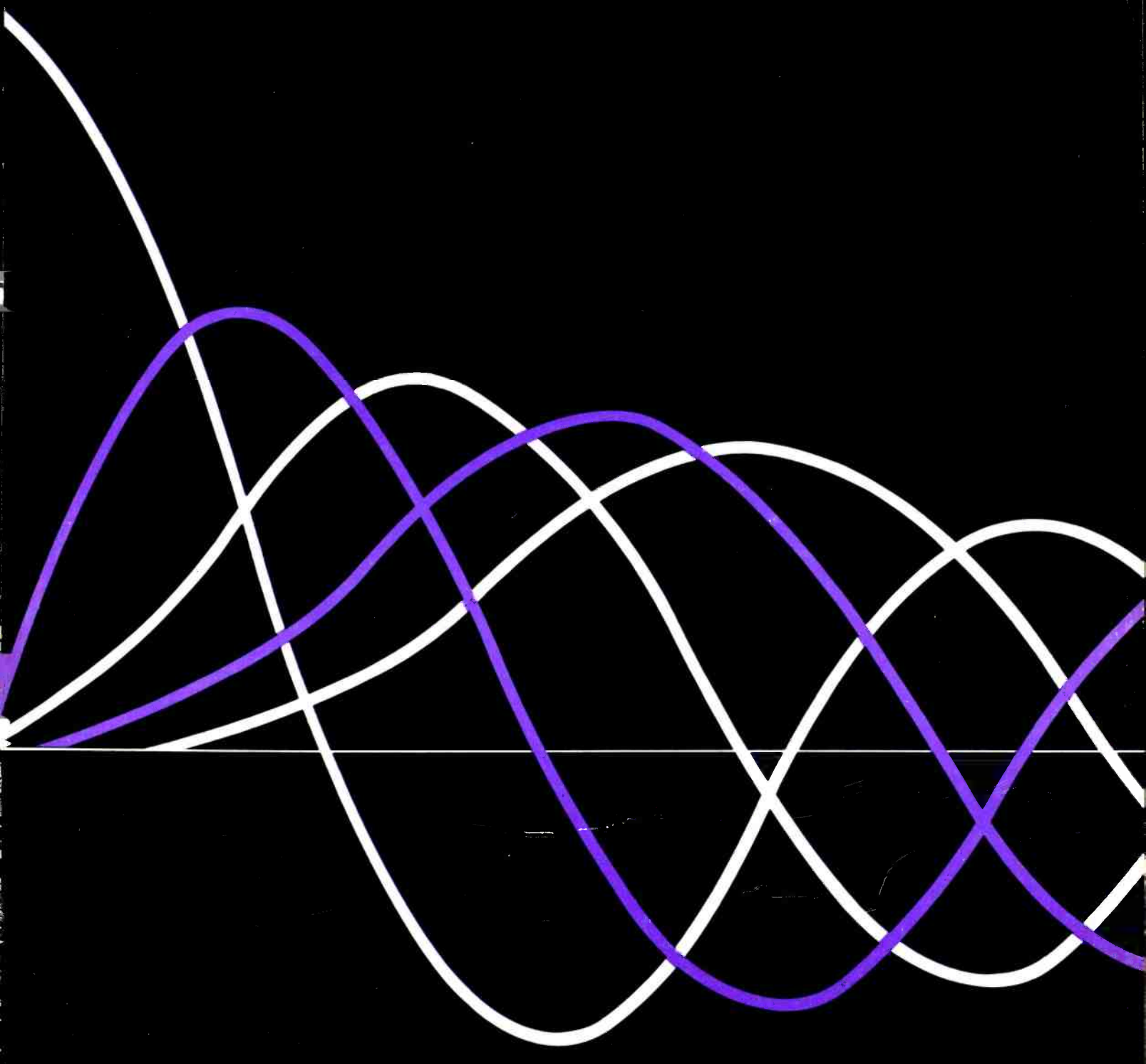
September 1975 25p

studio sound

AND BROADCAST ENGINEERING



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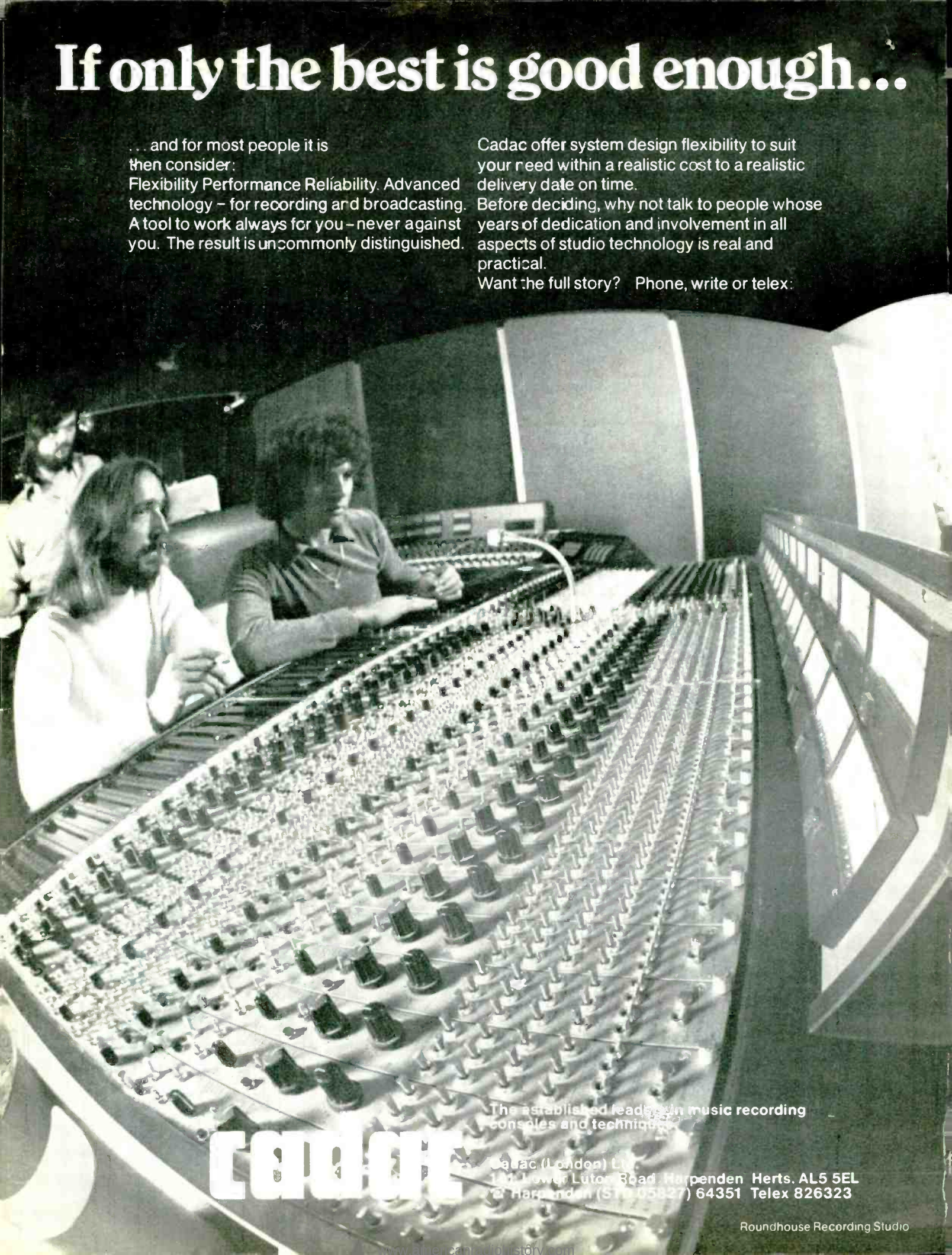

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Telegrams: Aviculture Croydon

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FEATURES

COLUMNS

REVIEWS

STUDIO SOUND is published on the 14th of the preceding month unless that date falls on a Sunday, when it appears on the Saturday.

DISTRIBUTION
STUDIO SOUND, published monthly, enables engineers and studio management to keep abreast of new technical and commercial developments in electronic communication. It is available without charge to qualified readers; these being directors, managers, executives and key personnel actively engaged in the sound recording, broadcasting and cinematograph industries in any part of the world. Non-qualifying readers can buy STUDIO SOUND at an annual subscription of £4.17 (UK) or £4.20 overseas.

BINDERS
Loose-leaf binders for annual volumes of STUDIO SOUND are available from Modern Bookbinders, Chadwick Street, Blackburn, Lancashire. Price is £1.25 (UK and overseas). Please quote the volume number or date when ordering.

SEPTEMBER 1975 VOLUME 17 NUMBER 9

Equipment reviews and the subsequent judging of whether or not they achieve the claimed specification have always been a problem. The immediate headaches are obvious: deciding what to measure, how to measure it, and whether it should be stressed or even mentioned at all. That done, the review must be written and edited so that physical measurements are presented as such and subjective reactions as something else. And there are so many parameters that can be read off a meter that choice of the relevant ones remains, paradoxically, subjective.

Fortunately, we do not suffer from the sheep-like following that afflicts reviews in consumer areas, the most obvious parallel of which is the hi fi sector. It is not the consumer's business to know about such things as im and power bandwidth, but it is the concern of the engineer, whether he installs a console, drives it, or mends the cans and makes the tea. But there remain pitfalls in the interpretation of published reviews.

A particular application needs a particular object. That object is something in the engineer's mind. It's his problem to relate it to the conclusions and measurements in a review, which ideally are as uncluttered as possible with unjustified preferences. There is never a best buy to suit; always, the need is to assess the compromises which have to be made and where. It's a question of deciding where on some arbitrary quality scale you choose, and only then comes the relating of your own preferences in design, performance, layout and so forth. This demands another transformation of the published figures and conclusions, as personal preferences are overlaid.

This is where the hazy blend between gear and technique arises. There are different ways of using things, different ways of working. To take an extreme case, you may prefer lead through an *AC 30* rather than a *DC 300A*. In the olden days before voltage control and fancy attachments, you found a fuzz sound by overdriving some hapless amp stage. Tape squash is not always a disadvantage.

And then there are the issues of reliability and ease of servicing, and how they relate to the performance in an isolated week at the lab. What of the safety margins? Do they matter? Compare EMI's standard for quadraphonic masters on 25 mm tape with the highly creditable performance delivered by some of the new generation of tape recorders operating on half the conventional nominal track width. Again on tape, the minimal dBs extra print-through as a result of using lp tape might not be the end of the world for mobile people.

Reviews are presented as honestly and as objectively as possible, but that will never absolve the reader of the responsibility to make his own assessment of the review and the particular preferences of the writer. He will never agree, ideally, but that is not the point. The aim is for us to provide a convenient presentation of information from which to work, and to show in the course of that presentation where there may be divergences.

But not to pronounce. That isn't possible.

CORRESPONDENCE AND ARTICLES
All STUDIO SOUND correspondence should be sent to the address printed on this page. Technical queries should be concise and must include a stamped addressed envelope. Matters relating to more than one department should occupy separate sheets of paper or delay will occur in replying

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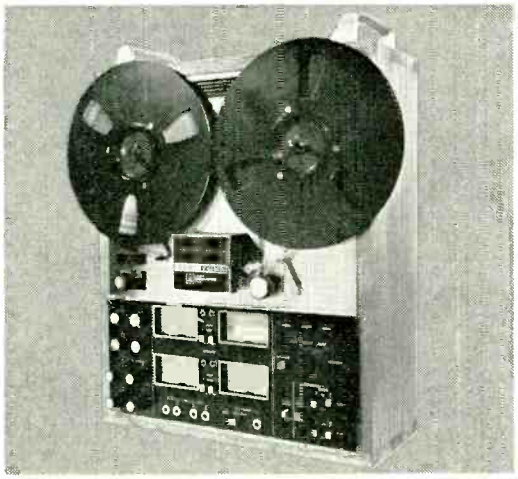

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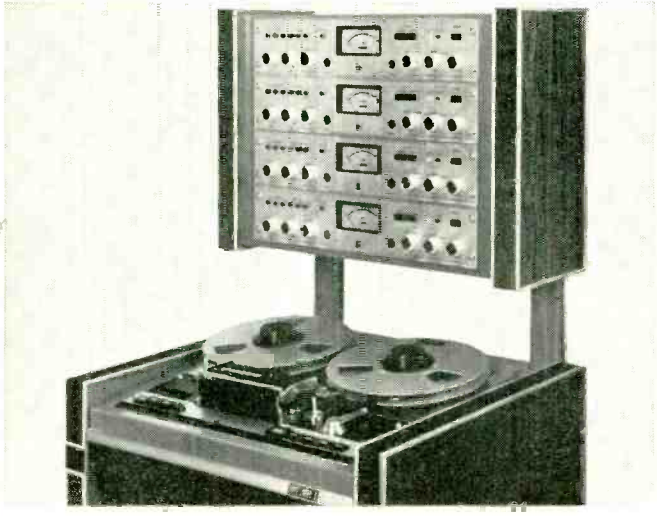

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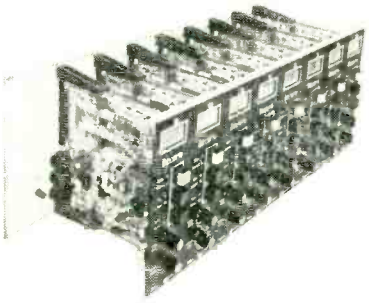

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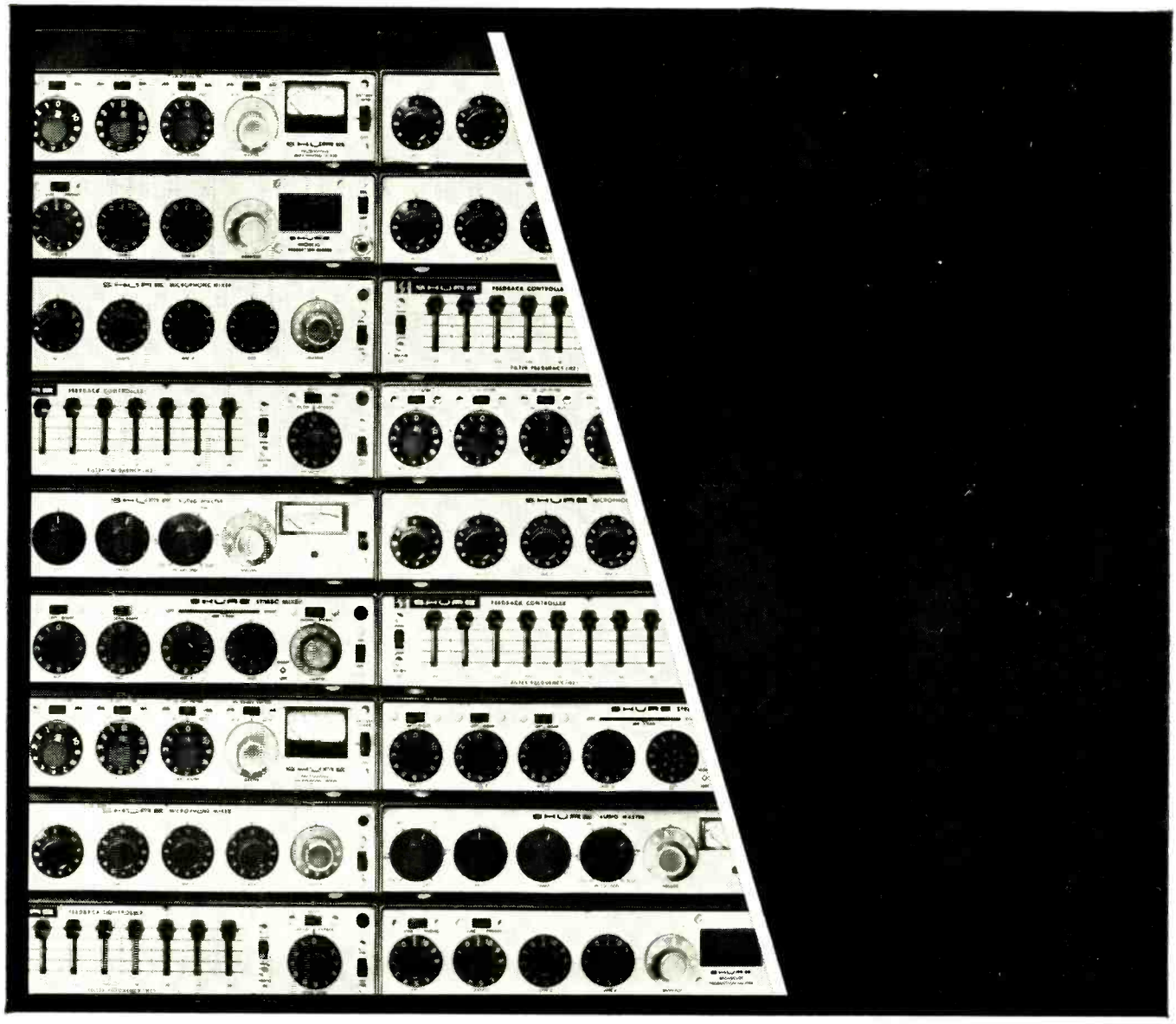

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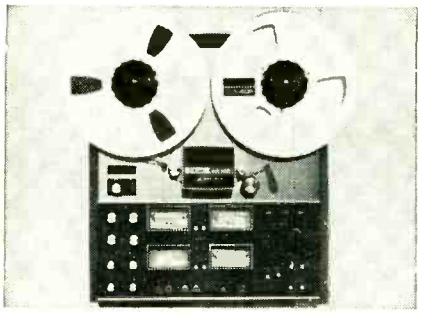

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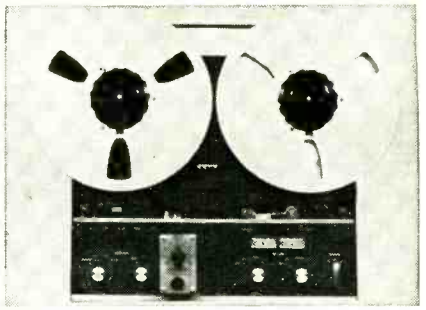

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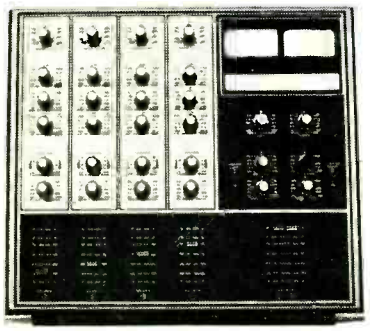

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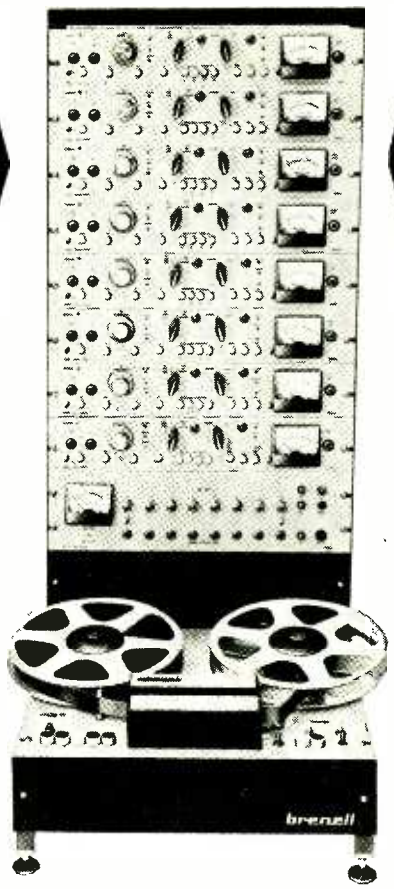

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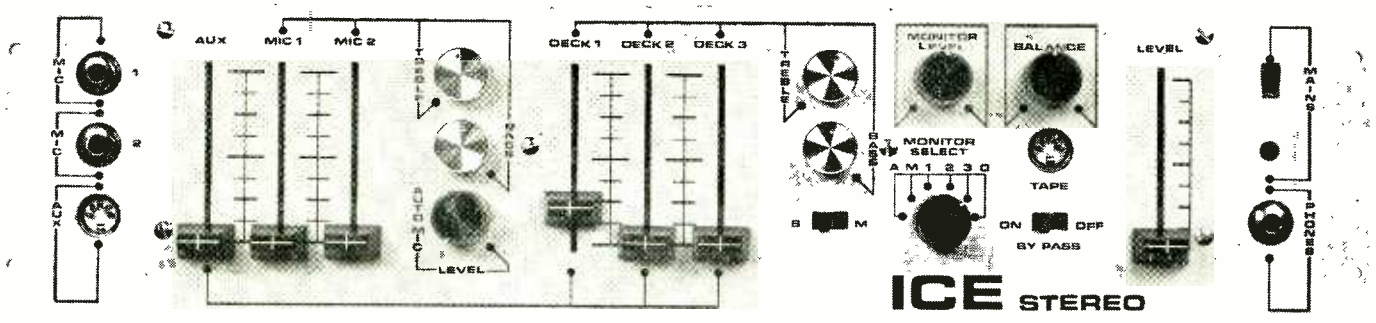

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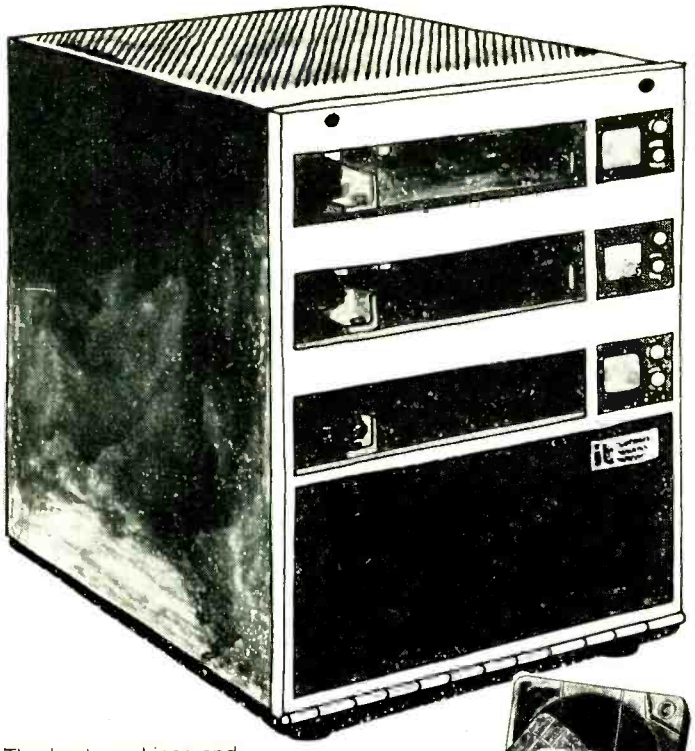

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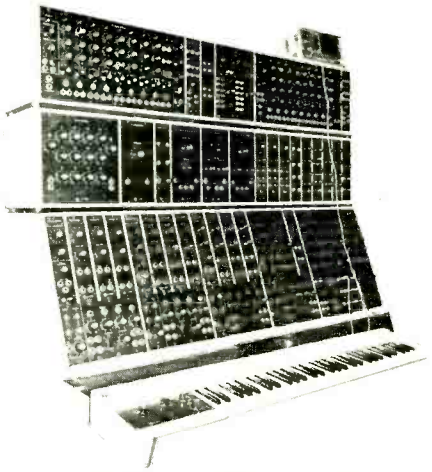

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The AR-10π
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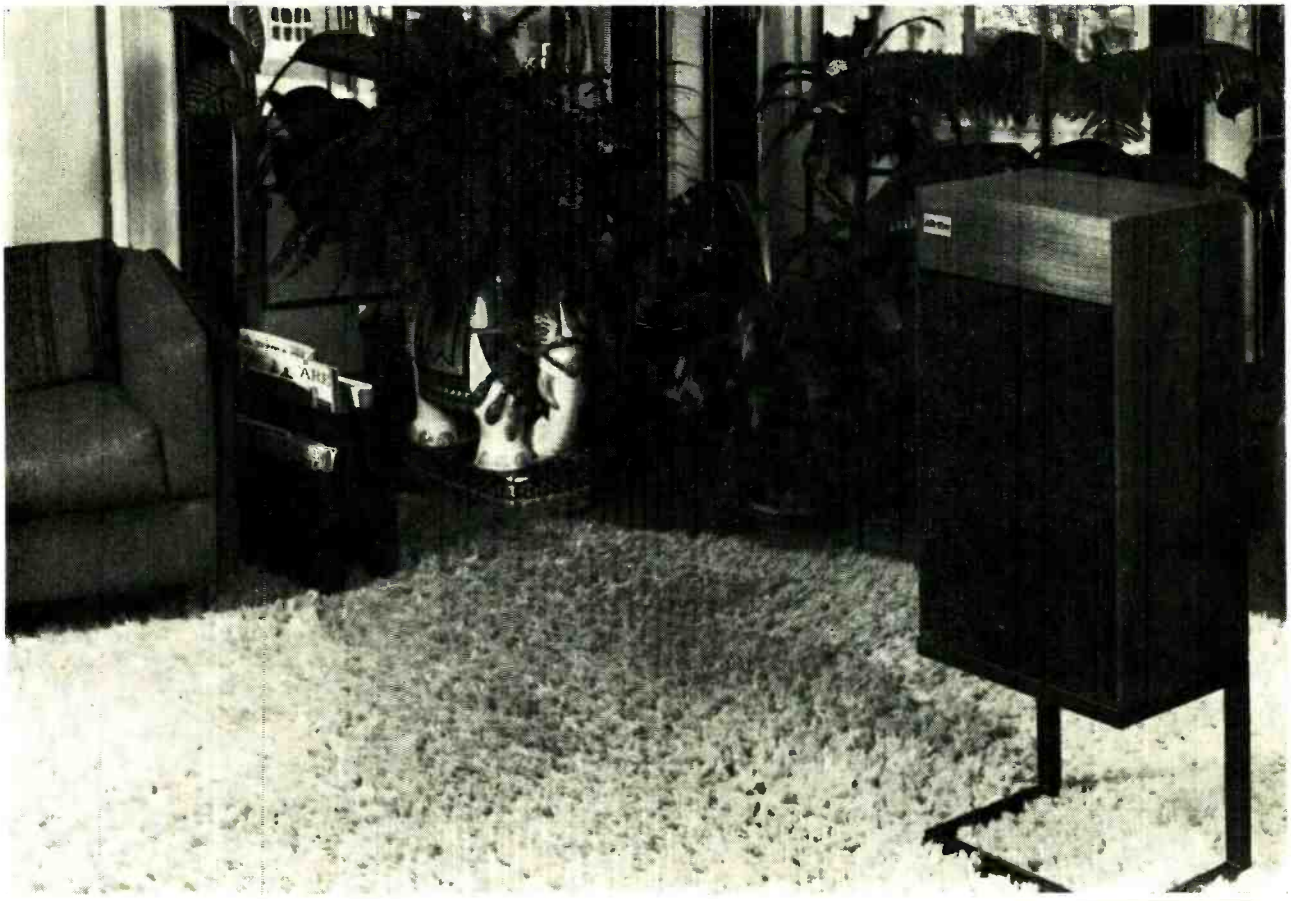

Musical accuracy
The new AR-10π is the most accurate musical reproducer that Acoustic Research has ever built for use in the home. It has been designed to deliver uniform flat energy response in most listening rooms. This means that the musical balance of the input signal will be accurately transmitted to the listener, and listeners in virtually all listening positions will hear the performance in the same way. A new tweeter and crossover network make this new standard of accuracy possible.

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Please send me a complete description of the AR-10π

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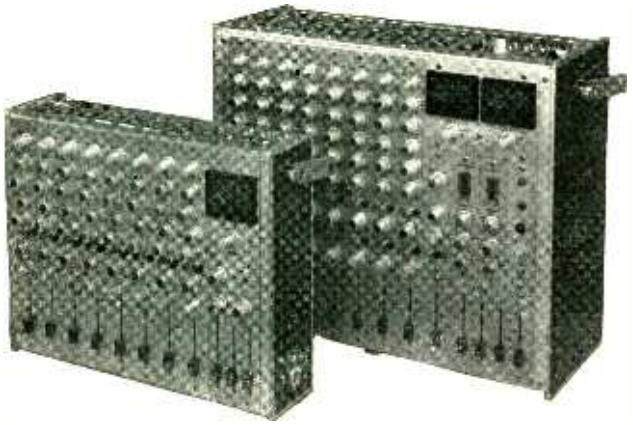
AUDIO DEVELOPMENTS
PORTABLE MIXERS



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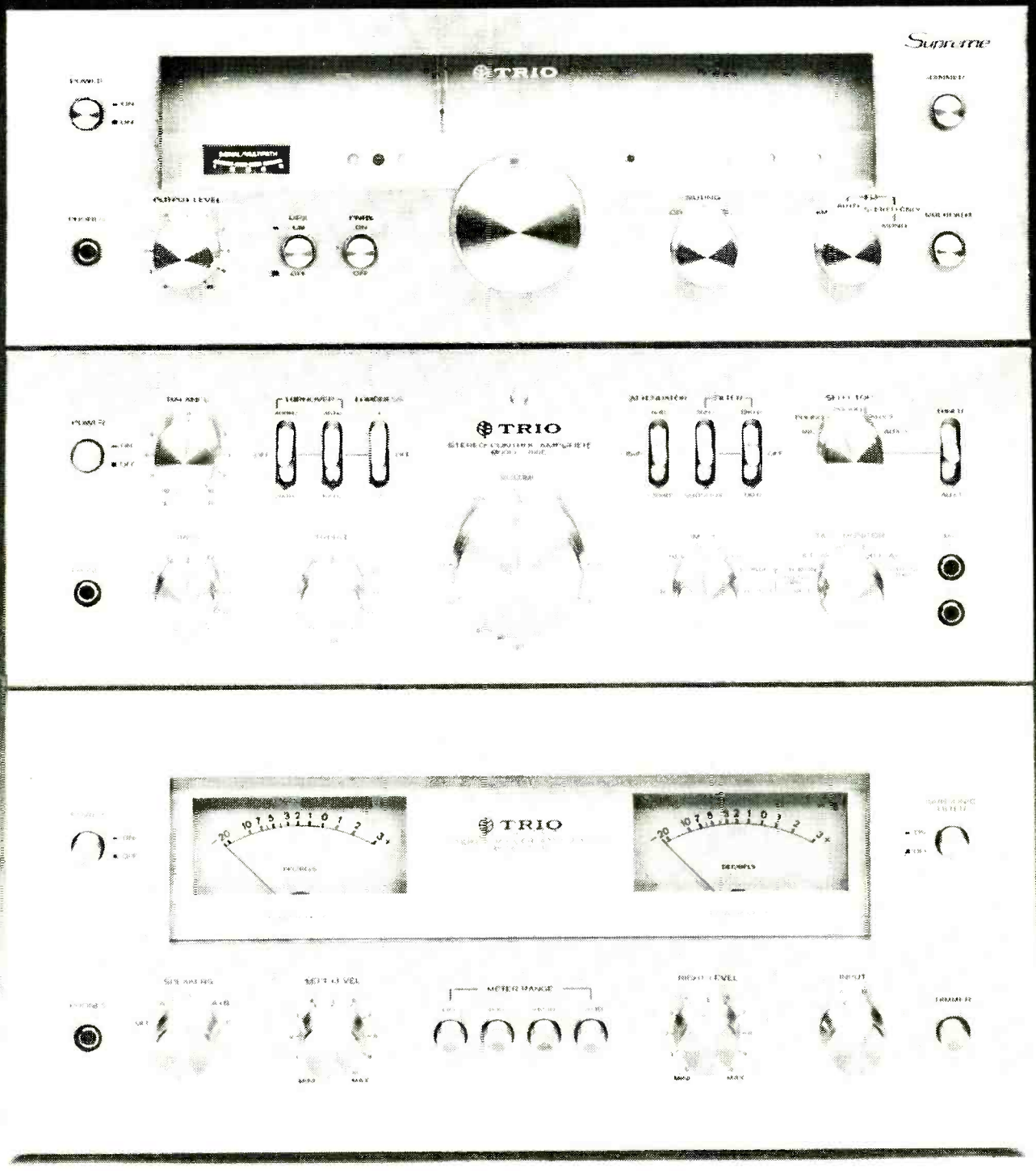


£1,120 SOUNDS A LOT UNTIL YOU HEAR WHAT YOU GET FOR IT.

The trouble with equipment this advanced is there are so many features we haven't room for them here. But if you write to the address below we'll send you the details that will convince you £1,120 isn't a lot to ask. TRIO

The 700T stereo tuner £390.00. The 700C control amplifier £300.00. The 700 Mpower amplifier £430.00. Prices shown are maximum selling prices excluding VAT. B. H. Morris & Co. (Radio) Ltd., Trio House, The Hyde, London NW9 6JP. Tel: 01-205 6441. Agents in Eire: Peat Wholesale Ltd., Dublin.

New Ampex products

THE FIRST OF these is designed to link the *MM-1100* or *AG440* series tape machines with the *RA4000* automatic programmer for use in multitrack audio production. The *Auditec II* permits the multiple sound tracks to be mixed in synchronisation with the video. By interfacing with the recorder and programming units, electronic splices may be set up, previewed and executed immediately, or maintained in the memory so that the entire audio/video edit sequence may be accomplished in a single, continuous operation. The synchronising process requires the use of one track of each recorder.

The second product is a new video layback head designed for use with the *MM-1100* recorder. The head allows video tape to be run through a conventional audio machine to enable audio processing work directly on the video tape. This cuts out unnecessary video tape head wear and frees the vtr for other duties. For correct equalisation to the vtr standard, the eq plug-in boards must be changed.

The third product is a new search to zero device for use with *MM-1100*. Position of the tape is shown on a digital display; a — or – display indicates whether the current reading is ahead of or behind the zero point. In addition, the locator has an automatic 'drop into play' facility which operates on reaching the desired spot on the tape.

The fourth product, the company claim, assures clean edit inserts when multichannel recording. Called the Pick Up Recording Capability, the accessory permits the editing or dubbing of new material over previously recorded material without creating errors at either end of the new insert. Errors can occur because of time delay between erase and record head. By individually controlling the turn-on and turn-off operations of the heads, PURC prevents over-recording at punch-in and eliminates gaps at punch-out.

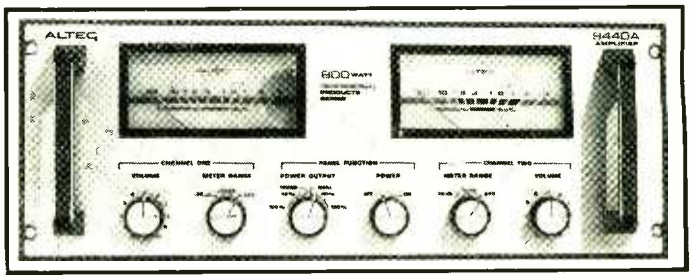
The final item concerns a distribution agreement reached between the Ampex Corporation and the Electronic Engineering Company of California to distribute EECO time code editing and synchronising equipment worldwide. Ampex Corporation, Audio-Video Systems Division, 401 Broadway, Redwood City, Ca 94063, USA. Phone: (213) 240 5000. Ampex (Great Britain) Ltd, Acre Road, Reading, Berks. Phone: 0734-85200. Telex: 848345.

DBX complimiter

ONLY RECENTLY AVAILABLE in the UK, the unit features an fet switch isolating the output stage during mains power turn on/off. This provides a high degree of mains induced transient suppression. The DBX patented voltage controlled amplifier which provides the essential gain reduction function, is driven by an rms rectifier. This means that the compression of the signal takes place according to the rms energy content of the programme material.

Model *160* incorporates line matching transformer for use in balanced systems. The *161* is unbalanced. The units cost respectively $300 and $250. The UK price is £172 and £137. DBX Inc, 296 Newton Street, Waltham, Mass 02154, USA. Phone: (617) 899 9555. Telex: 923472. UK agents: Scenic Sounds Equipment, 27/31 Bryanston Street, London W1H 7AB. Phone: 01-935 0141.

DBX Complimiters: models 160 *(balanced)* and 161 *(unbalanced)*



Altec 9440A amplifier

Free demos

ACKNOWLEDGING THE problems facing young musicians going out into a competitive world, Mark Sutton of Sutton Sound Studios intends to give them a helping hand by offering free 20-minute demo sessions to create an instant portfolio on tape. The students, to be selected by the principals of leading London colleges, will record their recital in the Great Hall of Bishopsgate Foundation on loan from the Governors of that body.

Mark will offer the services of his recently-completed mobile and EMI will supply the tape free of charge. Sutton Sound Ltd, 23 Redan Place, London W2 4SA. Phone: 01-727 6681.

New power amplifiers . . .

FROM ALTEC, THE company's first-ever model delivers a claimed 250W/channel into 8 ohms or 400W/channel into 4 ohms with less than 0.1% total harmonic distortion. The circuit design provides 'fail-safe protection for the output transistors and the load'.

Provisions have been made for mounting two accessory fans on the heat sink shroud for greater thermal drainage from the output stage. Other features include illuminated vu meters indicating the full wave average rectified output level of each channel on selectable fsd ranges of 0 dB, –10 dB and –20 dB. Model *9440A*, designed for rack mounting, is compatible with standard line terminations and levels when used with optional line transformer *15335A*.

The unit costs $999 from Altec Sound Products Division, 1515 South Manchester Avenue, Anaheim, Ca 92803, USA. In the UK, the cost is £610 from the agents: Theatre Projects Services Ltd, 10 Long Acre, London WC2E 9LN. Phone: 01-240 5411.

AND FROM Harman/Kardon, a new addition to the established range of amplifiers. The *Citation 16* offers a claimed 150W/channel from 20 to 20k Hz into 8 ohms at less than 0.05% total harmonic distortion. Other parameters, quoted from the manufacturer's specification, include a risetime of 3 μS and an input sensitivity 1.25V for the rated power output.

The specification quotes many other performance standards without stating the conditions under which they were measured. These, of course, are meaningless.

Intended for standard rack mounting, the unit weighs 24.9 kg and costs (UK) £465. Harman/Kardon Inc, 55 Ames Court, Plainview, NY 11803, USA. Phone: (516) 681 4000. UK agents: Highgate Acoustics, 38 Jamestown Road, London NW1 7EJ. Phone: 01-267 4937/8. 18 ▶

PERFORMANCE PLUS

TECHNICAL SPECIFICATION

Mean sensitivity open circuit voltage per dyne/cm² (micro bar) 0.064 mV
Open circuit voltage level per micro bar reference 1 volt -84 dB
Power delivered into 30 ohms for 1 micro-bar reference 1 mW -76 dB.
American A.S.S. rating reference 1 mW -150 dB.
Nominal impedance 30 ohms.
Distortion less than 0.5% for a sound intensity level of 125 dB above 0.0002 dynes/cm² (20 micro-newtons per square metre) at 500 c/s.
Dimensions: length 21.3cm, mean diameter 2.54cm, weight 260gm.
Response curve is sensibly flat from 30 c/s to 12,000 c/s for sound incidence within a solid angle of 30°.

4037A Moving Coil Microphone ideal for Television Interviewing

This microphone is unobstrusive, and neat in appearance, and is therefore ideal for television and sound interviewing. It is finished in black shrivel enamel and satin chrome. There is a special locking device to prevent it becoming accidentally detached from the 4069A Jack during use. The response of the microphone to wind conditions is reasonably low, and in severe wind conditions a P.A.S. 45/39 windshield is recommended, this will permit speech clarity. A first class professional inside and outside broadcast omni-directional microphone.

HHF **Hampstead High Fidelity,** 91 Heath Street, Hampstead London NW3 6SS
Telephone 01-435 0999 and 435 6377

NEWS

Tin Pan Alley

BY MID-NOVEMBER Central Sound, Tin Pan Alley Studios, KPM, Southern Music, Regent Sound and the other tenants of London's rapidly-decaying Denmark Street will know whether Harry Hyams has appealed against Camden Council's rejection of his development proposals. Sovneath Investments, a wholly-owned subsidiary of Oldham Estates who built Centre Point, wanted to redevelop all 18 of the premises they owned in the street and in nearby Denmark Place. Seventeen of the applications involved change of use and the last was for demolition. Chairman of the Tin Pan Alley Association, Peter Robinson of disc cutters LTS, said that of the six listed buildings in Denmark Street three would be knocked down and the other three rebuilt behind their facades.

The standard work on speculative redevelopment in London is Christopher Booker and Candida Lycett Green's 'Goodbye London', written over two years ago. Of Denmark Street they said that outline planning permission had been granted in the early sixties to Sovneath for a second phase of the Centre Point redevelopment. 'Although this is no longer active there are signs of developer's blight in Denmark Street and some proposals seem probable.' By developer's blight they mean allowing buildings to become either so unsightly or, preferably, so dangerous that any objection to the removal even of listed buildings was removed. The six listed buildings in Denmark Street are those in the worst condition.

Robinson says the TPAA now has a membership of 800, many of them customers of businesses in the street. He's disgusted by the lack of support from smaller businesses. Most of the donations have come from concerns that could afford to move away.

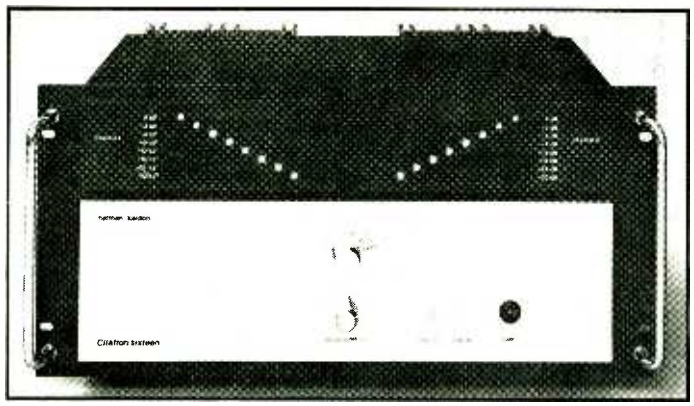
He didn't want to say whether Hyams would appeal or not, even after all this time: 'These people move slowly'. If he does appeal, a public enquiry will be held, a procedure which Hyams might find unwelcome but which the TPAA might find even more expensive.

Another factor is in Hyams's favour. It might be thought that a Labour - controlled Camden Council might do everything in its power to prevent Hyams carrying out these proposals. They were very noisy about Centre Point, but some in Denmark Street feel that Hyams would have got his planning permission had it not been for the press and television publicity the plans were given.

When Oldham Estates was taken over by the Co-operative Insurance Society early in 1974 *The Times* reported that the CIS had already lent Oldham £38 million in long term mortgages at 6½ per cent. In February that year CIS took a majority shareholding in Oldham, leaving Hyams in charge as chairman and managing director. Oldham's shares were suspended in 1971 at 45p each. At the time of the takeover they were worth about 30p in unofficial deals, but CIS paid about 50p for the four per cent they needed to take control. 'It is stressed,' said *The Times*, 'that the close friendly links between Mr Hyams and the CIS continue'.

That might also be a perfect description of the relationship between the co-operative movement and the Labour Party, which controls Camden Council. Many Labour MPs reacted at the time of the takeover as if the Labour Party itself had been guilty of making money from property speculation, and said that such deals were inconsistent with the aims and ideals of either the Labour or co-operative movements.

Not much has been heard since, and despite the soothing noises from the town hall Central and all the others will believe they can record in peace when those little orange and white notices come off the walls. **John Dwyer**



Harman/Kardon Citation 16. *Details on p14*

CD-4 handbook

INTENDED AS A consumer's guide to the CD-4 system, the handbook, a 28-page 'discrete point of view' published by John Eargle's JME Associates, offers a low key explanation from the original recording to the final disc. It also gives a list of CD-4 equipment manufacturers, a complete list of *Quadradisc* titles and a glossary of quadraphonic terms. It should be available, free, from local dealers or direct from JVC America Inc, 50-35 56th Road, Maspeth, New York 11378, USA.

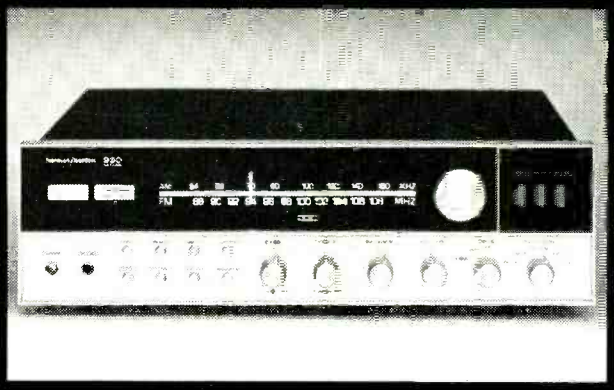
Mic prices down 30%

CALREC AUDIO LTD announce price cuts in their microphone range of 30% across the board. The company state that this has been made possible by increased turnover and improved production techniques.

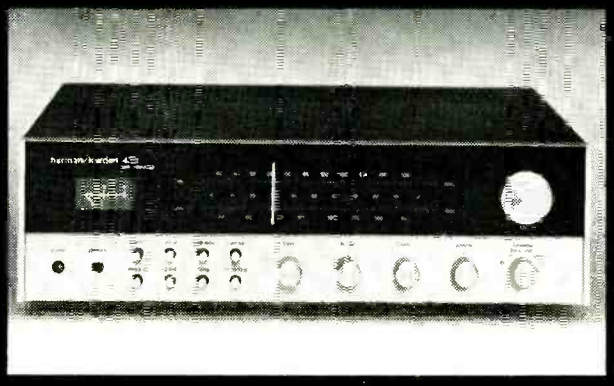
The new prices will apply both to home and export orders. Calrec Audio Ltd, Hangingroyd Lane, Hebden Bridge, Yorks HX7 7DD. Phone: 042284-2159. 20 ▶

Harman/Kardon, need we say more?

HK 1000 – Dolby cassette deck with wow and flutter specification of 0.13% or less, plus switching for Standard, Low Noise & CrO_2 tapes.

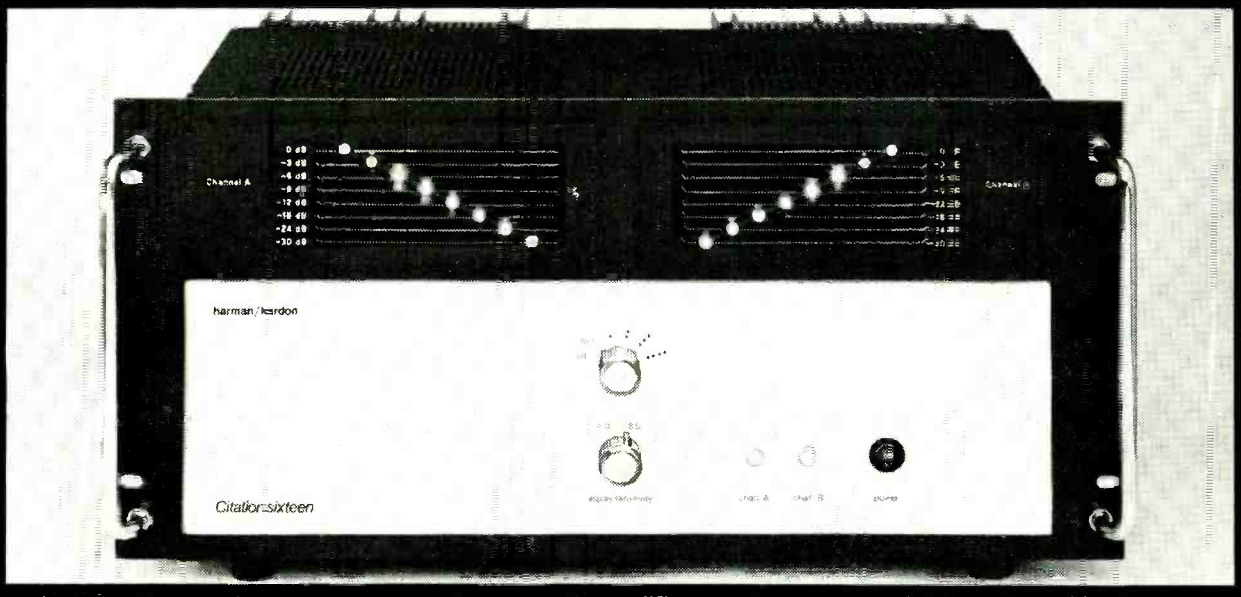


HK 930 – the first AM/FM stereo FM solid state receiver with two totally separate power supplies. 45 watts per channel into an 8 ohm load.



HK 430 – an AM/FM stereo tuner/amplifier with twin power packs giving a minimum of 25 watts RMS per channel into 8 ohms with both channels driven.

A 401 – an integrated amplifier giving 20 watts RMS per channel, both channels driven into 8 ohms, from 20 Hz to 20 kHz with less than 0.5% THD.



Citation 16 – a professional standard stereo power amplifier with total output of 300 watts RMS minimum plus twin power and extremely wide bandwidth.

Five superb items that live up to their looks from the comprehensive range of superlative Harman/Kardon hi-fi equipment. Ring or write for details.

harman/kardon

Highgate Acoustics 38 Jamestown Road London NW1 7EJ Tel: 01-267 4936

NEWS

IBC 76

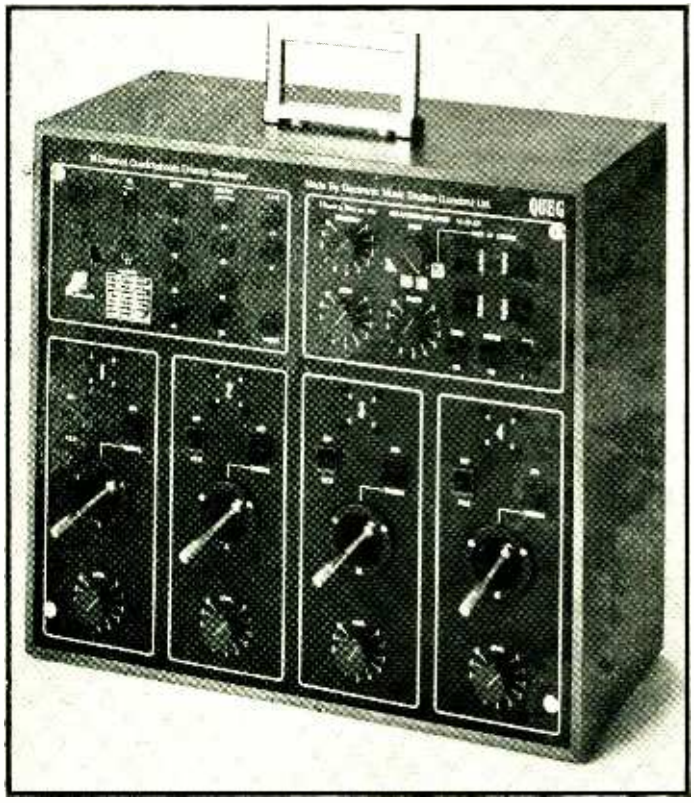
SPONSORED BY THE Electronic Engineering Association, the Institution of Electrical Engineers, the Institute of Electrical and Electronics Engineers, the Institution of Electronic and Radio Engineers, the Royal Television Society and the Society of Motion Picture and Television Engineers, this biennial event has now become an international forum for new techniques covering the entire broadcasting field; the show, concurrent with the convention, serves as a shop window for professional broadcasting hardware.

The sixth convention will be held in London at Grosvenor House, Park Lane from September 20 to 24, 1976. All enquiries in connection with IBC 76 should be addressed to the Secretariat, International Broadcasting Convention. IEE, Savoy Place, London WC2R 0BL.

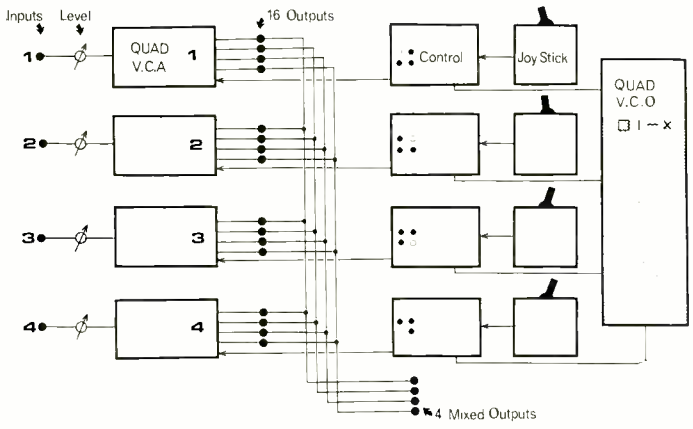
Meter drive card

FROM RAINDIRK COMES a ppm meter drive amplifier card to BBC spec ED 1477. It will mount directly on to the rear of a number of different meter movements and can be supplied with a balanced or unbalanced input. The manufacturers claim excellent thermal stability and state that precision components are used where appropriate. Input impedance is 16 kΩ with −1 dB points in response at 20 Hz and 80 kHz. The board costs, one off, £14.50.

The same company has announced another module designed for use as an overload indicator and, as such, has a fast response time. An led is used to provide the overload indication. The unit handles an input range between −3 and + 30 dB. One-off price is £12. Raindirk Ltd, 33A Bridge Street, Downham Market, Norfolk. Phone: 036-63 2165/3617.



Above: *Quadraphonic effects generator from EMS.* **Below:** *functional diagram*



Musexpo 75

FOR THE BENEFIT of European readers, the show is like the MIDEM, is staged in Las Vegas with exhibitors from all over the world. The three-day convention will take place at the Las Vegas Convention Center from September 21 to 24.

Over 80 exhibitors, mainly record companies, will take part; these include organisations from both Americas, Japan and Europe. Some hardware companies are to be represented. Roddy Shashoua, president of the organising body, International Record & Industry Market, has acknowledged mounting pressure from managers and record companies to include a talent showcase as part of Musexpo, which will be held in the Rotunda within the Convention Center. International Record & Music Industry Market, 1350 Avenue of the Americas, New York, NY 10019, USA. Phone: (212) 489 9245. Telex: 224972.

Quadraphonic effects generator

THE LATEST DEVICE from EMS will place up to four independent mono audio signals within the bounds of the conventional quadraphonic listening 'square'. It allows each of the four input channel signals to be panned anywhere within the square domain such that the total signal power generated by the reproducing system is kept constant.

Voltage - controlled amplifiers split the signal between the four corners and may be controlled by an x-y voltage derived from a pan pot or by the output of an integral quadrature voltage-controlled oscillator. This facility offers apparent 'round the room' or diagonal or side to side movement continuously. The rate of sound rotation may be manually or externally controlled. In the 'round the room' (square) mode, the motion can be frozen at any position using a freeze/go switch. The x-y control voltage outputs are available for external display on an oscilloscope.

The four quad outputs from each input channel are mixed on to a four group output buss connecting to the output of the unit via four output buffer amplifiers. As each input channel has a separate x-y input, the unit may be externally operated from sources such as joysticks, footpedals, envelope followers and synthesizers. Inputs and outputs are compatible with the standard 0 dBm operating level; the control functions require ±1V for full movement of sound. The quadrature vco offers a frequency change of one decade/V over a 1000:1 range. Power requirements are 110/240V ac. EMS (London) Ltd, 277 Putney Bridge Road, London SW15 2PT. Phone: 01-788 3491/2.

USA: EMSA Inc, 460 W Street, Amherst, Mass 01002. Phone: (413) 256 8591.

Neve exports

THE COMPANY HAS recently announced four major orders from overseas organisations. To Radio Tele Luxembourg will go a 24 input 16 output sound mixing console as part of the re-equipment of the Luxembourg Concert Hall. Special feature of the new desk will be a colour crt level metering display in place of the more usual moving coil ppms. It is said to be the first desk of its type in the country.

The second order is for a 36/16 console received from the American tv network, NBC. The desk will be installed in the New York Rockefeller Center Studios for 16 track music recording. This order represents the first from the network.

The third order originates from the Broadcasting Council of New Zealand and is for 11 *8014* 16/4 multipurpose sound mixing consoles for installation in the radio and tv studios before the end of the year.

The fourth comes from the Iraq Broadcasting, Television and Cinema Establishment and consists of ten *BCM* 10/2 consoles to be installed before the end of the year. This follows an order received in 1974 for 12 similar units.

School's out

IF YOU PART with an unspecified sum of money, you should be able to obtain some knowledge, and in due course, a degree in 'recording arts'.

Leo Kulka, first president of the College for Recording Arts founded

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The specification says...

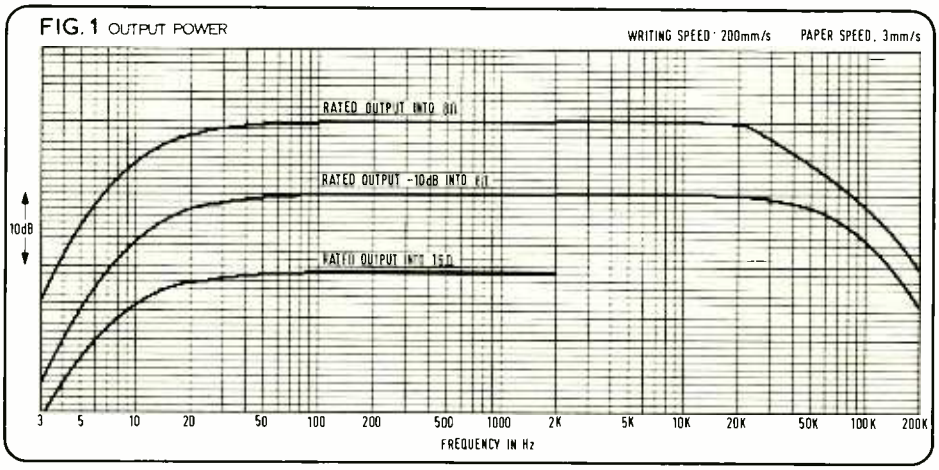
HUGH FORD*

MANUFACTURERS' SPECIFICATION
Portable reel-to-reel recorder Brand X model Y
Power requirements: AC 110V, 120V, 220V and 240V, 50/60 Hz, 6W DC 12V 8 size—'D' standard batteries 12V in total. 12V car battery by using Brand X car battery cord abcdef.
Track system: Two-track mono.
Reel size: 5″ maximum (130 mm).
Tape speeds: 7½ ips, 3¾ ips, 1⅞ ips and 15/16 ips (19 cm/s, 9.5 cm/s, 4.8 cm/s and 2.4 cm/s) with speed tuning, variable +5 to −10%.
Recording time with 900ft. 275m' tape: 45 min total at 7½ ips (19 cm/s) 1.5 hrs in total at 3¾ ips (9.5 cm/s) 3.0 hrs in total at 1⅞ ips (4.8 cm/s) 6.0 hrs in total at 15/16 ips (2.4 cm/s).
Frequency response: 30 18,000 Hz at 7½ips (19 cm/s) 30 13,000 Hz at 3¾ ips (9.5 cm/s) 30 7000 Hz at 1⅞ ips (4.8 cm/s) 30 4,000 Hz at 15/16 ips (2.4 cm/s).
Signal-to-noise ratio: Better than 48 dB at 7½ ips (19 cm/s).
Wow and flutter: less than 0.1% at 7½ ips (19 cm/s).
Recording bias frequency: Approx 55 kHz.
Inputs: Microphone input: Impedance 600Ω Maximum Sensitivity 0.19 mV (—72 dB). Auxiliary input: Impedance 100 kΩ Maximum Sensitivity 0.062V (—22 dB).
Outputs: Monitor: Impedance 10 kΩ Maximum Sensitivity 0.775V (0 dB).
Power output: 1W maximum.
Semiconductors: 16 transistors and 9 diodes.
Integrated circuit: 1 pc. (built in the microphone).
Battery life: 6.5 hrs with Brand X Super Batteries, Size "D".
Dimensions w x h x d: 12¾ x 4 3/16 x 10¼in (322 x 107 x 263 mm).
Weight: 11 lb 13 oz (5.4 kg) with batteries.

THIS IS THE manufacturers' specification for a portable reel-to-reel recorder, which while it is not perhaps a strictly professional machine, is used by a number of broadcasting authorities and also featured among the White House bugging regalia! The specification is taken verbatim from the manufacturers' service manual for their general export model and has features which are to be found in many specifications for both domestic and professional equipment. Just what are we told about this machine?

1. It runs from batteries or from the common mains supply voltages and frequencies, consumes 6W from the mains and offers a battery life of 6.5 hours with brand X Super Batteries — battery consumption remains a mystery.
2. It runs at four nominal untoleranced tape speeds with a variable speed facility. Presumably, it has some equalisation in the replay chain but we are not let into the secret of the standards or time constants.
3. It accepts 5″ reels (spools) of undefined type, and presumably works with any type of smaller reel (spool).
4. Rather remarkably it offers a recording time of 45 minutes total with 900 ft 275m of tape at 7½ ips (19 cm/s) with its 'two-track mono' track system, and pro-rata at lower tape speeds. This information is not only completely irrelevant to the specification, but at least the manufacturer might have got his sums right! 900 feet is not 275m and does not run for 45 minutes.
5. We next come to the mystical frequency response which is quoted without any reference to limits, level, or tape types.
6. As the signal-to-noise ratio is only quoted for one tape speed, we can only assume that it is so poor at other tape speeds that the manufacturer dare not quote a figure —the 48 dB quoted is quite meaningless anyhow because there is no reference level specified, no measuring instrument defined and no weighting or bandwidth suggested.
7. The input and output sensitivities are not related to any reference level, the microphone input impedance is incorrect, the power output is not related to load or distortion or frequency. It contains transistors and diodes and an integrated circuit which for want of a better place to hide it has been put in the microphone! The last straw—not only has the manufacturer got the dimensions wrong, he has also got the metric conversions wrong!

Perhaps this is a particularly ill-written specification, but all too many manufacturers and agents publish erroneous or useless information about their products. This not only makes comparison between products almost impossible, but also is a great hindrance to maintenance because, without knowledge of measurement methods which have been used to formulate the specification, it becomes impossible to determine if a piece of equipment is working to its original performance criteria. Clearly it is to advantage to use



*H.F. Engineering

standardised measurement methods where suitable standards exist, but unfortunately there are few International Standards relating to the specification of professional equipment. In many instances politics stop the use of National Standards when the standard of interest originates from an alien country.

This situation leads to the incompatibility of measurement methods which, with the added confused thinking by engineers, sales departments and advertising agents, ends up with the type of specification which I have quoted. The following comments upon individual measurements will, I hope, give some food for thought. Unfortunately the available space in a single article somewhat limits the depth in which I can treat the problem, as it would be all too easy to fill a large book on this subject.

Frequency response

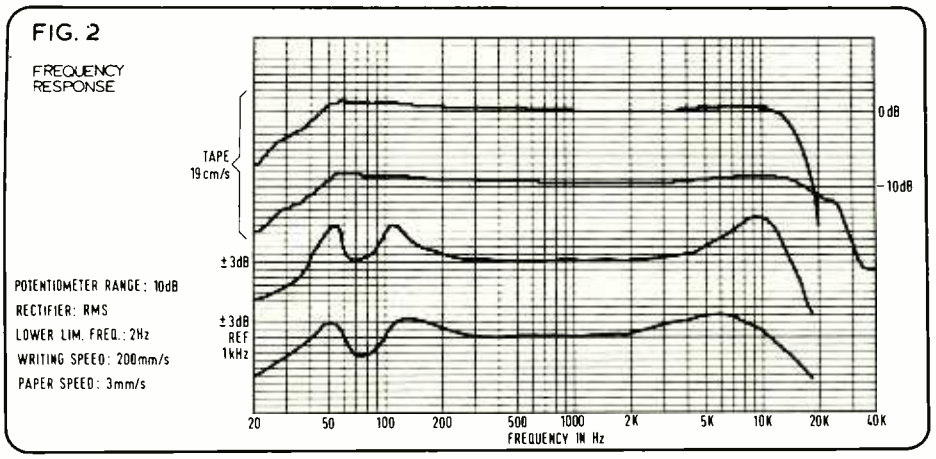
The example of a specification which I have given does not even quote limits for the frequency response, and fortunately most manufacturers at least bother to quote limits which give some better guidance. However, what do we mean by ±3 dB? It is all too common to find a specification saying for instance ±3 dB 20 Hz to 15 kHz. Does this mean a 'peak-to-peak' excursion of 6 dB between the frequencies, or does it mean ±3 dB relative to some unspecified reference frequency?—more often than not it means the former, which can be a far more objectionable performance. The correct way of specifying frequency response is of course +x dB −y dB reference z Hz, followed by the level at which the response was measured and the load. The reason for this is shown in **fig. 1** which illustrates the frequency response of a well-known power amplifier at two levels into 8Ω and also at its rated power into 16Ω—substantial differences will be noted. This problem is further emphasised by **fig. 2** which illustrates the frequency response of a tape recorder at two levels into the same load. The figure also demonstrates two response curves which are ±3 dB from 40 Hz to 15 kHz, the upper curve not having a reference frequency, and the lower curve being with reference to 1 kHz—the choice between the two is all too clear.

The same curves also show the danger of evaluating frequency response without using a frequency sweep: in the case of the lower curve, if we have evaluated the frequency response at spot frequencies of 40 Hz, 63 Hz etc upwards we would have concluded that the response was +3 dB −0 dB from 40 Hz to 10 kHz reference 1 kHz, when in fact the limits are +3 dB −2.5 dB. This shape of response is typical of tape recorders which are commonly evaluated with spot frequency calibration tapes.

Another danger in measuring tape recorders is to use a wide band voltmeter as an output meter. Such a meter will measure any bias in the output and also take account of wide band noise; unless the level of these is at least 10 dB below the wanted output there will be an apparent improvement in frequency response due to the addition of unwanted signals. The same comment applies to vhf radio tuners where stereo pilot tone or other remote switching tones may be present at quite high levels in the audio output.

It is often assumed that frequency response can be accurately checked with any old oscillator and voltmeter, provided that they are first checked against each other, and any response errors noted for subsequent corrections. Unfortunately this procedure is itself rather unreliable because it is common for the frequency response of both voltmeters and oscillators to vary according to their attenuator settings, so unless the checking is done at the attenuator settings which are to be used during measurement, the procedure is unreliable. Further errors may be introduced by loading the oscillator, and unless its output impedance is very low in comparison with the sum of the input impedance of the equipment being tested and the effective impedance of the connecting cables (some cables have enormous capacities) substantial errors may be introduced.

Before leaving the subject of frequency response, mention must be made of frequency response calibration tapes. The normal procedure for replay response alignment is to use the appropriate calibration tape for 'tweaking' the replay equalisation controls, and having got things so that the maximum excursion of the replay signal is, say, within 1 dB, to pronounce that the replay response is flat within ±1 dB over the band. I have already mentioned the problem of using spot frequency checks, but it is not always realised how wide the manufacturers tolerances are on calibration tapes. A typical specification at tape speeds of 38 cm/s and 19 cm/s is ±0.5 dB up to 4 kHz increasing to ±1 dB above 4 kHz, the situation



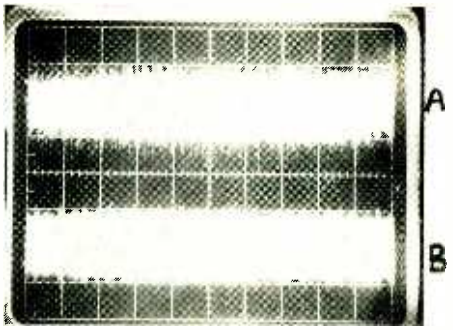


FIG. 3

at 9.5 cm/s giving ±1 dB up to 8 kHz and ±2 dB at 10 kHz and above. This applies to new unused tapes, and even with careful use. the high frequency tolerances will deteriorate.

Noise or signal-to-noise ratio

'Signal-to-noise ratio greater than 45 dB'—it is difficult to make a more meaningless statement. Any statement about noise is first of all meaningless if it is not accompanied by a statement about measurement bandwidth, because noise is always related to bandwidth. Secondly, any statement about signal-to-noise ratio by definition requires a statement about the reference signal level. Thirdly, it is essential that the method of metering be stated—the apparent measured noise depends upon the rectifier characteristic of the meters used and in some cases upon the ballistics (or effective ballistics) of the meters.

The problem of meter characteristics for measuring noise is somewhat confused: in the USA the standard VU meter which has an average rectifier characteristic is standardised; in the UK a true rms meter is standardised and in Germany a quasi-peak meter is standardised. To add to this confusion, the vast majority of electronic voltmeters use average rectifiers, but are calibrated in terms of rms voltages. Without detailed knowledge of the noise spectrum it is completely impossible to correlate between the different characteristics, but for general measurements (as opposed to product evaluation) the indication of rms and average meters will be within a few decibels of each other provided that the noise does not have a high crest factor.

The errors of this type are shown as follows with reference to **fig. 3** which shows two different noise waveforms, the upper waveform 'a' approximating to white noise:

	Waveform 'A'	Waveform 'B'
True rms	0 dB	0 dB
True average	−2 dB	−1 dB
True peak	+12.6 dB	+15 dB
DIN peak	+5.0 dB	+1.5 dB
Average calibrated rms	−1.1 dB	−0.1 dB

In the case of white noise the noise power will be proportional to the effective measurement bandwidth, so it follows that the measurement bandwidth must be defined. Where a noise weighting filter is used the problem has already been solved provided that the filter

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characteristic is to specification and does not do peculiar things outside the specified frequency response band. Where weighting is not used, a bandwidth from 20 Hz to 20 kHz is generally accepted for audio measurements, but some people feel that the upper limit should be set at 15 kHz; generally this does not matter provided that the bandwidth is specified.

My feeling is that unweighted and weighted noise should always be specified, for any weighting network is based on the subjective effect of random noise and does not take into account the subjective effect of steady tones such as mains frequency harmonics which will show in an unweighted measurement.

From the point of view of measuring the noise performance of high quality audio equipment, there are three weighting networks of current interest: the internationally standardised 'A' weighting, the German DIN weighting, and the new proposed CCIR weighting. The last certainly can be shown to be closer to the subjective effect of tape noise. The characteristics of the three curves are shown in **fig. 4**, from which it can be seen that the main area of difference is the weighting of noise above 1 kHz where substantial differences occur. It is, therefore, quite impossible to give a correlation factor between weightings. A further warning, for convenience of comparison, a common point for the curves at 1 kHz has been shown in **fig. 4**—in practice there is a substantial difference in gain between the networks, and the choice of a reference frequency for noise measurement has drastic effects upon the measured result. It is my feeling that 1 kHz should be retained as a reference frequency. However, commercial interests suggest that a higher reference frequency should be used with the new CCIR weighting because the retention of 1 kHz gives 'bad looking figures'.

Following on from this is the overall problem of a reference level to which noise is referred. The reference frequency of 1 kHz is, for most professional purposes, convenient. But the choice of level is a different problem. It is a prime requirement that the reference level should be specified in terms of physical constants, eg 200W rms sinewave at 1 kHz into 8Ω—this is a fixed reference which is repeatable, unlike a reference level of 3% third harmonic distortion at 1 kHz which will vary from one equipment sample to another. In the case of amplifiers and similar equipment the problem of a reference level may be avoided by specifying noise power output, or noise voltage referred to the input; but, in the case of magnetic tape, it is vital to specify a reference level-to-noise ratio because any other method of specifying noise performance depends upon the characteristics of the tape in use which is itself a variable even within a single reel of tape.

Having defined a reference level-to-noise ratio, a signal-to-noise ratio may then be added. However, signal-to-noise ratios depend upon the choice of the signal level which usually depends upon how much distortion the particular manufacturer considers 'safe' to specify. Signal levels with 2% or 3% third harmonic distortion are quite common as signal-to-noise references with tape, but who would dream of defining an amplifier's power output at the 3% distortion point! Furthermore, how do we define input sensitivities and various output levels?

Inputs and Outputs

The maximum input sensitivity for many devices is specified against the output at some magic percentage of distortion as is the signal-to-noise ratio. This is the most unscientific way of going about things and prone to numerous measurement errors, particularly in the case of power amplifiers where the final result is controlled by the following factors: mains voltage, load tolerance, temperature, accuracy of distortion measurement, accuracy of output voltage measurement, input impedance, accuracy of input voltage measurement. If we allow 0.3 dB tolerance on each of these factors we have a potential error of 2.1 dB. A more civilised method of dealing with sensitivities is to measure the input and output impedances and the overall voltage gain into an open circuit. This provides not only the input sensitivity into a rated load, but also enough information to calculate the input and output levels into any required load. The addition of information about maximum permitted input level and rated output level in terms of voltage and current, completes the input/output picture. I agree that this system does not work for disc and tape, but in these instances there are standardised reference levels in terms of physical quantities such as webers, metres and seconds and therefore no excuse for using zero VU or 2% distortion and similar artifices depending upon a whole collection of variable factors.

While on the subject of inputs and outputs, I cannot resist an attack on some of the strange input and output impedances which are found in professional equipment. With modern circuitry, there is no difficulty in providing input impedances greater than 10 000Ω and output impedances less than 100Ω and the combination will always match and be tolerant to loading. There is no longer a place for 600Ω outputs and peculiar 1500Ω inputs which vary from 1000Ω to 2000Ω over the audio frequency band due to transformers used in the inputs.

When an input or output impedance is specified it is meaningless if not accompanied by a statement defining the frequency at which the measurement was made or the frequency band over which the impedance holds. Ideally impedances should be determined by a bridge method separating the resistive and reactive components. However, it is very convenient to plot overall impedances against frequency by using a constant current variable frequency source in conjunction with a selective voltmeter which eliminates errors due to noise.

THD and IM

Third harmonic distortion? Total harmonic distortion? Some of us reckon it means the latter, but it is time that this abbreviation was buried. A further common sin is to quote 'im distortion less than x%'—we all know it means intermodulation distortion, but it would be nice to know which method was used for measurement as the two common methods produce different results.

By definition the total harmonic distortion is the relation between the power of the harmonics and the power of the fundamental; this means that, in order to measure total harmonic distortion, it is necessary to determine the amplitude of the fundamental and the harmonics and to derive the rms value of the harmonics. This is the only method of measuring total harmonic distortion if noise approaches the amplitude of the harmonics of interest, as is often the case when determining harmonic distortion at low signal levels or in the presence of other irrelevant signals such as bias in tape recorders.

The well-known total harmonic distortion meter attempts to determine total harmonic distortion by rejecting the fundamental frequency and at least in theory measuring the remainder of the signal with an rms meter. The rms of the total signal is then compared with the rms value of the harmonics, noise and any other signals other than the fundamental. If other than an rms meter is used the instrument becomes sensitive to the relative phase of the harmonics and will give a result that does not agree with the wave analyser method.

In addition to the above, there is a basic source of error at higher distortion levels in the total harmonic distortion meter because it compares the total signal with the harmonics, where the individual harmonic method compares the fundamental only with the harmonics. The result of this is that, where the genuine percentage of total harmonic distortion is 10%,

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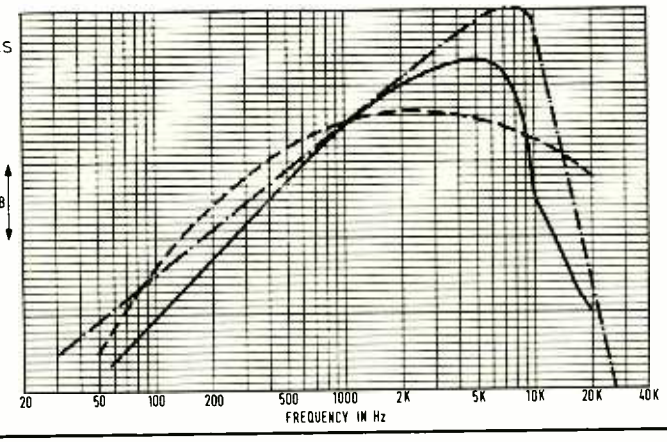
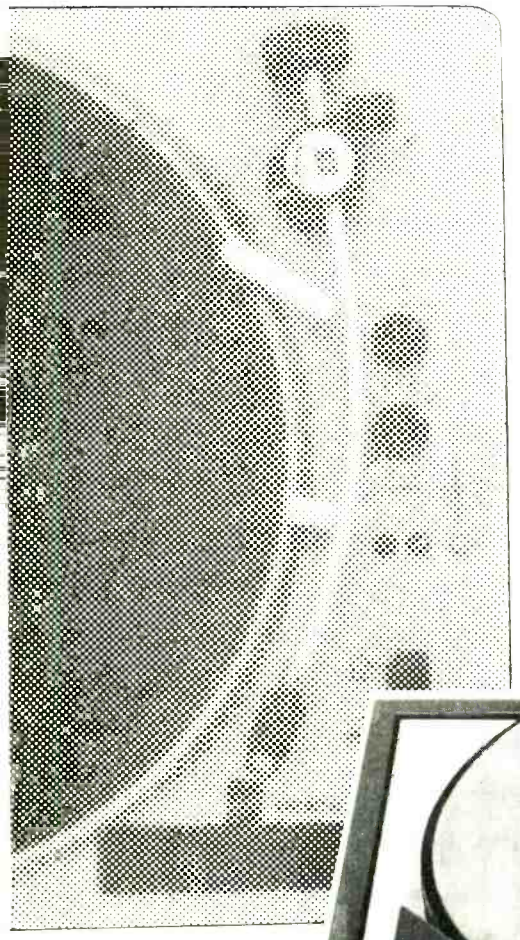
FIG. 4
NOISE WEIGHTING CURVES 'A', DIN AND NEW CCIR



SOUND STUDIO EQUIPMENT OF WORLD-WIDE FAME



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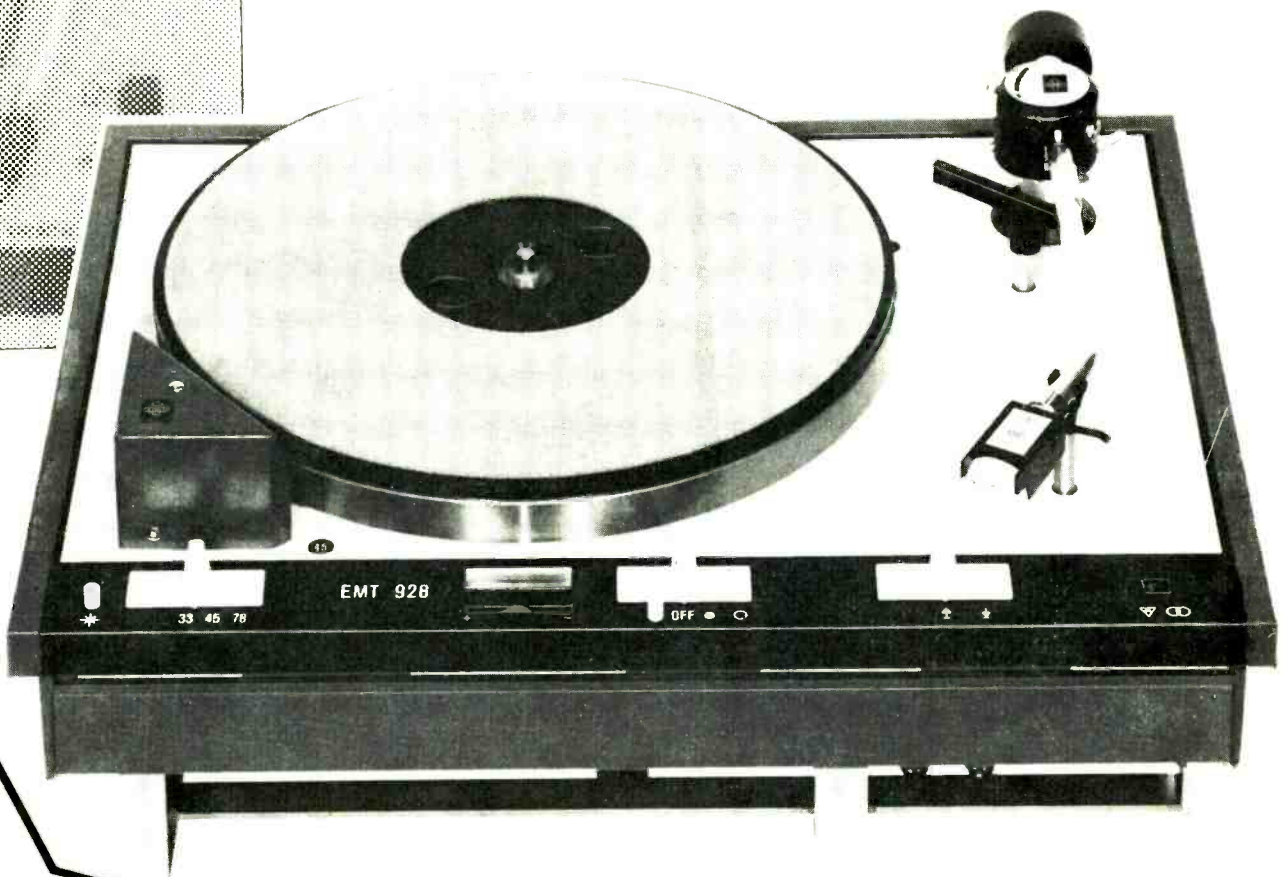

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SPECIFICATION SAYS . . .

the meter will indicate 9%, a genuine 5% becomes 4.76%, 1% becomes 0.99%.

For some reason it is popular to specify distortion performance at high output levels, where in practice the distortion at low levels is equally objectionable and in some instances worse than the high level distortion—a meaningful distortion specification will read 'total harmonic distortion at x Hz less than y% at z volts output or less' . . . It is not, however, so easy to measure distortion at low signal levels, and noise dictates that a narrow band wave analyser be used.

Overall, the measurement of harmonic distortion is difficult at low distortion levels, as even the best modern oscillators have an inherent distortion greater than 0.001%, which may give little margin when measuring good quality studio equipment. It should also be realised that very low harmonic distortion levels may well be meaningless from a subjective point of view because the ear and most instruments generate their own harmonics. What are far more objectionable are non-harmonically related products such as inter-modulation distortion.

With the exception of some measurements on magnetic tape, the SMPTE (Society of Motion Picture & Television Engineers) method for measuring intermodulation distortion is almost universally used. The waveform used in this method is a mixture of a low frequency (typically 50/60 Hz) and a high frequency tone (typically 7 kHz) which are often used in the amplitude ratio 4:1 as is shown in the oscillogram **fig. 5.** The first confusion that arises with this waveform is also illustrated in fig. 5 which contains two different amplitude sinewaves. The higher amplitude sinewave is an equivalent peak sinewave to the intermodulation testing waveform, and the low amplitude sinewave is an equivalent rms sinewave which would give the same reading with an rms meter as the inter-modulation testing waveform.

In most electronic devices at high output levels it is the peak voltage which is of concern,

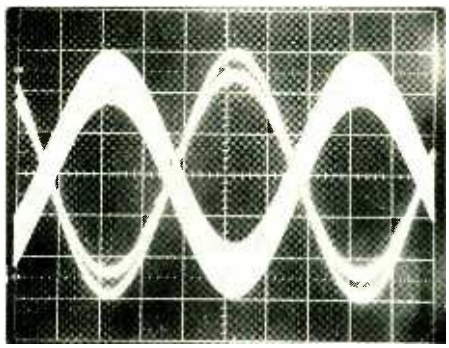

FIG. 5

it is therefore normal to do intermodulation testing at an 'equivalent peak sinewave' output . . . only a genuine peak reading meter will measure this; it may however be calculated in terms of average or rms with a knowledge of the amplitude ratio of the two tones.

The im meter passes the incoming waveform through a highpass filter, thus eliminating the low frequency tone and its harmonics. It then rectifies the remaining high frequency tone with any of its harmonics and passes the rectified product through a lowpass filter which feeds a meter. The meter then indicates any low frequency modulation of the high frequency tone. A nicety of this system is that the harmonic distortion of the two oscillators can be relatively large without having any influence on the measurement, and compared with the measurement of total harmonic distortion, the results are fairly insensitive to noise in the equipment under test. Commercial currently available im meters will measure to a residual of only 0.0002% SMPTE intermodulation distortion, and measurement is quick and simple to make without any requirement for balancing rejection bridges and similar time-consuming fiddles.

Conclusion

While I do not believe that specifications alone sell equipment, the specification is an entré to the potential customer. If it is impossible for him to interpret and is full of typographic errors (hz Db nWb/cm mhz cm/S et al) this will give little confidence in the manufacturer.

I have but touched upon a few of the common measurements on audio equipment, and I hope have provided some food for thought. I fondly assume that the purpose of a published specification is to inform the potential customer of the capabilities of a piece of equipment: if this is the case, it is only reasonable to write the specification in terms which the potential customer can understand and interpret.

AGONY COLUMN

The producer's request taxed the Moog operator beyond his capabilities; there was no way that he could produce the sound of the bagpipes to the satisfaction of the great man. And so it was, the session ground to a halt while the fixer made some long distance telephone calls, for competent bagpipe session men are few and far between. Rather more than put out by this display of pedantry, the excitable superstars retired for coffee and unusually strong cigarettes to consider the possibilities.

Some hours passed before the dour Scot, worthy of his instrument, was ushered to meet the band who were, by now, amiable but not mollified in attitude towards the producer. Totally unaccustomed to the situation in which he found himself, the highlander politely but firmly refused the social formalities on offer from guitarist. Instead, he expanded on a theme concerning the evils of tobacco and whisky pointing out that his only weakness was the occasional pinch of snuff. At this, the drummer told the piper that indeed, he too had the weakness and perhaps he might like to try some of his. Not wishing to offend, the Scot took a large pinch of the curiously pale snuff proffered and in the approved manner, took it down in one.

Unable to obtain further sense from either bagpipes or operator, the producer quietly took the Moog player to one side and admitted defeat.

Tandberg 10XD.

In the field of professional audio equipment, you can spend a lot of time piecing together information, comparing notes on standard and optional features, across so many different tape decks.

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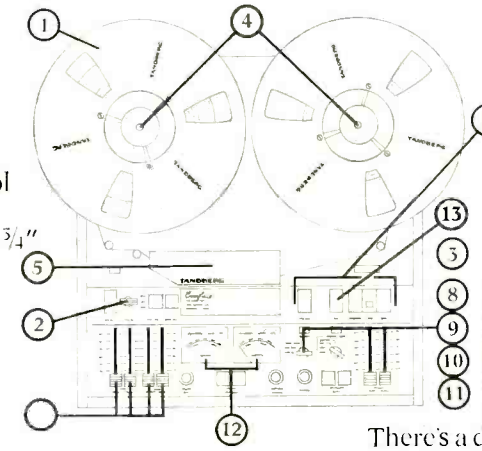

1. The 10XD will take any spool up to the 10½" size you see here.

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To offer detailed information on all the equipment within the scope of this survey would be impossible. Equally, partial coverage of a limited sector would be unhelpful and unfair. The following comprises a directory of available product types compiled on a manufacturer by manufacturer basis.

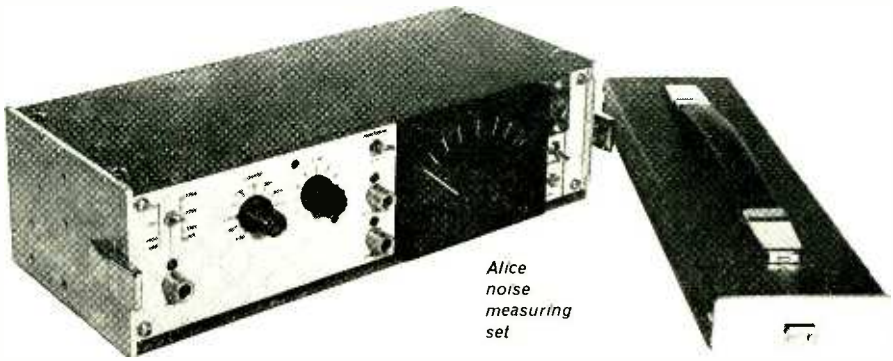
Survey: audio and broadcast test, calibration and measurement equipment

ADVANCE
Gould Advance Ltd, The Instrument Division, Roebuck Road, Hainault, Essex.
Phone: 01-500 1000. Telex: 263785.

Products
AC MILLIVOLTMETERS
FREQUENCY AND PERIOD MEASUREMENT
SIGNAL GENERATORS
TIMER COUNTERS

ADVANCED ELECTRONICS
PO BOX 63, 63 Lincoln Street, Newton, Mass 02161, USA.

Products
FUNCTION GENERATORS



Alice noise measuring set

ALICE
Stancoil Ltd, 38 Alexandra Road, Windsor, Berks.
Phone: Windsor 51056/7.

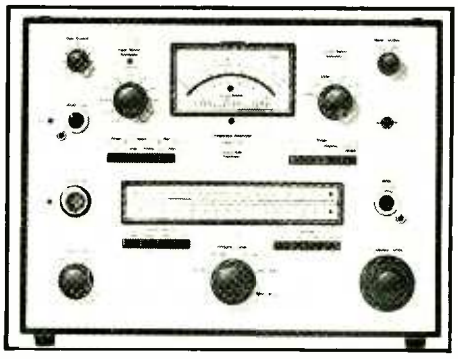
Products
NOISE MEASURING SETS
Features: intended for noise measurement of equipment in the signal path in accordance with the IBA code of practice. Uses CCIR 468 noise measurement weighting curve.

AMBER
Amber Electro Design Ltd, 1064 Chemin du Golf, Montreal, Quebec, Canada H3E 1H4.
Phone: (514) 769 2739.
UK agents: Scenic Sounds Equipment, 27/31 Bryanston Street, London W1H 7AB.
Phone: 01-935 0141.

Products
AUDIO TEST SET
Features: multipurpose test facility comprising function generator, sweep generator, noise generator, audio comb generator, gated burst, digital level meter, digital frequency counter, vari Q wave analyser, spectrum analyser and digital memory for response storage.
SPECTRUM DISPLAY

B & K
A/S Bruel & Kjaer, Naerum, Denmark.
Phone: 02 80 05 00. Telex: 15316.
B & K Instruments Inc,
5111 West 164th Street, Cleveland, Ohio 44142 USA.
Phone: (216) 267 4800. Telex: 810421.
Bruel & Kjaer Ltd, Cross Lances Road, Hounslow, Middlesex.
Phone: 01-570 7774. Telex: 883148.

Products
ACOUSTIC STANDING WAVE MEASUREMENT
BEAT FREQUENCY OSCILLATORS
DISTORTION ANALYSERS
FILTERS
FREQUENCY RESPONSE MEASUREMENT
IMPULSE RESPONSE TESTING
INSTRUMENTATION AMPLIFIERS
LEVEL RECORDERS
MEASURING MICS
MIC CALIBRATION GEAR
NARROW BAND ANALYSERS
NOISE ANALYSERS
NOISE GENERATORS
OSCILLATORS
PHASEMETERS
POWER METERS
PO TELEPHONE TEST SETS
REVERB PROCESSER
SINE/RANDOM GENERATORS
SPECTRUM ANALYSERS
VOLTMETERS



B & K 2121 audio frequency analyser

DANA
including distribution for CUSHMAN, EXACT, EIP
Dana Labs Inc, 2401 Campus Drive, Irvine, Ca 92664, USA.
Europe: Danalabs International, 119 Rue Anatole France, 1030 Bruxelles, Belgium.
Phone: 02-241 4550. Telex: 84623662.
UK agents: Dana Electronics Ltd, Collingdon St, Luton, Bedfordshire.
Phone: 0582-24236. Telex: 82430.

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SURVEY: AUDIO TEST EQUIPMENT

Products
ALIGNMENT SETS
COUNTERS
FUNCTION GENERATORS
MILLIVOLTMETERS
SWEEP GENERATORS
SYNTHESISED GENERATORS
WAVEFORM GENERATORS

DYMAR
Dymar Electronics Ltd, Colonial Way, Radlett Road, Watford, Herts WD2 4LA.
Phone: Watford 37321. Telex: 923035.

Products
AUDIO POWER METERS
COUNTERS
DISTORTION FACTOR METERS
SSB TEST GEAR
WAVE ANALYSERS

EAGLE
Eagle, Precision Centre, Heather Park Drive, Wembley, Middlesex HA0 1SU.
Phone: 01-902 8832. Telex: 922131.

Products
SIGNAL GENERATORS

FARNELL
Farnell Instruments Ltd, Sandbeck Way, Wetherby, Yorkshire.
Phone: 0937-3541. Telex: 557294.

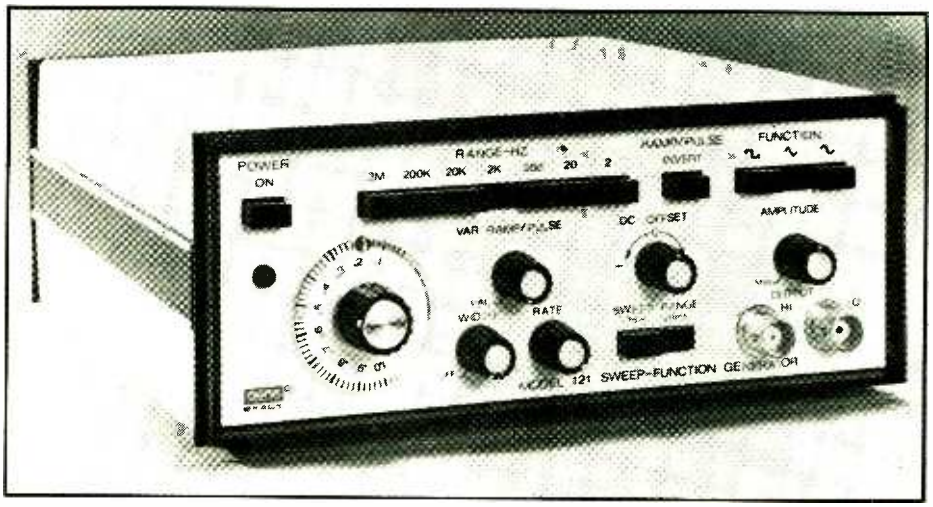
Products
ATTENUATORS
FUNCTION GENERATORS
MILLIVOLTMETERS
OSCILLATORS
Features: some models supplied with output suitable for driving a three ohm load.
SIGNAL GENERATORS

FERROGRAPH
Ferrograph Professional Recorder Co, 442 Bath Road, Slough SL1 6BB.
Phone: 06286-62511. Telex: 847297.

Products
AUDIO TEST SET
Features: compendium of test equipment comprising low distortion oscillator, millivoltmeter, distortion factor meter, wow and flutter meter and long term speed stability.

HEWLETT-PACKARD
Hewlett-Packard Co, 1501 Page Mill Road, Palo Alto, Ca 94304, USA.
Phone: (415) 493 1501. Telex: 348461.
UK agents: Hewlett-Packard Ltd, Kings Street Lane, Winnersh, Nr Wokingham RG11 5AR.
Phone: 0734-784774. Telex: 847178.

Products
DISTORTION ANALYSERS



Dana sweep function generator

FLUKE
John Fluke Manufacturing Co Inc, PO Box 43210, Mountlake Terrace, Washington 98137, USA.
Phone: (206) 774 2211. Telex: 910 449 2850.
UK: Fluke International Corporation, Garnett Close, Watford, Herts.
Phone: Watford 33066. Telex: 934583.

Products
COUNTER TIMERS
MILLIVOLTMETERS
Features: true rms, average rectifier, differential, analogue and digital types available.
SIGNAL GENERATORS
Features: analogue and frequency synthesised types available.
VOLTMETERS
Features: manual and auto null.
FOURIER ANALYSERS
FUNCTION GENERATORS
GROUP DELAY MEASUREMENT
NETWORK ANALYSERS
OSCILLATORS
Features: synthesised, phase locked and low distortion types available.
PO LINE INVESTIGATION EQUIPMENT
SIGNAL GENERATORS
SPECTRUM ANALYSERS
Features: H-P manufacture real time equipment suitable for use between Hz and 40 GHz.
SWEEP GENERATORS
Features: suitable for use in sync with other equipment.
WAVE ANALYSERS

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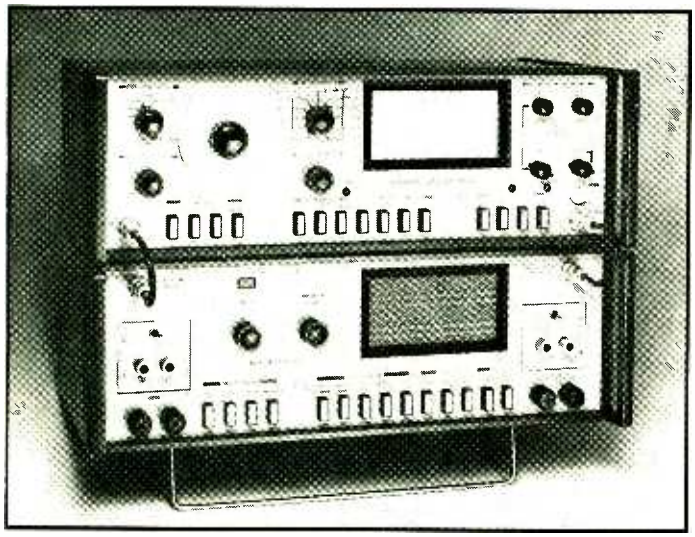
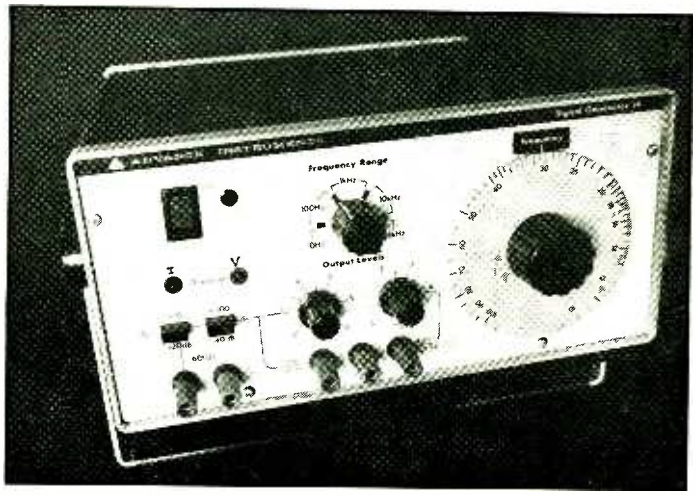


Left: *Ferrograph RTS2/ATU.* **Below:** *J4 signal generator from Gould Advance*



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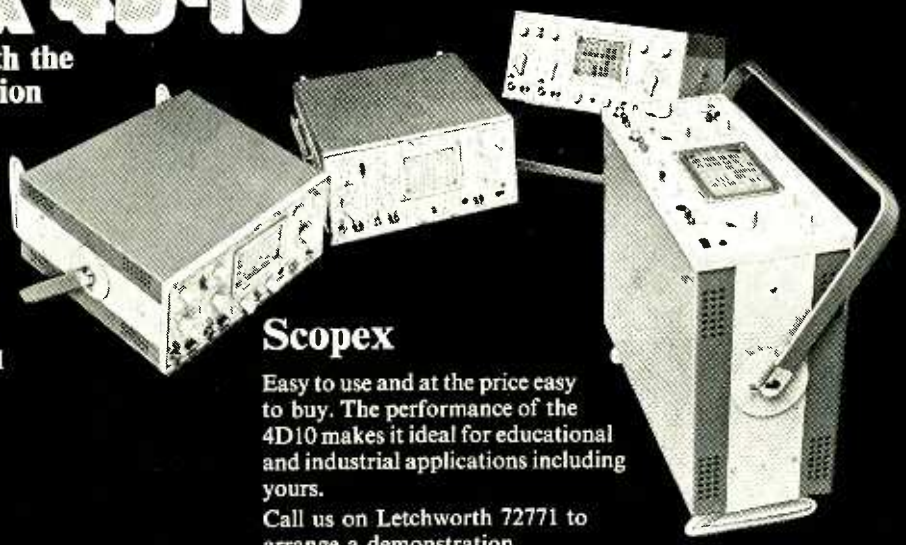

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HICKOK
The Instrumentation and Control Division, The Hickok Electrical Instrument Company, 10514 Dupont Ave, Cleveland, Ohio 44108, USA.
Phone: (216) 541 8060.

Products
FUNCTION GENERATORS

LEVELL
Levell Electronics Ltd, Moxon Street, Barnett, Herts.
Phone: 01-440 8686/449 5028.

Products
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Features: fsd from 15 μV to 500V.
OSCILLATORS
Features: some models select frequency by digital thumbwheel. Rapid tuning and bounce free operation.
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MARCONI
Marconi Instruments, Longacres, St Albans, Herts AL4 0IN.
Phone: St Albans 52292. Telex: 23350.

Products
ATTENUATORS
DISTORTION ANALYSERS
Features: manual and auto null.
FREQUENCY METERS
MILLIVOLTMETERS
MODULATION INDEX METERS
OSCILLATORS
PCM TEST EQUIPMENT
POWER METERS
SIGNAL GENERATORS
SPECTRUM ANALYSERS
SWEEP GENERATORS

3M
Mincom Division, 3M Company, 3M Center, Saint Paul, Minnesota 55101, USA.
UK: Mincom Division, 3M United Kingdom Ltd, Whitley Works, Whitley Gardens, Southall, Middlesex.
Phone: 01-574 5929.

Products
TEST SET
Features: the seven integrated functions include tracking sine and square oscillators, frequency counter, wave analyser and a millivoltmeter.
WOW AND FLUTTER METER
WAVE ANALYSER
Features: low frequency unit specifically designed for flutter analysis.

MUIRHEAD
Muirhead Ltd, Measurement and Control Division, 154/160 Croydon Road, Beckenham, Kent.
Phone: 01-650 4888. Telex: 262710.

Products
ATTENUATORS

NOMBREX
Nombrex Ltd, Exmouth.
Phone: 039 52-3515.

Products
ANALOGUE AF FREQUENCY METERS
SIGNAL GENERATORS LF/RF

PHILIPS
Pye Unicam Ltd, York Street, Cambridge CB1 2PX.
Phone: 0223-58866. Telex: 817331.

Products
AM/FM SIGNAL GENERATORS
FUNCTION GENERATORS
MICROVOLTMETERS
PCM TEST ENCODERS
SINE/SQUARE GENERATORS
SWEEP GENERATORS

PRODUCTION DEVICES
Production Devices, 7857 Raytheon Road, San Diego, Ca 92111, USA.

Products
AUDIO SWEEP GENERATORS

RACAL
Racal Instruments Ltd, Duke Street, Windsor, Berks SL4 1SB.
Phone: Windsor 69811. Telex: 847013.
Racal Communications Inc, 5 Research Place, Rockville, Maryland, 20850, USA.
Phone: (301) 948 4420. Telex: 898456.

Products
COUNTERS
FUNCTION GENERATORS
SIGNAL GENERATORS
Features: both lf and hf. Output synthesised from frequency standard.

RADFORD
Radford Laboratory Instruments, Ashton Vale Road, Bristol BS3 2HZ.
Phone: 0272-662301.

Products
DISTORTION MEASURING SETS

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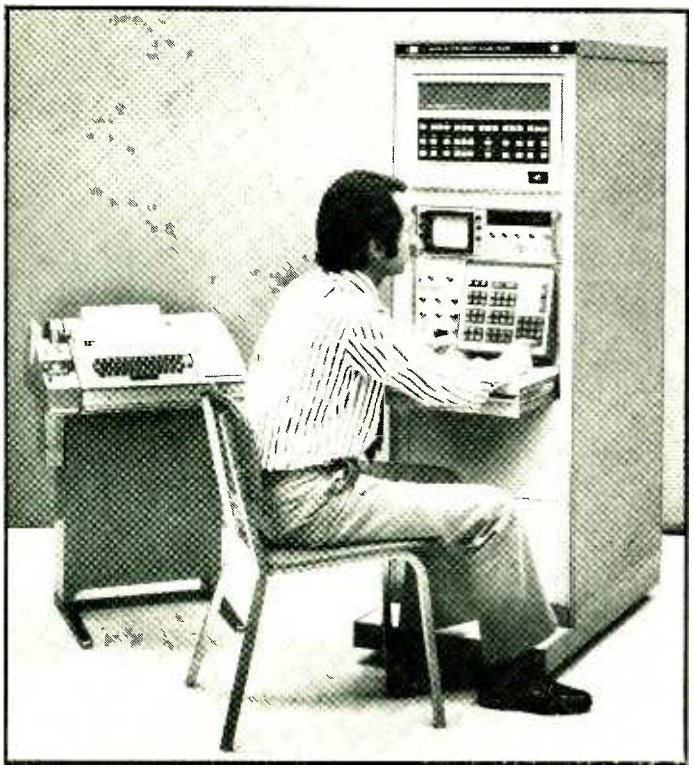
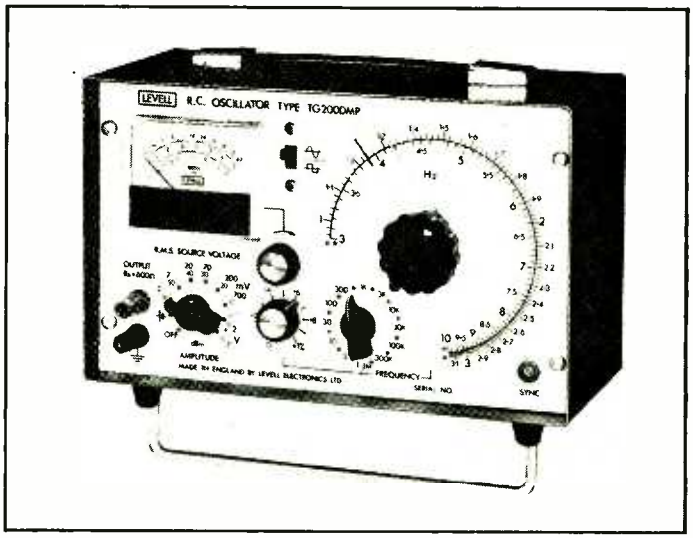
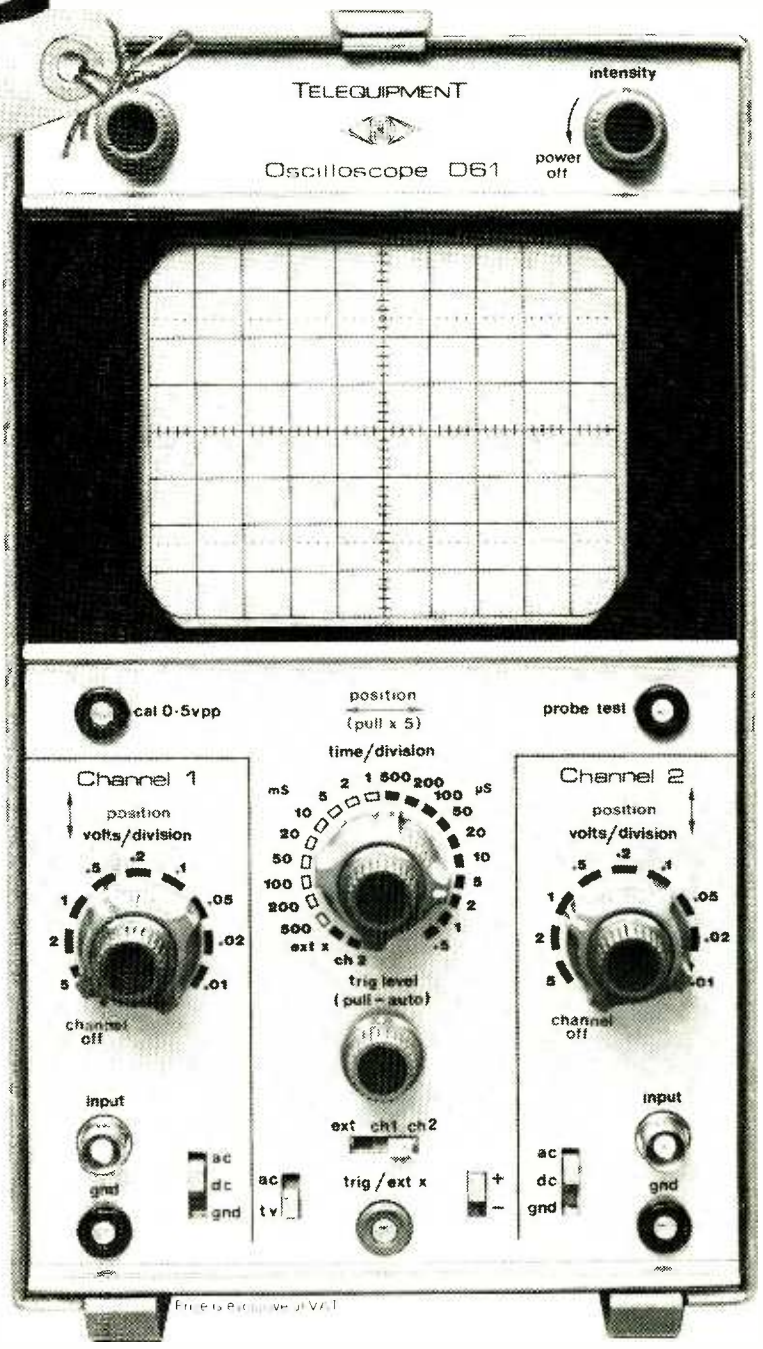




Left: *5451B fourier analyser, Hewlett Packard*
Right: *Levell RC oscillator*



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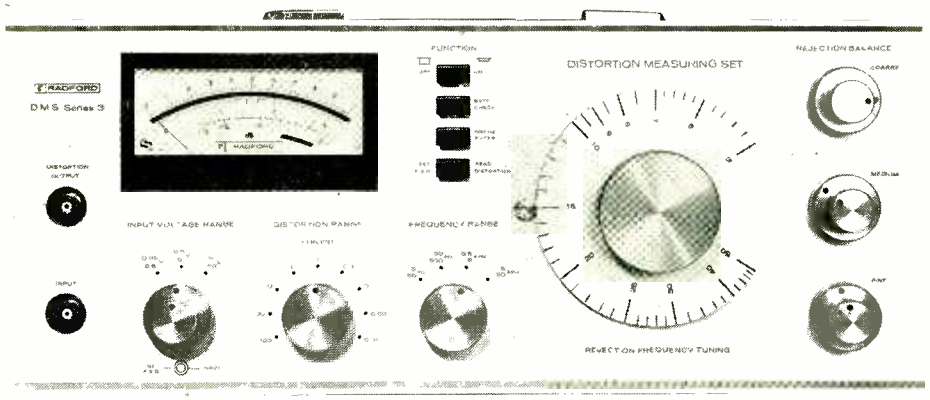
RCA
RCA Distributor and Special Products Division, Camden, NJ 08101, USA.
RCA Ltd, Electronic Components, Lincoln Way, Windmill Road, Sunbury-on-Thames, Middlesex TW16 7HW.
Phone: Sunbury-on-Thames 85511.
Telex: 24246.

Products
SIGNAL GENERATORS
SINE/SQUARE GENERATORS

ROGERS
Rogers Developments (Electronics) Ltd, 4/14 Barmeston Road, London SE6 3BN.
Phone: 01-697 8511.

Products
DISTORTION MEASURING SET
NOISE GENERATOR
Features: continuous or burst.
OSCILLATORS



Above:
Radford DMS series 3
Below:
Rogers distortion factor meter

SOUND TECHNOLOGY
Sound Technology Inc, 1400 Dell Avenue, Cambell, Ca 95008, USA.
Phone: (408) 378 6540.
UK agents: C. E. Hammond & Co Ltd, Lamb House, Church Street, Chiswick London W4 2PB.
Phone: 01-395 4551.

Products
ALIGNMENT SIGNAL GENERATOR
DISTORTION MEASURING SYSTEM
Features: claimed to measure total harmonic distortion down to levels below 0.002% at settling times of less than five seconds.
DIAL CALIBRATION STANDARD
OSCILLATORS
Features: residual distortion less than 0.001% over the audio band.

SUGDEN
J. E. Sugden & Co Ltd, Carr Street, Cleckheaton, West Yorkshire BD19 5LA.
Phone: 09762-2501.

Products
DISTORTION MEASUREMENT SETS
Features: £35.
MILLIVOLTMETERS
OSCILLATORS
Features: 0.03% thd, RIAA equalised output in addition to normal mode.

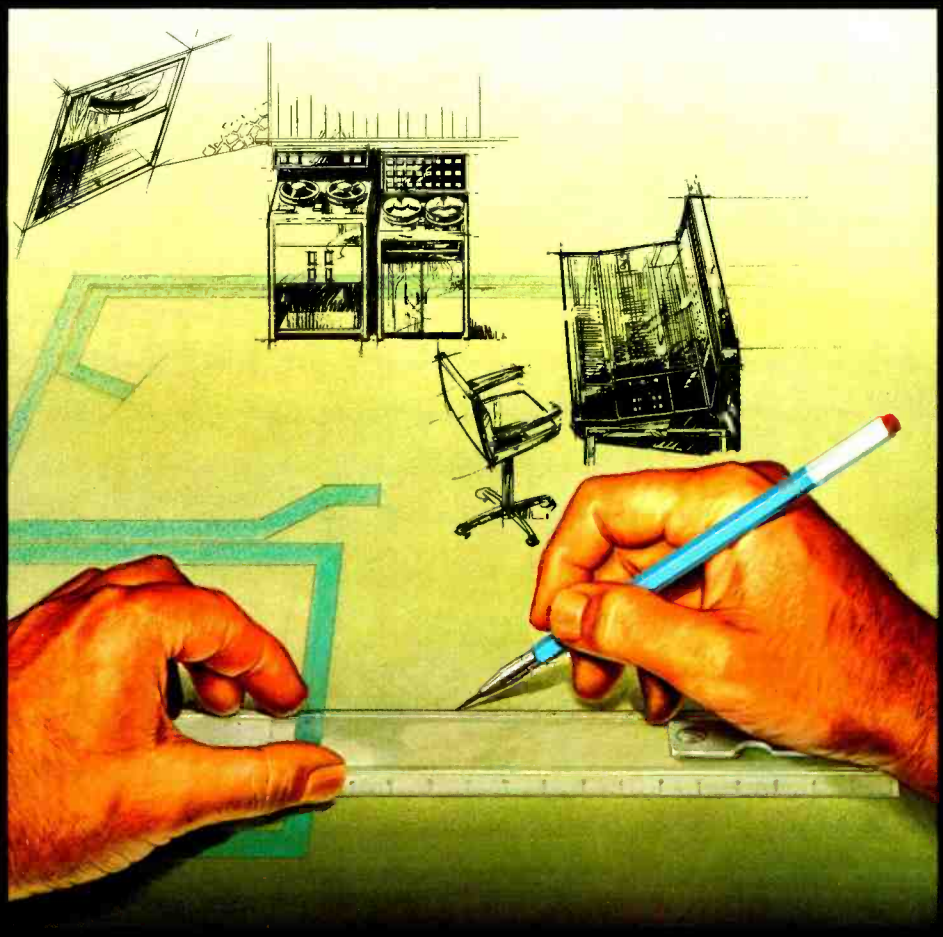
USSR IMPORT
Z & I Aero Services, 44A Westbourne Grove, London W2 5SF.
Phone: 01-727 5641. Telex: 261306.

Products
LF OSCILLATORS

WANDEL & GOLTERMANN
Wandel & Goltermann, Reulingen, Postfach 259, West Germany.
UK agents: Wandel & Goltermann, 40/48 High Street, Acton W3 6LG.

Products
GROUP DELAY
LEVEL METERS
NARROW BAND WAVE ANALYSERS 40 ▶

Acoustical Guarantee



Performance Specifications

from acoustic design
to down beat...

Westlake Audio

Kent R. Duncan, President, Kendun Recorders, Burbank, California: *"The new room has been in operation for six months now and our success is as much a tribute to Westlake Audio and Tom Hidley as it is to our long hours and attention to detail (and possibly some good engineering). Our Westlake room made us a 2 studio operation but instead of just doubling our gross, we went from $12,000 a month to $60,000 a month. The incredibly accurate planning of our Westlake turnkey installation resulted in completion exactly on time, response precisely as promised, all equipment functioning within one day of installation, and all within budget! In the past six months we have mastered such acts as Stevie Wonder, Bob Dylan, America, Buddy Miles, Fleetwood Mac, Rick Nelson, Tower of Power, Livingston Taylor, Isley Bros., Rod McKuen, Nitty Gritty Dirt Band, Emitt Rhodes, Richard Greene, El Chicano, Nana Mouskouri, Cleo Laine, Bola Sete, San Sebastian Strings, Jo Stafford, Maxayn, Pharoah Sanders, Archie Shepp, Ballin' Jack, Vickie Lawrence, Maureen McCormick & Chris Knight, Don McLean, Vikki Carr, Bill Medley and even Rodney Allen Rippy. Over half these acts were recorded on Westlake monitors in various studios around the country, attesting to the fact that truly, you are the professional."*

Christopher Stone, President, Record Plant Recording Studios, Los Angeles: *"As you know, we have used Westlake Audio and yourself since the inception of the company for all of our studio design, construction, electrical interface and implementation. During the past four years you have designed and implemented eight studios for us in New York City, Los Angeles and Sausalito. Obviously we are known as a Westlake-designed operation. We have built our total reputation around your studio design and have always been happy with our decision to utilize you on an exclusive basis for all our acoustical requirements and equipment consultation. The success of your design speaks for itself in the form of our success as an independent studio operation."*

John Sandlin, Vice President A & R, Capricorn Records, Macon, Georgia: *"Words alone cannot express my appreciation for the friendly and courteous atmosphere I enjoyed while at Westlake mixing Bonnie's (Bonnie Bramlett) album.*

It was really a pleasure to work with such extremely competent and dedicated people. Thank you for giving me an opportunity to experience the automated mixing facilities and to work around the type of people I love and can relate to.

Take care of Baker, he's incredible."

Tony Clarke, Threshold Records Ltd., London, England: *"Modern recording has become an art-science. Recording artists like the Moody Blues and Bluejays require absolute flexibility of technique and yet at the same time a fixed and constant sound! Our Westlake Room gives us that. It can also give us the same sound in London, New York or Los Angeles. I think our only criticism is that it's a bit too comfortable.*

PS When you consider that every piece of equipment and a lot of the finished materials were shipped from L.A., I think it shows Westlake was the only choice I could have made."

Complete, unedited photocopies of these and many other testimonial letters are available on request from Westlake Audio.
Phone or write direct to Tom Hidley, President.

Below are excerpts from a typical acoustical system acceptance from a client authorizing the release of the final portion of the construction monies from a trust account.

This guarantee is binding financially and legally when a Westlake Audio design-construction project is undertaken.

SYSTEM PERFORMANCE ACCEPTANCE

In accordance with the terms set forth in those certain Letters of Credit established in favor of Westlake Audio, Inc., the undersigned hereby:

1. Acknowledges receipt of and accepts a final sound measurement report from Westlake Audio, Inc.
2. Agrees that Westlake Audio has, as relates to the design and construction of the Threshold Records studio facility in London, England, met or exceeded all performance specifications as set forth in the Westlake Audio brochure entitled *Acoustical Guarantee Performance Specifications.*
3. Acknowledges that all work has been completed in a satisfactory manner and that all materials and equipment have been delivered and function as specified.
4. Acknowledges the fact that Westlake Audio, Inc. has complied with and fulfilled all the terms set forth in those certain Letters of Credit drawn in favor of Westlake Audio, Inc. and hereby instructs the advising bank — Bank of America, Westlake Boulevard, Westlake Village, California, U.S.A. to honor and pay at sight said Letters of Credit on or after June 10, 1974.

THRESHOLD RECORDS

By Tony Clarke

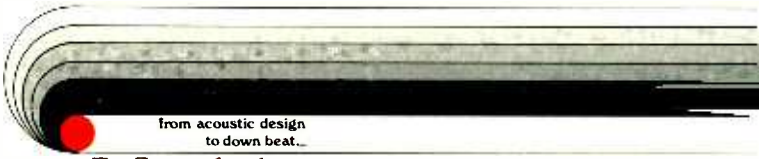
Dated 10th June '74

THAT'S WHAT AN ACOUSTICAL GUARANTEE IS ALL ABOUT!

Representatives:

SCENIC SOUNDS EQUIPMENT
27-31 Bryanston St.
London W1H 7AB
01-935-0141

3M France
135, Boulevard Serurier
75940 Paris 19
France
202-80-80



Westlake Audio
6311 Wilshire Blvd.
Los Angeles, California 90048
(213) 655-0303
TELEX: Audio West LSA 698645

PATENTS

THE FOLLOWING list of Complete Specifications Accepted is quoted from the weekly *Official Journal (Patents)*. Copies of specifications may be purchased (33p) from The Patent Office, Orpington, Kent BR5 3RD.

June 4
1400008 Marconi Co Ltd
Microwave transmission arrangements.
1400061 Sony Corporation
Multisignal transmission apparatus.
1400071 Western Electric Co Inc
Directional couplers.
1400122 Soc De Fabrication D'Instruments de Mesure
Doppler radar detector.
1400133 Sony Corporation
Signal amplifying circuit.
1400167 Hamilton Kent Mfg Co
Apparatus for providing a directionally stabilised beam of radiation.
1400169 Matsushita Electric Industrial Co Ltd
Colour television receiver
1400274 Agfa-Gevaert AG
Recording supports and reproduction apparatus.
1400275 British Broadcasting Corporation
Artificial reverberation systems.
1400306 Siemens AG
Information transmission systems.
1400383 International Business Machines Corporation
Carriage assembly for magnetic disc information storage apparatus.
1400427 RCA Corporation
Video signal processing apparatus.
1400525 Defence, Secretary of State For
Antenna incorporating artificial dielectric material.
1400582 Lyon & Healy Inc
Harp construction.

June 11
1400706 Westrex Co Ltd
Film pay-off and take-up apparatus for a kinematograph film projector.
1400788 Plessey Co Ltd
Telephone retaining device.
1400812 Kockums Mekaniska Verkstads AB
Steam-driven diaphragm valve sound transmitter.
1400839 International Standard Electric Corporation
Flexible laminated antenna for portable radio sets or the like.
1400850 RCA Corporation
Communication system using geosynchronous satellites in quasiequatorial orbits.
1400911 United Aircraft Corporation
Integrated video processor.
1400983 Godlement, D. M.
Amplifier employing phase controlled thyristors.
1401003 Marklew, E. G.
Attachment for a camera.
1401083/4/5 Hewlett-Packard Co
Acousto-optic filter apparatus.

June 18
1401336 Nippon Victor KK
Expander circuit for a compression and expansion system.
1401419 Nuclear Enterprises Ltd
Apparatus for producing an analogue output signal having a value representing the mean value of successive in-coming analogue signals.
1401476 Rank Organisation Ltd
Optical beam splitting systems.
1401520 Bell-Northern Research Ltd
Electroacoustic transducer.
1401561 Ustav Pro Vyzkum Rud
Photometers.
1401562 Matsushita Electric Industrial Co Ltd
Four-channel stereophonic demodulating system.
1402151 Gakken Co Ltd
Facsimile master-making machine.
1402160 Siemens AG
Telephone systems.
1402180 Turuga, T.
Loudspeakers.
1402236 Sony Corporation
Tape loading device for magnetic recording and/or reproducing apparatus.
1402238 Marion Health & Safety Inc
Process for producing a formed-in-place earpiece.
1402290 Sumitomo Electric Industries Ltd
Piezo-electric acoustic device.
1402303 Ricoh, KK
Video signal processing
1402320 Sansui Electric Co Ltd
Decoder for use in "4-2-4" matrix playback system.
1402341 Nippon Electric Co Ltd
Self-adaptive equaliser.
1402352 Siemens AG
Electroacoustic transducers.
1402378 Videofax Communications Corporation
Video information storage and retrieval systems.
1401637 Addressograph Multigraph Corporation
Encoding system and method.
1401678 Sony Corporation
Decoding systems for colour television receivers.
1401740 Sony Corporation
Tape recording and/or reproducing apparatus.
1401765 Sucre, A. J.
Methods of producing continuous recordings of sinusoidally varying signals for a sound producing device and device including such recordings.

June 25
1401868 Mitsubishi Denki KK
System for optically reproducing video information.
1401926 Texas Instruments Inc
Surveillance systems.
1402008 Sunstein, D. E.
Television image-display system.
1402022 Nippon Electric Co Ltd
Presettable equaliser.
1402081 Palazzola, N. A.
Audio announcing system and apparatus.
1402119 Siemens AG
Telecommunications characteristic receivers.
1402137 Research Frontiers Inc
Cells.
1402394 California Data Machines
Magnetic tape drive apparatus.
1402458 Wolf, P.
Transmission systems.
1402474 Sansui Electric Co Ltd
Sound reproduction systems.

SURVEY: AUDIO TEST EQUIPMENT

PCM TEST EQUIPMENT
PO LINE FUNCTION TESTING
SPECTRUM ANALYSERS
STANDARD LEVEL GENERATORS
WHITE NOISE GENERATORS

WAVETEK
Wavetek Inc, 90454 Valboa Avenue, San Diego, Ca 92123, USA.
Phone: (714) 279 2200. Telex: 910 335 2007.
UK agents: Fluke International Corporation, Garnett Close, Watford, Herts.
Phone: Watford 33066. Telex: 934583.

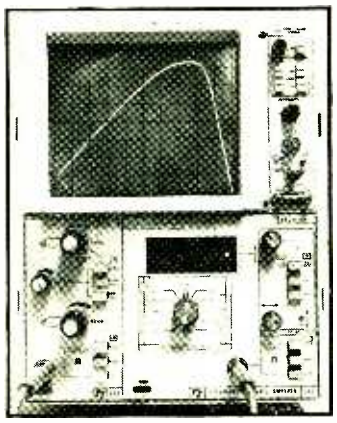
Products
FUNCTION GENERATORS
Features: over 30 models in the product range.
GROUP DELAY MEASUREMENT
OSCILLATORS
PHASE METERS
Features: analogue and digital indication.
PO LINE TESTING EQUIPMENT

WAVETEK (INDIANA)
Wavetek Indiana Inc, 66 North First Avenue, Beach Grove, Indiana 46107, USA.
Phone: (317) 783 3221. Telex: 810 341 3226.
UK agents: Wavetek UK Ltd, 10/12 Oxford Road, Marlow, Buckinghamshire.
Phone: 06284-72246.

Products
SWEEP GENERATORS

WAYNE KERR
The Wayne Kerr Co Ltd, Durban Road, Bognor Regis, Sussex PO22 9RL.
Phone: 02433-25811. Telex: 86120.

Products
LINE TRANSMISSION TEST EQUIPMENT
Features: for use on PO lines and coaxial rf lines.



Left: *Wandel & Goltermann ROR 300*
Right: *Wayne Kerr selective level measuring set MS136*

WOELKE
Woelke Magnetbandtechnik, 8069 Schweitenkirchen, Germany.
Phone: 08 444-394. Telex: 55547.
USA agent: Gotham Audio Corporation, 741 Washington Street, New York, NY10014, USA.
Phone: (212) 741 7411.
Telex: 129269.
UK agents: Lennard Developments Ltd, 206 Chase Side, Enfield, Middlesex EN2 0QX.
Phone: 01-363 8238.

Products
FLUTTER ANALYSERS
WOW AND FLUTTER METERS

NEWS

in early 1974, has reported the first graduations from the San Francisco based college. He states that 'several of the students have already found work in the industry . . . one second semester student landed a job with the sound department of the Grateful Dead Studios . . . another student got a job on a part-time basis with a local distributor during the Christmas season and has received two promotions since . . .'.

Regarding curriculum, the publicity handout says: 'The College for the Recording Arts presents a detailed and comprehensive view of the industry and it presents more than an ample opportunity to develop new skills and strengthen existing ones. Students have more opportunity to explore several fields at once including audio engineering, music production, music and copyright law, interpretation of contracts as well as the business and financial aspects of this complex industry.'

The college is owned and operated by the 'Bicultural Foundation Inc', a non-profit and tax-exempt organisation. It solicits scholarship fund donations to enable 'talented and dedicated young persons who are lacking in funds, to attend'. The sting: 'A repayment system makes the scholarship fund self-perpetuating to assure a continuation of the benefit of the tax-deductable donation'.

Kulka states that the college 'is closely patterned after the Tonmeister school in Germany, which is considered a must before entering the profession in Europe . . . I predict that this institution will become a requirement for any position in this industry within a few more years'. To European engineers who didn't attend a Tonmeister school: please write to Mr Kulka, not this magazine.

The final quote rests with one of the students from the College for the Recording Arts: 'You have taken the glitter and tinsel out of our minds and planted our feet firmly on the ground,' although he never did say if he got a job as a result.

CBS Technology Center

HAVING COMPLETED THE transfer of the Professional Products Department of CBS Laboratories to the French company Thomson-CSF resulting from a transaction made on April 2, CBS president Arthur R. Taylor has announced that the former CBS Labs research activities in broadcasting and audio recording have been transferred to the new CBS Technology Center based at High Ridge Road, Stamford, Connecticut. Ben Bauer, vice-president of the erstwhile CBS Labs, is the vice-president and general manager of the new operation.

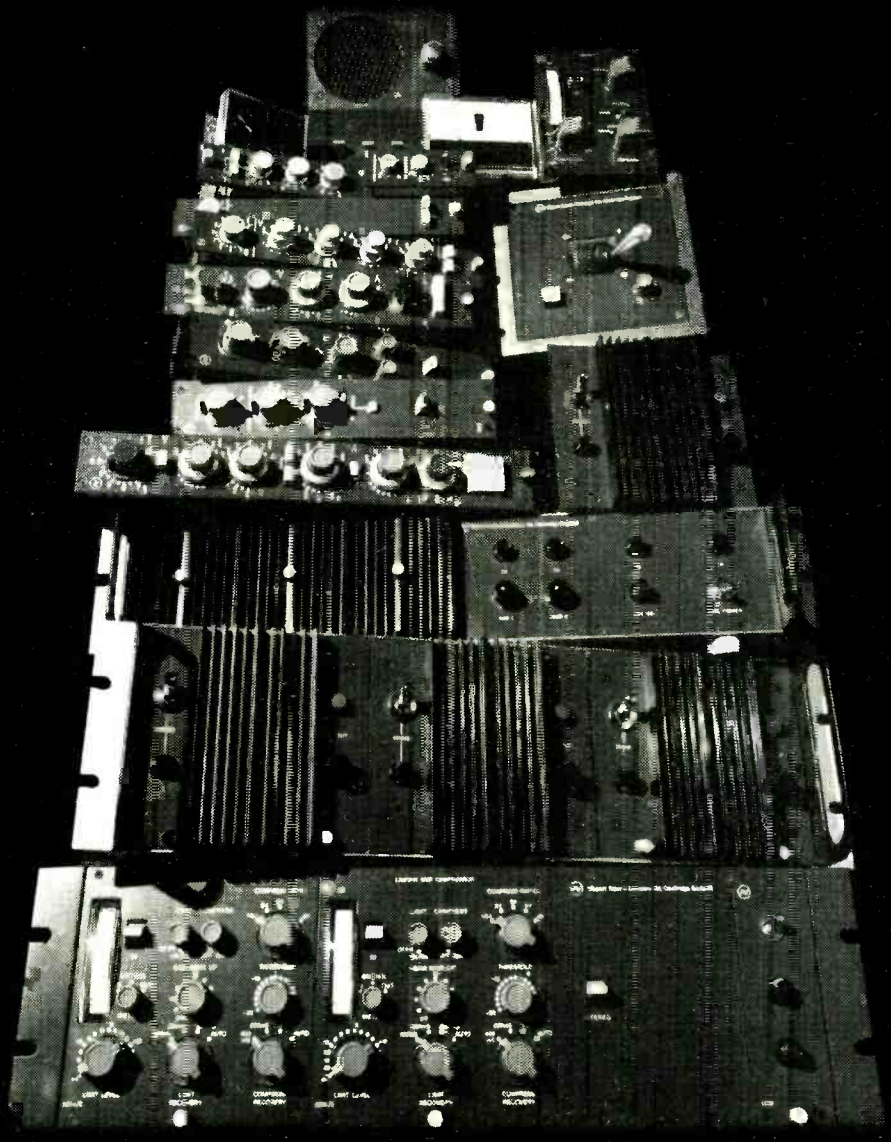
The center will be divided into four separate departments along the following lines: Advanced Television Technology run by J. Kenneth Moore; High Density Recording Technology run by Robert Castrigano; Audio Systems Technology run by Emil Torick; Sound Reproduction Technology run by Louis Abbagnaro.

The activities of the Center will be totally funded by the parent company and its operating divisions and will support long range 'corporate and divisional research and development goals'. The facility was described by Arthur Taylor as 'a continuing commitment to broadcasting, audio recording and other CBS related technologies'.

One of the first tangible products of the facility is a new range of professional test records available from Columbia Special Products, 51 West 52nd Street, NY 10019, USA. The series includes: stereophonic frequency test record STR 100, seven steps to better listening STR 101, square wave, tracking and intermod STR 112, wide range pickup response test STR 120, RIAA frequency response STR 130, RIAA pink noise STR 140, broadcast test STR 150, 318 μs test STR 170, and quadraphonic test STR 1100. CBS Technology Center, High Ridge Road, Stamford, Conn 06905, USA. Phone: (203) 327 2000.

Mixer hire

A SERIES OF Audio Design mixers are available for hire from NSR Ltd, South Harrow. The company claims the hire equipment has been 'approved' and used by most of the UK broadcast companies. All models will operate from either mains or internal batteries. NSR Ltd, Audio Visual Services, 394 Northolt Road, South Harrow, Middlesex HA2 8EY. Phone: 01-422 1863/4825.



Now add Neve components to your total sound

If you weren't aware of it before, let us tell you now. You can add Neve components to your total sound. We make and market a number of ancillary units that can integrate with your current system.

And you get the same standards of quality that have made Neve the world leader in sound-mixing consoles. We are sure of that because we use the same components ourselves in the systems we produce.

Perhaps you need –

- **Neve Series 78 Digital Stop Clock** to assist in the accurate timing of programme material.
- **A Limiter Compressor 2254** regarded as the best in the business to meet the varied needs of sound recording and broadcasting studios for a flexible and comprehensive instrument for the control of programme dynamic range.
- **A Notch Filter 2081** to enable the rejection of chosen frequencies within the band 25HZ to 30kHZ simply and efficiently.
- **A Background Noise Suppressor 2257** to attenuate audio signals below a predetermined level and features variable attenuation depth and recovery time.

And there are many other modules. They can make a significant contribution to your sound. But if you want the best in total sound, you need a Neve console.

Neve

The Sound of Neve is Worldwide

Rupert Neve & Co. Ltd., Cambridge House, Melbourn, Royston, Herts., SG8 6AU, England. Tel. Royston (0763) 60776 Telex 81381 Cables NEVE Cambridge
Rupert Neve Incorporated, Berkshire Industrial Park, Bethel, Conn. 06801, USA. Tel. (203) 744-6230 Telex 969638
Hollywood: Suite 616, 1800-N, Highland Ave., Hollywood, Ca. 90028. Tel. (213) 465-4822
Rupert Neve of Canada Ltd., 2719 Fera Road, Malton, Ontario, Canada. Tel. (416) 677-6611 Telex 0696 8753
Rupert Neve GmbH 6100 Darmstadt Bismarckstrasse 114 West Germany. Telefon (06151) 81764

Westminster

THE DECISIVE ASPECT of the broadcasting of parliament for MPs, and therefore the aspect that may decide whether we hear any more broadcasts from the Commons, is how well the two organisations edited the extracts of the proceedings. MPs watched very carefully how balanced the reports were both politically and in terms of how much real business was sacrificed to merely spectacular clashes between Thatcher and Wilson, or Benn and everybody else.

Therefore it was surprising that the House did not ask for any recordings other than that of the clean feed of the proceedings taken from, broadly, the Tannoy sound reinforcement system. All MPs would hear in these archive recordings would be, in the words of one engineer, 'what they can read in Hansard'. Slight differences might occur because MPs are allowed, within reason, to alter Hansard's account of what they have said.

Some MPs made their own arrangements for assessing the broadcasts. Phillip Whitehead, MP, told me he had asked his wife to record any programmes he couldn't hear himself and he said he would also be asking the BBC for some tapes. Whitehead, a former television producer, is a member of the Commons Services Select Committee which decided the terms on which the broadcasts would be carried out.

Others thought that the decision as to whether the broadcasts become permanent would be made in a less rational way. Robin Corbett, MP, said the House of Commons was such an illogical place that this decision would be no different from any other. 'People will decide about it on the basis of a gut reaction.'

The success of the experiment seemed to be taken for granted, a reasonable view if one considers it unlikely that MPs would allow us to hear what went on in parliament and then say the idea hadn't worked. According to Phillip Whitehead, most MPs had moved in favour of the broadcasts whereas most people outside the House had moved against. 'I've been favourably impressed,' he said. About the objectors in the Commons Robin Corbett said: 'This place is run like a club and a lot of them felt that if they let the cameras or microphones in the place would become just another BBC outside broadcast unit'. Their fears had not materialised.

But if parliament was taking the experiment's success for granted the BBC wasn't. Although not officially required to do so, the BBC made available to the House cassette recordings from each of the regional and local radio stations. MPs could listen to the cassettes in the committee room at seven each evening of the experiment. To make sure that the contents of the cassettes would be acceptable Ian Trethowan, radio managing director, insisted that all the editing of the proceedings be done at Westminster.

Some local and regional radio stations took live programmes during the experiment, but they were not then allowed to record them and present edited highlights later in the day unless a suitable package was sent to them from London. Although Independent Radio News made similar packages available to commercial stations, not all of them entirely satisfactory to the recipients, the commercial stations could take live coverage if they wanted and do their own editing.

During the committee hearings after the Commons had voted for the radio experiment the BBC also promised the House that the tapes would not be made available to light entertainment programmes such as the Jimmy Young Show or Week Ending. The Corporation has been less than assertive and, in its present economic position, with the Annan Committee still sitting and with the Labour Party still, presumably, examining its election coverage, that's hardly surprising.

Technically, the broadcasts have placed great strain on the Corporation's resources. Equipment and staff have had to be drawn from other places at a time when the outside broadcast season is at its height and when staff are beginning to take their annual holidays. When the broadcasts are resumed on a permanent basis some serious thought will need to be given to where the resources are coming from. One of the reasons for restricting the length of the experiment to one month was that the broadcasting organisations could not support a longer period, and ob vans, cable and tape machines had to be begged, borrowed and filched from places already using equipment past its best. 'We want to make it clear that the BBC can't just summon up ten new *B62s* just like that,' an engineer said.

Most of the complexity of the operation derived from the need for studios and editing channels supplying all the BBC's radio services on the site. The signal itself was readily available from Tannoy's sound reinforcement system, and needed only to be spiced with a little ambience from two overhead microphones the corporation installed in the chamber to mask changes in sound as the Tannoy staff switched among

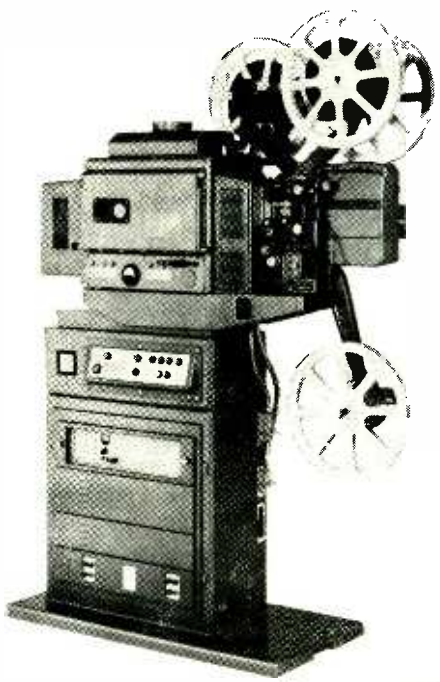
44 ▶

Right: *Control room at Westminster*

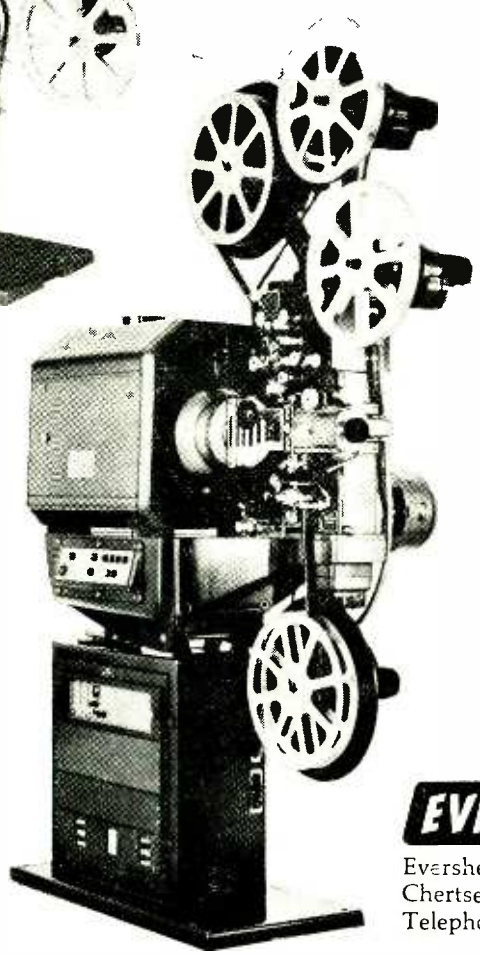
Below: *The commentary box, specially built beneath the public gallery of the House of Commons for the four week experiment in radio broadcasting*

The standards by which others are judged...

Bauer

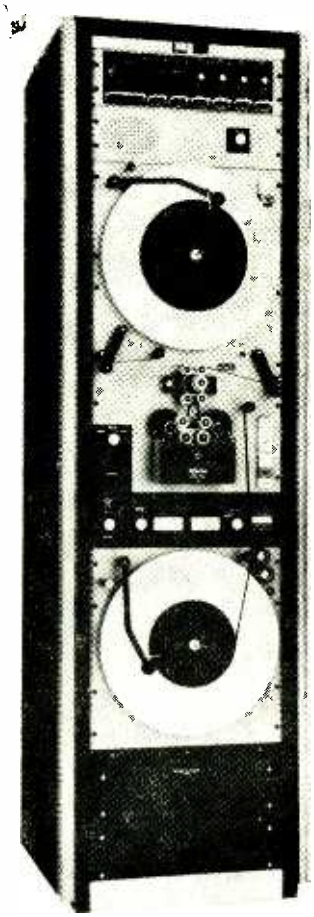


SELECTON STUDIO
16mm 2-band projector



B14 studio 35mm
2-band projector

Perfectone



OR-MULTI

also available are the
Perfectone portable TRANS
ULTRA film recorder and Bauer
P6 range of 16mm projectors.

EVERSHED POWER-OPTICS

Evershed Power-Optics Ltd, Bridge Wharf, Bridge Road,
Chertsey, Surrey KT10 8LJ.
Telephone: (09328) 61181 Telex: 929945.

■ WORK

the 41 microphones to select the nearest one to the person speaking.

Tannoy insist, on the other hand, that the ambience microphones weren't necessary, and were a little upset, too, that the real heroes of the piece, the Tannoy staff (who, in two-hour shifts, operate the pa console selecting which of the microphones should be on, altering the volume of each according to how near they are to the speaker, how loud he is, and so on) have gone unsung. It seems ironic in view of the Corporation's caution in other areas that most of the early criticisms of the broadcasts should be that the background noise was too loud.

As to how the broadcasts have affected the conduct of the house, one of the real worries of the MPs, Jock Stallard expressed the view in an LBC interview that although he had voted for both radio and television broadcasting of the House he would have second thoughts about doing so again. Although this isn't a widely-held view as far as one can discover, he said that broadcasts had removed spontaneity in parliamentary question time by encouraging the use of written notes, and had also encouraged some to ask questions who wouldn't normally be in the House at all. Corbett hadn't noticed any of this. 'When you're asking a question you're too concerned with the business in hand to worry about whether auntie's listening.'

All the same the House will be very impatient of any talk about democratic access and, to make it clear just who is in charge, may seek to extract from the broadcasters some irritating concession, such as refusing to allow proceedings sound to be used in television.

John Dwyer

Victor—Tokyo

TO ONE NOT concerned with earning a direct living from making recordings, the more interesting of Victor's two studios in and near Tokyo is a non-commercial studio installed as part of Victor's Audio Engineering Research Center, and for that reason it attracted more of my attention than did the massive Victor Studio in downtown Tokyo. I visited the latter in the evening and, apart from a little activity in one of the mixdown studios, the place was deserted. That, coupled with a fair amount of communication difficulty, meant that while it was relatively easy to gather statistics of the 'this collective made 800 more tractors than last year' variety, it was not so easy to get a feel of the life of the place. The experimental studio, on the other hand, was not only more interesting from an acoustical point of view, but I was also able to see it during a normal working day.

The commercial complex is housed in a purpose-made building of the poured concrete slab variety and comprises numerous administration offices, restaurants, tv lounges and the like as well as actual studios. Of these there are three, the largest being an impressive 363 square metres in floor area with a ceiling height of 9m. The walls are lined with a series of six layers of fibrous panels supported on studs and battens which are crenellated to give an irregular zig-zag outline to the room. The suspended ceiling has a similar construction giving a canopied effect. The net result of this tremendous quantity of acoustic treatment is a reverberation time of only 0.6s, a pretty low figure for a room of over 3000 cubic metres.

Although quite large enough for recording full-scale orchestral works, Studio One is never used for that. Instead it is used almost exclusively for the recording of rock, pop and wallpaper music, generally of a Western idiom. Most of the music one hears in Japan is of this type—from hotels and restaurants to fm radio it is the exception rather than the rule to hear either European classical music or genuinely Japanese music, but that's another story. The expected close miking is used throughout and extensive use is made of movable screens and partitions to separate various sections. Some of these partitions are conventional, simple affairs about 1½m high, but to reduce interference to a minimum the studio also has a number of really massive partitions four metres high. These are made of fibre-filled, fabric-covered, horizontally-mounted half cylinders mounted on substantial steel frames fitted with wheels to facilitate moving.

The mikes most in evidence were the Sony *37P* and *C38*. Also standing about in quite large numbers were Sony *C55Ps* and Neumann *M49s*, *M269Cs* and *SM69s*. I wasn't able to ask anyone which of these was preferred for what. I was told that the engineers found the *37Ps* to be the best for most applications and that generally Electrovoice *RE30s* were used for bass drums.

Studio One's control room has a 24 into 16 desk which was built in 1969 by Victor's own engineers. Needless to say there is access to a considerable battery of reverberation devices. There are 14 EMT plates and six genuine echo chambers. Monitoring is done via JBL *4325* and the 16 tracks are put down on a 3M *M79*. Owing to the low reverberation time and the pressure on the studio for more commercial ventures classical recordings are nearly always done in concert halls. Even chamber music is recorded in concert halls and, surprisingly, so apparently are most of the quadraphonic recordings, classical and pop.

There are two other studios, both very dead, that are used for more modest recordings. Studio Two has a floor area of 132 square metres and reverberation time of 0.4s and Studio Three which has a floor area of 33 square metres and a reverberation time of 0.3s. Both these studios are fully floating and well isolated acoustically. Some chamber music and solo instrument recordings are made in Studio Two while Studio Three is mainly used for singer/guitarists etc. Again the same mikes are used and the control rooms also use 24 into 16 desks.

There are three mixdown studios, one being fully equipped for quad. The mixdown desk is a 16 into four, though there are two auxiliary inputs which can be used if required for adding independently-recorded material. For location recording of sound effects and so on, the studio has a stereo Uher *CR210*, Stellavox, and a four channel Stellavox. The other two mixdown rooms incorporate 16 plus two into two desks which, like all the desks in use, are of Victor's own design and construction. Plans were well advanced to install Quad/Eight Compumix, which should be in by now.

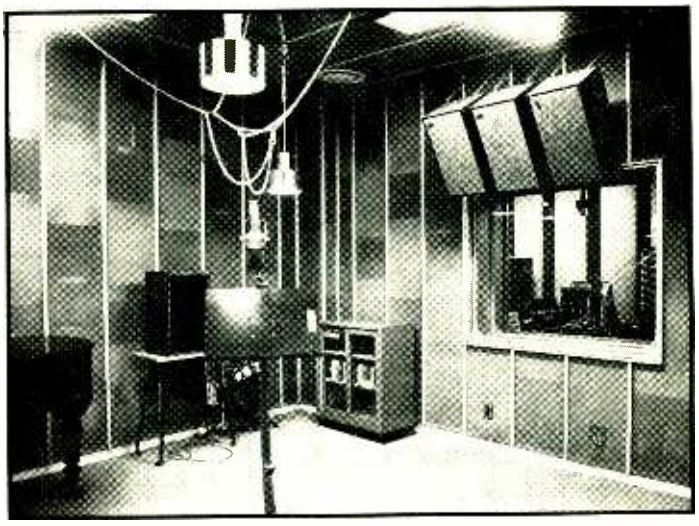
The mixdown session that was taking place the evening I was there was in one of the stereo rooms—a rather turgid Japanese cum Western ballad with heavy and unimaginative percussion. Not chart material, perhaps. The guy who was doing the mixdown was being even more inscrutable than the unfortunate souls landed with this kind of thing at unsociable hours usually are.

The facilities are completed by several rehearsal rooms available to artists which vary in size and decor, one being in traditional Japanese style with paper walls and *tatami* mats on the floor. This room would be used for rehearsing traditional Japanese music.

The experimental studio is situated some 35 km away in Yamato and is in striking contrast to the Tokyo place. There is only one studio and at first sight it looks more like a small concert hall, having a stage area and seating for an audience. It is a medium-sized affair having a volume of just under 1300 cubic metres. The walls of the stage area consist of reversible panels. These are covered on one side with a 50 mm thick layer of glass fibre while the other side is covered with a 4 mm skin of asbestos cement. The ceiling panels above the stage are reflective and are rotatable.

The walls of the main part of the studio slope inwards at an angle of 7° and are zig-zagged like the walls in Studio One. The walls are made up of plasterboard louvres

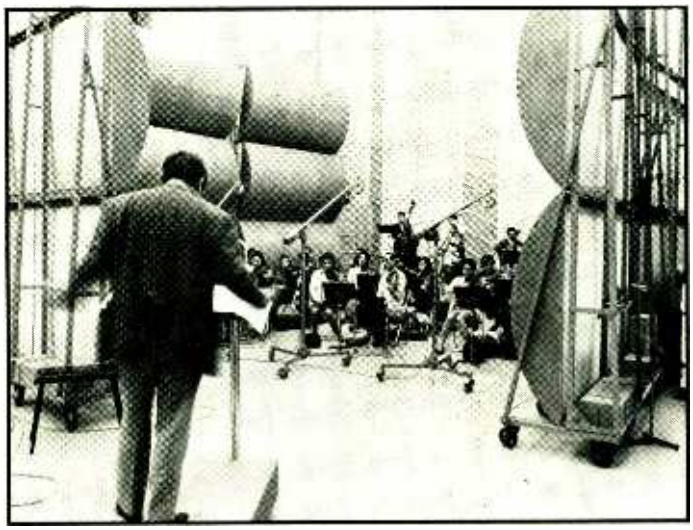
Victor's experimental studio in Yamato. The movable louvres, partly open, are visible on the left wall. Two of the four Mora playback loudspeakers can be seen on the stage



Above left: *Studio Two.* **Above right:** *Studio Three*
Below: *Studio One*

which can be raised or lowered electrically. As they move apart they expose the surface of sound-absorbing and fibre-filled cavities. The extent to which the louvres are closed or open determines the reverberation time of the studio. The *modus operandi* is that the desired acoustics are selected and dialled on a control knob.

A few million yen's worth of computer and servo-motors then take over. The walls become alive with movement for a few seconds while everything is shifted to the appropriate positions for the required effect and, presto, a new recording environment. Thus, at the twiddle of a knob, the reverberation time can be varied from 0.6s up to 1.4s. There are full four channel recording and playback facilities and particularly noteworthy are four cinema-sized monitor speakers. These are four-way horns said to be able to produce an spl of 120 dB. The four units each have their own amplifier and the audio signal is split electronically before being fed to the power amplifiers. A plot I saw of the frequency response was flat between 50 Hz and 20 kHz. This experimental studio is used mainly to make recordings for Victor's internal use and in conjunction with a massive anechoic chamber (8.5 x 8.5 x 7.5m) their engineers while away their hours conducting experiments in psychoacoustics.



It was at this Yamato Research Centre that Victor's Mr Inoë developed the CD-4 discrete quadrophonic disc record system. In the studio's other role as a monitoring room, I heard CD-4 discs compared with other matrixed, records and discrete tape. Considering the speed with which Victor convert their engineers' ideas into hardware, one wonders how soon the experience gained here will be incorporated in commercial studios. Presumably the instantly adjustable reverberation will not be replacing padded screens, springs and plates just yet.

Gareth Jefferson

Countdown Studio

THE YAMAHA GRAND is a very fine piano. Everyone agreed; each taking his and her turn to be Scott Joplin. The drummer told the guitarist that he ought to take up the guitar who in turn implied that the singer might do better with her feet. Everyone said that the journalist had not missed his vocation as a keyboard player. The operator must have been the man lurking in the corridor, bewildered by this display of talent.

The piano neatly filled one corner of the functionally complete eight track recording studio; the remaining work amounted to fixture of the glitter nominally required by the music industry. Situated in a converted store house at the cheaper end of the High Street, Manchester, the studio is the brain child of pro musicians Bruce Turner and Clem Lee; they feature as guitarist and drummer behind Alvin Stardust and, in their own right, claim to be 'very famous this side of Salford . . . We've done all the gigs in all the right places, Manchester Free Trade Hall, all the best clubs . . .' Engineer Steve Foley chips in: 'You really took the Metal Polishers and Dyers by storm, and what about the Pigeon Fanciers?' Clem: 'Shurrup four-eyes . . . you don't want to listen to him'.

Behind the banter, everyone takes the job very seriously; the reason for this new involvement is to provide facilities on tap for Clem, Bruce et al with a view to the eventual creation of a house record label. On its own, they know that this work, at the moment, is not enough; these plans are something very much for the future. The present concerns itself with the operation of an independently viable studio taking bookings from allcomers. What may be lacking, if at all, in balancing experience should easily be made up by having competent musicians on tap, including Clem's very talented singer-wife, Shann.

Promotion of studios provides immense problems and everyone agreed that the best way was by word of mouth—the source of consistently good work very soon gets around, although not quite as fast as the source of rubbish. Inevitably, studios advertise the facilities with varying degrees of response. Clem placed such an advert in the local evening newspaper with interesting results.

Phone: Brr-brr brr-brr.
Clem: Hello, Countdown Studios.
Caller: Er hello, I'd like to talk to you about doing some recording.
Clem: Yeah, sure. Go ahead.
Caller: Well you see, I've got one as well.
Clem: Eh? Where is it?
Caller: At the moment, in my garage.
Clem (after a few secs): What sort is it?
Caller: Dunno, me Dad got it for me.
Clem: Silence (followed by)
Phone: Click.
Motto: Never advertise an eight track studio as such in a popular newspaper.

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The regulations covering radio broadcasting are designed to prevent chaotic wavelength interaction but work to reduce the dissemination of any view opposed to the status quo. Those who do not like the situation have disagreed in the direct way, as in the heyday of the UK pop pirates, often finding a majority audience listening. Now, things are a little more discreet.

Alternative radio

JOHN DWYER

THERE ARE AT least 40 radio stations you can hear in the UK: 20 BBC and 14 IBA local stations, the four national BBC stations, Radio Manx, Radio Luxembourg, Voice of America, American Forces Network, and BBC World Service. There is also Radio Caroline, parked off Clacton. Yet with all the outward appearance of an abundance of choice that this presents, there is still a large seemingly lunatic fringe ready to risk jail for transmitting excellent but illegal programmes from the tops of blocks of flats. Clearly they aren't happy with what's already available. Moreover, they represent only the visible signs of the growing number who, each in his own way, want to democratise broadcasting.

The malcontents fit loosely into one of two broad groups. The first, of which the pirates are the best example, are those who are dissatisfied with the musical content of what's already on offer, and the second are those who see radio as a political instrument. This latter group can also be split into two sub-groups: those who think radio is being used as a political instrument against the best interests of most of the population and who wish to give everyone wider access to it: and those who wish to use radio as a political instrument, as a means of social change. The last sub-group includes every dissident political group in the country, from the British Movement, led by Colin Jordan, to the edge of the Conservative Party. The Conservatives are on record as wishing to leave broadcasting alone. On the left there are more dissident groups which extend from the middle of the Labour Party to the International Marxists, the Marxist-Leninists and the vague regions beyond.

Pirates at sea

The last sea-going British pirate radio station was also the first. Radio Caroline opened at 21.00 hrs on March 27 1964 with an announcement by Simon Dee. Regular transmissions began the following day. On March 3 1968 the Caroline was hi-jacked and towed away with her sister ship, the Mi Amigo, the home of Radio Caroline South, formerly Radio Atlanta.

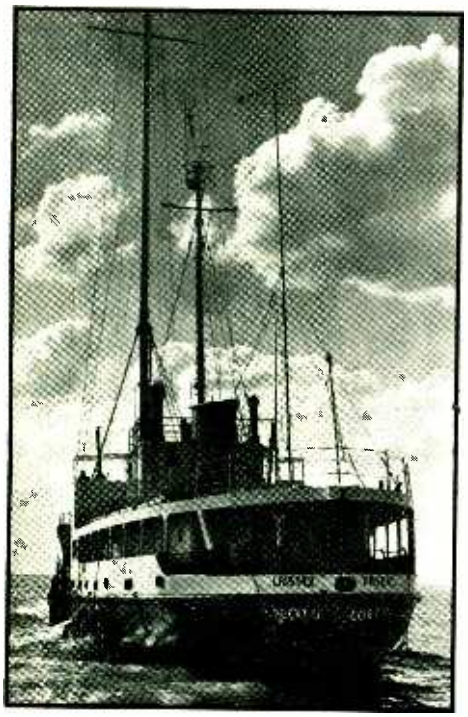
When Caroline closed down the story had only begun, whether you're talking about legal or illegal radio. Dutch pirates, for example, who were there before Caroline, carried on after, and three of them only recently closed down because of the Dutch Broadcasting Act which became law on August 31 last year. Radio Veronica, whose programmes were pre-recorded in their Hilversum studios, was the oldest and most popular, having begun to broadcast on May 6 1960; Radio Northsea offered both a Dutch and an international (English) service. Her Swiss owners plan to move her to the coast of Italy. The youngest of the three was Atlantis (not to be confused with Atlanta) which broadcast in Flemish and Dutch during the day and in English at night.

The Dutch had ratified the 1965 Treaty of Strasbourg which banned pirate broadcasts from international waters in January 1974, but no action was taken against the three pirates until Radio Veronica's application for a licence had been considered. Only one station is now left. Radio Caroline was reborn on September 3 1972 on Ronan O'Rahilly's Mi Amigo. Since then its mast has blown down twice, its generator has broken down, and there has been a mutiny on board. In April 1973 the Mi Amigo broadcast programmes for Veronica, which had run on to the beach at Scheveningen, and the following month Caroline began to broadcast simultaneously in English on 389m and in Dutch on 259m, the present frequency. The programmes became known as Radio Atlantis during the day and Radio Seagull during the evening. The *Sunday Times*, giving the frequency of Radio Seagull in October 1973, described it as 'the best popular music station currently broadcasting'. It offered no commercials or jingles and little chatter. The mast came down during the same month and Radio Atlantis moved to its own vessel. A few weeks after it was repaired, Radio Seagull changed its name to Caroline and Radio Mi Amigo, which replaced Atlantis, hired airtime from Caroline during the day. That is still the situation at the time of writing.

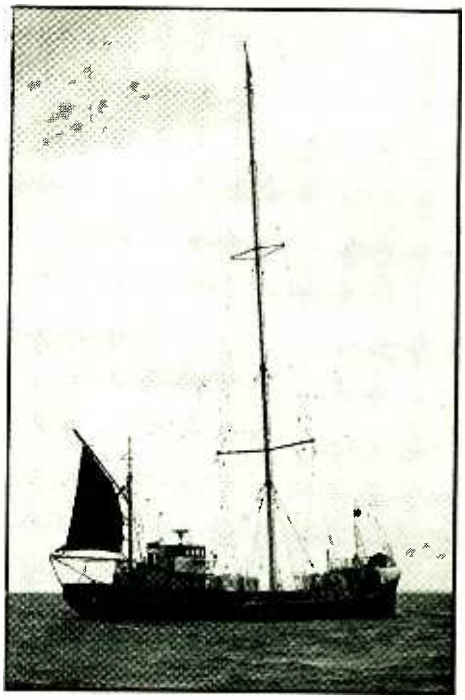
On the eve of the Dutch law coming into force, the Mi Amigo moved from her position near the other three pirates to a new position 20 miles north of Margate, 18 miles east of Clacton. During the day the prerecorded programmes of Radio Mi Amigo in Flemish reach Holland and Belgium, and at night Radio Caroline broadcasts in English. Mi Amigo is owned by a Belgian, Sylvain Tack, who also has sweet factories and a music publishers.

Amigo's income is from record plugs and Belgian advertising. Although Belgian law makes it illegal to advertise on a pirate, Amigo get round this by reading 'information' from advertisements in the Belgian press. The other legal difficulty is that of supplying the ship, which O'Rahilly is reputed to do by tender from Spain. Transmitter power is 50 kW.

**All photos courtesy of East Anglian Productions*



Left: *Laissez Faire from which Radio England and Britain Radio transmitted simultaneously*
Below: *Radio 270 off Scarborough*



Space does not permit a full account of the pirates' history, fascinating though it is, but one recurring theme has been that of violence. At one time or another there have been murders, mysterious disappearances, petrol bombs and various other gruesome incidents, yet the seaborne pirates persist. I asked one of the new generation of land pirates why and he agreed the only reason must be that there was money in it. 'Mind you,' he added, 'I don't see how, do you?'.

Pirates on land

As the months go by, the number of land-based pirates seems to diminish, though it seems unlikely that they'll disappear altogether. Usually medium wave pirates prerecord their programmes on cassette and hide the equipment until the end of the broadcast. According to author and one-time free radio lobbyist Nigel Turner, it needs an army to run a station of that kind without getting busted or losing your equipment. 'I've been on a few of these things and the organisation is utterly fantastic. It's like a massive security operation. They've got about five or six cars circling round the transmitter watching out for police or detector vans.' Not that the police are too much trouble. According to Mike Knight of Radio Jackie, the police once asked a suspicious looking character to open the boot of his car: "They asked him what was in it. He replied: 'A tape recorder, three car batteries, and a t-t-tr-transmitter'. At this the police realised who they had caught (they thought it was Radio Free London). They all started laughing. They asked how the transmitter worked, and then prepared to leave, saying: 'I'm afraid you can't transmit from here today".

According to the news editor of *The Radio Guide*, formerly *Script* magazine, only one pirate of this kind still broadcasts regularly, Radio Kaleidoscope, though the situation is confused and constantly changing. Two things are responsible for this. Inevitably, the arrival of Capital and the other stations has made a difference to both the number who are prepared to listen and the number who see some point in transmitting. The other reason is that the Post Office have been ruthless in stamping out the land pirates: the most famous station was Jackie, now defunct according to Mike Baron of *The Radio Guide*, and Jackie had notched up over a hundred prosecutions in its five-year history.

London Music Radio was an offshoot of Jackie and is sometimes heard on public holidays, always active times for land pirates. LMR started with help from Radio Invicta, a vhf station of incomparable quality whose only aim was once to broadcast soul music. Invicta too operates only during bank holidays, and has begun to campaign for greater exposure for such music, preferably a show on Radio One, the only station that doesn't have one.

Vhf is harder to track down than medium wave and Invicta make it even harder by using at least two 100W transmitters and switching from one to the other each hour. They say they have a network of sites all over London, mainly atop blocks of flats, but say they could always do with more. Invicta have no need for the security paraphernalia necessary on medium wave and just keep a good lookout with binoculars. Nevertheless they have lost

Above:
Radio Caroline studios, on board the Mi Amigo—present day

Above:
Edward Cole in Radio 390 studio

Below:
Mebo II—Radio Northsea International

a couple of transmitters and have been fined up to £80. They've had two conditional discharges.

The penalties can be more severe. According to Turner, Mike Knight of Jackie has been fined up to £250 and, on the last occasion, was given a suspended prison sentence. The Wireless Telegraphy Act allows fines up to £400 or two years' prison or both. Unlike the Marine Offences Act of 1967 there seems to be no sanction under the act against advertisers. None of those advertising with Invicta has been prosecuted as far as I could ascertain, though the advertising they do have is only for token payments if any, and mainly by friends of the station.

Why run the risk, particularly since commercial radio is here? One student of the pirates, now working for the BBC, put it like this: 'It's the programme content,' he said, speaking of the BBC. He mentioned an occasion when Johnny Walker was asked on Radio Birmingham who decided what records were played: 'He said that executive producers of Radio One decide what's on the playlist. The BBC have always denied that there is a playlist at all. The truth is that only established artists can get their records played on the BBC. It's all a hype. That first Wombles record was a super-hype. It had been around for months and then they decide to start plugging it and it's suddenly a big hit. I guarantee I can listen to Radio One and I can tell you which records are on the playlist.'

According to Tony Johns of Radio Invicta many of the other pirates are only indulging in nostalgia: 'We're only interested in soul. The days of the pirates are over.' Invicta make a modest claim that they have been partly responsible for the popularity of soul: 'They say it's a minority music but it isn't—there must be very few households in this country that haven't got at least one Tamla Motown record in their collection'.

He sees two ways to run broadcasting: 'Take a city like New York. You have six pop stations, two soul stations, one classical station, two chat and news stations and a country and western station. You can hear any kind of music you want. Now in New York they have gone a bit berserk; there are far too many stations and one of each would be quite enough . . . The other way is that instead of Radio One playing the lowest common denominator all day long why not have from one o'clock to three for the housewives, from 12 to one soul, from six to seven country and western—can't stand country and western myself but some people like it—and at other times classical music and heavy rock?'

Knight of Radio Jackie puts it this way: 'We would like to see room for local stations run for young people by young people. This would make stations like ours obsolete, because that's exactly the type of service we are trying to give. And we will continue to give this service illegally until we are permitted to do it within the law . . . free radio isn't necessarily commercial, and commercial radio most certainly isn't free.'

Nigel Turner is more cynical: 'The pirates did act as a catalyst, yes, but it's really not more important than that. All they did was to tap a feeling that existed in this country in the mid-sixties. They transported the kind of thing that was going on in the States over here from the US . . . It's true they caused a mini-earthquake within the BBC, and they did away with some of the Reith cobwebs, but the programming was really crap.' Their biggest contribution, he says, was their amateurishness, their informality. 'If broadcasting is too professional you're going to cut off a lot of people who feel they haven't a contribution to make.' The reason for continuing pirate broadcasts was 'a hankering after the good old days of pirate radio—a fixation. They would have you believe they're carrying on in the great tradition of pirate radio broadcasting but really it's an addiction, and any purpose it might have is swamped by the need for a weekly fix.'

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ALTERNATIVE RADIO

There may be a certain swashbuckling glamour to it, too; a spurious sense of conspiracy. Turner said, and he was right, that it was difficult to find out the real names of anyone connected with pirate radio on land or sea. He tells of a court hearing where three people were to come up for trial for unlicensed broadcasting. The three turned out to be this one little man who had been charged under three different names.

Alternative broadcasting has its own infrastructure, though it is now disintegrating. Since the introduction of commercial broadcasting there have been any number of splits, reformations and regroupings of the various factions. One that has suffered more than most from these is the Free Radio Campaign. According to *The Radio Guide* its sole function at the moment is selling stickers. What used to be the north-east section of FRC has now reformed into a radio listeners' council to advise and consult with all the radio stations, including the BBC and commercial local stations. The Chairman of the new group expects the FRC to disappear when the last pirate goes off the air, which he thinks will not be long. Another organisation, the Southern Independent Radio Association, has now disbanded, according to Mike Baron.

The Radio Guide describes itself as 'the magazine of alternative radio', though it has articles about the local BBC stations as well as about the commercial stations, which they describe as commercial and not as independent, I note. Mike Baron explained that 'alternative' in his view meant an alternative to Radios One and Two, which were adequately covered in other magazines. He said in many cases the BBC local stations offered an alternative worth having. Turner agrees: 'The BBC stations come closest to what I'm advocating. They're severely under-financed . . . They do try to direct themselves at the community at large.' According to him, the BBC stations were more flexible, less highly programmed than the commercial stations. His impression was that LBC, and to a lesser extent Capital, didn't give a damn.

Megaphone or telephone

As I have said, the pirates serve merely as an introduction to various disaffected potential broadcasters. Separate from the pirates are those who think of radio as a means to an end rather than an end in itself. They tend, generally, to be more politically conscious than the music enthusiasts, although the latter have taken an active part in general elections, particularly that in 1970, the first at which the vote was available to those of 18 years and over. Radio Northsea, for example, broadcast Conservative propaganda under the name of Caroline, and was jammed by a naval station in Kent until the last week of the election when, according to *Script* (as it then was), Harold Wilson ordered the largest transmitting station in Europe, a 2 MW station at Southend, to jam the vessel's broadcasts.

Ironically, the jamming didn't cease when the Conservatives won the election and the ship had to move away after a few weeks. The pirates maintain they lost Harold the election

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Above: *Red Sands Towers Radio 390*

Below left: *Norman St John in the Radio London Studio*

Right: *Emperor Rosko in Radio Caroline South Studio*

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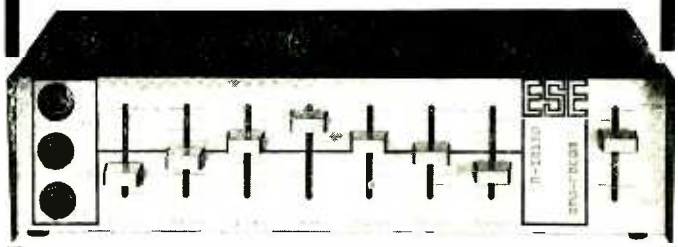

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and so were responsible for the introduction of commercial radio. Wilson blames a bad set of trade figures: his memoirs mention the Pirate Broadcasting Act once in 1000 pages.

It is perhaps true to say that the pirate brigade want to carry on using radio in the old way, as a megaphone. They want more people to be allowed to use the megaphone and, if they wish, to use it to make money. The Free Radio Campaign submitted a plan to Christopher Chataway when he was Minister of Posts and Telecommunications saying that they could find no large demand for local radio and proposing a number of national and international stations on the lines of the old pirates, Radio Monte Carlo and so on. These stations should be free from programming control, censorship or 'external commercial pressures'. Some of the channels would be taken from the BBC.

The other approach is perhaps more introspective, more thoughtful. The political groups are keener on dialogue, on giving access to points of view, rather than pandering to musical prejudice. Programmes like 'Open Door' they find inadequate and insulting: in their view what that provides is 'not access guaranteed as a right, but access granted as a privilege'.

One of the more political groups is Whole Earth Tools, who have published a book written by Nigel Turner and others called 'Community Radio in Britain: a practical introduction'. At the front is a quotation from Brecht: 'Radio must be changed from a means of distribution to a means of communication . . . capable not only of transmitting but of receiving'. Turner proposes a series of up to 1000 low power local stations in addition to the local channels so that radio could be used on behalf of the community instead of to address it. The ideas expressed in the book bear a remarkable similarity to those made respectable by Anthony Smith in *The Shadow in the Cave*, though Smith's book came out a year later, in 1973.

Turner told me his ideal in broadcasting was Radio Three, and saw no reason why it couldn't be done on a local scale a great deal less stuffily. His interest in radio as a means of social exchange started when he heard American radio. He was particularly impressed by a millionaire called Lorenzo Milam, whom he had met when in the US four years ago. Milam built a station each in Seattle (KRAB) and Portland (KBOO) and then gave them away. He also helped to set up stations in St Louis, Los Gatos, Santa Cruz, Atlanta, Miami and Dallas. Turner said that by the time he died early in 1974 he was a millionaire no longer.

Milam wrote in Turner's book: 'An important change in broadcasting in the US is what has come to be called "Community non-institutional Radio". Through an easing in the licensing requirements by the Federal Communications Commission non-school, non-commercial, non-establishment groups are being licensed for fm stations around the country. And these stations are strong and

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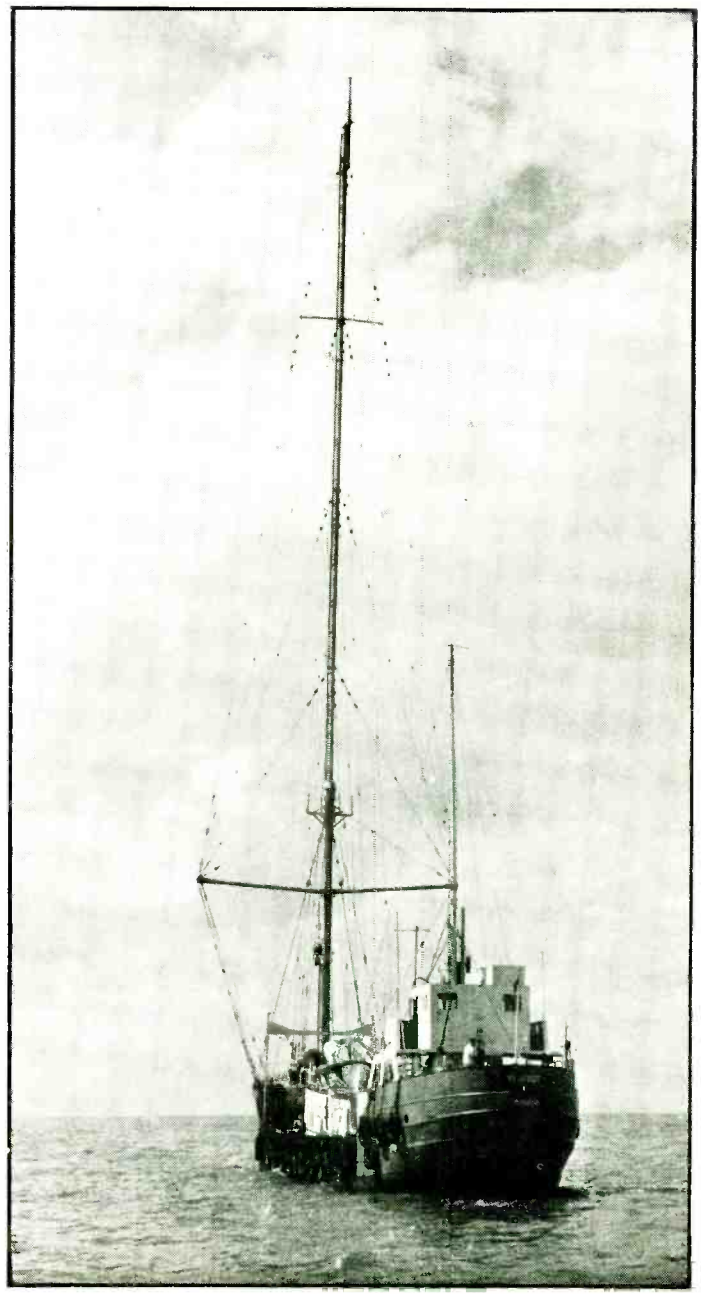
Right: *M.V. Mi Amigo, Radio Caroline South, formerly Radio Nord, and Radio Atlanta*



Below: *M.V. Galaxy, Radio London*

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BASF United Kingdom Limited, Knightsbridge House, 197 Knightsbridge, London SW7 1SA. Tel: 01-584 5080.

non-nonsense, often partisan and heavily aesthetic. The dream is to draw the best of the BBC's Radio 3 and the Canadian Broadcasting Corporation and American Radio and television but to put it on a community free form basis. It's exciting radio, and there are outposts in New York City, San Francisco, Los Angeles, St Louis, Seattle, Houston and permits for stations are coming up in Atlanta, Miami, Dallas and other southern cities which have the strongest need for an alternative voice.'

He said the result sounded refreshingly real, amateur and naive. The budgets are tiny and the programming erratic: 'Some great, some terrible, all outrage and brimstone and "It's gotta change". And the best of these stations specialise in non-political bias: that is, portions of all of the conservative and revolutionary and religious and aesthetic community will be heard—given blocks of programmes for 15 minutes of an hour or two to shoot off their mouths.' One of the best such stations, in St Louis, has suffered shotgun raids by the local police.

Slow Scan

Another development in the US is described in an article in *Undercurrents*, an underground magazine advocating what they call alternative technology. Cop Macdonald writes about ham radio and slow scan tv, telling how Sunday afternoons are spent conversing with people from all over the US and Canada. Sometimes one man will present a paper over the air which the others will then talk about in a discussion session. They've had book reviews, sessions on the energy crisis, employment, women's liberation, computer networking and organic gardening.

Macdonald says that usually a dozen or 15 stations will be involved: 'The core group is made up mostly of people oriented to alternatives and change. The transients, however, often represent the reactionary majority of the ham population and we've had a few out and out fascists advocating "retroactive birth control" and World War III as solutions to the world's problems.' It's only fair to point out that Rochester, Minnesota, home of Mr Macdonald, the Mayo Clinic and IBM, is hardly a typical American community, being one of the few where there are no blacks, there is universal affluence and plenty of people who can afford ham radios and slow scan tv equipment in the attic. It is to be hoped Mr Macdonald is not just conversing with people from similar communities elsewhere.

Slow scan tv operates with a bandwidth low enough to be transmitted along normal voice channels. The scanning speed is once every eight seconds and resolution is 120 lines either way. The screens, which are better watched in a darkened room, are long persistence, often converted oscilloscopes. The picture can be recorded on audio tape. The first transatlantic transmissions took place, very unofficially, in 1959. The FCC and the Ministry of Posts and Telecommunications, now part of the Home Office, have both approved the use of the systems in the amateur bands. According to Macdonald the system is being used by 2000 hams in 60 countries.

His article comes in an *Undercurrents* supplement about communications: 'The existing structures of communication in Britain are used to bolster up the status quo and to perpetuate the basic injustices of our present society'. The rest of *Undercurrents* reveals itself as one of the most jargon-free and intelligent publications in underground journalism. It provides well-written articles on people's radio and the future of cable tv, the latter a thorough and brilliant analysis of the way large companies own our means of communication by courtesy of the PO.

The people's radio article starts from the premise that it is indefensible for the Post Office to be given, by various laws and amendments to those laws, a monopoly over broadcasting and communication so extensive that a mains intercom is deemed to be used illegally if it communicates between one premises and another. 'Such censorship would not be tolerated with respect to the spoken or written word. There is no valid argument against throwing open some sections of the radio spectrum for unrestricted communications and broadcasting—an indispensable part of any attempt to keep a de-centralised society communicating.' The theme in the people's radio or community radio camps is seen, therefore, to be the same: de-centralisation, in Turner's case the use of radio to service small 'societal units'.

Illegal transmitters

The *Undercurrents* article goes on to describe, under a picture of Plaid Cymru pirate radio equipment, the construction and operation of illegal radio transmitters 'intended to apply to those few enlightened countries where such devices are legally permissible, or to the bright future day when all these repressive acts have been abolished or, better still, government itself abolished and ordinary mortals like you and I have the freedom of the airwaves'.

Dreamers all, and gloriously impractical. Or is it that the rest of us have no imagination? Paradoxically, those connected with alternative radio, whatever their conception of it, are among the most realistic people you could meet. Tony Johns, for example, knew there was no chance of Invicta ever broadcasting legally, despite the efforts he had made to check the broadcast quality of its signal with spectrum analysers and what all else: 'We haven't got Lord Harlech or someone like that at the head of us'.

Whatever the truth may be, the Post Office and all its works *seem* to present an unreasonable concentration of power, and where such concentration exists the conviction will follow in some places that that power is being abused. What is sad is that the PO feels no obligation to offer any evidence to the contrary, and so we must assume the worst. There is one other country where the harassment of illegal broadcasters is carried on on the same scale as it is here, where, in a single industrial area, 115 illegal broadcasts were recorded within a five-hour listening period. Radios Demon, Dragon, Ninochka and a score of others were tried in the summer of 1973 in the river town of Kazan. They were given heavy sentences. The country is Soviet Russia. Of course, that makes the Russian pirates heroes . . .

Meet the creator. The TEAC A-3340S.

Think of a professional recording studio engineered into a 50 lb package — at a fraction of its cost — and you'll have an idea of the capability of the TEAC A-3340S 4-channel tape deck.

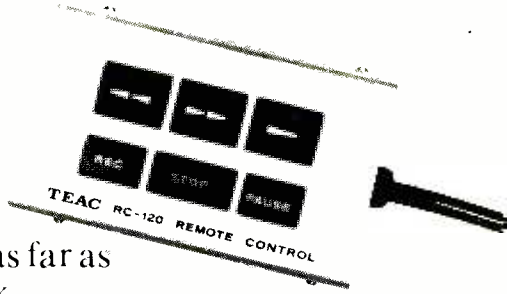
Consider its versatile features. Like Simul-Sync. It allows you to record several instruments and voices at once or at different times *individually*. And each track of the Simul-Sync record head can be electronically switched to permit monitoring of the previous tracks as each new track is being recorded. Since the A-3340S is a 4-channel deck, you can lay down four individual tracks at the exact recording levels you desire. This material may be mixed and subtly blended together at a later date until the desired end result is achieved.

TEAC is innovator of the 3-head/3-motor tape transport system. A 4/8 pole, dual speed synchronous motor powering an extra heavy, balanced flywheel drives the capstan. This motor assures a stable and constant tape run, impervious to line voltage fluctuations or other external factors.

TEAC's own Permaflux heads, specifically designed for 4-channel operation, are notable for their excellent frequency response and low distortion.

Simple and positive touch-button controls enable you to move through directional functions (play, fast forward, stop, record, pause and rewind) with a mere touch of the finger. All of the six control buttons are positioned for easy operation.

With the RC-120 remote control unit (optional extra) you don't have to hang over the A-3340S. All the basic transport functions will be at your finger tips as far as 16 feet away from the deck.



Separate Bias and EQ switches maintain a compatible adjustment between the tape deck's electronics and the different types of tape.

The "Punch-in" record feature permits you to go directly from play mode to record mode (running splice). This facilitates creative recording and editing, and is a valuable, unique feature of the A-3340S.

Signals from 8 sources (4 line and 4 mic inputs) may be recorded simultaneously. Independent mic and line preamps, each with its own level control, provide maximum flexibility for creative recording, and permit input from a combination of line/source and mic signals.

The A-3340S with its 10½" reel capacity is an inexhaustible partner in the creative process — one that opens up a realm of original sound limited only by your imagination.

TELEDYNE ACOUSTIC RESEARCH High Street, Houghton Regis, Dunstable, Bedfordshire LU5 5QJ Telephone: Dunstable (0582) 603151

The 51st AES Convention was held in Los Angeles between May 13 and 16, the eighth APRS Exhibition in London on June 19 and 20.

London and Los Angeles

MICHAEL THORNE

AES:

ALTHOUGH THE genesis and initial justification of the AES Convention is the series of papers, the exhibition at the LA Hilton downtown undoubtedly attracts the majority of the over 4000 delegates who were expected to arrive during the four-day event. It always has been the largest function of its type in the world, and in passing eclipses other exhibitions peripheral to the central point of recording, sound reinforcement and broadcasting. The number of exhibitors was given as 101, of whom around 25% were appearing for the first time. Add this to the technical sessions running from 9.30 on Tuesday morning to Friday afternoon, with particular evenings also involved, and you find an occasion which requires the most dedicated delegate to get round its entirety.

In the event, the technical sessions were gear oriented and as a result may not have been of prime interest to many of the recording and music fraternity passing through; one breed wants to know how to use, the other how to design, and it is towards the latter that many papers turn. However, the blend between the two is probably wider than in Europe, reflecting slightly different attitudes in these two areas. To have the two operating in the same place is another important facet of such shows: there's still nowhere else that provides for such an extensive meeting and exchange for the recording industry. And despite beers at $1.20 and polite local-style hassling of STUDIO SOUND for its editor's id, the Hilton bar served well as an adjunct.

Actual criticisms of the place are probably lower than usual. The lack of informal meeting places is one, coupled with the situation of the particular Hilton miles from anywhere else of related importance. Communications remain generally easy, marred for any non-US resident by the lack of a Telex terminal.

But the room size is useful, as are the adjacent hall areas where the majority of the exhibitors were located (although some found themselves upstairs on the fourth floor). Running and organisation were startlingly efficient—helped, doubtless, by the consistent venue. Although the admin area was always busy, it didn't feel from the outside as if over a thousand people a day passed through and did their piece, and the speed with which the exhibition was set up and subsequently broken meant that by Saturday morning all that remained were a few itinerant hangovers.

The most spectacular appearance was probably that of API, who presented a partly-completed board with ever more functions automated and scored several orders as a result. The figure shows both the *944* input module and its adjunct *954* programmable parametric equaliser and is, hopefully, self-explanatory. The red led indicators provide immediate read/write status recognition.

The Automix console itself is a basic 24 into four, although it's obvious that the option of up to 32 channels is going to be taken by a large number of people even if in principle the number of tape tracks needed could be eased slightly given the better control over track jumping. On all channels, automation covers level, quad panning and eq, and echo send on any of the four sub groups. In conjunction with quad panning is an optional vdu which shows the position of all panned functions, thus enabling quicker matching. (As soon as panning is between more than two groups at once, ie for any sort of central, non-peripheral image, it is impossible to land the cursor on the written position with a sweep of a single control, and aural location becomes harder.) Quoted system specifications include that for distortion as 'less than 0.1% thd at +4 dBm and less than 0.15 thd at +18 dBm sinewave output, measured at any frequency between 30 Hz and 20 kHz'. Demonstration was with a 16/4 remix, with Ampex tape machines and a resident engineer being very patient with a few limited tracks for a whole week.

It is claimed that the cost of the system compares with that of a conventional board fulfilling similar system needs; and if required the whole board can itself be operated conventionally, for example in a recording or overdubbing situation. Any part of it may be nulled. For example, any equaliser may be automated independently of other normal operations, or the board may be used as a level-only device if needs be. The whole system is based on the ubiquitous Allison Research programmer. API were the first mixer manufacturer to use this system extensively which has since surfaced elsewhere, for example in Cadac's new system design. At the show, Cadac's own distributors were fixed as Cara Pacific Sound, since confirmed.

Allison herself and themselves were very much in evidence, with a change of direction in Tin Pan Valley. Situated in an out of the way valley a few miles outside Nashville, it is the scene of a semi-cooperative venture centred on music and its recording but which it is hoped will extend outwards to form a fairly self-sufficient community. Plots of land are available for purchase which may then be used subject to the constitution which has already been drawn up. McDonalds will have trouble in finding their 16 billionth customer there, and General Motors will not be able to exceed the limitation on non-partnership employment even if, as a conglomerate, they were permitted to settle. In this way it is hoped that a community will develop naturally which provides the right environment without erecting a high fence against the rest of the world.

Quad-Eight Electronics, despite having their other lines in evidence, were nevertheless centring on automation. For them, it turns slightly away from the central music recording field in the form of a desk for Prague TV, the second of two, which was due to leave town the following Monday night. It is surprising, in retrospect, that automation should have developed in the music field and not in the film/tv area, where many more hands are generally needed to work a large console and coordinate multiple cues and separate effects insertions and so on, especially since the emphasis is on level and switching operations. Perhaps the money is available and flowing (increasingly) for music operations, although tv is not exactly short in that respect, and the development of low distortion vcas would not be as important as to the record industry.

Although when I called there was no one really able to give a guided tour around the console, it was clear that the advantages of being able to punch it to a particular scene and to commence updating immediately are

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considerable, when compared with the need for two or three people and 'ten times the time' using conventional techniques. The cue sheet becomes a series of memory addresses and the associated instructions for routing and level, which may be built up piece-meal.

The number of people claiming associations with *Earthquake* grows. It's a talking point in this part of the world, even the Hilton four days having their own seismic version of the midnight creep. So you know all about Cerwin Vega high power systems (the ambience did) and BGW power amps (one of which is reviewed shortly). BGW were also showing two channel, five band graphics using gyrator resonance circuitry based on the *318* op amp.

Of particular interest from UREI was the *529* third octave active filter set specifically designed for room tuning and thus providing just roll-off up to 15 dB centred on 27 frequencies. The new *530* is a twice nine band rack mounting unit giving ±10 dB, and the *560* feedback suppressor a four band narrow notch filter device. Each filter is variable to –20 dB and adjustable between 60 and 6k Hz, and individual filter bandwidth is given as one-sixth octave (–3 dB) for 5 dB cut.

Amber Electro Design, of Montreal, have achieved a fair success with their spectrum analyser (see review last month). Their stand was augmented with the new Model *4100* audio test set. Within one compact case this offers oscillator, sweep, noise, comb spectrum and tone burst generators, autoranging digital counters for level and frequency, wave and spectrum analyser, and a twin digital store for output of plots on to conventional oscilloscope and thus removing the need for storage facility at the scope.

Stephens remain the only company to go above 32 tracks for their tape recorders, in the form of the *103*. The tolerances needed are achieved without even the use of capstan or pressure rollers, using their particular servo system. Additional facilities with this particular control is simple multi-unit operation, and speed variability which can be fast enough to provide for 'vibrato and/or warbling'. Scanning at 152 cm/s is also standard. The machine on view was a Leon Russell custom extravaganza with inlaid wood panelling. By August, the company hoped to have an autolocator ready.

Although Ampex (see News pages for product details) and 3M were both making a large point about their new generation tapes and remain locked in polite competition between Grandmaster and *250*, the large tape transports were in evidence. With others, they were finding that the sale of such machines, which is probably a fair guide to the financial state of the recording industry and thus a reflection of the amount of incoming business from record companies, was beginning to increase after a recent lull. The tone of the whole show, from obvious statistics like the number of exhibitors exceeding 100 for the first time ever, was of cautious expansion in addition to the consolidation which has been the watchword of the past year or so. Thus, while there were very few dramatic introductions, thus limiting the bar conversations slightly, there is still much extension on a more modest level than API's automated desk.

BASF reappeared with the range of tapes and accessories, but concentrated part of the effort on the Unisette, the tape cassette running at 9.5 cm/s on 6 mm tape and designed for critical applications. It is claimed that better performance figures are obtained than with the standard cartridge. A mock-up deck

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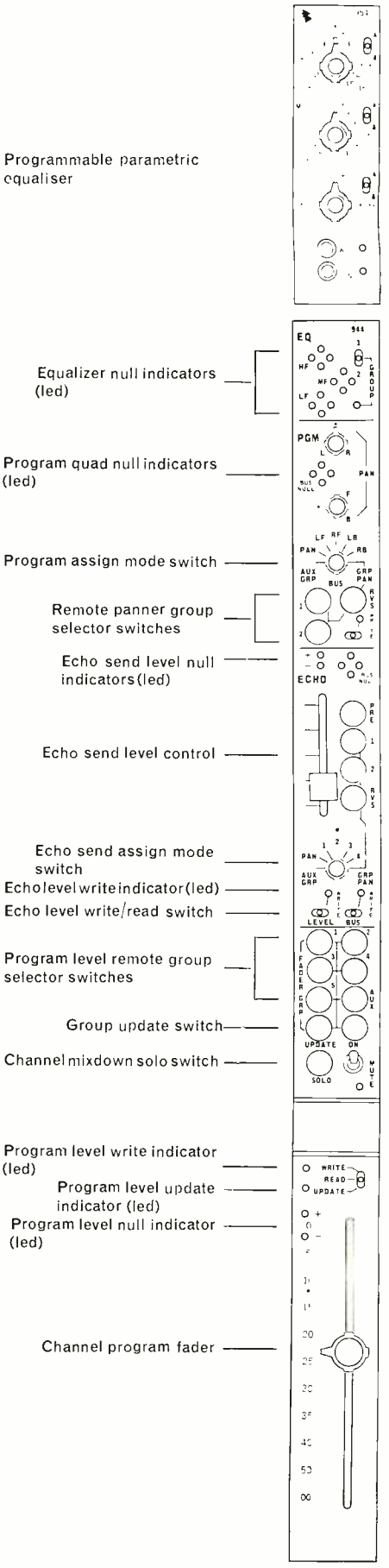
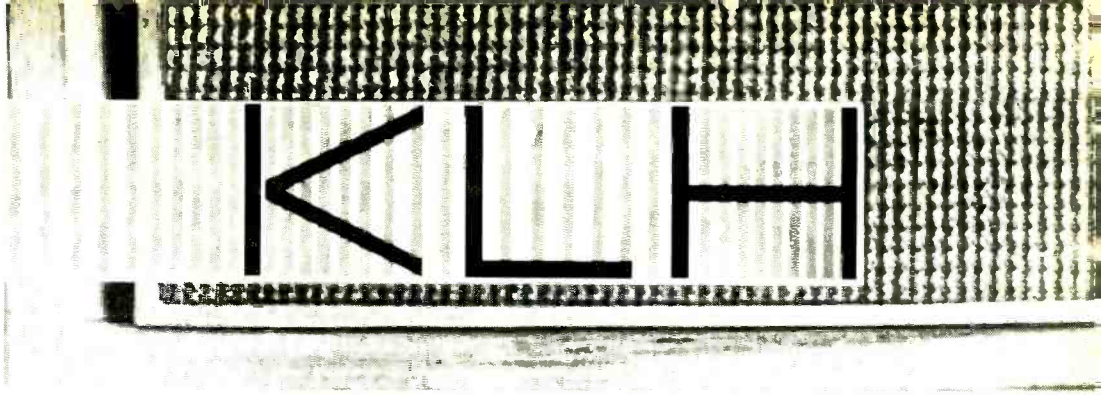
Automated Processes' desk display **(below)** *and channel module* **(right)**





The Natural Choice

The new CBS recording of Schoenberg's massive "Gurre-lieder," winner of the French Grand Prix du Disque, involved musical forces of 500 singers and players. To capture the detail as well as the magnitude of such a recording, producer Paul Myers selected, as always, KLH speakers for the recording sessions. The complexities of such a task have again called for the finest assembly of men and technology. When only the best will do, KLH loudspeakers are the natural choice.

Webland International Ltd. Mirabel House 117-121 Wandsworth Bridge Road London SW6

was on show, with production of the first commercial models expected in December from Studer. In the meantime, familiarisation continues. The recording tape, which has but a small share of the US market, was also provoking some interest.

In fact, tape products other than those obvious ones relating to studio mastering are becoming more common viewing at such shows. Tape duplication in various quantities is increasingly represented. Here, Liberty/UA Tape Duplicating and Pentagon Industries showed tape copying equipment, and on the next equipment level was Pratt Spector with labelling and dispensing gear, and Tentel with tape tension gauges for both cartridge and open reel.

In among all the flash, trendy gear it came as a surprise to see more workaday objects in mute splendour. But the presentation of plating equipment by Gotham made a direct point to an American audience particularly sensitive to matters of pressing quality. Europa Film of Stockholm claim a quicker and more reliable electroplater. The units are supplied in pairs, although up to six can be accommodated—London Records of Montreal have four groups of four. With higher bath temperature and current flow (up to 600A) it is claimed that matrix production is in around 25 minutes, giving 80 from four positions in a ten-hour period. Other installations number four in the US and an additional three in Canada, with similar numbers in Africa and Asia. Europe, obviously, has the bulk.

Also prominent on the Gotham stand was the *UE 1000* Universal Equaliser from K+H. Designed for use in high tolerance applications, it is basically eight active filters combined in six modules, as follows: lf boost/cut; hf boost/cut; lf band pass/stop; hf band pass/stop; high pass filter; and low pass filter. In addition, input and output interface is comprehensive. Selection is by pushbutton, with variable characteristics for each module such as 12/24/36 dB/octave in the filters, or a 14 dB range by 2 dB for the equalisers. The successor to the *UE 100*, it offers operating improvements such as click suppression as well as the extended ranges. An extensive manual of suggestions and module characteristics comes with it.

Possibly the most noticeable feature was the large increase in both range and scope of pa and sound reinforcement equipment. One comment was that this might have something to do with the 200th birthday celebrations next year, in which case 1977 may see an upsurge in the number of second-hand dealers. Like recording mixers before them, those specifically designed for this work are split between units off the shelf and a growing number of larger, modular options.

An apparently new company taking the former approach is 2005 AD, renamed after copyright troubles. The pairing at the show with Community Light and Sound reflects the J. Geils Band setup. The *2022* mixer is thus especially beerproof, but in addition presents an easily workable and neat format. Identical channel modules, coloured in fours, extend from the usual mic amp padding through three range eq with additional lf roll-off pan, cue and echo bussing to the two main groups which feed 600 ohm balanced out, as does cue. Led vu meters read all four groups. Other features include independent monitor outlet with solo, long throw plastic faders, channel break points and (often missed and thus boosting sales of camera tape) a vinyl scribble strip. Price is basically $1600 for frame, power supplies and blanks plus $220 per channel. Model shown accommodates up to 20/2 format.

On a larger scale and offering a wide spread of mixer formats is the Straitahead Sound Corporation, whose work for Seals and Crofts covers the demand for live multitrack recording using the same desk. This particular split function hardware has been approached from both the recording and the sound reinforcement sides, but it seems only comparatively recently that the two have met. In particular, Straitahead's project is at the head of a 50 kW amp system. The 32 input board, apart from the usual facilities includes six stereo reinserts for combination submixing of drums, horns, strings and so on, 3 x 3 eq ranges, an additional two output busses switchable pre/post for use as echo and/or cue and/or 'effects', solid-state switching, built-in crossovers for split band power amp feeds, led 'peak-reading vu', and lo-cut and phase options switchable pre/post the input line transformer.

In addition to equipment manufacturing, this outfit is extending their premises as a small recording studio/sound stage accommodating sound/video and up to 600 people, eventually to provide for larger projects in a larger studio with quad remix. Hopefully, this will appear in early 1976, offering also 32 track recording with up to 50 channel capability, the desk being based on that delivered to Seals and Crofts.

Cetec were emphasising their high powered sound reinforcement systems in the usual direct way. Installations with Gauss speakers include Elton John's setup, with 'almost exclusive' coverage of both Floyd and Purple for the last year another claim. The *215* horn system is based on the Gauss Model *1000* and Community Light and Sound horn, built in fibreglass to 90° flare pattern. Claimed intensity resulting from 150W drive is 105 dB spl at 30m. The 215 uses correspondingly smaller drivers to give 102 dB. On the way is a studio monitor speaker 'by the end of the year' due to retail around $1000. Electrovoice probably score loudest with their recent installation at Walt Disney's Florida emporium, where their island-installed system produces 94 dB at 600m, or almost half a mile . . . at AES they preferred to talk about their new *CO85* electret Lavalier mic.

And Bozak claim a year and more's sound reinforcement at the Hollywood bowl, without entering the mind mangling competition. Their room principally contained a range of three speakers, the *ST12*, *ST10* and *ST3* for semi-critical applications and which coped with Sheffield transients as sharply as seemed appropriate. Also: the *8* series, using parallel tweeters for applications where dispersion is paramount such as in discos and for pa 'other than rock'. Recessed cabinets assist side propogation. Recent outing for them was with Benny Goodman at Carnegie, using 2/4 units.

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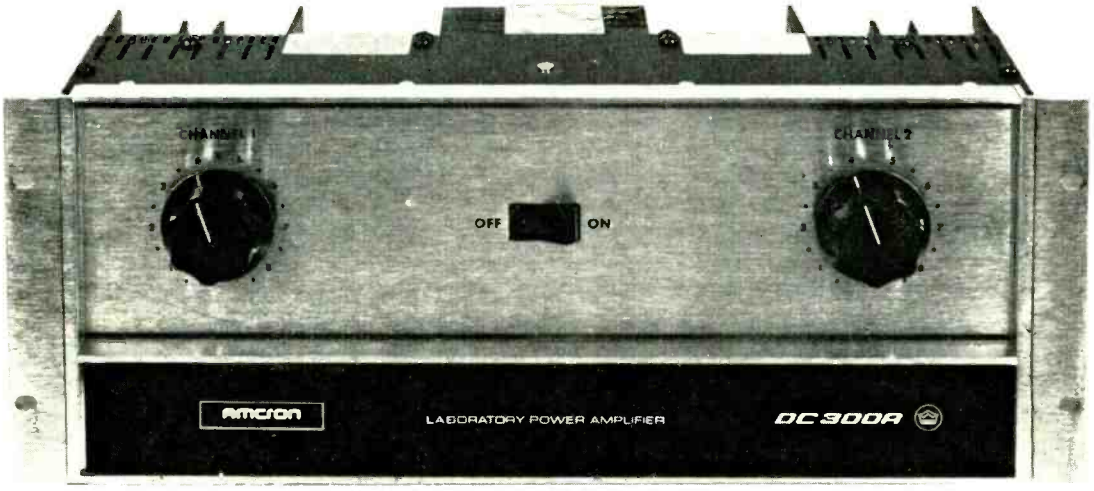
amcron

DC 300A
"STATE OF THE ART"

POWER



The DC300A succeeds the famous DC300 power amplifier, and continues Amcron's tradition of leading the world in power amplifier design. There are no fancy gimmicks, or fragile meters on the DC300A, just plain, solid, functional design. Each channel will give up to 500 watts rms, Intermodulation Distortion is typically below 0.01% (and that's low), and the amplifier can handle loads as low as 1 ohm. Damping factor is above 1000 up to 300Hz into 8 ohms, and this explains why the DC300A controls **any** speaker so well. Equally important, of course, is the fact that the DC300A will continue to deliver night after night after night. This is as everyone knows, why AMCRON has such a high reputation for Reliability. Jethro Tull, Sadlers Wells, Covent Garden and Elton John chose Amcron because they know it will meet their exacting requirements. All Amcron amplifiers carry a full 3-year warranty on parts and labour. If you are building a new rig, installing new monitoring in your studio, or simply require a status symbol, then you can do no better than choose AMCRON — The State of The Art.

Our London stockists for all AMCRON equipment are REW (Audio Visual) Ltd., 146 Charing Cross Road, London WC2. Tel. 01-240 3883, and also at 10-12 High Street, Colliers Wood, London SW19. Tel. 01-540 9684.

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AES REPORT

Sheffield Labs also turned up in dem almost next door in JBL's suite, this time with a test pressing of Vol 4 (see *Work* last month). Updated speaker range included the *4331*, basically an improvement on the *4320* and comparable with the *4341*. The cabinet had been adjusted, but components remain the same except for an adjustable universal mounting for the hf units. The *4333* is a three-way system as is the *4331*, with the addition of hf slot radiators. Aluminium cone yields a claimed thd of around 0.5%.

Dukane were offering in particular active filter networks for pa use, and a range of suitable amps ranging from 50 to 333W output and which are included in the recent update equipment at Grand ol Opry.

Also in the sound reinforcement business, with particular emphasis on the power side, is Orange County, originating in Canada ('we wanted a name that people would remember, you see') but now with US office in North Dakota. For their first AES display they concentrated on the *200* amp series, ranging from single channel 75W to two channels of 200W each. All have claimed power bandwidth from dc to 43 kHz and noise at 90 dB below rated output with 600 ohm source. Short circuit protection gives instant recovery when acceptable impedance conditions are restored. Layout is simple but useful; 'juice' light gives an indication of the power supply conditions, brighter with power output; 'tilt' is fed by an input/output comparator with the appropriate gain compensation which lights if discrepancies arise. Thus, clipping is indicated visually for the particular amp which is being overdriven, with the threshold nominally set for the light to come on at around 0.5% distortion. Most amp malfunctions will obviously be detected by the same mechanism. Controls are rear-mounted away from 'non-authorised personnel'. Also offered: a range of preamp and switching modules, and a small monitor speaker based on a Tannoy driver.

Growing perhaps in parallel with the rise in interest in sound reinforcement has been the tendency for the better-lined bands to stock up on home studios. Thus, the Tascam range was introduced, and has since spread fairly widely across the studio world. Their arguments often centre around the idea that gear need not necessarily be idiot- and oaf-proof: that with careful maintenance and regular attention, what they offer can square up to less compromising designs. And in a home studio environment, the equipment is not going to be used so intensively anyway, since it is often installed simply as a convenience to have around.

The new Teac machine uses 16 tracks on 25 mm tape, using a transport with dual pinch rollers resembling that of 3M. Again: 'There's no overwhelming need for balanced line working. Typical rf and hum are low anyway, so all you need is a little patience and a cold water pipe that works. It's not magic or anything else.' Back to Tascam for their introduction of the *L-150T* developed by Sound Genesis to fit their standard desk module space. Four compressor/limiter sections with usual basic controls may be linked via one of two tie lines, such as all four or two pairs. Compression variable between two and ten to one, attack 100 μs to 0.1s, release 0.1s to 5s.

Yamaha are now beginning to appear in the professional field. Newly-introduced is a range of small unit mixers, principal among which is the *PM-1000* which is in 16/4 format and fulfils standard requirements in eq and sub-grouping. Demonstration was via headphones and a Studer 16 track. The more modest *EM-100* is designed for small pa and mobile recording applications and is 6/2. The *B-1* fet power amp, inevitably the most interesting product shown, was reviewed in our April issue.

The mixer establishment was naturally there in force; like the tape transport manufacturers they were finding business brisker and sensed that the studio business at least was turning upwards again. Apart from the tendency to sell single unit desks on a larger unit basis, little changes. Delivery is a big issue, and Spectra Sonics made their point by showing two identical consoles side by side, the *1024-24*, a unit/modular system expandable up to 24/24. For Neve, the introduction of a similar model, the *8024*, also 24/24. For a survey of mixer manufacturers, see the next issue of STUDIO SOUND.

All four quadraphonic interests were represented, the object being to reach the studio engineers and producers in conjunction with the domestic push at the consumer shows. All had something new to say in developmental terms. For Nippon Columbia it was largely a question of being there to sense the commercial temperature, their hardware from Denon being used to mount a running demonstration still suffering from repertoire shortage. JVC presented a paper by Toshiya Inoue, Masahiro Fujimoto and John Eargle on the new Mark *III* cutting system, which centres on a phase lock loop modulator. First results, such as from the quadraphonic *Playing Possum* test pressing as heard at the Hollywood Cutting Centre the following week, are encouraging. More about that studio in a later issue. Sansui discussed some matrix tinkering and went on to present a paper by Ryosuke Ito, Susumu Takahashi and Kouichi Hirano discussing the differences between m-2 and 4-2 encoding processes and possible extensions of the QS system to 4-3-4 and 4-4-4 systems. CBS took a suite to demonstrate SQ with the improved paramatrix logic decoders which, in conjunction with the Columbia catalogue, a newly-introduced high quality domestic speaker with dipole skew-directionality and some slick presentation, produced one of the neatest and cleanest SQ demonstrations ever. For fuller discussions of the differing approaches and how they relate to the studio, see the June issue for articles presenting all four points of view, also August for articles on Ambisonics.

The combination of consultancy work and design of a complete studio is a considerable task, so it is not surprising that this particular corner of the business, although in demand, should have only two concerns exhibiting at the convention. Westlake, of course, have been going for some six years, since Tom Hidley left the Record Plant, but have now expanded enormously over before. The biggest project currently going was a multiple studio/

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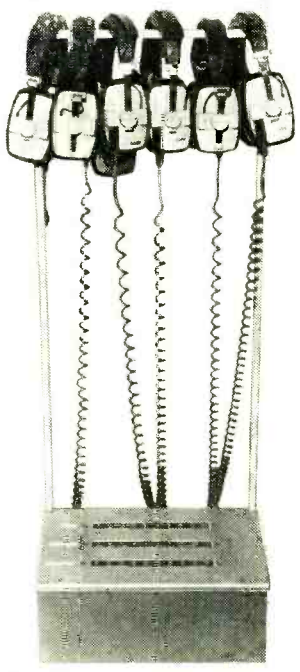
Speaking to the professionals at EMISON



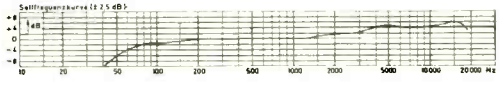
The Emison custom designed fold back amplifier system carries Beyer Dynamic DT100 Headphones

John Andrews said: *"I have used Beyer Dynamic from the very start because we work to Broadcast standards."*

M201 Dynamic Moving Coil Microphone

The M201 is a high quality product for the most demanding professional users. It will find its application as hand held or standmounted microphone particularly in recording and broadcast use. By its excellent hypercardioid characteristics the M201 is immune to unwanted noise even under extreme acoustical conditions.

Frequency Response:	40 – 18 000 Hz
Polar Pattern:	Hypercardioid
Output Level:	1.4 mV/Pa ≙ -56 dbm
EIA Sensitivity Rating:	– 149 dbm
Electrical Impedance:	200 ohms
Load Impedance:	> 1000 ohms
Hum Pickup Level (50 Hz):	5 µV/5 µ Tesla



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Tel: Haywards Heath 51003

AES REPORT

rehearsal room/playing area project for the University of Colorado at Denver, which also requires different acoustic settings to provide for music right through the spectrum from rock to chamber. In Europe, though, Virgin Records' UK Manor Studios nears completion, as did another big installation in Montreux Casino which should have been finished by our publication date. Further European news is expected shortly, although at the time of writing nothing was 'on' the record.

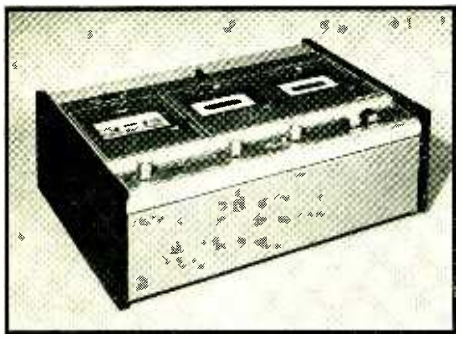
The other, newer outfit is Everything Audio, a summary of whose design principles is incorporated practically in Thee Studios which should, by the time of publication, have opened in Claremont, Ca. Three other jobs are in progress. To summarise an approach here is impossible, but an overall change from convention happens in some instances. For example, they suggest that monitors be at ear height, in contrast with the normal position somewhat higher and often clearing the control room window. These are then flush-mounted at 90°. The area between the engineer and the walls beneath the monitors is changed into a flat table-like area, or 'dashboard', serving to eliminate any monitor-console back-studio window splash but also to provide housing for ancillary equipment and a convenient area for leaving the usual personal paraphernalia lying around. Elsewhere, the room is deadened, to eliminate completely first reflections as far as is possible at all frequencies. Following the same principle, the widely-used tier drop ceiling is abandoned.

In Thee Studios, JBL *4341*s are installed in the flush format. Another advantage claimed for this particular defensive approach to the reverberant field is that lower total listening levels are necessary, since the secondary contribution, that of the reverberant field, is reduced. Since the direct, primary sound is considered to be the engineer's paramount concern, then for a given level from the monitors the ambient spl will be reduced, with improvements in ear fatigue and possible protection from damage. The range of equipment carried is wide, but in addition to the pure audio items is an av package based on a video recorder for music-related studio work and selling for $5000.

Another very fast growth area is in application of digital techniques, particularly in the relatively simple delay field. Units were offered by a wide range of people, including Eventide with options of the *1745A* and the *C200*, and whose Instant Flanger offers an extension of the previous Instant Phaser in music filtering/phase distorting. Lexicon's digital delay range now extends to a Varispeech time expansion and compression unit based on standard cassette storage in Mark II version. Micmix introduced their new Studio B models with variable decay time (to be reviewed shortly). Inexpensive spring system was introduced by Multi-track, of Hollywood, at a fixed decay time around 2.5s and with separate two-channel controls and basic response shaping at top and bottom. Unbalanced in and out. From Horizon Electronics of Alhambra Ca. came the *SR-5000* two-channel reverb unit, and from Marshall Electronic of Tinonium Md. a wider delay and processing unit.

Parallel with the growth in digital applications is vc technology. Although custom and unit synthesizers have been with us for some time, and ARP, as part of the establishment, put on a demo/concert as well as exhibiting, there is an upsurge in companies catering for very specific musical needs. While in principle a large synthesizer could provide the functions required, some refinement is necessary when economics arrive. 360 Systems added to standard modules *73-B* frequency follower and *20/2* frequency shifter a guitar synthesizer. Meaning synthesizing from the guitar through to more complex patterns rather than imitation. The application extends beyond conventional synthesis hookups using as input simple note shapes from mono or paralleled stereo pickups. They claim full polyphony, so that playing chords yields chords rather than the intermod breakdown of single channel systems. And from West LA Music came Roland and Univox synthesizers, and Hapenstill piano pickups.

Oberheim Electronics offered a more conventional synthesizer system with polyphonic capability, also with sequencer interface. E-mu Systems, exhibiting for the first time ('we kept it kind of quiet up to now'), were demonstrating a fair range of modules and synthesizers based on a range of conventional modules designed to a claimed uncompromising standard. Systems are built up generally in conjunction with single or multivoiced keyboards. Layout is particularly clean, with interconnections via 6.25 mm jack patches. The expressed intention is to maintain as a small operation offering high quality, custom systems.



Wollensak 2770 duplicator

APRS:

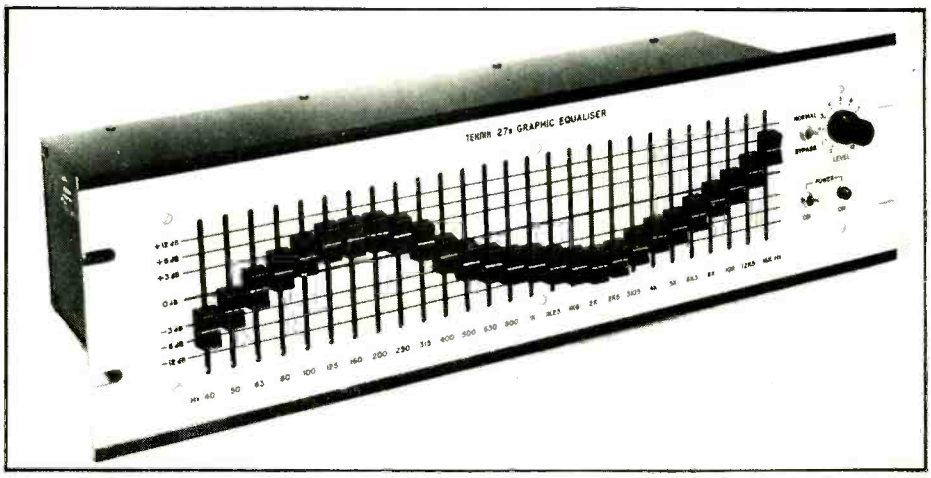
IN CONTRAST WITH other shows in professional and consumer fields, the APRS exhibition remains a concentrated two-day event. This year, the times were shifted to make Thursday and Friday two very full days, in contrast with the Friday and Saturday of previous occasions. Despite some confusion in the published dates, which STUDIO SOUND passed on in its innocent turn, apparently no one turned up at the Connaught Rooms the following Saturday.

The object in changing the dates was twofold. Firstly, it coincided more directly with the normal working week, thus hopefully giving twice as much inclination to jaded engineers already lined up for their first free weekend in 17. Also, it served to keep out the hi fi fringe and casual spectators—obviously, efficiency was uppermost in many people's minds.

The general reaction was thus in favour of these genteel changes, with a split if anywhere on the subject of whether the openings should be extended to three days or not. There is little widespread disagreement with the APRS decisions, since all broad scale matters tend to reflect member surveys, an area in which the organisation appears particularly efficient. Perhaps the only criticism of the opening hours was that they were too early, for 10.00 am on the Friday witnessed a curious collection of human debris which did not really have much need to respond to the stimulus of potential custom before midday.

And the show was quieter. Figures published show the total number of visitors down from 1980 to 1731. However, of these the number actually representing a parent organisation increased from 641 to 777, as did the foreign visitors from 122 to 148. Unlike the American shows, which begin to draw on an audience increasingly widespread geographically within the home country, this regular London event attracts the UK studio market largely coming other than from the bigger centre(s), since the relatively concentrated studio business means that rep coverage of the larger concerns is easier. As a result, the influx of European and visitors from farther afield increases, reflecting the lack of a comparable exhibition anywhere else outside the US.

'Well, yer come in here, head for the bar, get the warm lagers down, go and see what Michael Bauch has got, tell him you'll have three and then get back to the bar. Then you're exhausted so you've got to go over the pub to recover.' Maybe not the official line, but it reflects the attitude of much of the hairy London recording establishment.



Above: *Calrec*
Above right: *Klark-Teknik*
Below: *Raindirk*

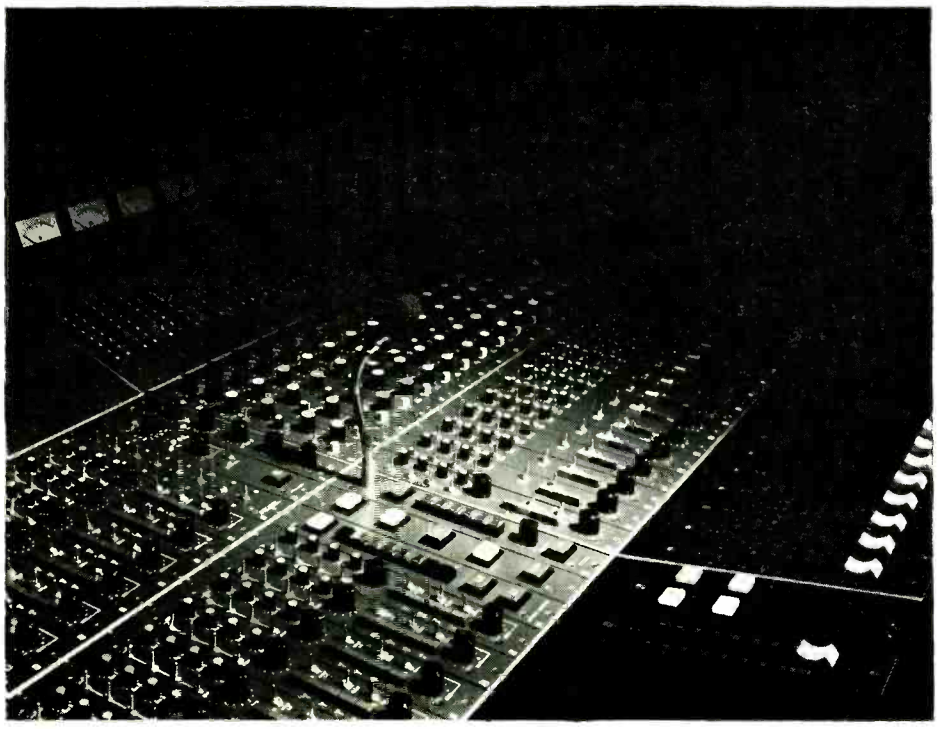
Communications were reasonably efficient, although the paging system from a single point didn't provide much outgoing assistance. The public phones downstairs were either out of order or jammed, although at one point the mingling of Cadac and Neve queueing to spend 2p promoted a certain conviviality if nothing else.

As in LA, there was a perhaps surprising general optimism about the health of the studio business. This was even amplified by one of the American contingent who commented that he found more activity in UK and Europe rather than in the LA of his base. Likewise the English manufacturers, although as already noted their business comes especially from abroad at this show.

It had been expected that the AES 50th Convention, held in London during March, would have discouraged the European contingent. One or two people thought this, but in general people seemed to come over more from that part of the world. Certainly the pub across the road afterwards reflected little consensus gloom.

Again in step with the two previous AES shows, there was less new product around than over the last few years, the emphasis being on improvements to existing lines rather than wholesale developments. As to coverage here of the hardware offered, most has been preempted by the preview in the July issue, so comment remains patchily limited to odds and ends which were not included there for one reason or another.

Sound Developments split into two for the purposes of separating the equipment development from the consultation and installation side of their operation. The former becomes Primrose Electronics, with the other branch as Philip Drake Electrical. They shared a stand on which they showed particular specialised applications in simple pa systems for conference, concert and more extensive recording situations. Sound Developments now manages the United Biscuits Network, which it set up and which now has 12 full-time people broadcasting through the UK network.



In pa and sound reinforcement work, Midas and Martin work closely together, so they filled an entire side of one of the halls with a morass of mixers and cabinets. Of particular interest from Midas was a desk due for delivery to Roy Harper, based on the Studio Range of modular mixing equipment, and in particular on the *SR/003* input module which goes from 12 position pad through 2+4+3 frequency eq and pan to the main groups with two fb pre/post and two es subroutings. This semi-custom desk had a special module with eight echo send busses: 'he's into echo'. Also available: portable range series of desk modules, from which similar systems may be constructed.

Martin Audio have by now a rather extensive range of pa and instrument cabinets. New at APRS was the *MR212* mid-range system, primarily designed 'as the mid range section of a four-way pa system', it is also offered for bass and lead, with necessary auxiliaries. At the bottom was a prototype bass unit to form part of a 750W pa system. Four 30 cm units are used in preference to the conventional pair of 38 cm drivers. For its turn, Martin Audio was fulsome in the praise of the recent ATC (Acoustic Transducer Company) range of high power drivers. These are available in standard,

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■ APRS REPORT

bass and hi-fi forms, differing principally in the free air resonance, for the usual reasons.

Altec introduced to Europe the *9849A*, designed as a studio monitoring loudspeaker. For space-critical applications, power handling is given as 60W and price as £265. The new *604-8G* handles 65W, costs £170 and is comparable with the ubiquitous *604E*. Also introduced was their first-ever power amplifier: for fuller details, see our News section.

Audix took a whole corner to show their considerable range of consoles, amplifiers and associated programming gear directed primarily towards the broadcast market. In common with others partly broadcast-oriented, they found an increase in interest at the show; particularly, for some reason, from Middle and Far Eastern areas. The particular range is the new series of mixing gear designated *B-100*, ranging from 16/4 free-standing to the *B103* 8/2 transportable.

Fraser-Peacock announced their appointment as distributors of the 3M UK product Scotch AVC Heavy Duty Cassettes, available on an industrial basis particularly for high-speed duplicating applications. Also from Fraser Peacock, the Wollensak range, which they have distributed since just after Christmas, now including the *2551* AV 'visual-sync

Right: *Stellavox*

Below: *View of main hall*

recorder', the *2515 AV* heavy-duty cassette tape recorder and the *2770* high-speed cassette 'desktop' duplicator, with master and two copies running at 76 cm/s, 16 times program speed. UK prices are £240.70, £169 and £770 respectively.

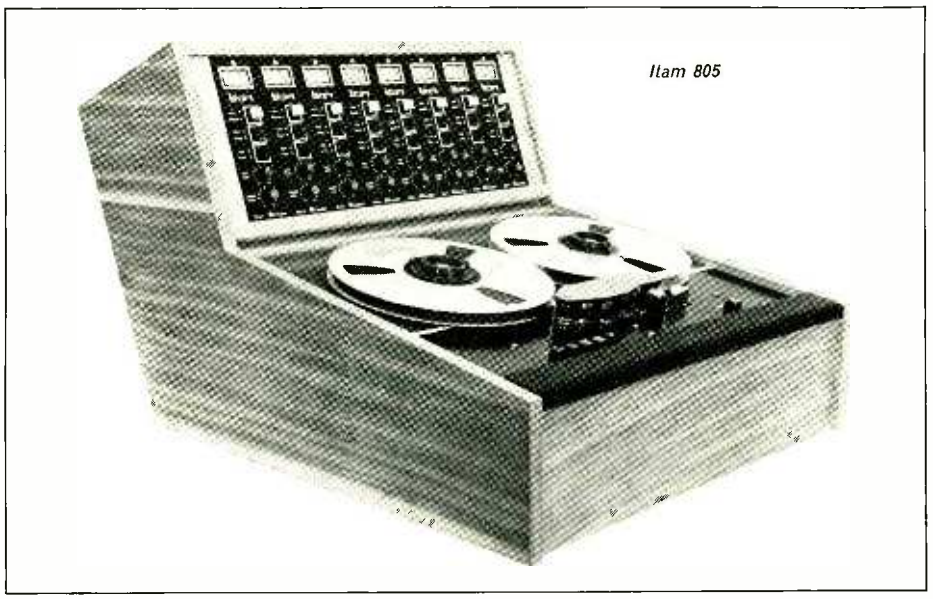
Calrec's mixer range stayed much the same as before, albeit rather exposed in one case in chassis form as part of the exhibit. Their big news was of price reductions of 30% right across their range of microphones, attributed to improvements in both turnover and production techniques. Cuts apply to both UK and export deliveries.

Tweed Audio, exhibiting for the first time, offer a range from modular custom mixers right down to a comprehensive 10/4 portable. On the former, a channel module comprises initial channel attenuation in 10 dB steps between −20 and +80 dBm, with 4+6+3 eq, hi and lo pass filters. These feed routing units, typically four push-selected output groups with pair-panning, with two each of nominally es and fb subgroups, although both have pre and post fade options. Since their inception, Tweed have been diversifying, through the *Twin-100* power amp to a compressor/limiter Type *CL601*. This offers a wide range of options, with the usual gain, threshold and release sections feeding a ratio selector with positions at 1.5, 2, 3, 4, 6, 9 and limit. Release is manually adjustable from 100 ms to 3s, or can be 'automatic self-adjusting' which provides for rapid adjustment after high peaks and more gradual recovery after sustained high levels.

Helios introduced a range of modules to be integrated within their console range. Of principal interest is the input module, reflecting 'particular customer demands'. From top to bottom, this offers switchable pad, phase reverse with light indicator, hi/lo filters, line input (as of patch bay/tape machine) pot, parametric eq in three versions including variable frequency on a continuous pot and adjustable Q, pan on two switches odd/even 1-24 but with alternative arrangements facilitating conventional quad remix grouping and joystick routing. The main departure from standard practice is the extra line level control, used to adjust the remix signal to the usable range of the fader. Dreamt-of possibilities for impressing producers with a ruler-straight mix off the 24 track are now a reality.

On the tape machine front, Brenell were able to demonstrate the 50 mm recorder which they showed in mock-up at the London AES show, and thus became part of a select band of British manufacturers defying the superstition about home produced 16 tracks which Unitrack left as their epitaph. Another 50 mm console was on the Amity-Schroeder stand, which had been seen before but was offered as part of a viable package whereby a home-produced 24 track machine could be assembled for around £7000, a figure which raised a few eyebrows. Finally, the ITA exhibit included a first in the Danish Lyrec 16 track recorder. The Itam *805* recorder, eight tracks on 12 mm tape, had another startling price tag, at £1790. Completing the largest range of tape machines were Otari, Teac and Revox, the last of which was massed into one of the few eyecatching displays around.

The Lyrec recorder is built around a flexible head format accommodating from eight to 24 tracks on 25 or 50 mm tape. The construction at first sight is thoughtfully conventional, particular attention being paid to service accessibility. Usual standard facilities; tape speed between 19 and 76 cm/s, delivery with either level indicators of integral noise reduction facility to taste, twin servo system for rewind control, as well as an upper limit on rewind speed and eddy current (reverse flux) braking from spooling functions. The remote control includes digital tape timer/reset, record/sync/play switch for all channels with individual setup if required. Quoted prices range from £8548 for eight on 25 mm to £14 142 for 24 on 50 mm. And on the same ITA stand came from Otari the *MX-5050* 'Mini-pro' giving two or four channels on 6.25 mm tape. Speeds offered are from 9.5 cm/s to 38 cm/s, with three motor control and four heads. Edit is catered for, as is sync.



Itam 805

SOUND TECHNOLOGY 1700A

Hugh Ford

MANUFACTURERS' SPECIFICATION

Total harmonic distortion measurement

Fundamental frequency range: 10 Hz to 110 kHz in four overlapping ranges with 3 digit resolution. Distortion analyser is tuned simultaneously with oscillator.
Input voltage for 100% set level: 0.1V to 300V.
Distortion range: 0.01% to 100% full scale in 9 ranges.

Distortion measurement accuracy including autonull error for harmonics up to 300 kHz:

fundamental frequency	2nd thro 5th harmonic accuracy
10 Hz to 20 kHz	±1 dB
20.1 kHz to 50 kHz	± 2 dB
50.1 kHz to 110 kHz	±3 dB

Residual distortion: total harmonic distortion below 0.002% up to 10 kHz rising to 0.003% at 20 kHz, typical performance below 0.001% up to 10 kHz rising to 0.0015% at 20 kHz. Above 20 kHz residual distortion is 0.007% to 30 kHz, <.02% to 50 kHz <.05% to 80 kHz, <0.1% to 100 kHz.
Noise: if distortion products of the signal under analysis are significant, residual noise will be reduced by the average responding meter. Worst case noise (80 kHz filter in) is 0.0025% to 10 kHz, 0.003% to 20 kHz with the measured signal greater than 0.3V rms. At lower signal levels the noise spec of the voltmeter applies.
Fundamental rejection: greater than 100 dB.
Input impedance: 100 kΩ shunted by <100 pf, balanced to ground.
Distortion output: at least 31.6 mV rms for full scale meter deflection. Output impedance is 1kΩ.
Voltmeter ac output: a ranged reproduction of the input signal is available on the rear panel.
Automatic null: operates on all distortion ranges, Automatic null time <6s when used with internal oscillator.
Meter response: meter indication is proportional to average value of waveform.
Frequency calibration accuracy: better than ±2% of selected frequency.
Common mode rejection: >40 dB at 60 Hz with 'set level adjust' fully ccw, decreasing to 25 dB with control cw.
Maximum common mode voltage: not to exceed input voltage range setting or 1V whichever is the greater.
Input filters: lowpass: 3 dB point at 80 kHz with 18 dB/octave rolloff. Normally used with fundamental frequencies <20 kHz. highpass: 3 dB point at 400 Hz with 18 dB/octave rolloff. 60 Hz rejection >40 dB. Normally used only with fundamental frequencies <400 Hz.

Voltage/power measurement
Frequency range: 10 Hz to 110 kHz.
Input range: 3 mV to 300V full scale (1μW to 10 kW across 8Ω) in 11 ranges. Full scale resolution can be extended to 30 μV using 'ratio' switch.
Input impedance: 100 kΩ shunted by <100 pf, balanced to ground.
Voltage accuracy: ±2% 20 Hz to 20 kHz. ±5% 10 Hz to 110 kHz.
Residual noise: <8 μV with 80 kHz filter in. <15 μV with 80 kHz filter out.
Power: power scale converts voltage reading to power across 8Ω.
Common mode rejection: >40 dB.
Maximum common mode voltage: as distortion section.
Voltmeter ac output: as distortion section.

Ratio measurement:
Voltage measurement specifications apply with the following additions.
Input voltage for 0 dB 'set reference': 0.1V to 300V.
Accuracy: ±0.2 dB 20 Hz to 20 kHz. ±0.5 dB 10 Hz to 110 kHz.

Oscillator
Frequency range: 10 Hz to 110 kHz in 4 overlapping ranges with 3 digit resolution. Oscillator is tuned simultaneously with distortion analyser.
Frequency accuracy: ±2% of setting.
Frequency response: flat within 0.2 dB.
Output voltage: variable 1 mV to 3V with single turn logarithmic potentiometer.
Output impedance: variable up to 625Ω.
Distortion in low distortion mode: 0.0025% at 10 Hz falling to 0.02% from 20 Hz to 20 kHz. Typically about 0.001% from 20 Hz to 10 kHz. Above 20 kHz <0.007% to 30 kHz, <.02% to 50 kHz, <.05% to 80 kHz, <.1% to 100 kHz.
Distortion in fast frequency mode: <.05% 100 Hz to 50 kHz. <.2% 20 Hz to 110 kHz.
Hum and noise: 100 dB below rated output.

General
Dimensions w x h x d: 437 x 221 x 305 mm.
Power: 115V ±10%, 50 to 60 Hz, 18W 220V optional at no charge.
Weight: 7.25 kg.
Shipping weight: 9.52 kg.
Model *1700A* Option *001* (no oscillator) Option *002* (Rack Mount).
Price: UK £935 plus VAT. Model *1400A* oscillator only £330 plus VAT.
US $1625. Model *1400A* oscillator only $610.
Manufacturers: Sound Technology, 1400 Dell Avenue, California 95008, USA.
UK agents: C. E. Hammond & Co. Ltd, Lamb House, Church Street, W4.
Phone: 01-995 4551.

BY MODERN STANDARDS an amplifier with 0.1% total harmonic distortion is a run of the mill device; things become more respectable if the distortion reads around 0.01%, but really good modern equipment has a total harmonic distortion performance in the third decimal place. The standard technique for measuring such low distortion figures has been to make purpose-built filters for a series of fixed frequencies such that the harmonics are filtered out of the oscillator waveform.

Such a method is both time consuming and cumbersome, but in lieu of really low distortion oscillators there is no alternative. Furthermore most available rejection bridges have been difficult to balance, and only stay balanced when the wind is in the right direction—literally in some instances.

The new Sound Technology type *1700A* distortion measuring system overcomes all these problems, in that not only does it contain a really low distortion variable oscillator but it also contains a self-balancing rejection system which eliminates all the ghastly knob twiddling and balances the system in only a few seconds. This combination is so good that the residual distortion which is in the order of 0.0015% total harmonic at mid-frequencies can be read in less than 5s. Even better, the oscillator is tuned in parallel with the distortion measuring system by four horizontal rows of interlocked pushbutton switches. These together select three digits of the required frequency and a decade multiplier providing a frequency range from 10 Hz to 110 kHz. It is, therefore, extremely quick to select any desired frequency which is specified as being within ±2% of setting; in practice the accuracy was found to be very much better at the worst case limits +0.7% -0.65%. Rather unfortunately, there is no fine frequency control, as I find such a facility very useful when adjusting filters such as stereo pilot tone rejection filters and bias traps.

I have another mild objection to the oscillator: it is not possible to

read directly the output voltage which is adjusted by a single turn potentiometer in a variable impedance output arrangement. The output impedance varied from 3Ω to 633Ω which is rather a large range. However, the available output could be finely adjusted from 1 mV to 3.07V with the possibility of reducing the output down to 60 μV with loss of fine adjustment. Two oscillator modes are provided: a 'fast response' mode and a 'low distortion mode'. The idea of the 'fast response' mode is to eliminate amplitude bounce when the frequency is changed during the measurement of frequency response, where the ultimate in low distortion is not necessary. In practice the amplitude bounce was minimal in the 'fast response' mode as is shown in **fig 1.**

Another good feature of the oscillator is that the signal ground can be isolated from the chassis by means of a slide switch. This feature, in common with the balanced input to the distortion section, does away with earth loop problems which can have the most obtruse effects when measuring distortion.

Turning to the distortion metering section, this can also serve as a millivoltmeter and a ratio meter in addition to having a meter scale calibrated in watts into 8Ω and a decibel scale. The input comprises four banana socket/terminals on standard spacing: two inputs being the balanced input and the remaining two, a signal ground and a chassis earth—this is the ideal combination for unravelling possible earth loops or hum pickup.

The function of the metering section is selected by four interlocked pushbutton switches identified as 'volts power', 'set level', 'distortion' and 'dB volts'. The latter two are also identified as ratio functions. To use the meter as a voltmeter or power meter, the 'volts power' switch is depressed and the 11-position input attenuator set to the appropriate range, which is calibrated in terms of fsd from 300V to 3 mV and from 10 kW to 1 μW into 8Ω. For distortion measurement, the 'set level' pushbutton is depressed and a set level potentiometer manipulated in conjunction with the input attenuator until the meter is at fsd (this covers the input voltage range from 100 mV to 300V). The 'distortion' pushbutton is then depressed and the ratio control set for an appropriate meter deflection. Conveniently, the ratio control is calibrated in both percentage and decibels, as is the meter with full scale calibrated down to −80 dB 0.01%) and the attenuator providing 10 dB steps. If it is required to measure ratios other than distortion, the 'dB volts' button is pressed and the fundamental rejection circuit put out of circuit with the 'set level' facility remaining in action.

Should the input be accidentally overloaded during ratio measurements or distortion measurements, this is indicated by a lamp (led) next to the level adjustment potentiometer which has a calibration mark at the fully anticlockwise position. When it is set to the 'calibrate' position and the 'dB volts' function selected, the ratio attenuator may be used to provide extra voltmeter gain such that a maximum full scale sensitivity of only 30 μV is available. However, some caution is required when using this facility and also when measuring distortion at very high or very low frequencies—this is because the integral 400 Hz highpass filter and 80 kHz lowpass filter are located after the voltmeter and set level functions so that they do not affect these, but will affect distortion and ratio measurement if they are accidentally left in circuit. The filters are, of course, a great asset when measuring distortion as their 3 dB points and the 18 dB/octave rate of attenuation are excellent for removing mains hum or high frequency noise when it is outside the wanted frequency band.

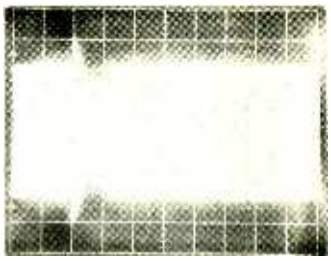
In addition to the basic inputs and output, there are two well contrived monitoring outputs in the form of BNC sockets. The first of these is effectively a voltmeter output which is scaled by the input attenuator and the level setting potentiometer but not affected by the selected function. It is therefore useful for monitoring the incoming signal without creating earth loops. The second output is a residual distortion output after passing through the filters and rejection circuit, and is therefore useful for displaying the distortion waveform. Furthermore, this output is active when the meter is reading input power, voltage, or distortion.

A final general point is that the meter rectifier is an average rectifier as opposed to a true rms rectifier which would be theoretically correct for distortion measurement. For sinusoidal waveforms this makes little difference, but there could be a large disagreement between this and other genuine rms indicating instruments when measuring high crest factor waveforms such as are typical of crossover distortion—I am however doubtful if any unweighted metering bears a significant relation to the subjective effects of this type of waveform. It is, of course, possible to overcome this limitation by connecting an alternative meter to the distortion output socket, but a genuine rms meter will be more affected by noise than the inbuilt average meter, and this is why an average meter was used.

Previous page: Exterior of 1700A distortion measurement system

This page right: FIG. 1

Below: 1700A interior



The oscillator performance

Mention has already been made of the frequency accuracy and of the output arrangements of the oscillator section. Bearing in mind that the oscillator is primarily intended for frequency response and distortion measurements the flatness, distortion and noise of the oscillator are of prime interest. Dealing first with the flatness, this is better than ±0.1 dB over the entire frequency range from 10 Hz to 110 kHz.

The second and third harmonic distortion content of the output was measured at full output voltage using a passive rejection filter followed by a narrow band wave analyser, the residual self-measured distortion also being determined. The following results confirm the first-class distortion performance of the oscillator:

Frequency	Third Harmonic less than:	Second Harmonic less than:	Self Distortion
1 kHz	0.001%	0.0007%	0.0014%
10 kHz	0.0006%	0.0008%	0.0020%
20 kHz	0.0005%	0.00085%	0.0025%
60 Hz	0.0011%	0.0009%	0.0014%
20 Hz	0.00075%	0.0011%	0.0016%

Hum in the oscillator output was at least 125 dB below full output, taking into account the second and third harmonics of the incoming mains frequency and oscillator noise over the bandwidth 20 Hz to 20 kHz was 103.5 dB, below either the full 3V output or 0.3V output. These performance figures are absolutely first class.

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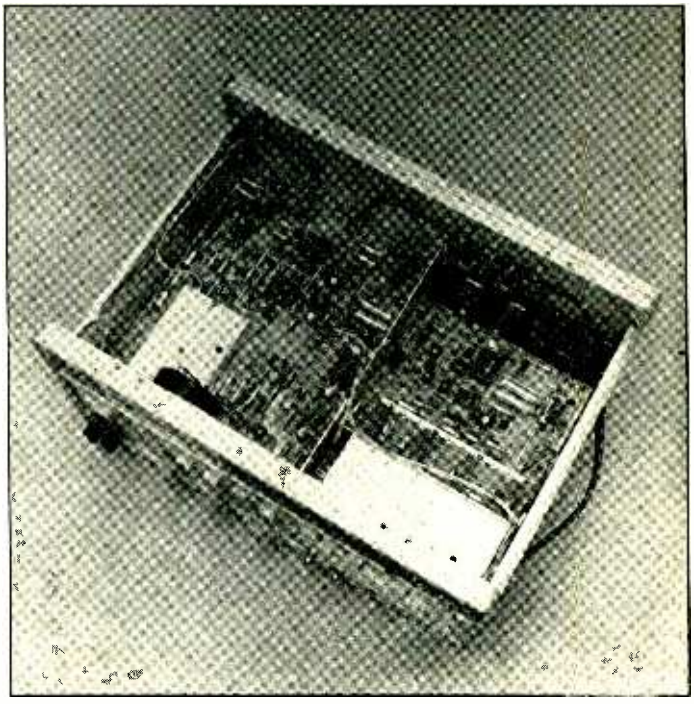


SOUND TECHNOLOGY 1700A

The voltmeter mode

The absolute accuracy of the voltmeter was checked on the 1V full scale range at 1 kHz and found to be within 1% at full scale and at 60% deflection falling to 2% error at 30% full scale. Readability of all the meter scales is excellent and a parallax mirror is fitted.

Attenuator accuracy was then checked and found to be within 0.04 dB including the accuracy of the second 'ratio' attenuator. The frequency response of the metering system was flat from 20 Hz to 70 kHz with −0.5 dB points at 5.6 Hz and at 95 kHz on all ranges. However, one condition was found to upset the instrument's accuracy—this occurred if the 'set level' control was not at its calibration point and on the verge of overloading without the warning lamp being illuminated.

The input impedance was found to be within 1% of 100 kΩ on all attenuator settings, the shunt capacity varying up to 62 pF according to the setting. The common mode rejection of the balanced inputs was excellent as is shown in **fig. 2** being in excess of 60 dB over the audio frequency spectrum. The inherent noise in the voltmeter section was found to be 14 μV wide band, reducing to 6.5 μV when it was arranged to have the inbuilt highpass and lowpass filters in circuit. As stated by the manufacturer, the meter is an average reading meter which is calibrated in terms of rms voltage, therefore care must be exercised when using the meter for measuring noise which should normally be measured with a true rms reading meter.

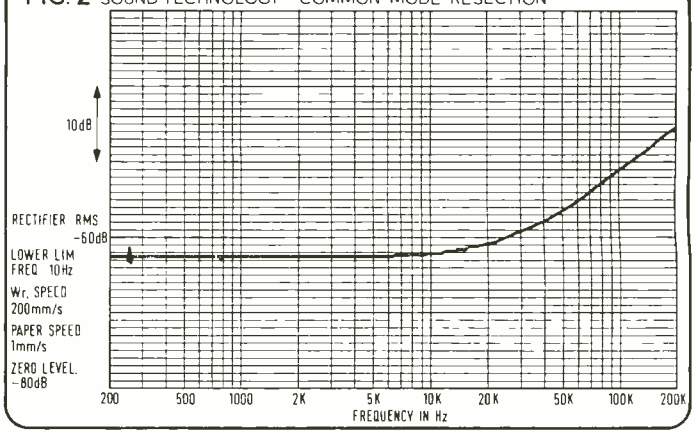
The distortion mode

In the distortion measuring mode a rejection filter is inserted between the metering section and the input, with the option of inserting either the 400 Hz highpass filter or the 80 kHz lowpass filter, or both. As can be seen from **fig. 3** both these filters are 18 dB/octave filters which have a clean characteristic without ripples or overshoots.

The fundamental rejection of the inbuilt oscillator was in excess of 100 dB at frequencies up to 20 kHz, 93 dB being measured at 100 kHz. The rejection is, of course, a function of the short-term stability of the oscillator and may be degraded with external oscillators. The behaviour of the automatic nulling circuitry was really first class with a true null occurring within about 5s with the internal oscillator or around 10s with external oscillators. In the latter case the frequency should be within about 5% for proper nulling. The correct null condition is indicated by two led indicators which illuminate if the notch frequency as set by the internal oscillator controls is too high or too low.

Reference to **fig. 4** shows the characteristics of the notch filter with its centre frequency set to 10, 100, 1000 and 10 000 Hz. The attenuation of the second harmonic was less than 0.3 dB and the attenuation of higher harmonics was negligible.

FIG. 2 SOUND TECHNOLOGY COMMON MODE RESECTION



AGONY COLUMN

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THIS INVENTION SHOULD BE OF INTEREST ....
TO YOUR ORGANIZATION !

May 22, 1973

Capitol Records Inc.
1750 N. Vine
Hollywood Calif.

Gentlemen:

We represent the inventor of an invention that we believe will be of interest to your organization. It is described on the sheet contained within.

We have the largest invention listing in America. Should you have need for any special type invention or product, we probably can provide just what you are looking for. It costs you nothing to have us try.

Your comments on the enclosed description of the invention we believe you may be interested in, will be appreciated.

Cordially yours,

UNIVERSAL INVENTION SALES

Donald J. Francill
Managing Director

DJF:dlh
Enclosure

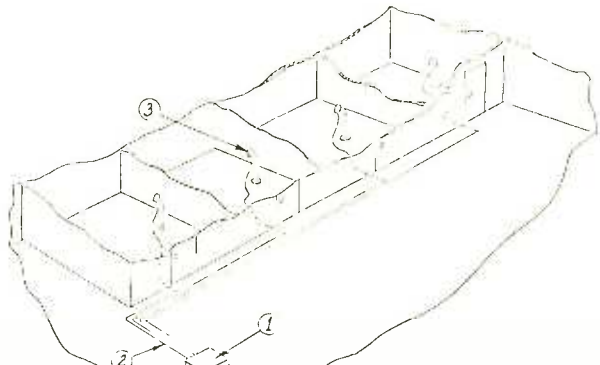


FIGURE 1

INVENTION: Multiple Recording Channels on One Sound Tape

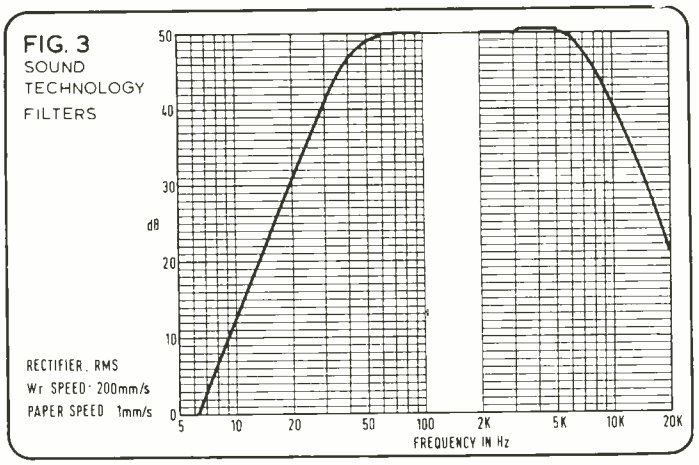
INVENTOR: Carson

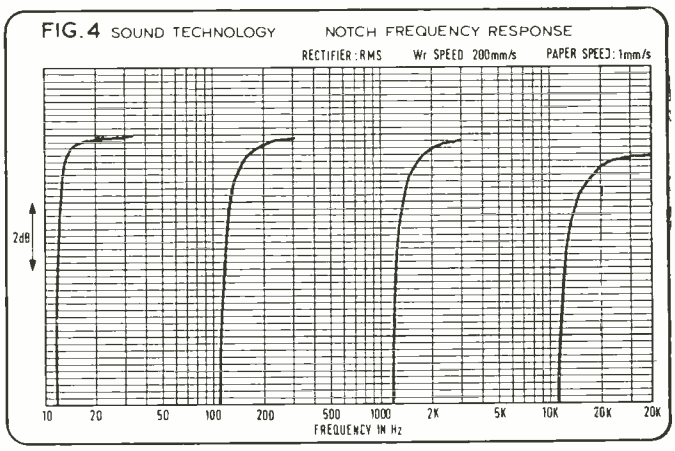
FIGURE 1: Perspective View of Multiple Band Production Means

This invention relates to sound recording equipment and, more particularly, to a new improved audio tape.

As illustrated, this invention consists of a means (1) to record four separate channels (2) on one sound tape. Four individual recording sources with separate microphones (3) are connected to a common tape recorder (1), each of the four sound signals can be controlled to mix, amplify, and diminish the individual sounds according to the listener's desires.

The main object of this invention is to provide an audio tape with four separate bands for a multiple channel recording.





General

The construction of the instrument was to a high standard, but at the time of writing, only a provisional and rather sketchy instruction leaflet was available. The input and output facilities for monitoring the incoming signal and the residual distortion were excellent, and the general input/output arrangements are a lesson to other manufacturers with the exception of the variable output impedance of the oscillator—this was rather tiresome.

Overall, there is room for detailed improvement, but, in spite of this, I can only describe the instrument as being a leader in the field of distortion measurement. So far as I am aware, there is only one manufacturer who can compete with the measurement of such low distortion levels, and his product does not have the automatic nulling facility which is such an enormous time saver.

FERROGRAPH RECORDER TEST SET TYPE RTS 2 AND AUXILIARY TEST UNIT TYPE ATU 1

Hugh Ford

MANUFACTURERS' SPECIFICATION RTS 2

1 Generator Section

Frequency coverage: 15 Hz to 150 kHz in 4 ranges.
Distortion: less than 0.025% at 1 kHz. Less than 0.08% over range 100 Hz to 20 kHz.
Frequency response: ±0.2 dB over range 15 Hz to 150 kHz.
Output level: max 3V into open circuit: +8 dBm into 600Ω load.
Output attenuator: coarse: Six 10 dB steps. Fine: continuous over approx 15 dB range. External: For insertion in oscillator lead, fixed, 40 dB.
Output impedance: dependent on attenuator setting: Max. 450Ω. With external attenuator 50Ω.

2 Millivoltmeter

Indication: average reading meter calibrated in rms for sinusoidal inputs.
Ranges: 11 in 10 dB steps from 1.0 mV to 100V fsd.
Input impedance:** 1 MΩ (No dc path).
Accuracy: within ±2% fsd over range 30 Hz to 20 kHz.
Frequency response: ±0.2 dB over range 10 Hz to 150 kHz.

3 Wow and flutter meter

Type: peak wow and flutter measurement using a carrier frequency of 3.15 kHz provided by an internal oscillator. Carrier frequency 3 kHz on model *RTS2/A.*
Frequency response: weighted to DIN 45 507. Max response at 4 Hz (3 dB points 1.2 Hz and 12 Hz).
Meter response: average reading calibrated in peak values for approx. sinusoidal wow and flutter waveforms.
Input requirement: 35 mV to 5V.
Sensitivity: three ranges: 0.1%, 0.3% and 1% peak fsd.
Drift measurement: centre zero for mean frequency as mean internal oscillator. Scaled ±2% for measurement of mean speed changes; also indicates slow cyclic wow rates with peak reading under 1 Hz. Oscilloscope output provided for visual examination of wow and flutter waveform or for connection to an external analyser.

4 Distortion section

Type: total harmonic distortion measurement by rejection of a fundamental frequency in the range 400 to 1100 Hz.
Second harmonic rejection: less than 0.25 dB.
Bandwidth of harmonic measurement: 15 Hz to 20 kHz with optional lf cut (turnover 400 Hz approx.) for rejection of hum and other lf noise components.
Minimum reading (from distortionless source): less than 0.05%.
Minimum input signal: 100 mV (smaller inputs may be used with increased minimum distortion reading).
Input impedance: 100 kΩ.
Oscilloscope output: provided for visual examination of distortion waveform or for connection of external filters. Provision for use as a variable sensitivity meter with bandwidth of 100 kHz by use of 'set level' control, eg for frequency response measurements where no external gain controls exist.

General

Power supply: fully stabilised. 105-120V, 200-250V. 50-60 Hz 12W approx. 70▶

■ FERROGRAPH RTS2/ATU1

Dimensions w x d x h: 441 x 254 over handles x 143mm.
Weight: 5.9 kg.
Price: £290 plus VAT. U.S. $1300.
****Note** The input impedance has recently been changed from 2 megohms to 1 megohm.

MANUFACTURERS' SPECIFICATION ATU 1

1 Oscillator Amplifier Section
Input/output gain: —20 dB, —10 dB, 0 dB, +10 dB.
Input impedance: 20,000Ω (nominal).
Maximum input: +10 dBm.
Frequency response: 30 Hz to 20 kHz, +0 —0.5 dB (measured with 600Ω load. 600Ω source).
Distortion: 600Ω source and load: at +10 dBm less than 0.05% from 40 Hz to 20 kHz rising to 0.4% at 20 Hz. At +20 dBm less than 0.07% from 100 Hz to 20 kHz rising to 0.4% at 40 Hz.
Output impedance: 600Ω balanced (less than 100Ω on +10 dB gain setting).
Maximum output: +10 dBm into 600Ω load (+20 dBm with internal adjustment).
Hum and noise: at least 85 dB below signal (600Ω load).

2 Meter section
Input/output gain: unity at 1 kHz for all control settings.
Input impedance: balanced: greater than 50,000Ω. Unbalanced: 1 megohm +approx 150 pF***. Loading (for bal. or unbal., pushbutton selected). 8Ω. 600Ω. 10,000Ω***.
Maximum input: balanced: +10 dBm (30 Hz to 20 kHz) +20 dBm (60 Hz to 20 kHz). Unbalanced: 100V (direct connection between input and output).
Frequency response: balanced: 30 Hz to 20 kHz +0 —0.3 dB.
Distortion added by balancing transformer: less than 0.03% 60 Hz to 10 kHz rising to 0.5% at 20 Hz at +10 dBm input.
Hum and noise: less than —85 dBm (600 Ω source).
Common mode rejection: greater than 70 dB at 50 Hz.
Weighted noise filter: instrument supplied with one plug-in filter DIN 45 405/CCIF 025-365 or CCIR (Recom. 468) 025-413 or NAB curve 'A' 025-414.
1 kHz pass filter: level 900-1100 Hz —20 dB at 500 Hz and 2 kHz —65 dB at 100 Hz and 10 kHz.

General
Power supply: 105-120V. 200-230V or 230-260V. 50-60 Hz.
Dimensions w x d x h: 440 x 254 over handles x 143 mm.
Weight: 5.5 kg.
Price UK: £110 plus VAT. Additional filter boards £12 plus VAT. U.S. $550.
***Note** The input load resistances have recently been changed from 8/200/600Ω.
Manufacturers: The Ferrograph Company Limited, Auriema House, 442 Bath Road, Cippenham, Slough, Buckinghamshire, UK.
US agents: Elpa Marketing Inc., New Hyde Park, New York 11040. Phone: 516 746 3002.

THOSE READERS WHO hoard earlier copies of STUDIO SOUND will find my review of the Ferrograph type *RTS 1* Recorder Test Set in the February 1972 edition, but I make no apologies for reviewing the latest type *RTS 2* together with the auxiliary unit. I had some criticisms of the original *RTS 1*, particularly from the point of view of professional use, and now Ferrograph have produced the new instruments taking into account the points raised by reviewers and users.

The Recorder Test Set *RTS 2*, like its predecessor, is a combination instrument containing an audio oscillator, a millivoltmeter, a rejection filter for distortion measurement together with a wow and flutter meter—a miniature test bench in one small and relatively inexpensive box. This combination of instruments is, of course, suitable for testing audio equipment other than recorders, but its input and output facilities do not match professional requirements and it does not contain noise weighting filters.

It is here that the Auxiliary Test Unit *ATU 1* comes into its own, and while it was primarily designed for use with the Recorder Test Set *RTS 2*, it may be a useful addition to servicing laboratories in combination with existing oscillators and voltmeters. The *ATU 1* contains an input 'metering section' which will match any common electronic voltmeters and provide a floating input together with switchable load resistors of 8/600/10,000Ω which, in combination, overcome the all too common ground loop problems when measuring amplifiers. The input section also contains a 1 kHz bandpass filter for selective measurements as required for determining crosstalk, erasure etc. In addition it contains a noise weighting filter for signal-to-noise measurement; there are three filter options available in the form of internal plug-in boards for either the international standard 'A' weighting, the DIN/CCIF weighting or the most recent weighting to the CCIR recommendation 468.

The output 'oscillator section' of the *ATU 1* contains an amplifier capable of delivering +20 dBm into 600Ω with the option of floating or unbalanced output and suitable for connection to any common signal sources capable of driving a 20,000Ω load at up to +10 dBm ref. 0.775.

Collective features

Both the *RTS 2* and the *ATU 1* are identical in mechanical construction and back panel layout. The cabinets are equipped with substantial carrying handles at the front, which also serve the purpose of protecting the control knobs from accidental damage. Furthermore, the back panel is recessed so that the mains voltage selector and its associate (unidentified) fuse are also protected. Both units are supplied with fixed mains leads together with suitable brackets on the rear panel for stowing the mains leads—personally I would prefer to have detachable mains leads with the standard IEC connectors.

When the two units are used in conjunction, one can be stood upon the other thanks to the sensible rubber feet. The input and output signal leads, equipped with BNC plugs, make a tidy loop connection between the two units. However, we are left with two long mains leads—a small improvement could be to arrange for the mains supply on each unit to be equipped with twin connectors.

Tilting feet are supplied with both units, so that either or both can be tilted to a convenient viewing angle, which is more important for the *RTS 2* because this is equipped with a mirror scale meter. The overall standard of mechanical construction is solid but perhaps a little crude, with screen printed front panels not up to the best standards. The electronics are arranged on a modular system so that faulty parts can be readily identified and replaced. However, detailed servicing may be hampered by the lack of identification of the individual components on the printed boards. It is only fair to add that the service manuals provide full circuit diagrams and parts lists in addition to detailed operating instructions for the less initiated engineers.

Credit must also be given to the manufacturers specifications which are down-to-earth and clearly specify worst case limits for the majority of parameters, as opposed to the 'we made one like this once' specifications for some cheap instrumentation.

Recorder Test Set RTS 2

Part of the concept of the *RTS 2* is to eliminate the need for a bird's nest of wiring when checking audio equipment; for this reason the unit has a single *BNC* input socket and two *BNC* output sockets, one for a monitoring oscilloscope (if required) and the other for the equipment under test.

The oscillator section has in effect four controls: a frequency selecting dial calibrated from 15 to 150, a set of four multiplier switches x1, x10, x100 and x1000 which work in conjunction with the calibrated dial to cover the frequency range 15 Hz to 150 kHz and finally two output level controls. These comprise a variable control with a measured 14 dB range and a six-position step attenuator giving 10 dB steps from 3V (nominal) maximum output down to 10 mV. A separate 40 dB plug-in attenuator is also provided so that sensitive inputs can be checked down to less than 10 μV using the 10 mV range and the variable attenuator.

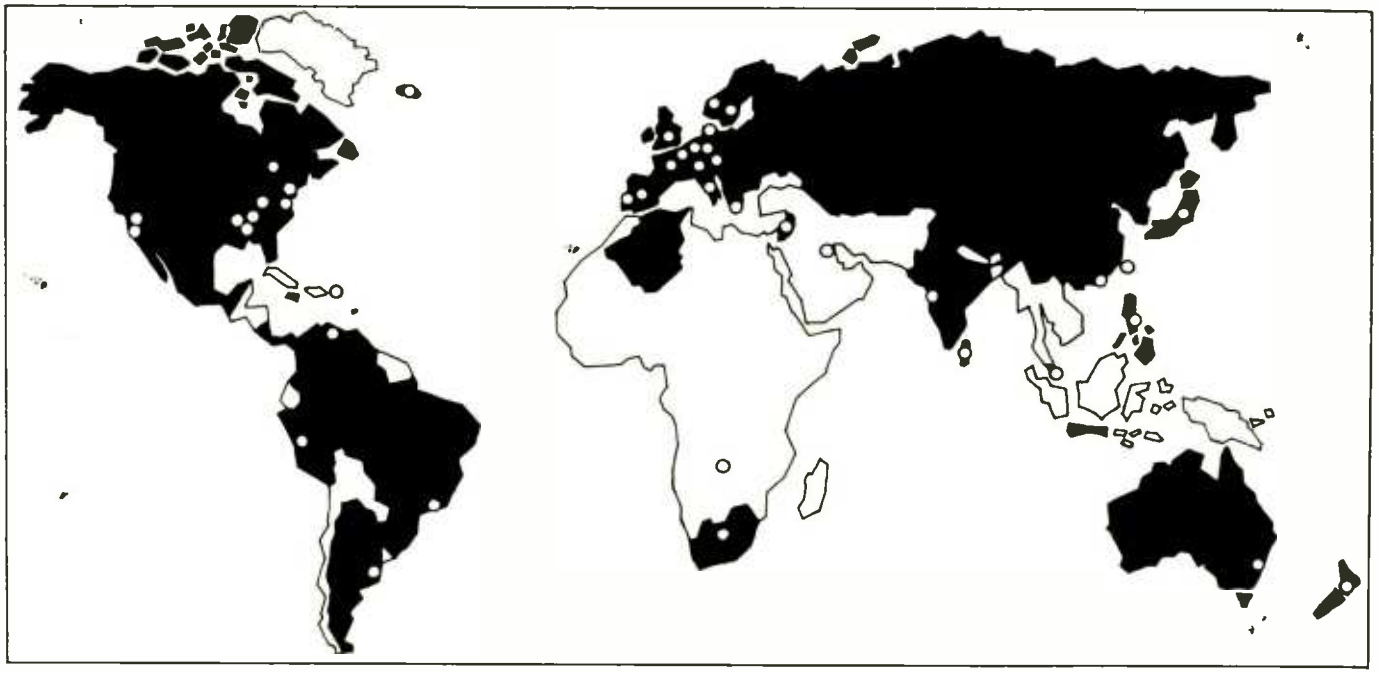
The millivoltmeter section is a multi-purpose unit which may be switched to read voltage either at the input or the oscillator output, distortion, wow and flutter, or drift. In addition, it has 'calibrate' facilities for calibrating both voltage and the wow and flutter section from internal sources. The appropriate function is displayed on a clearly calibrated and illuminated meter, the function being selected by a row of interlocked pushbutton switches which have colour coded identifications. In the voltmeter and distortion modes a highpass filter with a nominal turnover point at 400 Hz may be inserted for the reduction of hum during signal-to-noise or distortion measurements.

As a voltmeter, the range is selected by an 11-position rotary switch which is in 10 dB steps from 100V to 1 mV full-scale deflection and calibrated in both voltage and dBm as well as percentage distortion—the meter has identical calibrations in addition to wow and flutter and drift scaling. One good feature of the voltmeter in the oscillator measurement mode is the measurement of voltage at the oscillator output terminals, thus taking into account oscillator loading which can cause such deceptive results when the metering is before the attenuator system.

Distortion measurement is by the fundamental rejection method and covers the limited nominal frequency range from 400 Hz to 1100 Hz; I feel that this range is rather limited and most certainly should be extended

72 ▶

Countries shown in black have Dolby equipped recording centres.
Dots show location of authorised distributors of professional Dolby Noise Reduction equipment.



The geography of silence.

International operations in the music industry are easier, now that so many studios are Dolby- equipped. In addition to aiding engineers to achieve the highest possible quality on an original recording, the Dolby system reduces any low-level noise introduced when further work is done with a tape at another studio, often in another part of the world.

Because so many studios now have Dolby equipment installed, the system is widely used to protect the substantial investments of time, money, and creative effort made at recording sessions. Whether an original tape is sent to Nashville or Peking for reduction, or a copy master is sent to a licensee in Tahiti or Hanover, professional Dolby installations are there to guard against noise build-up.

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People everywhere will hear the difference.

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Telex 919109

down to 315 Hz which is a standard measuring frequency for low speed magnetic tape recorders. Distortion measurement is achieved by two pushbutton switches '100%' and 'read'. The 100% setting is adjusted by a potentiometer which permits input voltages down to 100 mV to be set to full scale—this facility can also be used for relative measurements such as frequency response measurement, where it is convenient to be able to select an arbitrary scale calibration for the zero reference.

Having set the 100% level, the 'read' button is depressed and a coarse and fine frequency control manipulated in conjunction with a phase control to obtain the optimum null. In spite of the 'fine' control being rather stiff on the review sample, the balance point was unusually easy to reach and did not show any significant tendency to drift.

Wow and flutter measurement is permanently to the weighted frequency response as originally prescribed by the German DIN 45 507 standard and now standardised by many other authorities. However, the *RTS 2* is not as such to the peak weighted standard because the metering is in terms of peak calibration of an average reading meter for sine wave inputs. This means that for sinusoidal wow and flutter waveforms, the indication will be correct to the peak weighted standards, but for non-sinusoidal wow and flutter waveforms, errors will be introduced. However, for general servicing work, I consider this concept to be acceptable as most wow and flutter does not have a very 'peaky' waveform and the waveform can be checked at the 'scope output of the *RTS 2*.

Three wow and flutter ranges are provided giving 1%, 0.3% and 0.1% full-scale deflection, in addition to which there is a single 'drift' range of ±2% with a readability down to about 0.2% which I consider to be rather insensitive for use with high quality recorders. Finally there is an inbuilt fixed frequency oscillator for wow and flutter and drift measurement with a nominal frequency at the standard 3150 Hz, with the option of a 3000 Hz version identified as the type *RTS 2A*.

Performance of the RTS 2

Oscillator Section

The frequency calibration accuracy was checked at the extreme ends and at the centre of the dial on all four frequency ranges and found to be within ±3% worst case errors which is considered to be satisfactory for the majority of audio measurements; this is not adequate for aligning bias traps and other sharp filters such as pilot tone rejection filters in recorders and tuners.

It was found that the maximum available output from the oscillator fell short of its rated 3V by 6%, and equally short of full-scale meter deflection on the attenuated ranges. It is suspected that this is a one-off fault in the review sample of the instrument. The oscillator output is quite adequate for measurements on domestic equipment, and the use of the Auxiliary Test Unit *ATU 1* extends this output to professional signal levels. The overall flatness of the oscillator was found to be better than ±0.1 dB over the entire frequency range from 15 Hz to 150 kHz—an excellent standard. It was, however, found that some amplitude bounce occurred when changing frequency; this did not produce dangerous amplitude increases and settled quite quickly even at low frequencies. The output impedance was variable according to the attenuator settings but remained within approximately 100Ω and 450Ω which is quite satisfactory, particularly since the metering section measures the output terminal voltage.

The total harmonic distortion of the oscillator section at the maximum output is shown in **fig. 1** from which it is to be seen that the mid frequency distortion is outstandingly good at around 0.01% total harmonic. Above 40 kHz the distortion continues to increase to 0.76% at 100 kHz, but this is normally no cause for concern. Oscillator noise was also found to be to a high standard, being measured at 102 dB below 3V output over the band 400 Hz to 20 kHz with mains hum and its harmonics being well below −100 dB.

Output attenuator accuracy was measured at 1 kHz and found to be within 0.05 dB overall or incremental error—an extremely high standard resulting from the use of 0.2% resistors in the attenuators.

Voltmeter section

The input impedance of the review sample was found to be 2 MΩ in parallel with 46.4 pF, but this will be modified to 1 MΩ in later instruments and will then permit the use of standard probes and other accessories as the input impedance is constant with attenuator settings.

As with the oscillator attenuator, the meter attenuator was extremely accurate, giving a maximum incremental error of ±0.04 dB with a worst case overall error of 0.05 dB with reference to the 1V range. The meter frequency response was checked at both 0 dB and −60 dB attenuator settings and found to be within ±0.1 dB relative to 1 kHz over the range 10 Hz to 200 kHz at the 0 dB setting or 10 Hz to 57 kHz at the −60 dB setting where the −0.2 dB limit occurred at 150 kHz. In both cases the −1 dB limits occurred at 2.8 Hz at the lower frequency end, but at the high frequency end the response goes rather mad above 1 MHz. It is felt that the meter response should be intentionally rolled-off at high frequencies so that a definite noise bandwidth is defined.

The absolute accuracy of the voltmeter is controlled by the accuracy of the reference calibration source within the instrument and the readability of the meter scale. Within the readability of the instrument, the reference source was found to be 0.06 dB (+0.7%), which leads to an overall accuracy from 20 Hz to 20 kHz; far better than the specified ±2%.

The final matter which affects the voltmeter section when used for noise measurement, and also the distortion section, is the characteristic of the switchable highpass filter. This is shown in **fig. 2** which confirms its turnover point as being just over 400 Hz and shows that it rejects 50 Hz hum to the extent of 47 dB or 60 Hz hum by 43 dB. As with other measurements on non-sinusoidal waveforms such as distortion residual, it must be remembered that the meter is an average reading meter calibrated in terms of rms sinewave signals. American readers will note that this corresponds to the characteristic of the vu meter so far as rectifier characteristic is concerned; it does not however correspond to British Standard requirements for noise measurement. It is only fair to point out that this characteristic is to be found in all the less expensive meters, and that in many circumstances, the errors introduced are small in comparison with a true rms reading instrument.

Distortion measuring section

The minimum input level necessary for full performance of the distortion section was found to be 93.5 mV and the range over which

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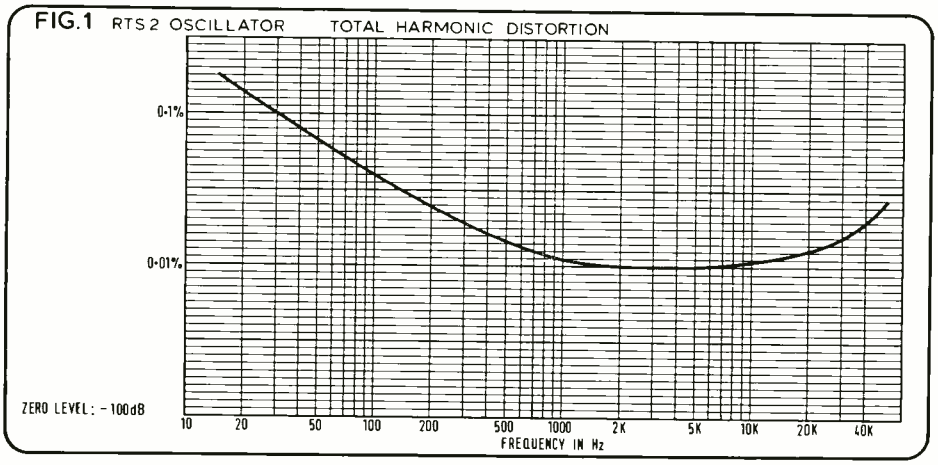

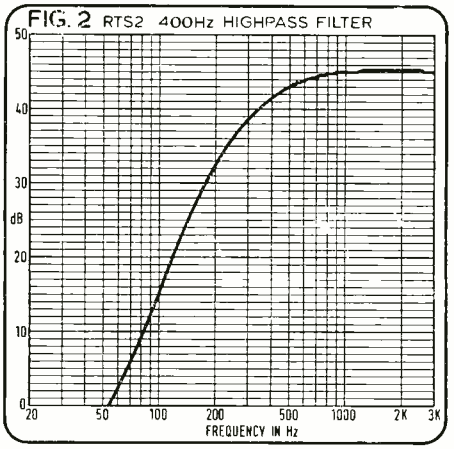

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A **truly** professional quality tape unit is your wisest audio investment. It will last for years and years.

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REVOX

The illustration contains optional extras.

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Revox Corporation 3637 Cahuenga Boulevard West, Hollywood California 90068.
Revox International: Regensdorf 8105 ZH, Althardstrasse 146 Switzerland.

BHE

the rejection filter could be tuned was somewhat wider than the specification, extending from 358 Hz to 1266 Hz. **Fig. 3** shows the rejection characteristic of the filter when tuned to the specification limits of 400 Hz and 1100 Hz, in which circumstances the attenuation of the second harmonic is in the order of 0.1 dB. This represents an unusually good filter shape. It is to be noted that the response falls away to almost −3 dB at 20 kHz, and this, in fact, offers an advantage because it reduces noise during distortion measurement while not giving any significant attenuation of the harmonics up to the fifth harmonic of 1.1 kHz.

Using an independent very low distortion oscillator with harmonic distortion an order of magnitude better than the rejection capabilities of the *RTS 2*, the following minimum attainable residual readings were obtained:

Frequency	100 mV input	1V input
400 Hz	0.012%	0.008%
1 kHz	0.012%	0.010%
1.1 kHz	0.015%	0.014%

As with many other parameters this performance is considerably better than the manufacturer's specification; however, a potential error was found during these measurements. This turned out as a breakthrough from the internal oscillator to the millivoltmeter section of the instrument if the source impedance to the millivoltmeter was high; the breakthrough increased with the frequency of the internal oscillator. This potential failing is unlikely to be of concern with solid state circuits where impedances are generally low, but if the oscillator is set to 150 kHz and maximum output, it interferes significantly with both voltage and distortion measurement if the source impedance is in excess of 1000Ω. If an oscilloscope is connected to the 'scope output it will, of course, give warning of interference—but this is the sort of failing which can lead one on a real wild goose chase!

Wow and flutter and drift measuring section

Attention was first paid to the performance of the internal 3150 Hz oscillator which provides an output for wow and flutter and drift measurement, as well as being used for calibration of the relevant meter scales in conjunction with two screwdriver-operated calibration controls. The frequency of the oscillator exhibited some drift from the time of switch-on, amounting to 0.2% over the first ten minutes and a further 0.1% over the subsequent ten minutes. The drift then stabilised to satisfactory limits but did continue to the extent of 0.3% over the following eight hours. This means that periodic re-calibration is necessary during a working day if accurate drift measurements are to be made. The effective frequency of the internal oscillator is dictated by the oscillator itself rather than the drift meter, and stabilised at 3143 Hz with an output voltage of 485 mV which is generally compatible.

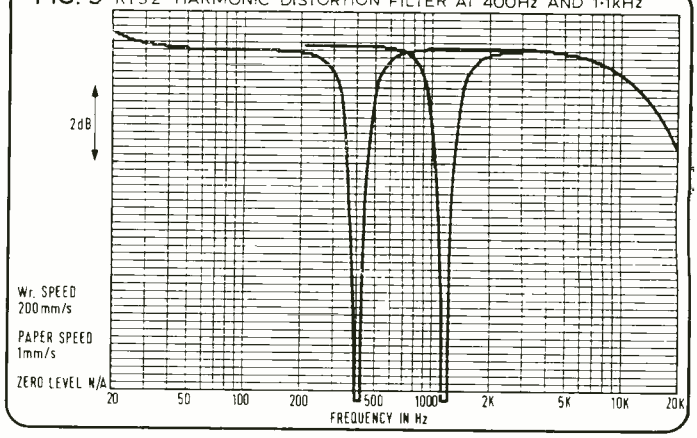
The readability of the drift meter is within 0.1% or better, and the following measurements of the accuracy of the drift meter do justice to its accuracy:

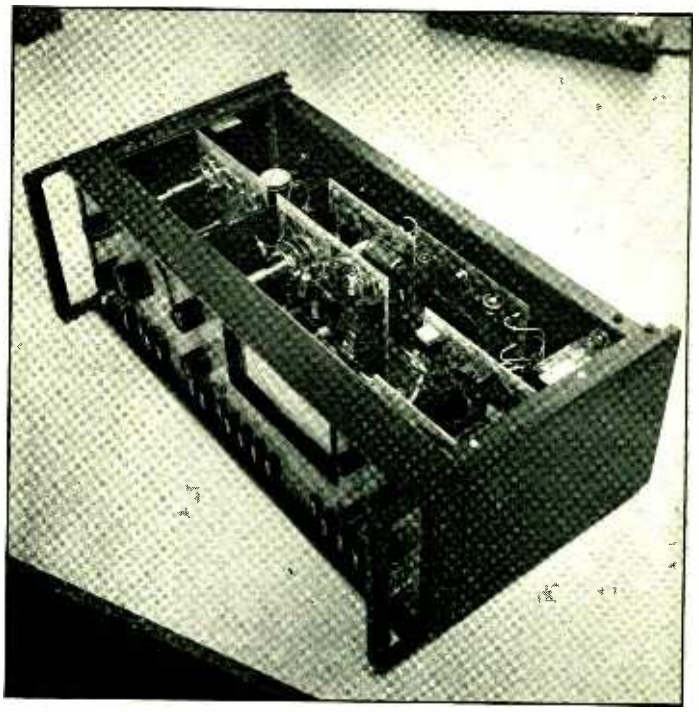
Indicated drift	Actual drift
+2%	+2.09%
+1%	+1.05%
−1%	−1.05%
−2%	−2.16%

It was found that the frequency response of the wow and flutter weighting network was well within the limits specified in DIN Standard 45 507 and as no claim is made about the ballistics of the meter, this was not checked against the standard; neither was the rectifier characteristic which is stated by the manufacturer to be an average characteristic as opposed to the DIN requirement for a special peak characteristic. The accuracy of the wow and flutter indications were, however, checked by means of a frequency modulated generator modulated by a sinewave to known deviations. The following table shows that the accuracy in these terms is perfectly satisfactory:

Range	Indicated wow and flutter	Actual peak sinewave wow and flutter
1%	0.98%	1.0%
1%	0.27%	0.30%
0.3%	0.29%	0.30%
0.3%	0.09%	0.10%
0.1%	0.097%	0.10%

FIG. 3 RTS2 HARMONIC DISTORTION FILTER AT 400Hz AND 1·1kHz





Ferrograph RTS2

Auxiliary test unit ATU 1

The *ATU 1* is intended to act as an interface between the Recorder Test Set or other similar equipment, and professional equipment which generally requires higher levels than domestic equipment and, of course, uses different connectors and balanced lines etc . . . In addition to containing a small loudspeaker and monitor amplifier complete with its own volume control, the *ATU 1* may be divided into two sections, the input voltmeter section and the output oscillator section.

For monitoring recorded announcements on calibration tapes and such purposes, the monitor loudspeaker is invaluable, and in spite of its performance being far from 'hi-fi' it can be useful for fault finding. My only criticism is that it would be even more useful if the amplifier had more gain and was less noisy. As is to be expected the monitor amplifier is connected to the voltmeter section of the *ATU 1*, but perhaps surprisingly it comes after the available filtering. As with the *RTS 2* itself, the voltmeter section may be switched to read the input and output terminal voltages, but here again the available filtering may be in the metering circuit and could lead to confusion when reading the output terminal voltage from the oscillator. A further mechanical interlock on the switches would overcome this potential problem.

Turning to the input voltmeter section, the input is either via two spring terminal/sockets (which will be terminal/banana sockets on standard 19 mm spacing in future production), or via either of two three-

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pole jack sockets which are mounted on a small panel together with a selector switch. The idea of this is to select either of two stereo channels, and the panel may be removed and replaced with a new panel containing a particular customer's favourite connectors. The input is followed by a selection of load resistors which are switch-selected by interlocking pushbuttons which also provide for an unloaded condition. In the review sample, the available loads were 8Ω 17W, 200Ω and 600Ω, but this selection will become 8Ω, 600Ω and 10 000Ω in future production as a result of customer demands. The loads are followed by what Ferrograph claim to be a switch-selected balanced/unbalanced condition achieved by means of transformer. However, I would argue that what is claimed to be a balanced condition is, in fact, a floating input condition—not that this necessarily makes much difference for many purposes. The signal may then be switch-selected to pass through a noise weighting network, or through a 1 kHz bandpass filter before proceeding to the external meter. Three standard noise weighting filters are available from the manufacturer covering the International Standard 'A' weighting, the DIN Standard/CCIF weighting or the new proposed CCIR weighting. The instrument is normally supplied with one installed network, but others may be purchased and fitted as required. However. the instrument can only accommodate a single plug-in network which could be made rather easier to change.

Turning now to the output/oscillator section of the *ATU 1*, this has similar output terminations to the input section, with the addition that either or both of the jack socket outputs may be switch-selected on a second removable panel. From the external oscillator (normally the *RTS 2*) the signal is fed through a power amplifier and limiter followed by what is again claimed to be a balanced/unbalanced transformer and thence to an attenuator and to the output with the option of switch-selecting a 600Ω load. The attenuator provides from 10 dB gain to 20 dB loss in 10 dB switch-selected steps and, as has been previously mentioned, the output terminal voltage may be monitored with the metering section.

As supplied, the output of the oscillator amplifier is limited to +10 dBm, but this may be extended to +20 dBm by inserting a link within the instrument. The latter is a level which will cope with many professional requirements in studio equipment but would benefit from an extra 6 dB available. No doubt the inclusion of a limiter will puzzle some readers —I am told that this was included to meet the requirements for some telephone networks which don't like more than +10 dBm.

The general presentation of the *ATU 1* is excellent with all controls clearly identified by colour-coded labelling, and certainly it offers a number of facilities which are not generally available in service departments. It also tidies-up measurement set-ups which often take the form of a string of load resistors, transformers, weighting networks, attenuators etc.

Performance of the ATU 1

The input metering section

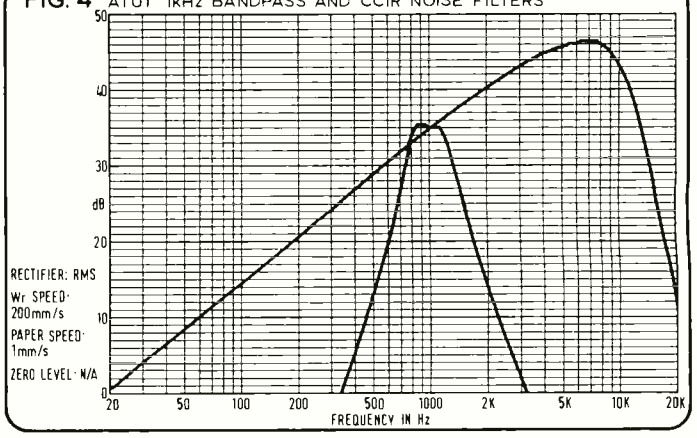
Initial investigations were directed at the input in terms of loads and input impedances. In the unbalanced mode, the input impedance is the same as the input impedance of the meter connected to the *ATU 1* and the loaded conditions depend entirely on the tolerances of the inbuilt loads which are nominally ±5% for the 8Ω load and ±1% for the 200 and 600Ω loads. However, the measured input impedances were well within these tolerances. It is felt that the ±5% tolerance of the 8Ω load is excessively wide and that this tolerance should also be changed to ±1% in common with the other load resistors.

In the so-called balanced mode, the loaded input impedance is virtually unaffected by the input impedance of the matching transformer, which in the unloaded condition was always above 108 kΩ at 1592 Hz but depends to a certain extent upon the filters selected. The common mode rejection in the 'balanced' mode was found to be −90 dB at 50 Hz rising at approximately 6 dB per octave with frequency.

The overall gain of the input section was found to be within 0.1 dB of unity at 1 kHz in the three conditions 'unweighted', '1 kHz filter' and 'weighted in the unbalanced mode'. **Fig. 4** shows the frequency response in the '1 kHz filter' and 'weighted' modes. The CCIR weighting was within 1 dB of the curve published in the CCIR study group documents, and is obtained in the *ATU 1* by means of an active filter as is the 1 kHz bandpass function, which was found to be within 1 dB of unity gain over the frequency range 823 Hz to 1117 Hz, with skirts in the order of 18 dB per octave.

As a result of the active filters, the maximum output level which may

FIG. 4 ATU1 1kHz BANDPASS AND CCIR NOISE FILTERS



be accommodated was found to be +20 dBm when the filtered or weighted modes were in use. This level coincided with the useful gain adjustment of the monitor loudspeaker amplifier. Certainly, in the case of the 1 kHz bandpass filter, this is a potential limitation in professional use, and it is felt that an extra 6 dBm would not come amiss in the overload margin.

In this context the manufacturers claim for '100V input capability in the unbalanced mode' must be treated with caution, and it is also suggested that the load selection switches should be identified with the maximum permitted input level for the load resistors. In the 'balanced' mode the maximum input level is limited by the distortion introduced by the input transformer and measurements showed that the claimed level of +10 dBm from 30 Hz to 20 kHz has an insignificant effect upon the distortion measurement capabilities of the *RTS 2* and furthermore did not produce frequency response errors in excess of +0 −0.2 dB over the range 30 Hz to 20 kHz.

The noise performance of the *ATU 1* in the 'wideband' mode was magnitudes better than the manufacturers' specification of a minimum of −85 dBm from a 600Ω source, being measured at −108 dBm over the band 20 Hz to 20 kHz in the unbalanced mode. However, the noise performance in the 'weighted' and '1 kHz' modes was considerably worse (probably as a result of the use of active filters) and was measured at −82.5 dBm in the 'weighted' mode and −76.5 dBm in the '1 kHz' mode. While this performance is more than adequate when the *ATU 1* is used in conjunction with the *RTS 2*, the performance may leave something to be desired if the *ATU 1* is used in conjunction with more sensitive metering.

Output/oscillator section

As has already been explained, the output section contains a limiter which limits the output to +10 dBm in the current version of the instrument; it is, however, understood that while this feature is to be retained, new instruments will be delivered with the simple internal modification which permits a maximum output of +20 dBm. Generally this output level will cope with the majority of professional requirements, but I would again suggest that an extra 6 dBm drive capability could be useful.

The frequency response of the oscillator section is shown in **fig. 5** from

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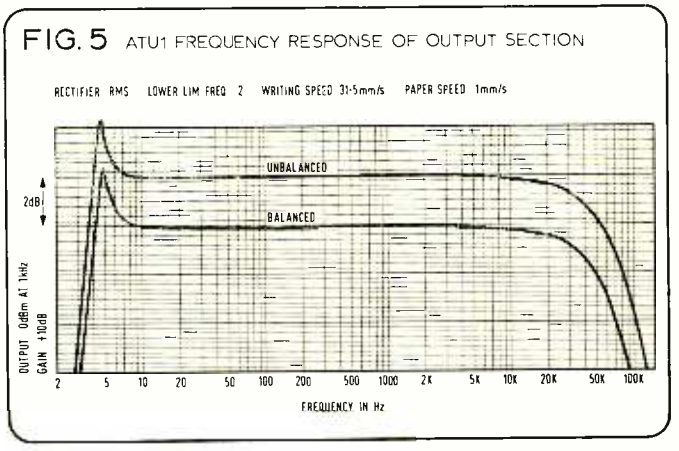
FIG. 5 ATU1 FREQUENCY RESPONSE OF OUTPUT SECTION



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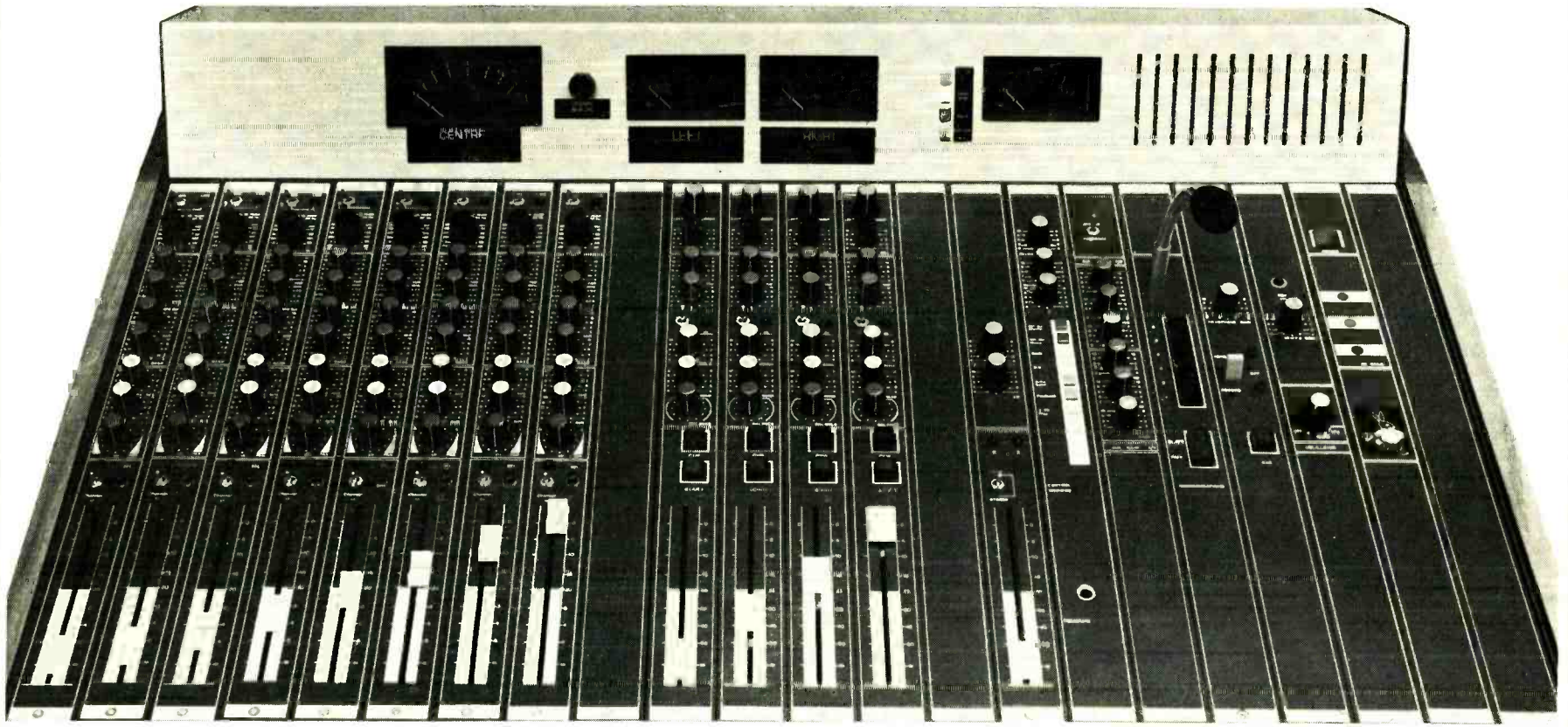

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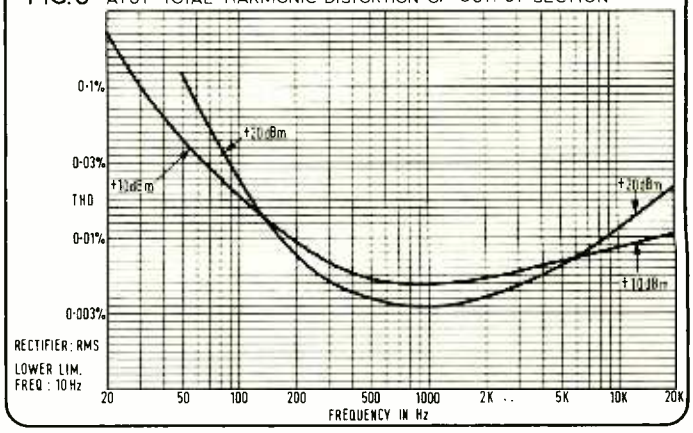
■ FERROGRAPH RTS2/ATU1

which it is to be seen that the response is virtually unaffected by the balancing transformer and that it remains within +0 −0.5 dB reference 1 kHz from 10 Hz to 20 kHz.

Attempts to measure noise generated in the oscillator section initially caused much puzzlement, until it was discovered that the earthing arrangements within the instrument depended upon which output facility was used, as a result of the shorting effect of two pole jack plugs which grounded the output low terminal in the unbalanced condition. If a plug was not inserted, the output remained floating in the unbalanced condition! No doubt Ferrograph will put this matter to rights, and the eventual noise measurement led to the figure of −86 dBm below rated output over the band 20 Hz to 20 kHz.

With the limiter in operation the maximum available output was found to be +12 dBm into 600Ω, or +13 dBm into an open circuit. Inserting the internal link to remove the limiter produced output levels of +30 dBm into an open circuit or +27.5 dBm into 600Ω at the onset of clipping. The distortion introduced by the oscillator section is shown in **fig. 6** for +10 dBm and +20 dBm outputs loaded into 600Ω. This demonstrates that the performance is considerably better than the manufacturer's specification would suggest. The review sample was found to be capable of delivering up to +26 dBm into 600Ω at mid-frequencies with low distortion levels, but such levels are only attainable by using an oscillator with higher output than that available from the *RTS 2*.

FIG. 6 ATU1 TOTAL HARMONIC DISTORTION OF OUTPUT SECTION



Other matters

Both the *RTS 2* and the *ATU 1* have stabilised power supplies and neither instrument minded the mains voltage being lowered as far down as 210V from the nominal 240V setting.

Mention has been made of the plug-in 40 dB attenuator for use on the oscillator output where low levels are required. The accuracy of this attenuator was found to be within 0.04 dB and its output impedance 47Ω, which is usefully low for measuring low impedance inputs such as microphone inputs.

Finally, mention must be made of the accessories which are provided with the instruments. The *RTS 2* is supplied with two *BNC* to two pole jack plug leads and a calibration tape which is stated to correspond to the 19 cm/s NAB equalisation standard and is recorded with spot frequency tones. It also has an azimuth section and a reference level section at 320 nW/m. The accuracy of this tape was not investigated.

The *ATU 1* is provided with two short *BNC* to *BNC* leads for interconnection with the *RTS 2* when mounted on top of the *ATU 1*.

Summary

I have investigated these two pieces of testgear in depth because I feel that they are important instruments which have very wide applications. While I have criticised some parameters, this is for the purpose of showing the limitations of the instruments which are generally far better performers than the published specifications would suggest.

The combination of the Recorder Test Set and the Auxiliary Test Unit is an excellent set-up for general maintenance work, and without any doubt, it offers outstanding value for money together with a very good performance. In its own right the Auxiliary Test Unit can be an important addition to any workshop which is already equipped with a reasonable oscillator and millivoltmeter. The balanced input and output are invaluable to professional users, and even where these are not required, the ability to measure weighted noise and the 1 kHz bandpass filter are facilities lacking in far too many workshops.

■ WORK

That little episode kept them going for weeks. As Bruce pointed out: 'It was probably Elton John taking the piss.' They should go far.

In times when 24 track is becoming commonplace, what sort of client does a small, albeit very friendly, eight track studio attract? *Steve:* 'Lots of ads, but we're hoping for deals directly from the record companies . . . and of course, there's always the hopeful cabaret duos etc. They book in for four hours, take six but they pay for it themselves.' *Clem:* 'Remember that band? . . . they had done the gigs and thought it was time they did a demo. They walked in, looked a bit vague and scratched their heads. It took a bit of time before one of them asked if they should use their pa or ours.' There must be a first time for everybody.

The control room, Countdown Studios

From L to R: *Clem Lee, his wife wife Shan, Bruce Turner and Steve Foley*

Countdown use an Allen and Heath 16/8 desk feeding into a Brenell 25 mm eight track machine. The monitor groups drive Custom Sound amplifiers powering specially built Altec cabinets which incorporate the new version of the *604E* chassis unit. The only complaints with the hardware arose out of a basic malfunction of the driver units originally supplied by Altec. After some period of operation, each cabinet in turn started to produce a farting noise (the description originates from Mike Ingram of Theatre Projects, the UK agents for Altec). The cause was subsequently traced to a manufacturing defect running through the batch, the very first of the new model from the State side production lines, supplied to Theatre Projects. The fault, caused by an ill-fitting gasket between the bass driver and integral horn, has now been remedied. Altec have since eliminated the problem at source. Once again, the ubiquitous *A77* Revox finds a place in a studio. The Countdown high speed machine handles the mastering and provides more than adequate performance for the task.

The studio floor seems typical in most respects; Beyer cans littered about and AKG *D202's* flowering from the mic stands. However, the studio must be virtually unique in one respect: a small squeak in the floor boards a couple of feet in front of the piano. Clem says that with close micing, no problems result but the trouble is in line to be fixed. If this amounts to the only teething trouble of a new studio, the future is assured. Opposite the control room window, a separate booth offers isolation for drummers or vocalists, sufficient room being provided for either.

Frank Ogden

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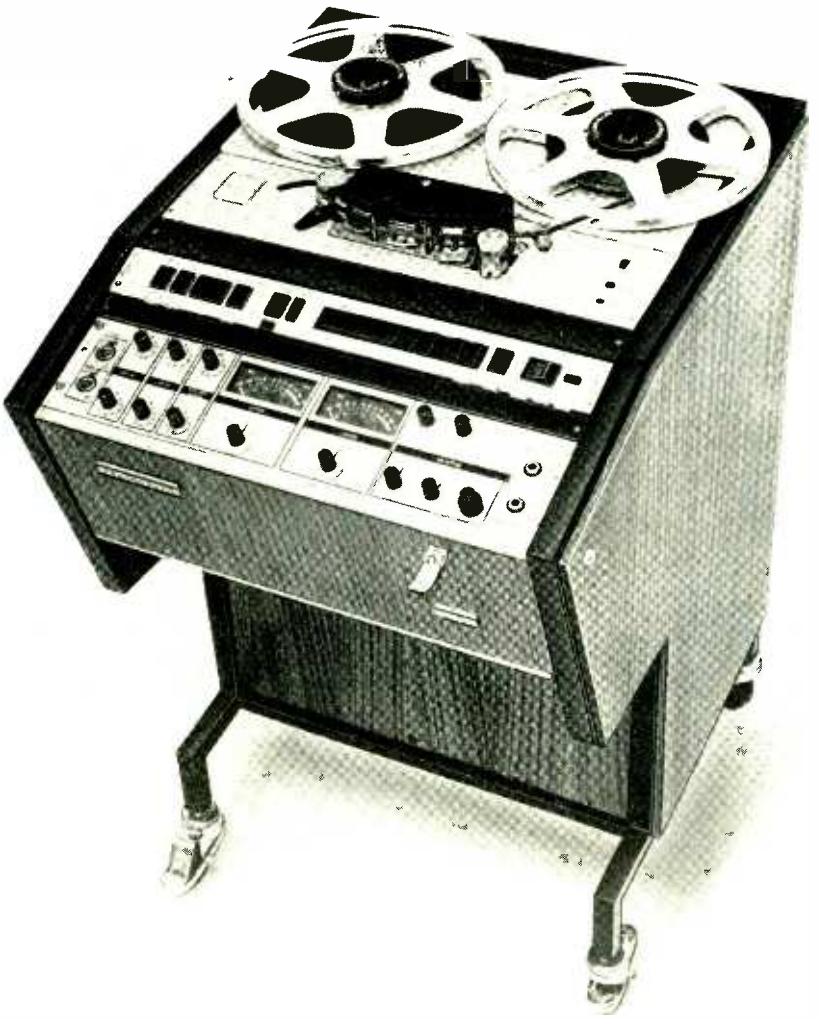

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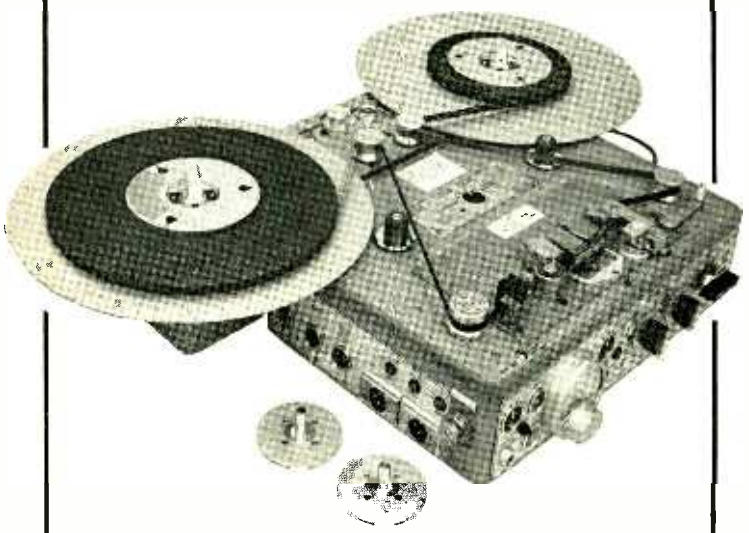

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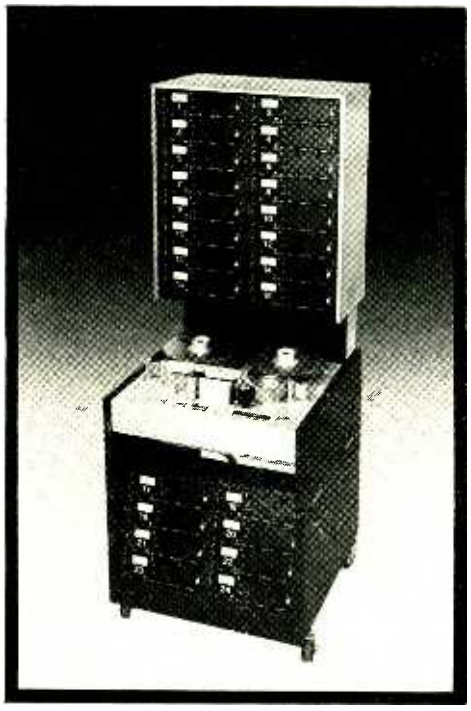

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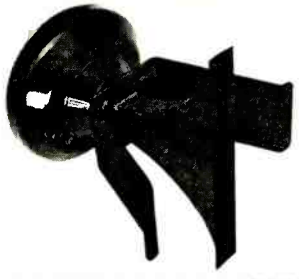

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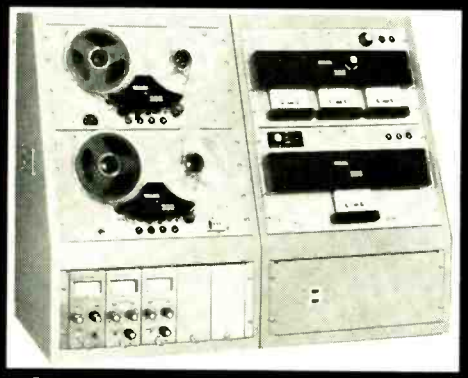

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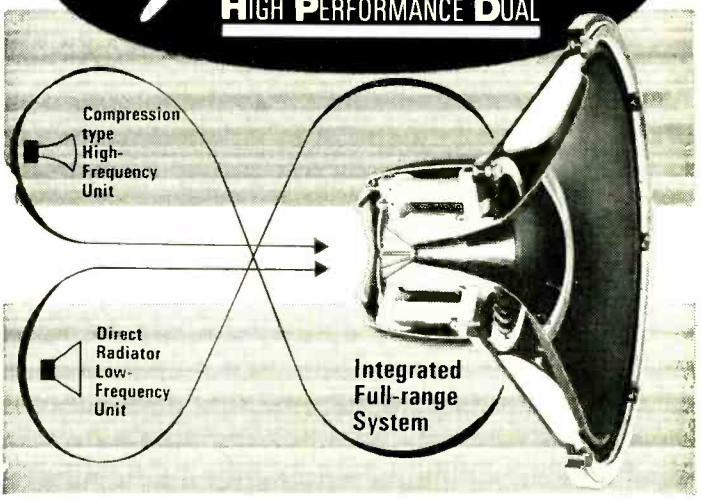

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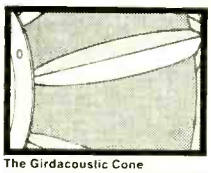

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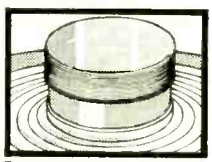

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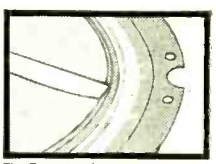

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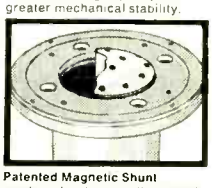

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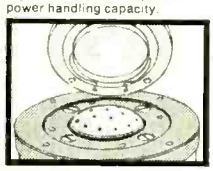

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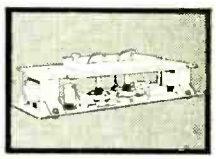

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Published by the Proprietors, Link House Publications Limited, 10-12 South Crescent, Store Street, London W.C.1, and printed by Arthurs Press Limited, Woodchester, Stroud, Glos. GL5 5PB.

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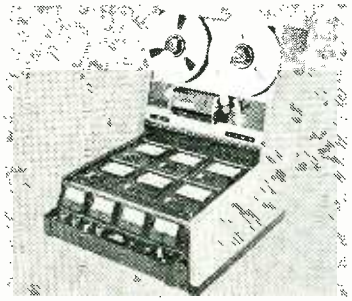

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