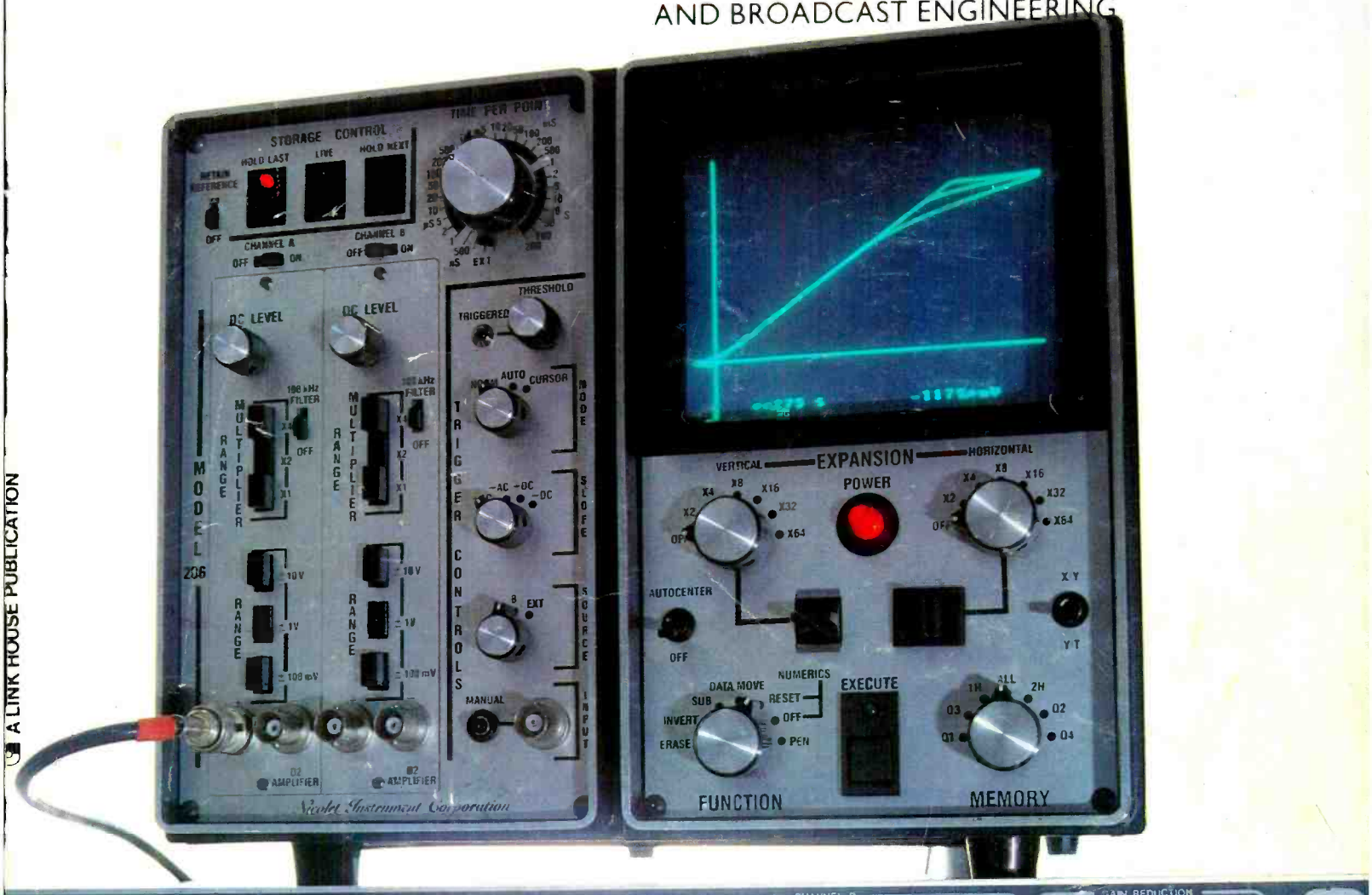
March 1981 £1

studio sound

AND BROADCAST ENGINEERING

A LINK HOUSE PUBLICATION



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A LINK HOUSE PUBLICATION

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studio sound
AND BROADCAST ENGINEERING

Undercutting whose interests?

I'm not so sure about the situation in the US, but I know very well that there is a sad lack of work for freelance engineers in the UK. The reasons are obvious: many clients are tending to use house engineers because they can't afford the cost of studio time *plus* freelance rates for an outside engineer (obviously, you can't give your studio time away at a much cheaper price because your engineer is now sitting around doing nothing and you still have to pay him). So I guess, a number of engineers who would have gone freelance had they reached this stage a few years ago are staying in their 'home' studio and with any luck are getting promoted to chief engineer or studio manager. And there's no harm in having creative people in the hot seat rather than let the accountants run everything (as long as they can talk to each other).

There being so little freelance work around, it does rather annoy me when I come across some engineers who are heavily undercutting the usual rates for this kind of work. It may be an even greater problem in the US, where there seems to be far more freelance engineering going on. It must be very easy, if you're making your real money elsewhere, to do an album or two as a freelancer at a rate far lower than the price the professionals need to charge to live. It may be easy, but it may force a lot of the true professionals out of business. Of course the top-league freelance engineers will not suffer in this way, but those engineers who are still making their mark in the industry may be driven out of it, and that doesn't bode well for the future.

It would be a good idea, therefore, if we could organise some kind of standard minimum rate for freelance engineering (no, don't throw up your hands in horror!). Obviously the 'top people' will go out for far more than this, and that's fine. But a *minimum* rate, whilst at first sight looking as if clients would end up paying more, would ultimately make it possible for new talent to survive in the freelance world without being driven into bankruptcy. Undercutting isn't just a bad thing for those of us who don't get the work: it's a bad thing for the future of our industry as a whole.

Forward into the past . . .

This year sees an important anniversary in the audio world: in a few months time we'll be commemorating 100 years of stereo sound reproduction, with an interesting article on the man who started it all by transmitting the Paris Opera via telephone lines to the 1881 Paris Exhibition. Starting this month, therefore, we will be running a series of more philosophical articles from a number of contributors on the direction the audio industry is taking, and the basic philosophy of recording and reproducing sound. Many of these articles will be quite controversial and will challenge some of the basic assumptions we make in modern multitrack recording techniques, and we hope that many of you will be prompted to write to us with comments on the points raised, and hopefully contribute articles to the discussion yourselves.

In a similar vein, we are getting together a series of articles on New Technology in the studio. In this series, we want to examine not only the technical aspects of console automation, digital recording, reverberation and the like, but also what they are like to use, and give some pointers on how to get the best out of such systems. We'd like you to help us in this: if you have any comments on the design, use and so on of these new systems, please get in touch with us as soon as you can, whether you're a recording engineer, designer or manufacturer. We'd like to hear from you, be it a letter or a 3000-word feature article.

Richard Elen

Cover of ADR compressor limiters by Adrian Mott

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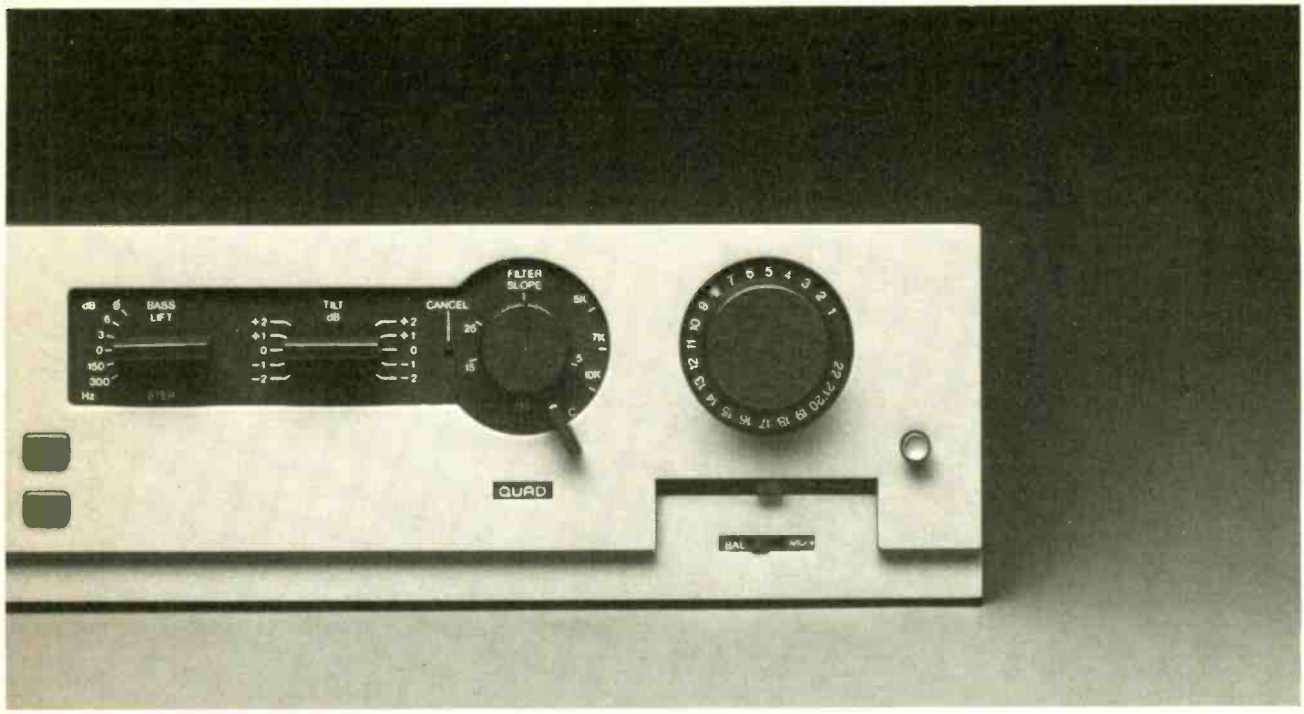

If everything were perfect...

It is rarely necessary to have to boost the bass response of a top quality high fidelity system, (although the Quad 44 tilt control does enable subtle changes to be made to the overall balance of the programme), but there are a number of high quality loudspeakers on the market, which because of their Lilliputian dimensions, necessarily have attenuated low frequency response and the Quad 44 is fitted with a bass control which in the lift position provides optimum equalisation.

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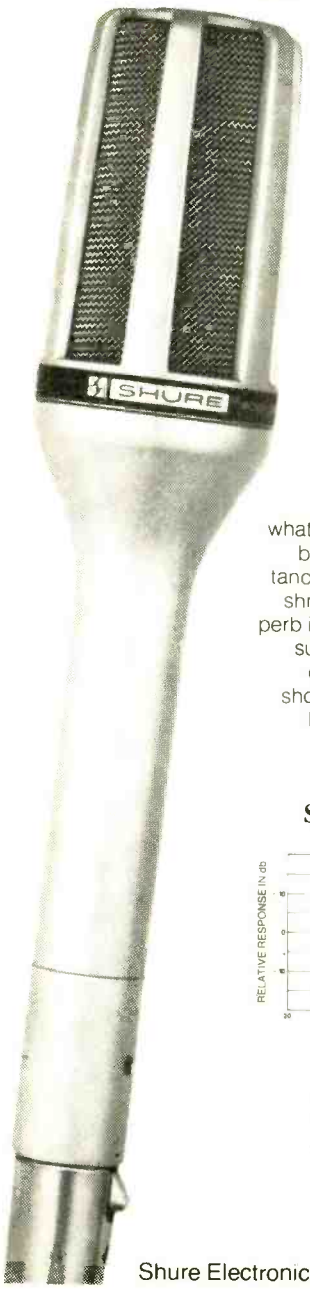

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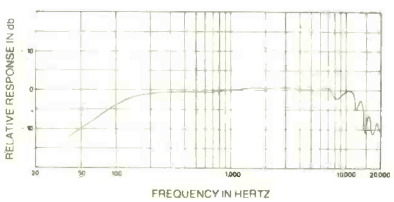

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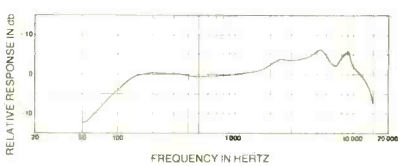

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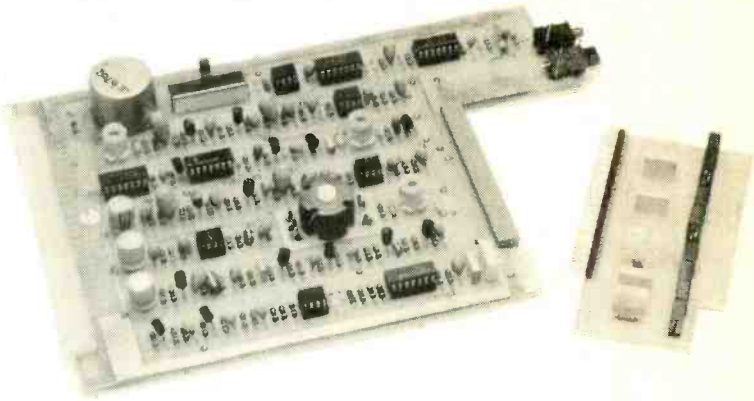

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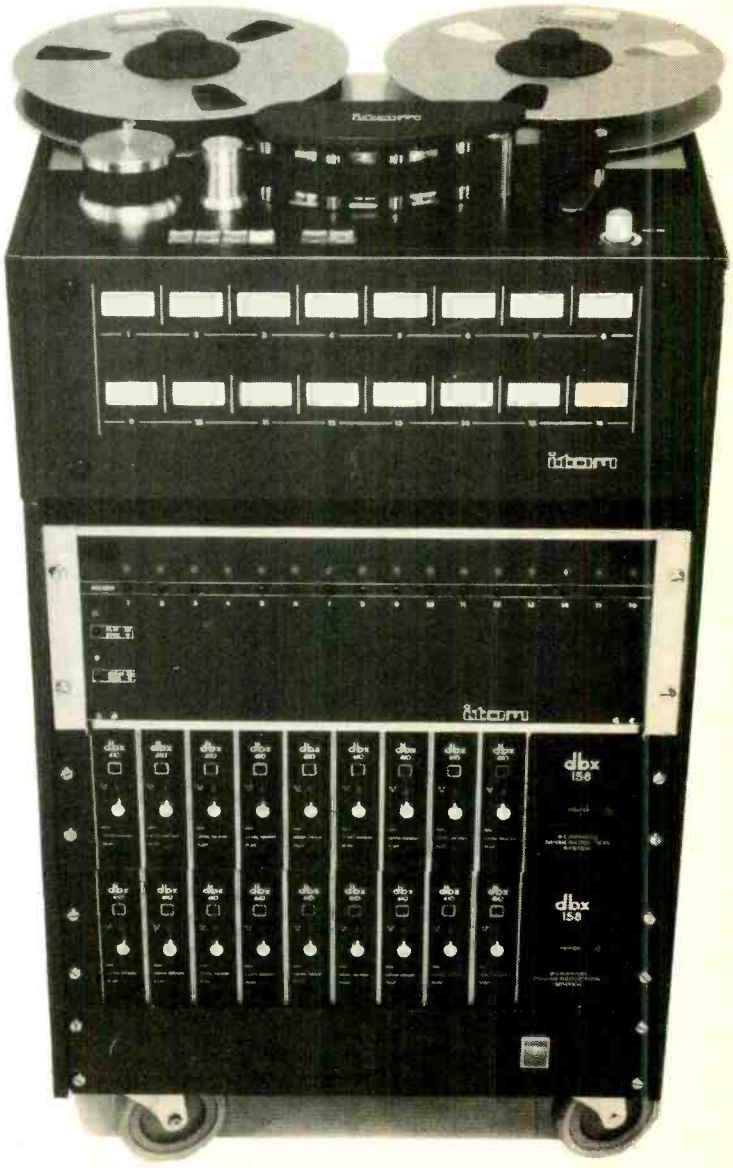

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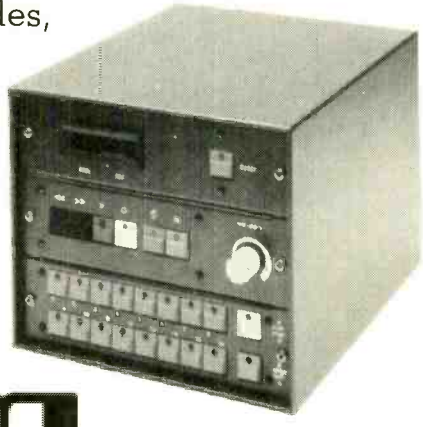

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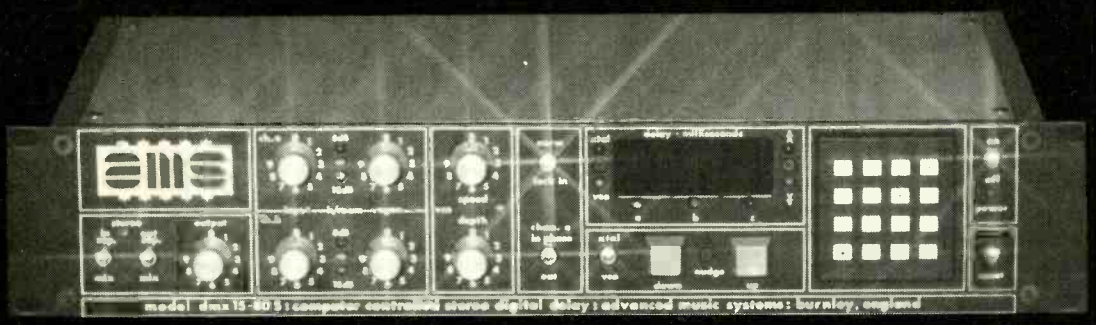

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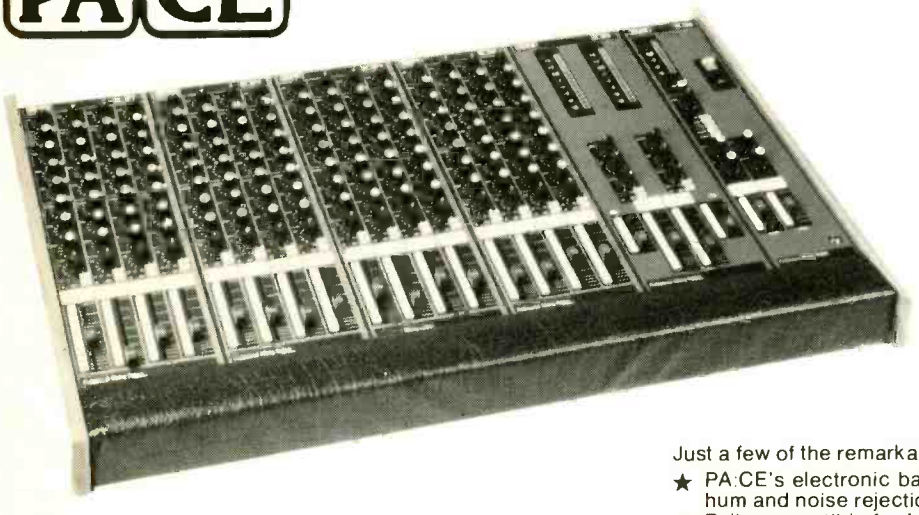

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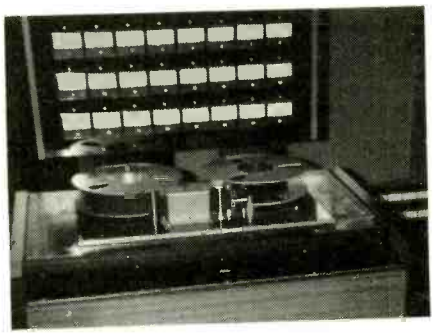

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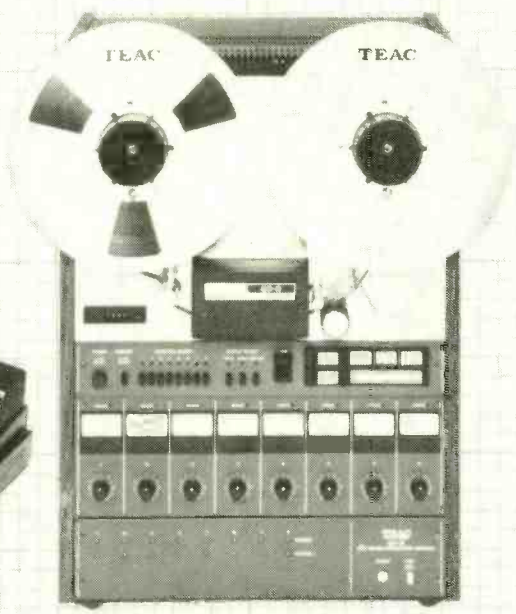

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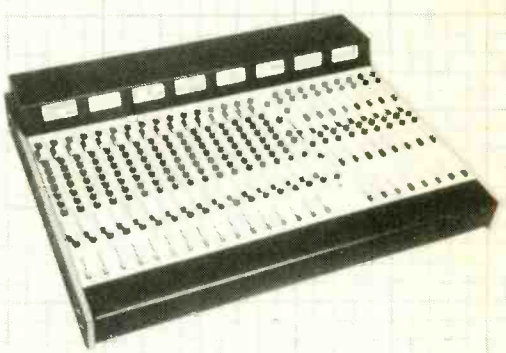

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news

KS Search – Recorder

A new Danish company, KS Technic, has introduced a novel unit termed the *Search-Recorder,* this comprising a conventional tape recorder remote control unit with the additional facility of a search mode. Nothing unusual about that you might think, but the method of operation certainly is. To facilitate the search mode, the reverse side of an open reel tape is coded such that any location on the tape (up to 99 different locations) can be searched out with an accuracy of less than 2mm and without any friction wear to the tape heads.

As can be seen from the accompanying photograph the unit has conventional tape-run mode controls with LED indicators allowing ordinary playback and recording to take place independent of the search points. The additional search mode which automatically searches for the programmed location also has an LED indicator which when extinguished indicates that the recorder is ready for play. Further features of the unit include LED digital display of the programmed location with separate LED indication of when a selected location has been reached; 'up' and 'down' locator keying selectors; an APS (automatic play-stop) key which stops a recorder automatically in the playback mode at the next tape location; and a POS key which when pressed indicates the position of the tape on the digital display. Other features include a rear panel socket allowing remote control of start (ie facilitating remote start from a mixing console).

The KS *Search-Recorder* is supplied as a standard type to accompany the Revox *B77* recorder, but is suitable for use with almost any logic controlled tape machine.

KS Technic, Hybenvej 12, DK-2830 Virum, Denmark. Phone: 01 78.32.60.

Kemps 1981 yearbook

Kemps International Music & Recording Industry Yearbook 1981 is now available. Format of the yearbook follows the established Kemps style with sections covering broadcasting, concert halls, PA equipment and services, recording studios and studio equipment and service suppliers, record companies, and general music industry services, plus an international section. As a handy reference work the yearbook is invaluable.

Kemps Publishing Group, 1-5 Bath Street, London EC1V 9QA, UK. Phone: 01-253 4761.

Clyde Electronics

A new company operating in the field of broadcasting turnkey systems is Clyde Electronics Ltd. Evolving from the engineering department of ILR station Radio Clyde and operating from the same premises, the company is managed by John Lumsden—a figure well known to readers for his editorial contributions to *Studio Sound*—assisted by Phil Collins, formerly with Wayne Kerr, Alice (Stancoil), and Helios Electronics.

The majority of the company's staff have been actively involved with the day to day running of radio stations and Clyde Electronics now handles the maintenance of Radio Clyde's technical equipment. This arrangement provides the company with an ideal testbed for new products and technology, giving excellent feedback of operational requirements.

First project for the new company was the supply, installation and commissioning of all equipment for the new ILR station covering the Dundee area, Radio Tay. For this installation a range of products was designed and produced by Clyde including a station/transmitter interface unit; peak limiters; an automatic sequential monitor unit; a modular distribution amplifier; PPM and line-up oscillator; and fault condition, on-air and cue indication systems. Future products are likely to include a new concept in broadcast consoles. In addition to the aforementioned services Clyde can also supply mobile recording and OB vehicles.

Clyde Electronics have also recently been apponted as UK consultants to ITC the broadcast cartridge machine manufacturers, and in conjunction with UK distributors FWO Bauch, Clyde are making a number of modifications to the well respected *3D* triple stack unit to make it more suitable for ILR use.

Clyde Electronics Ltd, Ranken House, Blythswood Court, Anderston Cross Centre, Glasgow G2 7LB, UK. Phone: 041-221 5906.

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Sennheiser HD222

For situations where the much respected Sennheiser *HD414X* open headphone is unsuitable due to external noise, Sennheiser has introduced a new dynamic closed headphone with similar characteristics. Termed the *HD222* the new headphone utilises samarium cobalt magnet drive units with light corrugated disc diaphragms. Designed for low distortion and wide range reproduction, the headphones retain the company's characteristic lightweight and modular construction principle. Cost of the *HD222* is in the region of £33.

Hayden Laboratories Ltd, Hayden House, Churchfield Road, Chalfont St Peter, Bucks S19 9EW, UK. Phone: 02813 88447.

Space Station loans

Ursa Major are to loan *Space Station SST–282* digital reverb systems to five American universities. Students will research the systems during a term and then report back to the company what they have learned about reverberation and signal processing.

Survey correction

In our January survey of mixing consoles we stated that the UK agents for Perfectone were Future Film Developments. This is incorrect.

UK agents for all Perfectone's products are Bell & Howell Ltd, Alperton House, Bridgewater Road, Wembley, Middx HA0 1EG. Phone: 01-902 8812. Telex: 26178. Our apologies for the error.

IBA standards

A useful new publication from the IBA is its 13th Technical Review which details the IBA standards for television and local radio stations. Covering operational practices, signal paths, OB radio links, tape recorders and reproducers, signal sources, acoustics, and broadcast systems operational requirements; the new publication defines the technical requirements applicable to studio centres and outside broadcasts. Copies of the publication are available from the Engineering Information Service, Independent Broadcasting Authority, Crawley Court, Winchester, Hants SO21 2QA, UK.

Whirlwind Constrictor

Whirlwind has introduced a new type of instrument cord called the *Constrictor* which combines the neatness of retractile cords with the freedom of movement offered by straight connecting leads. The new lead which combines 10ft of straight cord with a 20in coiled section giving an overall length of over 20ft, is manufactured from Belden cable, with a Whirlwind Ultra Snake plug at one end and a Switchcraft right-angle jack at the other.

Whirlwind Music Inc, PO Box 1075, Rochester, NY 14603, USA. Phone: (716) 663-8820.

UK: Atlantex Music Ltd, 34 Bancroft, Hitchin, Herts SG5 1LA. Phone: 0462 31511.

Edcor multiplex snake

Edcor has introduced the *Multiplex Snake* mic cable transmission system which will accommodate up to eight audio signals over a single mic cable. Using digital and analogue circuitry to create a timesharing encoded/decoded transmission system, transmission lengths of 500ft or to a maximum of 1,500ft can be achieved. The system uses either high quality mic cable or data cable consisting of two conductors and a shield. The standard system comprises an encoder and a decoder with the user supplying the connecting cable and two *XLR*s.

For cable runs of over 500ft user adjustable line compensation controls are provided on the decoder to match specific lengths and cable characteristics for optimum cross-talk/channel isolation performance. The system is available in two formats, either balanced mic line encoder and unbalanced decoder with *XLR* connectors, or unbalanced line level encoder and decoder with ¼in phone jacks. Either encoder can be used with either decoder.

Edcor, 16782 Hale Avenue, Irvine, Cal 92714, USA. Phone: (714) 556-2740.

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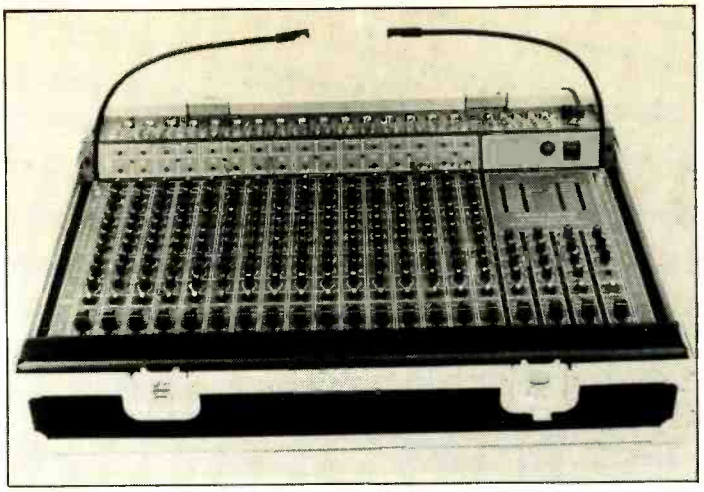
equipment. Known as *Quicknobs*, the range is manufactured by DT Electronic AB of Sweden, and comprises knobs formed from a plain or knurled sleeve and a locking cap. The knobs can be push-fitted on to a shaft in seconds and where necessary can be dismantled with stripping pliers or non-chamfered side cutting pliers. Standard knobs are black with options of graduated flange, directional or positional arrow on flange, and positional arrow on cap. Other sizes and colours are available to special order.
Selectronix Ltd, Tower House, Lower Kings Road, Berkhamsted, Herts HP4 2AB, UK. Phone: 04427 74973.

H & T catalogue

H & T Components has produced a shortform catalogue covering its new range of IDC connectors. Electrical and mechanical details of all available components of the Hi-Tec family are included.
H & T Components, Crowdy's Hill Estate, Kembrey Street, Swindon, Wiltshire SN2 6BN, UK. Phone: 0793 693681.



Peavey PA console

Peavey has announced the introduction of its new *Mark III Series* of PA sound mixing consoles. Although eventually intended to include 12- and 24-channel mixers, the first Peavey console in this series is a 16-channel model. Features of the console include transformer balanced inputs with switchable 48V phantom powering; two independent pre-monitor sends; 4-band eq; two post effects sends; a PFL/cue button; pre and post fader send and return jacks on each channel; and LED status indication of normal or overload operation condition. The master section includes all the usual facilities plus the facility to blend the signals from the effects and reverb returns to both Monitor A and Monitor B. An additional feature is a sum output with its own transformer balanced line amp that yields a composite of both A and B mains.
Peavey Electronics Corp, 711 A Street, Meridan, Mississippi 39301, USA. Phone: (601) 483-3565.
UK: Peavey Electronics (UK) Ltd, Unit 8, New Road, Ridgewood, Uckfield, Sussex TN22 5SX. Phone: 0825 5566.

C-ducer prices cut

The C-ducer contact mic produced by C-Tape Developments Ltd (see *Studio Sound* page 32, June 1980) has been reduced in price. The battery-powered C-ducer is now priced at £44, while a 6-way C-ducer drum-kit system now retails at £299.

Annis Han-D-Kit

A useful kit to measure and eliminate magnetism in tape machines has been produced by American manufacturer R B Annis. Known as the *Han-D-Kit* the package comprises a pocket magnetometer, magnetic test strips, hand demagnetiser, clip-on extension probe to reach inaccessible components, and a comprehensive instruction manual which explains the causes of magnetism with reference to tape recorders, how to measure it accurately, and how to eliminate it. The pocket magnetometer measures residual magnetism levels in tape heads, drive capstans or tape guides and is calibrated in gauss. The hand demagnetiser which has a 2in probe provides a sinewave demagnetising field strength of over 350 oersteds.
R B Annis Co, 1101 N Delaware Street, Indianapolis, Indiana 46202, USA. Phone: (317) 637-9282.

Agencies

● Cetec International has announced that its *Gauss* loudspeaker range is now to be distributed in the UK by HHB Hire & Sales, Unit F, New Crescent Works, Nicoll Road, London NW10 9AX. Phone: 01-961 3295. Telex: 923393.

● Ampex has concluded an agreement with ACI/Filmways Pro Audio Sales for the company to market the Ampex *ATR 116/124* and *MM1200* multitrack tape machines.

● Aphex Systems has signed an agreement with AKG Acoustics for the latter to market Aphex and B & B Audio products in Austria, West Germany, the UK, Africa and Eastern Europe.

● Future Film Developments have been appointed sole UK distributors for the Stellavox range of portable recording equipment.

● Trident Audio Developments has reached an agreement with Melkuist Automation Systems to distribute the company's dual floppy disk based, mixing console processor on a worldwide basis through existing Trident dealers.

● Advanced Music Systems has appointed Audio Consultants, 9th Floor, Kai It Building, 58 Pak Tai Street, Kowloon, Hong Kong; and Auvi Private Ltd, Unit 5-316, 5th Floor, Merlin Plaza, Beach Road, Singapore 0719 as its latest Far East representatives.

People

● Wallace Johnson, executive director of the Association for Broadcast Engineering Standards (ABES) is to receive the NAB 1981 Engineering Achievement Award. Mr Johnson was previously head of the FCC broadcast bureau.

● San Francisco's Automatt studios has appointed Michelle Meisner as its studio manager, and Susan Gottlieb and Maureen Droney as recording engineers.

● Tangent Systems has appointed Gary Bailey as its general manager. In addition Craig Olsen has been appointed national sales manager, while sales manager Thomas Scott will now concentrate on broadcast and overseas marketing.

● Robert Weirather has been appointed vice-president, engineering of Broadcast Electronics Inc.

Address changes

● Elliott Bros have moved to new premises at 9 Warren Street, London W1. The company also has a new telephone number: 01-380 0511.

● Harman (Audio) UK Ltd has moved to larger premises at Mill Street, Slough, Berks SL2 5DD. Phone: 0753 76911.

● RABIT, the studio construction company, has moved to 4 The Crescent, Westmead Road, Sutton, Surrey. Phone: 01-642 0139.

● Richard Swettenham Associates is now located at 38 Mount Pleasant, London WC1X 0AP. Phone: 01-837 5873.

Contracts

● Singleton Productions of Barcelona, Spain has supplied Estudio Escorpio, Madrid with an MCI *JH 636* automated 36/36 console.

● Eastlake Audio have completed a quality assessment room for Philips Research Labs in Eindhoven, Holland. The room is a conventional control room without tape machines which looks on to a 'studio' housing sophisticated computer equipment and will be used for subjective assessment work in connection with Philips' consumer electronics digital audio development programme.

● Trident has concluded a contract with Swedish Lokalradio AB, Stockholm, to supply a *Series 80* console modified for broadcast usage. Further broadcast consoles are likely to be supplied over the next 18 months. Other Trident contracts include a 48-input *TSM* console with *Fadex* automation for Master Sound Productions, New York; a 40-input, 32-monitor *TSM* console for Sound Stage Studios, Nashville; and a *TSR* tape machine for Eddie Hardin Recording Studios in the UK.

● Solid State Logic has installed a *4000E Series* console with *Total Recall* at RCA Studios, Mexico City. A similar installation has been fitted in a new mobile for Danish Radio, Copenhagen. Additionally the new BBC Manchester network production centre has received a *4000E* 32-channel console.

● Advanced Music Systems has supplied the BBC with a further 13 stereo DDLs bringing its total to in excess of 30 systems. Other recent contracts include *DM-DDS* disc mastering systems for Strawberry Mastering and EMI Abbey Road in the UK, Frankford Wayne in New York, and Tonstudio Bauer in West Germany; stereo harmonisers for ABC Television; and stereo delay lines for Walt Disney Productions, Los Angeles. Recent live concert users of AMS harmonisers and DDLs include Yes, the Police, and Genesis.

● Melkuist is to supply London Weekend Television with a *GT800* console automation system to be installed in a 36-channel custom built video dubbing console supplied by Neve. The equipment, for LWT's new No 2 sound dubbing suite, will also include an event control unit capable of controlling 32 simultaneous on/off events at up to 150 different points in time.

● Quad-Eight is to supply The Palace of The Arts in Sofia, Bulgaria with two custom *Coronado* console systems incorporating the company's *Compumix III* automation system. ■

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studio diary

Berwick Street, London — a renaissance

No, the GLC have not announced a multi-million pound scheme to close down Berwick Street market, move it to a custom-built site in Battersea and open up a (modern?) market in its place. The rebirth in question quietly took place during the middle part of 1980 behind the unchanging exterior of 8 Berwick Street — or more precisely, Berwick Street Studios.

Sue Manning and Don Boyd originally conceived the idea back in 1975 when a 24-track facility was opened up to cater for the proprietors' film contacts and the small ad agencies in the area. The studio thrived on a mixed diet of new talent, jingles demos and short films and among its many claims to fame was the mixing of *The Secret Policeman's Ball* by house engineer John Middleton.

For the uninformed, Berwick Street (well-known for its daily street market) runs parallel with Wardour Street joining Brewer Street and Broadwick Street, in the middle of London's Soho district. As with any Soho studio, amenities in the area are excellent, ranging as they do from the fresh fruit and veg right outside the door through a veritable plethora of restaurants, hamburger and snack bars to, of course, the usual fair smattering of pubs. After 6pm the street market closes affording excellent access and parking facilities around the studio. That is not to decry daytime access though, which is handled from Wardour Street through an adjacent alley, Tyler's Court.

On the ground floor are located the comfortable and extremely airy reception area and lounge/kitchen equipped with constant coffee and microwave facilities. Also, looking out over the busy street trading scene, is the office of new studio manager Denny Bridges (of AIR Studios, London and Montserrat fame). Denny is charged with the managerial development and administrative duties of the studio and perhaps the occasional emergence from 'retirement' to engineer the odd special project. Other 'staffers' at Berwick Street are John Middleton, already mentioned, and tape op Cheryl Nicholson although freelancers are, of course, very welcome.

View from the Steinway grand into the control room

Downstairs lies the business end. The control room, which was completely refitted by Rabit, is about 270sq ft and incorporates an impressive array of equipment. The original Helios board has been extensively refurbished and further customised by Peter Smith of S & P Audio, who also calculated and oversaw the new acoustic refit in both the control room and studio. The aim has been to create a fairly natural sound using wall-mounted absorption boxes, fully carpeted floor and ceiling mounted panels.

Tape machines in use are Studer *A80* 2- and 24-track and two *B67* 2-tracks. The 24-track comes complete with remote and autolocate. Auxiliaries include Audio & Design Recording *Compex* limiter and *Vocal Stresser*, *SCAMP* gates, noise filters, compressor/limiters and auto panner, AMS *15-80* delay and tape phase simulator, Eventide delay/*Instant Flanger* and Helios parametric eqs, UREI limiters, Dolby noise reduction and Klark Teknik graphic. Reverberation is via two EMT *240 Gold Foils*.

The Yamaha *FX1* monitor speakers deserve a mention, being the first pair in the UK. They are rapidly gaining in popularity in US studios but have yet to take off in the UK (perhaps the turning point?). Also available are Yamaha *NS1000*s and *Auratones*. Amplification for the *FX1*s is HH *V500* MOSFET, Yamaha *B1* amps on the *NS1000*s and *Auratones*.

The studio itself is about 970sq ft and one's eye is instantly taken by the Steinway concert grand lurking in the corner. Mood lighting and air conditioning are installed, as are half- and full-height acoustic screens and the usual scattering of chairs, mic stands and music rests. At a pinch the studio capacity is probably about 20 (tidy?) musicians, although heavily-equipped bands would reduce the number by about 50%. Microphones are Neumann *U87*s, *FET 47*s and *KM84*s; AKG *D12* and *D190*; Sennheiser *441*, *421* and a Beyer *160*. Foldback cans are Beyer *DI100*s. Connection with the studio is through wall-mounted multiway boxes, a foldback distribution box and DI boxes.

Asked to comment on the studio philosophy, Denny Bridges said "The thing we have to offer above all, is that we are professional people with professional equipment offering a small, intimate facility where people can get on with the process undisturbed. What we are trying to offer people is the ability to buy a day's studio time and get a day's worth of work out of it."

Although the studio only re-opened on August 26, some indication of the success of the refurbishment can be gained from the fact that they have already attracted a lot of interest with Nick Rowley from Noise Music in laying down and mixing jingles for Saatchi and Saatchi, Paul Hart with Joe and Co, and Cambar Productions and Nick Rowley again with Brian Protheroe. Bookings at the moment are also looking reasonable with the anticipated general revival of studio fortunes gathering pace.

Berwick Street Studios, 8 Berwick Street, London W1V 3RG, UK. Phone: 01-734 5750. **Harry Mangle**

Ricordi recording studios, Milan

One of the big names in international publishing as well as one of the Italian 'majors', Ricordi (Dischi) Spa have their studios in one of the more industrial suburbs of Milan. Situated in a quiet side street, conveniently near a tram stop, traffic noise does not present a problem and the building possesses adequate parking facilities. The actual building houses quite a complex of studios but as large renovation plans are in the process of being finalised for most of the rooms, it was decided to confine this report to the main studio that is used for pop, hit parade and rock sessions. My hosts for the afternoon were chief engineer Walter Patergnani and engineer Carlo Martenet, who also served as interpreter!

The main studio is on a 'one up—one down' basis, with access via the studio itself. Due to the high ceiling the studio looks smaller than it is and fifteen musicians can get themselves in there without feeling the pinch. While being quite functional in appearance, the use of soft colours in the furnishing materials coupled with variable 'mood' lighting, makes for a pleasant working atmosphere. Being fairly irregular in shape, the room also gives good results acoustically. As well as the carpets on the studio floor there are two isolation booths along the far wall—with reference to the control room—with one specialising in drums and the other for vocals, guitar, bass, etc. Again the usual fair collection of instruments at disposal including a Hammond *C3/Leslie* and Steinway grand piano. There is also quite an impressive array of microphones available with Neumann *U47*s, *U67*s, *U77*s and *U87*s (whatever happened to the 57?), Schoeps, Siemens valve condenser mics, Beyer, Sennheiser, PML and AKG *221*s and *C12*s. Quite a choice.

The wall that contains the control room window also supports the steps leading up to that same room, which for the sake of convenience we can consider as being on the first floor. Though there is a good view of the studio from up above, the control room is turned through 90° so that the musicmakers can get on with musicmaking and the recordists on with recording! The room itself is not exactly what you might call symmetrical, both in floor plan and ceiling, but the final result seems to turn out alright so why worry? The main acoustical treatment consists of various acoustic tiles, panelling and panel absorbers, giving a low reverb time and pulling out troublesome resonances, although with the shape of the room, the latter should not be any problem! As a hangover from the fever days of quad, the room is dominated by four immense custom built speakers using RCF components. However, these are now rarely used, having ceded their place to a pair of JBL *4343* speakers that are bi-amped by HH *500D*s and

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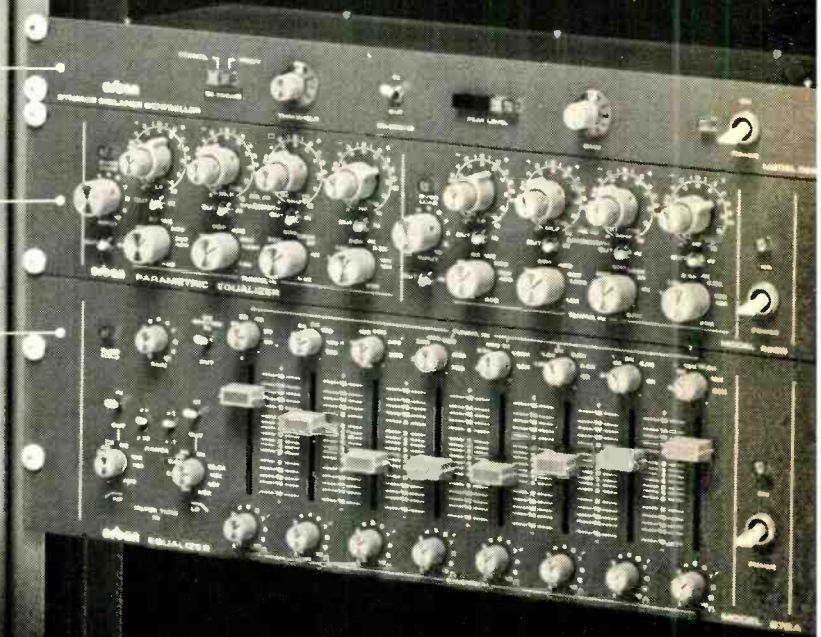

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Piero Bisleri 'fades' at the Telefunken desk

Durium recording studio, Milan

For those of us who were habitués of the Soho Record Shop or who had girlfriends who liked continental records in the sixties, the name of Durium must spark off a few memories. In those days the name was synonymous with Italian films, songs, sun, etc. However, before all the nostalgic rush off to the pub to cry in their beer thinking of the good/bad old days, let me reassure you that Durium are alive and well at the start of the eighties and that I was able to pop in and see them during my walkabout in Italy.

The studio is situated fairly well away from the city centre and off one of the main roads coming into Milan, being in the lower level of a block of buildings set back from the road. Access is by a short service road leading down into the studio and past the security gates. The studio itself is exclusively for artistes on the Durium label and this includes people such as Dee Dee Jackson, Papetti and Nini Ropc. In the control room engineer Piero Bisleri was putting the final touches on a vocal overdub, and, pooling our resources of limited English and Italian, we were able to have a chat about the studio!

The control room could be described as small to medium-sized—depending upon what you are used to—and has a functional appearance. The room backs on to the entrance courtyard and has large windows which means that there is the choice between daylight or, if you draw the heavy drapes, electric light. I suppose in modern jargon that could be termed 'variable mood lighting coupled with variable acoustics'—the brighter the light, the brighter the sound! Hmm. The acoustic treatment consists of a mixture of acoustic tiles and slat and panel absorbers giving a short reverb time and quite an even response.

The equipment is all fairly recent, (1977) and is principally Telefunken, consisting of desk, *M15* multitrack and stereo recorders and a large cassette recorder. The rather large, to say the least, console is in a 24-24-24 configuration, with the groups and monitor section placed in the middle. Piero told me that this particular layout made the desk difficult to work with at times due to the physical distance between the two input sections and groups/monitors. Though the desk is classed as a 24 output model—which I suppose it is if you take the fact that each channel has its own direct out—the actual routing consists of 12 groups, with each group output paralleled up with two inputs on the recorder, ie 1/13, 2/14, etc, so that final track selection is determined by the recorder. The desk itself features very comprehensive eq and monitoring facilities and has eight auxiliary sends for the various duties that aux sends are called upon to do. Two Telefunken compressor/limiter modules are also built into the console as are four extra eq modules that can be patched in at will for those times when very precise equalisation is required. In order to keep everything within easy reach—and thus save rack space—all the outboard effects boxes are also built into the desk and these comprise two Dynacord *DRS78* ddls, two EMT *256II* compressor/limiter modules and one 156 stereo compressor/limiter/expander, four *Kepexes,* an Eventide *Instant Phaser* and two UREI ⅓-octave graphics. Just arrived and waiting to be installed were also a *Prime Time* and Publison stereo compressor. Apart from the size, Durium are very pleased with the technical performance of the desk and so far operation has been completely trouble-free. Monitoring is by JBL *4343* speakers that are bi-amped by BGWs and two common or garden speakers (Canton) are used for 'domestic' listening. Reverberation is obtained by an AKG *BX20* or EMT *140*. All tape channels are Dolbyed.

Access to the studio is either from the entrance lobby or the control room, giving free circulation to both engineer and musicians. The studio itself retains the same functional appearance and is large enough to take 40 musicians seated in comfort. The acoustics are quite lively with a fairly short reverb time, making it a good environment for strings, brass, etc. Isolation booths are in the form of little huts with one reserved for drums and the other for all-round use. Instruments available include Bechstein grand piano, large Hammond and Eminent organs, Rhodes and Clavinet. Microphones are mainly Neumann *U67* and *U87*, with a sprinkling of Sennheiser and AKG. The drums are largely miked up with Sennheisers.

Other facilities at Durium consist of a copy room and cutting room. The former employs the old Neumann 8-track desk from the early days which, still going strong, commands a collection of Telefunken *M10* and *M15* recorders. The cutting room employs a Neumann lathe with Telefunken recorders and at the time of my visit studio manager and engineer Ugo Scerbo was cutting a Boney M album for Italian release. Durium do a lot of cutting for releases in Italy, ie labels under their distribution, and this includes people like Boney M, Kiss, Donna Summer, Village People and even the Reader's Digest! As well as cutting, Durium also have a large pressing plant and this is one of the most important in Italy with a daily capacity of 20,000 LPs and 4,000 cassettes. Clients for pressing include names such as RCA, Ricordi, EMI, Phonogram, and K-Tel. It is also not uncommon to do cutting work for these.

Time to be getting along to the next appointment so I thanked Signori Ugo Scerbo and Piero Bisleri for a friendly welcome and interesting visit and was off for the next on the list.

Durium Recording Studio, Via Troya 7, Milan, Italy. Phone: (2) 470 778.

Terry Nelson

Ricordi, cont'd

equalised by UREI ⅓-octave graphics. Centrepiece of the room is a large L-shaped Cadac console in a 32-16-24 configuration, complete with four Cadac compressor modules and extensive patch-bay. Recording is on a Studer *A80* 24-track, complete with autolocator, *A80* 4-track, two *B62* stereo recorders and a Revox bringing up the rear. All recorder channels are Dolbyed. As with many other Italian studios, Ricordi showed itself to be quite a little treasure trove in the effects department having two Fairchild *663* compressors, two Pultec *EQP-1A3* equalisers, two Siemens filters and two Altec graphics of long lineage. Fairchild are also represented by their *659* reverb unit which has comprehensive equalisation as part of the control system. Though used mainly for creating special effects on instruments rather than just as straight reverberation, it is also popular for re-creating the ambience of earlier recordings as made in the '50s and '60s. Further echo facilities are in the form of EMT *Gold Foil* and *140* stereo, AKG *BX20*s and two natural echo chambers. Gain reduction equipment includes UREI *1176* limiters, *Gain Brains* and *Kepex* and EMT *256II* compressor modules, with sibilance control courtesy of Orban. Other toys for sound mangling include Orban parametrics, Eventide *Instant Flanger* and a Lexicon *Prime Time*.

Listening to some tapes that had been done recently and that were in the course of production showed that the studio gets a nice airy sound without too much clutter, while at the same time retaining a punchy feel to make it come out well over the airwaves. In fact clarity of recorded sound seems to be a general trade mark in the Italian studios where there is not so much of a struggle to get the last dB out of the tape. In passing I feel I should also mention that the control room (and, indirectly the studio) enjoys the benefits of daylight and that the flat roof, accessible from the control room would make an ideal sun terrace! Whether a roof garden café is on the cards is still a trade secret.

Other facilities officially visited were the copy room where four Studer *A80*s officiate with a battery of UREI parametrics and *1176* limiters plus EMT expanders should any tweaking be necessary. Ricordi also have a sizable cassette production room where they turn them out by the thousands, and all on Ampex tape.

Time will tell what developments at Ricordi are likely to be as until things are finalised it is being kept very much under the wraps. Still, it'll be a good excuse to go to Milan when the changes are made! Thanks to all at the studio for their friendly welcome and their time.

Ricordi Recording Studios, Via Barletta 11, Milan. Phone: (2) 539 2392.

Terry Nelson

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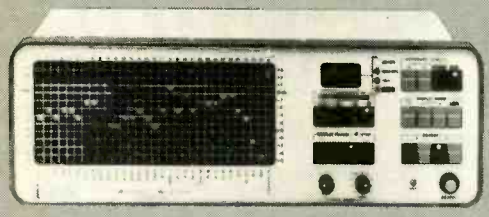

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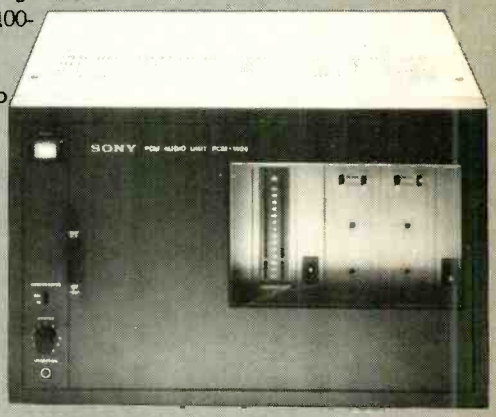

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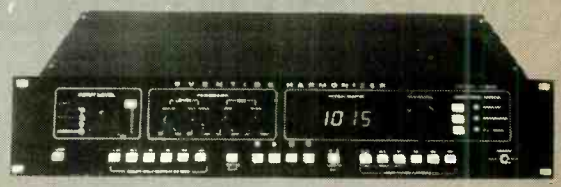

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Feldon Audio Ltd.,

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Penny Lane, New York

Commercials! Jingles! Can a recording artist find happiness in a studio built to produce 30- and 60-second paeans to bubble gum, airlines, and fast food hamburger franchises?

"Absolutely," says Alan Varner, studio director and chief engineer of Penny Lane Studios. Available for just over a year, this 24-track facility was built to service Radio Band of America, parent company and producer of commercials and advertising themes. Now it is attracting jazz and rock recording artists as well.

The studio is owned by Harley Flaum, president of Radio Band. As a writer and producer of radio spots, Flaum and his large creative staff have garnered 18 Clios and numerous other awards, some for work completed in the adjacent sound rooms of Penny Lane. Three years ago Flaum hired Alan Varner, formerly an engineer with Mediasound, to design a studio complex that would "be the best of all the outside studios we'd been working in."

Flaum's influence over the design of the space is manifest in the signed Al Capp seriographs on the conference room walls, an antique barber chair in the foyer, and church pews that provide random seating around the halls. In his bright office overlooking Avenue of the Americas he says the current slump in record production in the US has had little effect on a studio geared to so much internal production.

Studio A is roughly 25 × 35ft. The 'blonde' wood planking on the walls extends to the ceiling, where it is broken up into odd angles, irregular coffering, and weird trapezoid-shaped bass traps.

"I became really frustrated with the isolation in some of the newer studios I was working in, so I took the opposite approach," says Varner. "There's a lot of trapping in here but basically we were looking for a very live room that contributes to the music instead of soaking it all up."

Al Fierstein was the acoustic consultant and Maurice Wasserman was the architect for the space. Bass traps are distributed around the room and in some areas the 16ft ceilings are revealed unobstructed, like the nave in a small church.

Besides an unprepossessing drum kit, the studio has a Steinway piano and a small, single keyboard Rhodes organ. A row of guitars and basses lined up against the control booth window all belonged to company personnel—everybody there plays something. There are plenty of amplifiers, mostly Fenders and a variety of mics, booms and stands.

Clean and roomy, the control booth boasts a Trident *TSM* console, 32 in/24 out, with 4-band parametric eq. Monitoring controls are separate; it's a longer board but Varner says he finds it easier to work with. Any of the monitoring outputs can be converted to inputs in a mix, expanding the capacity to over 50 tracks if necessary.

The single 24-track recorder is a 3M *M79*. There are two Ampex 4-track machines and two 2-tracks for in-house advertising work. Because so much of the commercial music is scored for television commercials, a *U-matic* videocassette player is close at hand, and feeds into both a control room monitor and a secondary monitor on the studio floor.

It's a very basic setup, geared to the daily needs of Radio Band. Besides the ease of a computerised autolocator, few frills are provided beyond EMT and AKG echo systems and a lone ¼in tape machine. Everything else is rented from outside on a 'per-job' basis. There is no noise reduction system as Varner prefers not to use one. "I'd rather run at 30in/s at elevated levels, and avoid the headaches," he says.

The second studio is a 10 × 12ft space but its control room is nearly as big as the first. The Trident *Fleximix* is a 4-track console. Eventually it will expand to 24-track and will serve as an overdub and post-production room.

Both facilities are used daily for the production of jingles and advertising themes by Radio Band. The first recording artist to use Penny Lane studio was Aretha Franklin, for her album *La Diva*. Portions of the Manhattan's hit album *After Midnight* were recorded here, as was overdubbing on several cuts from a Brecker Brothers release called *Detente*. Steve Becker and Donald Fagin (Steely Dan) also booked time earlier in the year to 'try out' the studio, bringing their own engineer.

Twenty-four track recording is $200 per hour; time can be booked through studio manager Mandy Aimetti. Varner, as chief engineer, handles all in-house recording and most outside jobs as well, assisted by his two young 'discoveries' techs Brian Marine and John Terelle. His favourite sessions? Those with Stephen Bishop on the latter's latest album.

Varner says he's also excited about working with some new artists. A fledgling production company TSRP Productions, and a publishing firm, Seller's Music, are associated with Penny Lane. Both are taking advantage of an 'off' period in the industry to aggressively search for and develop new sounds.

One project nearing completion is three spec demos by David Roter, mastered and mixed by Varner and his associates.

"It's rock but it's a little unusual," Varner explains. "It's a little Randy Newman-esque—a little left field." The production of these experimental tracks will perhaps best indicate the direction of Penny Lane in the rock music area.

Commercials are still the company's bread and butter, and it's important to remember that Penny Lane was originally created for the jingle producers at Radio Band. At the time of my visit work in production included themes for television commercials and an entire radio campaign for Greyhound, the national bus service. There were also several in-house projects in the works. Like the David Roter demos, all are being completed at a leisurely pace.

"As the record business dropped off the commercial business has picked up even more," says Harley Flaum. He says this means less late hours and weekend work for his staff, but declines to crystal-ball the future of the recording industry.

"We've had a lot of calls in the past year from people with gold and platinum records under their arms who suddenly want to write commercials," Flaun continues. "Maybe this is a temporary situation, due to the state of the record business, but we're all hoping the record business has bottomed out and will soon be on its way up again." **Mia Amato**

Penny Lane Studios, 1350 Avenue of the Americas, New York, NY 10019, USA. Phone: (212) 687-4800.

Studio News

● Scenic Sounds Equipment has recently completed the installation of the world's largest Allison automation system for Jimmy Page of Led Zeppelin. The facility is based on the latest version of the Valley People/Allison *65K* programmer incorporating anti-dither circuitry and expander package. The programmer is interfaced with an API console and the 352 automation channels control all level, pan and equalisation functions.

Other recent automation up-dates using the Allison *Fadex* system include two retrofit systems installed by 3M France to 52 channel and 36 channel Plus 30 consoles installed at the Grande Armee Palais de Congres in Paris.

● British band Genesis are building a private multitrack studio in the depths of Surrey. The studio is equipped with an Amek *M2000A* 36/24 console, Studer *A80* 24-track and a full range of outboard gear. HHB are commissioning the new studio.

● Radio Hallam has re-equipped its commercial production studio with a Tweed Audio 28-channel custom production console. In addition the station has purchased a new radio car—a Range Rover fitted with a Studer *069* console.

● Ampex has presented a Golden Reel Award to Bob Seger and the Silver Bullet Band, for their platinum album *Against the Wind*. The album was produced in Criteria, Bayshore, Muscle Shoals and Capital recording studios.

● A range of budget recording services can now be provided by Y Studios at the YMCA in London. During the evening live broadcasts are made to students' rooms within the building but voiceovers for commercials, jingles and promotion and training tapes provide much of the studio's work during the day. Tape and cassette duplicating and editing can also be carried out.

Opened in January 1980, the control room houses an Alice custom 12/4 desk; Revox, Ferrograph and Teac mastering machines; and Tannoy monitoring. A 100sq ft speech booth has been recently completed and it is hoped that further development will include land line broadcasts to local hospitals.

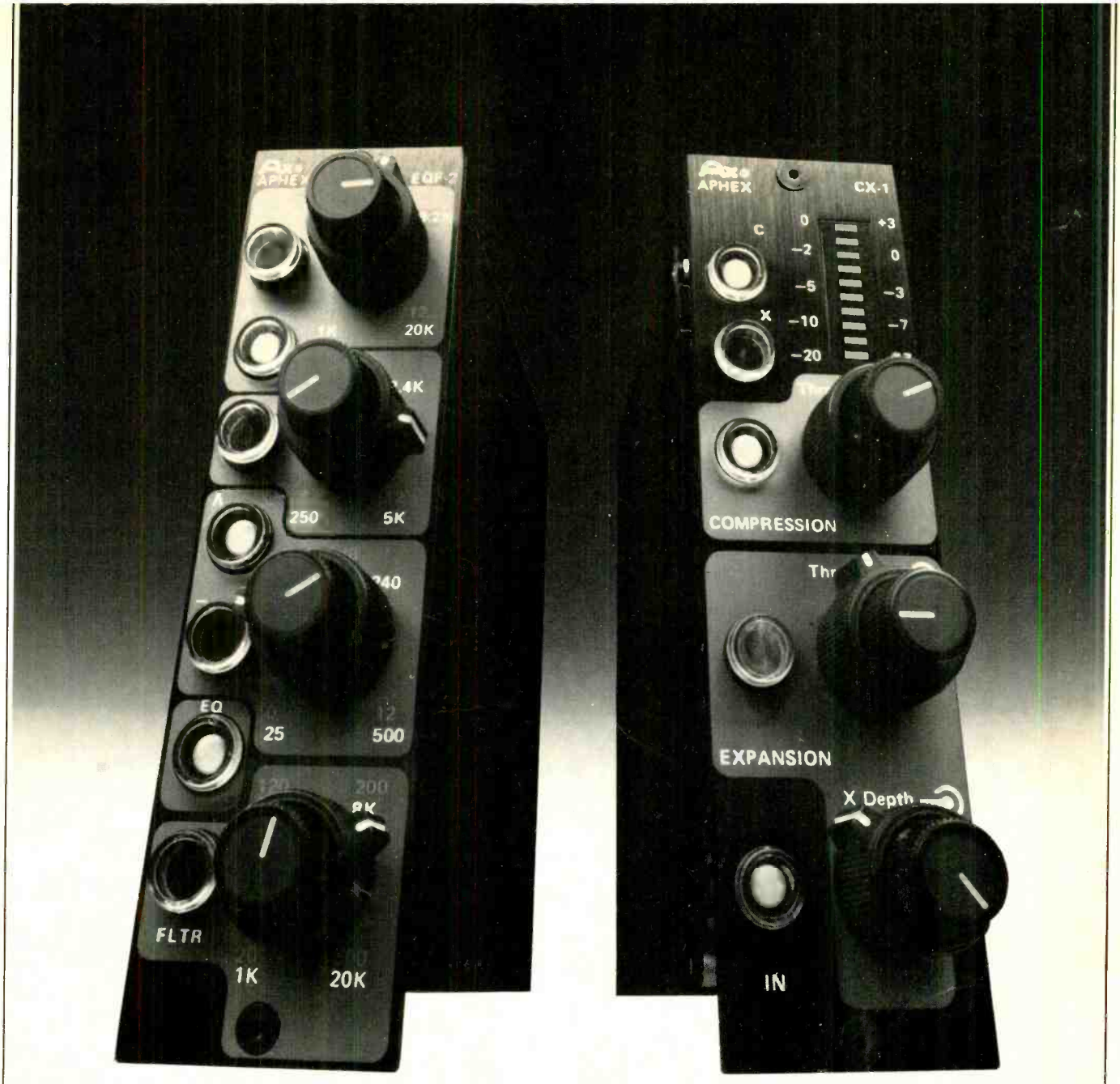
Y Studios, London Central YMCA, 112 Great Russell Street, London WC1B 3NQ. Phone: 01-636 7289.

● De Lane Lea, London has opened a new self-contained unit for the production of radio commercials and allied work. Operating under the banner Sound Centre Radio, the new studio is equipped with an Alice desk (7 stereo, 5 mono input), Studer and Revox tape machines, Technics disc unit, and Nakamichi cassette decks. Cart machines are from Cartridge Technology, while monitors are JBL *4311*s. The studio's recording booth is designed to accommodate up to four artists and is equipped with AKG mics and Beyer headphones. The new unit also has a transfer suite which in addition to cart and cassette machines is equipped with 16/35mm record and replay units.

● Advision, London has installed a Sony *PCM1600* 2-track digital recording system which was recently used to record Stevie Wonder's concert tour in the UK and which will result in the release of a digital album.

Other recently installed equipment includes a Studer *TLS2000 MkII* SMPTE interlock system and JVC *8500LE* U-matic recorder.

● Villa Recorders, Modesto, California, has taken delivery of a Studer *A80* 24-track tape machine and Ferrograph *Studio 8* mastering machine for their existing 24-track facility. ■



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letters

Noise measurement

Dear Sir, In his article on noise measurement in your November issue, Hugh Ford condemns the adoption of a 2kHz unity-gain frequency for CCIR/ARM noise measurements as 'commercial cheating' which he feels has no scientific justification.

For the normal purpose of comparing noise measurements made to the same standard it does not matter at all what frequency is chosen; there is certainly nothing 'right' about 1kHz apart from it being a convenient round number. There are, however, two other valid requirements to consider. Firstly, it is desirable that different methods of noise measurement should give about the same figures so far as is possible — they could for example be arranged to read the same on white noise. Secondly, it makes sense that a 60dB S/N ratio should sound like a ratio of 60dB, as is the case when IEC curve 'A' is used since this is based on subjective assessment of loudness. I therefore propose that ideally all methods of noise measurement should read the same on white noise as the IEC curve 'A' measurement.

The CCIR/ARM 2k method meets this requirement within about 1dB, so I believe Dolby Laboratories made the right choice for the wrong reasons when they stressed commercial acceptability. The official CCIR quasi-peak method yields figures 11dB higher, and I think there is a good case for it being revised. Dolby Labs have suggested that the quasi-peak circuit should be redefined to read 11dB lower, but this does not make sense as the same meter is normally used to measure signal as well as noise. I would like to see the weighting curve dropped by 11dB (0dB at 5kHz would be about right) and both 2k/ARM and 5k/Q-Pk methods adopted as IEC standards with the recommendation that they be regarded as interchangeable except on impulsive noise sources such as radio links and telephone lines. If this were done, equipment could be compared regardless of the method of noise measurement used, provided that it was appropriate to that equipment, the quasi-peak method being quite unnecessary for most measurements.

With regard to other parts of the article, I cannot see why the importance of a genuine VU meter is stressed in relation to CCIR/ARM measurements as Dolby made no mention of VU meters in their paper to the AES (1978) and I would not have thought that a VU meter should be used as it is permitted to have a non-linear rectifier and so is not an average responding meter. The ballistics of an average responding meter have no effect on noise readings.

In his discussion of unweighted noise measurement, Hugh Ford makes no reference to standards, and it is worth noting that CCIR Rec 468-2 now includes a filter specification for unweighted measurements. The CCIR curve shown in **Fig 6** *incidentally, shows incorrect tolerances: they should be symmetrical and are difficult to represent properly on a graph.*

Finally, I would like to respond to the request for information from manufacturers of quasi-peak meters. The Lindos LA1-P *Professional Audio Analyser incorporates CCIR quasi-peak and 'A' weighted true rms measurement in addition to CCIR/ARM 2k and CCIR (22Hz to 22kHz) unweighted noise measurement. It also measures wow and flutter and distortion and is available with an optional PPM facility. We also manufacture the basic* LA1 *without true rms or quasi-peak facilities.*

Yours faithfully, P J Skirrow, Lindos Electronics, Sandy Lane, Bromeswell, Woodbridge, Suffolk IP12 2PR.

Hugh Ford replies: Mr Skirrow's letter adds useful comment to the problems of specifying noise performance but I would take him to task about his statement "it is desirable that different methods of noise measurement should give about the same figures".

The mere fact that noise spectra from different noise sources vary widely make it impossible for different noise weightings to give compatible results. Furthermore, the crest factors of different noise sources make the rectifier characteristics and ballistics of meters incompatible.

It is these factors that have led to the proliferation of different weighting curves and metering methods. Clearly the noise characteristics of analogue and digital audio equipment differ widely as does that of studio equipment, telephone lines and over-flying aircraft. I do not therefore believe that we can ever arrive at compatible figures.

Reverting to my desire for weighting networks to have unity gain at 1kHz, until the advent of Dolby CCIR/ARM methods this was the case. In those circumstances it was possible to calibrate a complete system at 1kHz using reference tapes, disks and sound sources, etc. Calibration at 1kHz was safe because the effect of equalisation, pre-emphasis and de-emphasis is minimal—this is not the case at 2kHz and even worse at 5kHz.

Roll on the discussion, we really do need a sensible international standard for measuring noise in audio equipment both analogue and digital.

Blooming booms

Dear Sir, With reference to the article 'Blooming Booms' (December Studio Sound, *Business) I feel a number of points warrant comment.*

In the instance of 16mm film whether for cinema or television, it is usual to use the location sound with little or no post-syncing. The recording techniques by which this aim is achieved vary in preference from one person to another and include the continuing practice of plant mics hidden on the set. However, it is the boom microphone that is still ubiquitously used, simply because even after 50 years there is not a totally satisfactory alternative. Although a radio mic is indispensable for certain situations, it is not without its problems. Leaving aside that the fitting of a concealed personal mic may be inconvenient, difficulties are experienced in the form of clothes noise, less resistance to wind noise and that the sound itself will always be of close perspective although this can be disguised in part by balancing an ambience mic to match the shot. The radio systems themselves have a fairly high order of reliability, and problems come more from the direction of possible rf interference, and radio signal absorption and phase cancellation, increasing in likeliness with the more channels in simultaneous operation.

The use of a boom necessitates not only keeping the mic itself out of vision, but also its shadows and any reflections that may occur in, for example, glass surfaces, whilst closely following the action and maintaining sound perspective to match the camera. To this end co-operation is required in the lighting of the set and perhaps even the framing of the shot. Should a 'boom in' (the term is misleading as it can also be due to a change in camera framing over that rehearsed) be suspected, it is brought to attention allowing another take to be made when possible so that it doesn't appear in the edited product.

Finally, concerning the suggestion of rigging multiple mics in the overhead lighting of a boxing ring, this would have little advantage over using just one, and in either case there is a major drawback. Differing in type to those found in theatrical floats and battens, the lights are prone to singing, an effect that would be undesirably close on mic!

Clive A Cowan, 27 Stirling Avenue, Leigh-on-Sea, Essex, SS9 3PP.

Mic response changes

Dear Sir, We were pleased to see the article 'Developments in Recording and Monitoring Acoustics' by Andy Munro in the October issue of Studio Sound.

Mr Munro covered many of the new developments that we are happily involved with at Syn-Aud-Con.

There is one point I would like to make with regard to flush mounting of microphones. Mr Munro notes that a microphone suffers severe response changes when near a reflecting surface. He implies that this problem is solved by flush mounting of the microphone.

True, the microphone has a flat response so long as the source does not move. If the source moves, we're back to the same "severe response changes". (TDS demonstrates this effect.) Pressure Zone Microphones *are free of this problem and therein lies one of the outstanding advantages.*

Yours faithfully, Carolyn Davis, Synergetic Audio Concepts, PO Box 1115, San Juan Capistrano, Cal 92693, USA.

Tape cutting

Dear Sir, A belated postscript to the reviews and heated correspondence re the Stellavox SP-8 *and Uher* CR240. *Last month I recorded an ecology conference in the south of France. Technology had to maintain a low profile, so five AKG* C451s *were suspended above head level about the hall and mixed to stereo through a Stellavox mixer and fed simultaneously to the two recorders in question, both set up for Ampex* Grand Master *tape. Whenever a reel ran out during a particularly long discussion period, I relied on the Uher for subsequent transfer.*

Back at the studio, I've now dubbed the overtime to reel-to-reel and tacked it on the end of the appropriate spools. The joints are undetectable. After the first couple of splices, I started cutting experimentally in the middle of words to maximise the difference; still undetectable. Both recorders, incidentally, performed flawlessly through several days of constant use. I've never had such a prolonged trouble-free session. All the controversy, so far as I'm concerned, is strictly academic.

John Whiting, October Sound, 24 Old Gloucester Street, London, WC1. ■

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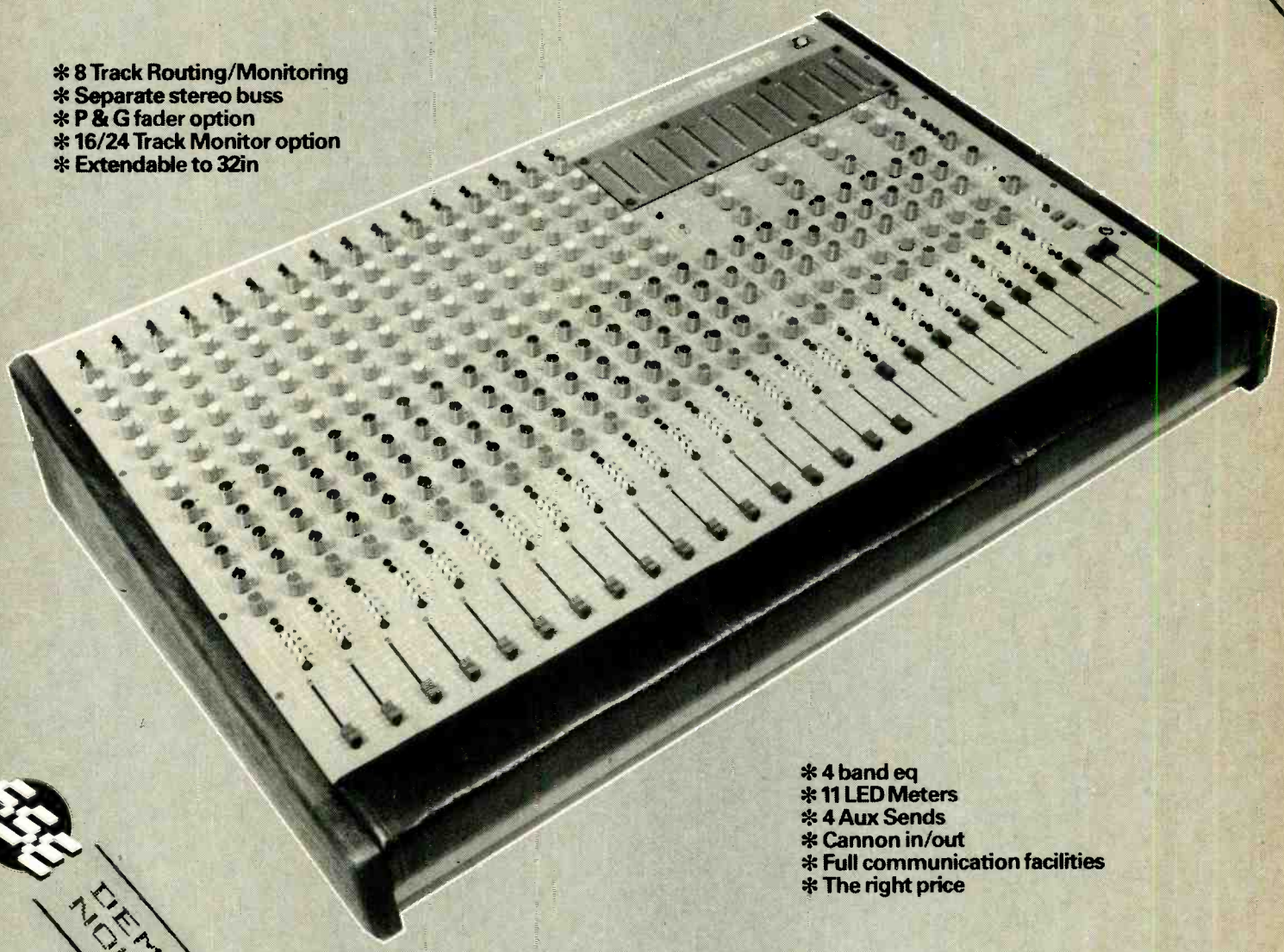

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Stereo recording techniques

William B Feil **Steven P Cadenhead**
(Sound Storage Recording Co)

Sounds come at our ears from all directions and problems arise when they must be captured in two channels and reproduced for the listener as authentically as possible. Here, some of the problems involved in creating the correct aural illusions are studied.

REPRODUCTION of a musical event via the stereo medium will never be indistinguishable from the original event, although it can be an aesthetically pleasing facsimile of it. In real life, sounds originate from all directions and distances. Stereo systems, however, usually have only two loudspeakers — considerably less directions of sound origin than the infinite number in real life but it is possible, via the stereo medium, to create the illusion of a curtain of sound when the recording and the playback system are utilised in a manner complementary to the human hearing system's interpretation of sound from a pair of speakers.

The human ear/brain system unconsciously makes use of several clues in live sounds to determine the direction of a sound source. The most important of these is the difference in the time of arrival of the sound at the two ears. Any off-centre sounds arrive at one ear before the other. The ear/brain translates differences of only a few ten-thousandths of a second in the interaural (between the ears) arrival times into accurate directionai information. Other far less precise clues include the differences in loudness between the two ears due to the baffling effects of the head at middle and high frequencies; and the colouration of high frequency sounds by the pinnae of the ears.

Any owner of a good stereo system is witness to the amazing ability of the ear/brain to hear sounds which seem to originate from points between the two loudspeakers. These are known as phantom images. A listener seated equidistantly from two identical loudspeakers, positioned approximately 30° to either side of the centre and fed identical signals, will not hear two separate sounds but one phantom source apparently located exactly between the two speakers. Such a phantom image is easily shifted to any position along the arc joining the two speakers, in either or both of two ways. By delaying the signal emanating from one of the speakers, the image will shift in the direction of the undelayed signal — known as the 'precedence effect'. By increasing the volume of one of the loudspeakers so the image will be shifted toward the louder speaker.

The image may be shifted outside the arc formed by the speakers by inverting the phase of one and substantially reducing its volume. In a correctly set-up system the image will shift to the outside of the unaffected speaker. This effect occurs naturally in recordings produced with coincident bi-directional mics at 90°. The subjective effect of this is a noticeable and accurate broadening of the stereo field beyond the left and right speakers, sometimes referred to as 'lateral image width'.

Limitations

It is not widely understood that the inherent limiting factor in the ability of a stereo system to recreate correct or desired image location is the fact that both ears hear the signal from both loudspeakers. In real life, the interaural time delays are unique for each direction of sound. In 2-loudspeaker stereo, because both ears hear both signals, there are always two sets of time delays corresponding to the actual location of the left and right speakers. (Except, of course, with a fully left or right signal where one speaker will be totally silent.) The brain receives two sets of cues for each single source which suggests the presence of two actual sources, namely the speakers, rather than one phantom source which is the desired objective.

Because of this, whenever interchannel time delays are used in the attempt to convey directional information, a seriously distorted left-to-right perspective occurs. For instance, if the signal from the left speaker is delayed more than 0.3ms, which is the interaural time delay for approximately ±30° speaker placement, the sound from the right speaker is heard first by the right ear and then 0.3ms later by the left ear, before either ear has heard anything from the left speaker. Information is already on its way to the brain which will localise the signal at the right speaker and the brain will have difficulty in modifying subsequent information from the left speaker so the image will be placed at the right speaker. Only 0.3ms delay is needed to shift the image from the centre to an extreme position. The image could be shifted back to the centre with varying degrees of success by reducing the volume of the leading speaker but in practice this rarely occurs.

Spaced mics

Nonetheless, recording engineers still make use of these interchannel time delays to present directional clues, with less than satisfactory results. Two or more mics are positioned across the front of the sound stage spaced by an essentially arbitrary distance. Sounds from off-centre take longer to arrive at the farther mic(s) and are louder at the nearer, leading mic, providing faulty delay and amplitude information, which the listener perceives as distorted directional information. If only two mics are used, any sound far enough off-centre to present an interpath difference to the two mics of 1ft or more (corresponding to 1ms or more) will appear upon playback to be located at the speaker reproducing the leading signal (ie from the closer mic). If the mics are separated by * feet, then any source located more than a few inches to either side of centre, regardless of the width of the sound stage, will cause an interchannel delay of 1ms or more, and upon playback will seem to originate from the speaker fed by the closer, louder mic, thereby reinforcing the exaggerated effect. Only sounds which originate dead centre will produce centre phantom images. As a source moves gradually off-centre its image upon playback will jump suddenly to the leading speaker; an off-centre stationary singer who turns his or her head will seem to jump from left to right as the difference in loudness alternately reinforces or counters the delay due to the interpath difference.

The standard remedy for this is to place a third mic in the centre of the sound stage, whose output is fed in equal amounts to both channels. This '3-point' technique does produce a stable centre image but it generates severe distortions in the signals. It will always be a textbook rule of thumb that two or more mics spaced apart by more than a fraction of an inch should not simultaneously interact acoustically and electrically. Audio frequency ½-wavelengths vary from about ⅓in to 20ft long. In the case of the 3-point system, signals arriving at the mic at different times (hence out of phase by varying degrees) are mixed together. If the instantaneous pressures at both diaphragms are positive, then the voltages add; if the pressure at one diaphragm is positive and the other negative, the voltages will partially or completely cancel. In practice, varying degrees of additions and cancellations will occur, dependent upon frequency and interpath differences. Tremendous peaks and dips in the frequency response result (known as the 'comb filter' effect because a graphic representation of the frequency response resembles the teeth of a comb) which cannot be corrected with equalisation, even if desired. Also, low frequency information which is out of phase causes severe unwanted vertical modulation of the cutting and playback styli, sometimes lifting them out of the groove entirely.

At the cutting stage, recordings made in this way require corrective measures such as substantial low frequency roll-off, or mixing of the lf information into monaural, with resultant comb filter effects. One audiophile company which uses the 3-point method takes great care to position the bass drum in the exact centre during recording sessions in order to avoid this problem at the cutting stage.

Amplitude-encoded directional information

There is a way to convey directional clues without these problems. Over the entire frequency range it is possible to present directional information without time delays by the use of in-phase signals differing only in relative loudness. It has been known for years that two loudspeakers driven with the same signal in-phase but with differing amplitudes can convey accurate directional information. This occurs through a combination of physical and psychoacoustic phenomena. At lower frequencies below about 700Hz (whose ½-wavelength is equivalent to the distance from one ear to the other) two identical in-phase signals differing only in amplitudes cause a relative phase shift between the two ears because the resultant peak in the combined signal from both speakers occurs a little sooner at the ear closer to the louder speaker. An amplitude-dependent phase shift is thus generated, which the ear/brain interprets as accurate directional

* NEGLECTS DISTANCE FROM STAGE!

information.

For signals above about 700Hz, the mechanism is less well understood because it is a psychoacoustic rather than a purely physical effect. Philip Vanderlyn, of the Central Research Labs of EMI, offers the most plausible explanation of this:

". . . some time after the onset of the partial stimuli (the sounds from the two speakers reaching one ear) . . . the integral of the energy received by one ear will reach a threshold value before the other, depending on the relative amplitudes of these partial stimuli, and an action potential will be generated at that ear earlier than the other, as though it had resulted from a single virtual stimulus . . ." ('Auditory Cues in Stereophony', *Wireless World*, September 1979).

In other words, at frequencies above about 700Hz, the ear/brain responds to relative energy envelopes, rather than to the relative phase of the two signals. With this system, perceived image localisation correlates very closely to actual instrument location, with none of the frequency-dependent problems of the spaced mic system.

Depth cues

The use of in-phase signals varying in amplitude guarantees only that the signal will localise properly in the left-to-right arc between the speakers; it does not guarantee the proper sense of depth, which is the ability to sense the front-to-back spatial relationships of the instruments or voices. The practice of multimic panpotting performs the function of providing in-phase signals varying only in amplitude. The result is unambiguous and smooth left-to-right phantom images. However, in addition to a plethora of insurmountable problems with this system, all instruments treated in this fashion seem to be located along the imaginary line joining the two speakers. The perspective is flat, lacking the illusion of depth, and louder instruments mask softer ones. This is because depth cues are not present on a recording made in this fashion.

Such highlighted instruments are perceived as grossly exaggerated in size relative to the overall group. The instruments will sound different at the very close distances needed for solo mics. There is the problem of balancing all the instruments, which is taken out of the conductor's hands and put into an engineer's. If the instruments being panned are also picked up by the main or overall mic pair, there will be frequency response aberrations and comb filter effects, resulting in smearing of transients, ambiguous location in space and other problems.

Depth cues are provided by "reasonably accurate reconstruction of the directionality and associated time delays of indirect sounds" ('Surround Sound Sense', P B Fellgett, *Hi-Fi News*, February 1975). Each instrument radiates into a particular acoustic environment, setting up reverberation patterns unique to itself, the room and its position in the room. It is the preservation of these reverb patterns on a recording that provides the sense of front-to-back depth. The presence of these patterns makes it possible to determine that one instrument is in front of another and to sense the air and space between instruments or voices. These patterns define the acoustics of the original recording environment and lend overall image stability and balance to a recording.

These subtle patterns must be captured properly. Improperly captured or (worse) injection of artificial reverb smears the sonic image. Reverb patterns cannot be properly captured with only a single mic panned to any location. Reverb by nature comes from virtually every direction and panpotting assigns the reverb to the same specific location as the instrument.

Coincident mic

The use of a pair (or more as in the Calrec Ambisonic *Soundfield* mic) of coincident mics produces signals which meet all of the criteria for smooth left-to-right, as well as accurate front-to-back phantom imaging, with none of the time related problems inherent to spaced mic techniques. Coincident mics are directional (ie not omnidirectional); otherwise there would be no effective difference in the output of the capsules. By definition, the output of all directional mics, at least in part, is proportional to the angle of incidence of the sound, thus they encode directional information into in-phase amplitude variations, which are precisely what the ear/brain needs for accurate interpretation of directional information within the medium of 2-loudspeaker reproduction.

The use of bi-directional coincidental mics arranged at 90° to each other (the method advocated by Alan Blumlein) assigns a unique pair of voltages to every position in a 360° plane allowing an entire sound field plane to be encoded on to two channels. This is the most accurate storage of the direct and reverb patterns possible with two channels. Upon playback, recordings made in this manner offer an unsurpassable accuracy of instrument or voice location, sense of space between instruments, ability to sense accurately the dimensions and acoustics of the recorded environment, the ability to follow single voices through dense and complex passages and a noticeable, accurate and subjectively pleasing broadening of the stereo 'curtain of sound' or 'lateral image width'.

Surround from stereo

The use of the Blumlein method of recording accurately encodes the entire 360° plane, but loudspeakers usually subtend an arc of only approximately 60°. Thus more directional information is present in Blumlein recordings than can be reproduced via two loudspeakers.

It is not only possible but also relatively easy, to extract this additional genuine (as opposed to synthesised, as in delay networks) directional side or rear information which is present in any recording made with coincident mics. This side information usually represents the reflected sounds which define the acoustic environment and positional arrangements. An additional matched pair of speakers is required, preferably identical in all respects to the main front pair. Additional power amps may or may not be needed. The details of the many possible interconnections are beyond the scope of this article, but generally the additional pair should be connected in series (or in parallel for greater rear volume) with their polarities reversed, across the hot terminals of the power amp such that the left-front and left-rear diaphragms move in the same direction (eg both move out on a positive pulse) together and the left-front and right-rear diaphragms move in opposite directions (eg left-front diaphragm moves out when the right-rear diaphragm moves in on a positive pulse).

Loudspeaker arrangement

When reproduced via two spaced loudspeakers, phase coherent amplitude differences between two information channels (due to the nature of the signals resulting from coincident mics) provide a cue which the ear/brain interprets as accurate directional information. It is essential that the reproduction system preserves this delicate relationship of phase and amplitude. Failing to retain these critical requirements will distort the aural image potential (eg width and depth) of stereophony.

The weakest link in the reproduction system is certainly the speakers. In setting up two speakers for stereo it is essential that a monaural signal leaving both speakers at the same time arrives at the same time at a point which would be between the listener's ears. Only one listening axis can exist which can meet this requirement. (Recall that a path difference of only 1ft is enough to shift a central image to the extreme left or right position.) This position will be determined by a juggling of parameters through which the best compromise will be reached.

Stereo loudspeakers should form an arc of approximately 60° with final positioning depending on loudspeaker characteristics. Too great an angle produces what the ear/brain perceives as two separate signals without an integrated spread between the speakers; too small an angle tends to sound monaural. An aid for setting this parameter is to listen to a monaural source and to change the distance between the speakers by a small amount until the spread is as great as is possible while the phantom centre image remains precisely between the two speakers.

Loudspeakers vary dramatically in driver type, arrangement and number; crossovers; cabinet dimensions; dispersion characteristics; tonal balance; phase response; room coupling effects; etc. Because of these differences small final vertical height and azimuth adjustments and rotation about the central axis of the speaker (tow-in-angle) must be performed in order to realise the best subjective compromise. These final adjustments must be made while listening to a recording which contains the cues necessary for accurate image reconstruction by the ear/brain. (Recordings made with a pair of coincidental mics are capable of providing this information.) All of these adjustments are interrelated and changes in any area probably will require correction in other areas.

Absolute polarity

Another factor that will affect the sound of a system is the absolute phase of the final sound pressure from the speakers. Due to the asymmetrical nature of musical waveforms, it is essential that the speaker diaphragm produces a positive pressure when the mic diaphragm receives a positive pressure and vice versa. If this relationship is inverted the subjective sound will tend to have less mid-range detail and clarity and a more distant perspective, a subtle but clearly noticeable difference. This relationship will vary from recording to recording and from component to component. The only way to determine the correct polarity for a given system or recording is to listen, invert the polarity of both speakers, and listen again and decide which sounds more natural (ie open and clear). It is important to note that this test is irrelevant to recordings not made with coincidentally placed mics because the absolute phase of such recordings is essentially random.

The means of capturing, storing and reproducing stereo information vary considerably. The research performed by Sound Storage supports the conclusion that the Blumlein system of sampling the sound field provides, both subjectively and theoretically, the most realistic reproduction of sound possible within the limitations of the stereo medium. The result is the natural sound of the musicians in their intended places, in an acoustic environment appropriate to the music — not a sonic spectacular but a musical reality. ■

CTEAP 80 Exhibition, Paris-a report

Noel Bell

The CTEAP 80 Exhibition was held at the Hotel Sofitel, Paris from Saturday November 29 to Tuesday December 2. Noel Bell reports on this annual French professional audio exhibition.

THREE YEARS on from its inception the CTEAP exhibition organised by the Association pour les Techniques Electro-Acoustiques Professionnelles has progressed to become an established annual event. The 1980 exhibition again saw an increase in the number of exhibitors, with a total of 45 displaying their product lines on this occasion. However, although the number of exhibitors was up, this latest CTEAP did not appear to be as well attended as the 1979 exhibition. This could have been a reflection on the present parlous state of the professional recording industry, but could also have been a result of the decision to change the timing of the exhibition. The previous CTEAP exhibitions were held in mid-November whereas the latest was at the commencement of December. Whatever the reason—and despite the advent of winter in Paris which caused exhibitors and visitors alike to think twice before venturing out of the Hotel Sofitel into the semi-Arctic weather—the lack of visitors gave the exhibition a rather subdued atmosphere. As such CTEAP 80 was more a consolidation and retrenchment of the exhibition vis-a-vis the French professional audio scene and an opportunity for the French recording industry to see recently introduced products at first hand, than an all encompassing exhibition with multifarious new product launches. Despite this, several new products debuted at CTEAP, and rather than retread ground covered in previous exhibition reports, I will confine this report to items seen for the first time.

Dynacord displayed a wide range of professional and semi-professional equipment including four new units. These were the *MC16/4/2* console; the *TAM 21* phaser/flanger; and the *EQ270* and *EQ210* graphic equalisers. The *MC 16/4/2* as its name implies is a 16 input, four subgroup, two output channel console for PA usage. Features include 3-band equalisation with a parametric middle section, plus a 48V phantom powering facility for mics. The *TAM 21* phaser/flanger is a 2-channel unit, switchable for mono or stereo operation, with facilities for voice doubling in addition to stereo phasing and flanging. Features include short or long delay effects mode and regeneration control, sweep and depth controls, and a control voltage facility for remote control purposes. The *EQ 270* graphic equaliser is a 27-band ⅓-octave equaliser on the standard ISO centre frequencies offering ±12dB of boost or cut. Facilities include a bypass switch, LED display of modulation level, and an input level control covering the range −10dB to +15dB. The same facilities are also provided on the *EQ 210* graphic equaliser which is a 2-channel, 10 band/channel unit. The facilities being available separately for each channel.

A company which I hadn't come across before was **EAA** who are based at Villebon s/Yvette. On this company's stand two ranges were displayed, these being products under the names Quest and Square. From Quest there was the *Quest 1200* console, a 12 input, four subgroup, four output console available with numerous options including multipair connectors, phantom mic powering, Penny & Giles faders, a transport case, and with the facility to extend the console for 8-track operation. Also from Quest were the *802* and *1602* film and TV post production consoles, and the *EM8* and *EM16* 8- and 16-track monitor blocks. Finally from EAA, were two stereo amplifiers from Square; the *Square 1000*, a 500W per channel power amp; and the *Square 800*, offering 400W per channel.

In addition to its established range of broadcast consoles, **Girardin** introduced a new modular console, the model *C84*. This new console has 16 mic/line inputs, an 8-track mixdown section, two main outputs, plus two aux outputs. Having similar facilities to the *C124* and *C184* consoles, the new console offers the additional facility of being automation ready.

French mic manufacturer **LEM** introduced a new radio mic system at CTEAP together with a new electrodynamic omnidirectional mic, the *DU 100*. The radio mic system comprises three units. First is the *EHFP 1585* mic transmitter available for use with either dynamic or electret mic capsules and with antenna powering being provided by the mic. Operating frequency is 32.8MHz, with mic input sensitivity being 0.6mV for electret mics and 0.2mV for dynamic types. Frequency response of the system is 40Hz to 15kHz ±2dB, and the unit has an rf output power of 1mW. The second unit is the *EHFP 1651* compact transmitter which has three switchable operating frequencies: 32.8MHz; 36.4MHz; and 39.2MHz. This unit has the same rf output power as the *EHFP 1585*, incorporates a mic, and is battery powered. Specifications include: mic input sensitivity 80dB at 1kHz for ±30kHz FM deviation; and S/N ratio 35dB. The final unit is the radio mic receiver which can be either mains (220V, 50Hz) or external 12V powered. Antenna input is via a BNC connector with 50Ω asymmetrical impedance. Output is BF symmetrical 200Ω with a sensitivity of 600mV.

Another company new to me was **Log Audio Equipement** which displayed two parametric equalisers. The first, termed the model *EQ4A* is a modular 19in rack mount system—a 19in rack accepting seven units vertically arrayed in a frame 6U high. The *EQ4A* is a single channel parametric equaliser with four bands of equalisation covering the ranges 40Hz−1kHz; 150Hz−3.8kHz; 320Hz−6.8kHz; and 1kHz−20kHz. Centre frequencies are continuously variable with a control range of ±15dB, and the unit features highpass and lowpass 18dB/octave filters which may be switched to one of three cut off frequencies (30, 70 and 150Hz, low; 7, 10 and 15kHz, high). Other features include 'Q' continuously variable on all bands between 0.8 and 5 octaves, digital display of the equaliser's channel number, and input and output level controls variable over the range ∞ to +22dB. Specifications include: input 20kΩ symmetrical; output 600Ω symmetrical; and frequency response 20Hz to 40kHz ±2dB. The second parametric equaliser, the *EQ4B*, is a 2-channel 19in rack mount unit with exactly the same facilities and specifications as the *EQ4A*, but without the digital channel display facility.

MCI mounted a comprehensive display of its products with particular emphasis upon the recently introduced *JH-600* console and its wide selection of tape machines. Although still handled by Studio Equipment, MCI have opened a French subsidiary company to expand its share of the French market. The new company, MCI Professional Recording Equipment France sarl, is based at 60 Boulevard Pereire, F-75017 Paris. Phone number is 227.25.95.

Pyral introduced a new open reel tape at CTEAP, the type *CJ 90*. The new tape is polyester based having a total thickness of 55µm (36µm polyester; 15µm magnetic coating; and 4µm grey back coating) Available in ¼in, 1in and 2in widths, the tape features antistatic back coating, and is available in 750m lengths on NAB hubs. Specifications include: coercivity 34kA/m; operating level +1.5dB; print through −51dB; sensitivity +0.5dB (1kHz), +0.8dB (10kHz), +0.5dB (14kHz); output level for 3% third harmonic distortion +11.8dB: and modulation noise level −55dB.

Although not actually showing anything at CTEAP, the UK based studio construction company **RABIT** were in attendance at the exhibition. This was primarily to announce the opening of a French office for the company. Accordingly, all enquiries for France should now be directed to 18 Rue de Beudant, F-75017 Paris, (Phone: 294.94.86.).

French console manufacturer **SAJE** announced the introduction of two new consoles these being the *Odyssey* multitrack recording console and the *Auxy* PA and theatre console. The *Odyssey* is a modular console accepting from 12 to 30 input channels and with eight echo sends and 24 outputs. Features include 3-band parametric eq, three stereo echo sends, auto-mute, VCA subgrouping, transformerless inputs, and LED VU metering. The *Auxy* console will accept 12 to 32 inputs and has eight aux outputs, four subgroups, and two main outputs. Both consoles can be automated.

Studio Equipment the French distributors for AMS, Barth and MCI showed a new range of French manufactured stereo power amplifiers called Neva. Three models are available, the *Model 400*, *Model 200* and *Model 80*, with individual channel power outputs being the same as the model numbers. All the amplifiers are 19in rack mount units and feature 10kΩ asymmetrical *XLR* inputs (600Ω symmetrical as an option). The top two models also feature LED VU metering of output level. Specifications include frequency response 10Hz to 45kHz, −3dB; harmonic distortion <0.05%; slewing rate 6V/µs; damping factor >100; input sensitivity 0.8V; and S/N ratio >104dB.

To conclude, CTEAP 80 was an excellent opportunity for the French recording industry to see what products its home based manufacturers have to offer, while in addition, a wide range of foreign manufactured equipment available from French distributors was also displayed. As a perhaps somewhat parochial exhibition outside the mainstream Anglo-American affairs CTEAP 80 did not prove to be a launching pad for many new products, but with AES Hamburg looming this wasn't exactly unexpected. ■

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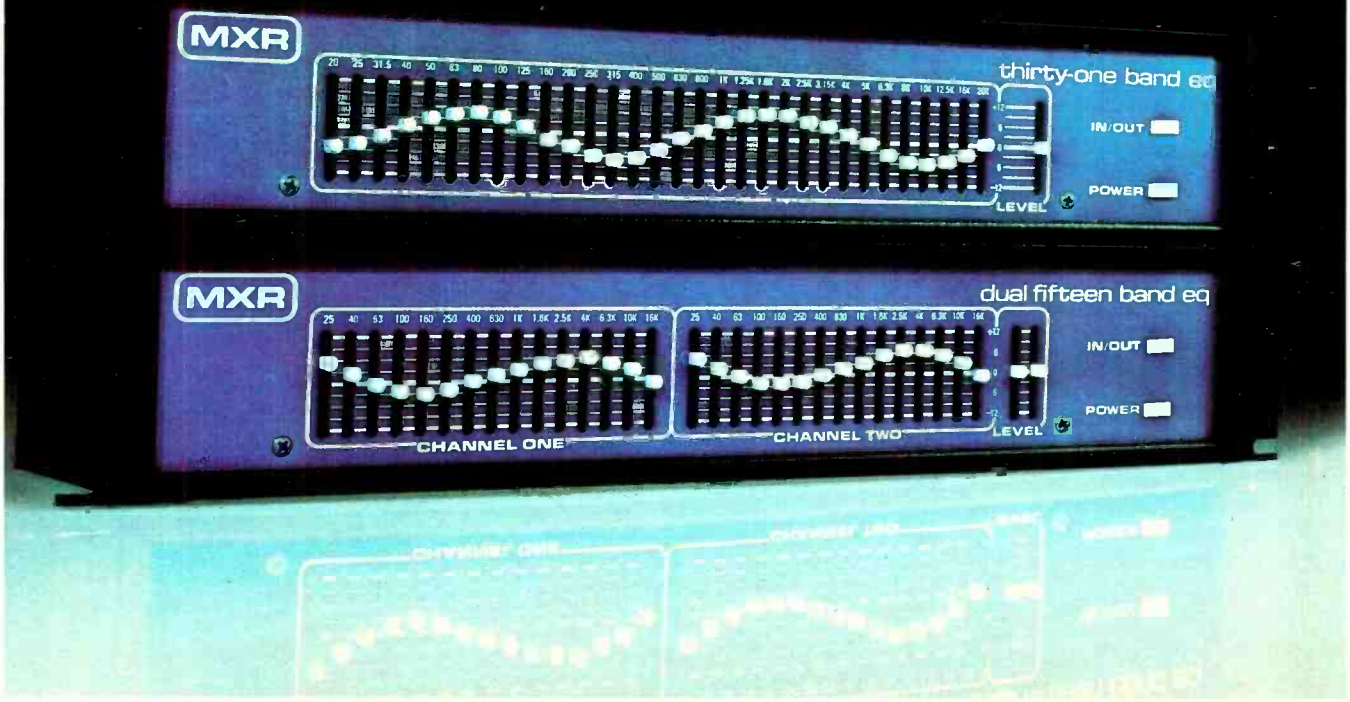
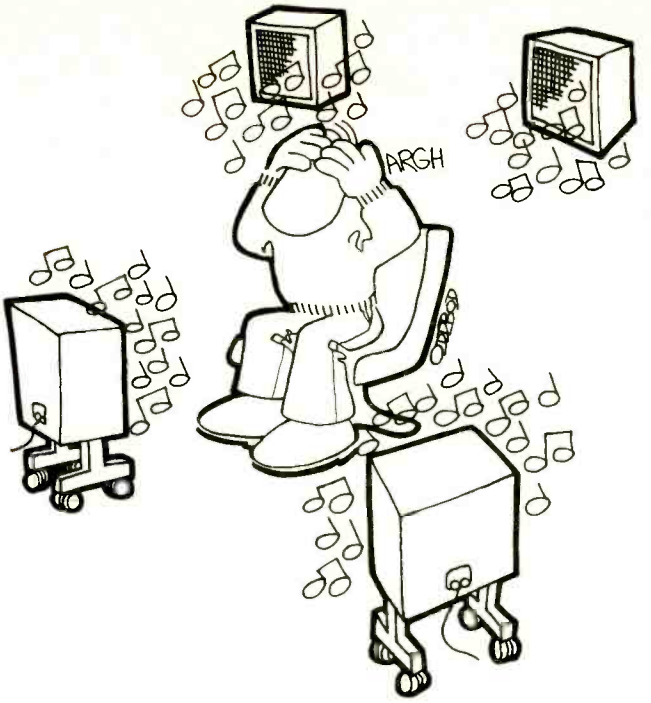


Accuracy in sound reproduction

Prof P B Fellgett



The first attempts at 'quad', based on mistaken assumptions, never worked well enough to gain a wide public.

Our pleasure in music depends on the ability of the ear and brain to discriminate and interpret sounds but our faculties are becoming blunted. We listen more frequently to reproduced or amplified sounds, often with distortion caused by poor equipment or even deliberately induced, than we do to live, natural sounds. In this article, based on the Reading University Public Lecture presented last December, Professor Fellgett explores the thorny path to overcoming the many distortions that can mar reproduced music. We are publishing this article as a contribution to the continuing discussion on the future and direction of the audio industry.

OUR FOREFATHERS, who were fond of numbering things, enumerated five senses: sight, touch, hearing, taste and smell. We would today distinguish: mechanical — touch, kinesthetic, balance; thermal — heat and cold; chemical — taste and smell; visual — seeing; and auditory — hearing. All are important, and we regard someone with the misfortune to lack any of them as handicapped, or at least deprived of enjoyments others can have. It is not possible to say that any one is the most important as all are complex and highly developed, but our subject here is hearing.

Hearing is of special social and emotional importance. One of the first things a baby learns is to recognise and respond to its mother's voice. As we grow up, we use voice and hearing in all our relations with other people, and in learning about the world about us. As our perceptions become practised and refined, we begin to appreciate rhythm, melody and harmony, and so we are led to music. Some assert that all music began from the voice.

What we call 'the ear' (really the combination of brain and hearing) has wonderful powers of analysis and discrimination. One example is the 'cocktail party effect' — the ability to lock onto one conversation out of a babble of others. Even more strange, in a way, is the ability to recognise who is speaking even when the voice is too faint or too overlaid by other sounds, for the words to be intelligible. We can often do this, for example, on the telephone, where almost every characteristic we know how to measure objectively has been distorted apparently out of recognition.

So far, we do not have any convincing explanation of how the ear manages to do these things. The 19th century pioneers, Ohm, Helmoltz and Lord Rayleigh concluded that all that matters to the ear is the spectral composition of the sound; the relative amplitude of the fundamental and its partials, overtones or harmonics.

There seems no way in which this picture can fully explain the ear's performance and today we regard it as just a first approximation which needs to be supplemented by other, more complex, considerations. We know that transient effects are important. It also seems logically necessary to suppose that the ear can do what is called 'non-linear processing' and thus make use of phase information which the 19th century scientists thought it did not have access to. This is expressed mathematically by saying that the ear can supplement ordinary spectral information. Although strongly supported by indirect evidence, efforts to verify the bispectral hypothesis by direct experiment have so far been unsuccessful, and the research is continuing.

The 'cocktail party effect' is important to our appreciation of music, since through it we are able to distinguish voices, instruments or sections, and to hear inner lines. The different sections of an orchestra should blend without losing their identity, and each instrument should be able to make itself heard above the whole orchestra when the music requires it to do so.

Another important ability of the ear is to locate sounds in space, and to recognise the size, shape and characteristics of the place where, for example, a musical performance is taking place. It is an ability we conventionally recognise in blind people, but we must not forget that their special facility is just the result of more intensive practice of a faculty which sighted people also have, and use all the time.

There is little doubt that the 'cocktail party effect', and our ability to resolve a complex musical texture, are closely bound-up with spatial auditory perceptions. Each constituent in a rich web of sound is, so to speak, 'labelled' with an acoustic quality characteristic of its place of origin. This 'ambience labelling' depends on the ear interrelating direct and indirect, reflected sounds, and is very important musically. We hardly care, for example, whether the tympani are to the left or right of the woodwinds; what matters is that each section of the orchestra or chamber ensemble should be perceived as contributing its proper share to the overall sound.

When we listen to reproduced sound, many processes, and many pieces of equipment, lie between us

and the original sound. Each one of these is imperfect, and as their imperfections add up so this progressively distorts the original.

In early loudspeakers, for example, the suspension of the moving parts was not free enough for good reproduction of bass notes. As this was corrected, being able to hear the drum became a sales feature, leading to the mellow-toned Radiogram. Gradually a reaction set in, and it was realised that the lack of top notes was giving a woolly sound of poor definition. To correct this, the moving parts of loudspeakers had to be made lighter, so that they could respond faster (and, of course, matching improvements were needed elsewhere in the equipment).

Better high frequency response, however, exacerbated another form of distortion; non-linearity, which causes the components of the sound to interact, generating combination tones and harmonics, instead of coming through cleanly and separately as they should.

It is also necessary to preserve the sense of space; that is to say of depth and direction. The original single-loudspeaker reproduction, which we now call monophonic, or mono for short, of course gave no perceptible sense of direction. Stereo provides this information only over a front stage, and we really need to be able to reproduce sounds, both direct and reflected, from all around the listener. Unfortunately the first attempts to do this, called by the hybrid name 'quadraphonic', were based from the start on mistaken assumptions and methods and never worked well enough to gain a wide public.

Our own research over the past decade has been very much concerned with a new and more fundamental approach to overcoming directional distortion. The work has been supported by the National Research Development Corporation, and has been done in collaboration with colleagues elsewhere in other universities and in industry internationally.

From this research has emerged a flexible and comprehensive technology, which is called Ambisonics, for surround-reproduction of sound. It depends on a thorough analysis of how the necessary directional information can be picked up, how it can be handled and recorded in the studio, how it can be transmitted to the eventual listener, and how that listener can be given a convincing illusion of the desired directions of arrival of the sounds.

This last step is in many ways the most difficult, as it necessarily involves the psychology of hearing. Michael Gerzon made a fundamental advance by asking not 'what directional clues *does* the ear use' but 'what clues is it mathematically possible that the ear *might* use'. In this way he was able to understand the diverse experimental results of perception psychologists in a way susceptible to use in engineering design, eventually incorporated in Ambisonic decoders.

For the first step, picking up the directional information, Michael Gerzon and Dr Peter Craven invented the *Soundfield* microphone, the world's first truly 'omni-directional', as opposed to non-directional microphone. It treats sounds from all directions, horizontally or vertically, not in the same way (as would a nondirectional microphone) but in an equivalent way which distinguishes each direction without favouring any one above another.

Modern high-quality audio equipment has a nominally flat frequency response as wide as from 20Hz to 20kHz, and less than 1 part in 1000 nonlinear distortion. Are we therefore approaching perfection? Look at this quotation: "He said he had just heard the voice of [his colleague in Chicago, from New York] with such an intensity of sound and such clarity that he imagined his colleague must be behind him, among us in the same room, not 1,000 miles away . . . The voice was vibrant and precise, . . . without the least distortion." Is this a description of the latest digital microwave or optical fibre link between the two cities? No, it actually refers to a telephone experiment in 1886 which we should today regard as primitive.

The history of audio has indeed been a story of always underestimating the discriminating power of the human ear, and therefore of over-estimating the amount of distortion that can be allowed. We have learnt to be suspicious of any claim to be 'without the least distortion'. We would not regard any of the recordings we have made as free from distortion. Modern equipment may indeed have non-linear distortion levels of below 1/1000, but we are fairly sure that some kinds of distortion can be harmful at levels as low as 1/million.

The problem of distortion would be much easier if the various kinds of distortion kept themselves to themselves; but of course they interact. For example, one of the first things to be affected by low levels of non-linear distortion is sense of depth. There can also be falsification of the apparent musical dynamics of the performance.

When natural ambience clues are eroded by any kind of distortion, it is tempting in these days of plentiful and comparatively cheap electronic equipment to compensate by artificial means. This is the route that, largely, the industry has taken, using a separate mic for almost every performer or section, recording on anything up to 46 tracks of magnetic tape, and then mixing and adding artificial reverberation in elaborate mixing desks.

Such methods of course destroy the natural clues, with the result that almost every part in the music has to be at nearly the same loudness if it is to be heard at all, and the sense of space and of the scale of the instruments is falsified. The result is an 'overbalanced' presentation which may have initial impact but which soon palls because there is too much coming between the performer and the listener, preventing the intimate communication which should take place.

Today we listen to more reproduced than live music. The availability of the world's repertoire at the touch of a switch has enormously widened our musical experience, with great benefit to our musical appreciation. But there is the danger that if we listen to distorted reproduction, in which natural clues are falsified or suppressed, our ability to respond to these clues may become atrophied.

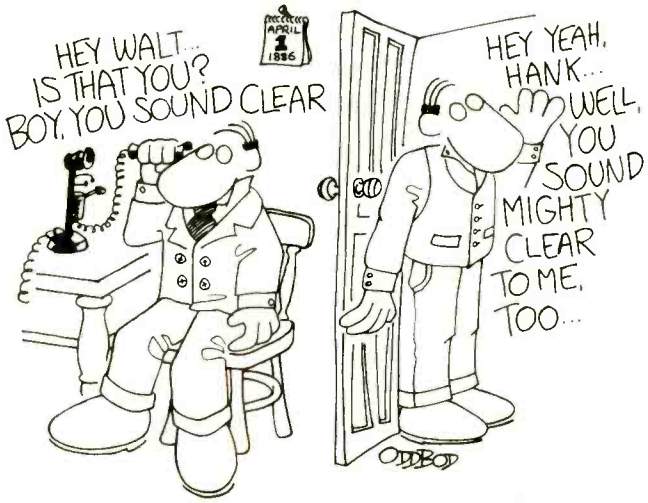
A manager is reported as having said 'something happens between a group and the audience when they go over 110dB'. Indeed something does; they go deaf. Evidence is accumulating internationally that a generation is growing up whose members may be deaf by 10dB or more through exposure to overloud reproduced sounds. Although undesirable, this is not too serious now, but it means that with the natural deterioration of hearing with age, they may become socially deaf 10 or 20 years earlier than they otherwise would, and this is very serious indeed.

If misuse of modern electronic gadgetry is causing measurable physical deafness, how much greater is the danger that it is impairing our powers of aural discrimination, so that we are becoming less well able to listen to and enjoy live music? The other day I went to a concert by the pioneer jazz violinist Stephane Grapelli. Instead of hearing Mr Grapelli and the obviously talented musicians with him, I was able to hear only a bad reproduction of him and his associates through the electronic equipment littering the stage. So unpleasant was it, that I went home at the interval, where in greater comfort I could, if I wished, hear Mr Grapelli reproduced much better. So widespread is the disease of 'microphone-itis' that when we do go to a live concert, often we still hear only reproduced sound.

Anyone who reads the newspapers will know that the audio and record industries are in a state of depression and upheaval, even in comparison with other industries. It would be absurd to suggest that deficiency in musical interest in many records, caused by distortions and ill-advised attempts to compensate for these instead of removing them, is more than one of the contributing causes to a very complicated situation. Nevertheless a number of firms who have taken a pioneering road in what is sometimes known disparagingly (but why so?) as 'purist techniques' have been doubling and trebling their sales while others have been going out of business.

In this article, I have tried to show through examples, how academic research and contemplation in universities can, by going back to fundamentals, refresh parts of the industry others cannot reach.

Contemplation is not sitting back and day dreaming. It is among the hardest kinds of work a human being can do, requiring a completely dedicated desire to understand. ■



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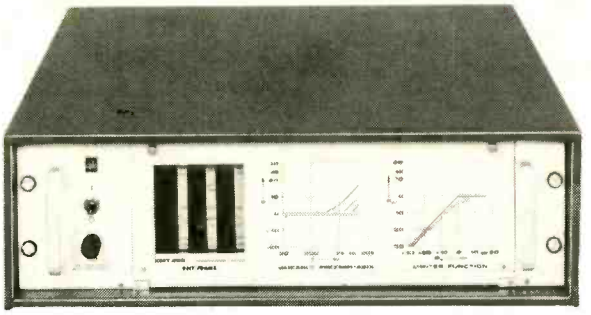
Prof Fellgett is head of the Dept of Cybernetics at the University of Reading.



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Ratio: approx 6 to 1.

ALICE (UK)
Alice (Stancoil Ltd), Alexandra Road, Windsor, Berks.
Phone: 07535 51056. Telex: 849323.

9904 Module
Contains two comp/limiters with switched stereo ganging built into Alice desks, and not available separately.
Noise: 86dB 20Hz to 20kHz.
Distortion: 0.1% THD.
Attack time: 1 to 10ms limiter 100µs.
Release time: auto 600ms to 5s, manual 400ms to 1.2s.
Ratio: 1.3 to 5:1.
Price: £330.

ALLEN & HEATH (UK)
Allen and Heath Brenell Ltd, Pembroke House, Campsbourne Road, London N8.
Phone: 01-340 3291. Telex: 267727.
USA: Audio Marketing, 652 Glenbrook Road, Connecticut 06906.
Phone: (203) 359-2312. Telex: 9965/9.

Feed Forward Delay Limiter
The unit employs an analogue delay circuit in the main signal path that activates a side chain limiter circuit in advance of an incoming transient peak. This is claimed to eliminate normal limiting-related problems such as transient distortion and overshoot. Variable threshold, release time and output level are featured, plus an overload indicator, stereo linkage and a 3-position LED PPM.
Price: £300.

Pro Limiter
Portable limiter designed for use with small studios and PA systems. Features 7:1 compression ratio, balanced mic input, line input, low level hi z input for guitar, switchable attack and delay times, overload indicator, variable input gain.
Price: £55.00.

ALLISON (USA)
Valley People Inc, 2820 Erica Place, Nashville, Tennessee 37204.
Phone: (615) 385-4737. Telex: 558610.
UK: FWO Bauch Ltd, 49 Theobald Street, Boreham Wood, Herts WD6 4RZ.
Phone: 01-953 0091. Telex: 27502.

Gain Brain Model 700
A unit containing the 'unique' combination of peak and rms limiters plus high-speed LED readout. Several units can be connected for tandem limiting.
Noise: 83dB below threshold of peak limiting.
Total harmonic distortion: 0.3%, 40Hz to 15kHz.
Gain: 0-30dB reduction.
Attack time: peak section 1.5dB overshoot 1µs after application of 50kHz tone burst exceeding the threshold of limiting by 15dB; rms section 7 to 40ms for 90% ultimate gain reduction, dependent on complexity of waveform, amount of limiting and control positions.
Release time: peak section 1µs for transients of 50µs duration, variable between 50ms and 5s for other peak signals; rms section 0.25 to 5s.
Limiting ratio: peak section approx 50:1; rms section approx 40:1.
Threshold: – 20 to + 30dBm in peak mode; rms mode raises peak threshold 6dB. This allows a separation of thresholds that is continuously variable from 0dB (peak mode) to 12dB (rms mode).
Power: 24-28V dc, 70mA.
Price: $283.50, $2,410 8 channels in powered rack, $4,400 16 channels in powered rack.

Gain Brain II
Compressor/limiter/ducker with LED readout of attenuation. Unit has provision for stereo intercoupling, side chain operation for frequency dependent gain control, and for remote VCA and /or remote GR metering.
Gain: 0-48dB reduction.

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Series 800. Designed to leave the final design to you.

A completely new console system, designed to give the creative engineer the sound he desires in the professional 8- and 16-track studio or, as an advanced specification concert, theatre or stage monitor mixing console.

The Soundcraft Series 800 is enriched with all of the technological developments that enhance the Series 1624 studio console, whilst providing total flexibility to the discriminating engineer in any situation demanding a high quality 8 buss mixing console.

This total flexibility means that the engineer's exacting demands can be fully realised, with a series of module options built into one unit.

With two sizes of mainframe to accommodate 18- or 32-channels, you can obtain the console custom-built with the choice of input and output modules for your particular creative application.

You can use the Standard Input Modules and four Double Recording Output Modules to achieve a superb 8- or 16-track studio console with 16-track monitoring.

Or, choose the Standard Input Modules with four Double PA Output Modules each containing two full-function effects return channels, for a highly versatile front-of-house PA Console. The Series 800 on-stage Monitor Input Modules provide up to ten independent mixes which is also ideal for theatre sound.

And, of course, the console is enriched with all those thoughtful Soundcraft touches which are typical of the complete range of Soundcraft products.

Series 800 is the flexible system that gives you all the creative options without compromising your demands. Tough, compact and beautifully finished, the Series 800 mixing console is designed especially for professionals by Soundcraft – Masters of Quality.

Send the coupon for further details and full technical specifications or telephone your nearest dealer as listed below.

The new Series 800 mixer system from Soundcraft.

Australia:	Klarion Enterprises Pty. Ltd. Melbourne (31) 613801
Austria:	Kapla Vienna 02 2292 97
Canada:	McKeen Productions Ltd. Ottawa (613) 236 0393
Denmark:	SLT Copenhagen 01-341284
England:	Turnkey London (01) 440 9221
Finland:	Studiotec Helsinki 90 520604
Germany:	Hausmann Concert Electronic Berlin (030) 433 6097
	GTC Studiotechnik München (089) 2971 71
	Klever Studiotechnik Hamburg (040) 690 1044
	Thum and Mahr Audio Leverkusen (Köln) (021 734) 1600
Holland:	Selectronic B.V. Lithoorn 02975 60 600
Italy:	AEG Telefunken Milan (02) 6266
Japan:	Hibino Electro Sound Inc. Tokyo (03) 8644961
Norway:	Tal and Ton Oslo (02) 20 97 05
Sweden:	Tal and Ton Gothenburg (031) 80 36 20
Switzerland:	Professional Audio Systems Basle (061) 504151
USA:	Soundcraft Inc. (616) 382 6300

Please send me further details of the Series 800 mixer console and full technical specifications.

Name _____ Position _____

Studio/Company _____

Address _____

_____ Tel: _____

Soundcraft.
Masters of Quality. 1979

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

Survey

Attack time: 0.2 to200ms.
Release time: 0.05 to 5s, lin/log switchable.
Limiting ratio: 1.3:1 to ∞, ducker 1: – 50.
Threshold: + 20 to – 40dBV with in/out/external mode switch.
Price: $380.

ALTEC (USA)

Altec Corp, 1515 South Manchester Avenue, Anaheim, Cal 92803.
Phone: (714) 774-2900.
Europe: Altec Lansing International Ltd, 17 Park Place, Stevenage, Herts SG1 1DU, UK.
Phone: 0438 3241. Telex: 825495.
UK: Theatre Projects Sound Ltd, 10 Long Acre, London WC2E 9LN.
Phone: 01-240 5411.

1612A Limiter
A 2-input device that functions either as a line amp or a limiter amp.
Equivalent input noise: – 130dBm with *1588C* mic preamp; maximum output noise – 55dBm, 20kHz bandwidth.
Total harmonic distortion: as a limiter amp; 1% typical, 50Hz to 20kHz at + 8dBm output, threshold to 25dB compression.
Attack time: typically 10μs in 'fast' mode; 33μs in 'slow'.
Release time: typically 800ms in 'fast' mode; 2.8s in 'slow'.
Threshold: variable from – 74dBm input with *1588C* mic preamp; from – 40dBm direct input.
Slope: nominally 20:1 from threshold to 25dB compression.
Limit/line balance: 0-20dB of compression.

ASHLY (USA)

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

SC-50
19in rack mounting peak limiter/compressor with balanced inputs, detector patch point for frequency sensitive limiting and LED gain reduction indicator.
Hum and noise: – 90dBV, unity gain.
Distortion: less than 0.05% THD, 0dBV 20Hz to 20kHz, no limiting, less than 0.2% + 18dBV worst case.
Gain: ±30dB.
Ratio: 2:1 to ∞.
Attack: 200μs to 20ms.
Release: 100ms to 2s.
Price: $299.

SC-55
Similar to *SC-50* but stereo unit. Limiting determined by the louder channel.
Price: $499.

AUDIO & DESIGN RECORDING (UK)

Audio & Design (Recording) Ltd, North Street, Reading RG1 4DA.
Phone: 0734 53411. Telex: 848722.
USA: Audio & Design Recording Inc, PO Box 786, Bremerton, Washington 98310.
Phone: (206) 275-5009. Telex: 152426.

F600 Broadcast Limiter
A 'straight forward' 2-channel limiter for use in systems that have critical overload conditions, such as optical film recording, disc cutting, and broadcast transmitters.
Noise: 80dB ref limiter threshold.
Distortion: 0.2% at 1kHz.
Gain: 34dB max, unity in bypass mode.
Attack time: 10, 25, 500μs, 1, 2.5 and 25ms.
Release time: 25, 50, 100, 200, 400, 800ms, 1.6 and 3.2s, plus 'automatic'.
Threshold: input: – 19dBm max for limiting; output: up to + 15dBm.
Price: £725.

F690 Music-Voice Ratio Limiter
Consists of a standard *F600* stereo broadcast limiter fitted with a voice-operated threshold switching circuit. Spec virtually identical.
Price: £815.

F760X Compex Limiter
A unit that combines a variable ratio compressor with an overall peak limiter and a low-level, noise reducing expander/gate. Available as a mono or stereo rack-mounting system, and as a mono module. Three limit pre-emphasis values—50, 75 or 100μs—can be supplied.
Noise: better than – 80dB ref threshold level as set by output attenuator; better than – 87dB with expander operational.
Distortion: compressor 0.1% at + 10dBm threshold (typically 0.04%); limiter 0.3% at + 14dBm.
Attack time: limiter 250μs for 100% control of overshoot without over-limiting; compressor 250μs, 2.5 and 25ms; expander 20μs, 2 and 40ms.
Release time: limiter 250ms; compressor 25, 50, 100, 200, 400, 800ms, 1.6 and 3.2s, plus 'automatic'; expander/gate variable between 25ms and 5s.
Threshold: limiter + 14dBm max ref unattenuated output; compressor calibrated wrt peak limiter threshold and marked 0 to 20dBm in 2dB steps; expander/gate – 40 to + 14dBm wrt input.
Price: £1,055 (stereo system).

F769X Vocal Stresser
Basically, comprises a *F760X Compex* limiter and an *E900* sweep equaliser. A routing switch changes the relationship between the two units: the equaliser can be positioned before or after the limiter, or inserted into the limiter's control side chain, thus modifying its response to frequency content. Not only de-essing, but 'de-rumbling' and 'de-bass end modulating' are among the useful applications said to be possible.
Price: £795.

E500/E560 Band Processor/limiter
Specifically designed for band-split limiting, the *E500* features the following: high and lowpass sweep filters for dynamic and static shelf-type eq; parametric notch filter of variable 'Q' for dynamic or static peaking/limiting; monitoring of selected area for adjustment and use as effect; switched threshold control that converts variable input/output limiters or expanders to unity gain; electronic crossover with zero phase-shift; simulated 'stereo' from mono tracks; and phasing effects by altering sweep notch control. The model *E560* combines the selective notch section of the *E500* with an *F600* limiter.
Price: *E500*: £915; *E560*: £1,025 (stereo models).

SO1 Compressor/limiter Module
A member of the *Scamp* family of 1in modules.
Noise: less than – 80dB (no conditions).
Total harmonic distortion: 0.1% (no conditions).
Attack time: limiter 500μs; compressor 500μs, 2 and 25ms.
Release time: limiter 250ms; compressor variable between 25ms and 3s, with an 'automatic multiple network' position that gives a fast recovery time over 5dB gain reduction range on a slowly changing release platform.
Threshold: limiter – 4 to + 16dBm max output level; compressor linked to ratio selection so that for 10dB compression on any slope the output level remains constant, and above that level of compression the slope tightens to 30:1 as the peak level limiter becomes operational.
Compressoion ratio: 1, 1.5, 2, 3, 5 and 10:1.
Price: £220.

Gemini Compact
Available as *Gemini Compact* or ITAM *Compliment.*
Noise: 78dB ref limit threshold at – 3dB and 25kHz.
Distortion: 0.2% at 1kHz for 10dB compression.
Attack time: 500μs and 5ms.
Release time: variable between 25ms and 3s, plus 'automatic'.
Threshold: – 10 to + 10dBm at output (– 20dBm at input).
Ratio: limiter 20:1, compressor 1.5 and 3.1.

ADR F769X

ADR F690—RS

Stereo matching: ±1dB on control voltage tracking over 10dB range.
Price: £310.

Gemini Easy Rider
Twin-channel comp/limiter with the facility to link control signals for stereo use. LED metering of gain.
Noise: – 82dB ref + 12dBm.
Distortion: 0.15% at 1kHz ref + 12dBm, 10dB gain reduction.
Attack time: fast 500μs, slow 5ms, dynamically controlled.
Release time: fast 15ms, slow 4s, plus automatic.
Thesholds: automatically change in relation to ratio.
Ratios: switched 1:1, variable 1.5:1 to 20:1.
Stereo matching: ±1dB channel to channel over 20dB gain reduction.
Price: £450.

Ex-press Limiter
Compact stereo compressor/limiter/expander designed for simplicity of operation. Digital logic switching, memory to retain 'last use' settings when switched off. Meter calibrated in VU and gain reduction scales to display output — left, right or sum, and gain reduction.
Noise: 82dB reference to + 12dBm (max limit level).
Distortion: 0.15% reference to + 12dBm at 1kHz.
Gain: 25dB gain control range from onset of limiting with 28dB make up gain.
Attack: 500μs to 5ms for 10dB over limit threshold.
Release: 25ms to 3s on 10dB over limit threshold. Auto position 25ms on 5s.
Ratio: 1.5:1, 2:1, 5:1 and limit (20:1) turning into a limit slope after 10dB of compression.
Price: £595.

ADM (USA)

ADM Technology Inc, 16005 Sturgeon, Roseville, Michigan 48066.
Phone: (313) 778-8400. Telex: 231114.
UK: Ampex GB Ltd, Acre Road, Reading RG2 0QR.
Phone: 0734 848346.

302 Limiter Module
Noise: – 73dBm max below threshold; – 85dBm max at 20dB limiting.
Distortion: 0.15%, typical.
Gain: 0dB below threshold; up to 30dB of gain reduction.
Attack time: 1ms.
Release time: 50ms to 2.5s.
Threshold: – 16 to + 24dBm.
Power: ±20V, 50mA.

AUDIO DEVELOPMENTS (UK)

Audio Developments, Hall Lane, Walsall Wood, Brownhills, West Midlands WS9 9AU.
Phone: 05433 5351. Telex: 338212.
USA: Coherent Communications, 13733 Glenoaks Blvd, Sylmar, Cal 91342.
Phone: (213) 362-2566.

ADO55
A rack-mounting unit, the two channels of which are completely independent but can be linked for stereo operation. DIN, *XLR* and audio jack connectors are fitted for ease of connection.
Attack time: 250, 500μs, 1, 2, 4 and 8ms, switchable.
Release time: 75, 150, 300, 600ms, 1.2 and 2.4s, switchable.
Threshold: two ranges; 'low ratios' adjustable from – 10 to + 10dBm in 2dB steps; 'limit' adjustable from 0 to 20dB in 2dB steps.
Ratio: 1, 2, 3 and 5:1, plus 'limit' (20:1).
Distortion: 0.05%.

AUDIX (UK)

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

4BO2 Module
A compressor/limiter in a 178 × 40 × 255mm module also equipped with a noise gate.
Noise: less than – 94dBm.
Distortion: 0.1%, typically 0.03% at 1kHz for 10dB limiting.
Attack time: 1, 2, 5, 10, 20 and 50ms.
Release time: 100, 200, 500ms, 1 and 2s, plus 'auto' which gives a time related to depth of compression.

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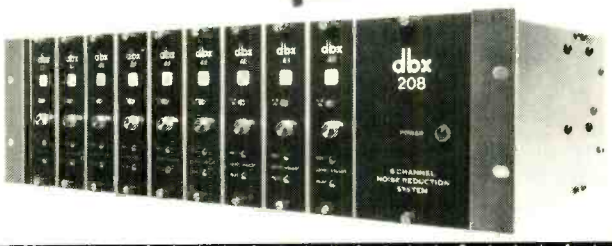
advanced technology for the recording industry

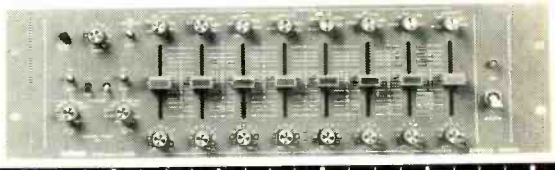
Mixing consoles from AMEK
Tape Pack & Allison 65K Automation

Monitoring,
from Eastlake to Auratone

Sole distributors
of dbx noise
reduction and
dbx compressors



Sole distributors of signal processors by,
Marshall Electronic, Deltalab, Orban, APSI



Sole distributors of
reverberation systems by
Lexicon, MIC-MIX, Orban

Scenic Sounds SSE Equipment Ltd.

97-99 Dean Street, London W1V 5RA
Telephone: 01-734 28[illegible]/3445
Telex: 27 939 SCENIC G

Survey

Threshold: – 10 to + 12dBm in 2dB steps.
Ratio: 1.5, 2, 3, 4 and 6:1, plus 'limit'.
Noise gate: sets gate to cut off input signal below – 50, – 40, – 30, – 20 and – 10dBm, and 'off'.

SP704 Limiter Amplifier
Designed for insertion into programme lines operating at 0dBm. Facilities for slave (tandem) and voice-over applications are incorporated.
Noise: – 80dBm (no conditions).
Distortion: 0.03% residual; 0.1% operating (at 500Hz).
Attack time: 'auto' (nominally 5ms for 12dB of control).
Release time: 100, 200, 500ms, 1 and 2s, plus 'auto'.
Threshold: – 12 to + 4dBm in 2dB steps, and 'off'.
Ratio: 8:1 internal drive and 2:1 external drive.

BARTH (West Germany)

R. Barth KG, Grillparzerstrasse 6a, D-2000 Hamburg 76.
Phone: 040 229-8883. Telex: 212095.
USA: Audicon Marketing Group, 1200 Beechwood Avenue, Nashville, Tennessee 37212.
Phone: (615) 256-6900. Telex: 554494.
UK: Eela Audio, 13 Molesworth, Hoddesdon, Herts.
Phone: 09924 68674.

Dynaset U311
Compressor/limiter with capability of two independent operational bands above and below the chosen dynamic range. Each band can be set for separate threshold, limiting/compression ratios. Upper range is between – 12dBm and + 12dBm while lower range is below 0 and – 30dB below the setting of the upper band. VCA circuitry. Available in single channel for rack mounting within master frame or stereo unit with channel coupling. Single module has additional expander position.
Noise: 94dB 20Hz to 20kHz input noise.
THD: at 6dB limiting and 18dB driving 600Ω at 1kHz in slow position 0.1%.
Attack: fast: 330ms/20dB; slow: 1.2s/20dB; variable 200ms to 1.2s.
Release: fast: 330ms/20dB; slow: 1.2s/20dB; variable 200ms to 1.2s or automatically optimised setting on two bands.
Price: stereo unit $1735, single module $930.

B & B AUDIO (USA)

Aphex Systems Ltd, 7801 Melrose Avenue, Los Angeles, Cal 90046.
Phone: (213) 655-1411. Telex: 910-321-5762.
UK: AKG Acoustics Ltd, 191 The Vale, London W3 7QS.
Phone: 01-749 2042. Telex: 28938.

CX-1 Compressor-Expander
Modular construction fitting *R-1* rack which holds 10 modules. Internal metering 10 segment bar graph showing compression and expansion gain reduction separately and together and output level. Also terminals for connection of external VU meter.
Noise: 85dB 20kHz bandwidth, at unity gain and input shorted.
THD: 0.1% 20Hz to 20kHz maximum value.
Release: 50ms to 2.5s (compression).
Threshold: – 20dBV to + 20dBV (compression).
Price: *CX-1* $495, £265; Rack *R-1* for 10 *CX-1* $195, £110; Power supply for *R-1* $250, £135.

BE (USA)

Broadcast Electronics Inc, 4100 North 24th Street, PO Box 3606, Quincy, Illinois 62301.
Phone: (217) 224-9600.
UK: Lee Engineering Ltd, Napier House, Bridge Street, Walton-on-Thames, Surrey KT12 1AP.
Phone: 09322 43124. Telex: 928475.

AM-400
AM Compressor/limiter. Operates in symmetrical or asymmetrical modes, the latter allowing positive peaks of 25% higher than negative peaks. Can be operated as compressor/limiter, compressor only or fixed gain conventional line amp. Rack mounting format and tamper-proof front controls. VU meter.
Noise: 60dB below + 20dBm output with – 20dBm input unweighted.
Distortion: 0.5% or less, 30Hz to 15kHz at + 20dBm output.
Attack: 1.0ms.
Release: 5 to 40s for 20dB release.
Ratio: 30:1 max.

AM-500
Similar to *AM-400* but includes audio gating for optimum low noise operation, overmodulation protection and a gain indicator meter.

FM-600/FM-601
Mono and stereo FM broadcast limiters. Several operational compression ranges varying from sampling incoming signal and only applying compression where necessary to 20dB dynamic range. Modular construction. Mode switching for pre-emphasis, frequency response and test position, gating and limiting. Automatic stereo balance. Specification similar or better than *AM-400*.

BIAMP (USA)

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

Quad Limiter
All purpose, multi-channel limiter/compressor. Four independent channels each with threshold control and LED to indicate when limiting or compression is occurring. Release time set by screwdriver adjustment on each channel.
Noise: below max threshold setting 102dB.
THD: 0.03% at 1kHz with 12dB reduction in gain.
Attack: 1ms.
Release: 150ms to 1.5s.
Price: $269.

CATHEDRAL (UK)

Cathedral Sounds Ltd, Fourways, Morris Lane, Halsall, Ormskirk, Lancs L39 8SX.
Phone: 0704 840328.

CL4
Quad comp/limiter, self powered.
Gain: nominal + 8dBm.
Ratio: continuously variable from 1:1 to 20:1.
Threshold: operating from – 24dB upwards.
Release time: 100ms to 5s approx.

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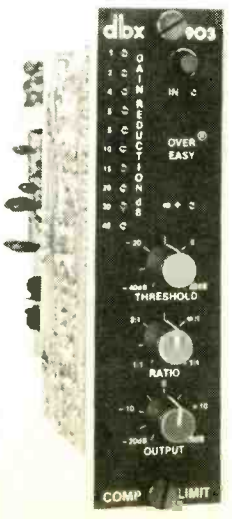
dbx (USA)

dbx Inc, 71 Chapel Street, Newton, Mass 02195.
Phone: (617) 964-3210. Telex: 922522.
UK: Scenic Sounds Equipment, 97-99 Dean Street, London W1V 5RA.
Phone: 01-734 2812. Telex: 27938.

Model 160
Single-channel unit utilising true rms sensing and feed-forward circuitry. The latter is claimed to eliminate noticeable distortion even at high compression ratios. Two units may be ganged for rack-mounting.
Equivalent input noise: – 78dBm, typical unweighted.
Distortion: 0.075% 2nd harmonic at infinite compression and + 40dBm output; 0.5% 3rd harmonic typical at infinite compression ratio.
Attack time: 15ms for 10dB level change above threshold; 5ms for 20dB change; 3ms for 30dB change.
Release rate: 120dB/s.
Compression ratio: 1:1 to infinity.
Threshold: – 38 to + 12dBm.
Price: £220, dual £440.



dbx Model 903

Model 162
A 'true-stereo' unit utilising true rms sensing, feed-forward circuitry and ganged threshold, compression and output gain controls. Two or more units can be linked for quadraphonic operation. Specification virtually identical to *Model 160*.
Price: £420.

Model 163
One knob only on the front panel which increases or decreases the amount of compression automatically maintaining a consistent output level. Features 'over easy' transfer curve gradually adds compression over several dBs around the threshold point. 12 LED level display.
Input noise: – 78dBm 20Hz to 20kHz.
Threshold: – 36dBm to + 4dBm.
Output: + 18dBm into 2kΩ.
Attack time: 5ms for 20dB level change.
Release time: 120dB/s in ∞ compression region.
Ratio: automatically varies from 1:1 below threshold to∞:1 above threshold.
Price: £110.

Model 164
Stereo version of *163* in 19in rack format.
Price: £220.

Model 165
Professional comp/limiter featuring automatic or manual control of attack and release rates, 'over easy' compression.
Input noise: – 90dBm 20Hz to 20kHz.
Threshold: – 40 to + 10dBm.
Ratio: 1:1 continuously variable to ∞:1.
Output: + 23dBm into 600Ω.
Attack time: manual 1 to 400dB/ms, automatic mode 15ms for 10dB level change, 5ms for 20dB, 3ms for 30dB.
Release time: manual 10 to 4000dB/s, automatic 120dB/s.
Features: stereo coupling facility.
Price: £325.

Model 903
Part of the dbx *900* series modular signal processing system. Each mainframe will hold up to 8 modules. Uses the dbx 'Over Easy' compression curve and offers negative compression that begins reducing the output volume once threshold is exceeded. rms level sensing.
Noise: – 88dBm.
Distortion: 0.05% 2nd harmonic, 0.2% 3rd harmonic at zero compression, 1kHz. 0dBm.
Attack: program dependent – 15ms for 10dB above threshold, 5ms for 20dB over threshold.
Release: 120dB/s.
Ratio: Variable (1:1) – (∞:1) – (– 1:1).
Threshold: – 40dBm to + 20dBm.
Price: $325.

D&R (Netherlands)

D&R Electronica BV, Keizersgracht 284, NL-1016 EW, Amsterdam.
Phone: 020 25.01.30.

Compressor
Frame mounting compressor, mains powered, adjustable compression ratio, stereo coupling, LED compression indicator.
Noise: – 76dB for unity gain.
Distortion: 0.05%.

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dbx Model 165

F.W.O. Bauch Limited
49 Theobald Street, Boreham Wood, Hertfordshire WD6 4RZ
Telephone 01-953 0091 Telex 27502

MR-2

MR-2 delivers more usable console for the money. Efficient design has reduced the labor and material content, while improving features, signal handling, and reliability.

MR-2 offers a full range of options and features, allowing you to specialize your console to your functional and budgeting needs.

MR-2 expansion frames and module update kits continue to keep your console matched to your future needs.

Resale prices of Harrison-designed-and-built consoles demonstrate that MR-2 will continue to protect you even at trade-in.

More Usable Console for the Money?

Somehow that sounds like cheating—as though you could get something for nothing. NOT SO!!

The secret is to eliminate things that cost money but do not add any function or "quality" to the console.

The console designers at Harrison Systems have identified many traditional inefficiencies and have eliminated these in the design of MR-2.

Printed-circuit boards have been made smaller (thus, less expensive) through the use of double-sided artwork and a more meticulous, time-consuming design process.

Almost all hand-wiring in the frame has been eliminated. Mother-board-mounted multi-pin connectors are used for inputs and outputs.

Seldom-used features (like Quad) have been eliminated and replaced with more desirable and useful features.

Module width has been reduced to 40.6 mm (1.6"), thus reducing metal-work cost for a given console size.

In other words, every small detail of the MR-2 design has been critically optimized for efficiency. This efficiency does not mean, however, a reduction in signal-handling quality or reliability. In fact, just the opposite is true.

A radical new multiple-ground system is at work to even further reduce induced noise.

Modern "dielectrically isolated" switches are used for all logically controlled switch functions.

Patch points now operate full line level (+ 4 dBu or + 6 dBu) and are isolated and balanced.

These are only a few of the reasons that allow us to confidently say that MR-2 is the most efficient, cost-effective console ever offered by anyone to the industry.

We think you will agree and make it your choice as well.

Harrison

NOW MORE THAN EVER

HARRISON SYSTEMS, INCORPORATED P.O. Box 22964, Nashville, Tennessee 37202/(615) 834-1184, Telex 555133

Survey

Input: – 20dBV to + 20dBV.
Gain: max 40dB.
Attack time: 20ms to 100ms.
Release time: 20ms to 5s.
Ratio: 1:1 to 20:1.
Price: on application.

Stereo Limiter
Frame mounting limiter, mains powered, linked input and output controls, LED limiting action indicator, bypass.
Noise: – 76dB.
Distortion: 0.01%, in limit 0.25%.
Input: – 10dBV to + 20dBV.
Attack time: less than 1ms.
Release time: 20ms to 2s.
Price: on application.

DUKANE (USA)

Dukane Corp, International Division, 2900 Dukane Drive, St. Charles, Illinois 60174.
Phone: (312) 584-2300. Telex: 720426.

Model 2A80B Compressor /Noise Gate
Described as a 2-input line amp combining a compression amp with an 'instantly operating' noise gate that reduces the no signal noise by 15dB.
Noise: – 70dB at threshold of compression, – 80dB dynamic noise level with amp on.
Distortion: 0.5% with 40dB of compression.
Gain: channel 1:5:15 ±2dB at threshold of compression; channel 2:39 ±2dB with 600Ω matching transformer.
Attack time: 30μs.
Release time: 1.5s.
Compression ratio: 10 and 5:1.

Model 2A103 Compressor Module
Noise: – 65dBm from threshold.
Distortion: 1% max.
Gain: 34dB at threshold.
Attack time: 1ms.
Release time: 1.5s.
Compression ratio: 10:1.
Power: ±24V, 20mA via octal plug.

Model 2A165 Compressor Amplifier
A pcb module designed to plug into standard 19in rack-mounting chassis.
Noise: 80dB below output, 20kHz bandwidth.
Distortion: 5%, 5dB into compression.
Gain: 20 ±2dB below threshold.
Attack time: 500ms.
Release time: 3-5s.
Compression ratio: 20:1
Power: ±22.5V, 20mA.

EMT (West Germany)

EMT-Franz GmbH, Postfach 1520, D-7630, Lahr.
Phone: 78025 512. Telex: 754319.
UK: FWO Bauch Ltd, 49 Theobald Street, Boreham Wood, Herts WD6 4RZ.
Phone: 01-953 0091. Telex: 27502.
USA: Gotham Audio Corp, 741 Washington Street, New York, NY10014.
Phone: (212) 741-7411.

EMT 156
2-channel unit with identical controls of dynamic compression and limiting to avoid any displacement of stereo image. Limiting or compression, or both, are pushbutton controlled.
Limiter threshold: – 2 to + 7.5dB (referred to internal reference level of 0dB).
Attack time: 0.1ms max.
Release time: 250ms to 2.5s adjustable, for 10dB gain variation.
Compressor gain: 0 to 18dB, adjustable.
Ratio: 1.5 to 4:1.
Rotation point: – 6 to – 1.5dB (0dB internal reference).
Attack time: 1 to 4ms, internally adjustable.
Release time: 500ms to 3.5s, adjustable, for 10dB gain variation.
Expansion ratio: 1.5 or 2.5:1.
Rotation point: – 35 to – 55dB (0dB internal reference).
Attack time: coupled with compressor release time.
Release time: 1.5 to 7.5s, adjustable, for 10dB gain variation; about 4.5s in automatic mode.
Distortion: 0.6% at 1kHz, 0dB gain.
Crosstalk: 35dB between channels at 1kHz and nominal level.
Other: internal gain can be varied over 40dB range by means of a 6V dc signal applied to a rear-panel socket.
Price: £2,749.

EMT 257 Limiter
In 'equalisation' mode an amp with a frequency-weighting network is inserted into the control loop. Components for the pre-emphasis are fabricated on a plug-in unit, and can be changed for any desired frequency weighting of the limiting threshold.
Attack time: 50 to 500μs.
Release time: 250ms to 20s/10dB.
Threshold: – 2 to + 10dB relative to internal zero.
Range: 20dB max.
Other: can be switched between linear or pre-emphasised mode.
Power: 24V dc (either polarity).
Price: £511.

EMT 260 Filter-Limiter
Comprises an amp and limiter linked by means of a frequency crossover network. Below the limiting threshold, If components are fed via the amp branch and hf via the limiter. If the threshold is exceeded, gain is reduced in the hf branch.
Attack time: 50 to 500μs/10dB.
Release time: 0.25 to 10s/10dB.
Range: 15dB at 20kHz.
Control: responsive to average value below threshold; peak value above threshold.
Turnover frequency: 4.5kHz.
Weighting: 60 or 180μs.
Power: 24V dc (either polarity), approx 130mA.
Price: £511.

EMT 258 Noise Filter
Comprises a bandpass, highpass and lowpass filter, all three set for the same frequency between 1 and 20kHz, linked to an expander circuit. The latter is automatically switched in and out as necessary, and functions in the range below 1kHz to supplement the effects of the lowpass filter. Thus the unit adjusts itself in such a way as to leave the signal modulation unchanged, while attenuating the hf noise components.
Noise: 80dB rms (unweighted) at 0dB internal level.
Distortion: 0.5% at 0dB internal level.
Expander release time: 50ms for 10dB.
Filter release time: 50ms to 2s, adjustable.
Turnover frequency: 1 to 20kHz, dependent on signal amplitude; threshold of signal that determines turnover frequency is adjustable between – 25 and – 65dB.
Power: 24V dc (either polarity).
Price: £547.

EMT 261 Compressor/limiter
Provides limiting, compression and expansion in a minimum size with variable adjustment of static and dynamic characteristics.
Ratio: 2:1 to 20:1, 1:2.5 expanding.
Attack time: 400 μs limiting, 2.5ms compression.
Release time: 250ms to 10s (or automatic).
Threshold: 3dB above normal level for limiter, expander – 35 to – 55dB.
Signal-to-noise: better than 69dB compression gain.
Gain: compression 0 to 12dB.
Power requirements: 24V dc, roughly stabilised.
Price: £528.

EMT 266 Transient Limiter
Suitable for FM broadcast modulation, disc cutting and cassette duplication. The input signal is delayed by 0.3ms while the input for the limiting control is taken before the delay. The limiter can then be fully prepared to respond to the program signal and ensure no excessive signals are present at the output. Variable pre-emphasis. Stereo operation.
Noise: 75dB rms unweighted refered to nominal level.
Distortion: 0.2%.
Price: £1,397.

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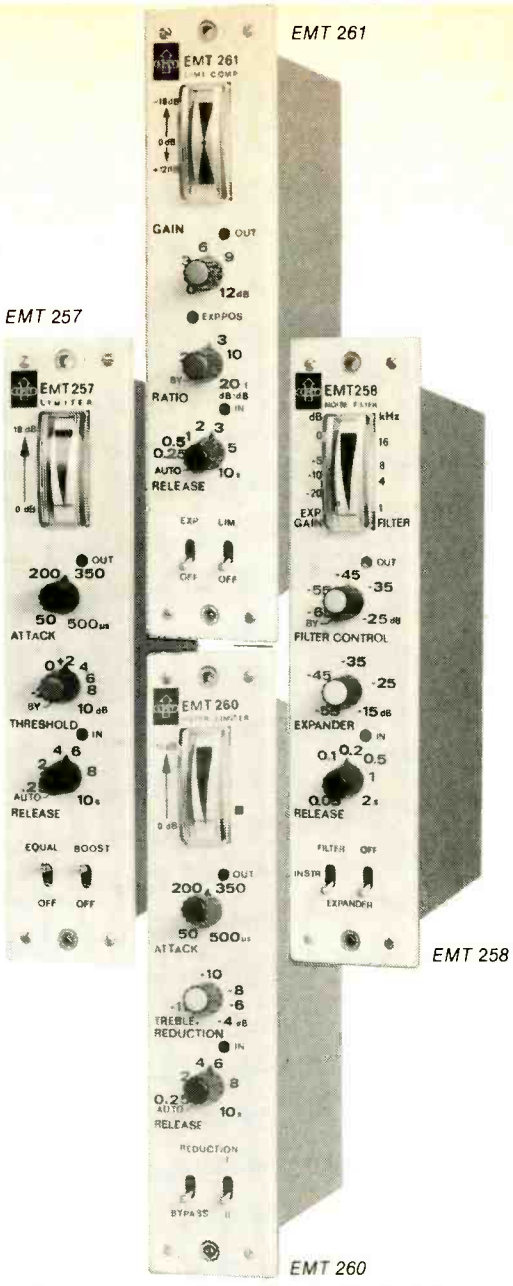

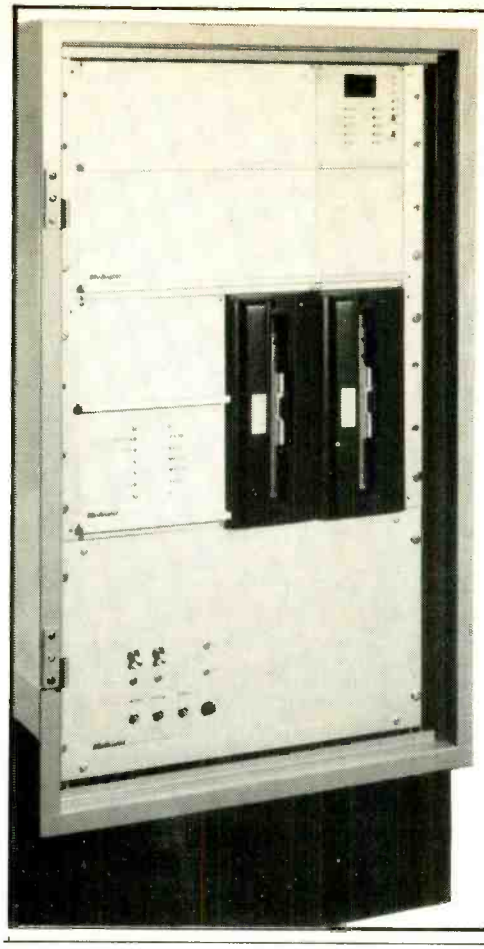

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EVENTIDE (USA)

Eventide Clockworks Inc, 265 West 54th Street, New York, NY10019.
Phone: (212) 581-9290.
UK: Feldon Audio Ltd, 126 Great Portland Street, London W1N 5PH.
Phone: 01-580 4314. Telex: 28668.

Omnipressor
Combines the characteristics of a compressor, expander, noise gate and limiter in a rack-mounting unit. Also capable of dynamic reversal + 10dBm input produces – 10dBm output and vice versa.
Noise: – 90dBm below output at unity gain.
Distortion: 0.05% 20Hz to 20kHz, and typically 0.02% at 1kHz with AGC disabled.
Attack time: 100ms to 100s, continuously variable.
Release time: 1ms to 1s, continuously variable.
Compression ratio: 1:1 through infinity to – 10:1, continuously variable. (Infinite compression setting gives constant output ±1dB for 60dB change in input level.)
Expansion ratio: 1-10:1, continuously variable.
Price: £402.32.

FURMAN SOUND (USA)

Furman Sound Inc, 616 Canal Street, San Rafael, Cal 94901.
Phone: (415) 456-6766.
UK: Atlantex Music Ltd, 34 Bancroft, Hitchin, Herts SG5 1LA.
Phone: 0462 31511. Telex: 826967.

Model LC-2
Comp/limiter with input/output level controls and LED display of gain range. Selectable normal compression, de-essing, or side chain modes. Two units may be interconnected for stereo operation.
Noise: 92dB with 5dB of gain reduction.
THD: 0.04% with no gain reduction, 0.07% with 5dB of gain reduction.
Attack: 400µs to 25ms.
Release: 200ms to 5s, program adjusted.
Ratio: 2:1 to 50:1.
Price: $300.

INOVONICS (USA)

Inovonics Inc, 503-B Vandell Way, Campbell, Cal 95008.
Phone: (408) 374-8300.
UK: Feldon Audio Ltd, 126 Great Portland Street, London W1N 5PH.
Phone: 01-580 4314. Telex: 28668.

Model 201
Suitable for recording, mastering and broadcast work. Operates as fast peak limiter and independent average-responding limiter. Gain reduction meter and 19in rack mounting. Stereo coupling facility.
Noise: 75dB 20Hz to 20kHz referred to + 4dBm line level.
THD: peak limiter—0.5% 50 to 200Hz and 0.25% 200Hz to 20kHz with slow release, average level limiter—same as peak response.
Attack: variable between 1µs/dB and 1ms/dB limiting.
Release: variable between 5ms/dB and 50ms/dB limiting.
Average level limiter AVG response 10ms/dB limiting.
Price: £280.89.

ITAM (UK)

Industrial Tape Applications Ltd, 1-7 Harewood Avenue, Marylebone Road, London NW1 0AE.
Phone: 01-724 2497. Telex: 21879.

Compliment
Only available in Europe. For specifications see Audio & Design's entry for *Gemini Compact* stereo compressor limiter.
Price: £247.

JBL (USA)

James B. Lansing Sound Inc, 8500 Balboa Blvd, Northridge, Cal 91329.
Phone: (213) 893-8411. Telex: 674993.
UK: Harman (Audio) UK Ltd, Mill Street, Slough, Berks SL2 5DD.
Phone: 0753 76911.

7130
Dual input compressor/limiter switchable for mic or line input. Compression threshold set by input level control. VU meter to show amount of compression or output level. Rack mounting.
Distortion: 0.25%, 30dB compression + 18dB output 20Hz to 20kHz.
Ratio: 1:1, 2:1, 20:1, switchable.
Attack: 40µs, 3ms, 140ms, switchable.
Release: 30dB/s, 8dB/s, 4dB/s switchable.
Threshold: – 10 to + 6dBm continuously variable.
Price: on application.


Omnipressor

ROGER MAYER (USA)

Roger Mayer Associates, 225 East 57th Street, New York, NY 10022.
Phone: (212) 486-1544.
UK: Scenic Sounds Equipment, 97-99 Dean Street, London W1V 5RA.
Phone: 01-734 2812. Telex: 27939.

Model RM68
Noise gate with 150ns attack capability and 'exceptionally musical sound'.
Release time: 30ms to 5s.
Attenuation range: adjustable 0 to 30dB.
Distortion: 0.05% under normal operating conditions.
Output noise: – 96dB 20Hz to 20kHz.
Power requirements: + 24V dc at 40mA.
Auxiliary keying input: permits ducking.
Sensitivity: adjustable – 56dBm to 20dBm.
Price: £72. *RM68X* is retrofit for other manufacturers' racks, price £85.

MM (UK)

MM Electronics, PA:CE Musical Equipment Ltd, 63 Kneesworth Street, Royston, Herts.
Phone: 0763 452075.

EP141
Stereo compressor/limiter for line level operation in recording and PA applications. Rack mounting.
Noise: 68dB reference to the input.
Distortion: better than 0.5%, typically 0.15% measured at 1kHz release 500ms, + 4dB input and 15dB limiting.
Attack time: 2ms.
Release: 50ms to 1s.
Ratio: 1:1 to 1-limit.
Threshold: – 15dBm to + 20dBm.
Price: on application.

MOSELEY ASSOCIATES (USA)

Moseley Associates Inc, Santa Barbara Research Park, 111 Castilian Drive, Goleta, Cal 93017.
Phone: (805) 968-9621. Telex: 658448.

TFL-280 Audio Limiter
A single-channel broadcast limiter for fm mono, stereo, quadraphonic and sca applications, plus TV sound. The unit is supplied with 75µs pre-emphasis, but can be converted for other time constants. An output de-emphasis network can be switched in when flat response operation is required.
Noise: 70dB (de-emphasised).
Distortion: 0.7% 50Hz to 15kHz at any degree of limiting.
Attack time: hf controller 20µs; wideband controller 20µs to 2ms (factory set to 100µs).
Release time: hf controller 50 to 500ms, programmable; wideband controller 200ms to 5s, programme-operated triple-timing.
Filtering: plug-in lowpass filter located prior to hf AGC.
Control range: 35dB.

Model TAL-320
AM broadcast limiter featuring switchable lowpass filtering, direct coupled transformerless output stage, FET input circuitry and stereo strapping facility.
Noise: better than 70dB 20Hz to 20kHz with lowpass filter in.
Distortion: less than 0.2% below threshold of limiting and less than 0.7% at any level or setting above this.
Attack: continuously adjustable 0.2 to 3ms.
Release: 100ms to 5s

Model TGR-340
Automatic gain rider. Includes recovery enabling gate to stop gain riding during programme pauses, control to allow time delay to be added to AGC recovery, switchable treble AGC.
Noise: better than 70dB, 20Hz to 20kHz.
Distortion: less than 0.3% below AGC threshold and less than 0.7% at any setting above.
Attack: 2ms.
Release: 200ms on transients, 5 to 25s on programme.

MXR (USA)

MXR Innovations Inc, 277 N Goodman Street, Rochester, NY 14607.
Phone: (716) 442-5320.
UK: Atlantex Music Ltd, 34 Bancroft, Hitchin, Herts SG5 1LA.
Phone: 0462 31511. Telex: 826967.

Mini Limiter
Noise: 73dB below threshold.
Threshold level: – 30 to + 10dBm.
Attack time: approx 1ms.
Release time: variable via rear-panel trim pot, and dependent upon amount of gain reduction.
Other: four LEDs indicating gain reduction.
Power: + 15 to 30V, 22mA.
Price: £103.02.

Dual Limiter
Two independent limiters that may be ganged for stereo applications, each channel having in-out switch, slope, input, output, attack and release controls with LED meter showing gain reduction, *XLR* and jack connectors, detector available on jack socket.
Noise: 90dB below cont output.
Ratio: 4:1 or infinity.
Attack time: 0.5 to 50ms.
Release time: 100ms to 5s.
Distortion: 0.05% below threshold.
Price: on application.

NEVE (UK)

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

22 Series
Available in a variety of formats: *2254/E* standard version with 133 × 137mm panel dimensions; *2264*, repackaged version with 222 × 46mm panel; *3314* another repackaged version with 222 × 35mm panel; *2254/S*, a variant of the *2254/E* with pre-emphasis in the compression side chain to reduce sibilance; *2264/X*, a variant of the *2264* for use in 150Ω systems; and *LCR2P*, a 133mm, rack-mounted package of two *2254/E*s with power supply and stereo link option. All models can be linked for stereo or multichannel operation. Independent limit and compress functions are also featured. The compression section samples ahead of the output amp, thus enabling mean programme level to be raised after compression.
Noise: better than – 75dB, rms unweighted, unity gain.
Distortion: 0.08% in linear condition, up to 0.5dB under limit ceiling; 0.2% with compression 6:1, 800ms release, + 80dB output, + 20dB input, – 14dB threshold.
Compression threshold: – 20 to + 10dB in 2dB steps.
Ratio: 1.5, 2, 3, 4 and 6:1.
Attack time: 5ms (nominal).
Release time: 400, 800ms and 1.5s, plus 'auto' (50ms/5s).
Gain: 0 to 20dB in 2dB steps.
Limit ceiling: + 4 to + 12dB in 0.5dB steps.
Attack time: 'fast': 100µs to 5ms, programmable.
Release time: 100, 200 and 800ms, plus 'auto' (50ms/5s).
Slope: 'at least' 100':1.

33609/10/11/12
Range of limiter/compressors that may be linked for stereo and multichannel operation and which sample ahead of the amp allowing the mean output level to be raised after compression.
Noise: without gain make-up – 75dB 20Hz to 20kHz.
Distortion: 0.2% compress, 0.4% limit.
Threshold: limiting + 4dBm to + 15dBm, compression – 20dBm to + 10dBm.
Attack: limiting 2ms, 4ms, compression 3ms.
Recovery: limiting 50ms, 100ms, 200ms, 800ms and auto, compression 100ms, 400ms, 800ms, 1.5ms and auto.

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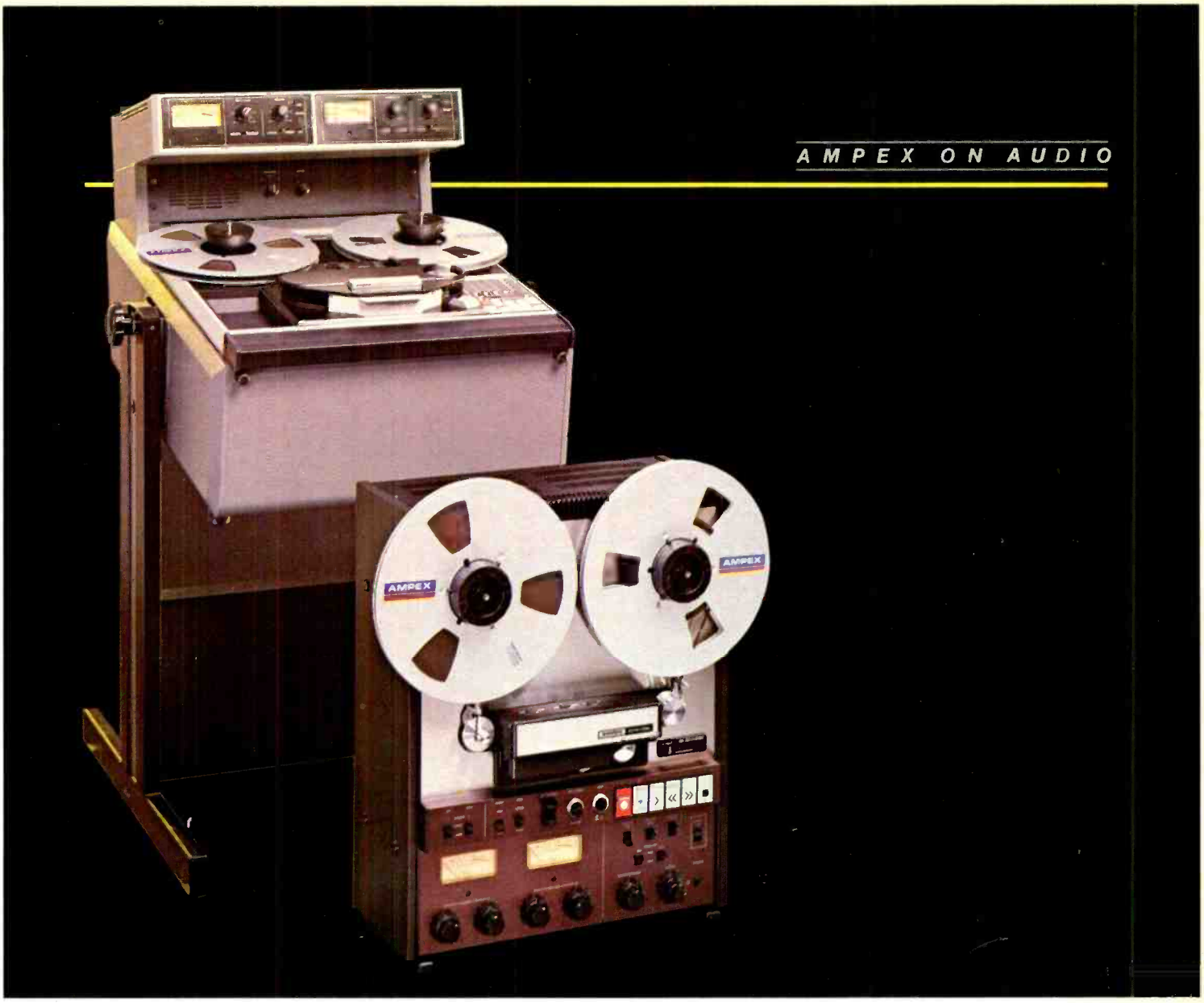

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Survey

33609 double unit with power supply, *33610* single unit with power supply, *33611* double unit less power supply, *33612* single unit less power supply.

NTP (Denmark)

NTP Electronik A/S, 44 Theklavej, DK-2400, Copenhagen NV.
Phone: 01-10.12.22. Telex: 16378.

179-120 Compressor
In order to operate with long attack times, a fast symmetrical limiter is provided. Control voltages of two units can be linked for equal gain stereo operation.
Noise: 80dB(A) at compression threshold.
Distortion: 0.5% up to 20dB gain reduction.
Gain: up to 15dB.
Attack time: 100µs to 200ms/20dB, adjustable in 11 steps.
Release time: 60ms to 4s/20dB, plus 'auto' (200ms upon 15s), in 11 steps.
Release delay: 0 or 50ms, switched.
Compression ratio: 1, 2, 3, 5 and 20:1.
Threshold: + 6dB (normal); + 19dB ('normal').
Power: 24V dc, either polarity, approx 100mA. Version for ±15V dc known as *179-140*.

179-230 Limiter
Incorporates a combination of a relatively long attack time with a symmetric log clipping curve to eliminate transient noise during striking. Recovery circuit is programme dependent based on a dual-time constant principle, said to eliminate pumping and similar effects. Control voltages of two units can be linked for stereo operation.
Noise: 80dB(A) at limiting threshold.
Distortion: 0 to 20dB limiting, 0.3%; 20 to 30dB limiting, 0.5%; 20Hz to 20kHz steady conditions.
Attack time: 1.5ms.
Release time: T1: 100, 200, 400ms, 1, 2 and 4s; T2: 1, 2, 4, 10 and 20s, and 'off'.
Threshold: + 6, + 0.5dB, referenced to output.
Range: 30dB.
Pre-emphasis: 50µs (normally not connected).
Power: 24V dc, either polarity, approx 75mA.

179-240/340
These are the same amps as the *179-230* but do not have the external controls of gain and release. *240* is for 24V dc operation and the *340* for ±15V dc.

179-300 Limiter Card
Based on same circuitry found in *179-230* limiter.
Noise: 82dB(A) at limiting threshold.
Distortion: 0.2% up to 20dB limiting, 40Hz to 20kHz.
Attack time: 1.5ms.
Release time: dual time constants, 200ms upon 15s.
Control voltage: 1V/5dB; may be linked for stereo operation.
Power: ±15V dc, 60mA.

179-310 Limiter
Built on a card system and intended for the protection of transmission lines. High input overload margin. Via the 31-pole connector external controls may be used for threshold and release. Switches on the board for output threshold and pre-emphasis.
Noise: 72dB weighted CCIR.
Distortion: 0.2% at threshold, 0.3% 0 to 20dB above threshold and 0.5% 20 to 30dB above threshold.
Attack: 1.5ms.
Release: dual time constant 0.1s upon 20s.
Power: 22V to 32V dc or ±11V to ±16V dc, 80mA.

179-160 Compressor Expander
Modular unit containing compressor, expander limiter and gate functions. Possible to remote certain functions. Stereo linkable. 16 LED display of gain reduction. Adjustable reference level to match external equipment separate from output level. In bypass mode acts as a linear amp. Fully comprehensive controls for each function with indicator LEDs.
Noise: 89dBu rms 20Hz to 22kHz output noise at 0dB gain.
Distortion: less than 0.1% 40Hz to 15kHz.
Ratio: 1.3:1 to 20:1 compression.
Attack: 0.1ms to 100ms compressor, 1.5ms for limiter.
Release: 0.1s to 6s or programme controlled frequency dependent position for compressor limiter recovery programme dependent with dual time constants.

NTP 179-170

Power: 22 to 32V dc, 130mA.

179-170
Compact 19in rack mounting compressor/limiter in the form of two channels of *179-160* with identical technical specification. Input and output connections on XLR plugs and 220V ac powered.

ORANGE COUNTY (Canada)

Orange County Electronics Corp Ltd, 1125 Empress Street, Winnipeg, Manitoba R3E 3H1.
Phone: (204) 775-8151.

VS-1 Stressor
A combined single-channel equaliser, limiter, compressor, expander and gate. The equaliser can be routed 'pre' or 'post' compressor-limiter, or inserted into the latter's control side chain.
Noise: – 84dB below limit threshold, – 91dB with expander.
Distortion: 0.1% for 15dB gain reduction at + 18dBm output.
Attack time: compressor 250µs, 2.5 and 25ms; limiter 10µs; expander 20µs, 2.5 and 40ms.
Release time: compressor 25, 50, 100, 200, 300, 400, 800ms, 1.6 and 3.2s, plus 'automatic'; limiter 20ms; expander 25ms to 8s, continuously variable.
Threshold: compressor 0 to –20dB ref peak limiter in 2dB steps, or frequency sensitive; limiter + 18dBm output unattenuated; expander – 40 to + 30dBm input, continuously variable.
Compression ratio: 1, 2, 3, 5, 10 and 20: 1.
Price: $1,855.

CLX-S-FM Stereo Processor
A combined limiter, compressor, expander, gate and hf limiter. The two channels may be used independently, or coupled for stereo operation.
Noise: – 84dB below limit threshold, – 91dB with expander.
Distortion: 0.1% for 15dB gain reduction at + 18dBm output.
Attack time: compressor 250µs, 2.5 and 25ms; limiter 10µs; expander 20µs, 2.5 and 40ms; hf limiter 10µs.
Release time: compressor 25, 50, 100, 200, 300, 400, 800ms, 1.6 and 3.2s, plus 'automatic'; limiter 20ms; expander 25ms to 8s, continuously variable; hf limiter 20ms.
Threshold: compressor 0 to – 20dB ref peak limiter in 2dB steps; limiter + 18dB output unattenuated; expander – 40 to + 30dBm input, continuously variable; hf limiter varies dynamically with frequency, follows 25, 50 or 75µs characteristic.
Ratio: compressor 1, 2, 3, 5, 10 and 20:1; limiter 250:1; expander 1:2 and 1:20; hf limiter 250:1.
Price: $2,275.

CLX Module
A combined single-channel compressor, limiter, expander and gate.
Noise: – 84dB below limit threshold, – 91dB with expander.

NTP 179-160

Distortion: 0.1% for 15dB gain reduction at + 18dBm output.
Attack time: compressor 250µs; 2.5 and 25ms; limiter 10µs, expander 20µs, 2.5 and 40ms.
Release time: compressor 25, 50, 100, 200, 300, 400, 800ms, 1.6 and 3.2s, plus 'automatic'; limiter 20ms; expander 25ms to 8s, continuously variable.
Threshold: compressor 0 to – 20dB ref peak limiter in 2dB steps; limiter + 18dBm output unattenuated; expander – 40 to + 30dBm, continuously variable.
Ratio: compressor 1, 2, 3, 5, 10 and 20:1; limiter 250:1; expander 1:2 and 1:20.
Price: $720.

VS-2 Stressor
Combines the features of several units into one while maintaining uncomplicated set-up and operation. Programme controlled comp/limiter and expander/noise gate loudness contour mode.
Noise: 97dB unweighted.
Distortion: less than 0.1% with 15dB gain reduction.
Limiter: ratio 250:1, attack 10µs, release auto.
Compressor: internal adjustments for ratio 2:1 to 20:1, attack 250µs to 25ms, release 25ms to 4s or auto.
Expander: internal adjustments for ratio 1:2, 1:20, attack 20µs to 40ms, release tracks with compressor.
Stereo couple: on barrier strip.
Price: $976.

VS-3
Similar to *VS-2* but stereo with additional hf limiter using 25, 50 or 75µs characteristics, ratio 250:1, attack 10µs, release 20ms.
Price: $1,148, with lowpass filter $1,298. 50 ▶

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Survey

ORBAN (USA)

Orban Associates Inc, 645 Bryant Street, San Francisco, Cal 94107.
Phone: (415) 957-1067. Telex: 171480.
UK: Scenic Sounds Equipment, 97-99 Dean Street, London W1V 5RA.
Phone: 01-734 2812. Telex: 27939.
UK (Broadcast units): Lee Engineering Ltd, Bridge Street, Walton-on-Thames, Surrey KT12 1AP.
Phone: 09322 43124. Telex: 928475.

▲

418A Stereo Limiter
Noise: – 80dB, typical.
Distortion: 0.05% at 1kHz.
Attack time: hf limiter 3ms; broadband limiter 1-2ms programme controlled.
Release time: hf limiter varies around 15ms according to programme history; broadband limiter continuously variable.
Compression/limiting ratio: 200:1.
Hf time constant: 75, 50, 37.5 and 25μs, and 'flat'.
Price: £498.

▲

Optimod-FM Model 8100A
Broadcast FM compressor/limiter/stereo generator suitable for wideband or multiband operation. Incorporates 'master' band compressor above 200Hz; 'bass' band compressor below 200Hz; hf limiter; FM 'smart clipper' output processor; and frequency-contoured side chain overshoot compensator. Unit available in two formats — standard single chassis, or dual chassis (studio/transmitter) option. Standard units are for 75μs pre-emphasis, 50μs to order — 25μs when used with the Dolby *334* broadcast encoder. Features include VCA gain control; peak reading gain reduction meters; stereo/mono mode switching; and built-in crosstalk test generator.
Frequency response: 75μs pre-emphasis, 50Hz to 15kHz ±0.75dB.
Noise: – 75dB below 100% modulation, 50Hz to 15kHz max; – 80dB typical.
Distortion: <0.05% THD, 50Hz to 15kHz; <0.05% SMPTE IM distortion (60Hz/7kHz; 4:1) compression/limiting defeated. Other modes <0.2% THD.
Attack times: 1ms master band; 5ms hf limiter; program-controlled bass band.
Release times: program-controlled master (adjustable, fast/slow) and bass (non-adjustable); 20ms hf limiter.
Gain reduction: 0 to 25dB master band: 0 to 30dB bass band.

Optimod-AM Model 9000A
AM broadcast processor incorporating a 6-band (150, 300, 700Hz, 1.6, 3.7 and 7.5kHz) frequency selective limiter with 'smart clipping'; a broadband gain-riding compressor; and a programme equaliser. Other features include a transmitter equaliser; a polarity follower; output filter and clipper; and VCA gain reduction of the 'smart clipper'.
Frequency response: 50Hz to 7.5kHz, ±1dB.
Noise: >60dB below 100% modulation, 30Hz to 20kHz.
Distortion: <1% (0.5% typical) at 100% modulation, 50Hz to 7.5kHz.
Attack time: 2ms broadband compressor; 2 to 10ms limiter, dependent on band frequency.
Release time: program-controlled non-adjustable, broadband compressor; program-controlled adjusted to band frequency, limiter.
Compression ratio: >200:1 broadband compressor; >10: 1 limiter.
Compression range: broadband compressor 20dB; limiter bands 1 to 4, 20dB, bands 5 and 6, 30dB.

PYE (UK)

Pye TVT Ltd, Coldhams Lane, Cambridge CB1 3JU.
Phone: 0223 45115. Telex: 81103.
USA: Philips Broadcast Equipment Corp, Audio Division, 94 McKee Drive, Mahwah, New Jersey 07430.
Phone: (201) 529-3800.

LDM0090 Compression Amp
Available as a stereo (2-channel) or mono unit.
Noise: better than – 60dB at 0dB threshold setting; typically – 78dB at – 24dB threshold setting. (Values weighted to CCIR 468.)
Distortion: 1% at 30, 1k and 8k with 600Ω load.
Attack time: compression 0.5ms; limiting 1s ±0.5ms.
Release time: 100ms to 3.2s in six switched steps.
Compression ratio: 1, 2, 3, 5:1 (switched), plus linear for line-up.
Threshold level: compression – 24 to + 16dBm; limiting – 16 to 24dBm; both controls calibrated in 2dB steps.

QUAD-EIGHT (USA)

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

CL-22
Compressor/limiter/expander. VCA controlled circuitry. De-ess switch offering – 3dB at 5kHz and – 10dB at 20kHz. Meter with ±30dB range. Available in three formats—horizontal and vertical modular or stereo rack mounting.
Noise: – 91dBV ref 0.775V zero gain.
Distortion: 0.35% 20Hz to 20kHz with 20dB of compression and 5dB/s release.
Attack: 0.002ms/10dB to 5ms/10dB.
Release: 100dB/s to 5dB/s.
Ratio: 2:1 to 20:1.
Expansion threshold: to – 20dB.
Power: bipolar ±28V dc, 80mA.

RAC (UK)

Rugby Automation Consultants, 220 Alwyn Road, Rugby CV22 7RA.
Phone: 0788 810367.

LIM1 Board
A pair of pcbs for incorporating a limiter into existing equipment.
Noise: – 80dB (no conditions).
Distortion: generally less than 0.5%.
Gain: 13dB unlimited.
Attack time: 20μs.
Release time: 33ms/700ms combination.
Compression ratio: 4:1 at – 10dB threshold, to 25:1 at + 13dB threshold.
Power: 24V dc.
Price: £14.25, $26.

RACLIM 2 Module
A mains powered unit for rack-mounting.
Noise: – 80dB (no conditions).
Distortion: generally less than 0.5%.
Gain: 20dB.
Attack time: 20μs.
Release time: switchable, four positions.
Compression ratio: 1-25:1.
Threshold: – 20 to + 10dB in six switched positions.
Price: £69, $130.

REBIS (UK)

Rebis Audio, Kinver Stret, Stourbridge, West Midlands DY8 6AB.
Phone: 0384 71865.
Export: Scenic Sounds Equipment, 97-99 Dean Street W1V 5RA.
Phone: 01-734 2812. Telex: 27939.

RA 301
A 2-channel 3½in rack mounting unit for independent compression and limiting, or ganged for stereo operation. VU metering of input, output and compression.
Noise: – 75dBm 20Hz to 20kHz.
Distortion: 0.6% at 5dB compression; 0.2% at 20dB compression.
Attack time: 20μs to 1.5ms.
Release time: 50ms to 3s.
Compression/limiting ratio: 1-40:1.
Minimum threshold: – 20dBm.
Max gain: 38dB.
Price: £435.

RA203
A 5¼in by 1in module compatible with the Rebis rack. Spec as for *RA301* except threshold control instead of separate input and output controls.
Price: £129.

SCV (France)

SCV Audio, Bât 3418 C, Rue de la Jeune Fille, F-95705 Roissy Cedex, France.
Phone: 862.43.04.

Compressor/De-esser
2-channel unit in 19in rack format. Stereo coupling. LED gain reduction meters on both channels.
Noise: 70dB at 20dB of compression.
Distortion: 0.5% with 20dB of compression.
Attack: 0.2ms to 70ms.
Release: 300ms to 3s.
Ratio: 2:1 to 20:1.

SESCOM (USA)

Sescom Inc, PO Box 590, Gardena, Cal 90247.
Phone: (213) 770-3510.
UK: Atlantex Music Ltd, 34 Bancroft, Hitchin, Herts SG5 1LA.
Phone: 0462 31511. Telex: 826967.

C-2 Compressor Module
A plug-in, octal-based unit with adjustable AGC time constant between 0.1 and 1s by means of an external resistor.
Noise: – 90dB below rated output.
Distortion: 0.5%, 20Hz to 20kHz.
Compression range: input varying between – 43 and + 14dBm provides constant 0dBm output.
Power: + 24V dc.
Price: £24.57.

SHURE (USA)

Shure Brothers Inc, 222 Hartrey Avenue, Evanston, Illinois 60204.
Phone: (312) 328-9000. Telex: 724381.
UK: Shure Electronics Ltd, Eccleston Road, Maidstone ME15 6AU.
Phone: 0622-59881. Telex: 96121.

SE30-2E Gated Compressor/mixer
Combines a 3-input mono mixer and a gated memory compressor in one unit. A 40dB compression range is featured, with a ratio of approx 10:1 in the normal operating range. The response rate (averaging time constant) is adjustable to compensate for various types of programme material. Attack and recovery are variable between 100ms and 8s, and in the 'hold' condition the gated memory holds the gain recovery to less than 20dB after 60s to prevent pumping. A stereo parallel jack allows two units to be synchronised.
Price: £321.30.

Model M625 Voicegate
A voice-activated microphone gain controller, typically for PA applications to block out unwanted background noise below a pre-set level.
Price: £105.30.

SOLIDYNE (Argentine)

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

250-XC Compressor
Compressor/limiter/expander. The attack as well as the recovery times are automatic and are controlled by an analogue computer which adjusts the action of the compressor to suit the programme.
Noise: better than 70dB.
Distortion: below 0.25% in any condition between 20Hz to 20kHz at + 18dBm.
Expansion threshold: between – 50/ – 35dB.
Expansion ratio: 3:1.
Limiter ratio: 3:1 to 50:1.
Power: 190-230V, 50/60Hz.

SONTEC (USA)

Sontec Corp, 10120 Marble Court, Cockeysville, Maryland 21030.
Phone: (301) 628-2283.

DRC-202
Designed for tape and disc transfer. All controls continuously variable. Stereo tracking between channels on compression but independent on limiting to avoid image shift on transients. LED metering.
Noise: 86dB at unity gain.
Distortion: THD 0.05% at any level – 30dBm to + 20dBm 20Hz to 20kHz.
Threshold: + 4 to + 24dBm.
Attack: adjustable attack time of the rms detectors only. Affects both limit and compression.
Release: effects both peak and rms timing.

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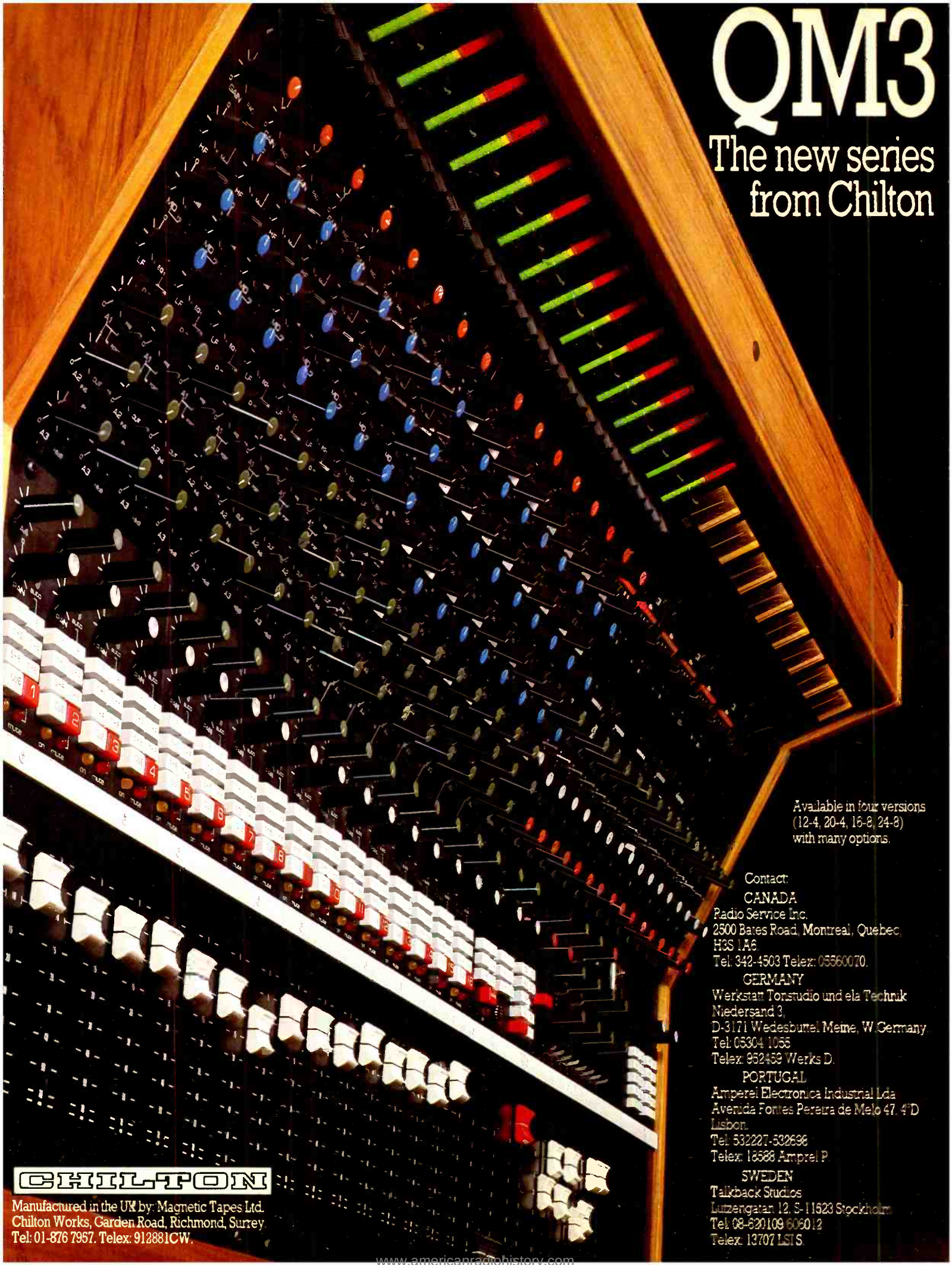


QM3

The new series from Chilton

Available in four versions (12-4, 20-4, 16-8, 24-8) with many options.

Contact:

CANADA
Radio Service Inc.
2500 Bates Road, Montreal, Quebec.
H3S 1A6
Tel. 342-4503 Telex: 05560070.

GERMANY
Werkstatt Tonstudio und ela Technik
Niedersand 3,
D-3171 Wedesbuttel, Meine, W.Germany
Tel: 05304 1056
Telex: 952459 Werks D.

PORTUGAL
Amperel Electronica Industrial Lda
Avenida Fontes Pereira de Melo 47, 4°D
Lisbon.
Tel: 532227-532696
Telex: 13588 Amprel P.

SWEDEN
Talkback Studios
Luttengatan 12, S-11523 Stockholm
Tel: 08-620109 606012
Telex: 13707 LSI S.

CHILTON

Manufactured in the UK by: Magnetic Tapes Ltd.
Chilton Works, Garden Road, Richmond, Surrey.
Tel: 01-876 7957. Telex: 912881CW.

Survey

SPECTRA SONICS (USA)

Spectra Sonics, 770 Wall Avenue, Ogden, Utah 844041.
Phone: (801) 392-7531.
UK: Sun Recording Services, 34-36 Crown Street, Reading, Berkshire.
Phone: 0734 595647.

Model 610 Complimiter
The unit can be used for peak limiting and volume compression, either independently or simultaneously.
Noise: 80dB below +4dBm output with −40dBm input (threshold), 20Hz to 20kHz, unweighted.
Distortion: 0.1%, 30Hz to 20kHz, at +16dBm and up to 30dB compression.
Compression/limiting ratio: 1.1-100:1, continuously variable.
Attack time: limiter 0.1-2μs; compressor 0.1μs to 1.2ms; both automatically variable.
Release time: limiter 0.09μs; compressor 50ms to 10s, continuously variable; both for 90% recovery.
Threshold attack level: −40dBm.

SYMETRIX (USA)

Symetrix Professional Audio Products, 109 Bell Street, Seattle, Washington 98121.
Phone: (206) 682-3076.

CL-100
Comp/limiter using monolithic VCA gain control element (not an FET) with additional de-ess control and side chain insertion allowing the control signal to be passed through an external equaliser etc, five LED indication of gain reduction.
Noise: −84dBV with 20kHz bandwidth.
Distortion: no greater than 0.1% with any combination of settings at +18dBm.
Ratio: 2 to 50:1.
Attack: 100μs to 1s.
Release: 1ms to 5s.
Stereo: interconnect.
Price: $299, balanced input and output $349.

SG-200
Dual channel signal gate. Specification not yet available.
Price: $399.

THOMSON-CSF (USA)

Thomson-CSF Broadcasting Inc, 37 Brownhouse Road, Stamford, Connecticut 06902.
Phone: (203) 327-7700.

VOLUMAX Model 4101/4111 Limiter
A limiter for monaural (*Model 4101*) and stereo (*Model 4111*) fm broadcasting.
Noise: 70dB below maximum output level.
Distortion: 1% with normal gain reduction levels, 50Hz to 15kHz.
Attack time: between 1μs and 3ms, depending on programme waveform and rise time.
Release time: 200ms (low frequencies); 10ms (mid frequencies); 2ms (high frequencies); all field changeable.
Compression ratio: 10:1/infinite.
Control range: 15dB.
Price: *Model 4101* $1,515; *Model 4111* $2,650.

VOLUMAX Model 4300 Limiter
A limiter for AM broadcasting.
Noise: 70dB wrt max output level.
Distortion: 1%, 50Hz to 15kHz.
Attack time: between 1μs and 2ms, depending on programme waveform.
Release time: 200ms.
Compression ratio: 10:1/infinite.
Maximum gain: 50dB.
Control range: 15dB.
Threshold level: selectable; 100, 115 or 125% of negative peaks.
Price: $1,325.

Audimax Model 4440A/4450A Compressor
A compressor for monaural (*Model 4440A*) or stereo (*Model 4450A*) broadcasting.
Noise: 70dB with normal gain.
Distortion: 0.5%, 50Hz to 15kHz at +16dBm output.
Attack time: 10 to 150ms, depending on programme.
Release time: 0.9, 1.5, 3s, gated and adjustable.
Compression ratio: 10:1.
Control: ±1dB of gain.
Gating threshold levels: adjustable from −20dB to normal input.
Price: *Model 4440A* $1,260; *Model 4450A* $2,245.

TRACK AUDIO (USA)

Track Audio Inc, 33753 9th Avenue South, Federal Way, Washington 98003.
Phone: (206) 838-4460.

LM-1R
Rack mountable comp/limiter, illuminated VU meter switchable to read actual output level, or gain reduction. Connections by barrier strip.
Ratio: variable 2:1 to infinity.
Attack time: 200μs to 20ms.
Release time: 100ms to 2s.
Price: $350.

Discriminate Audio Processor II
3-band compressor with each band having full separate controls, metering, compression in/out with separate output meter.
Attack: 2 to 20ms.
Release: 1 to 2s.
Ratio: 2:1 to 30:1.

TRIDENT (UK)

Trident Audio Developments Ltd, PO Box 38, Studios Road, Shepperton, Middx WW17 0QD.
Phone: 09328 60241. Telex: 8813982.
USA: Sound Maintenance Services, 12438 Magnolia Blvd, North Hollywood, Cal 91607.
Phone: (213) 877-3311. Telex: 674901.

CB9146
Compact comp/limiter occupying only ¾in of rack space, versatile operation, VU meter indication of gain reduction, *XLR* connectors.
Ratio: cont variable 1:1 to 20:1.
Attack: cont variable 20μs to 200ms.
Release: cont variable 25ms to 500ms.
Threshold: internally set at −20dBm.
Input and output: cont variable over 40dB range.
Distortion: 0.3% with 20dB limiting.
Price: £297.

TWEED (UK)

Tweed Audio Electronics, Rosewood Industrial Estate, Kelso, Roxburghshire.
Phone: 05732 2983. Telex: 727633.

CL603 Limiter Module
A side chain pre-emphasis option is available for FM broadcast applications. Two units can be supplied in a 19in rack for ganged operation.
Noise: −78dB, 20Hz to 20kHz.
Distortion: 0.3% at 20dBm limiting into 600Ω load; residual typical 0.05%.
Attack time: 20, 200μs and 2ms.
Release time: 70ms to 2s, variable, or automatic self-adjusting 70ms/5s.
Threshold: 0 to 12dB above reference level in 2dB steps.
Ratio: 100:1.

CL604 Compressor/limiter Module
Two or more units may be linked to track for stereo or quadraphonic applications.
Noise: −87dBm (or better) at 0dBm gain.
Distortion: 0.1% operating, residual 0.03%.
Attack time: 5ms (CCITT method) but self-adjusting on programmes.
Release time: 100ms to 3s variable, or automatic self-adjusting.
Threshold: −20 to +10dBm in 5dB steps.
Ratio: 1.5, 2, 3, 4, 6 and 9:1, plus 'limit' (20:1).
Power: ±15V, 30mA.

CL605 Noise Gate
Noise: 87dB 20Hz to 20kHz.
Attack time: 50μs.
Release: equal hold and fade times 100ms to 2s.
Threshold: −10dB to −5dB.
Depth: 10 to 30dB.
Bypass: switch provided with LED.

UREI (USA)

United Recording Electronics Industries, 8460 San Fernando Road, Sun Valley, Cal 91352.
Phone: (213) 767-1000. Telex: 651389.
UK: FWO Bauch Ltd, 49 Theobald Road, Boreham Wood, Herts WD6 4RZ.
Phone: 01-953 0091. Telex: 27502.

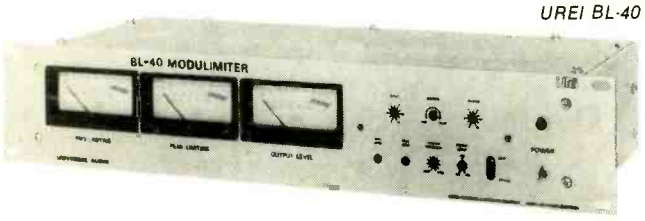
LA-4 rms Compressor/limiter
Utilises an electro-optical attenuator for 'smooth, predictable performance coupled with ease of operation'. Because the unit's gain reduction circuitry is rms-responding, it is not recommended for overmodulation protection of transmitters, disc or optical recorders, unless followed by a peak limiter, such as model *1176LN*. Two units can be linked for stereo application.
Equivalent input noise; 90dBm, 15.7kHz bandwidth.
Distortion: 0.25%, 30Hz to 15kHz,
Attack time: 1 to 10ms for 63% correction, depending on waveform.
Release time: 100ms to 1s for 63% return, depending on duration of limiting.
Compression ratio: 2, 4, 8, 12 and 20:1, front-panel switched.
Threshold of limiting: −30 to +20dBm.
Price: £240.

BL-40 Modulimiter
Designed specifically for AM broadcasting, but with TV and signal processing applications. A 'phase optimiser' circuit automatically maintains most favourable signal polarity, reversing phase whenever negative peaks exceed positive ones by a pre-set amount. Independent controls (plus meters) for rms and peak limiting, and variable positive modulation up to 125%.
Noise: 70dB at the threshold of rms limiting; equivalent input noise less than −100dBm.
Distortion: 0.5%, 30Hz to 15kHz, +24dBm output.
Attack time: rms section 1 to 50ms for 63% correction, dependent on signal; peak section 5μs for 10dBm limiting.
Release time: rms section 50ms to 2s for 63% return, dependent on duration of compression; peak section 100ms.
Price: £451.

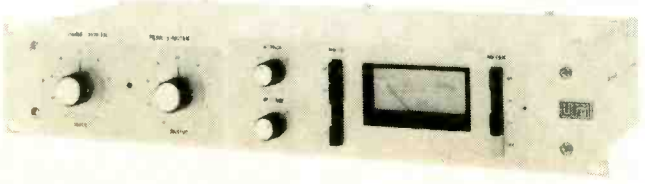
1176LN Peak Limiter
Utilises an FET as a voltage-variable resistor ahead of the first stage of amplification. Two units can be coupled for stereo applications.
Noise: 81dB at threshold of limiting, 30Hz to 18kHz.
Distortion: 0.5%, 50Hz to 15kHz with limiting at 1.1s release and +24dBm output.
Attack time: 20 to 800μs for 100% recovery.
Release time: 50ms to 1.1s for 63% recovery.
Threshold level: dependent on input and output levels and compression ratio setting.
Price: £281.

1178 Dual Peak Limiter
Two channel version of *1176LN*.
Price: £451. ■

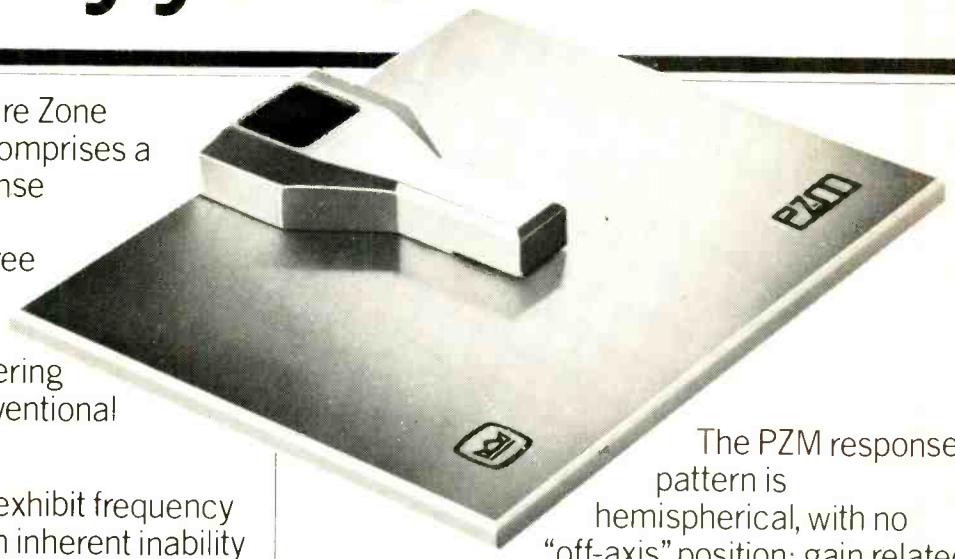
UREI BL-40



UREI 1176LN



Can you afford to ignore the most significant development in microphone technology of the last fifty years?



The revolutionary Pressure Zone Microphone (PZM[tm]) family comprises a range of hemispherical response microphones which give a transparently natural sound, free from non-linear characteristics – such as proximity effect and comb filtering – that are exhibited by all conventional microphones.

Traditional microphones exhibit frequency response anomalies, due to an inherent inability to satisfactorily combine direct and reflected signals, thus leading to phase-induced amplitude cancellations and reinforcements, or comb filtering.

Amcron PZMicrophones[tm] eliminate this effect because they detect sound by means of a new process. This takes advantage of the fact that, as a sound wave approaches a boundary (such as a wall, table or floor), there is formed at this boundary a pressure field four or five mm. deep, within which the direct signal and its reflection from the boundary remain in phase and add coherently.

The Amcron PZM places a small pressure transducer inside the primary boundary pressure zone, facing the boundary. This prevents any direct signal reaching the microphone, thus eliminating the possibility of phase-induced interference and providing a significant improvement in signal quality.

The PZM response pattern is hemispherical, with no "off-axis" position: gain related to distance will change, but not tonal quality. The PZM responds accurately to up to 150 db spl, yet hears a whispered conversation in an ordinary room at ten metres.

Engineers are finding that the PZM continually suggests new miking techniques. And that in many applications fewer PZM's are required than traditional microphones. In fact, the PZM is changing ideas about how a microphone should look, sound, and be used. Don't you think that it's time you got in on the act, and gave the PZM a listen?

Details of available models, prices, and suggestions for applications are obtainable from the sole UK importers and distributors. HHB Hire and Sales, Unit F, New Crescent Works, Nicoll Road, London NW10 9AX. Tel: 01-961 3295. Telex: 923393.

HHB

Amcron

PZM and PZMicrophone are registered trade marks of Crown International.

business

BARRY FOX

Home taping licence

After criticism earlier this year of the industry's track record on disc pressing quality the BPI reformed its technical committee with a working brief 'to ensure that standards are maintained in UK pressings'. No mention, you will note, of *improving* standards. A few outsiders from the record retailing and reviewing trade were brought in for a single meeting at which some frank comments were bounced around but there has been no sign yet of any minutes of the meeting or any follow-up discussions or follow-through proposals.

The BPI, on behalf of the British record companies, has now fallen out publicly with the Mechanical Copyright Protection Society, which represents the music publishing arm of the industry. Until recently the BPI and MCPS have been operating a home taping licence scheme which, for £1.73 a year, enables anyone in the UK to break the copyright laws with a clear conscience. The licence entitles the owner of records to tape them. It's obvious that the revenue from these licences (10,000 a year have been sold to honest souls) can't do much more than pay for the paperwork and it's dubious legal practice to license people to break the law but the home taping scheme has been justified because it at least establishes the principle of copyright in people's minds. If the MCPS had their way the licence scheme would continue, but the MCPS cannot have its way and the BPI have pulled out.

Without BPI approval the MCPS licence scheme is a dead duck because there is both record company and music publisher copyright in every recording. If the MCPS were to go-it-alone with a licence scheme, the owner of a record would still have to approach the record company for permission every time he or she wanted to tape it. The MCPS talked about sending out 10,000 letters explaining to licence holders that their honesty in buying a voluntary licence is no longer appreciated, although I (a licence holder) never actually received one. Newspapers are also having to carry correction notices to negate the small print 'buy-a-licence' notice normally to be found at the bottom of any advertisement for tape, rather like a government health warning on a cigarette advert. As one tape manufacturer put it "The record companies have put themselves in an awkward position. They wanted us to put a copyright warning and a mention of the MCPS licence on every tape advert and we've done just that. Now they realise they have made it more difficult to complain about our adverts so they have decided to kill off the home taping licence."

The BPI have pulled the plug on the scheme because the record companies are pinning their hopes and faith on a levy on blank tape. The MCPS is more realistic and realises that although there may one day be a levy on blank tape sold in the UK it won't be for some time yet. This winter the UK Government will probably publish a Green Paper or discussion document on the reform of British copyright law. This Green Paper *may* recommend a levy on blank tape. After discussion a Bill recommending a levy may be drafted and if and when it gets through parliament intact (assuming of course there isn't a change in government which will kill off any pending bill) the levy *may* become law.

At last the BPI has started talking (albeit secretly) about the level of levy—£1 on the price of a C60 cassette and pro rata. Unfortunately, there doesn't seem to be any talk (even in secret) about how the levy money will be distributed. It would seem grossly unfair if a few successful artists were to cream off some extra loot from a levy on a pro rata royalty basis. The people who really deserve to benefit from any levy are new artists at the bottom of the success tree. These are the lifeblood of the future but they can't get enough recording time because the record companies are pleading poverty and devoting all their energy to selling safe-bet albums.

Incidentally it's not generally known that the tape companies tried to discuss the whole business of a tape levy with the BPI but the offer was turned down unless the tape companies would agree in advance to a voluntary levy! By an unfortunate coincidence this happened at just the same time that EMI paid Malcolm McLaren of Sex Pistols fame a hefty advance (could it be £55,000?) for a record by a group which rejoices under the name Bow Wow Wow. The group's first single was *C30, C60, C90 Go* and as everyone by now doubtless well knows, the lyrics, which were printed on the record sleeves to ensure that everyone got the message, positively exalted home taping. Commercial release of the disc was delayed for a while after advance pressings had been broadcast by disc jockeys. There was a fair amount of internal squabbling over whether the contentious record should ever be sold but EMI decided to go ahead and claimed that release of the disc was intended "to bring the whole business of home taping out into the open". This, of course, may have been EMI's original intention, or it could have been a tailor-made philosophy cooked up after the company had recognised its faux pas. Some say that no one at EMI had bothered to listen to the lyrics of the discs before signing the contract with McLaren.

Tape spoilers

Believe it or not the record companies are still dreaming of a technical solution to home taping, ie a 'spoiler system' which magically prevents a record being taped even though it plays perfectly normally for home listening! There's been some awful garbage talked recently on spoilers, for instance it has been suggested that digital recording holds the key. Those who have made this claim have presumably forgotten that we all have analogue ears. So any digital signal will always have to be returned to analogue form at some stage in the chain. And that is where copying will take place. The latest group to claim success with a spoiler is the Bron organisation, which owns the Roundhouse studio in Chalk Farm. Bron's spoiler idea first surfaced at the BPI annual general meeting in June 1980 and there was talk of a "practical demonstration . . . in about three weeks time". But by the end of August, when the *Sunday Times* carried an hilariously garbled report on spoilers, there had still been no demonstration.

It would be easy to dismiss the Bron claim as just another example of industry ignorance but Gerry Bron is not your average record company executive. He's the first I've found who has shown any real understanding of the spoiler issue. He recognises all the old pitfalls and talks none of the nonsense constantly mouthed by other industry spokesmen who pontificate on technical matters on which they clearly understand less than nothing. It would surely be a supreme irony if the Bron organisation, essentially a music publishing house with only limited technical resources, were to succeed where the world record companies with massive technical backup have failed. No one doubts that spoiler signals can be made to work in a laboratory or on *some* domestic equipment.

Making them work without adversely affecting ordinary replay and on home taping equipment in the hands of punters who want to defeat the system, is quite another matter. The video world has already found this out. It's possible to degrade the sync pulses of a TV recording so that it won't re-record; but unfortunately it also won't play back on all domestic TV receivers, and you can already buy anti-anticopy devices for around $100 in the USA. If, as seems a foregone conclusion, the Bron scheme proves impractical on one count or another, or is too easy to defeat, then Bron must be prepared to disclose how it failed. In this way other researchers around the world will be saved the time and expense of re-researching the same dead ends. Any company which isn't prepared to explain how it has failed shouldn't publicly claim success until it has been conclusively proven in secret tests. In other words put up or shut up.

Blank tapes

A couple of reports have filtered through of anti-recording systems. These are *not* spoiler systems to prevent the unauthorised copying of discs. They are systems designed to prevent a tape recorder from operating normally in a security area. They parallel the situation which exists in some Japanese factories, where hidden ultraviolet lights ensure that any unauthorised photographs are fogged beyond recognition. It seems that several years ago a BBC reporter tried to make a clandestine recording inside the Chinese Embassy, using a hidden Uher *Reporter*. The tape recording was perfect up to the front door of the embassy but everything recorded inside the building was distorted as if badly under-biased.

More recently Andy Warhol of bean can fame, found an 18 minute gap in a tape recording which he made while covering the Democratic Party convention in New York for a magazine. Warhol had followed President Carter's mother into a lift and recorded some of her characteristically none-too-discreet off-the-cuff comments. Secret Service aides were close by and Warhol found that his tape was mysteriously blank.

Engineers will doubtless have their own theories on how these anti-recording systems work so let's hear them. The most likely suggestion to date is that a super-strong magnetic field is generated in security areas to saturate the recorder transformers, induce eddy currents, to screw up the bias and saturate the tape. ■

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Part Six - When is a Ground not a Ground?

A HUMAN working visualisation of anything electronic soon becomes impossible without a mental image of the nice, solid, infinite, immovable, dependable god — Ground. Similar to the Messiah, this one has many names too: Earth, Ground, OV, Reference, Chassis, Frame, Deck, etc — each of differing interpretation but all ultimately, alluding to the great Omnipotent Nothingness.

Electrons couldn't care less about all this. They just go charging about as potentials dictate and any circuit will work perfectly well referred to nothing but itself (satellites, cars and flashlights work, don't they?). 'Ground' in this instance is but an intellectual convenience.

Interconnection of a number of circuit elements to form a system necessarily means a reference to be used between them. To a large degree it's possible to obviate a reference even then, by the use of differential or balanced interfacing, unless of course power supplies are shared.

So having proved that ground is seemingly only a mental crutch, why is it the most crucial aspect of system design and implementation?

Wire?

Fig 31a shows a typical, ordinary long thin bit of metal known more commonly as wire and occasionally as printed-circuit track. However short it is, it will have resistance which, courtesy of Mr Ohm, means that a voltage will develop across it as soon as any current goes along it; similarly, Mr Maxwell says a magnetic field will develop around it — Bingo! Inductance. If it is in proximity to anything, it will have capacitance to that too.

So, **Fig 31a** actually looks more like **Fig 31b** with resistive and distributed reactive components. Admittedly these values are small and seem of little significance at audio frequencies but clues have already been laid (particularly in Part Three Op-Amps — Friend or Foe?) that believing the world ends at 20kHz is not so much myopic as stupid.

A radio engineer looking at **Fig 31b** would mumble things like "tuned line", "resonance" or "bandpass filter", maybe even (are you sitting comfortably) "antenna". Rf technology and thinking may seem abstruse and irrelevant to console design until it is considered that devices commonly used nowadays have bandwidths often many dozens, sometimes hundreds, of Megahertz wide. An even more frightening realisation is the enormous quantities of rf energy present as a consequence of our technological being.

A more obscure collection of equivalents is shown in **Fig 32**: **(a)** representing a wire into a bipolar transistor input; **(b)** a wire from a conventional complementary output stage; whilst for reference sake, **(c)** is a basic 'crystal-set' type radio receiver. Quaint, but for the presence now of considerably more V/m rf field energy compared to the heyday of 2LO. In all the three circumstances rf collected and/or delivered by the antenna/tuned line is rectified hence demodulated by a diode (being the base-emitter transistor junctions in **(a)** and **(b)**). As contrary as it may seem for demodulation to occur at an amplifier output, it is perhaps the most common detection mechanism with the demodulated product finding its way back to the amplifier input by means of the conveniently provided negative feedback leg.

Making our bit of wire fatter and thicker has the effect of lowering the resistance and inductance whilst increasing capacitance (greater surface area exposed to things nearby) so although the wire's resonant frequency stays about the same the

dynamic impedance (hence 'Q') reduces. Whilst in general this is deemed to be a 'good thing', in some instances it can merely serve to improve the matching and coupling of the rf source to the resonance.

Carried to a not-quite-fatuous extreme, even the console frame constitutes a big fat resonant tank at a surprisingly low (mid-vhf) frequency—and frame resistance, however heavily constructed, cannot be disregarded and treated as a universal earth path. Some 'earth' eh?

For the purposes of practical design, these considerations perhaps become a little better defined. The reactive elements of capacitance, inductance with the attendant effects of resonance, and filtering are concerned with less obvious aspects such as electronic stability and proneness to radio demodulation, whilst resistance gives rise to most of the horrors usually lumped under the collective 'grounding problems'.

A 'good earth'

The closest most of us get to earth is the big pin on a mains plug and fortunately for most purposes it is adequate provided just the one point is used as the reference — other points are likely to have slightly differing potentials due to dissimilar routing and resistances. Compared to a 'technical earth' (eg a water pipe (make sure the plumbing isn't plastic, *please*) alternatively a fortune in copper pipe hammered into the earth) conventional mains earth can have a surprisingly high potential — a volt or two even — considering it is principally a safety facility not ordinarily carrying current. Any potential implies resistance in the earth path which is bad news about something intended as a reference whilst also detracting from the safety aspect. Practically, though, it doesn't matter too much if everything is waving up and down a bit provided everything, including *even unrelated things in proximity* are waving up and down in the same manner. The potential is usually small thankfully, meaning that the 'earth' impedance is reasonably low to the extent it may be considered zero.

Why earth anything?

With all our component system parts tied together by a reference 'ground' (the organisation of which is a bramble patch in itself, to be trod in later) and everything working as expected, the question arises of why it is necessary to refer our 'ground' to earth. If the internal grounding is completely kosher our system will operate perfectly, quietly and tamely regardless of what potential (with respect to earth) it is tied to, whilst if not tied, it will derive its own potential by virtue of resistive leakages, inductive coupling and capacitance to things in its environ. For an independently powered system (say batteries) these leakages and couplings will be of far higher impedance and hence easily swamped by human body impedance to earth. (We are, dependent on hand-clamminess and footwear reasonably coupled to terra-firma at between 5kΩ and a couple of MΩ at 50Hz).

If, as is most often the case, most of the system is powered off the ac mains this floating ground potential becomes of far lower impedance and consequentially much more capable of dragging current through the human load (it's the current that does you in, not the voltage). A tell-tale sign is a burring/tingling feeling as you drag a finger across exposed metalwork on something that is deriving its own ground potential.

The mechanism for this lower impedance is fairly straightforward. Mains transformers are wound with the optimum transfer of energy at 50 to 60Hz and very high flashover voltages, say 2 or 3kV, in mind — the finer points of transformers such as leakage inductance, interwinding and winding imbalance capacitance are all but disregarded, meaning they end up being horrific.

Being far greater in scale than ordinary ambient reactive couplings, they primarily dictate the floating ground potential at anything up to 240V ac or whatever the mains happens to be locally.

A strange practice by a few, predominantly American, manufacturers is to tie either or both the 'live' and 'neutral' mains ac lines to chassis via capacitors, typically of 1 to 100nF with the result that if the chassis is not directly earthed it rides at (in the case of both lines being tied) half the mains voltage. The capacitor values grossly swamp transformer leakages and give the chassis floating potential an uncomfortably (literally) low impedance. The chassis tingle changes from 'Mmm — interesting' to vile oaths with attendant flailing limbs.

A system composed of many separate mains-powered things will almost certainly hum, buzz and sound generally uneasy — seemingly in direct contradiction to the earlier statement that ". . . the system will operate perfectly . . . regardless of what potential it is tied to . . .". Being tied to lots of different potentials at lots of different points along a ground path is definitely not playing the game, sorry.

Each different mains transformer will have different amounts and permutations of leakage and hence propagate different potentials and degrees of mains-borne garbage into our otherwise perfect grounding path. Assorted ground potentials mean assorted ground currents meaning assorted noises.

Tying the entire grounding path to earth is the ultimate swamp-out of leakage impedances. A connection to a (nearly) zero impedance makes a nonsense of most other potential creating paths, most of which have reactances exceeding 1kΩ. Sledge-hammer technique.

Ordinarily in such a multi-supply circumstance, regardless of earth termination, significant currents exist along the ground reference lines. The resultant inter-element noise and hum voltages (developed across the inevitable line resistances) quickly become intolerable in unbalanced systems — any wobbling of the ground reference becomes directly imposed upon the required signal.

Balanced, or pure differential transmission helps obviate these perturbances by rendering them common-mode in a system that is (theoretically) only sensitive to differential information. In reality, practical transformers can afford a good 70 to 80dB common-mode isolation at low audio frequencies but deteriorate in this respect at 6dB/octave with increasing frequency, to poor rejection (if any) around the winding resonance frequencies unless considerable effort is made to 'fudge' a more accurate balance externally. Although transformer balancing does effect a dramatic improvement

58 ▶

FIG. 31 WHAT IS A BIT OF WIRE?

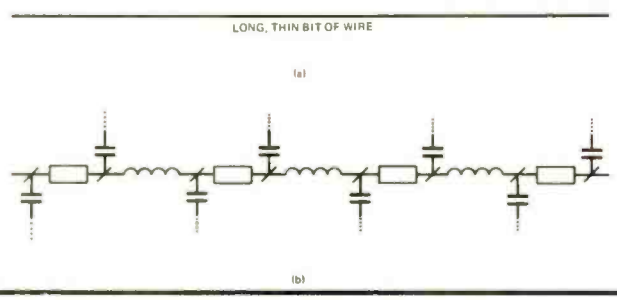
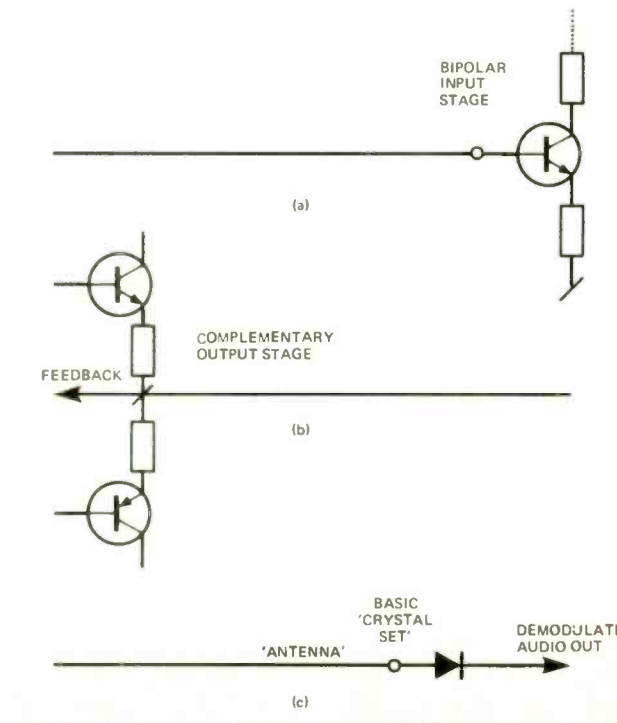


FIG. 32 COLLECTION OF EQUIVALENTS



in noise levels, it is far greater for fundamental hum (50 to 60Hz) than it is for other mains-borne noise. This explains why in 'dodgy' systems lighting dimmer buzz, motor spike noise or any source with a high hf energy or transient content is so persistent. The ubiquitous 'tizz'.

The golden rule is to treat any balanced system's grounding as if it was unbalanced — this minimises the inevitable reference ground currents whilst helping to unlearn that transformers are a panacea.

There is one good reason not yet mentioned for grounding to earth. The consequences of a piece of gear's chassis becoming inadvertently mains live potential, are obvious. Rather death to a fuse or breaker than one of us.

Let's assume (giggles) that the grounding for the studio control room is all sensible and that our console has a nice juicy solid earth termination. What about the intra-console grounding paths? This is perhaps the ultimate unbalanced signal path.

Inside the console

Most conventional amplifier stages rely on a voltage difference between their 'input' and 'reference' in order to produce a corresponding output voltage (referred, naturally, to the input's reference). If the input is held steady, though, whilst the reference is wobbled, a corresponding (amplified) inverted wobble will appear at the output.

It is plain, then, that any signal the reference sees that is not also *common* to the input (eg ground garbage) will get amplified and summed into the output just as effectively as if it were applied to the 'proper' input. The obvious (and startlingly often overlooked) regimen to render extraneous garbage unimportant, is to ensure that the point at which an amplifier's source is referred is tied directly to the amp's reference, whilst the amp's output is only taken in conjunction with its reference. Successive stages daisy-chain similarly — source reference to amp reference, amp reference to destination reference, etc, etc.

This thinking is called. . .

Ground follows signal

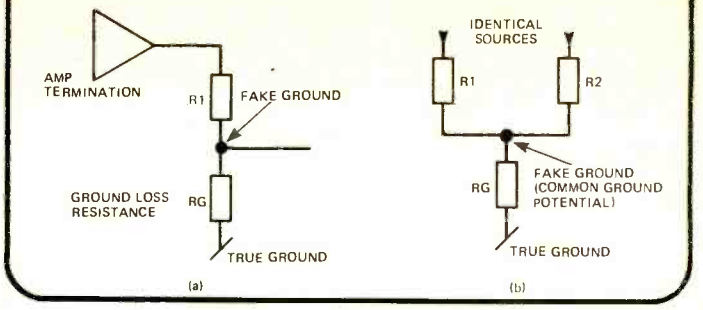
A classic maxim and one that has dictated the system design of nearly every console built. It was particularly true in the era of discrete semiconductor design, where 'ground' was not only audio ground but also the 0V power supply return. As an added complication the power supply positive rails, being heavily regulated and coupled to ground were an equal nightmare as they too became part of the grounding path. This could be fairly simply avoided though by spacing each circuit element away from the supply rail by an impedance considerably greater than that offered by the 'proper' ground path — achieved by either separately regulating or simply decoupling by a series resistor/parallel capacitor network.

Accelerating technology has for once, atypically, actually made life a bit simpler. Specifically, the trend toward IC op-amps with their required differential (+ve and −ve) supply rails. This, thankfully, removes electronic operating current from the audio system ground, whilst individual stage supply decoupling is rendered unnecessary (in most instances) by the excellent power supply noise rejection ratio of most popular op-amps. Nevertheless, correct grounding paths still apply, the removal of supply current just exposing and highlighting audio grounding subtleties.

Unfortunately, whilst op-amps have simplified matters in one respect, their ease of use and versatility have been largely responsible for the creation of enormous systems with so many stages, break points, mix busses and distribution networks that the simple daisy chaining of 'ground follows signal' becomes unwieldy if not unworkable. Alternate grounding schemes, such as 'star' grounding where every ground path and reference is taken to a central ground/earth tend to play an increasingly important role.

In practice, a necessary compromise between these two prime systems occurs in most console thinking. 'Daisy chain' applies mostly to 'on card' electronics (eg in the mic-amp/eq sections) whilst systems switching and routing rely on 'star'.

FIG. 33 AMPLIFIER OUTPUT LOAD



Ground current summing

A principal grounding-related manifestation is crosstalk, or the appearance in a signal path of things that belong elsewhere. Other than 'air-borne' proximity related reactive crosstalk (Part Two) most unwanted visitations are by courtesy of the resistive ground path mechanism.

In **Fig 33a**, R_1 represents the load of an amplifier output (what it is in actuality, say the 10kΩ of a fader or a 600Ω line termination, is immaterial for the present). RG represents a small amount of ground path wiring, etc, loss resistance. It is quite apparent that the bottom end of the termination is spaced a little way from true ground by the wiring resistance — the combination forms a classic potentiometer network. The 'fake ground' has a signal voltage present of the amplifier output voltage attenuated by R_1 into RG.

In a practical circumstance with a 600Ω termination (R_1) and a ground loss (RG) of 0.6Ω, the 'fake ground' will have present a signal voltage about 60dB down. Use of the 'fake ground' as a reference for any other circuitry is a sure-fire guarantee of injecting −60dB worth of crosstalk.

Two identical terminations sharing the same 'fake ground' **(Fig 33b)** happily inject a small proportion into each other by generating a common potential across the ground loss RG.

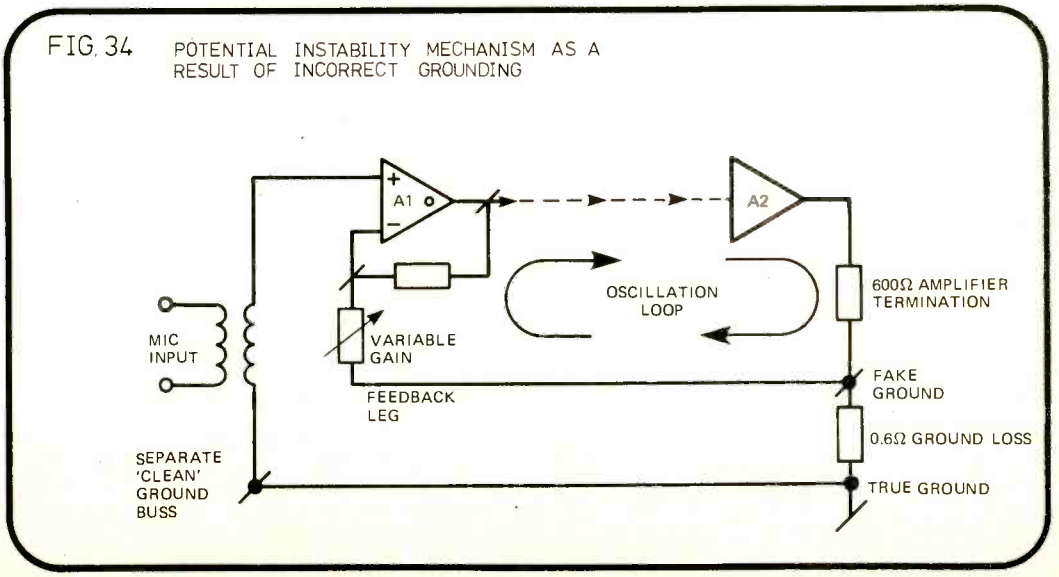
Should the second termination be far higher in impedance (say the 10kΩ of a fader) its contribution to the common 'fake ground' potential will be far less (−86dB) since the ground impedance is much smaller in relation to the source. Correspondingly, though, this higher impedance termination is more prone to be cross-talked into from the lower impedance contributors to the common ground.

Typical problems

Let's take a fairly unusual (but definitely not unknown) grounding anomaly caused as a result of inattention to grounding paths. A_2 is a line amp feeding a termination of 600Ω, into a lossy ground of 0.6Ω resulting in a 'fake ground' potential 60dB below the amp's output **(Fig 34)**. An earlier stage in the chain (A_1), in this example a mic amp, with a considerable amount of gain has its feedback leg (amplifier reference) tied to the same 'fake ground'. Its

60 ▶

FIG. 34 POTENTIAL INSTABILITY MECHANISM AS A RESULT OF INCORRECT GROUNDING



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input ground reference (here lies the cock-up) is taken from a separate buss supposedly to provide a nice 'clean' ground. This, of course, it does admirably, the buss being tied straight to 'true' ground and having no sources of great substance going to it.

Any signal present on the 'fake ground' is duly amplified by the mic amp (in its inverting mode), is attenuated at the line amp output back into the 'fake ground' and — you guessed it — as soon as the mic amp gain exceeds the output attenuation the entire chain bursts into glorious oscillation.

A very similar mechanism was responsible for an owner's criticism of his well-known type American console, that whenever he attempted to use the track routing on any channel module, the sound of that channel discernibly altered. It was found that ordinarily nothing in the channel drew much current, all ground impedance requirements being quite light. Until, that is, the track routing line amp was accessed with its load of routing resistors and terminated output transformer demanding a relatively large ground current. This output stage current shared the module's only ground access point (two parallelled connector pins) with all the rest of the module electronics — with the notable exception of the mic and line input transformer ground returns. The resultant feedback, although nowhere near enough to promote oscillation, did by virtue of the output transformer's phase shifting at both hf and lf frequencies result in distinct colouration.

A purist answer to these 'fake' and loop problems is to choose one grounding point for the entire console and to take every reference and ground return directly to it through separate ground wires (which must of course be coloured green in order to function correctly).

A few minor problems would ensue.

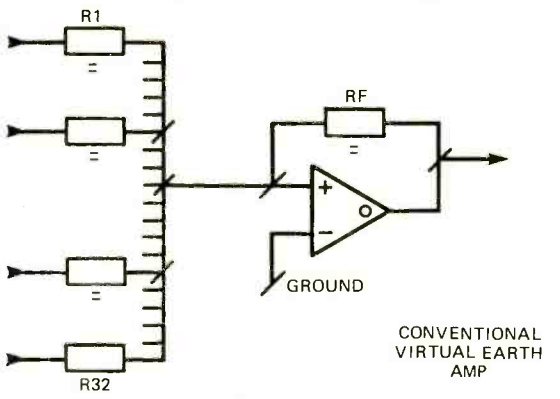
The enormous number of ground lines required would soon outstrip the capacity of the module connectors, the mass of wiring would cause apoplexy if not dark mutters of resignation from the wiremen whilst also severely aggravating the already desperate world shortage of copper. Fortunately, a working compromise suggests itself based upon separating the different classes of ground requirements by impedance.

It seems reasonably safe to tie fairly high impedance sources to a common ground point, buss or line, (since the ratio of their impedances is so great that resultant 'fake ground' potentials will be normally low enough to ignore). Anything that is likely to draw current (any kind of output or line amp stage) should go directly to ground, will not pass through any buss and not collect shared ground paths on the way.

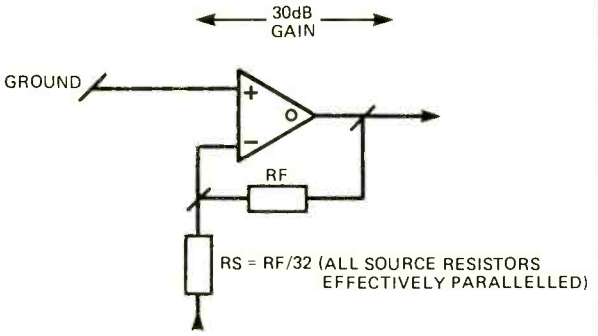
Any ground buss must have a measure of resistance and must therefore be 'fake' to a certain degree, if not a truly festering pit of garbled nasties. If we do our sums right, ground buss signal levels can be kept acceptably low, say below −100dBu.

Smugly, we can expect to ignore figures like that — until we (almost inevitably) amplify them up. If you're wondering what crazy circuit arrangement unavoidably amplifies up garbage ground noise — it's called the . . .

FIG. 35 VIRTUAL EARTH MIX-AMP AS AMPLIFIER OF GROUND-BORNE GARBAGE



(a)



(b)

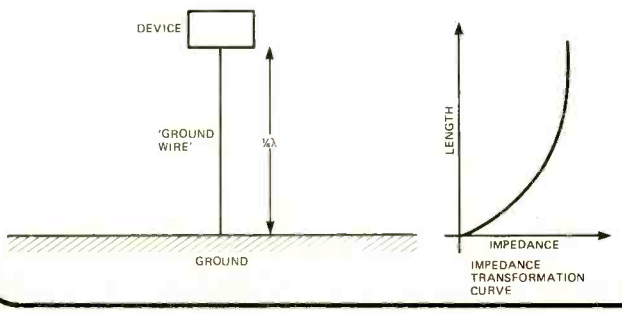
Virtual earth mix amp

Fig 35a tells the story. As, say, a multitrack mix amp, it can typically have 32 sources applied to it — the through gain from any source being unity (assuming the source resistors equal the feedback resistor) but the real electronic gain of the circuit is 33 or about 30dB. Redrawing the circuit slightly, **Fig 35b** shows exactly what this 30dB is amplifying. Clue: that which is directly applied to the op-amp's non-inverting input. Yep, ground! True, it is also merrily amplifying the noise due to the resistors and the internal noise mechanisms of the device, but for our argument here it is amplifying *ground*.

In any reasonably sized console, providing no sources are grossly out of proportion to the majority, ground garbage is pretty random and 'noisy' in character — the result being that on being amplified up it serves to make the mix amp apparently noisier than would be expected from calculation. In suspect systems it has been found to be *the* predominant noise source. It is truly astonishing what loving care and attention to virtual earth mixer grounding can have on buss noise figures.

For mix amps, practical noise performance has little to do with the device employed and nearly everything to do with grounding.

FIG. 36 THE 'STANDING ON ONE LEG' DISAPPEARING GROUND TRICK



. . . And higher up. . .

Noise generation due to grounds is not limited to the resistance predominant in the ground wiring at audio frequencies. At rf, well within the bandwidths of modern op-amps, even fairly short ground wires and busses can have very significant inductive reactances dramatically raising the effective ground impedance. This not so much reduces the isolation between the various stages as directly couples them together. All the inherent rf noise instabilities of the stages resulting become intermodulated (by the device's non-linearity at those frequencies) down to make their presence felt to audio earthlings as yet *more* audible and measurable noise.

A good 'shock-horror' example, which although described in simplistic theoretical terms, manifests itself sometimes dramatically in practice and can be called the 'Standing On One Leg Effect'.

The box in **Fig 36** represents a device that relies on the wire to be connected to the ground mass. Looks OK doesn't it? It is, apart from at the radio frequencies at which the wire is electrically ¼ wavelength or an odd multiple of ¼ wavelength. Our innocuous bit of wire turns into a tuned line transforming the 'zero' impedance of the ground to an 'infinite' impedance at the other end. Result — the device is totally decoupled from ground at those frequencies. Practical consequencies of this of course vary, from instability at very high frequencies on cards with long supply and ground leads to the author's most memorable encounter where an otherwise incurable case of TV signal demodulation in an electronic keyboard was fixed just by snipping a foot off the mains lead. ■

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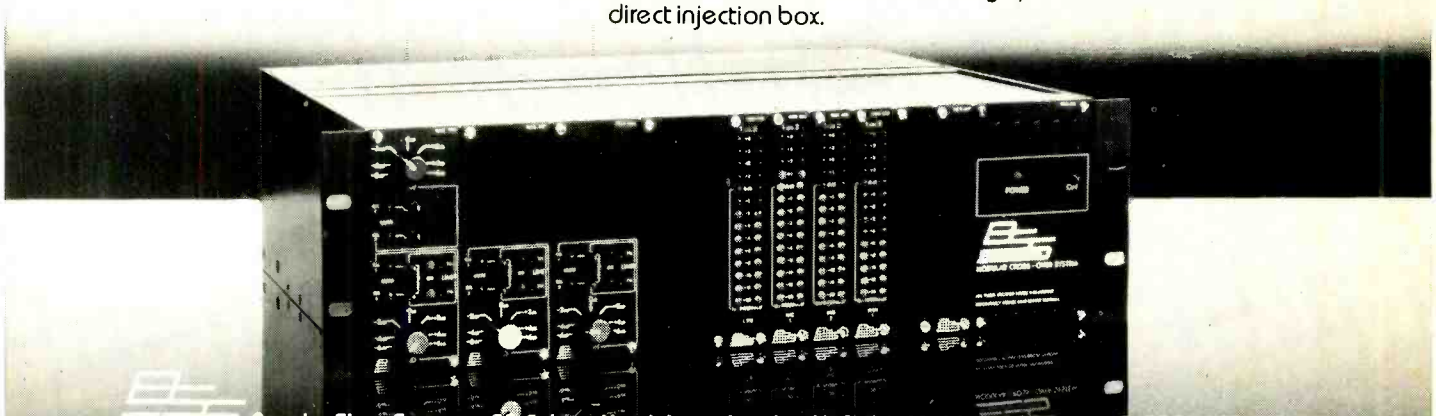

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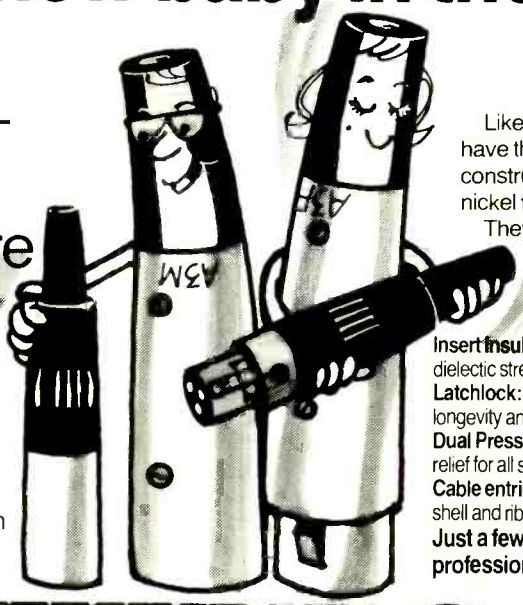

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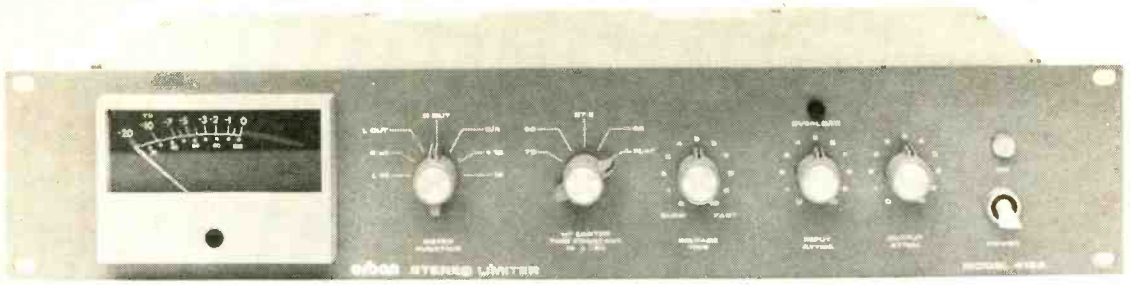
Telephone 01-953 0091, Telex 27502



Orban 418A

MANUFACTURER'S SPECIFICATION
Input: impedance 150kΩ balanced, active differential input.
Level: – 10dBm produces 10dB gain reduction with input attenuator fully clockwise. Absolute input overload occurs at + 21dBm.
Output: impedance less than 400Ω, unbalanced.
Level: + 4dBm nominal with output attenuator fully clockwise. Peak level approximately + 12dBm.
Frequency response: ± 0.5dB, 20Hz to 20kHz below hf limiter threshold.
High frequency limiter: controls hf peaks attempting to exceed a threshold defined by a single time constant roll-off of 75, 50, 37.5 or 25μs, ±3% roll-offs are switch selectable from front panel, and hf limiter is defeated in a flat position. Attack time approximately 3ms. Release time varies around 15ms according to program history.
Control element: junction field effect transistor.
Broadband limiter: attack time 1 to 2ms. Release time program controlled by means of quadruple time constant release-time analogue processor. Release time may be scaled fast or slow by means of continuously variable Release Time control available to user.
Range of gain reduction: greater than 15dB. Compression ratio in excess of 200:1. Interchannel tracking ± 1.5dB max, ± 1dB typical.
Control element: junction field effect transistor.
Separation: 50dB or better, 20Hz to 20kHz.
Noise: (dB below limited threshold at 100Hz: 20Hz to 20kHz bandwidth): – 80dB typical, – 75dB max.
Total harmonic distortion: graph supplied. Typically < 0.05% mid band.
Operating controls: output attenuator (left and right ganged). Input attenuator (left and right ganged). Release time. Hf limiter time constant 75μs, 50μs, 37.5μs, 25μs, flat. Meter selector left input, right input, left output, right output, gain reduction: + 15V power supply, – 15V power supply. Ac line off/on.
Indicators: Ac power pilot lamp. Overload (lights if attempt is made to exceed possible broadband AGC range). Meter [3.5in (89mm) with VU A-scale and characteristics].
Power requirement: 115/230V ac + 10%, 50 to 60Hz, approximately 6W.
Dimensions: (whd) 19 × 3.5 × 10in (483 × 89 × 254mm).
Operating temperature range: 0 to 50°C.
Price: £498.
Manufacturer: Orban Associates Inc, 645 Bryant Street, San Francisco, Cal 94107, USA.
UK: Scenic Sounds Equipment Ltd, 97/99 Dean Street, London W1.

THE Orban model *418A* is a 2-channel stereo compressor/limiter with the control of the gain of the two channels being permanently connected such that the channels track each other.

It follows that there is only one set of controls which operate on the two channels. Monitoring of the levels in the audio inputs and outputs, the instantaneous gain reduction and also the dc levels of the internal ± 15V supplies is by means of a VU type meter to the left of the front panel, the function of the meter being controlled by means of an adjacent 7-position rotary switch.

Proceeding to the right there is next a 5-position rotary switch which selects the time constant of the pre-emphasis in the hf limiter which may be set to 'flat', 25μs, 37.5μs, 50μs or 75μs. Whilst the limiting threshold and the degree of compression once limiting occurs are fixed, the unit includes two separate control circuits. There is first a wideband signal detector which operates on the overall signal. Depending upon the setting of the limiter time constant switch the signal is then subjected to pre-emphasis and fed to a second control circuit, thus providing a separate degree of limiting depending upon the hf content of the signal. After this the correct frequency response is restored by switchable de-emphasis which automatically corresponds to the pre-emphasis previously applied.

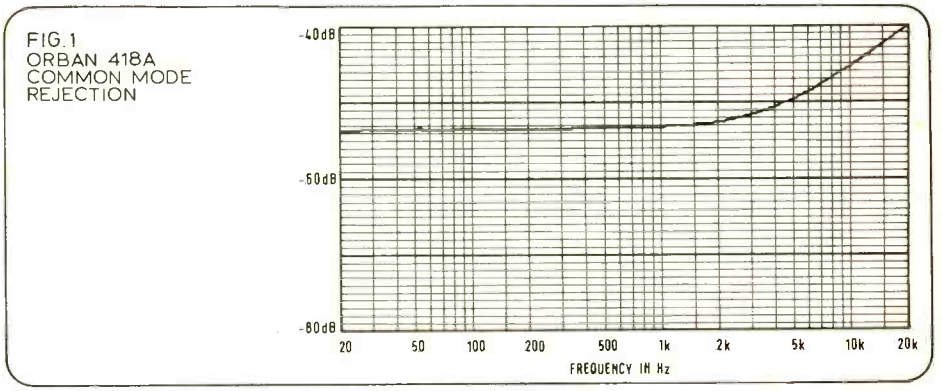


FIG.1
ORBAN 418A
COMMON MODE
REJECTION

Whilst the unit automatically controls the attack time, a front panel release time control allows the operator to optimise the release time depending upon the type of programme material and the desired effect.

There follow two potentiometer controls acting as input and output level controls, these being stereo controls with no balance adjustment between the two channels being provided (or, for that matter, desirable). A red overload lamp adjacent to these controls is illuminated if the unit is driven beyond 15dB limiting. This gives a good margin before the onset of serious distortion.

The remaining front panel features are the power on/off switch and indicator light, with the power being supplied via a fixed lead at the rear panel. In the review sample this lead had the American colour coding and the importer should rectify this matter.

A clearly identified imperial size mains fuse is fitted at the rear of the unit, together with the audio input and output connections in the form of a barrier strip. Whilst the inputs are electronically balanced, the outputs are unbalanced, but very sensibly links are provided for isolating the signal ground from the earth.

Externally the unit, which is designed for mounting into a standard 19in rack, has a pleasantly finished blue front panel in the form of an alloy plate which supports the controls with the rest of the chassis being made of cadmium-plated steel.

With the exception of the power supply, all the electronics are supported on a single, good-quality, double-sided pcb. Good quality components are used in an exceptionally tidy layout. No component identifications are to be found but the operation and maintenance manual does include a layout diagram, circuits and set-up instructions in a concise and sensible format.

As the front panel controls do not solder directly to the pcb there is a certain amount of wiring which was not particularly tidy with the quality of soldering leaving something to be desired. Also a number of resistors are mounted on the rotary switches — a practice which I do not particularly like!

Inputs and outputs

Measurement of the impedance of the balanced inputs showed this to be constant with gain setting at 97.6kΩ with the input metering being before the gain control such that an indication of zero VU corresponded to an input of + 4.2dBm — an entirely satisfactory state of affairs.

The maximum input level at the onset of severe distortion was also satisfactory at + 22dBm with the common mode rejection being reasonable as shown in **Fig 1.**

In the case of the unbalanced outputs, the metering is before the output level control with the maximum output for an indicated zero VU being + 6.5dBm, and the output at the onset of clipping being + 20dBm. In view of the fact that the internal limiting threshold occurs at an output of

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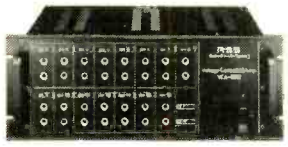
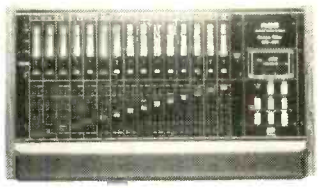
turnkey mix



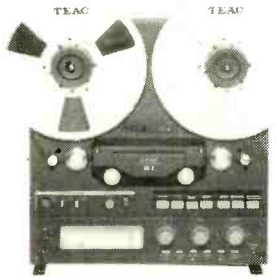


AUTOMATION NOW

The Roland Compu-Editor, is the first console automation system we have seen that does not use up valuable tracks and is also sensibly priced.
This self contained unit will control up to 15 channels of audio (inputs, outputs or auxiliaries), and stores all the working level information internally or dumps to tape. You can update, override manually and lock up to any tape machine using the internal SMPTE generator/decoder. Many advanced features make sophisticated automation possible for any studio. On demo now or send for details.

ANNIS MAGNET-OMETER

It works somewhat like a compass, but tells you when. Put it next to a tape head, guide or capstan, and you get an accurate reading of the residual magnetic field. The scale is accurately calibrated, 5-0-5 Gauss, and an extension probe for awkwardly positioned heads is available. Exclusively from Turnkey.



TEAC 32-2

As predicted in the last Mix, Teac's new stereo mastering machine proves to be a winner. Switchable NAB/IEC equalisation, varispeed, big VU's, motion sensing and a closed loop type tape path all contribute to its success. What's more, it's priced well below the competition.

ONE FOR THE ROAD

We've put TEAC's Portastudio into a roadcase with all the facilities you need for a working portable studio setup. A pair of Auratone monitors are driven by a custom 30W stereo amp, and we include, headphones, mikes, a patch bay and a selection of Accessit signal processors. All parts available separately or customised to requirements.

12 by 2 SPECIAL

We have acquired a batch of quality branded stereo recording or PA mixers. Each channel has wide range mike or line inputs, insertion points, four band eq, and two auxilliaries. The output section features echo returns, VU metering and powerful headphone monitoring. A snip at £360.00 plus VAT.

SHORT TAKES

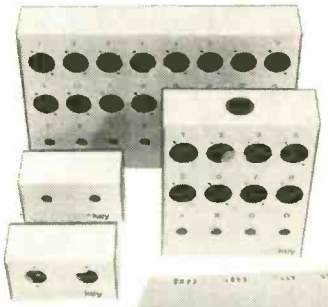
Flight cased eight track system available for hire . . . . **ASC** machine now sold but we can do a great deal on Wollensak copiers . . . . **bulk** tape scheme operating . . . . **we** wire a double decker bus for eight language guided tours of London . . . . **variable** delay GBS available soon . . . . **name** band buys 5 portastudios to take on tour and be creative in hotel rooms . . . . **Turnkey** monitor system completed, call in for a demonstration . . . . **New** TEAC sixteen track here at last . . . . **Plans** afoot to double the size of our present premises . . . . **number** one album made using Prokit/Seck mixer . . . .

MIKE BOX

We now have a range of exclusive wall or cable mounting connector boxes. The standard type takes 8 female XLR's and 4 jacks, the large version is exactly twice that, and the two smaller boxes accept 2 jacks or XLR's respectively. All types have back and side cable entries and fixing holes, and are available with or without connectors.

EXR EXCITEMENT

Introducing the alternative aural exciter that you can purchase outright. Employing patented circuitry, this stereo processor provides psychoacoustic enhancement for any signal. Connect simply to auxiliary send and return, or process stereo direct, and stereo spreads, clarity increases, putting it basically, everything sounds crisper. It is not a fancy tone control or compressor, call for a demonstration, and be convinced. An exclusive US import from TURNKEY.

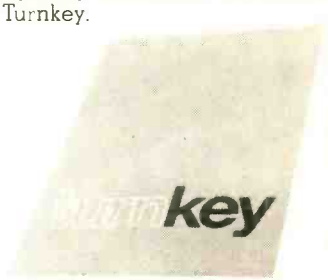


ADVANCED AUDIO DESIGNS DDL

New from America, this processor makes full band delays up to 250mS available in 1mS steps. A front panel digital display shows the programmed delay and full footswitch remote functions are available. As well as normal delay effects, (enhanced by a feedback control) the circuitry allows effects such as flanging, pitch alterations, frequency modulation and infinite repeat hold. Exclusively from Turnkey.

GREEN BOOK

Much more than a catalogue, the new "Turnkey by Mail", 28 page book includes hints on setting up a studio, choosing equipment, and other practical advice. Call or write for a copy or use the reply coupon in the September issue of Studio Sound.



5 STUDER 24 TRACK'S DELIVERED

The Soundcraft 1624 is the most sophisticated mixer in its price range. The Studer A80 twenty four track is the most reputed, and now at revised prices offers the best value in the market. Put them together and you have a package set for the eighties. Our experience of both private and commercial installations enable us to tailor this package to your exact requirements. Prices start from around £30,000. Call Andrew Stirling on 01-440 9221 for full details.

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New Barnet, Herts., EN4 8RW
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+13dBm, this allows a good margin of headroom.

As the output is fed directly from the centre tap of the output level control, the output impedance varied with the output level setting from a minimum of about 2Ω up to 64Ω which is getting on the high side.

Metering

Checking the ballistic characteristics of the VU meter showed these to correspond to the ASA standard, as did the frequency response and rectifier characteristics, but not the scale colouring — a matter of little significance.

So far as input and output levels were concerned there was no complaint about meter linearity but at higher gain reductions, the indicated gain reduction was not exact, as shown in **Table 1.**

Frequency response and noise

The overall frequency response of the unit under non-limiting conditions, and also when driven into 6dB of limiting with the hf compressor in the 'flat' setting, is shown in **Fig 2,** from which it can be seen that in both instances the response is flat within 0.5dB from 20Hz to 20kHz.

Noise was measured in the output, using various measurements, and related to the limiting output level of +13dBm to give the available

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TABLE 1

Actual gain reduction	Indication
0.4dB	0dB
5.5dB	5dB
8.0dB	7.0dB
12dB	10dB

TABLE 2

Measurement method	Dynamic range
Band limited 20Hz to 20kHz rms	79dB
A-weighted rms	81dB
CCIR-weighted rms ref 1kHz	71.5dB
CCIR-weighted quasi-peak ref 1kHz	67.5dB

FIG. 2
ORBAN 418A FREQUENCY RESPONSE

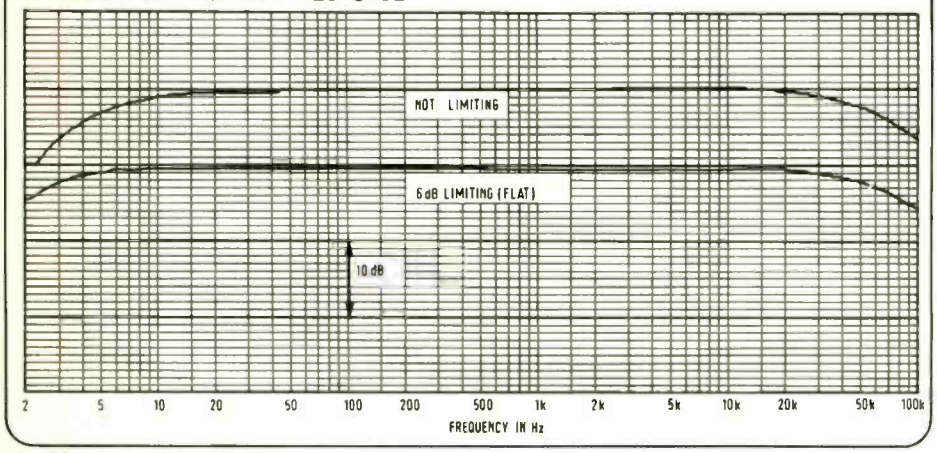


FIG. 3
ORBAN 418A
2ND AND 3RD HARMONIC
DISTORTION

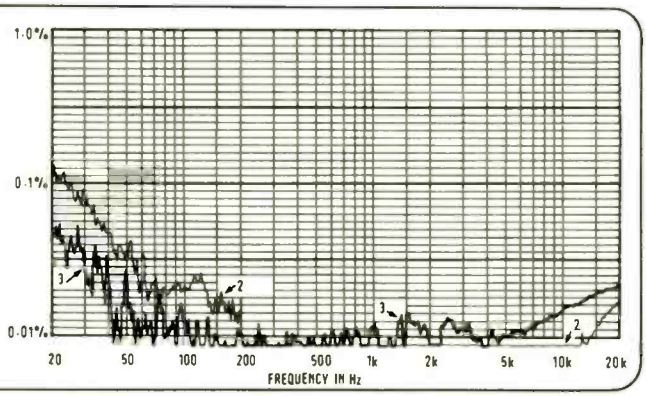
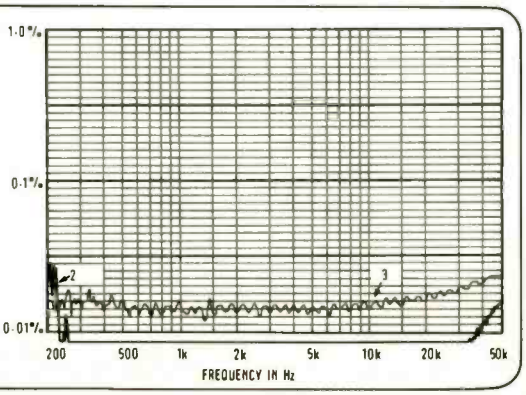


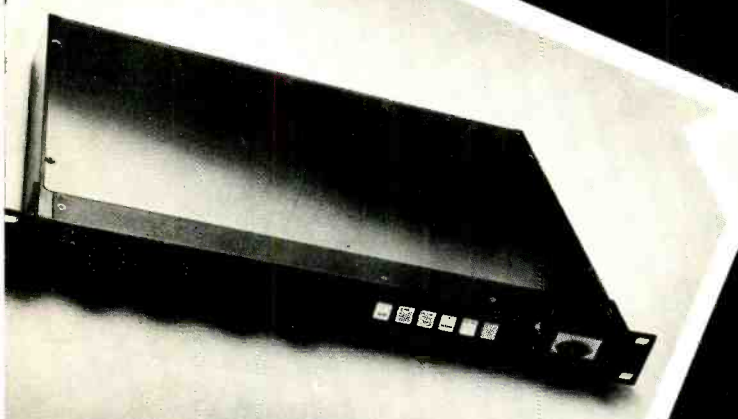
FIG. 4
ORBAN 418A INTERMODULATION
DISTORTION AT 10dB LIMITING

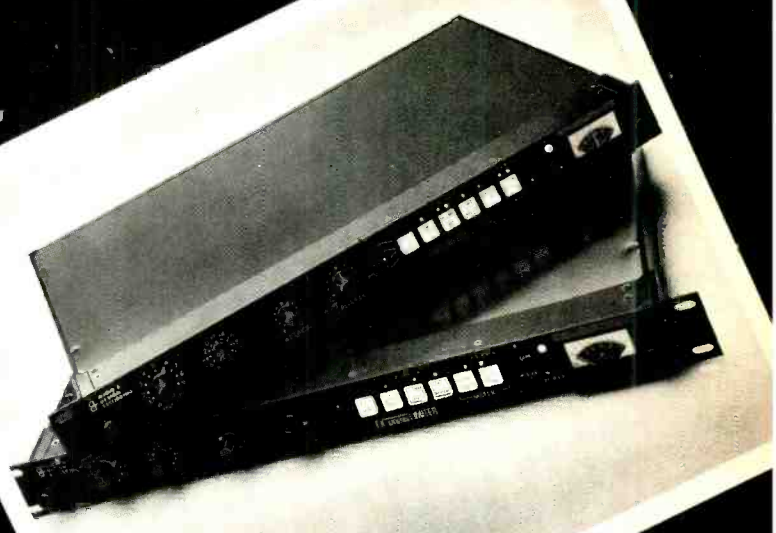


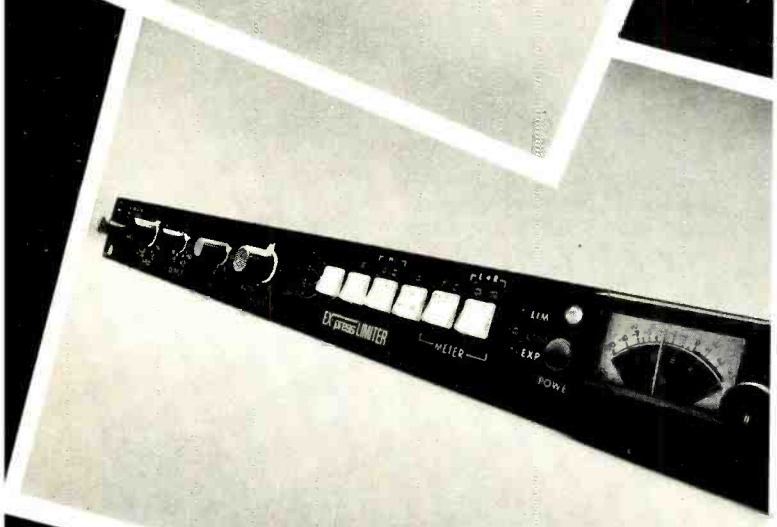
Glowing praise and flattering photos about the Ex-Press Limiter from ADR.

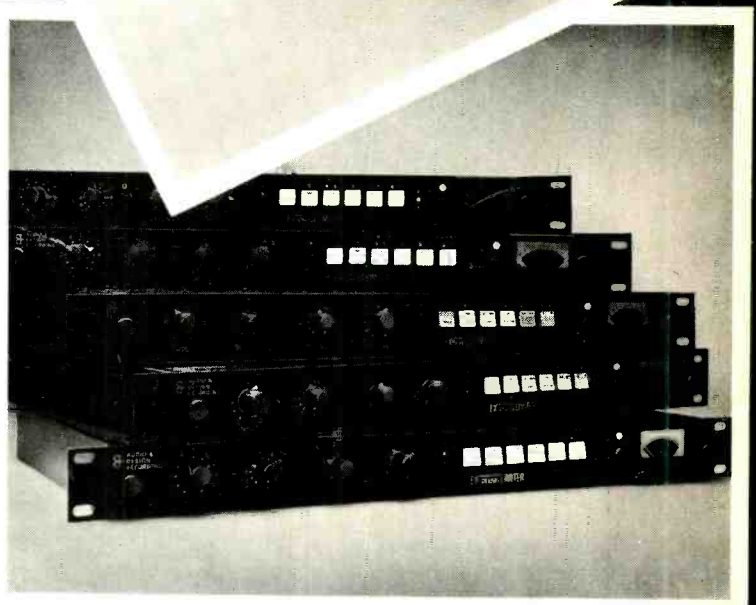
Stereo input/output attenuators and 1. 5:1, 2:1, 5:1 and limit (20:1) ratios.

Digital logic momentary switches for complete function mode control.









Unique dual–calibrated meter with both V.U. and Gain Reduction scales.

RMS or Peak sensing compressor side-chain.

The Ex-Press Limiter is a Compressor, Limiter and Expander designed and manufactured at ADR to our usual excellent technical specification.

Function Control is by digital logic switches and Led indicators show options in use as well as remembering 'last use' settings when the power is cut.

The Ex-Press also has stereo input/output attenuators, variable attack and release times and an auto release network for maximum in-studio versatility.

All this in a 1¾" rack mounting makes the Ex-Press about the best signal processor on the market.

And it's in stock! Call us now, we're as near as your telephone.

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PO Box 780, Bremerton WA 98310 U.S.A. Telephone: (206) 275 5009.
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DAL 9015

dynamic range which was as shown in **Table 2.**

Whilst the above figures applied at the majority of input gain settings there was a slight deterioration in the noise performance at maximum input gain, amounting to about 4dB for all measurement methods at maximum input gain.

The level of mains hum or other tones in the output was found to be completely insignificant and no peculiarities were noted in the noise performance under dynamic conditions.

Distortion

Under non-limiting conditions, the harmonic distortion levels for the second and the third harmonic were below −80dB (0.01%). As with any compressor or limiter the If distortion under limiting conditions depended upon the release time setting, but with this set to maximum and at 10dB compression the performance was excellent as shown in **Fig 3.**

Under similar conditions, the intermodulation distortion to the CCIF method using two equal amplitude tones separated in frequency by 70Hz was found to be at a very low level as shown in **Fig 4.**

Limiters

As can be seen from **Fig 5,** which is an input/output curve for the limiter with both gains at their 12 o'clock position, the I/O has a straight line relation up to a point at 0dBm input where the curve shows a very high degree of compression which is retained until the unit is limiting by 17dB, at which point overload occurred.

In practice, the overload lamp was fairly fast in action and gave an indication of overload before audible distortion was present in the output.

As the manufacturer rightly points out, this is not a very high speed limiter suitable for protecting broadcast transmitters and the like from overload. The primary intention of this limiter is to reduce excessive hf saturation in low speed tape recordings and similar applications where the end-products have soft saturation characteristics as opposed to hard clipping or drastic distortion as in the case of disc cutting.

It is therefore immaterial that in some circumstances the limiter may overshoot for a short time as shown in **Fig 6,** which illustrates the output when a 1kHz toneburst is applied to the input such that 6dB limiting occurs — the release time being set to 'fast' in this instance.

Under these conditions the range of the release time control gave virtually complete recovery in between 100ms in the fast setting and 1s in the slow position with the 12 o'clock position corresponding to 600ms.

The pre-emphasis characteristics of the hf limiter are shown in **Fig 7,** which shows a generally correct pattern, but the actual turnover frequencies were all on the high side as shown in **Table 3.**

Other matters

Matching between the two channels was measured at 5dB intervals for the compressors, and at 10dB intervals for the input and output gain controls, with the channel balance being as shown in **Table 4.**

In the case of the compressor, the creditable maximum error was ±0.2dB at compressions up to 15dB.

As a final measurement, the crosstalk between the two channels was measured, producing **Fig 8,** which demonstrates an excellent performance.

FIG. 5
ORBAN 418A
I/O WITH GAIN CONTROLS
AT 12 O'CLOCK

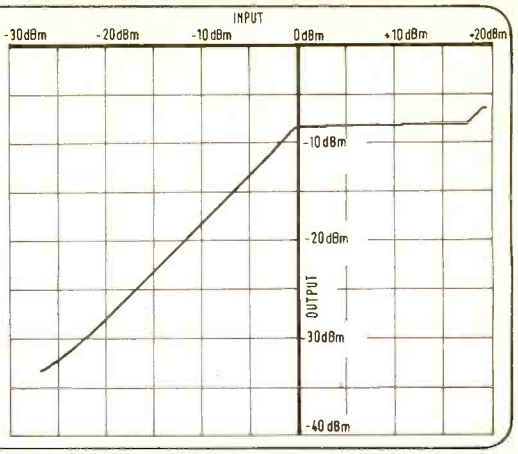


TABLE 3

Nominal time constant	Turnover frequency (−3dB) Nominal	Actual
75µs	2122Hz	2679Hz
50µs	3183Hz	3948Hz
37.5µs	4244Hz	5324Hz
25µs	6366Hz	7993Hz

TABLE 4

Gain setting	Output control	Input control
0dB	±0.1dB	0dB
−10dB	±0.6dB	±0.5dB
−20dB	±0.1dB	±0.05dB
−30dB	±0.3dB	±0.15dB

FIG. 6

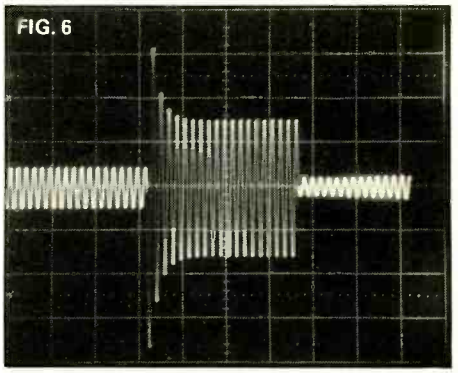


FIG. 7
ORBAN 418A
PRE-EMPHASIS
CHARACTERISTICS OF
HF LIMITER

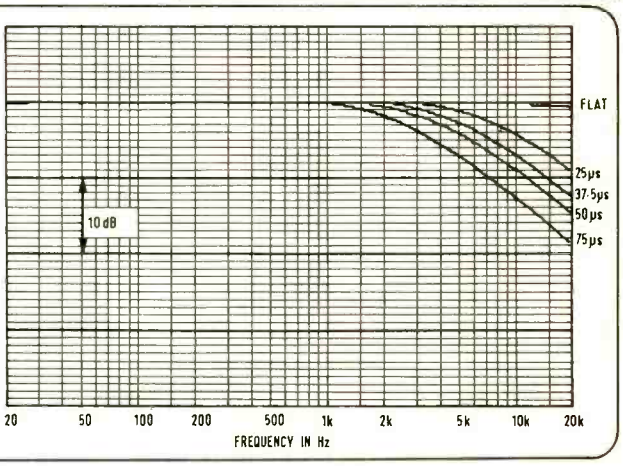
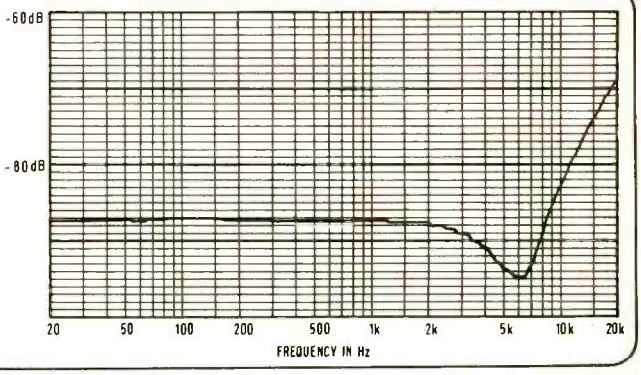


FIG. 8
ORBAN 418A
CROSSTALK



Summary

This Orban unit is an excellent device for tailoring music for recording on compact cassettes and other slow-speed tape devices where hf saturation presents a severe problem. Naturally, it will find its place also as a general limiter or loudness enhancer. However the choice of time constants (as opposed to attack and release times) in the hf section makes this a particularly useful unit.

Overall, both the standard of construction and the measured and subjective audio performance were excellent and this device is to be thoroughly recommended.

Hugh Ford

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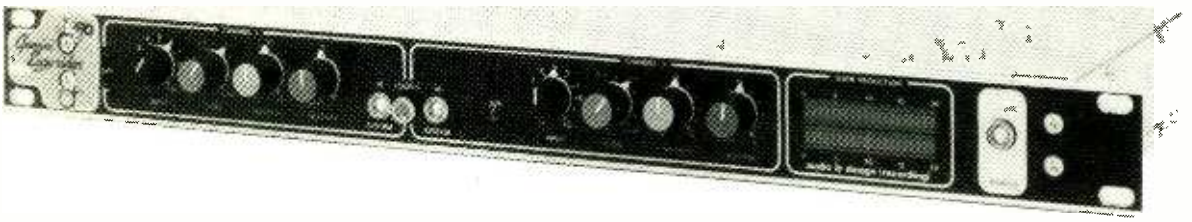
ADR Gemini Easyrider



MANUFACTURER'S SPECIFICATION
Frequency response: + 0dB, − 1dB, 20Hz to 25kHz at threshold reference 1kHz.
Noise: better than − 82dB referenced to limit level. Measured band limited 25Hz to 25kHz.
Distortion: at 1kHz 0.15% referenced to + 12dBm (maximum limit level). Measured with 3s release time at 1kHz, 10dB gain reduction.
Clip level: output stage + 18dBm into 600Ω. Input stage + 18dBm.
Crosstalk: at 10kHz − 77dB referred to + 12dBu on opposite channel.
Make-up gain: 33dB.
Output (pre-set): calibrated − 3dBm to + 12dBu reference limit threshold.
Stereo matching (worse case): ±1dB channel to channel over 20dB gain reduction.
Input impedance: >10kΩ at 1kHz.
Output impedance: <1Ω at 1kHz.
Thresholds/ratios: switched 1:1 variable 1.5:1 to 20:1 thresholds automatically adjusted.
Limit attack: fast—500μs for 10dB over limit threshold. Slow—5ms for 10dB over limit threshold. Dynamic attack changes in relation to level.
Release: fast—15ms on 10dB over limit threshold. Slow—4s on 10dB over limit threshold. Auto—15ms on 5s.
Input/output/earthing: via 12-way barrier strip.
Side chain access: via 3-pole jack socket.
Metering: calibrated 20-segment LED bargraph.
Power requirements: 230V ac ±7%. 115V ac ±10%. 50/60Hz selectable.
Power consumption: 15W.
Size: standard rack 1¾ × 19 × 7½in. (44.45 × 482.6 × 190.5mm)
Weight: 5.5lb (2.5kg).
Price: £450.
Manufacturer: Audio and Design (Recording) Ltd, North Street, Reading, Berks RG1 4DA, UK.

THE AUDIO and Design *Gemini Easyrider* is a twin-channel compressor/limiter with the ability to link the control signals of the two channels for stereo use.

Designed for mounting into a standard 19in rack and one rack unit high, there is a long, thin front panel to the right of which is the *Shardow* power on/off switch and the twin horizontal LED display for showing compression. This display increments in 1dB steps with a total range of 20dB calibrated at 5, 10, 15 and 20dB gain reduction.

At the centre of the remainder of the front panel are three *Shardow* locking pushbutton switches the centre one of which couples the two channels' control signals for stereo operation with the other two switching their adjacent channels in or out of circuit. This is achieved by directly connecting the unbalanced input and output—a practice which I, personally, dislike as it can upset loading although this can save the situation if the unit goes faulty.

The remaining front panel controls comprise four knobs for each channel and a recessed screwdriver operated output level control for each channel. The left hand black knobs are input gain controls with arbitrary calibrations from 0 to 10. There is next the blue compression ratio knob which controls a switched potentiometer. In the full anticlockwise position the compression ratio is switched to 1:1 whilst in the maximum clockwise position the unit acts as a limiter with intermediate compression ratio calibration points at 2:1 3:1 5:1 and 8:1. Two further knobs for each channel coloured red and green control the attack time and the release time respectively with simple calibrations of 'F', 'M' and 'S' for fast, medium and slow.

Turning to the rear of the unit, power is applied via a standard IEC socket with the nearby voltage selector switch and fuse being clearly identified in rating.

The audio connections are via a 12-way barrier strip with the individual inputs and outputs each occupying two terminals for their unbalanced connections. The complete electronics are isolated both from the chassis and from the power earth with the remaining four positions of the barrier strip giving access to the chassis ground, the power earth and two positions for the signal ground. These features are clearly identified as are other rear panel features.

Finally, at the rear of the unit there are two 3-pole ¼in jack sockets which give access to the side chains of the two channels.

The standard of finish and construction was very good, with the complete electronics being mounted on one double-sided pcb. All components were mounted on the pcb with the only hand wiring being the mains supply and the leads to the toroidal power transformer. With one unfortunate exception component identifications were excellent, however, Murphy's law had worked such that the identifications of the value for an onboard fuse partially ended up under the fuse clips!

Whilst the mains power wiring was protected by boots and sleeves as appropriate, I do have to complain about the voltage selector switch which not only lacked insulation on two linked contacts but also was of a type which would not meet British safety standards due to the small clearance between live parts and the chassis.

TABLE 1

Condition	Noise (dBm)	
	A-weighted rms	CCIR weighted peak
Gain <20dB	− 75.0dBm(A)	− 61.5dBm
Gain maximum (34dB)	− 70.0dBm(A)	− 55.5dBm

Inputs and outputs

It was found that the unbalanced inputs could handle in excess of + 22dBm without clipping, the input impedance varying with the input gain setting. At intermediate gain settings the input impedance was 10.8kΩ which is satisfactory, it however fell to 6.92kΩ at maximum gain. The unbalanced outputs were found to have a very low output impedance with a drive capability of + 19dBm loaded into 600Ω or + 19.5dB reference 0.775V.

The maximum available gain from the input to the output was found to be 34dB at 1kHz with the screwdriver operated output level control adjusting the output whilst the unit was limiting from − 12.5dBm to + 11dBm.

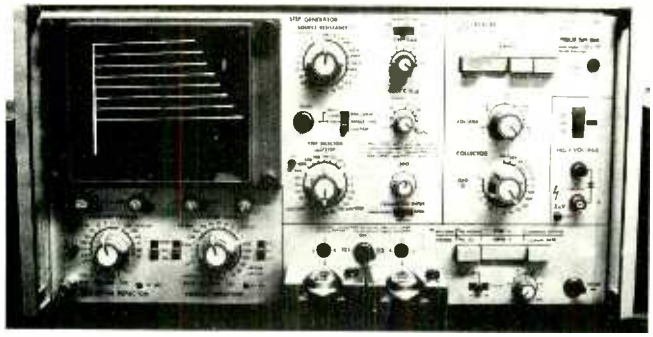
Frequency response and noise

The overall frequency response without the unit compressing or limiting is shown in **Fig 1** demonstrating the unit to be within ±0.5dB from 20Hz to 100kHz and investigating other conditions did not show any response deviations in excess of this.

Noise at the output depended upon the gain setting for gains above 20dB as shown in **Table 1.**

70 ▶

THE DAWN OF AN AMPLIFIER



Before we start to build our amplifiers we test and select every single component from the 1% tolerance metal film resistors to the drilling of the glasepoxy PC boards. The above picture shows transfer curves of an FM 17418 transistor displayed on a high-power curve tracer, a test that is performed at different voltages, currents, loads and temperatures. One of the four different tests that each and every of the 46 transistors used in an FM ACOUSTICS power amplifier has to pass. Very time consuming, very expensive and very safe. No other manufacturer is able to make this kind of effort, an effort that pays off: superb natural sound reproduction, no unit to unit variation, extreme stability and unmatched long-term reliability under worst case conditions. Just one of the reasons why an FM ACOUSTICS is more expensive initially but in the long run is more cost effective and therefore better value than any other power amplifier.
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Having regard to the output drive capability of +19dBm this noise performance is more than adequate and the comprehensive grounding arrangements lead to a complete absence of power line hum or its harmonics.

Distortion

Both harmonic distortion and intermodulation distortion to the CCIF method using two swept tones separated by 70Hz were investigated under various conditions.

Harmonic distortion in terms of the second and third harmonic at the onset of compression are shown in **Fig 2** from which it is seen that the third harmonic is at a very low level with the second harmonic predominating as is usual in compressor type devices.

Increasing the input level to attain 10dB compression with a 5:1 ratio with a fast attack time and slow release time, produced **Fig 3** for the harmonic distortion, showing some increase over the non-compressing state as is to be expected, but reasonable distortion levels.

Twin tone CCIF intermodulation distortion under the same conditions is shown in **Fig 4** demonstrating that the third order product predominates at a relatively constant 0.2%.

Attack and release times

Checking the performance of the attack and release mechanisms by means of tonebursts did not reveal any 'nasties', with the result of stupid control settings being that which should be expected.

The range of the attack time control was found

72 ▶

FIG. 1
GEMINI 'EASYRIDER' FREQUENCY RESPONSE

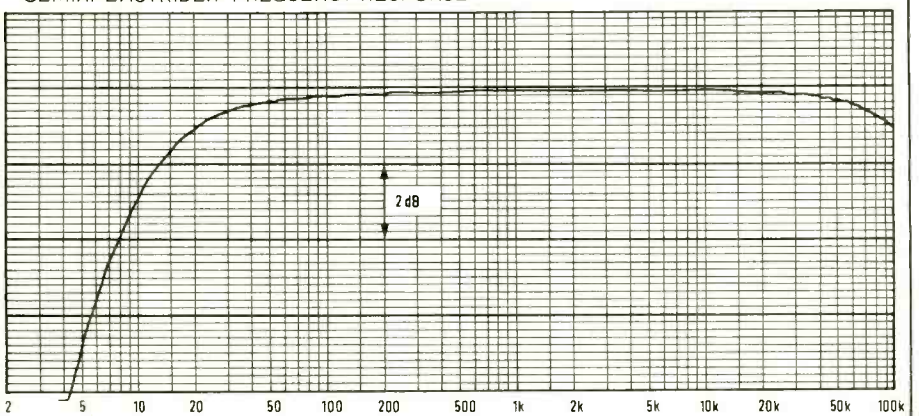


FIG. 2
GEMINI 'EASYRIDER' HARMONIC DISTORTION AT ONSET OF COMPRESSION

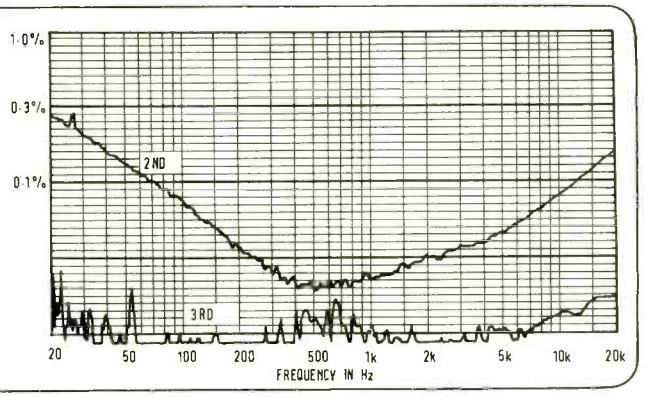
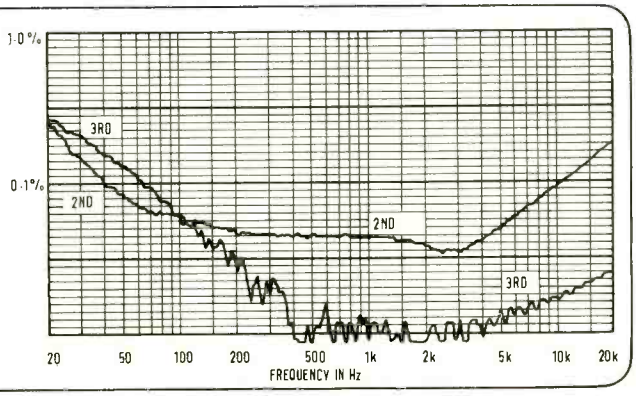


FIG. 3
GEMINI 'EASYRIDER' HARMONIC DISTORTION COMPRESSING 10dB



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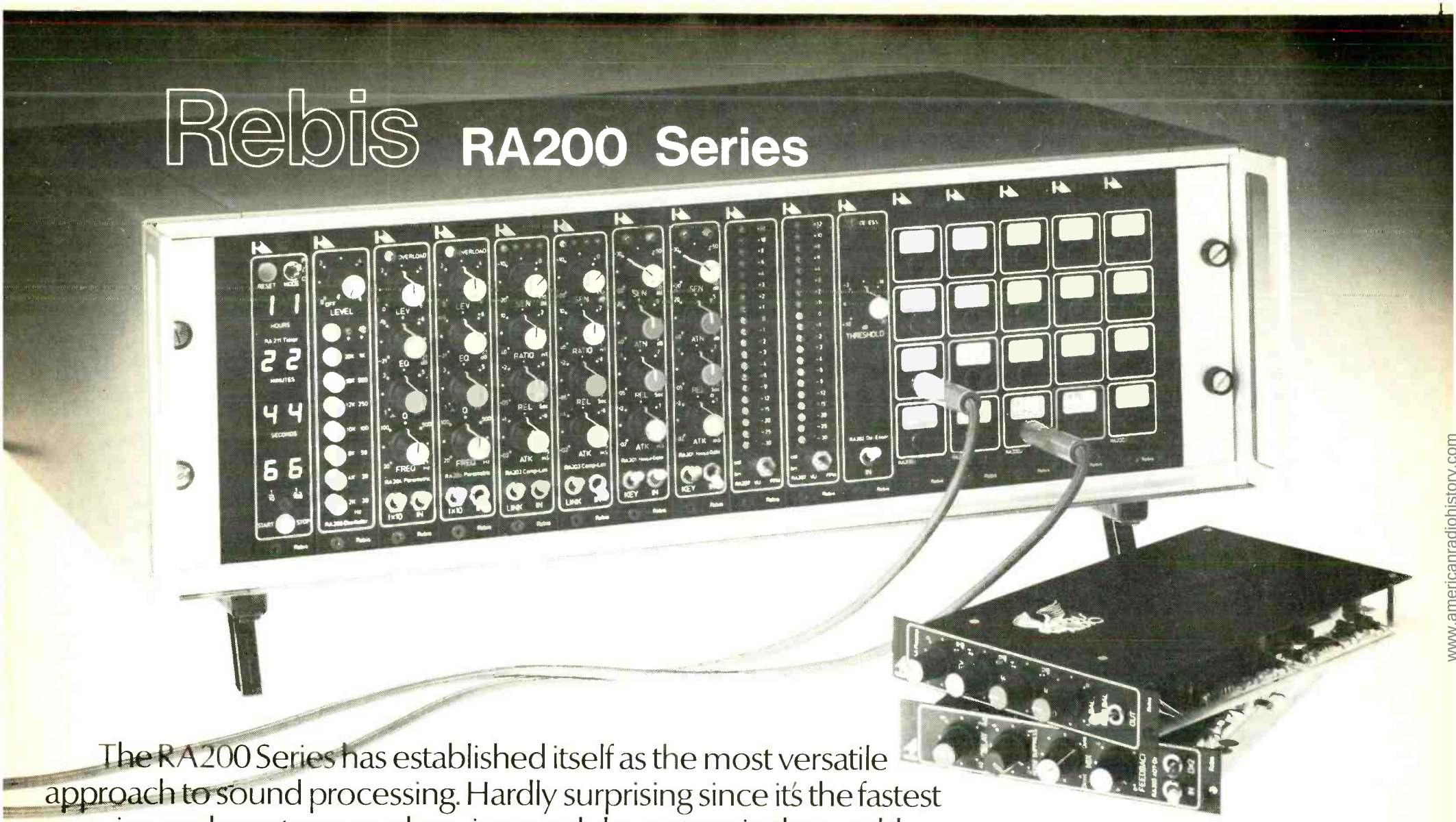

The RA200 Series has established itself as the most versatile approach to sound processing. Hardly surprising since it's the fastest growing and most comprehensive modular system in the world.

Modules to date include:

RA201 Noise Gate	RA204 Parametric Equaliser	RA207 LED Meter	RA210 RIAA Preamp.	RA213 Mono MDA.
RA202 De-esser	RA205 ADT/Delay	RA208 Modulator	RA211 Timer	RA214 Stereo MDA.
RA203 Compressor-Limiter	RA206 Oscillator	RA209 Mixer	RA212 Mic/Line Amp.	RA200J Connector

Rebis For further information contact: Rebis Audio, Kinver Street, Stourbridge, West Midlands DY8 5AB. Tel: 0384 71865.

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U.S.A. Klark-Teknik Electronics Inc, Farmingdale NY 249 3660. **Sweden;** Tal & Ton, Gothenberg 130216. **France;** Lazare Electronic, Paris 8786210. **Finland;** Studiotec, Espoo 520 691.

to be between 1ms and 200μs with the medium setting corresponding to 400μs—the fast setting being faster than the manufacturer's specification would suggest.

The performance of the release time control was such that the full measured range was from 4s to 15ms with the mid point medium setting corresponding to a release time of 200ms, just to specification.

Compression characteristics

Checking the actual amount of compression versus the indicated compression on the LED displays showed the displays to be adequately accurate with the worst recorded error being 1dB which is the resolution of the displays. Under static conditions, measurement of the matching between the two channels (stereo matching) over the full 20dB available compression range gave a worst recorded mismatch of only ±0.4dB which is a creditable performance.

The recovery characteristics from 10dB of compression with slow attack and release and with fast attack and release are shown in **Fig 5**.

The input/output characteristics for three settings of the ratio control are shown in **Fig 6**. The top curve depicts the 'limit' characteristic which naturally has maximum compression with the middle curve showing the 5:1 condition and the lower curve the 1:1 condition just before the operation of the switch on the ratio potentiometer.

Other matters

Crosstalk between the two channels with one channel in 10dB compression is shown in **Fig 7** which confirms a more than adequate channel isolation at audio frequencies.

A useful feature of the unit is the facility to break into the compressor's side chain—that is the feedback connection from the unit's output to the compressing amplifier. Insertion of an equaliser in this path can provide selective compression, such as de-essing if a highpass filter is inserted, or the reduction of rumble if a lowpass filter is inserted.

The required operating levels for this connection via a tip, ring and sleeve jack are just short of 0dBm for 20dB compression. It follows that any normal equalisers or other frequency modifying equipment should be compatible.

Summary

The Audio and Design *Gemini Easyrider* compressor/limiter is a very well made piece of equipment which has clearly been designed with ease of servicing in mind. Access to all components is very easy and identification of components, controls and other features is excellent.

Other than the usual precautions regarding attack and release times when using a compressor the only danger with this unit was clipping when in the 1:1 mode when the output was not up to driving the high level which can be accepted by the inputs.

In other respects the performance was good with excellent stereo tracking when in the coupled mode. Perhaps this compressor/limiter does not have the dramatic range of some units, but, neither does it have the traps to fall into.

Overall a well made and effective unit.

Hugh Ford

FIG. 4
GEMINI 'EASYRIDER' IM AT 10dB COMPRESSION

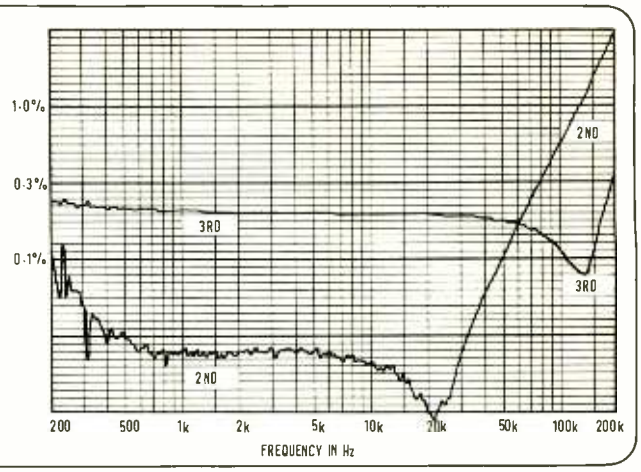


FIG. 5
GEMINI 'EASYRIDER' RECOVERY CHARACTERISTICS

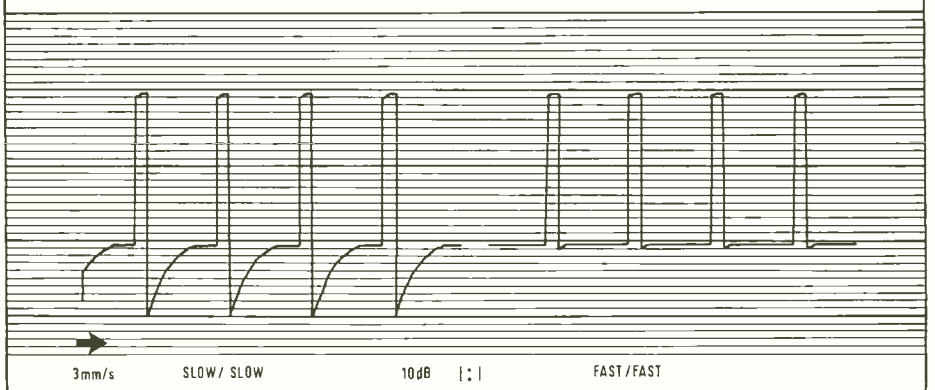


FIG. 6
GEMINI 'EASYRIDER' I/O CHARACTERISTICS

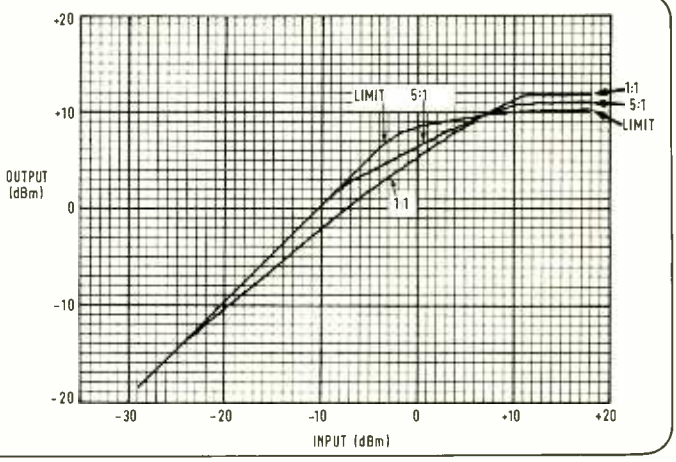
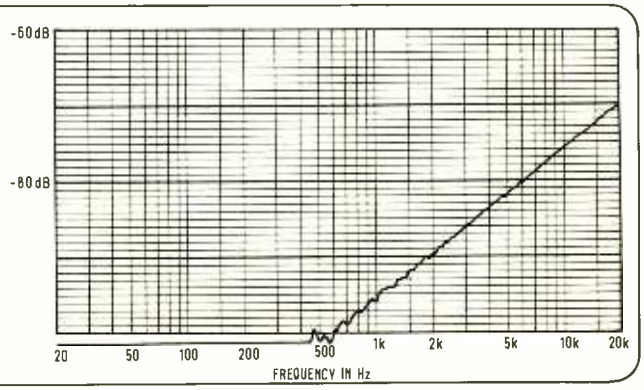


FIG. 7
GEMINI 'EASYRIDER' CROSSTALK



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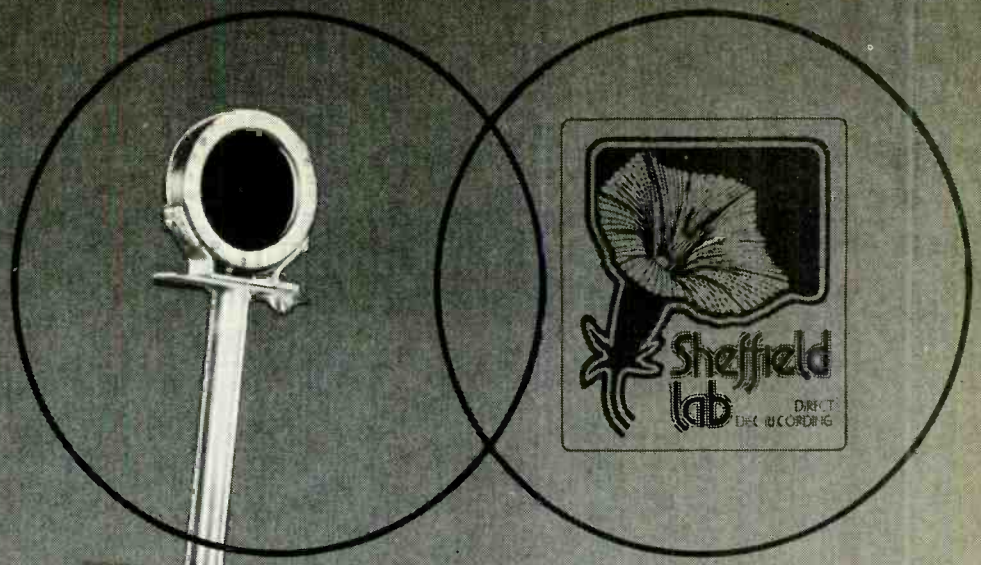

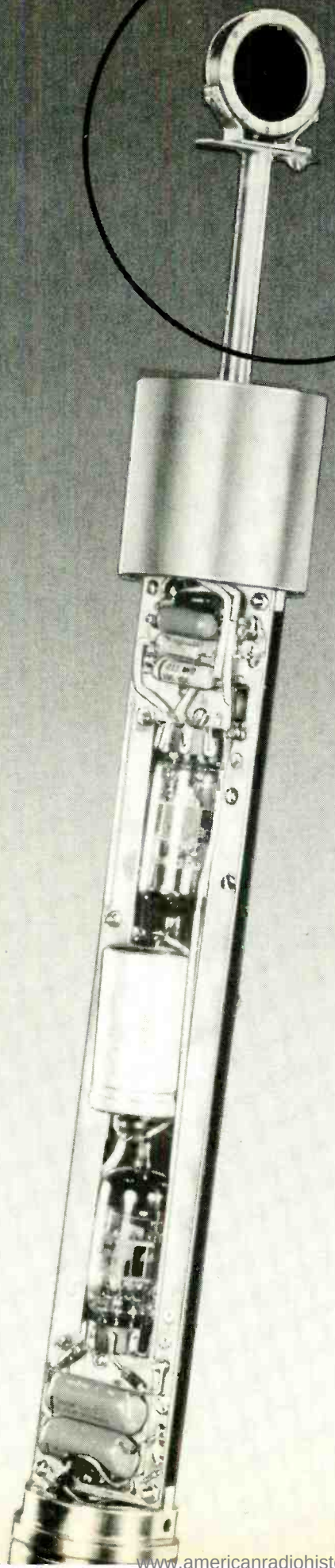

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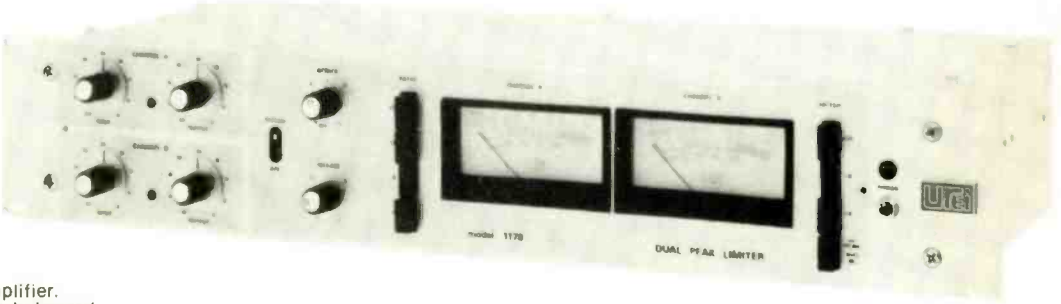


UREI 1178 limiter

MANUFACTURER'S SPECIFICATION
Input: balanced bridging differential amplifier.
Input impedance: 20kΩ when used as balanced input, 10kΩ when used as unbalanced (single ended) input.
Input level: +20dB max (reference 0.775V rms).
Gain: 45dB ±1dB.
Frequency response: ±1dB, 20Hz to 20kHz.
Output: floating, transformer isolated.
Output load: 150Ω or greater.
Power output: +24dBm into 600Ω load (12.28V); +20dB into 150Ω load (7.75V).
Distortion: less than 0.5% THD from 50Hz to 15kHz in limiting at any level up to rated output, release time set slow.
S/N ratio: >81dB at threshold of limiting 30Hz to 15kHz.
Attack time: <20μs for 100% recovery. Adjustable to 800μs with front panel control.
Release time: 50ms min, 1.1s max (for 63% recovery) adjustable with front panel control.

Threshold versus output level:

Compression ratio setting	Input level at min limiting threshold ±2dB*	Relative output at threshold**
20:1	−24dB	+10dBm
12:1	−25dB	+9dBm
8:1	−26dB	+8dBm
4:1	−30dB	+7dBm

* Reference 0dB = 0.775V rms
** with output gain control set to provide a reserve of approximately 10dB.

Connections: rear chassis barrier strips for input and output. Power through 3-wire style IEC connector.
Power requirements: 100 to 125V or 200 to 250V ac, 50/60 Hz, switch selectable, <10W.
Environment: operating 0 to +50°C. Storage −20 to +60°C.
Dimensions: (whd) 19 × 3½ × 8in (483 × 89 × 203mm).
Finish: panel is ⅛in (3.81mm) brushed clear anodised aluminium in two shades. Chassis is cadmium plated steel.
Weight: 11lb (5.0kg).
Shipping weight: 14.5lb (6.6kg).
Accessories: *SC-2* security cover. *Model 301 XLR/QG* adaptor for input and output.
Price: £451.
Manufacturer: United Recording Electronics Industries, 8460 San Fernando Road, Sun Valley, Cal 91352, USA.
UK: F W O Bauch Ltd, 49 Theobald Street, Boreham Wood, Hertfordshire.

THE UREI Model *1178* dual peak limiter is a stereo version of the UREI model *1176* unit and may be used either in the stereo mode with the two channels tracking or as two separate channels with a limited amount of individual control.

To the left of the typical UREI brushed alloy front panel are four potentiometers for adjusting the input and output gains of the two channels, all controls being of the full range configuration permitting the inputs or outputs to be fully shut.

A miniature toggle switch allows separate or tracking stereo operation by linking or disconnecting the dc control lines of the two channels with these lines being capable of being fed to the meters which will indicate instantaneous gain reduction.

An additional two potentiometers, one equipped with a switch, control the attack and release times with the controls being ganged controls for the two channels. When the switched attack time control is positioned in the 'off' position the gain control elements are disconnected such that no gain reduction can occur.

Proceeding across the front panel to the right, before the two illuminated VU meters are a vertical array of four interlocked pushbutton switches. These select the compression ratio above the gain reduction threshold: the choice of compression ratios being 20:1, 12:1, 8:1 or 4:1.

A similar set of pushbuttons to the right of the meters select the function of the two meters which may indicate either the instantaneous compression (gain reduction) or the output level. In the latter instance there is a choice of either VU or peak characteristics in addition to a switched choice of either +4dB or +8dB nominal output level.

The final front panel feature of this unit, which is designed for 19in rack mounting, is the power on/off toggle switch and a nearby indicator LED.

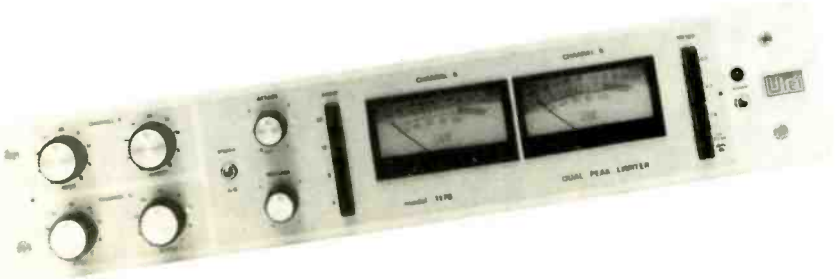
To the rear of the unit is the IEC-type power connector with a properly identified imperial size power fuse and a 2-position, screwdriver operated, power line voltage switch. Two 5-way barrier strips provide the audio inputs and outputs for the two channels, the inputs being electronically balanced and the outputs floating transformer coupled connections.

Within the unit all electronic components, except the power transformer and the front panel controls, are supported on a single good quality pcb with clear component identifications for servicing.

All integrated circuits are socketed and the instruction manual contains a clear circuit diagram together with alignment instructions.

The wiring from the pcb to the front panel controls was generally tidy with a sensible standard of soldering. Also the mains voltage wiring was generally insulated, but lacked protective insulation at the front panel on/off switch and the mains voltage selector. The latter was of a type which has insufficient clearance between live parts and parts connected to the chassis, to meet British safety standards.

In other respects the standard of both mechanical and electrical construction was good and the overall presentation clear and uncluttered with good legibility of control positions and input and output connections. Furthermore the manual supplied gave good alignment instructions with some description of the normal usage of compressor/limiters.



Inputs and outputs
The electronically balanced inputs were found to

76 ▶

GAIN BRAIN II

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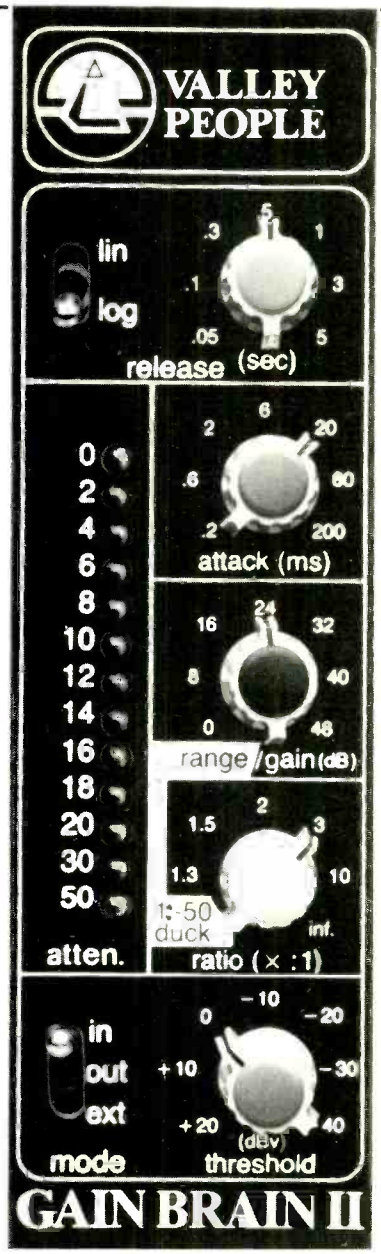

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GAIN BRAIN II can give you the *flattest VU meter output of any limiter/compressor device in existence,* while maintaining an *unheard of degree of integrity to the subtle dynamics of music and speech.* And it's a ducker, too.

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have an input impedance of 20.1kΩ in the balanced configuration or 9.9kΩ when used single ended, the impedance being constant with the input gain setting. As shown in **Fig 1**, the common mode rejection ratio was excellent at low frequencies being about 75dB up to 1kHz.

Overall gain to the unloaded output was found to average 47.2dB for the two channels, being more than adequate, with the input capable of handling up to +24dBm before the onset of clipping.

On the output end, the outputs are transformer coupled and isolated with an output impedance of 48Ω at 1kHz and a drive capability of +26dBm loaded into 600Ω or +27dB reference 0.775V into a high impedance.

Whilst the audio connections are in the form of a barrier strip, UREI manufacture adaptors to convert the connections to *XLR*-types, the unit having screw holes for securing these adaptors.

Metering

The two illuminated VU meters may be switched to measure gain reduction with an 'average' rectifier characteristic or the output level at the primary of the output transformers with either an 'average' or 'peak' rectifier characteristic. When using the 'average' or VU characteristic, zero VU may be switched to correspond to either +4dBm or +8dBm at the outputs with the levels being 6dB higher when using the peak indicating characteristic.

Checking the rectifier characteristics and the ballistics of the meters in the VU mode showed that the meters were genuine VU meters to the ASA standard, whilst in the peak mode the meters arrived virtually at their steady state indication with a single cycle toneburst of 10kHz tone. Whilst the rise time was very fast the fall time was about 2.5s giving easy readability.

TABLE 1

Measurement method	At 30dB gain	At maximum gain
Band-limited 20Hz to 20kHz rms	−63dBm	−55.5dBm
A-weighted rms	−65.5dBm	−58dBm
CCIR-weighted rms ref 1kHz	−56dBm	−49dBm
CCIR-weighted quasi-peak	−52.5dBm	−45dBm

The accuracy of the indicated gain reduction was found to be quite acceptable, being within 0.5dB up to 5dB indication with an indicated 10dB corresponding to an actual 8dB gain reduction.

Frequency response and noise

The overall frequency responses in the non-limiting condition and with 20dB compression are shown in **Fig 2**, which demonstrates that in both conditions the response is within 0.5dB from 20Hz to 20kHz.

Noise at the output was found to be identical for both channels varying with the input gain setting when overall gains in excess of 30dB were used, the latter corresponding to a 12 o'clock setting of the input gain control. **Table 1** shows the output noise as measured at 30dB gain and at max (47dB) gain under various measurement conditions.

Bearing in mind that the output, when limiting, at maximum output gain is in excess of +20dBm,

78 ▶

FIG. 1
UREI 1178
COMMON MODE
REJECTION

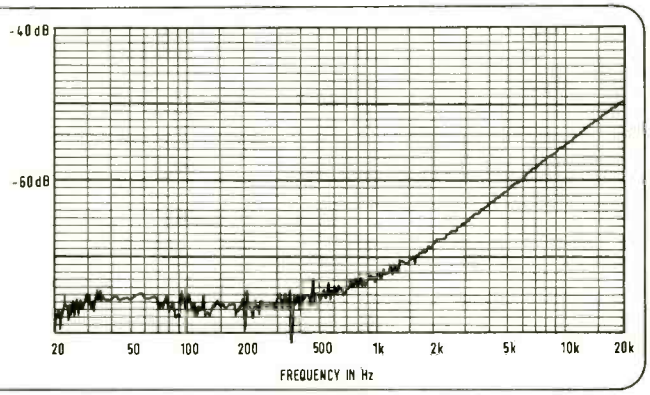
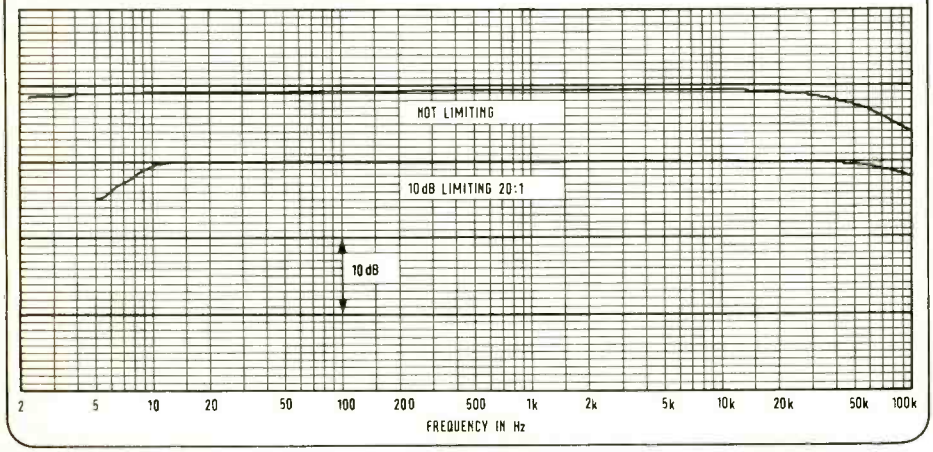


FIG. 2
UREI 1178 FREQUENCY RESPONSE



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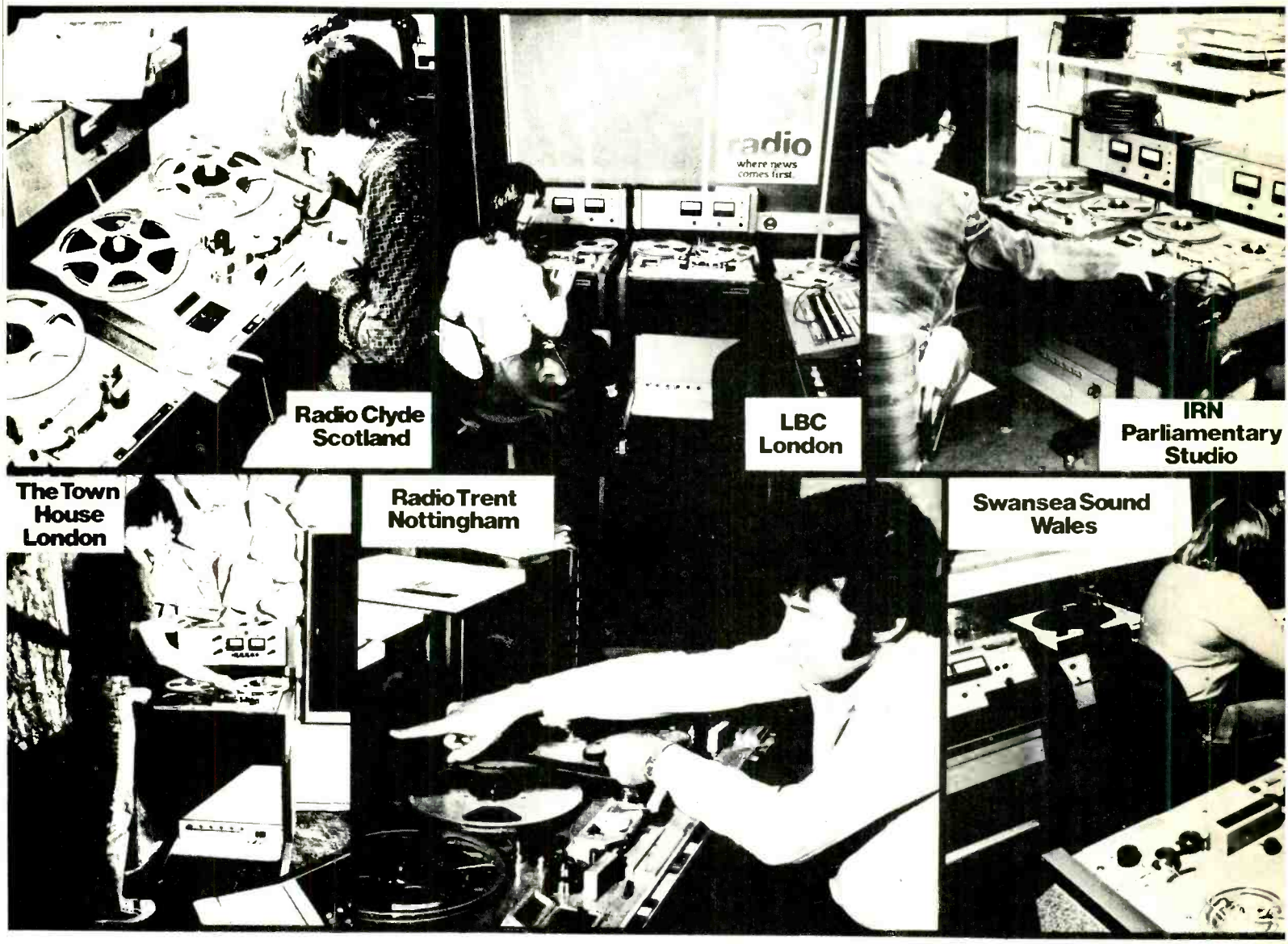

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the table represents a satisfactory dynamic range.

Checking the output for mains hum and its harmonics, or any other unwanted signals, showed that no problems existed in this respect

Distortion

Measurement of the second and third harmonic products without any compression or limiting in action showed that the unit introduced negligible harmonic distortion at up to +10dBm output at maximum gain, the harmonics being at less than −80dB (0.01%). As the level was increased towards +20dBm output the third harmonic rose to −70dB (0.03%) with the second and less irritating harmonic rising to −64dB (0.06%).

Investigations into the distortion at other I/O levels at first produced inconsistent results with the review sample until it was discovered that with or without compression the gain control preamplifier produced a high degree of distortion when operating at higher levels. With levels that would give 10dB compression this circuit element could produce 1% second harmonic and in the order of 0.5% third harmonic. It was eventually discovered that in both channels the linearity control was on its end stop—some poor factory procedures release a product adjusted like this!

After very careful adjustment of the best channel the harmonic distortion at 5dB compression with maximum release time and attack time settings was as shown in **Fig 3**, but the distortion rose at higher compressions.

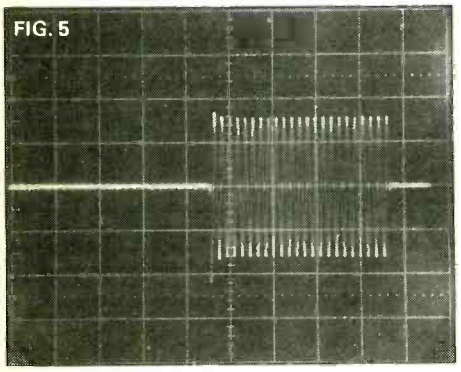
Intermodulation distortion to the CCIF twin-tone method using tones separated by 70Hz as measured under the above conditions was constant at just above 0.1% within the audio frequency band and changed little with operating level—a respectable performance.

Limiters

The I/O curves for the four different compression ratios are shown in **Fig 4**, which is generally in agreement with the manufacturer's data. However, the threshold for the onset of compression for the 12:1 and 8:1 compression ratios are rather close together.

Measurement of the attack and release times for full recovery from 10dB compression showed that the attack time could be varied from less than 10µs up to 4ms with the mid control setting corresponding to 2ms. Similarly the release time could be varied from 80ms to 1.4s with a mid point setting of 700ms.

FIG. 5



Editor's note: UREI have informed us that points raised in this review have been noted and relevant modifications will be made to *1178* Limiters manufactured in the future.

FIG. 3
UREI 1178
2ND AND 3RD HARMONIC DISTORTION

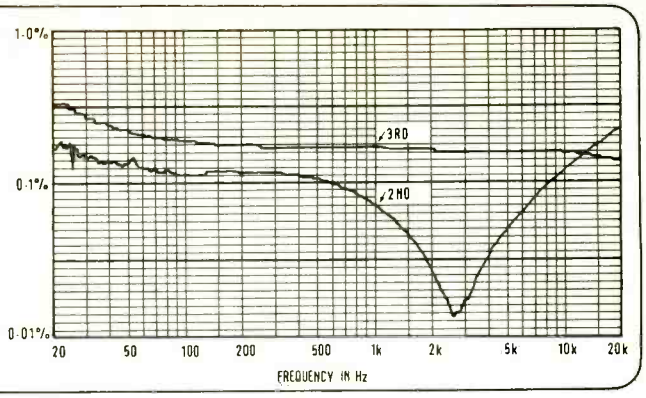
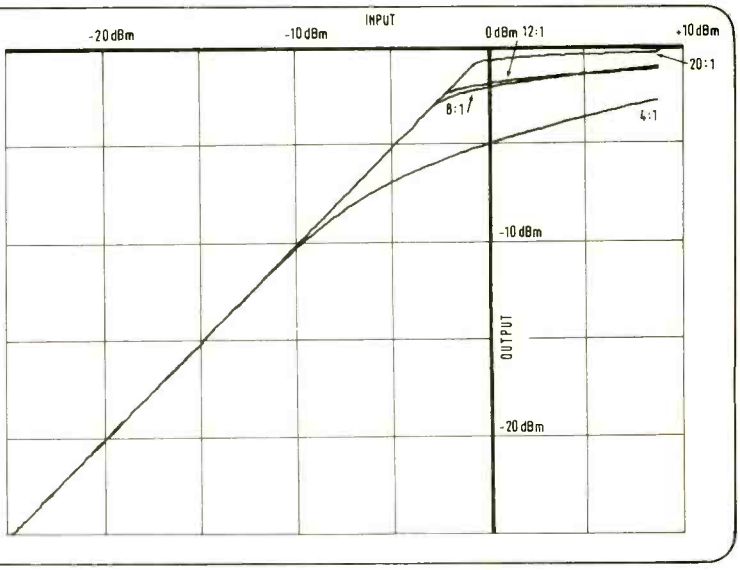


FIG. 4
UREI 1178
I/O CURVES



Examination of **Fig 5** shows the extremely fast attack upon a burst of 10kHz tone for a compression of 10dB at the 20:1 compression ratio—the uncompressed toneburst being equivalent to the full Y axis of the display.

Other matters

Crosstalk between the two channels was at a low level as shown in **Fig 6**, and little interaction was noted between the unit's controls.

The tracking between the two channels in the ganged stereo mode showed that there was no significant image shifting—the maximum measured unbalance being 0.5dB at any gain reduction up to 20dB.

Summary

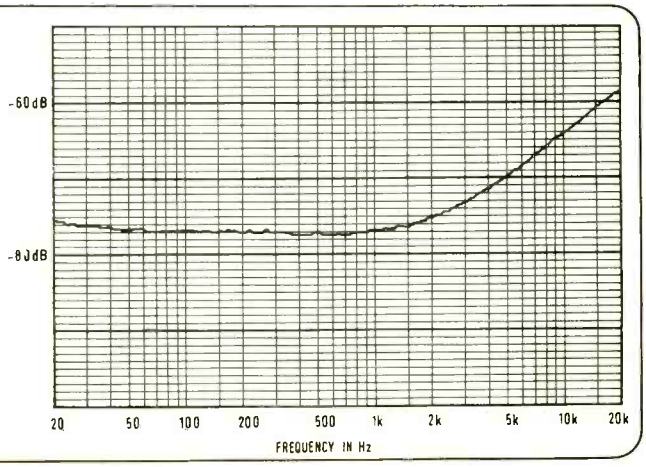
Subject to the units being very carefully aligned for minimum distortion, this is a good and versatile limiter with a very wide range of attack and release times which, if used sensibly, can be very useful without introducing any unwanted side effects.

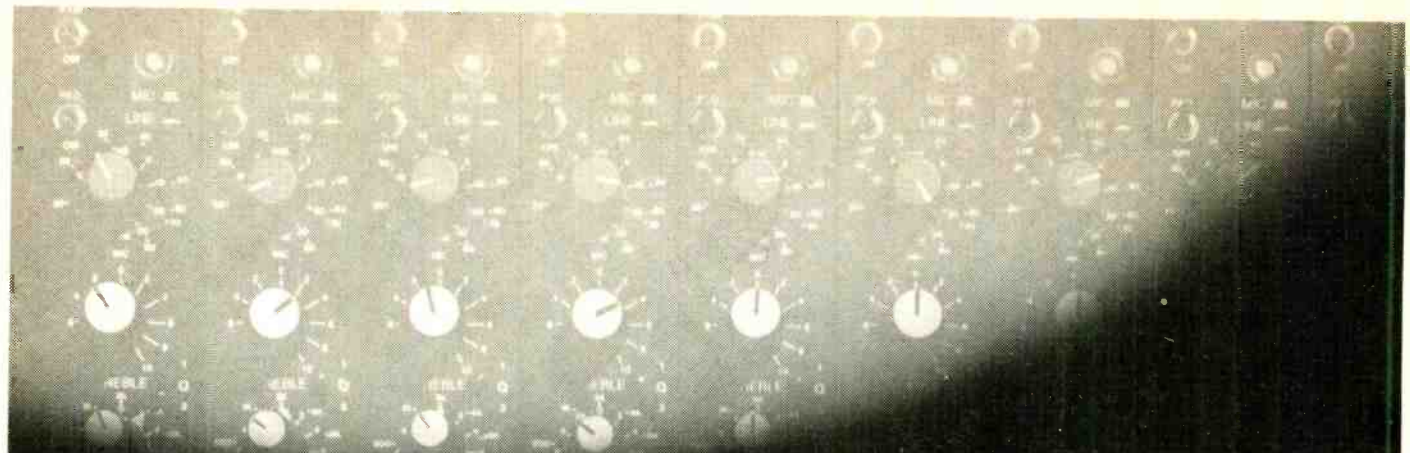
The metering was very sensible, with the peak indicating facility being most useful. Perhaps it's a shame this peak reading facility does not extend to the indicated gain reduction?

The standard of construction and the ease of maintenance was excellent and it is felt that a few minor modifications will make this an excellent product.

Hugh Ford

FIG. 6
UREI 1178
CROSSTALK





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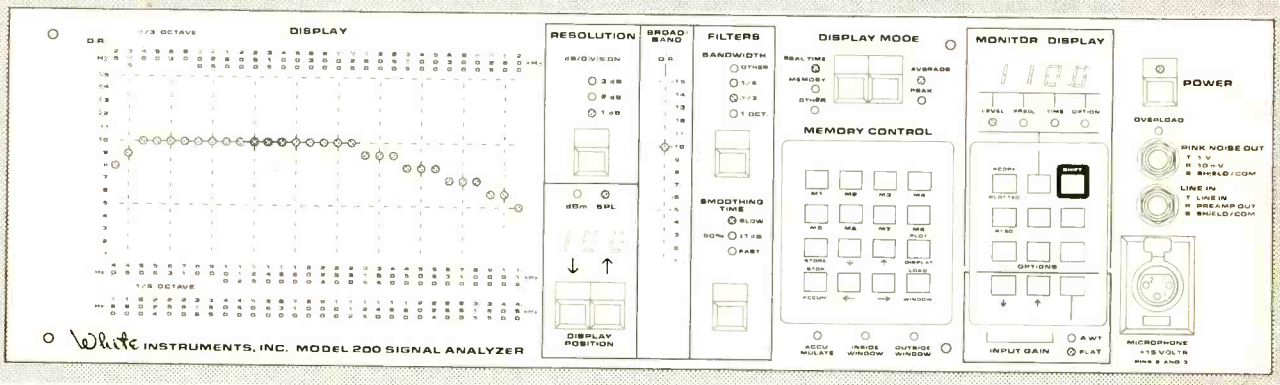

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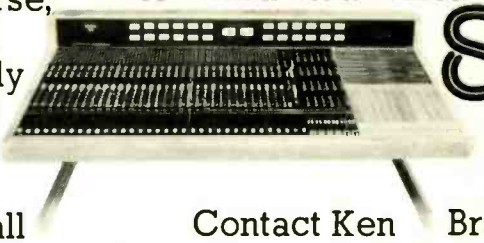

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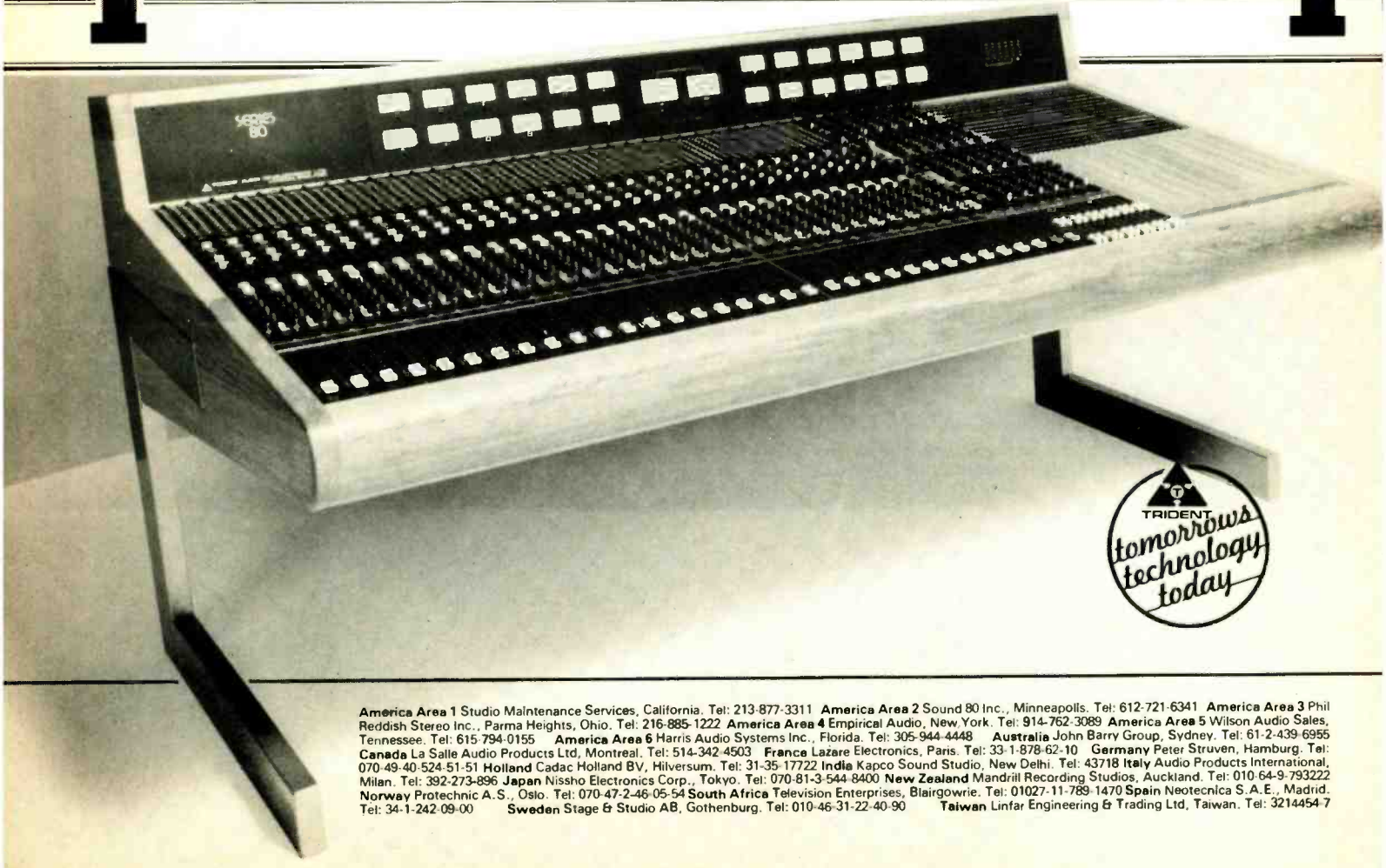

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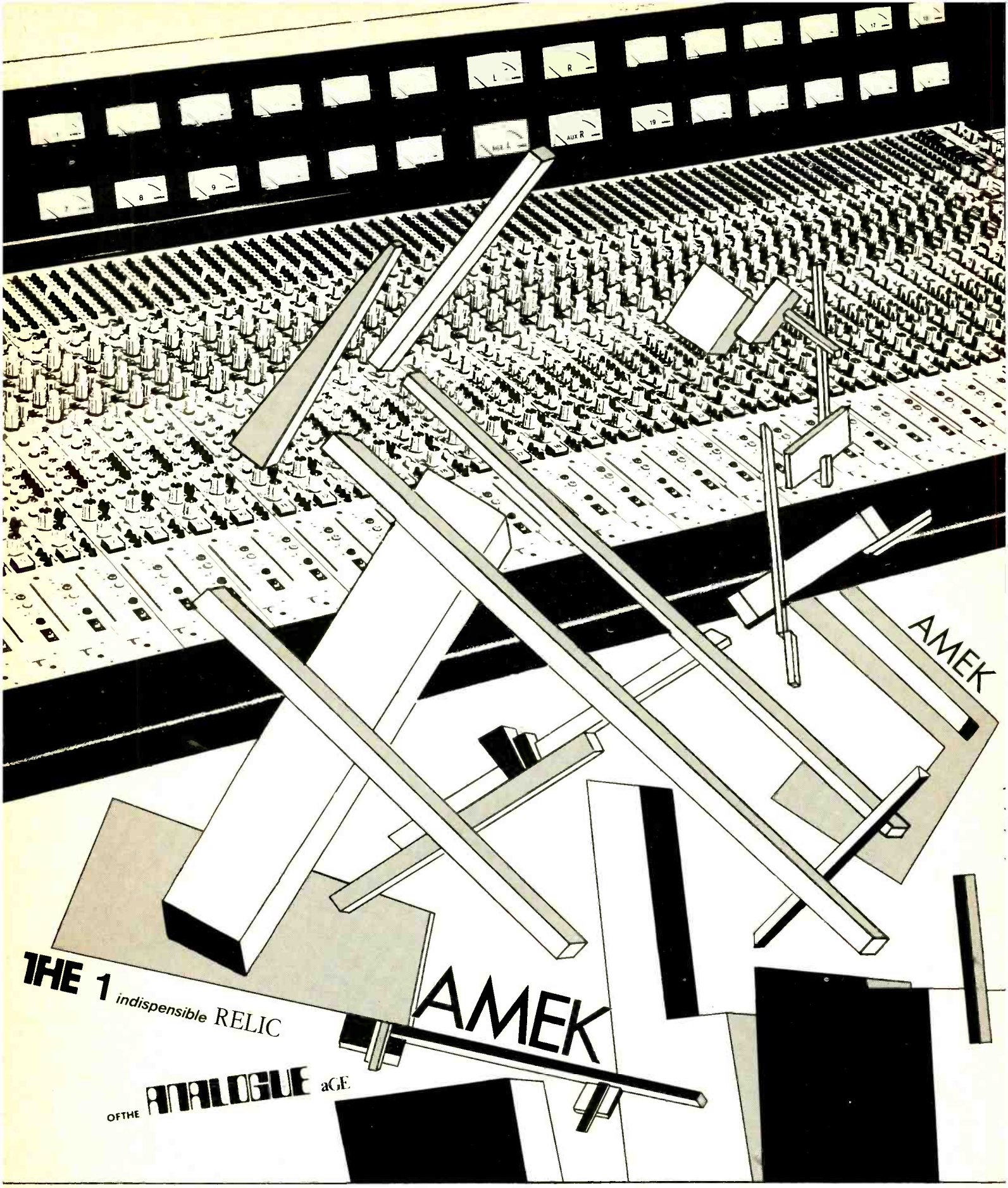

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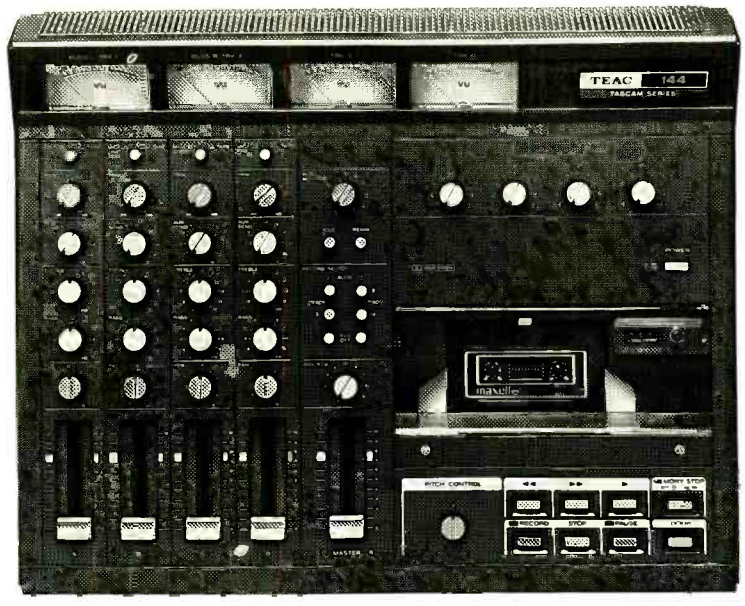

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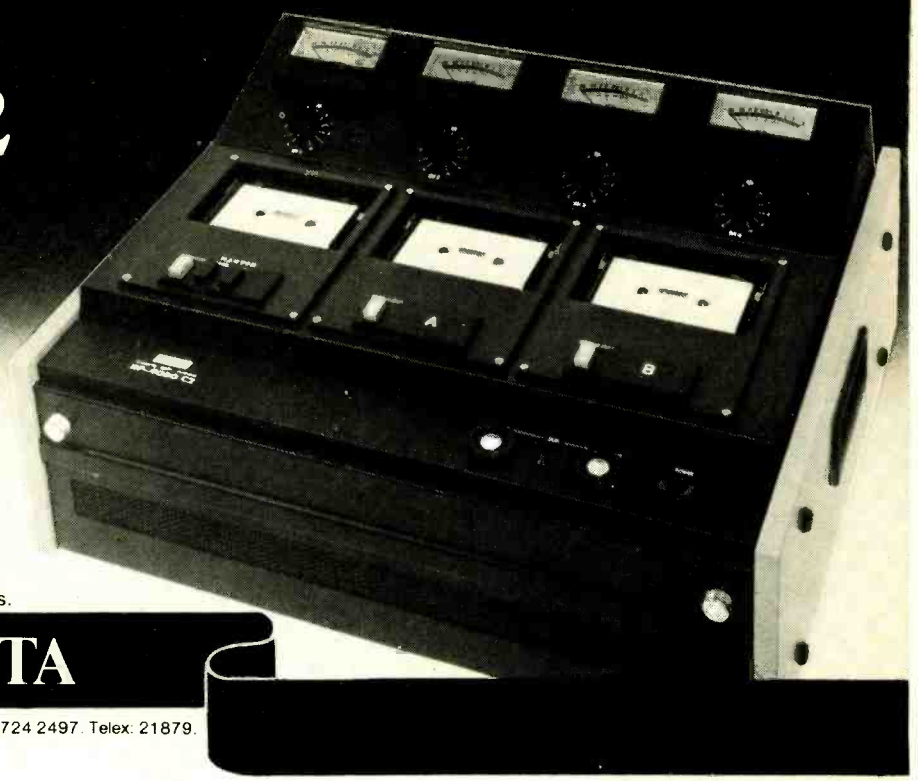

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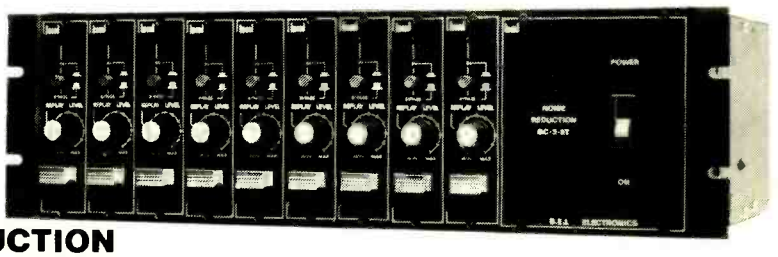

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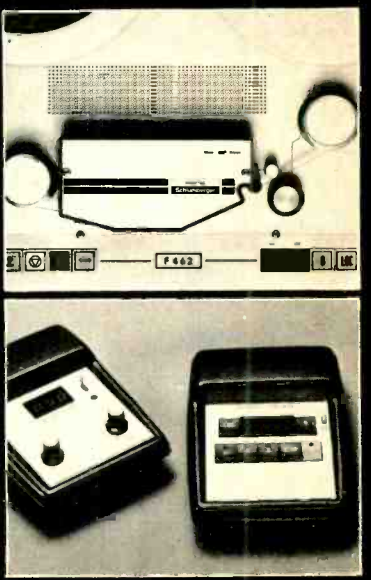

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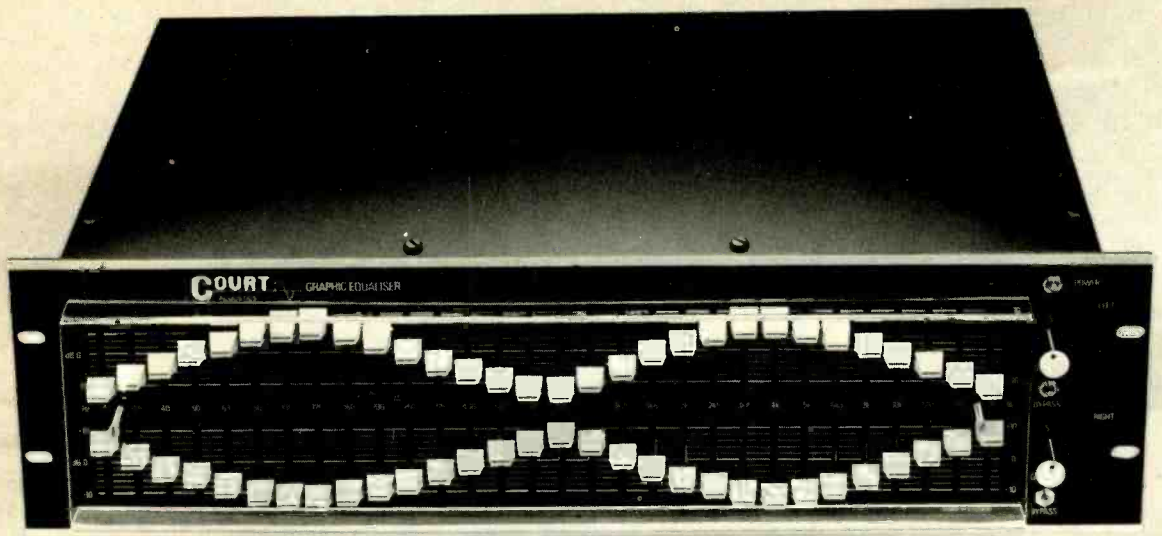

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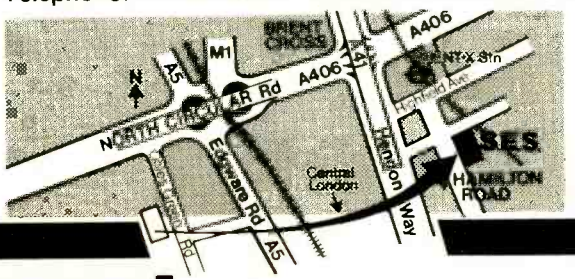

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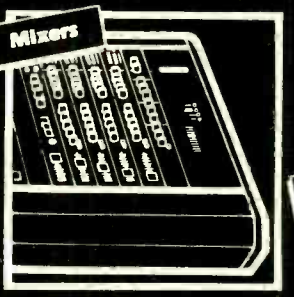

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Mics by AKG, Beyer, Calrec Neuman, Shure & Sennheiser. Ampex tape (bulk purchase discount), leader tape – all colours, editing blocks, blades, splicing tape, demagnetisers, cleaning kits etc.

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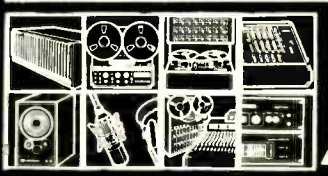

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Note: Advertisement copy must be clearly printed in block capitals or typewritten.

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SERVICES

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

A QUALITY pressing and duplication service provided to studios, etc. Complete with cutting, processing, labels, sleeves, art work, inlays, etc. Minimum order for LPS—250, singles—500 cassettes—250. Example price for complete 46 minutes cassette to include mastering, printed label and library case, on Agfa tape—80p each plus VAT. For further details: SRT Record and Tapes Ltd., 01-446 3218. X

NEVE 16-channel 4 group sound mixing console Spec. 8014. Offers invited around £8,000. Roger Cherrill Limited, 65-66 Dean Street, London, W.1. Tel. 01-437 7972. C

NEW Wollensak cassette copiers directly imported by C.A.V.S. Ltd., cost less and have full service/spares back up. E.g. Wollensak 2770 still costs £999 plus VAT. Also available Telex Copuette at £299 plus VAT and all other Wollensak, Telex, Pentagon similar units. Contact Yates, C.A.V.S. Ltd. 01-363 6125. X

STUDER A-800 24 track machine with complete remote control (Autolocate, Varispeed) and 16 track head block, as new (available June 1981). **SFr.** 95'000--, FOB Zurich. Bruno Spoerri Recording Studio, Schneckenmannstr. 27 8044 Zurich, Switzerland. C

D.I. Box, passive, 20dB insertion, ground lift. Suit guitar, keyboards, etc. Ideal for Stage or Studio use. Only £19.50. Sound Advice (SS), 396 Godstone Road, Whyteleafe, Surrey. H

FOR SALE—PRIVATE

TWO MODEL 527A UREI 1/3 Oct EQUALISERS.
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Telephone: (0903) 814321.

PAIR Tannoy Lancasters. 15in. monitor gold in teak cabinet, £400 o.n.o. 08832 6392 C

STUDER A80 MK1
Neve has for sale this 16T machine with very low mileage. Offers in the region of £8800 to **Alan Archer, Neve Electronics Ltd., Cambridge House, Melbourn, Royston, or Tel. (0763) 60776**

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BRENELL Mini 8 track, with remote supply and electronic counter, immaculate, £2,500 o.n.o. New Yamaha CS 40 M 20 memory 4 oscillator synthesiser £850 o.n.o. £3,250 the package. Ask for Steve on 01-980 7683; if unavailable leave name and number. C

ONE inch tape, surplus to requirements. New Scotch 206, £15 each, £135 for ten. BASF (SPR 50 LHR), genuinely once used, £7.50. 01-428 3714. C

LYREC 24 track + 16 track head block, 3 years old, £11,000. Box No. 848 c/o *Studio Sound.* C

24- 8/8 Alice A.C.M. Mixer. PPM metering, P & G faders, in all-wood console. Especially suitable for Broadcast Production. Offers around £3,900. Telephone Studio on 01-734 5572.

CHILTON 1032 Mixer Mark 5, three years old, balanced mic inputs, HF and LF filters, P & G faders, mid boost on all channels, low Z talkback, £1,150. Newark 73350. C

UHER 4000 Report IC. Complete with case. Carefully looked after, excellent condition. £250 o.n.o. Tel. 0670 58101 or 513658. C

VERY cheap. Leevers Rich 1in. 8 track, Alice 16/8/8 mixer with 32/2 foldback mixer, plus extras. Ex working studio. Tel. 0272 554721 or 01-992 6262. C

REVOX HS77 for quick sale £250 no offers. Davies 0342 832559. C

REVOX A77 ½ track 7½/3¾ ips, amplifiers, speakers, associated 4-channel mixer (tone generator, remote controls), microphones, quantity tape, leads. £400. Ferrograph Series 6 mono 7½/3¾ ips £80. Offers Chandlers Ford 61312. C

FOR SALE
Superb Trident 'B' custom console. Presently fitted and wired for 12/8 but has facilities for 18/16. PPM's, digital clock, etc. Regularly maintained by top technical engineer with whom installation can be arranged. Reason for sale has been our conversion to 24 track. **£2,500.** This desk is an absolute bargain! to view phone **Sounds Aquarian Recording Studios** on 01-437 8470.

TWO Neumann BS45i power units. Alice CNS Series 2 noise suppressor. RS 500W isolating transformer. Power amplifier, single channel. Offers: Sunbury 87108. C

AMPEX AG440B 4 track ½in. tape machine, service manual and tapes. £800. Tel. 0782 621111 extension 476. C

STUDIO FACILITIES

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

DISC Cutting master and demos, pressings, cassettes, mobile recording studio. Free brochure. TAM Studio, 13a Hamilton Way, London N.3. Tel. 01-346 0033. X

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FOR HIRE
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NAGRA 4.2 Pilot
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Phone 0274 307763

WANTED

RADIOMICROPHONE wanted, any condition. Transmitter/Receiver or incomplete system. Please telephone 02013 81987 after 8 p.m. D

SITUATIONS WANTED

YOUNG Sound Engineer would like London Studio to give him a chance. Generally experienced in Multi-Track, Mixing, AV and P.A. Systems. Good knowledge of wiring and electronics. Hard worker (Makes Great Tea). Tel. 01-992 9365 after 7 p.m. C

YOUNG man with experience and knowledge of Studer Revox equipment wishes to join the Studio field. Anything considered. 0246 75479. C

ENGLISH Recording Engineer, Studio Designer, Producer, 7 years experience in U.S.A. and England, seeks interesting position anywhere in the U.K. or abroad. Box No. 850 c/o *Studio Sound.* C

SITUATIONS VACANT

TECHNICIAN Engineer required to maintain and develop unusual, interesting Sound Studio within a large London organisation. HNC or similar qualifications essential. Salary £7,500 to £8,500. Send C.V. to Box No. 849 c/o *Studio Sound.* C

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WE REQUIRE A SKILLED ELECTRONICS ENGINEER WHO HAS HAD MANY YEARS EXPERIENCE IN A RECORDING STUDIO. THE APPLICANT MUST HAVE A FULL UNDERSTANDING OF STUDIO REQUIREMENTS SO THAT HE/SHE IS ABLE TO LIAISE WITH THE CUSTOMER AND TRANSLATE THEIR REQUIREMENTS INTO PRODUCTION DOCUMENTS.

PLEASE APPLY TO:
ALAN BROWNING,
TRIDENT AUDIO DEVELOPMENTS LTD., SHEPPERTON STUDIOS.
CHERTSEY 60241.

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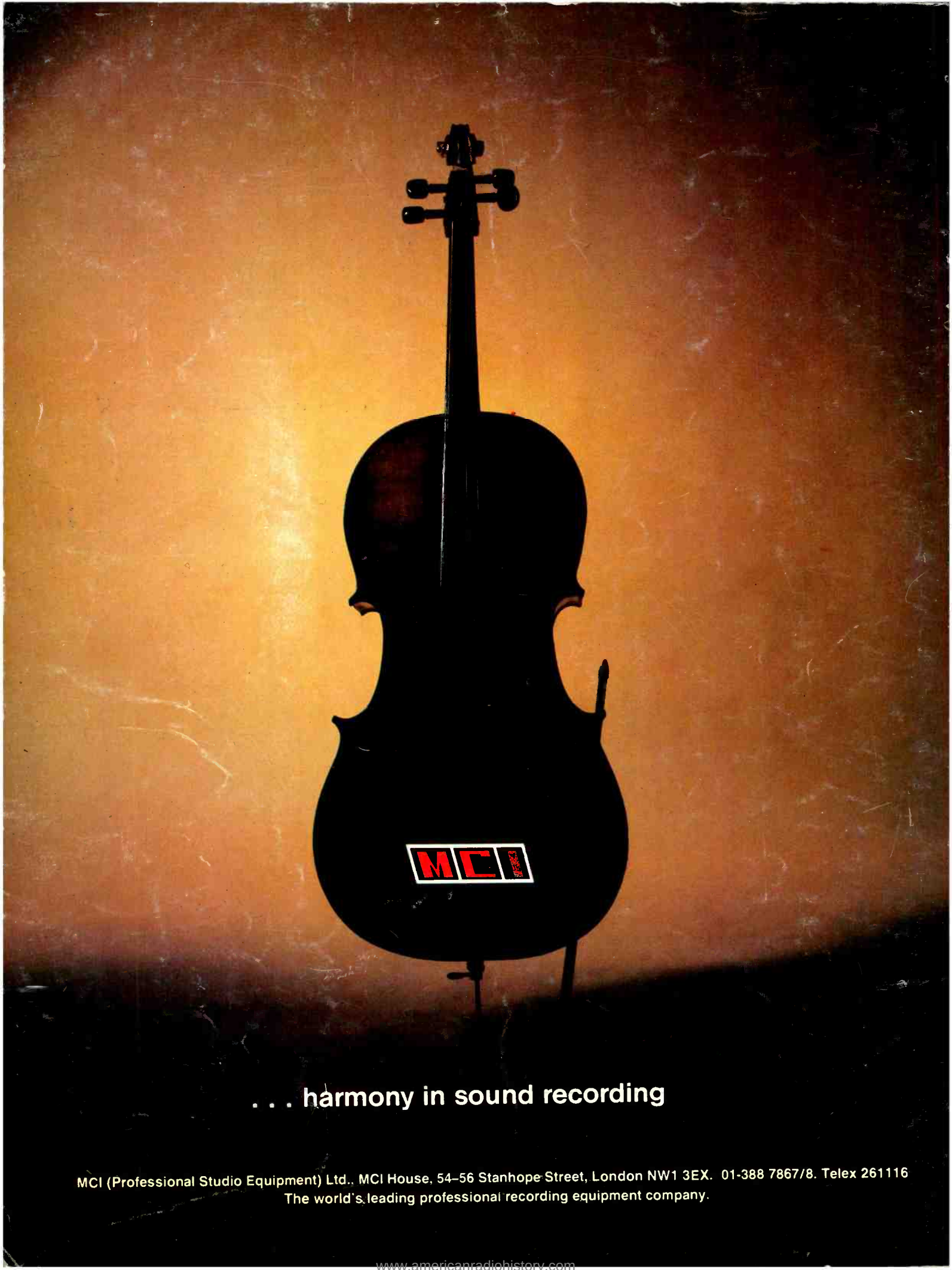

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