shows some boost in the 3 kHz region which would not appear desirable.

Overall frequency response of the analyser at the onset of the extinction of the lower led indicators is shown in **fig. 1** with and without the roll-off filter. The performance in both cases is very accurate having regard to the method of indication used and the requirement to adjust the level of individual bands during factory alignment. Similarly, the level at which the high-level led indicator operated in relation to the low-level led and thus the size of the frequency response envelope was of interest. This was checked for the 1 and 8 kHz filters at various control settings as shown in **table 3.**

TABLE 3

Control setting	Actual level difference	
	1 kHz filter	8 kHz filter
2 dB	+1.4 dB	+1.7 dB
3 dB	+2.3 dB	+2.8 dB
6 dB	+5.1 dB	+5.1 dB
9 dB	+8.1 dB	+8.6 dB
12 dB	+10.4 dB	+10.8 dB

Although the performance is not outstandingly accurate, it is quite adequate for many applications and does at least err in the right direction such that the analyser will be pessimistic.

Conclusions

While this Shure analyser has a very good pink noise source, the analyser section is adequate for the equalisation of public address and other sound systems where the final accuracy is not required to very close scrutiny. The analyser is very simple to operate and quite usable by relatively unskilled personnel, thus this system could well be very good for use with home entertainment systems and less critical studio applications. Furthermore, it can well be used for the alignment of tape recorders and disc systems where the ultimate in accuracy is not required, and indeed given pink noise test tapes and discs complete reproduction systems can be very rapidly checked. ■

PHILIPS

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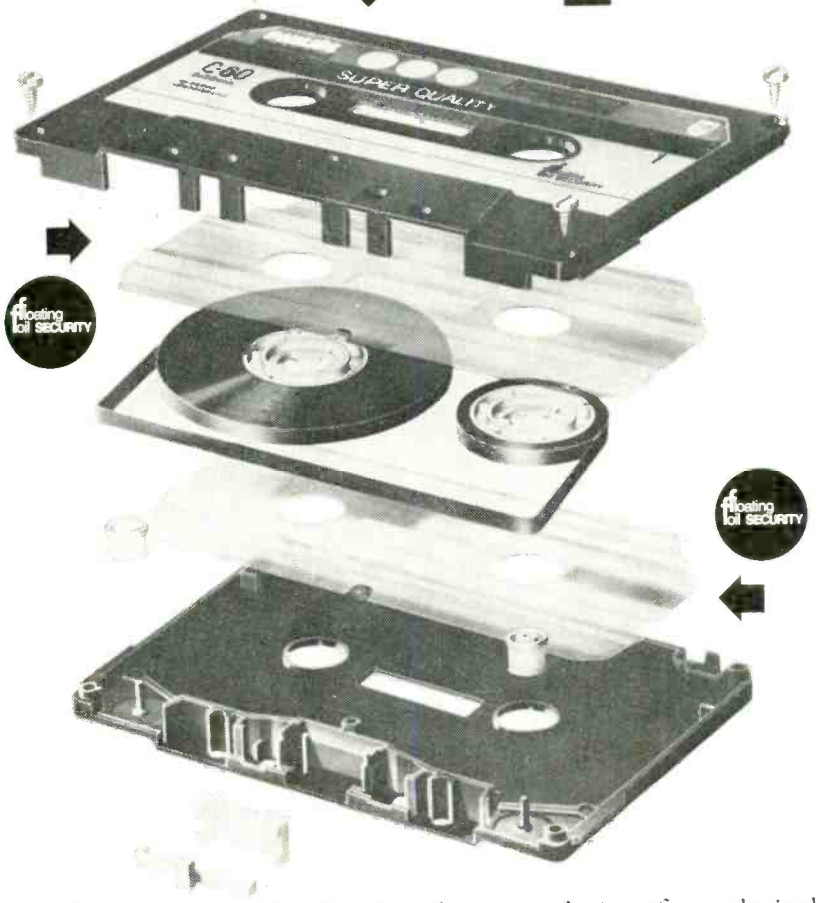

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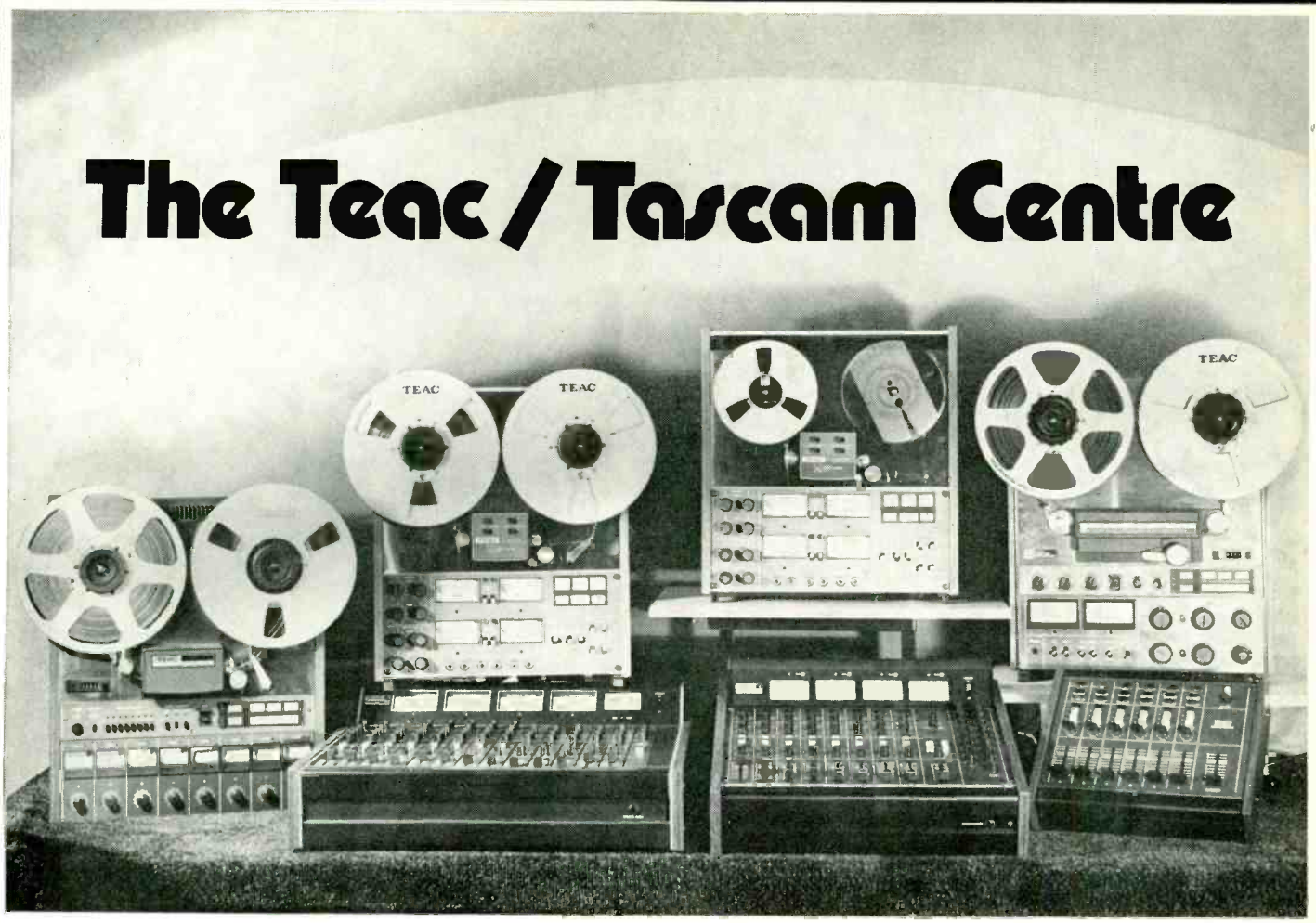

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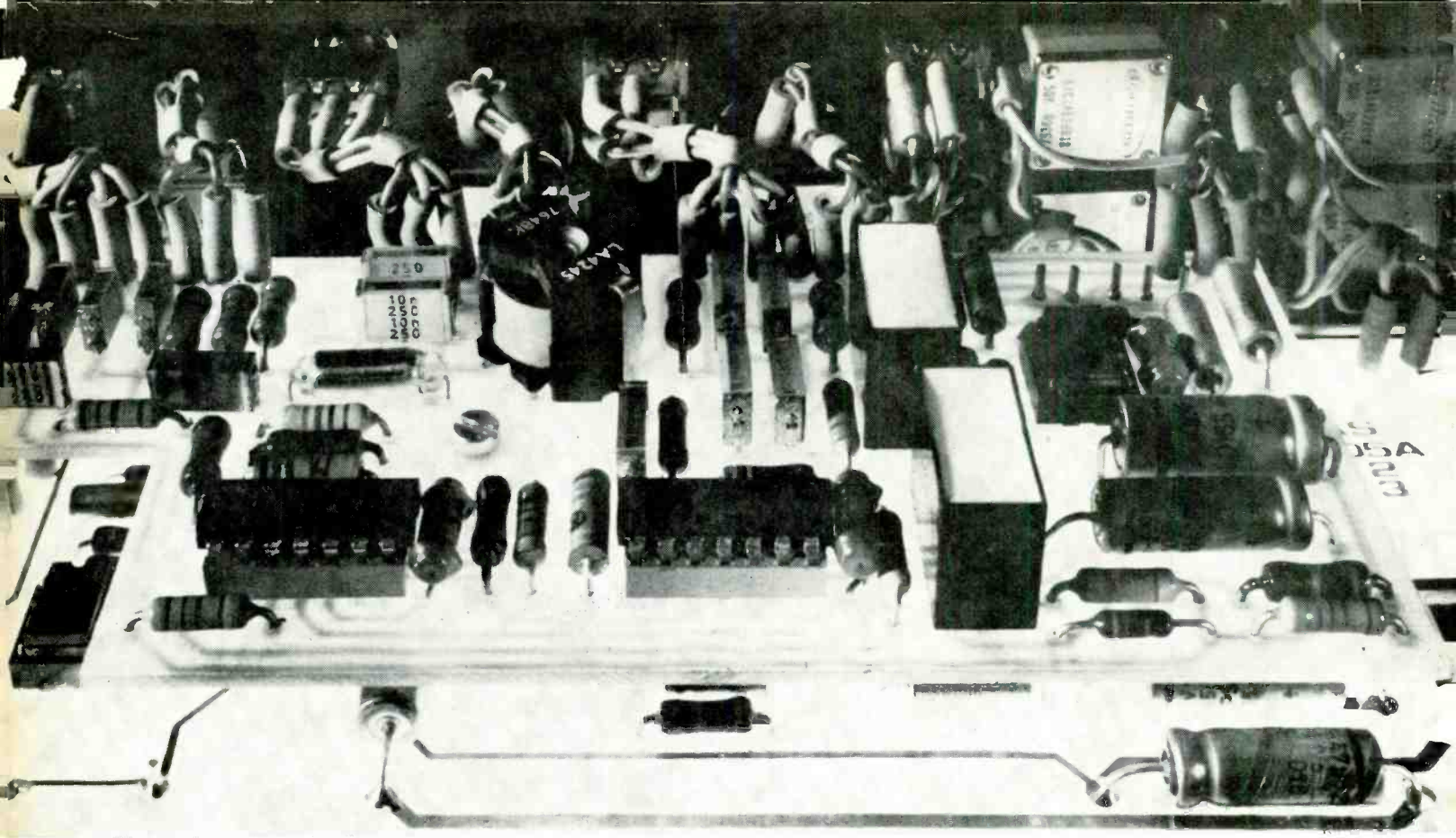

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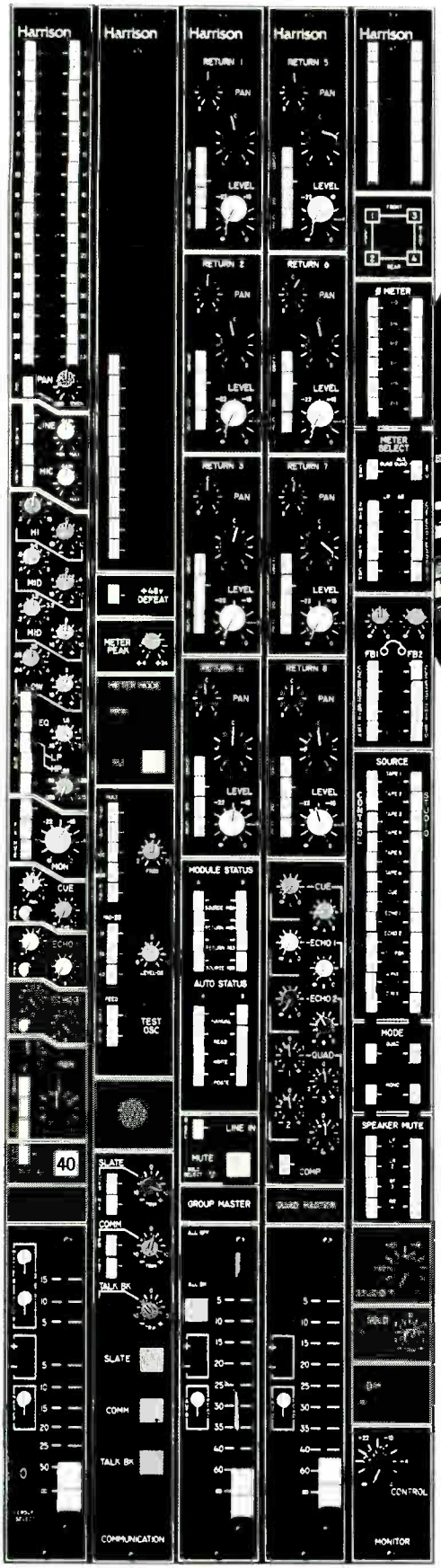

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