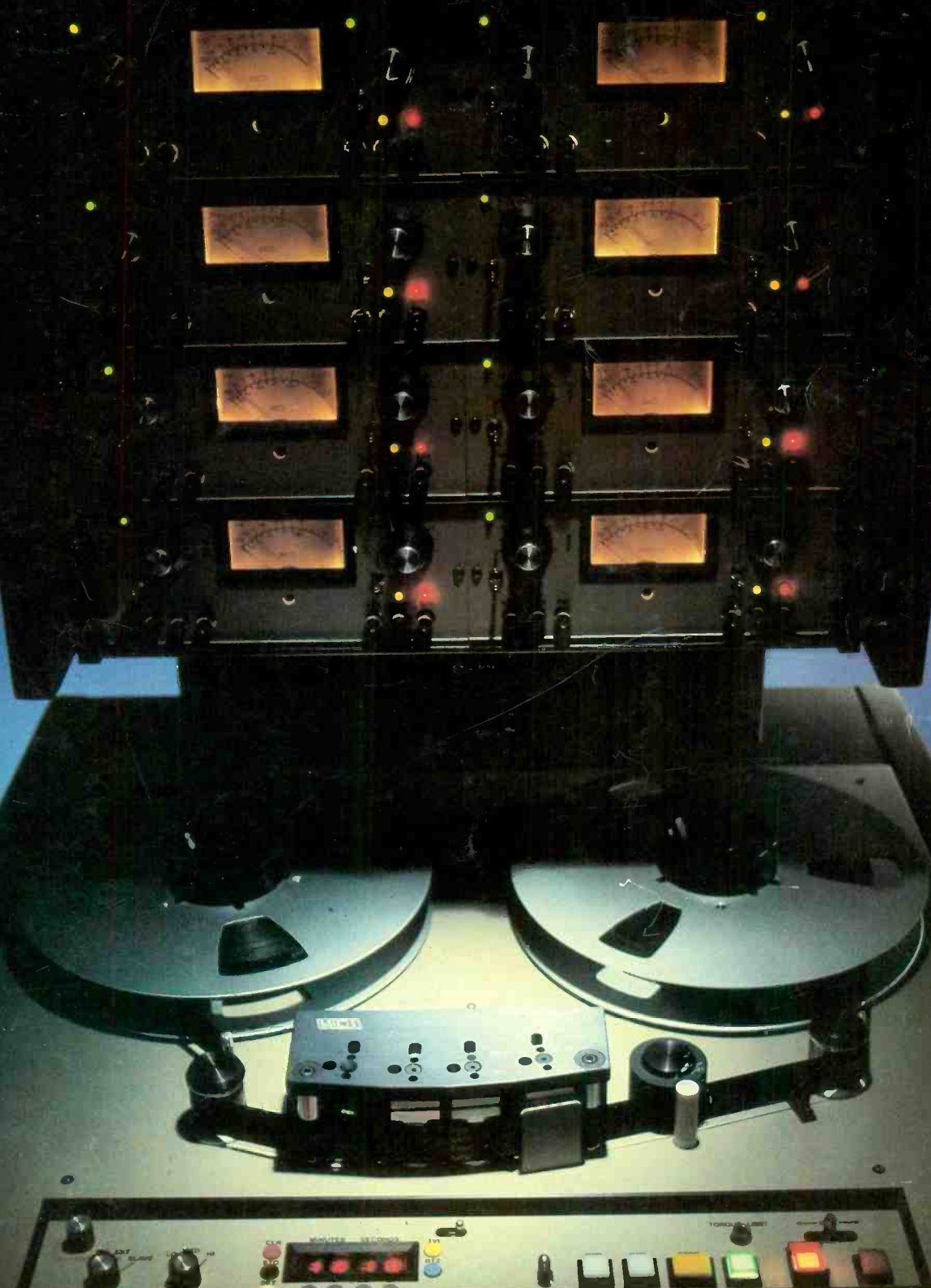


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studio sound

AND BROADCAST ENGINEERING

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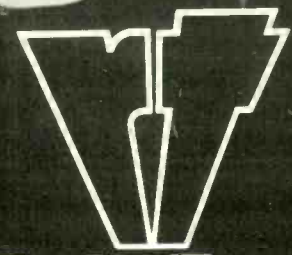
During the past few years, the cost of recording has risen sharply for a variety of reasons. Overheads are ever increasing, the range of services demanded by major bands obviously costs money while actual equipment costs are rocketing as new technology creeps in. For instance, while you can buy a standard 24-track for £20,000, the new Studer A800 is over £30,000 and a digital 3M 32-track is £75,000. Many studios argued when automation came in that the extra charge couldn't possibly be passed onto clients as a substantial extra charge but would have to be 'absorbed'. But more to the point, the record buying public couldn't care less whether the record was recorded using automation or digital techniques—they are only interested in the content—the artist. Fleetwood Mac's latest album, *Tusk*, is reported to have taken three years to record at a cost of \$1,000,000 and the record company sees this as promotional information which will convince the public that if that expense has been incurred it must be good. But back in Britain, Gary Numan and Tubeway Army currently have three albums in the Top 50 (two Gold), and total recording cost for all three was far less than £10,000, the longest taking an epic 10 days recording (it was mixed twice after an accident with a magnet), while the other albums took three and five days. And eventually, it is conceivable that Gary Numan's albums will make more profit than Fleetwood Mac's, simply because overheads are so low, and there are less costs to recover before going into profit. Does the fact that it required three years of recording mean it took three years to get it right, and that a more competent band could have done it in a month? Of course not, but Fleetwood Mac has a reputation to uphold, and must produce an album better than the last whereas Gary Numan's albums were all released (one being a re-release) within a couple of months to capitalise on media exposure. But then this is the situation with which many established bands are faced, and it is quite possibly the reason why record companies are prepared to pay ever increasing recording costs. They hope that even higher returns will be made from sales if they support the new goodies that producers consider necessary to make their band's sound 'better' than their last album. But there has to be a plateau beyond which investment in recording costs cannot be recovered from the record buying public—and many believe that this plateau has been reached.

Over the past few months, due to unprecedented demand for *Studio Sound*, it has been necessary to be rather more tight than previously on our free controlled circulation conditions. So we have been examining areas where there is duplication, as many recording studios and companies receive several copies, while others are waiting to receive just one. *Studio Sound* wishes to thank all those who have taken time to amend the free circulation lists within their own companies, and apologise to all those who have lost a personal copy of the magazine—although they should still have access to copies in their studio or whatever. But a wider circulation into more recording studios is better than a large circulation into a reduced number of studios, and that is our policy. Thanks for bearing with us.

And did you realise that *Studio Sound* celebrates 21 years as a magazine (it was called *Tape Recorder* until 1970) and ten years as *Studio Sound* with the February 1980 issue?

Cover of MC1 JH-110A 8-track tape machine
by Adrian Mott and Ray Hyden

DECEMBER 1979 VOLUME 21 NUMBER 13



Radio Trent

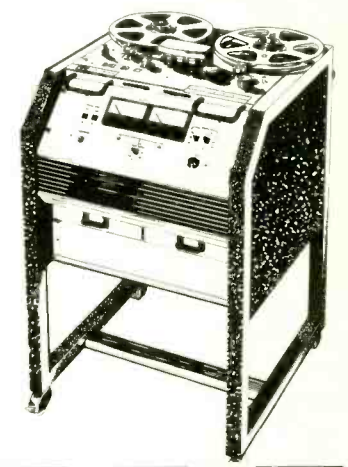
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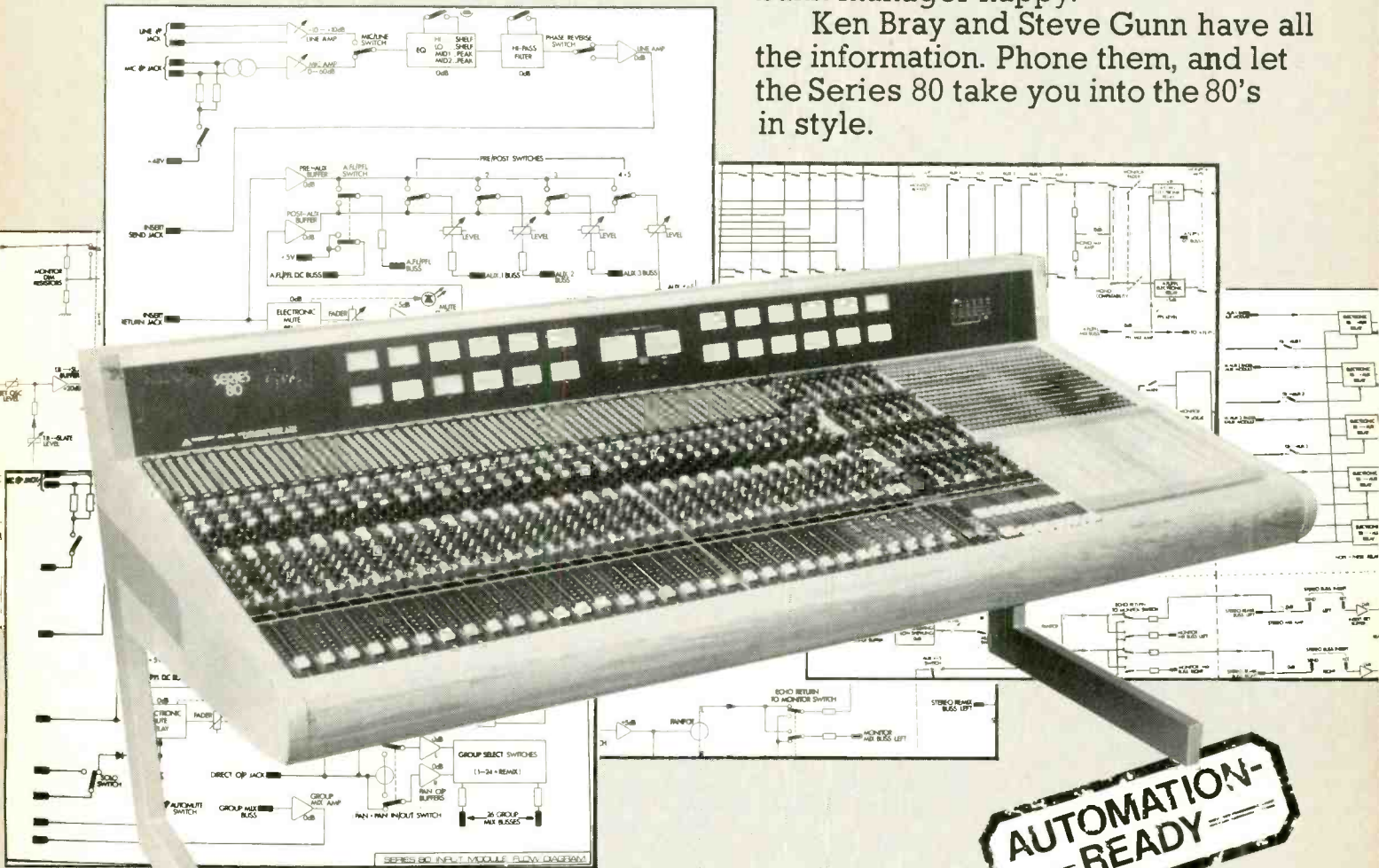
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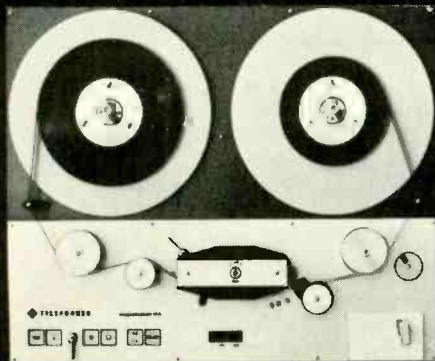
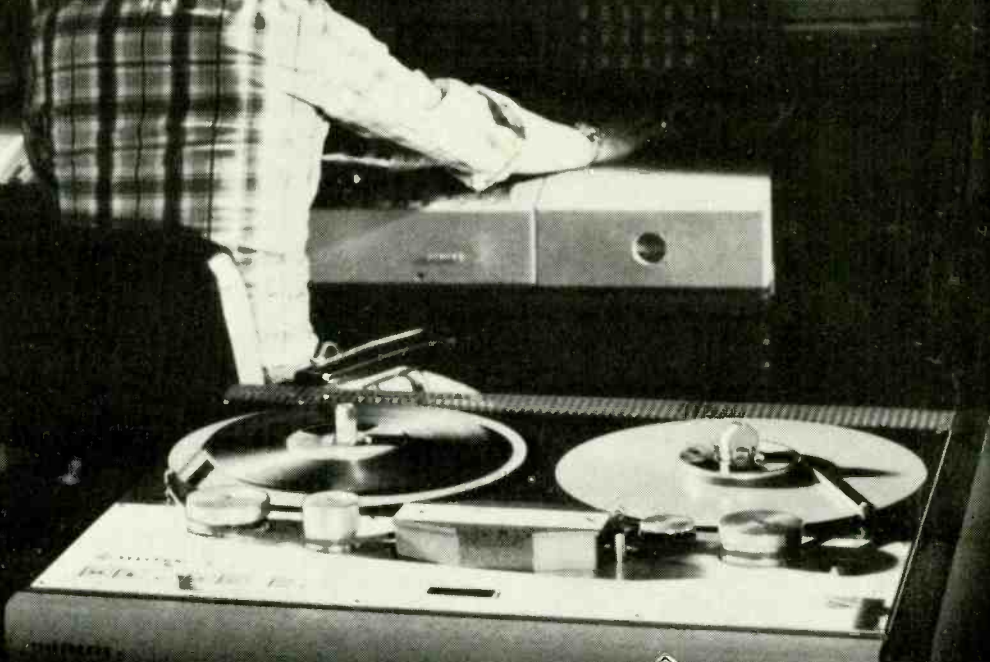
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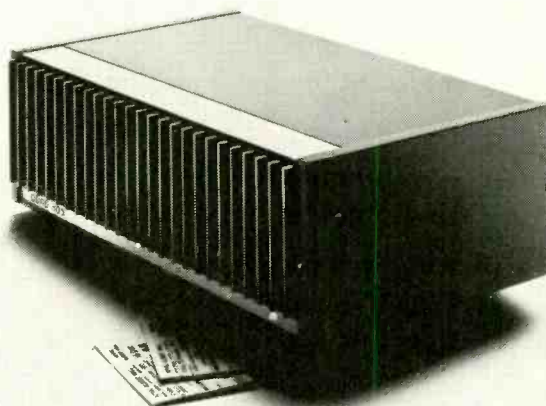
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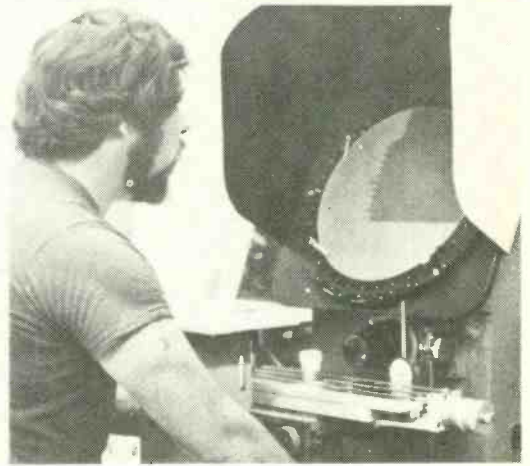
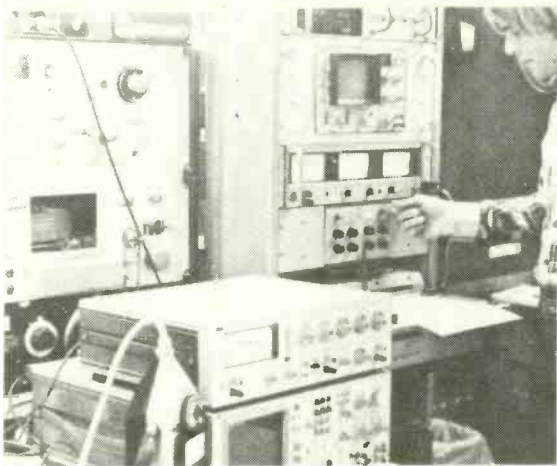
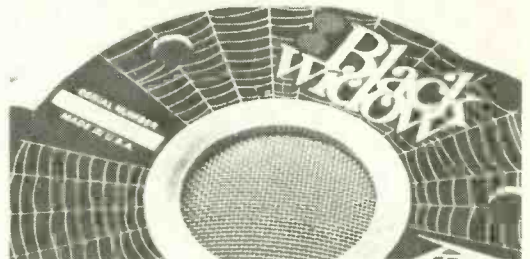
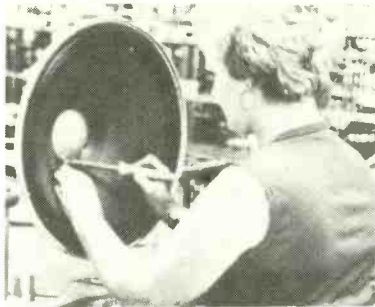
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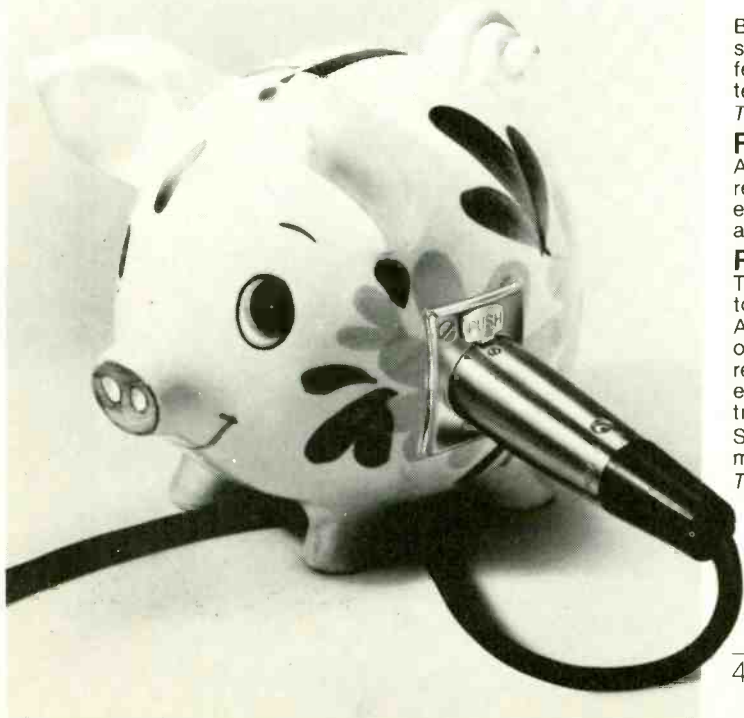
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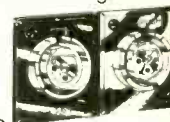
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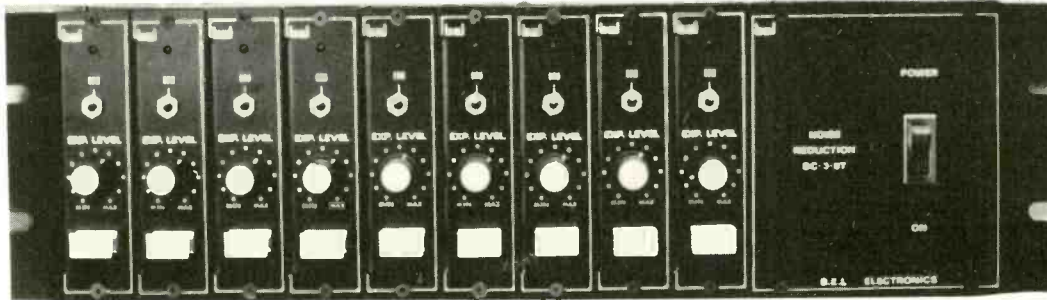
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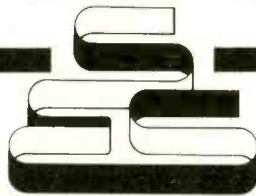


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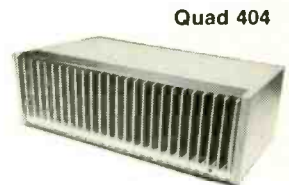
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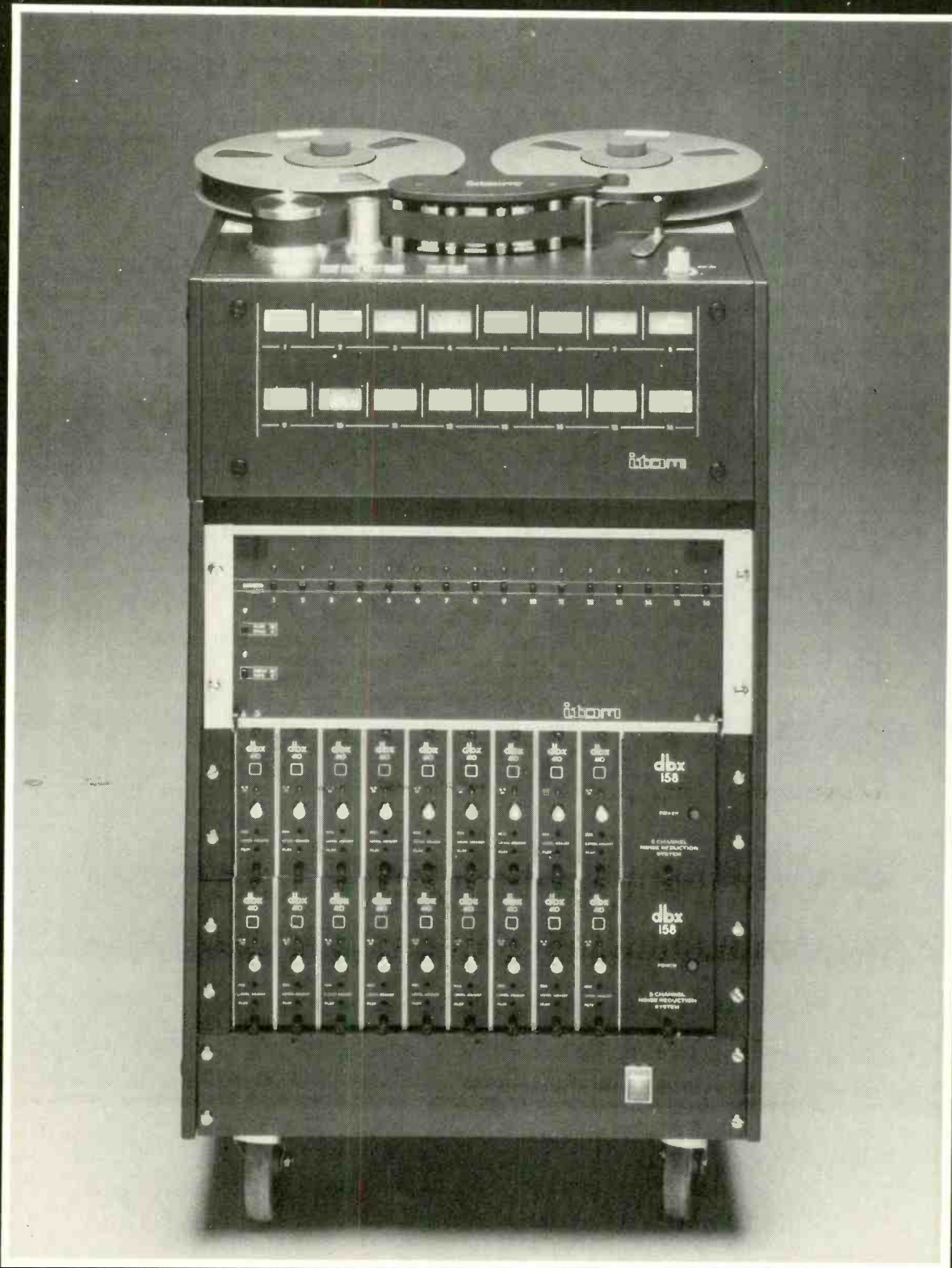
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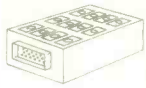
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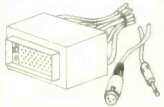
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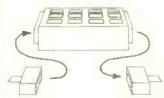
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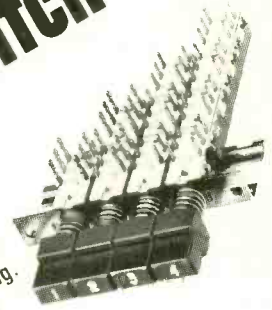
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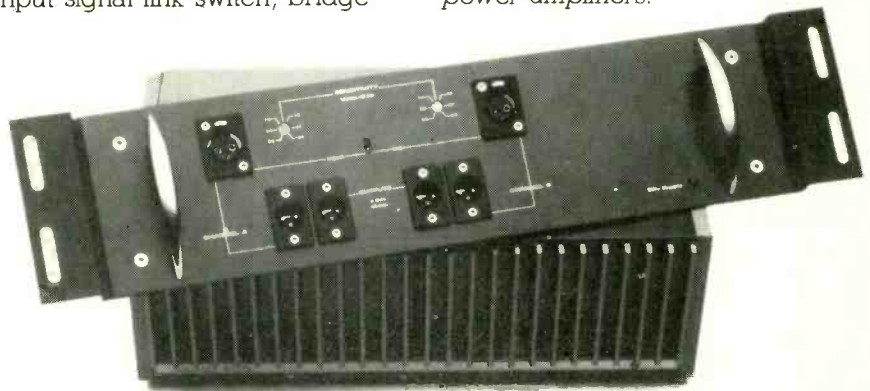
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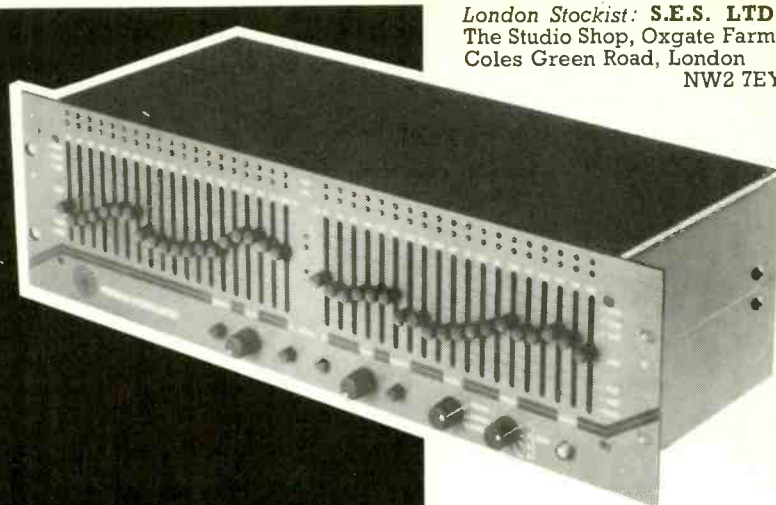
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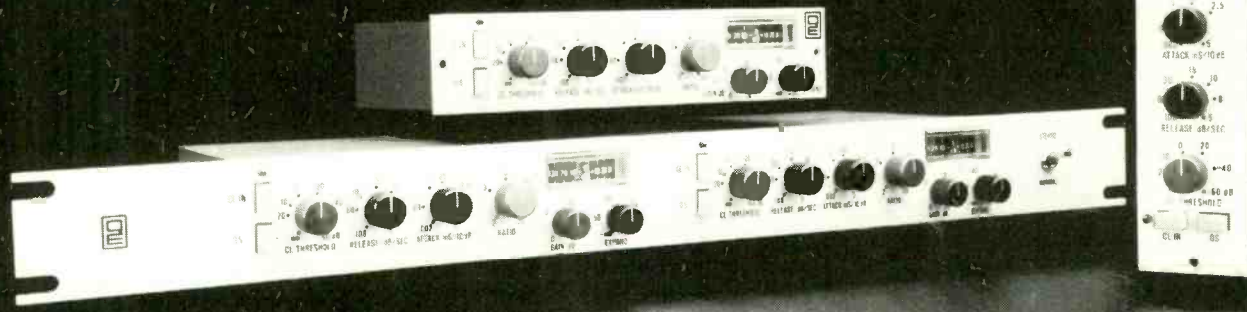
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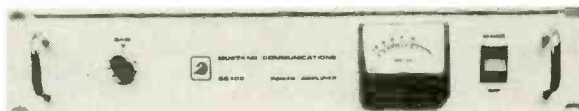
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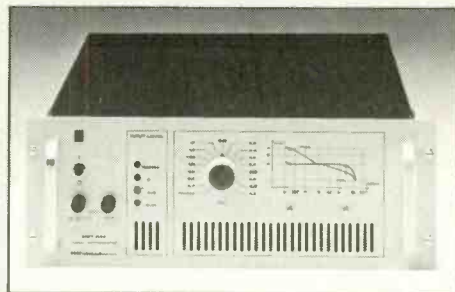
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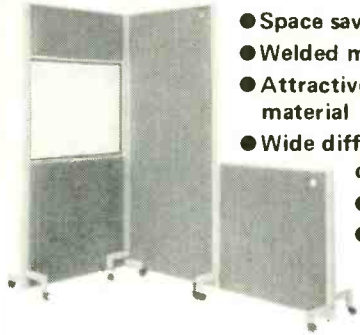
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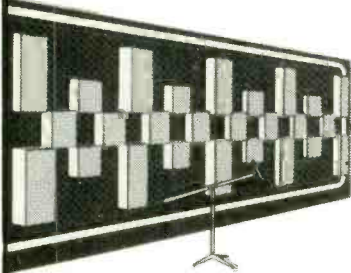
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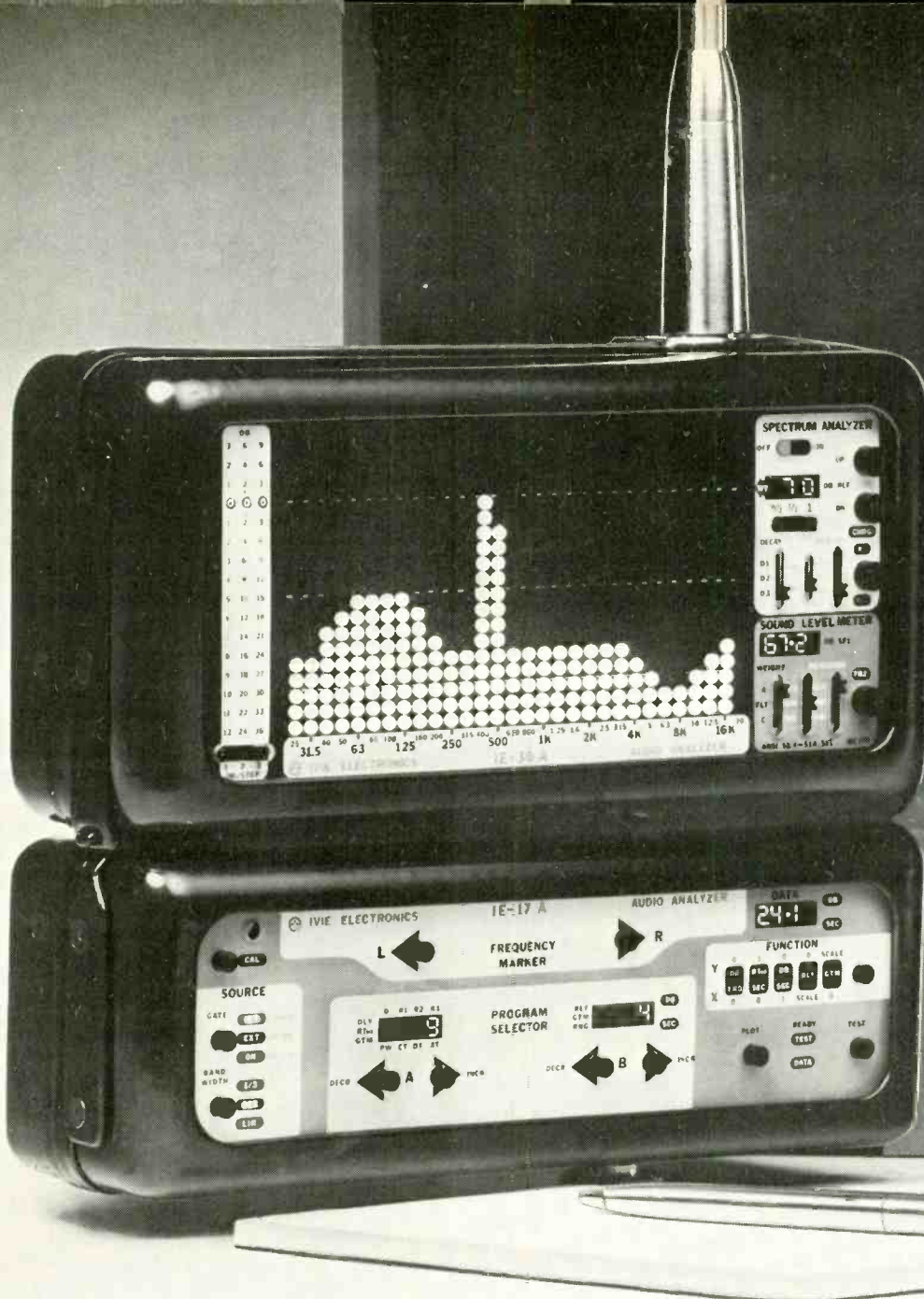


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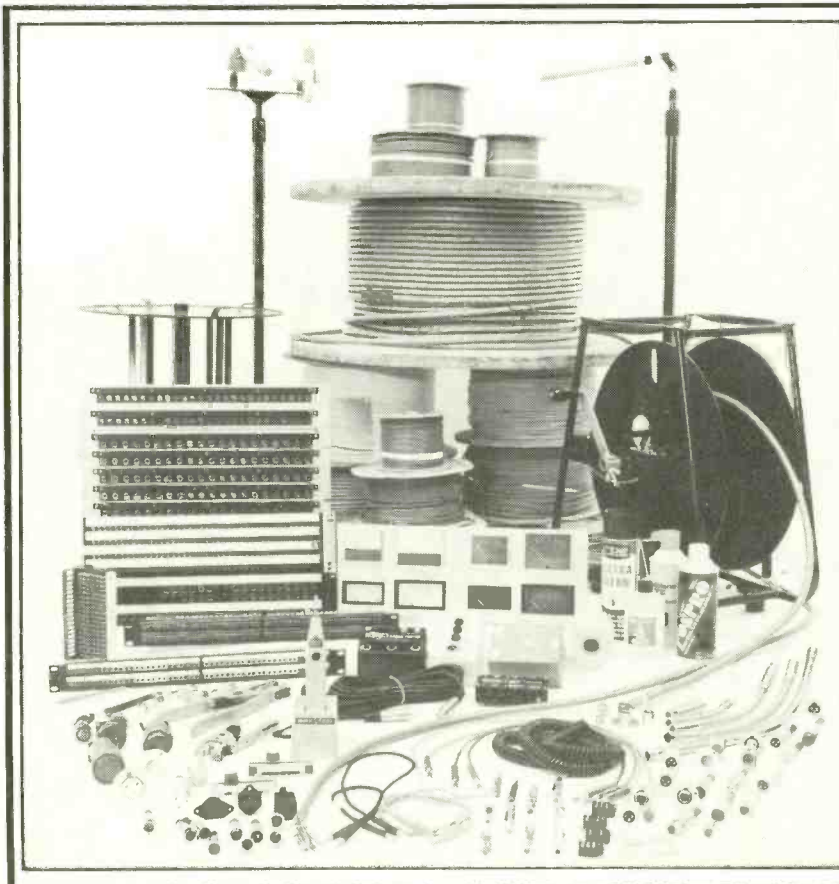
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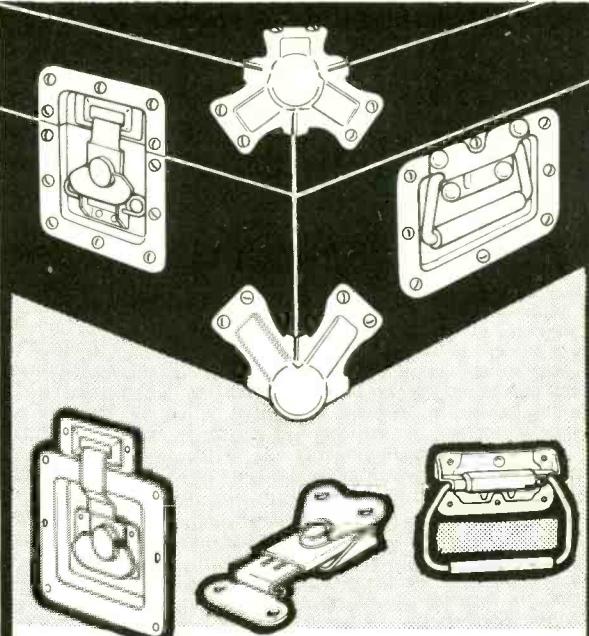
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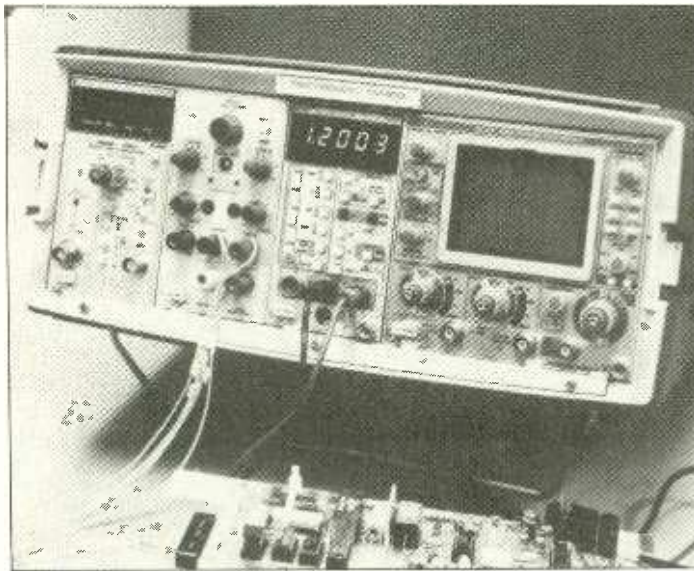
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Tektronix DM501A plus other TM500 modules

Tektronix digital multimeter

Tektronix has added the *DM501A* 4½-digit multimeter to its *TM500 Series* of modular test and measurement products. The *DM501A* features seven measurement functions comprising the usual ac and dc voltage and current ranges, plus resistance, dBm, dBV and temperature measurement capabilities. Measurable temperature range is from -62°C to +240°C and the unit's temperature probe contains a platinum sensing element for low thermal loading and fast response designed to withstand immersion at temperatures up to 140°C. Dc voltage is measured in five ranges from 200mV to 1,000V full scale; maximum resolution is 10µV; and accuracy is ±0.05% of reading plus 0.01% to 0.02% of full scale depending on the range selected. For ac voltages, five ranges may be selected from 200mV to 500V full scale; readings are true rms; and accuracy is better than 0.6% of reading plus 0.05% of full scale from 40Hz to 10kHz. On the dB scale -40dB, -20dB, 0dB, +20dB or +40dB ranges may be selected; readout may be either dBV or dBm; and accuracy is ±0.5dB from 20Hz to 20kHz. Dc or ac current is measurable in five ranges from 200µA to 2.0A full scale; maximum resolution is 10nA; and dc accuracy is ±0.2% of reading with ac accuracy ±0.6% of reading. Resistance is measurable over six ranges from 200Ω to 20MΩ full scale; maximum resolution is 10mΩ; and accuracy is ±0.1% of reading. A high/low ohms feature allows the user to choose whether semicon-

ductor junctions will be forward biased during in-circuit measurements. In addition to its own performance features the *DM501A* is designed to operate with other *TM500* modules including counters, oscilloscopes, signal processors, etc. To facilitate this a number of mainframes are available and the *DM501A* has backplane wiring to facilitate connection to other *TM500* instruments.

Tektronix UK Ltd, Beaverton House, Harpenden, Herts, UK. Phone: 05827 63141.

New IMF loudspeaker

IMF Electronics has introduced a new loudspeaker based on the *ALS 40*. The new loudspeaker system, the *ALS 30*, incorporates active transmission line loading as with the *ALS 40* but in an enclosure measuring only 22½ × 11½ × 11in (hwd). The system utilises two ribbed bextrene bass drivers (one as a sub-bass unit), plus a bextrene midrange unit and a domed tweeter, and is manufactured in matched mirror image pairs. Crossover frequencies are at 250Hz, 450Hz and 3.5kHz. Frequency range of the system is 29Hz to 20kHz; matching impedance 8Ω; efficiency 99dB (pink noise, at 40W at 1m); and is designed to be driven by amplifiers delivering up to 50W. Typical selling price is expected to be under £300 per pair. IMF Electronics, Westbourne Street, High Wycombe, Bucks HP11 2PZ, UK. Phone: 0494 35576.

Bauch lower prices

FWO Bauch has announced that due to the continuing strength of sterling it has been able to reduce the prices of the imported equipment for which they are the agents. Accordingly, prices have been reduced on the following ranges: Studer, EMT, Urei, Lexicon, ITC, Neumann and Transco. Full details are available from the company. Additionally, a comprehensive illustrated catalogue showing the ranges and units that Bauch handles is available on application. FWO Bauch Ltd, 49 Theobald Street, Boreham Wood, Herts WD6 4RZ, UK. Phone: 01-953 0091. Telex: 27502.

Altair mic cable tester

Altair has introduced a pocket sized microphone cable tester, the *CT-3*. The unit is 6in long by ¾in diameter with XLR connectors at each end and operates from a mercury battery. There are no buttons to push and the tested cable's conductors are tested simultaneously and continuously with a failure in any one causing one of two LEDs to be extinguished, while one LED remains illuminated to indicate the cable is under test. The *CT-3* checks for all common wiring faults such as shorts, open circuits and cross wiring (including reverse phase). The tester is provided with a remote testing accessory which allows a mic cable to be tested without the need for both ends of the cable to be brought together. Altair Corp, 202 West Bennet Street, Saline, Michigan 48176, USA. Phone: (313) 429-5454.

Mic cable tester, Altair



MCI exports to Eastern Europe

MCI has won nearly £500,000 of export contracts from Eastern Europe in the first half of 1979. This impressive total is made up of four separate orders for recording and mixing equipment from state broadcasting organisations in Hungary, Poland and Yugoslavia. Hungarian Radio has ordered two *JH-528* fully automated consoles for their music recording studios in Budapest with delivery to take place in January 1980, Polskie Radio i Telewizja is installing an automated *JH-536* console at its Poznan studio, while RTV Prstina in Yugoslavia has ordered two automated *JH-532* console and a 24-track tape recorder. The largest single order is from Radio Skopje in Yugoslavia where its new music studios are to be mainly MCI equipped with five automated *JH-532* consoles and six tape recorders in various configurations including 8, 16 and 24-tracks. Other recent MCI contracts include orders for four *JH-600 Series* automated consoles to various studios in Sweden including Polar Music Studios and the National Swedish Theatre.

Thermodyne shipping cases

American manufacturer Thermodyne International has notified us of the availability of two ranges of low-cost, low-weight shipping cases. The first range, called *Shok-Stop*, is available in 77 standard sizes suitable for shipping a wide variety of equipment, and the second, named *Rack-Pack*, is for standard 19in rack units and is available in a number of sizes to take units of various heights. Both case ranges are manufactured from polyethylene; have recessed ribs to absorb shock and vibration energy; are virtually dentproof, crackproof and scuffproof; have airtight hinges and recessed latches and carrying handles; and in the *Rack-Pack* range have elastometric shock mounts for shock and vibration isolation of the internal rack. All the cases have a complete watertight seal, can withstand all common industrial solvents, and can be stacked. A number of optional accessories are available including removable castors. Thermodyne International Ltd, 12600 Yukon Avenue, Hawthorne, Cal 90250, USA. Phone: (213) 679-0411.

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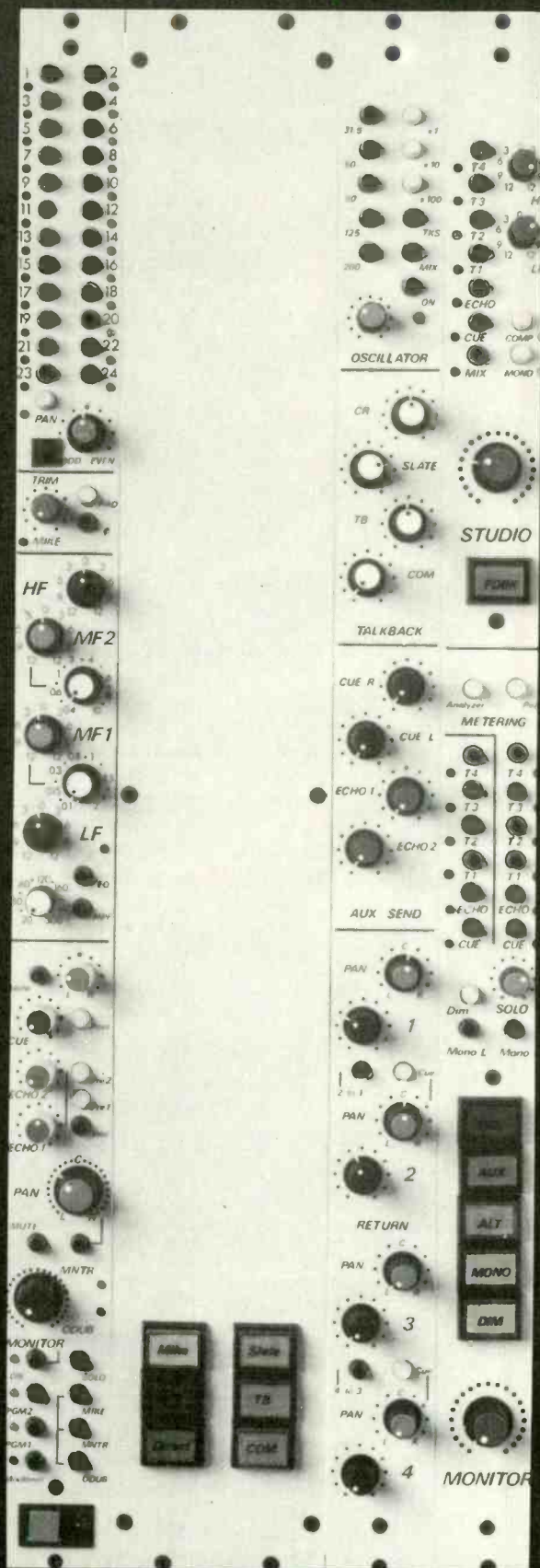
SAVE MONEY SAVE TIME

WHAT IS OPTIONAL FOR THE OTHERS IS FOR US A MATTER OF COURSE

- * From 16 to 52 in/out channels
- * 24 channel busses including panning
- * 4 band parametric equalizer
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- * Up to 28 sends as standard
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- * Momentary short travel mute switches
- * All solo facilities including «Solo in place» either in monitor or in remix mode
- * 3 master status logically reversible on each channel
- * 28 light meters either vu or PPM and phasemeter as standard
- * 28 Iso frequency third octave analyzer
- * PLUS 30, RS64 automation with separate mute and level encoding using one 6502 microprocessor per channel
- * High quality and high performance components
- * Tough, reliable and attractively designed

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75005 PARIS - Tél. 634.01.36
FRANCE





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

Angus McKenzie (March 1978)

REVOX

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

Foreign Agencies

Quad-Eight has announced the appointment of Studio - Centre, Paris as its exclusive French distributor. All French enquiries should now be referred to: Studio-Centre SA, 3 Rue du Télégraphe, 75020 Paris, France. Phone: 362 7310.

In a reorganisation of the dbx distributorship in West Germany the West German marketing operation is being split into three regions; north, central and southern, each being handled by a regional distributor. The first regional distributor to be appointed is Audiolive run by Klaus Schonbohm which will cover the central area. Audiolive, Kyfhauserstrasse 10A, 5 Koln I, West Germany. Phone: 221-230910. Telex: 8881094.

Special Audio Products BV has been appointed exclusive agent for the Allen & Heath/Brenell ranges in the Netherlands. All Dutch enquiries should be addressed to Special Audio Products BV, Scheldeplein 18, Amsterdam, The Netherlands. Phone: 020 797055.

Audio Kinetics and Advanced Music Systems products are now being handled in the USA by Quintek Distribution Inc, Suite 209, 4721 Laurel Canyon Boulevard, North Hollywood, Cal 91607. Phone: (213) 980-5717.

Contracts

● Neve has supplied Sound Labs, Los Angeles with an 8068 console, with a custom 48-channel *Necam* automation system for a new mixdown room.

● Audio & Design (Recording) has supplied *Scamp* systems to Crystal Recording Studios, Hollywood; Lansdowne Studio, London; and to Town House, London where the system is installed in the main console.

● Quad-Eight has just sold its 51st console in Japan. The console is a 32/24-channel model for the MIT Studio.

● Sierra Audio is to design an audio post production facility for Vidtronic in Hollywood. In addition Sierra has designed an audio/video production and editing complex including an acoustically designed video shooting stage for Premore Inc in North Hollywood. Sierra is also to design a new 7-room facility for one of Hollywood's leading film scoring studios.

San Francisco based sales and marketing organisation, Parasound, has been appointed exclusive worldwide distributor (excluding Europe) for the Synton Electronics range of vocoders and effects units. Parasound Inc, 680 Beach Street, San Francisco, Cal 94109, USA. Phone: (415) 673-4544.

Rebis RA200 Series

Rebis Audio has added a number of new modules to the *RA200 Series* modular ancillary equipment system. The first module in the series, the *RA201* noise gate was detailed in Studio Sound, May 1979 p 24. The new modules comprise the *RA201X* Kepex retrofit noise gate, *RA203* comp/limiter, and *RA204* parametric equaliser. Other modules which will be available in the near future comprise the *RA202* de-esser, *RA205* ADT/delay module, *RA206* oscillator, and *RA207* LED meter. The new *RA203* comp/limiter features continuously variable ratio from 1:1 to 40:1, wide range (20 μ s - 1.5ms) and release (50ms - 3s), LED indication of gain reduction, and the facility of linking two units together for stereo operation or voice-over. The *RA204* parametric equaliser offers up to 21dB of boost or cut, variable bandwidth from 5.5dB/octave to 36dB/octave, LED overload indication, and continuously variable frequency in two ranges—20Hz to 2kHz and 200Hz to 20kHz. Prices for the modules currently

Producers Sound.

● RDW Associates is to renew the audience and stage sound system in the Fairfield Hall concert auditorium in Croydon.

● Alice is supplying three announcer and three presenter desks to the BBC for new network continuity suites in Scotland and Belfast.

● Philip Drake Electronics has received an order from Scottish Television for a commentators communication system for OB use.

● Sound City, Los Angeles has taken delivery of a custom Neve *Necam* computer assisted mixdown system for its Studio A Neve console.

● TCI has been awarded a \$1.8 million contract by the Swedish Telecommunications Administration for the supply and installation of *Model 611* wideband, high-power shortwave antennae and ancillary equipment.

● Neve has supplied Queen Village



Tresham SR402

available are *RA201* £62, *RA201X* £65, *RA203* £115, *RA204* £62, while the *RA200 Series* 16-channel rack costs £80 and the power supply unit £78.

Rebis Audio, Kinver Street, Stourbridge, West Midlands DY8 5AB, UK. Phone: 0384 71865.

New Tannoy Cheviot

Following a 9-month break in production Tannoy's *Cheviot* loudspeaker is being re-introduced, fitted with the new *DC316* 12in dual concentric drive unit. The *Cheviot MkII* is a floor standing loudspeaker in a walnut veneered cabinet and is a ducted port design. Size of the loudspeaker is 33 $\frac{1}{2}$ x 18 x 10in (hwd) and it has a power handling capacity of 60W into 8 Ω . Specifications are frequency response 40Hz to 20kHz \pm 4dB, crossover frequency 1.2kHz, and sensitivity 90dB at 1W at 1m. Price of the *Cheviot MkII* is approximately £230.

Tannoy Products Ltd, St John's Road, Tylers Green, High Wycombe, Bucks HP10 8HR, UK. Phone: 049 481 5221.

Tresham Audio

Tresham Audio Ltd, previously known as PA:CE Studio Equipment Ltd, has introduced the *SR402* MOSFET power amplifier. The *SR402* is a low distortion, high slew rate design rated at 200W per channel into 8 Ω , and is fitted with comprehensive protection circuitry and with the facility for ac or dc coupled operation. The amplifier has complete thermal stability and features twin peak reading LED columns giving power output indication at 8 Ω . A rear panel switch allows the unit to operate in bridged mono mode (500W into 8 Ω). The unit is optionally available with electronically balanced inputs, while an accessory fan unit is also available for heavy duty use. Quoted specifications are frequency response 20Hz - 20kHz +0, -0.2dB ac coupled; THD less than 0.008% at 1kHz, 200W into 8 Ω ; intermodulation distortion less than 0.02%; rise time 1.5 μ s; slew rate 80V/ μ s; and hum and noise -110dB ref max output.

Tresham Audio Ltd, 32 Tresham Road, Orton Southgate, Peterborough, Cambs, UK. Phone: 0733 234340.

The Hands-On Sound Show

Turnkey along with AKG, Teac, Soundcraft, MXR and Allen & Heath are mounting a 2-day active workshop with lectures on acoustics, effects, mics and multitracks on Dec 7-8, 1979 at the Kensington Close Hotel. For details phone 01-440 9221.

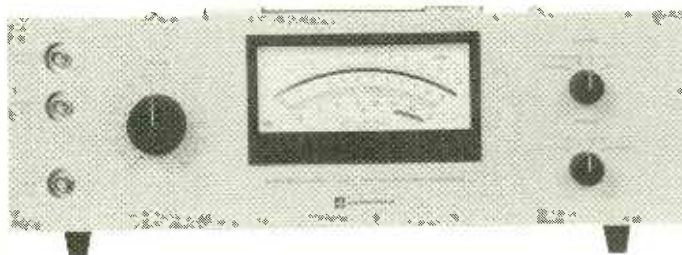
Hammonds acquire Libra

Hammond Industries has acquired Libra Electronics Ltd the well known theatre sound control console manufacturer. With the acquisition Hammonds anticipate that delivery of Libra consoles will be improved to an ex-stock situation with the added benefit of improved world-wide sales and service facilities. Libra informs us that recent console deliveries have been to the Wolsey Theatre, Ipswich, and to the Wimbledon School of Art. All enquiries for Libra should now be directed to: Libra Electronics Ltd, 105-109 Oyster Lane, Byfleet, Surrey KT14 7JH. Phone: 09323 51051. Telex: 262525.

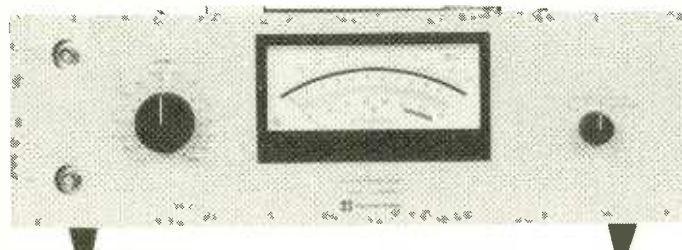
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Wayne Kerr Radford noisemeters

Wayne Kerr Radford has introduced two new noisemeters, the *ANM3* and *ANM4*, compatible with a wide range of recording studio and broadcast equipment. The *ANM3* is switchable quasi-peak/true rms responding; is suitable for low noise applications; has a sensitivity of $10\mu\text{V}$ fsd; and incorporates weighting filters to DIN, IEC 'A', and CCIR. The *ANM4* has an average responding meter and provides 16 measurement ranges, incorporates a modified CCIR filter with 2kHz unity gain, and has measurement circuitry conforming to Dolby recommendations. Both noisemeters have two sets of buffered inputs and outputs to accommodate external filters. Wayne Kerr Radford, Wilmot Breeden Electronics Ltd, Durban Road, Bognor Regis, West Sussex PO22 9RL, UK. Phone: 02433 25811.



Above: *ANM3* Noisemeter from Wayne Kerr Radford and Below: *ANM4* Noisemeter



People

● Joe Schick has joined Sugarloaf View as a managing partner responsible for business management, client relations and design consultation.

● CA Audio Systems has appointed Geoffrey Sore as sales manager and Tim Shuttleworth as engineering manager. Both were previously with Neve.

● Sid Zimet founder of Audio by Zimet and co-founder of Sound Workshop has joined Audio-techniques, the professional audio sales, rental and engineering company.

● In the recent Queen's Birthday Honours List two well known UK audio personalities received awards: consultant Angus McKenzie became an MBE, while Raymond Cooke, co-founder and managing director of KEF Electronics was awarded the OBE.

● JBL has made a number of appointments to its international division: Randy Patton joins the division as sales manager, consumer products; Garry Margolis becomes sales manager, professional products; and Ruth McNevin becomes operations manager.

●BGW Systems has appointed Peter Horsman as vice-president, marketing.

●Ken Talbot has been appointed audio quality control manager for the new Technical Centre which Memorex (UK) Ltd is setting up at its Staines offices.

●Magnetic Components Ltd has appointed John Farmer as its managing director.

●Neve has appointed John Hughes

to the position of sales manager for the UK and selected overseas areas.

●Former financial journalist and merchant banker Nicholas Leonard has been appointed a director of Millbank Electronics Group Ltd.

Anti-static Concrete!

We have received details of an unusual product from Marconi called *Marconite* which is a conductive concrete offering the possibility of permanent earthing, protection from the hazards of static electrical charges and microwave frequency screening. *Marconite* is a granulated electrically conductive aggregate which replaces normal concrete fine aggregates such as natural sand, permitting electrically conductive concretes to be designed by applying conventional concrete technology. Used in concrete construction work, in place of more normal aggregates such as sand, it produces grouts and concretes of normal compressive strength with a wide range of resistivity values. For example, compared to metals the volume resistivity of conductive concrete is high and can range from $0.5\Omega/\text{cm}$ or lower, for preformed sections cured under pressure, to $15\Omega/\text{cm}$ for trowelled floor screeds. *Marconite* is chemically inert at normal temperatures, and in particular, the sulphate and chloride contents are low, thus permitting it to be used with all conventional types of cement, proprietary resins, plasters and adhesives. Although developed by Marconi, who will

provide technical back-up facilities, the product is being manufactured and marketed under licence by the Pitch Marketing Company, a subsidiary of Simon Engineering. Pitch Marketing Co Ltd, GR House, 134/138 Borough High Street, London SE1 1LB, UK. Phone: 01-407 7070.

Allison Research EGC-101 VCA

Allison Research has introduced the *EGC-101* low cost 8-pin miniature VCA offering a gain control range of from in excess of 100dB attenuation to over 50dB gain. The control law is precisely logarithmic (dB vs Volts) over this range. The basic electronic gain control cell is intended primarily for OEM manufacturers and requires a minimum of external circuitry (one dual op-amp, resistors and capacitors) for precision VCA implementation. Price of the *EGC-101* ranges from £12 to £17 depending on the quantity ordered. Allison has also produced several complete factory trimmed VCAs utilising this cell: the *EGC-202* a physical replacement for the dbx #202 VCA; the *EGC-205M* a physical and electrical replacement for the Allison *VCA-5M*; and the *EGC-2500* a physical and electrical replacement for the VCA sub-assembly in MCI *500 Series* consoles. Allison Research Inc, 2817 Erica Place, Nashville, Tenn 37204, USA. Phone: (615) 385-1760. UK: Scenic Sounds Equipment, 97-99 Dean Street, London W1V 5RA. Phone: 01-734 2812.

WES equaliser

Further to our news item in September on Windsor Electronic Systems we have received additional information on the company's dual channel 4-band equaliser. This unit is designed specifically for use as a line correction amplifier for broadcast use, and has four discrete bands of lift and cut with variable frequency: Band 1 30Hz-300Hz $\pm 14\text{dB}$; Band 2 150Hz-1.5kHz $\pm 14\text{dB}$; Band 3 400Hz-3kHz $\pm 14\text{dB}$; and Band 4 1.5kHz-5kHz $\pm 14\text{dB}$. Inputs are $10\text{k}\Omega$ unbalanced with outputs at 600Ω unbalanced. Frequency response is $\pm 0.2\text{dB}$, 20Hz-20kHz with THD less than 0.05%. The unit is a 19in rack model and costs approximately £450.

Marketing is by Alice (Stancoil) Limited, 38 Alexandra Road, Windsor, Berks, UK. Phone: 07535 51056.

New Revox B77 options

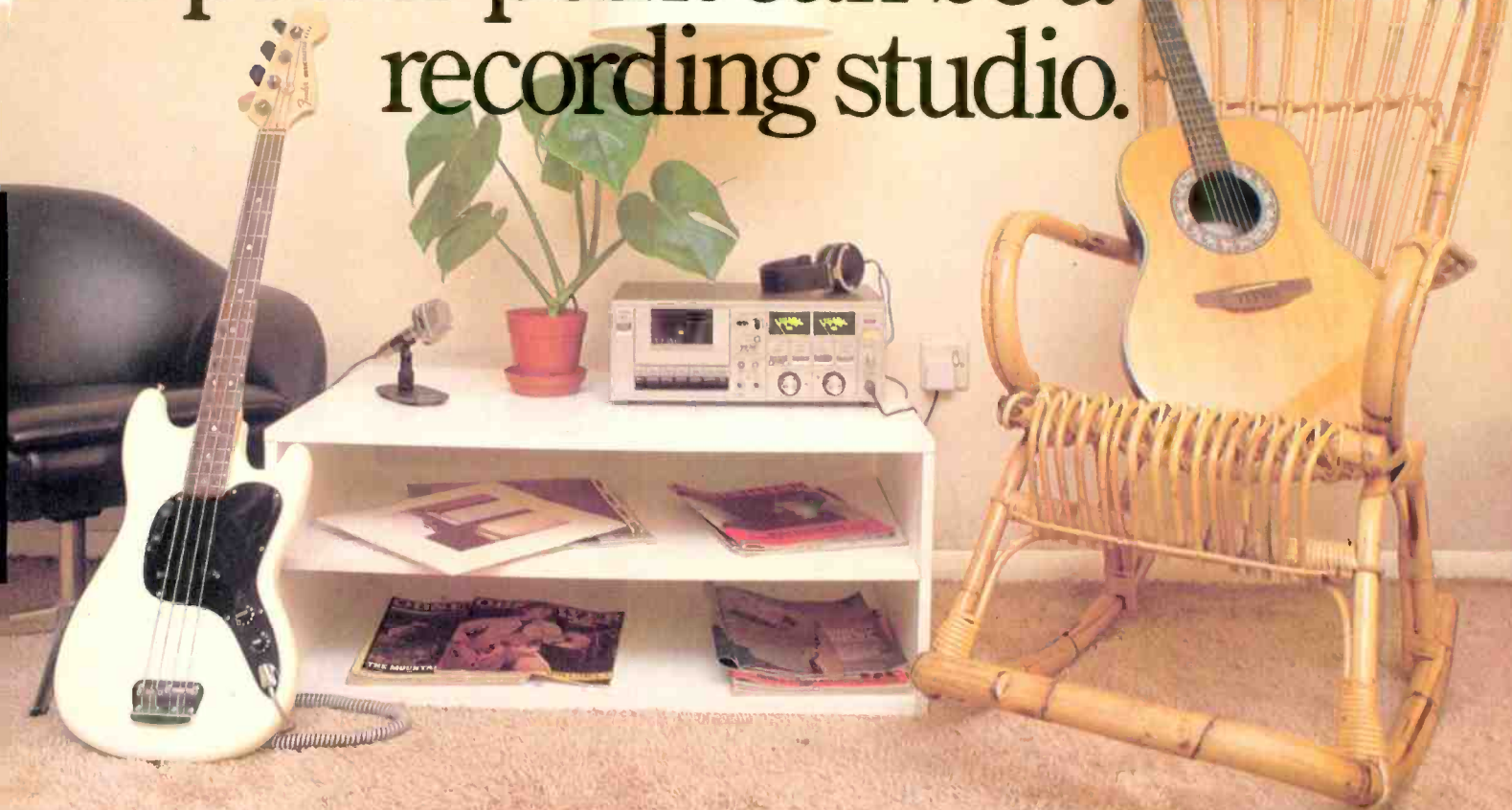
Revox has introduced several new versions of the now established *B77* tape recorder. The first model option is a *Self Sync* variant, which has the facility for synchronising a prerecorded signal on track 1 with a new signal being recorded on track 2, using the record head for playback of track 1. This version is available in both high speed ($7\frac{1}{2}/15\text{in/s}$) and standard speed ($3\frac{3}{4}/7\frac{1}{2}\text{in/s}$) formats. Other model options introduced are a super low speed ($1\frac{1}{8}/1\frac{1}{4}\text{in/s}$) version and an automatic (voice operated) start/stop version.

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

Plus 30

French console manufacturer Plus 30 has moved to new headquarters in the north east of Paris. The new premises of 7,200 ft² has allowed the company to bring together under one roof its manufacturing, management and administration staff, and has also allowed it to provide a large demo room. The need for new premises has come about due to a full order book stretching well into next year. At the moment Plus 30 are supplying two *RS80* consoles to the Studio de la Grande Armée, a 2-studio Eastlake designed complex situated at the Palais des Congrès, Paris. The consoles are respectively 52/48 and 36/24 configuration desks. Plus 30, 37 rue des Annelets, 75019 Paris, France. Phone: 202.21.02/202.58.69.

From today, anywhere with a power point can be a recording studio.



Up till now, if you were serious about making high quality, two-track simul-sync recordings, you had to resort to sophisticated reel-to-reel equipment.

Up till now.

Because we'd like to introduce you to the revolutionary TEAC A-108 Sync.

It's the world's first-ever two-track simul-sync cassette machine.

And it'll produce beautiful synchronised stereo recordings just like a multi-track reel-to-reel, only with all the simplicity and convenience of a cassette deck.

For the aspiring star, the A-108 Sync represents a unique opportunity to get recording experience without the horrific expense of a recording studio.

While to the fully-fledged professional it means a lot of studio time could be more profitably (and more comfortably) spent at home.

What can the A-108 Sync do?

Take one look at the controls of our machine and you'll realise it's more a question of what it can't do.

For a start, head layout and circuitry has been so designed as to allow you to record left and right channels individually, one after the other, in perfectly synchronised stereo.

Let's take an example.

You lay down your lead track on the left channel. You rewind. Then, while listening to the lead track back through the cans, you can over-dub the bass track on the right channel.

Play back the result, and you'll find both channels have been recorded in perfect sync with each other.

Then, to get some idea of how the vocals would sound, the A-108 allows you to place your voice in the middle of the two-track recording.

You can even hear yourself simultaneously on the cans while using the music blend control to adjust the mix of the new track to exactly how you want it.

We didn't stop there.

The A-108 Sync also boasts a mic/line mixing feature which lets you record your own voice or instrument on to your favourite record (so you can show them all how it should be done).

And once your recording session is over, you only have to flip the 'Cross-Feed' switch to blend left and right channels together to give that 'live' stereo feel to the final result.

As you'd expect, a machine like the A-108 Sync has all the advanced features normally found on TEAC cassette decks.

Features like the finely engineered and highly reliable transport system; the sophisticated Dolby circuitry; and independent bias and equalisation selectors.

Nor have we forgotten the memory re-wind facility built into the tape counter.

Where we did stop.

There is, however, one feature of the A-108 Sync that's conspicuous by its absence: the hefty price tag.

Incredible though it may sound, you'll find the machine retailing at around £200.00 plus VAT.

The way we see it, that's a mighty small price to pay for indefinite studio time.

Please send me a free information pack on the revolutionary TEAC A-108 Sync cassette deck and its accessories.

Name

Address

Post Code

SS.T.12
Harman UK, St. John's Road, Tylers Green,
High Wycombe, Bucks HP10 8HR.
Telephone: Perm (049 481) 5331. **TEAC**

studio diary



Left: Control room of Studio A, the largest. Above: the small Studio E.

Filmways/Heider—San Francisco

In the October issue (p.33) we covered the Los Angeles end of the Filmways/Heider empire. This month, in strong contrast, their San Francisco studios which, although being part of a corporate giant, have a small friendly (although business-like) atmosphere—similar to many large but independent studios. However, although in operation for 10 years, Heiders San Francisco are *not* independent; their budgets are firmly controlled by the powers that be in LA, but I definitely got the impression that they'd wish to control their own destiny given the choice.

Second engineer Marnie Moore showed me the studio complex which consists of one small and three large studios; the three large studios each have a grand piano, each tuned twice a week. There is also a games/rest room, copy room, maintenance area and outboard equipment room.

The small studio 'E' on the first floor is used almost exclusively for media work and contains an extensive sound effects library. It is occasionally used for very crowded 24-track music sessions and has an in-house designed custom console with Klipsch monitors.

On the same floor is studio 'C', a favourite with many, which is equipped with MCI board, 3M and Ampex tape machines, Urei limiters

and Altec 604 monitors. It's a very live studio with hard surfaces on floor, walls and ceiling. But at the same time, the characteristic of the room can be varied enormously with numerous folding wall panels. It smacks of the Sixties in terms of decor but is due for a face-lift.

Still on the first floor is studio 'D' which is in the final stages of remodelling. It will include a brand new Neve 24/32 console, replacing a custom DeMedio (a great board built for 16-track updated to 24-track but finally had its day), Urei time aligned monitors and new Yamaha amplifiers replacing the old Macintosh tube amps evidently giving a cleaner high end. The studio is 15x30x13ft, much the same size as 'C' but dimensionally different and acoustically much less live. The present reconstruction did not change the acoustics of the studio (simply the look) but the acoustics of the control room have been improved significantly: the whole back wall having been redesigned eliminating previous problems with bass standing waves. Ancillary-wise, the room is permanently equipped with Urei limiters, Eventide delay unit, API equalisers and Kepex gates.

Downstairs is the largest studio, 'A', it is 20x35x12ft and, on my arrival, a session using a 24-piece orchestra had just finished. The board is another Neve almost

identical to that of 'D' but with four more inputs. Apart from the standard 3M 24-track 'A' also has a new *ATR100* while outboard equipment has the standard Urei limiters as well as Pultec, Lang and API equalisers.

On to the copy room, devoted mainly to media, duplicating cassettes, mono, 2-track and 4-track reels simultaneously; plus the maintenance area which is very business-like and tidier than most I've seen with a full-time crew of three by day, two by night and one on standby.

So what happened to studio 'B'? Well, it became the games room with pool table, pinball and refreshments.

The outboard equipment room is well stocked with Urei limiters, Pultec, Lang and API equalisers. Eventide DDL's, an ADR *Vocal Stresser*, which is soon to be augmented by a *Scamp* system; and probably the largest collection of microphones in the West, enabling three full sessions at any one time. In addition to all this, an echo facility consisting of two EMT plates, two large and two small live chambers—more than adequate.

Marnie had to cut off the tour at this point to do some engineering leaving me with Ginger Mews (studio manager) who gave me some background information to Heiders SF.

Ginger has been with Heiders since day one with a brief sabbatical elsewhere. On April 27, 1969, Wally Heider opened the San Francisco studios after Filmways bought his LA operation—that makes this year their tenth anniversary (and their anniversary party was a lot of fun . . .). The studio started with one room. What is now the games room was planned to be a mix room, but a space was needed for people to 'hang out' which is why there is no studio 'B'—the same thing happened in LA incidentally, eliminating Studio Two.

Jefferson Airplane were their first clients and still use the studios regularly as Jefferson Starship—but just about every local band has used Heiders—the Grateful Dead were regular customers until they built a studio of their own.

The studio was the first 16-track and 24-track in town, and in those days there was little competition making it a lucrative period for Heiders. Then in the early Seventies masses of small studios opened their doors. With the growing competition and the 'SF Sound' changing, many studios were forced out of business . . . Ginger philosophises: "What with the problems of clients always demanding the latest equipment, so much of which is fashionable and short-lived in popularity, all of which is expen-



Above: Control room of Studio C.
Right: Studio D nearing completion.



sive; if you don't have the capital to stay out front (you have to put up the money before you can get it back) and find that clients dislike what you've bought, you don't survive. For example, for years Heiders wanted a Neve console. When we finally got one, the first client to come in said: 'Oh I never work with Neve so I can't use the studio'. Whatever colour you paint the walls there will always be someone who won't use the studio because it's the wrong colour. You have to accept that you can't please everyone."

"Still, it's hard sometimes for the big studios to make ends meet unless they can charge a very low rate. Heiders finds this hard because they have a large overhead including 22 staff which makes it impossible to offer the studios for \$20 an hour—the PG & E bill exceeds that."

Within the last year, San Francisco has been enjoying a renaissance while Los Angeles has remained relatively static. "A few years ago local people were saying LA is the place to record and wouldn't think of San Francisco. New producers are looking elsewhere and San Francisco is one of those places (like Seattle and Florida). New York is trying hard to improve their recording industry but are being forced to ask \$250 per hour in many places plus it's

an expensive place to stay."

Heiders avoids many of the problems caused by the whims of the music industry by opening its doors to the media. Advertising is a constant source of income and is good 'bread and butter' money; hence the decision to build the Media studio which allows the bigger studios to continue their function as music studios which would otherwise be tied up wasting space as well as sophisticated equipment. This also means Heiders can charge less for the Media studio. When the music studios aren't making music, then it's media that fills those too—often with very large budgets.

As to the future—opportunities in the Bay Area are improving and looking good. "There is no way of knowing how long this will last . . . record companies are not giving the budgets they used to, and of course the economy, oil and record prices going up all play their part . . . but it looks good for at least another two years."

It does indeed look good for Heiders—with as much media work as they need, several film soundtracks completed recently (including *King of the Gypsies*) and an expanding film industry in the Bay Area promising more of the same; with Sammy Hagar in 'C', June Millington in 'A', 'D' almost completed, and bookings ahead with

the likes of Allen Toussaint and Greg Kihu to name but two . . . many thanks to Ginger and Marnie for a very interesting and pleasant visit to Filmways/Heider, San Francisco.

Enbee
Filmways/Heider Recording, 245 Hyde Street, San Francisco, California. Phone: (415) 771-5780.

Soundpush Recording Studios, Holland

When you are a leading jazz musician in a country too small to support a really top-flight jazz scene you have several choices. If dedicated enough, you can keep on playing your kind of music to a limited public for small fees, or you can go abroad. On the other hand, if you want to stay in your own country, and be happy and make money, you have to find something else to do. That was the position facing Frans Mijts, one of Holland's top horn players, some 13 years ago. Like many musicians before and since, he decided to get into the recording side of things. Unlike most musicians, he started his own studio, Soundpush, in Blaricum, and in the intervening 12 years it has won itself a good reputation as a solid, no-nonsense, friendly studio.

"The studios in the Netherlands

were generally so bad 12 years ago, that I figured a decent one had to succeed. One of my first priorities was to have a different sound to anyone else, using different equipment. At that time Sony were making a cautious entry into the market, and I ordered one of their 8-track consoles. When it arrived it turned out to be fixed construction and not modular, so I sent it back. Sony then phoned me, and offered me a month's paid trip to Japan to specify what I wanted. I went, and the result was a fantastic console. It was the only one they ever made. I had it for years, converting it from 8- to 16-tracks, and used it to mix international hits like *Venus* by Shocking Blue, and *Ma Belle Amie* by the Tee Set, which was a big hit in the States. Unfortunately there wasn't enough room to expand it further, so when 24-track came along, we let it go for a 'sentimental' price to a small studio where it's still giving great service," says Mijts.

Soundpush is in fact a converted variety theatre on the outskirts of Blaricum, in the Hilversum area. There are two studios, a large 24-track, and a smaller dub studio recently converted to 24-track. Before converting it to a studio, Mijts looked at 'The Eastlakes and the Westlakes', finally doing the conversion himself with Adrian

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Kerridge of Lansdowne Studios and Clive Green then of Cadac. Being a theatre, the original building already had reasonable acoustics and the original auditorium and podium are still recognisable in the 2690 sq ft studio. The podium is still used by bands recording sessions for radio and TV. A new drum booth, with corridor, and a trapped bass cabinet were completed in 1978, when the control room also underwent a complete redesign and rebuild. Since then it has had a nasty attack of the ubiquitous shaggy red carpets, as has the control room for Studio Two.

The present set-up in the control room of Studio One is a Cadac 24-track mixing console, 16-output, four echo send and eight return channels. Recording is on Ampex MM1200 24-track with 15/30 in/s and Dolby M24H unit, two Studer A80-RCs with Dolby A361 units. Studio monitoring is with JBL 4343s, with Tannoy HPD 385A driver units and Auratone's. Amplification is with Harman Kardon Citation 16, H/H TPA 100D and Quad 303s. A special Soundpush cellar, and EMT stereo and mono plates, provide reverberation. There is an impressive amount of peripheral equipment including an Altec Lansing Acousta Voicette 2x24-way equaliser, Rebis stereo limiters/compressors, Synton time machines and bandfilter/phasers, Audio & Design Vocal Stressers and sweep equalisers, Eventide Harmonizers and Instant Flangers, Aphex Aural Exciters, Urei limiting amps, Allison Research's Kepex and Gain Brain, an H/H echo unit and Soundpush's own special purpose limiters. Microphones include a wide range of Neumann, U47s, U67s, U87s, VF14 and NuVistor, KM84 and 86, Sony C38, CB12, C57 and C500, Electro-Voice RE20, Sennheiser MD421, Shure SB545, and AKGs D707C, D12 and D202.

Soundpush specialises in shorter bookings for Studio One, and like many smaller studios it has had the galling experience of having to turn down big-name acts who wanted 3- or 4-week occupation. Both the Rolling Stones and David Bowie have been interested in Soundpush, but as Mijts says: "For three weeks, I might have to put off 20 regular customers, and you simply can't do that and survive".

However, Studio Two will be block-bookable, but for a day or days throughout the year. In other words, one might hire it for every Monday in the year. So far Monday, Tuesday and Wednesday are fully booked for the first year. So perhaps this will give better

flexibility for longer bookings. Studio Two will be completely up to the standard of Studio One, when completed and the emphasis will be on easy operation (Mijts is thinking about a computerised console) as the studio will not supply engineers, merely technical backup if needed. Soundpush has two permanent engineers, Jan Schurman and Maarten Hartrich, and uses a number of freelancers including Englishman Jay Denson. Engineers come expensive in the Netherlands, Hfl 60-70,000 per year, and Mijts is more than happy to use freelancers or for musicians to 'bring their own'. "Most engineers are virtuoso jugglers rather than technical people here, but even so it's difficult to keep up a fresh supply. It's difficult for a senior engineer to get enthusiastic about some thinly talented group. But that enthusiasm has got to be there. Even when English lyrics have literally to be added word by word the engineer mustn't get cynical. You can only do it for a while. It's a young man's game, like football. So the situation with Studio Two is perfect. The people who have hired it so far are independent producers working for big companies, the three of them all have their own key, so it makes it very easy for us from an administrative and personnel point of view."

Talk of jaded engineers and 'endless dubbing' of lyrics, points to Soundpush's main market; standard and progressive pop with a fair bit of TV and radio session recording, film music, advertising jingles etc. Most of the internationally known Dutch artists, George Baker, Golden Earring, Kayak, Lucifers Friend, Earth and Fire, Ekseption and so on have recorded here. The whole Dutch WEA stable in fact are regulars here, and Jan Akkerman and Kaz Lux recorded their album here.

"We used to be known as a jazz studio," says Mijts, fondly recalling sessions with Ted Jones and Mel Lewis. "One, two, three take, and that was it. The better the musicians the less problems you had. A lot of musicians nowadays are inclined to think they can adjust things on one of the 24-tracks, so it doesn't matter if it's not quite right."

While *Studio Sound* was at Soundpush there were two different sessions taking place; a girl singing group (who sounded like they would need every special effect known to man) and the 'Gijs Hendriks Quartet', one of Holland's top progressive be-bop groups,

who complained about the difficulty of finding a good jazz studio. "Everything nowadays, in Holland at least, is geared towards the pop band. It's difficult to recreate the spontaneity and get the same feeling when you're surrounded and cut off by soundboards." It's also difficult to turn an engineer's idea around to the needs of a jazz band if he's recording pop all week. It takes a little time. However, they worked it out at Soundpush.

"All musicians are unsure," says Mijts. "If you tune the piano to 745 they want it 746; a chronically unsatisfied breed." **Bill Third** Soundpush-CMS BV, Huizerweg 13, Blaricum, The Netherlands. Phone: (02153) 86050/86638.

Fun Recording Studio, Munich

Situated near what one might call the 'university' quarter of Munich in a mews-like building is Fun Recording Studio. In common with some small studios, Fun is the offspring of a demo studio-cum-rehearsal room of a group, in this case the Munich based Fun Band. Because of the influx of hopeful musicians to the city, the 'studio' had an active market doing demos and similar things, thus providing the impetus to become a fully fledged professional studio catering for the up and coming groups and musicians who wanted or needed professional facilities but could not pay for long hours in a large established studio. The studio has not forgotten the Fun Band either and it is often the driving force behind the studio's productions, either on the group's behalf or providing musicians for sessions as well as bringing in customers. Though Fun Studio certainly has that 'do-it-yourself' aspect, this is in no way a derogatory way of looking at the premises which positively exude a relaxed and friendly atmosphere as well as providing a pleasant acoustic. The overall tone is fairly subdued and suitable for pop and rock recording. Musically, the lack of luxury often has a beneficial effect as some groups tend to be overawed by the slick presentation of a 'top' studio and as a result the recorded performance may be sub-standard. With a small studio such as Fun they immediately feel at home, as if they were in their own rehearsal room, and can get on with the job in hand without worrying about the recording process too much. Obviously, as the studio expands—and with it, hopefully, the bank balance—improvements will be made and by the end

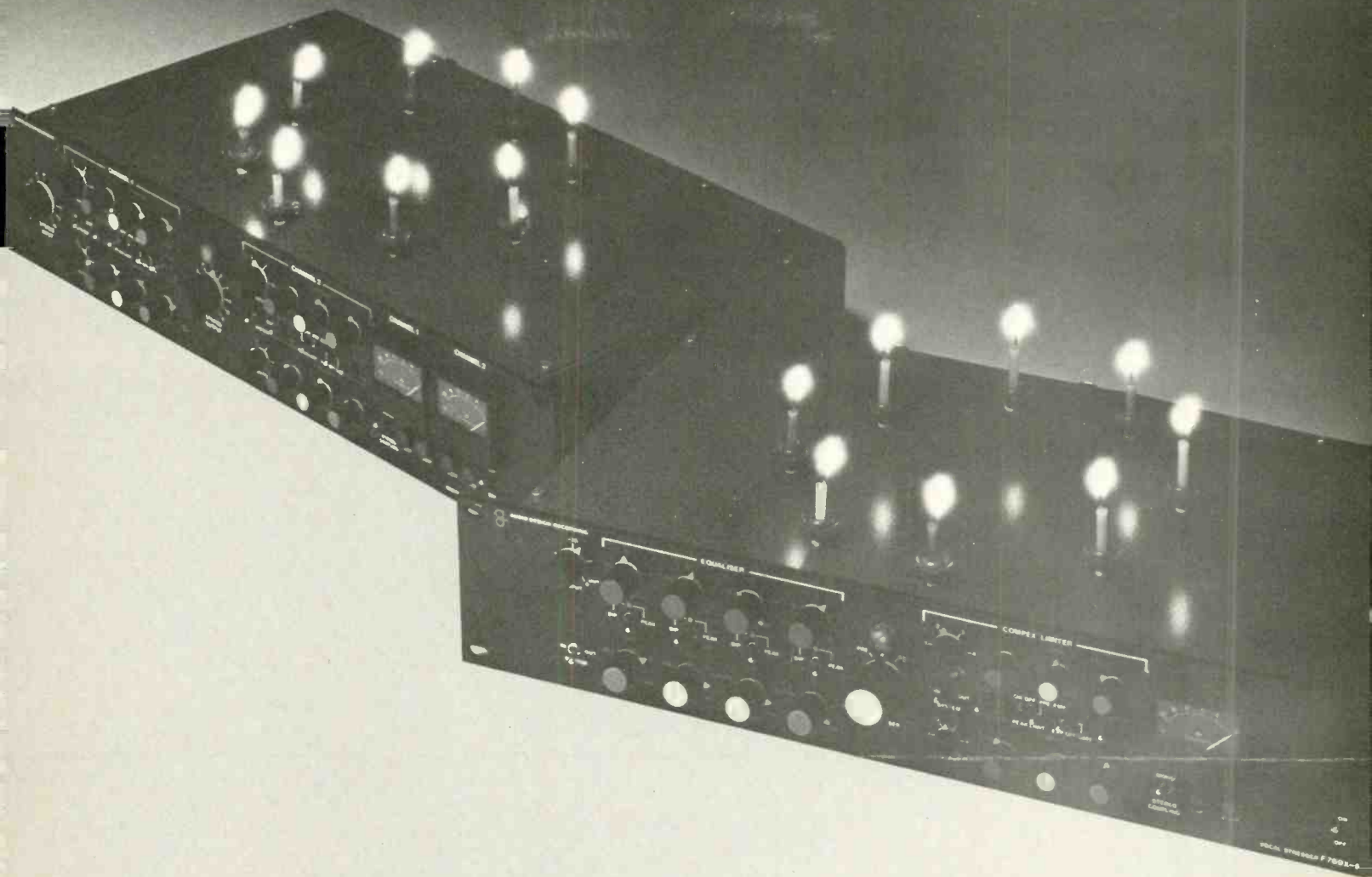
of the year the actual area will be augmented to include the second half of the present building when the lease runs out for the present occupants. However, the low-key presentation will be kept in order to maintain the studio's established identity. Roadies also like the studio because it's situated in a courtyard with direct access to the ground floor load-in, so parking and humping are no real hardship. On arrival I was met by studio manager Bernd Fricke, also PA engineer for the Fun Band, who was to show me around the premises.

Coming off the courtyard is the entrance lobby, which also serves as an office, from where you can pass directly into the studio. This could be classed as a small to medium studio as 10 musicians could play here without feeling the effects of overcrowding. Additionally there are two small isolation booths, one intended for vocal with a very low reverb time and a second for instrument overdubs giving a much more lively sound. The drum booth also displays a bit of home-grown ingenuity. Instead of being a closed box with a door or an area sealed off with half-screens, the entrance is baffled with three perspex and glass screens giving open vision into the studio for the drummer and at the same time providing a very good isolation. With the planned expansion, the drum booth will be used to form part of the new control room which, if you look at the present floor plan, would be a logical extension. Resident instruments in the studio are drum kit and concert size grand piano. However, there are usually pieces of equipment from the Fun Band trailing about and instruments can be brought in at very short notice should they be required.

In the small control room engineer Uli Rudolf was setting up for a mixing session with provision for a couple of possible overdubs. A small control room does not necessarily mean small equipment—in both senses of the word—as witnessed by the two enormous Cadac monitors (the twin 18in variety), Studer A80 16-track and 2-track recorders, 22/8/16 custom desk and outboard equipment. It is also easy to see why Fun want to enlarge their control room! The desk has been custom-built from GTC modules and has 22 inputs, 8-outputs, 16-track monitoring which can be used as auxiliaries during mixdown, with foldback facilities of one stereo and three mono sends. The total adds up to

40 ▶

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quite a flexible desk when you also include the very respectable patchbay that has been wired in. Metering is by NTP light beam units and also built-in to the console are five Roger Mayer noise gates and Audio & Design *Vocal Stresser* and *F760RS* comp-limiter.

Other effects equipment consists of the almost inevitable A & D *Scamp* rack with noise gates, compressors and the popular *S24* ADT module. Eventide *Harmonizer*, Aphex and Countryman *968* phaser. The Aphex is there because of the magical connotations it seems to have for groups and not so much for what it does. The Countryman must be one of the nicest phasers around even if it is pretty much a rarity, capable of very subtle sounds, especially when used in conjunction with the plug-in triangle wave oscillator. It goes almost without saying that Revox are represented but this time with an *A700*. Microphones are the habitual collection of Neumann and AKG, etc though there are several valve *U47s* for the benefit of the connoisseurs. One question that posed itself was why such large monitors for a small room? Simple, they were almost new and going for a very good price! For small studios budget problems have to be carefully weighed in the balance, perhaps a bit more than with larger studios and when good equipment is selling for bargain prices it would be foolish to let it pass by. Certainly upon hearing the results their choice of equipment seems justified and once the new control room is built things will be even better.

All in all, I found Fun Recording Studio very aptly named. Towards the end of my visit the musicians for the session came in and started getting warmed up and it was evident that they were going to have fun! A welcome change from the sometimes too serious aspect of the recording world and once again demonstrating that variety is what keeps our industry from

Uli Rudolf at the controls of Fun Recording.



going stale. You can have fun at: Fun Recording Studio, 120 Leopoldstrasse, Munich. Phone: (089) 397868. Terry Nelson

Polar Music Studio—Stockholm

The ABBA studio project started way back in May 1974, when the possibility of having our own studio was first discussed. The actual studio was not opened until May 1978, so it took quite a long time, even for a project this size.

In 1974 nobody in Sweden had heard about Tom Hidley, not even about acoustical design for that matter, but during a visit to New York we came across a very strange room—it was the Record Plant of course, and we were totally impressed. We learned that a company named Westlake was responsible for this unusual design, and eventually asked Tom Hidley to help us out. By that time Westlake was Eastlake and Tom had moved to Europe.

We had this idea of a control room in the middle of the studio floor, with full 360° vision. We had been working in so many studios where the musicians were locked in separate boxes, with communication only via the headphones, that the first important goal was to get an environment with maximum communication between the control room and the musicians.

All ABBA sessions were produced by Björn Ulveaus and Benny Andersson, who 99% of the time are out playing in the studio, and that's why communication is so important to us.

Eventually we had to abandon the idea of a control room in the middle of the studio area and settle for a 180° vision instead. But even this would take up too much studio space, so we decided on placing the control room by the back wall giving more space for the studio. Naturally Tom said "You can't build a control room with that much glass, it's impossible, but I'll do it."

We had a great deal of help from Jan Setterberg, a Swedish acoustician and Michael Borowski, an architect who helped us transform the original design to a more Swedish-looking environment. We were very anxious to get away from the night-club feeling you seem to get in modern studios.

Our studio is divided into five parts, with completely different acoustical characteristics. The first room to the left of the control room, is an isolation room, reasonably tight, with a glass door to the next room, making it a very bright room. It has glass walls and marble floor and the entire ceiling is metal, so all surfaces are highly reflective, making

the room ideal for strings and big choirs and adds an ambience that cannot be achieved with echo-plates. Behind the glass on the walls are paintings that look like clouds on a not-yet-polluted sky by Swedish artist and designer Rune Söderkvist.

Next to the string room, behind a high isolation door is the tightest area. It's right in front of the control room, so we usually cut all vocal and choir overdubs here because of the high degree of visual contact. In this tight section of the studio there are also traps for guitars, bass and piano—plus the drum booth. I was very insistent in demanding a drum booth big enough for two drummers, so consequently it is just big enough for one thin drummer and one midget—playing maracas. The booth is heavily bass-trapped with soft, non-reflective walls. These walls, however, are constructed the same way throughout the studio, with a system of 3½ sq ft frames. If you want a reflecting wall, you simply substitute one of the soft frames with a hard surface frame—so there are millions of combinations to give a total control of the acoustical response. The grand piano is a 9ft Yamaha, slightly modified by Yamaha themselves to give a brighter-than-normal sound.

The last room is the pride of the studio. From the very first day of planning, I wanted a room with a specific sound in it, as a sort of trade mark. Most studios are so tight today that it is hard to distinguish any real difference in acoustics between them—dead is dead, I mean. I wanted a room that you recognise the sound of, even if you just hear it over the Luxembourg AM.

So we built this beech-wood panelled room—and it sounds just like Hollywood 1936! Real character, but without the muddiness, thanks to heavy bass-trapping. Horn-players love it simply because the sound of their instruments isn't soaked up by heavy carpets and absorbent walls, but they can actually feel what they are playing by the response of the walls. Another important feature of the studio is the little 5-channel mixer for every musician!

Our Harrison desk is 32-out, and since most of the time we are only using 24 tracks for recording at the same time, the last eight can be assigned to the musicians mixers as four independent programmes eg: Drums and bass in stereo—channel 1, acoustic guitars—channel 2, stereo piano—channel 3, vocals—channel 4. The fifth channel is mostly used for echoes, when

wanted.

Every musician's mixer has a pushbutton which activates built-in communication microphones for connecting to the headphones, so there is always a talkback mic ready for the musicians.

There is a pair of Eastlake monitor speakers, in the control room fed by two JBL *Ice-cubes* in a bi-amplified system. There is also a pair of old trustworthy *604s*, preferred by many. The philosophy behind the control room was to carefully avoid over-trapping, but to let the room have some character. I even insisted on a wooden floor on top of all that glass, so I would describe the room as fairly live, but very easy on the ears. The result is a very bright-sounding room where you can work for hours without any ear-fatigue at all. Of course there are Auratones up on the console, and another pair built in the wall above the 2-track machines. Very convenient whenever splicing. Out in the studio there are four Philips motional feedback speakers for playback. The machines are all MCI's with the two multitracks synchronised for 46-tracks.

There are all kinds of outboard equipment—almost anything you can think of. You name it—there's two of it! Even the ancient RCA valve limiters, remember? There's a pair for stereo if you like!

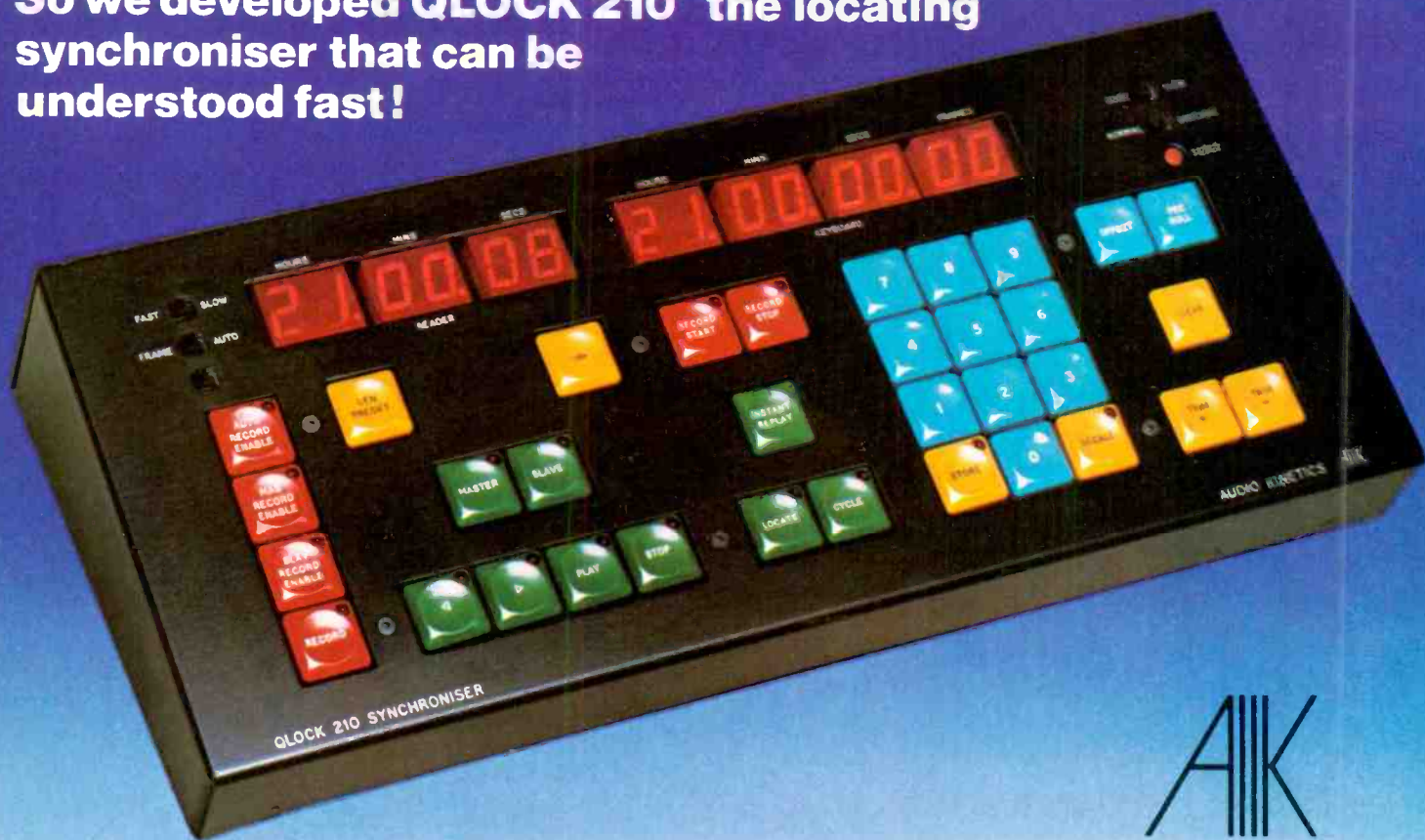
For once, money was no object when we built the studio, Björn and Benny like toys—so there's everything. Vocoders, exciters, echoes, synthesisers, all kinds of drums, chimes, marimba and vibraphone, White's spectrum analyser—for those of you who strive for the ultimate flat response. The console is as mentioned a Harrison *4032*, heavily modified. In fact all the IC's are substituted for faster and better amplifiers. There are Dolby's and dbx's for those who still want them. All kinds of mics, with the AKG *C34*, which is sort of a studio favourite; it's used for overhead drum miking, stereo piano, strings and vocals—everything. It's a bit brighter-than-life, so it never needs any eq, you just plug it in and go ahead.

Some studios have a tendency to overlook the importance of a good solid coffee. The Polar coffee is high class, ABBA likes it, Led Zeppelin likes it, Mike Rutherford and Tony Banks of Genesis likes it. We may have hum, distortion and noise, but everybody agrees about the coffee—it is alone worth the 650 Swedish crowns that Polar music studio charges per hour. Michael Tretow Polar Music Studios, S:t Eriksgatan 58-60S-11234 Stockholm, Sweden. Phone: 08 54.06.95.

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RADIO Drama first started in this country in 1924 with a BBC broadcast, "Danger" a mining disaster lasting 20 minutes. It was a simple affair done on simple equipment and the relationship between complexity of format and equipment available was to underlie much future development. During the Thirties multi-channel control panels and multi-studios (studio complexes consisting of several differently acoustically-treated rooms) gave rise to much development of dramatic techniques—but with the abandonment of many specialised premises during the war, producers had to cope without multi-studios. Thus the techniques were modified again. Radio Drama during the war years became a major focal point for a wide audience—after the war, new production departments and networks and a host of highly talented writers ensured greater growth still.

During the early Fifties most of the plays were still broadcast live, but by the end of that decade recording was more commonplace to the extent where about three quarters of the output was recorded. The basic methods of approach had not changed greatly though, as a remote recording channel would have been plugged up to take the studio's output and then record a complete runthrough followed by retakes. But with further reorganisation in the late Sixties, on site recording became the norm. With the advent of stereo at about the same time with its more complicated settings, discontinuous recording became the accepted approach. It is these current processes which I would like to outline here in this article.

At the BBC network production centre in Bristol there is one big



Radio Drama is an area of audio engineering so far little touched on in *Studio Sound* but one where much creative work is done and on a time-scale greatly contrasting with that of most commercial music recording. The factors that control the end result in drama are more varying, more intangible, and generally more perverse than in music but they also make it a particularly interesting area to work in and one which might stimulate those readers inured to the routine of multitrack music recording. Andrew Lawrence describes how the BBC Bristol Audio Unit handles radio drama.

drama studio complex called Christchurch, a mile away from the main site. Here the whole gamut of radio plays is produced from 15-minute *Just Before Midnight*s to 6-part *Sunday Serials*, from comedies and tragedies to all manner of inbetweens—experimental features, Nativity plays, historical dramas and science fiction. But different as the individual requirements of each play may be, the basic audio engineering task remains the same—to create a dramatic aural location in terms of acoustics and sound effects.

Christchurch Hall, built originally as a brewery, is a large stone structure with two main floors and a basement. It is particularly well off for natural acoustics. The main studio, called the Lower Hall, is on

the ground floor and has adjustable carpeted and bare-floor areas, a dead room, a suspended ceiling area and a centrally dividing double curtain. Upstairs, a capacious Upper Hall, and in the basement seven chambers of various sizes, which include a disused bowling alley. Elsewhere in the building are a fully practical kitchen, a library, several offices and other rooms of various sizes, and hall areas with concrete and wooden staircases. Many of these ancillary areas are wired with microphone points and tie-lines back to the control room.

Even the exterior gets used at times, for fortunately Christchurch is situated at the bottom of a fairly quiet cul-de-sac and has cobbled courtyards on either side. Drama

OB's can range as far as the nearby Clifton Downs occasionally, but this does seem to invite bad weather!

The usual crew for a radio drama is three. The panel operator (balancer) is at the helm with a tape/grams operator and a spot effects operator working to him. The tape/grams man and the panel operator work upstairs in the gallery while the spot-man looks after live effects and general stage management down on the floor.

The first job on any drama, is for the technical crew to build the sets and lay out the microphones before the rest of the participants arrive. The script and its requirements may have been looked over in a planning meeting a week or two earlier and the panel operator will from this, or from his own private study, have worked out how many different locations he has to cover and how many sets he will need to build in order to do this. Then as the actors arrive and the producer initiates a preliminary read-through, the crew members start to sort out their own particular areas of contribution. It is at this time that the spot-man may be found building a body out of carpet felt and army boots, or rummaging through the effects store to find something that will sound like a dying chicken.

There are permanent collections of spot effects items attached to most drama centres in the BBC. They contain everyday items like crockery and cutlery, glasses and bottles, boots and bells, in short anything that makes a noise. When something out of the ordinary is required, these items can usually be adapted to suit, but if not, then the required item is either purchased or borrowed.

So, the spot-man collects his

effects together, lays table, sorts out creaky chairs, tries to get recalcitrant effects doors to work and generally furnishes the empty sets with all the objects that will be needed to bring them to audible life.

Upstairs in the control gallery, the tape/grams man will have lined up the record and replay tape machines and will now be sorting out all the recorded effects the script suggests. The present complement for Christchurch is two Studer 480s and a Ferrograph Logic 7 twin-track, used for tape echo and odd effects. There are also four stereo disc players (two of which have wide-range varispeed) and two mono 78 players. Each of these replay sources can be selected to one of four bussbars, three stereo and one mono, and these in turn can be plugged to the desk.

Although there is a very large permanent library of pre-recorded effects available throughout the BBC, it has been supplemented locally over the years with many tapes of successful studio effects and location recordings—mostly of backgrounds and atmospheres. Even so, there is inevitably a great deal missing, and before any recording gets under way some time is usually spent making up, say, stereo groups of horses (out of several mono discs) or building up effects montages.

Most of those effects which require dubbing from one machine to another can be handled independently of the desk, and so this operation may go on even while the play is under way; but, due to the lack of separate loudspeaker monitoring and equalisation in this part of the system, coffee and lunch breaks are often used by the tape/grams man to put together a quick



Christchurch lower hall laid out for action (the control room is upstairs in the background)

naval battle or a hansom cab crash.

One of the difficulties of fitting recorded effects to a play is the elastic nature of the artistic performance. A carefully pre-timed effects sequence will quickly go astray if the actors speed up or slow down, however minimally; therefore the effects must be broken down into elements that can be handled separately and overlapped. Those all too familiar interior car scenes (changes gear, slows for light, pulls away, screech of brakes, switches off engine) look deceptively straightforward on the script but can be murder to fit in around the lines in practice. Each element may need to be on a separate replay machine from the previous one and with only a limited number of machines this may mean a lot of stopping, starting and recueing in a very short space of time!

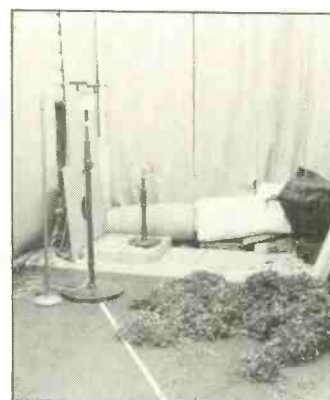
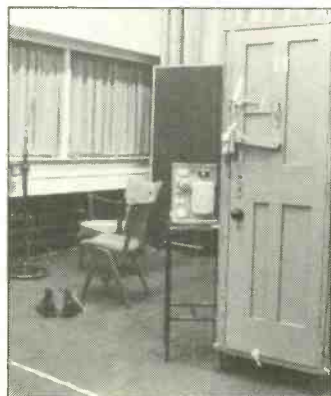
One answer of course, would be, to dub all the effects on afterwards but this has several disadvantages. The first is that post-dubbing takes a long time. Also the absence of effects at the time of the initial recording means that the director no longer has control over all the elements under him, including the direction of actors in the correct pitch and pace relative to the overall aural context of the scene. The balancer, too, is deprived of the opportunity of match making between the studio acoustic and that on the tape/grams effects; and the cueing of the actors must now be handled separately instead of letting them take their cues from the effects.

Meanwhile, the balancer, having checked out the microphones and the desk may have a few spare moments to gather his thoughts (while horses gallop past him, or bulldozers fall over cliffs, or theatre

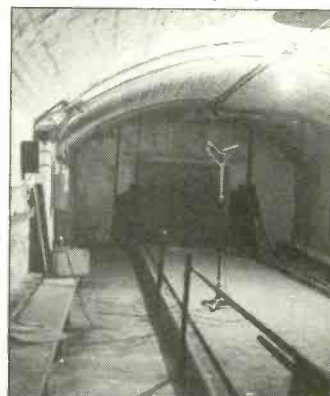


Above: the "car" in action.

Below: the neighbour's typical living room set



*Above: the dead room with rustling and gravel bed
Below: the basement suite
No 1 the bowling alley*



Radio drama

balconies collapse around him) but the heavy tread of the producer advancing up the stairs means business is about to start.

In the days of live radio, the normal procedure was a series of rehearsals culminating in a full 'as-live' run-through, followed by the transmission. Even now, the odd producer will still sometimes work to the pattern established by live broadcasting, rehearsing the complete play right through once or twice and then recording the performance as a complete run. There is much to be said for it from the point of view of continuity and stylistic unity, but the extra pressure it puts on all those involved in the production may cause them to restrain from stretching themselves to their utmost, or may cause mistakes to be made which can only be rectified with difficulty. Because problems can be ironed out immediately and committed to tape while fresh in everyone's minds, a system of rehearse/recording is now more often used.

In this, the play is recorded either one scene or in groups of scenes at a time. These are rehearsed, recorded and if necessary re-recorded until they are adjudged good before there is a move on to the next recording section. The correction of small errors is often catered for by recording separate internal retakes. So, considering also that the scenes may not even have been worked on in the correct order, the reels of tape that appear at the editing session may be a lot further removed from the required end result, than would have been produced during a complete-run type recording.

Most actors seem to be able to cope with discontinuous recording and it is usually only if someone needs to leave early or arrive late, or if a musician is booked for an afternoon to do scenes at either end of a play, or if crowd scenes are to be done all together, that the written sequence of a play is broken.

By whatever method the producer works, however, he still requires plenty of intuition, inspiration and imagination from his crew and the more he can rely on them to supply his aural locations the more he can concentrate on the actors.

A complex play may have as many as 50 scripted locations and sets must be provided to cover all. This does not necessarily mean one set per location but the requirement must be broken down into how many different basic types of location are needed. Most simply this means looking to see which scenes are exterior, interior, or

neither (thoughts, dreams and narration for example). Obviously the subtler differences between the scenes must then be analysed further. A cottage interior does not sound like a submarine, nor a railway carriage like a ballroom.

Interior locations are most often domestic rooms or offices, and these vary principally in size and acoustic 'liveness'. Usually three or four different sets will cover all the varieties of rooms required and many plays can be managed on less.

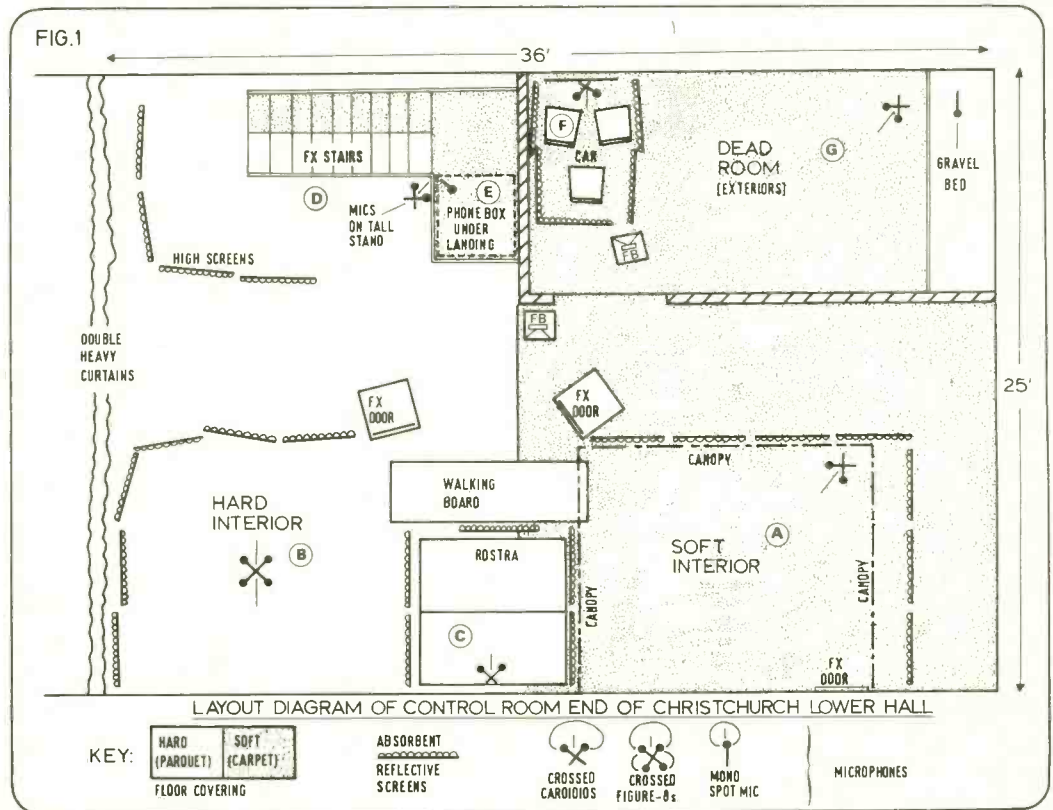
Sets will be built of different sizes and with different types of screens to control the amount of sound reflection around the set. Sometimes a roof may be added, or the permanent canopy utilised to tighten

another set on the other side of the heavy curtains, that end of the studio usually being used for large resonant interiors like ballrooms and courtrooms. When a hard floor sound is needed, in an area otherwise laid with carpet, walking boards are sometimes used (as between sets A and B) and similarly odd rolls of carpet are available for when the reverse is required.

Otherwise the layout should be fairly self explanatory. In the hallway shown, it is intended that the listener's point of view will be from the landing so microphones have been raised to landing level on a tall stand and extra-high screens placed around to keep adequate wall reflections at this height.

known) is that very often, however good the loudspeakers and microphones involved, a boxiness creeps in from the exaggeration of frequency response errors that this 'second generation' procedure produces; so more often than not a mix of direct effects and AER is used.

Exteriors are handled in two different ways in Bristol—by using the real thing or by using the dead room (a heavily padded room with a low reverberation time). It depends very much on the script and the producer's artistic intentions as to which is chosen—factors in the decision include the acceptability of extraneous traffic noise, or whether the type of exterior is easily to hand



the vertical spaciousness.

The screens used are of several different types but they all have a reflective side and a sound absorbing side in common. This not only allows fine-tuning of the acoustic, by reversing selected screens, but also means that a set can quickly be changed from one sort of location to another.

Fig 1 shows the Lower Hall studio laid out for a production requiring A soft interiors (bedrooms, well furnished living rooms etc), B hard interiors (rustic cottages, old offices and so on), C a small cramped room with a resonant floor (ship's cabin, attic etc), D a hallway with stairs and landing, E a telephone box, F a car interior and G various exteriors.

In addition to this there may be

Another thing worth noting at this stage is the foldback loudspeakers. These are often required to feed sound effects down into a set, sometimes just as a quiet 'bleed' from the mix upstairs to provide atmosphere or cues for the actors and sometimes as a direct feature within the set so that the effects will be modified by the set acoustics, and then reach the overall mix after being picked up by the microphones. Clocks, doors, babies and juke boxes, for instance, are often done in this way, babies are surprisingly successful, for by using a small portable loudspeaker they can be carried anywhere around the room by the 'parent'.

The usual drawback when using folded-back effects (or Acoustic Effects Reproduction, AER, as it's

outside. More often than not the dead room is chosen because greater technical control can be exerted and communication is easier.

The room itself has its drawbacks, it is often not big enough and it sounds boomy when actors speak close to its walls. But with careful usage and the right microphones good results can be obtained. Another problem concerning its use is that exterior acoustics are seldom in fact dead—something easily verified by clapping your hands or shouting in streets, woods and open spaces everywhere. So a great deal must be done with echo, reverberation and background effects to give realism to dead room voices. However, too

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Radio drama

exciting an exterior sound may be confusing to a listener and he may be distracted from the subject matter while he tries to work out quite where the character is. Our audio memories are far poorer than our visual ones and the complexities of exterior reverberation and ambience are best compromised with something that is at least readily identifiable and so the convention of an only slightly modified 'dead' exterior has become the normal practice.

A lot depends on the actors in this sort of scene setting. People naturally tend to pitch up out of doors, especially in windy or noisy

the performers have something to fix their movements on. For instance a rowing boat is easily simulated by upturning a rostrum, and gives the bonus of realistic foot noises as people clamber in and out. Likewise rostra (the right way up) make a good cart.

In addition to the main studio, Christchurch has the benefit, as I have said, of having various ancillary areas. The basement in particular has proved very useful for providing tombs, vaults, caves and prison cells. Sheet metal was laid on the floor of one of its chambers for the copper-lined tomb of Roderick Usher's cataleptic sister (in a recent production of Poe's *The Fall of the House of Usher*) and in another production microphones

Neumann SM69s, AKG C414s, C451s and D202s, and Beyer M88s, the latter work particularly well in the dead room. due to their bass roll-off and presence lift.

The most useful microphones are those which have variable directivity patterns and special mounts have been made to allow the resident C12s to operate as coincident pairs, because they have this facility. The pattern selected in any situation is done so according to various criteria. One is that changing the directivity pattern changes the direct-to-ambient sound ratio of the output and variations from the classic crossed cardioids to crossed figure-of-eights, for instance, may well be to obtain a more open reverberant sound. Secondly, C12s and SM69s have four main directivity positions, with intermediate positions between them, and this is extremely useful for controlling the working stage width. If action is

someone may wander into the out-of-phase areas at the sides and hence go into a positionless limbo for the stereo listener, and probably partially disappear in mono. To avoid these undesirable effects, the 'danger areas' are often marked off by lines taped on to the floor. Out-of-phase areas can present difficulties with other directivity patterns (the rear lobes on hypercardioids, for instance, giving problems when actors get too far round to the edge) but generally these effects are less severe.

The need to bear the mono listener in mind, whilst recording in stereo, is part of a discipline to which all technical operators in radio must work. But making compromises to achieve good mono compatibility is not hard for an experienced drama operator who is already making compromises with his effects and acoustics so as to augment the acting in a play rather than distract from it.

The actual physical position of the microphone within the set may be dictated by its mode of working, the need to pick up or suppress



Left: The basement suite No 1—rigging the prison cell



Right: The control room—with the author at work

environments, and it will make all the difference if an actor can match his delivery to the supposed location.

The Christchurch dead room is commonly used to provide an interior car acoustic. Cars are a strange combination of absorbent and reflective surfaces inside. To achieve this acoustic for radio a car set is built in the dead room made of screens and chairs laid out in a more or less realistic fashion. Even a perspex panelled screen is placed where the windscreen would be, and the microphones are placed immediately in front of this, inside the car. Interior running noises are fed in via a foldback loudspeaker to 'set the scene' (and get a few eidentones going) and the car is complete.

Special locations like this are a fairly common feature in plays and may present an interesting challenge to the crew's collective imagination. A list of past successes and failures in achieving unusual acoustics would take up too much room here, but all sorts of things have been tried over the years.

It often helps if there is a realistic element to whatever structure or layout is contemplated, for then

were placed inside a sewage pipe around which the actor walked to simulate a well.

Other specialised locations more commonly occurring are telephone boxes and stairs. In the main studio there is a specially-built telephone box and a flight of effects stairs, with one side carpeted and the other plain. For stone stairs, the flight of concrete steps down into the basement is used—if necessary pre-recorded and played in on a cue.

An important factor in the creation of an acoustic is the microphone used to pick it up with—the actual type of microphone used and more importantly its position and directivity pattern.

Although a wide range of microphone types is available in Bristol, only three basic types are actually kept at the studio and hence these are the most commonly used. They are Calrec CB21Cs, AKG C12s and the ever popular ribbon 4038s. These are supplemented by

concentrated too much in the middle of the stereo sound stage, due to say limited floor space, a move from cardioid towards hypercardioid can effectively widen the action outwards.

Another use for crossed figure-of-eights is to give improved visual contact for the actors, because the double-sided working allows actors to stand opposite each other rather than side by side and this can be beneficial to them. But precise blocking—the planning of stage moves—becomes essential here or the situation easily arises where due to the inversion of the image on one side of the microphone pair with respect to the other, two actors diagonally opposite each other appear to be standing in exactly the same place in the stereo sound stage. There is also the danger that

resonances, and the layout of doors and props around it. Any or all of these may prove problematical and sometimes subsidiary spot microphones may be needed to help out, as when we have to follow someone as they sit down on a sofa or get into bed. But before you get the impression that hundreds of pairs of microphones are liberally strewn throughout the studio, it should be said that much microphone moving goes on from set to set during recording breaks.

And so, amongst the (hopefully) clearly signposted labyrinth of sets and microphones, the actors set to work. There are so many variable factors in any scene of a radio play that perfection is not an obtainable goal much of the time, for if the performance is just right, the



Right: Christchurch upper hall. Ideal for very large interiors



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Radio drama

positioning may be just wrong, and if too much time has been spent achieving perfection on the effects then the actors may have gone off the boil. All the time the producer has to judge when he has obtained the best he is going to obtain or when to accept what he has obtained in the interests of leaving time for the rest. Obviously the better his crew's performance, the simpler his decisions become.

To illustrate just how busy it can be, let me dissect a scene from a recent Christchurch production (*Westward Ho!* by Charles Kingsley). The action was as follows:

A party of slaves is being led along a jungle track. A dialogue ensues between the soldiers driving them. Unknown to these soldiers an ambush party is watching them from under cover and we go to this party for their dialogue. We then return to the slave train, where an old man collapses—to disconnect him from the chain, his captors chop his hand off. We hear muttered comments from the slaves out of earshot of their guards and then return to the ambush party who launch their attack with a great deal of noise and hoo-hah. The scene finally goes out under music.

From the spot-effects man, the scene called for whip-cracks, hand-chopping, crashing about in undergrowth and sword-play. From tape-and-grams, it required jungle atmosphere, gunfire, the alarmed cries of monkeys and birds, and the playing in of music and pre-recorded sections. The balancer, fed with all these sources, plus, of course, declaiming and wailing slaves, guards and ambushers on the studio floor, had to devise how to handle the sequence so that it would be quite clear what was happening at any time, to the

listener.

Because of the difficulty of having both ambushed and ambushers in the exterior atmosphere of the dead room, and yet retaining sufficient separation between them, when switching from one to another, it was decided to pre-record everything the slave train did and then play that in against a 'live' ambush party. Furthermore, in order to keep a good pace going and to allow natural cues, the slave train sequences were further subdivided into three.

Sequence One consisted of the basic noises and whip-cracking of the slave-party fading up into the first section of dialogue, and then continuing on as effects and noises only, to act as a distanced background behind the ambush party's dialogue.

Sequence Two was the second section of the slave train dialogue including the hand chopping sequence, the slaves' asides, and more

general effects and noises to act as background.

Sequence Three was the ambush from the slave train's point of view. A further advantage here was that members of the cast were able to double up as members of both conflicting parties, which helped swell the ranks involved in the final attack. Fig 2 shows all this diagrammatically.

The whip-cracks available on disc had turned out to be disappointing in sound and acoustic, and so live ones were needed instead; but the absence of a real whip and the obvious dangers of wielding one in a room full of actors required they be put on to tape. The final whip noise consisted of a cane swish played at half speed hard-edited on to a crack made by jerking two belts together. Several of these were made up ready to be played in.

Likewise, the problem of having to do perhaps several takes of the

scene went against live amputation! So a pig's trotter and an axe were brought in and the sound pre-recorded during the lunch hour. A bonus here was an accidental and revolting noise made by a bit of trotter falling onto the floor, and this was added on as a gruesome extra to the basic chopping effect—'severed hand falls off'! (And we always thought they used a cabbage! Ed).

And so, in front of a main pair of M88s, the slave train sequences were duly recorded with whips and amputations played in, and with the spot-man rustling foliage and clinking weapons at the appropriate points. The slaves' asides were handled on a subsidiary pair of microphones away from the main pair, while the latter were 'distanced' on the fader during the slaves' lines. These pre-recordings were then banded up ready to be played in by the tape/grams operator.

FIG. 3 FEEDS TO THE MIXING DESK FOR 'AMBUSH SCENE' FINAL MIX

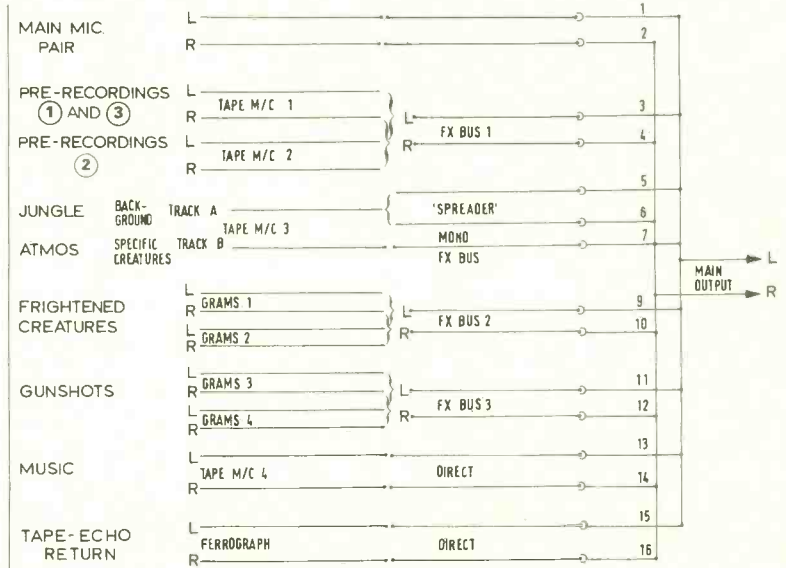
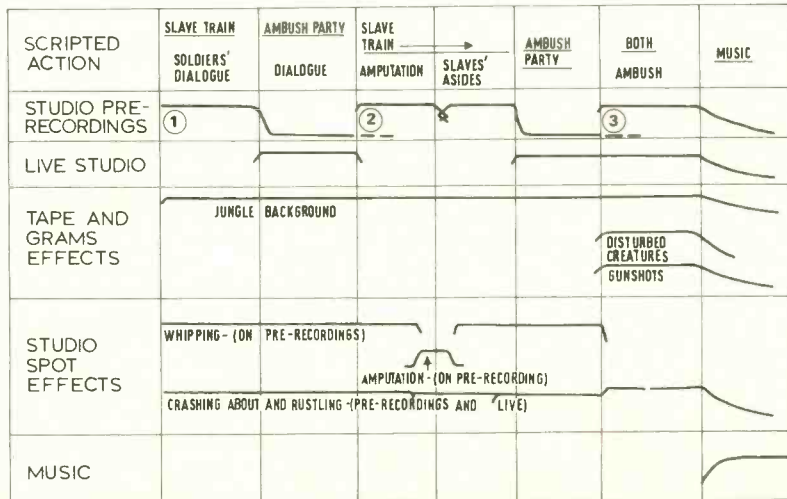


FIG. 2 CHART SHOWING THE COMPONENT LAYERS OF THE 'AMBUSH' SCENE



While the spot-man then prepared to crash, rustle and clink from the ambushers point of view, and some of the actors likewise 'changed sides', the tape/grams man set up his end of the business.

The slave train pre-recordings had been done dry of jungle background to prevent any subsequent mismatches, and this would now need to be played in throughout the scene. Stereo South American jungle atmospheres are hard to come by, so mono ones were used, played through a pseudo-stereo 'spreader', and augmented by specific animal and bird noises panned into the jungle at suitable positions. Also lined up to be played in were the noises of creatures taking fright when the ambush started, and pre-panned gunshots to



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Radio drama

come from the ambushers. The pre-recordings occupied two tape machines, the end music another, and tape echo was set in motion to give specific forest echoes on shots and loud shouts. The accompanying charts, **figs 2 and 3**, may help to clarify this diagrammatically.

The final assembly is now ready to commence. The pre-recorded slave train (sequence one) set off against the jungle background and proceeded to the end of the first section of dialogue, at which point the 'live' actors making up the ambush party down in the studio were cued for their lines, and the slave train was pulled back and used as a distant background behind them. Then, as soon as the 'live' ambush party had finished their lines, the slave train pre-recordings were faded forward again with sequence two played in. All this while the hot steamy jungle background played on, and added realism was gained by having no ventilation in the dead room (to avoid air-vent rumble)! When we had all winced suitably at the fate of the fallen slave, and listened to the bitter asides of those still standing, it was back to the ambush

party live in the studio, and into the ambush; and following the verbal cue from the leading actor, frightened parakeets and monkeys screamed off into the jungle, gunshots played in and panned for the attackers mingled with those already pre-recorded on sequence three for the attacked, and many men, both live and recorded, stomped and yelled in a 19 x 9ft room in Bristol, recreating a great imaginary but imaginative moment in Elizabethan history. And as the final battle noises subsided under the swelling music, there was still time left to record another couple of scenes before tea-break.

Whilst most plays may have, perhaps, only one or two scenes of that technical complexity—and some none at all—it does show how much can be done in a short time. All the above was completed inside three hours including preparation and rehearsals.

Inevitably there are a few rough edges with such a scene—the odd line is a little indistinct amongst the fighting, somebody's position may inadvertently wander a little, some cues may not be taken by the participants (both on the floor and in the gallery) in exactly perfect time, but the excitement is there, and if all is going well the performance has conviction.

In some Radio Drama productions abroad and very occasionally at home, the use of multitrack

working has crept in, the temptation of keeping options open to the last moment seducing some into laying submixes to be further finely adjusted at a later point. In a sequence like that above it might mean that an irritating minor error of, say, a stumbled line could be corrected, but the temptation to isolate the various elements of a drama more and more from each other, so as to give greater and greater control, can surely only be at the expense of spontaneity and of empathy between the actors, one to another and to their 'surroundings'. Greater technical control can lead, ironically, to a loss of artistic control.

In music recordings, outside of strictly 'classical' music, things are different, especially in 'pop' music, as here this detached individualistic approach has developed to where musicians can react to what is on their headphones just as well as to a live band around them; but in drama, where we are creating essentially visual images through sound, that direct connection is bound to remain essential to the process.

It is that aspect of the work which makes radio drama such an interesting field to work in. I would argue that it can be more demanding on technical skill and judgement to get a good result out of a situation where no-one has full control and nothing is quite the same twice,

than out of that where almost everything is capable of control and the demands are on the ability to fine polish sound, with the only real constriction being that of the depth of the producer's purse. It would certainly be hard to think of another audio engineering job that required so much from the imagination.

And so the days go by, the scenes are all recorded, the cast says goodbye, the sets are left scattered with discarded scripts, spot effects items and full ashtrays, and the crew prepares to abandon ship to the local cider house only 45ft from the front door.

The recorded tapes will be edited the next day or so by one of the crew, and any retakes cut in, fluffs cut out, and then the whole thing fine edited to the time required to fill the available network slot. By the time the play is actually transmitted, the studio will probably have been converted from Elizabethan South America to Victorian Wapping, to present day Bristol, but with each passing play some small feature somewhere takes on a new permanent identity—"that's the body we dropped down the cathedral steps—that graffiti appeared during episode five of *The Woodlanders*—that was the guitar we broke for *The House of Usher*—Oh heavens! There's that pig's trotter we used in that amputation scene four weeks ago. Get a shovel, quick!"

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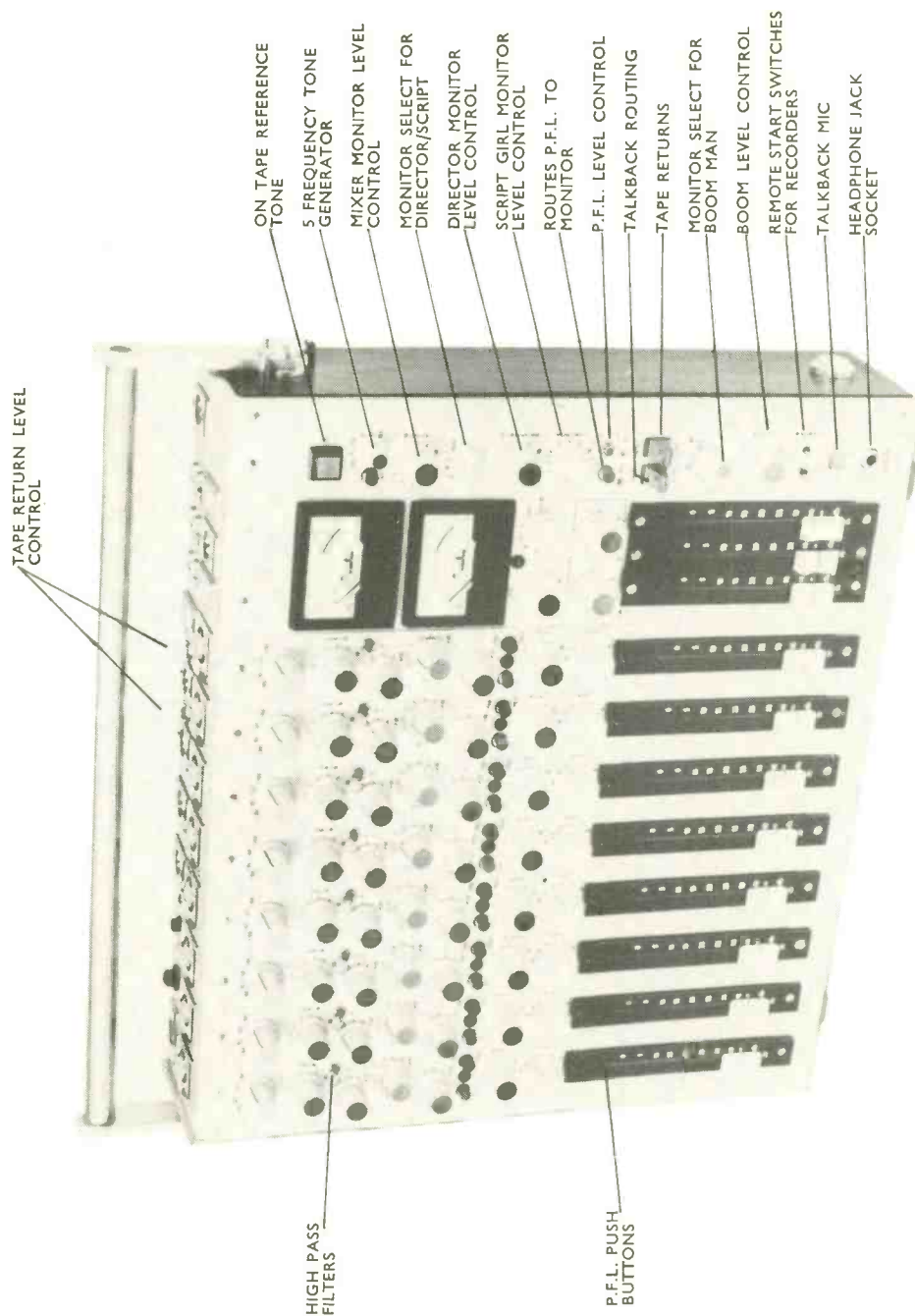
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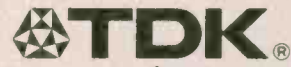
TDK Super Avilyn video cassettes in 1, 2 and 3 hour lengths for all VHS systems.



true – an essential for a completely stable picture.

In other words, TDK Super Avilyn is the video tape by which other tapes are judged – the difference between ordinary video and definitive sound and picture quality.

And if you're making up your mind what system to buy, it's the difference between VHS and other video systems.



The great name in tape cassettes

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Speed accuracy

As previously noted some disc cutting lathes are still locked to mains frequency and so liable to introduce a speed error into the cut if the mains is slightly up or down in frequency. In Britain, for example, the electricity supply can legally vary by $\pm 0.5\text{Hz}$ from the nominal 50Hz ie $\pm 1\%$ speed drift. This makes a nonsense of the current hi-fi obsession for speed accuracy to within 0.025% on a gramophone. Interestingly, perhaps inevitably, Matsushita Technics is now offering a quartz-locked drive system which can, and I quote Technics' tactful wording verbatim, 'easily be attached to Neumann recording lathes'. In other words you can now modify your Neumann lathe with a Technics high-torque direct drive unit. These are a natural progression from the drive used for hi-fi and DJ instant start turntables. I well remember Technics' engineers a few years ago explaining that they had deliberately kept the torque of replay turntables *down* to a target level because the high torque potentially available from their direct drive motors could well be a physical danger to the user.

The new mastering lathe drive has a torque of 28kg/cm and can bring a 50kg platter up to full rotational speed in just 1.5s! From then on the quartz lock keeps it accurate to within $\pm 0.001\%$ or better, which makes mains-lock accuracy to $\pm 1\%$ look pretty sick. Again to quote Technics verbatim 'installation . . . can be easily accomplished in a short time with no complex adjustment procedures necessary'. So, provided owners of Neumann lathes are prepared to bolt on a Japanese mod, hi-fi freaks the world over can now justify their purchase of a super-speed-accurate turntable. Mind you the chances are that they won't ever notice the difference. How many of them, for instance, recognise the whacking great 4% pitch error which they hear almost every day, when a feature film shot at 24fps is screened on UK television at 25fps?

Ear, Ear

Just how easy is it for a studio engineer to get an ear test and so keep a check on any slowly developing hearing problem? There surely can't be anyone now who disputes the fact that prolonged exposure to excessively high levels of sound puts human hearing at risk. But just as smokers continue to puff away despite irrefutable evidence that cancer cures smoking, so some sound engineers and rock musicians continue to pound their ear-drums with high level sound. Because hearing defects usually develop slowly the standard recommendation is for anyone at potential risk to have their ears regularly checked. I have recommended this procedure myself in this and other magazines. But I recently

found out for myself that it is much easier to recommend such tests than actually arrange them.

I had been mildly irritated by an occasional buzz in one ear, which was triggered by certain low frequencies at high levels and decided to get it checked. Rather than pull strings with specialists I had met while researching articles on hearing loss, I decided to see how the NHS could help the average patient seeking an ear check.

First stop, one might better say first obstacle, was a visit to my local GP. "Your ears are quite clear", he said looking for wax. "But I would still like it checked," I insisted. "I earn my living by listening to hi-fi and audio systems and writing about them". "Ah, well, you'll just have to stop listening to hi-fi", declared the doc without further ado. "You don't understand," I repeated, "I earn my living with my ears, so I have to look after them." "I do understand," declared the doc. "And I'm telling you you'll just have to stop listening to hi-fi." He then launched into a tirade that confirmed what I'd now begun to suspect, namely that high fidelity and high levels of sound pressure are one and the same thing to your average elderly GP. "Do you know that some pop groups are deaf for 24 hours after playing," he scolded. Finally, and only by wielding a lot of long words like intermodulation distortion and citing phrases like '90dB on the logarithmic scale' did I persuade him to write a letter of referral to the local hospital. From then on it was a very different story, even though the problem had cleared itself by the time an appointment could be arranged. The hospital doc took audiograms to check my threshold of hearing over the audio range, and tympanograms to check pressure differentials across the ear drum by optimising acoustic transfer and impedance at a range of ear pressures. With relief, turning to pride, I learned that the audiograms were fine and the tympanograms were the 'best the specialist had seen in seven years'. But most important I was invited to make an urgent return appointment if ever the trouble returned.

There's an obvious moral for studio engineers in this story. My GP, although apparently perfectly competent to cure everyday diseases, was hopelessly out of depth in the specialist area of hearing. Even worse, his ignorance was coloured with arrogance, an unwelcome combination in anyone but very dangerous in a doctor. In all seriousness and with what subsequently proved to have no medical justification whatsoever, he'd advised a patient to abandon activities essential to his career. I now sympathise with any studio engineer who tries to arrange a routine hearing check every year. If my GP is anything to go by, an engineer who admits that his work involves exposure to high sound levels is likely to be told to give up studio work rather than referred to an ear specialist.

Computers v humans

Murphy's Law and Sod's Law together guarantee that anything that can go wrong with a piece of equipment, will go wrong, and at the most inconvenient time. In a recent book, American computer buff Jerry Willis, claims that computers have a unique characteristic, also based on Murphy's Law: 'When the going gets rough a component will invariably blow or burn up to protect the fuse'. To a cynical observer it seems that computers 'crash', taking a RCM or disc-full of meticulously programmed bits with them, at the very first sign of danger to a fourpenny fuse.

Remember, for instance, how NASA's onboard computer 'crashed' just when it was most needed, during the first moon landing a decade ago. The module crew had to override their computer and land under manual control.

Studios, embarking on the excitement of computerisation, have a whole new area of Murphy and Sod's Law to explore.

All in the mixing

How is it that we oldies who listen to those early Beatles stereo recordings, like *Sergeant Pepper*, over and over again can still find something fresh and new? Michael Gerzon suggests an interesting answer triggered by surround sound research. In those early days of multitrack, actually not much over a decade ago, there weren't any established rules for mix down. No one knew then that engineers 'had to' mix in every melodic line at meaty level to give the finished product maximum impact, ie grab the punter by the ears at first listening. No one had really worked out that you could make a record sound loud on AM radio or in a crowded disco by mixing in Motown EQ fashion, ie by cranking up the sound of each instrument within a tight frequency band to pack the full audio spectrum as tightly as possible with sound.

Back in those early days when tracks were bounced backwards and forwards between a pair of one inch 4-track machines together (as happened on Pepper's *A Day in the Life*) everyone involved was still feeling their way by ear. So not every melodic line was cranked up into prominence in the final mix and there was a wide dynamic range between lines. Listen again to those early recordings and you'll hear a cobweb of subtlety. And, of course, subtlety always offers longer lasting pleasure and interest. How does this relate to surround sound? If you happen to have an old quadraphonics decoder, with Sansui Variomatrix or SQ logic gain riding circuitry, try playing one of those early stereo recordings through it. The circuitry will tend to pull out some of the subtle lines, route them to individual speakers and wind up the gain. The result can be almost a new mix. ■

Your own one-off Ferrograph at a price no similar machine can equal.

Why Ferrograph?

Quite simply because it gives you the very best sound recording quality, based on 30 years production.

And the reliability that comes from near-total in-house manufacture, stage by stage control and 100% unit inspection before despatch.

How else could every Ferrograph reel-to-reel recorder offer you 10,000 hours regular use?

Why the SP7?

Because it offers all this Ferrograph quality in a machine that's custom-built with the exact facilities you need, at an



extremely competitive cost.

You have the performance and flexibility normally available only on more expensive recorders, without paying for features you don't need.

You have the best there is within a budget.

Just specify the features you want.

They'll be built into a 3-head, 3-speed, 3-motor recorder which uses the transport and logic controls that made the Logic 7 famous.

The price? Basic Mono £395. Basic Stereo £495. Plus the options you choose. And that's your next step.

◀ Stereo + Mono Track Selection

Select your SP7

Tick the facilities that interest you



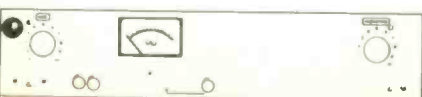
Stereo + Mono Track Selection + Dolby



Stereo + Mono Track Selection + Mic inputs



Mono



Mono + Mic input

Basic Type

Mono

Stereo

(incl. Mono Selection)

Line in/Line out

Microphone Input(s)

Heads

Mono - Full Track

- Half Track

Stereo - Half Track

- Quarter Track

Tape Speeds (3)

High 15"/7 1/2"/3 3/4"

Medium 7 1/2"/3 3/4"/1 7/8"

Low 3 3/4"/1 7/8"/1 1/8"

Equalisation

IEC/CCIR

NAB

Optional Facilities

Balanced Line in/out

Power Amps (10w)

+ Speakers

Dolby B NR System

(Stereo Models only)

Rack Mounting Kit (19in)

NAB Adaptors (1 pair)

Stainless Steel

Reel Retainers

Cannon XLR Connectors

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Quantity Required

Demonstration requested

Send us the completed coupon and we will let you know how much your custom-built SP7 would cost. And we'll send you the SP7 leaflet.

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NEAL FERROGRAPH



ATEAP Exhibition, Paris

The second annual exhibition in Paris organised by the Association pour les Techniques Electro-Acoustics Professional takes place at the Sofitel Hotel in Paris, from November 13 to 15. In addition to the exhibition, which now covers three floors at the hotel, there is also a conference, round table and seminar. Opening hours are from 10am on each day, closing at 8pm, 10pm and 4pm on the three days respectively.

List of exhibitors

Lower Ground Floor

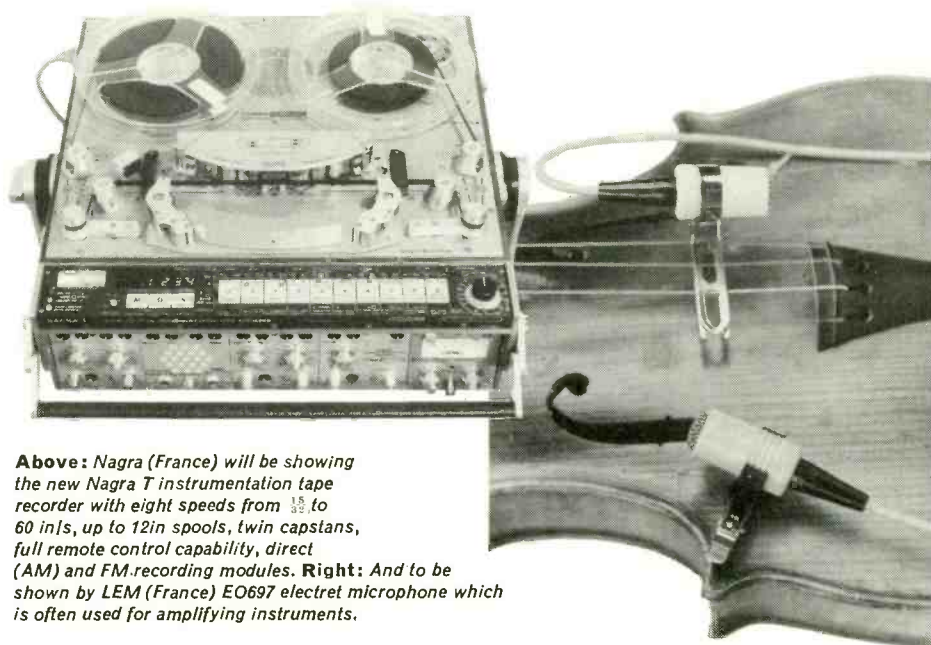
SAJE
LEM
Regie Scene
Spektrix
Son Professional
Soracitel
Brandt
Marc Wood
LTM
Enertec
Ramses
E2-A
Picot

Ground Floor

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Appel
Cineco
Girardin
3M
Publison
Agfa
Canetti
Freevox
Technicobel
Shaeffer Riesser
Pyrat
RED
Ampex
Philips
Sonetec

First Floor

Tradelec
Harman France
SCV Audio
Simplex Electronique
Elna
Acoustique Consultant
Nagra France (Demo Room)
Ampex (Demo Room)
Cabasse (Demo Room)
Reditec (Demo Room)
Publison (Demo Room)
AP France (Demo Room)
Freevox (Demo Room)
Nexo (Demo Room)
Lazre (Demo Room)
High Fidelity (Demo Room)



Above: Nagra (France) will be showing the new Nagra T instrumentation tape recorder with eight speeds from $\frac{15}{16}$ to 60 in/s, up to 12in spools, twin capstans, full remote control capability, direct (AM) and FM recording modules. **Right:** And to be shown by LEM (France) EO697 electret microphone which is often used for amplifying instruments.

10 OUTLET DISTRIBUTION AMPLIFIER 2



One floating input, 10 floating outputs at 600 Ohms for general studio work or feeding multiple slave pa amplifiers. They are used extensively during press conferences and state occasions to provide sound feeds to radio and television networks, and Stabilizers are also used in the public address system to reduce howl-round. Over 200 line feeds were in use during the Pope's visit to Eire.
DISTORTION, all outputs loaded, at +12dBV.7.

1kHz —84dB, 0.005%
30Hz—20kHz —64dB, 0.05%
INTERMODULATION DISTORTION 50Hz + 7kHz, 4:1
Output + 12dBV.7. —84dB, 0.005%

The unit meets the IBA 'signal path' specifications and is available as a complete unit or as a set of all parts excluding the case and XLR connectors.
Stereo Disc Amplifier 2 * Stabilizer * Frequency Shift Circuit Boards * Peak Programme Meter Drive Circuits and Ernest Turner Movements * Chart Recorders * Peak Deviation Meters

SURREY ELECTRONICS

The Forge, Lucks Green, Cranleigh, Surrey GU6 7BG
Telephone 04866 5997

The Technology Must Serve The Music

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

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

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

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

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

Solid State Logic
—at the leading edge of recording technology

Solid State Logic

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099 389 324 • TLX 837400

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Oxford, England
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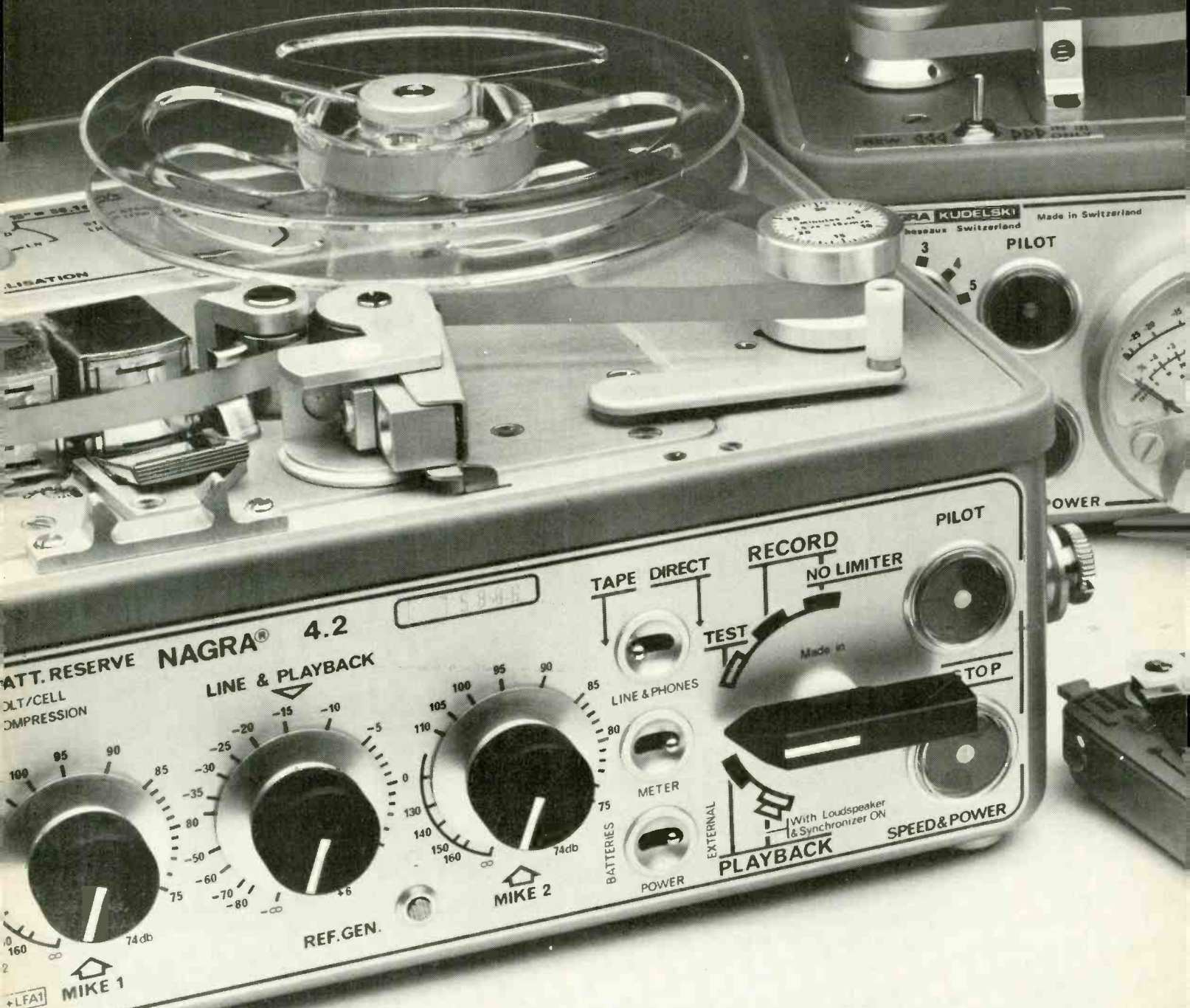
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Viale Brianza 20
20092 Cinisello Balsamo
A. Savasi
Milan 61798
TLX 31473

Germany

B.F.E.
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Postfach 81
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Mainz 42430
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Stefan Kudelski has a lot to answer for.



During his search for recording perfection, Stefan Kudelski has developed a unique range of professional machines.

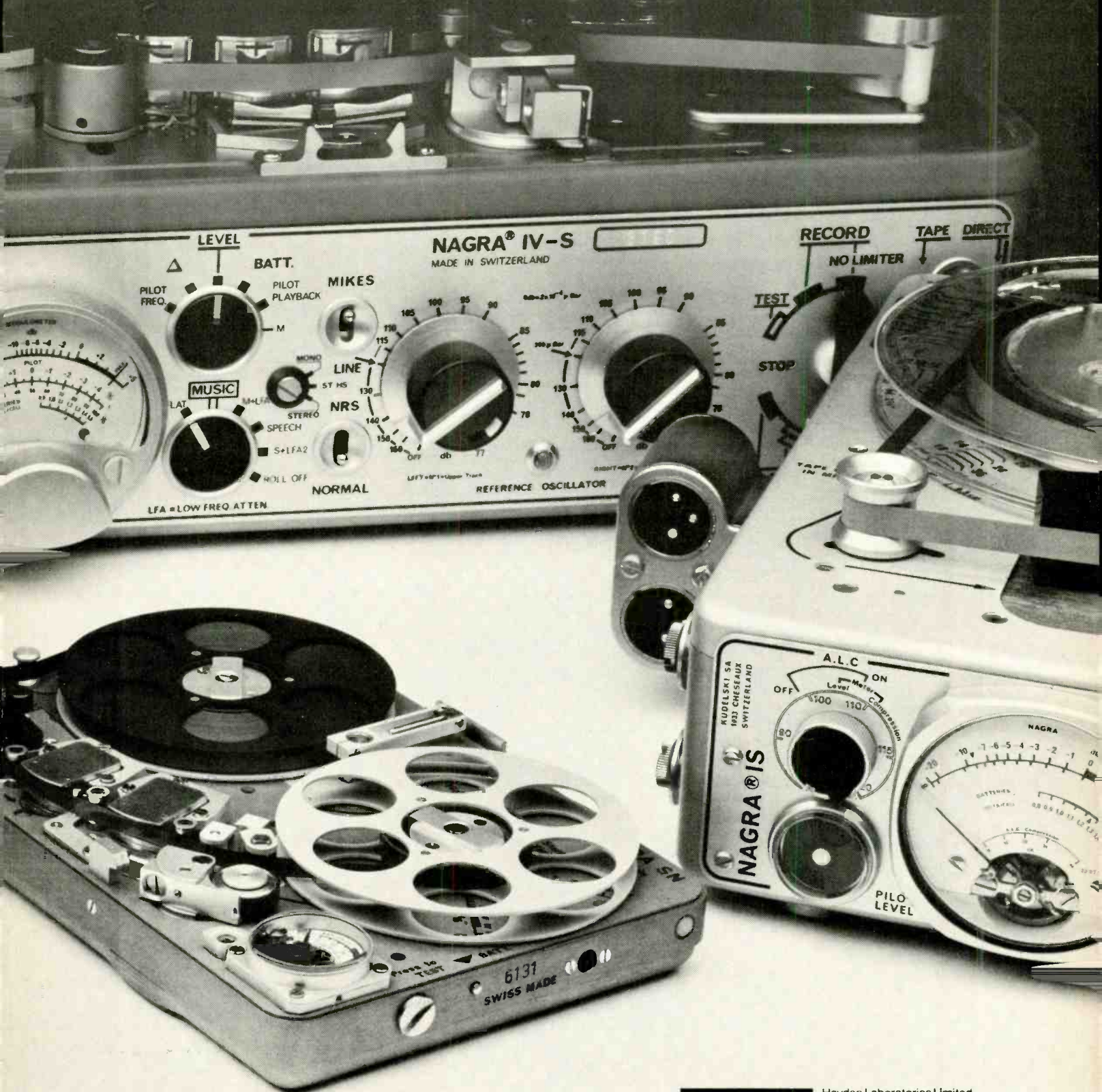
They all carry the famous Nagra name and with it a guarantee of highest quality.

From the miniature SN (used by Chris Bonnington on his successful climb of Everest) to the 3-times Oscar award-winning 4.2, Nagra

recorders have become unquestioned world-leaders.

Having created this height of perfection, Stefan Kudelski can surely be looked to for all the answers.

NAGRA KUDELSKI



HAYDEN
 Exclusive UK Agent

Hayden Laboratories Limited,
 Hayden House, Churchfield Road,
 Chalfont St Peter, Bucks.
 Telephone: Gerrards Cross 88447.
 Telex: 849469.

Survey: 2 and 4-track machines

ACCURATE SOUND (USA)

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

MODEL 2600 TRANSPORT

Tracks/speeds: 1, 2 or 4 on $\frac{1}{2}$ in or $\frac{3}{4}$ in; $3\frac{3}{4}/7\frac{1}{2}$ or $7\frac{1}{2}/15$ in/s, or all three (higher and lower speeds to special order).

Wow and flutter: 0.08% rms at 15in/s.

Features: full logic control and motion sensing; capstan off until 'play' initiated; remote control option; 'constant torque and/or tension holdback and/or takeup'; MCI, Inovonics or ASCO electronics package available with selsync and meter options.
Price: on application.

AMPEX (USA)

Ampeg Corporation, 401 Broadway, Redwood City, Cal 94063, USA.
Phone: (415) 367-4151.

UK: Ampeg GB Limited, Acre Road, Reading RG2 0QR.

Phone: 0734 864211. Telex: 847611.

AG440C

Tracks/speeds: 1, 2 or 4 on $\frac{1}{2}$ in or 4 on $\frac{3}{4}$ in; $3\frac{3}{4}/7\frac{1}{2}/15/30$ in/s in any combination.

Frequency response: ± 2 dB, 50Hz to 20kHz at 30in/s.

Noise: 70dB, ANSI-weighted, at 30in/s.

Wow and flutter: 0.04%, peak-weighted, at 30in/s.

Features: full logic control with motion sensing and interlock plus memory; dc servo capstan; remote control and varispeed option; full selsync; NAB/CCIR eq; available in portable, console and rack-mounting versions.
Price: on application.

ATR100

Tracks/speeds: 1 or 2 on $\frac{1}{2}$ in, or 4 on $\frac{3}{4}$ in; $3\frac{3}{4}/7\frac{1}{2}/15/30$ in/s, in any combination.

Frequency response: ± 0.75 dB, 200Hz to 20kHz at 30in/s; ± 0.75 dB, 100Hz to 15kHz at 15in/s.

Noise: 81dB, ANSI-weighted, at 30in/s.

Wow and flutter: 0.03%, peak-weighted, at 15 and 30in/s.

Features: full logic control and motion sensing; closed-loop servo tape drive without pinch rollers; remote control, autocue and varispeed options; full selsync; digital tape timer; CCIR hubs, cue amplifier; 2-track $\frac{1}{2}$ in heads; 4-speed dual eq padnet; editing kit; available in console, table top, portable and rack-mounting versions.
Price: on application.

ATR700

Tracks/speed: 1, 2 or $\frac{1}{2}$ -track on $\frac{3}{4}$ in; $3\frac{3}{4}/7\frac{1}{2}$ or $7\frac{1}{2}/15$ in/s.

This survey does not include digital tape recorders that use a separate video or instrumentation recorder as the recording medium with a PCM adaptor, but only specially designed digital tape machines. Multitrack machines are surveyed next month.



Ampex ATR 100



Frequency response: 15in/s 40Hz to 100Hz ± 3 dB, 100Hz to 18kHz ± 2 dB, at $7\frac{1}{2}$ in/s 100Hz to 15kHz ± 2 dB.

Noise: overall A-weighted 60dB 2-track.

Wow and flutter: 0.08%.

Features: logic control, space for extra head, DC servo capstan motor, mechanical tape timer in minutes, tape lifter, motion sensing, remote control, varispeed, XLR connectors.

Price: on application.

ASC (West Germany)

Audio Systems Componenten GmbH, Seibelstrasse 4, D-8752 Hosbach, West Germany.

Phone: 06021 5.30.21. Telex: 04188571.

UK: Audio Systems Components Ltd, 32 Crown Lane, Theale, Berks RG7 5BG.

Phone: 0734 302108.

AS6002/38

Tracks/speeds: 2-track, optional $\frac{1}{2}$ -track head, $3\frac{3}{4}/7\frac{1}{2}/15$ in/s.

Frequency response: 15in/s 20Hz to 25kHz, $7\frac{1}{2}$ in/s 20Hz to 25kHz.

Noise: 56dB DIN, 59dB IEC.

Wow and flutter: 0.04% 15in/s, 0.05% $7\frac{1}{2}$ in/s.

Features: logic control, plug-in headblock, optional extra head, digital actual tape length counter, XLR connectors.

Price: £599.

ENERTEC (France)

Erntec, 296 Avenue Napoleon Bonaparte, F-92505 Rueil-Malmaison, France.

Phone: (1) 732.92.23. Telex: 203404.

UK: Clive Green & Co Ltd, Britannia House, Leagrave Road, Luton LU3 1RJ.

Phone: 0582 411513. Telex: 8812495.

F462

Tracks/speeds: full track, 2-track or stereo on $\frac{1}{2}$ in tape, $15/7\frac{1}{2}$ in/s. Options for $7\frac{1}{2}/3\frac{3}{4}$ in/s and $15/30$ in/s.

Frequency response: 15in/s 40Hz to 18kHz ± 2 dB, $7\frac{1}{2}$ in/s 40Hz to 15kHz ± 2 dB.

Noise: CCIR full track 15in/s 61dB unweighted, $7\frac{1}{2}$ in/s 61dB.

Wow and flutter: 15in/s 0.04%, $7\frac{1}{2}$ in/s 0.06%.

Features: optional varispeed, CCIR/NAB eq, remote control, real time digital counter correct in each speed, external counter, XLR connectors, optional local monitoring, zero locator, logic control, optional VU meter panel, optional pilot track models.
Price: £4,240.

FERROGRAPH/NEAL (UK)

North East Audio Ltd, Simonside Works, South Shields, Tyne and Wear NE34 9NX.

Phone: 0632 566321. Telex: 537227.

US: Neal Ferrograph (USA) Inc, 652 Glenbrook Road, Stamford, Conn 06906.
Phone: (203) 348-1045.

STUDIO 8

Tracks/speeds: 1 or 2 on $\frac{1}{2}$ in (or 0.15in to special order); $3\frac{3}{4}/7\frac{1}{2}$ or $7\frac{1}{2}/15$ in/s.

Noise: 62dB, DIN-weighted, at 15in/s.

Wow and flutter: 0.06%, rms quasi-peak weighted, at 15in/s.

Features: full logic control with motion sensing; line-in/line-out plus headphone monitoring as standard; varispeed and remote control; mic inputs optional; built-in monitor speaker amps; variable (preset) spool speed; bin/dump or standard edit; LED elapsed-time display; available in console, transportable and rack mounting versions, VU or PPM metering, optional remote control.

Price: from £3,050 (\$5,600) for transportable and from £3,495 (\$6,650) for console versions (both line-in/line-out). Also available as a quality control/tape stock check machine for 0.15in cassette duplicating tape, in either record/replay mono or bidirectional, replay-only stereo formats.

SP7

Tracks/speeds: 1 (full or $\frac{1}{2}$ -track) or 2 ($\frac{1}{2}$ or $\frac{1}{4}$ -track) on $\frac{1}{2}$ in; $15/7\frac{1}{2}/3\frac{3}{4}$ in/s, $7\frac{1}{2}/3\frac{3}{4}/1\frac{1}{2}$ in/s, or $3\frac{3}{4}/1\frac{1}{2}/\frac{3}{8}$ in/s.

Frequency response: ± 2 dB, 30Hz to 20kHz at 15in/s.

Noise: 60dB unweighted (ref 2% distortion) at 15in/s.

Wow and flutter: 0.08% at 15in/s; 0.1% at $7\frac{1}{2}$ in/s.

Features: full logic control with motion sensing and command memory; remote control of all main functions; variable speed spooling; digital turns counter; damped tape tension arms; very fast start on Run (0.1s for correct speed); 3 motors, 3 heads, 3 speeds; VU meters; tape/source switching; headphones output. Options include line-in/line-out, balanced or unbalanced; microphone input; IEC or NAB eq; 10W power amplifiers and loudspeakers, Dolby B noise reduction (stereo models only); stainless steel reel retainers; rack mounting. Range of accessories available, including remote control unit, dust cover.

Price: £395 (\$1,200) basic mono; £495 (\$1,400) basic stereo.

LOGIC 7

Tracks/speeds: 2-track ($\frac{1}{2}$ or $\frac{1}{4}$ -track) on $\frac{1}{2}$ in; $15/7\frac{1}{2}/3\frac{3}{4}$ in/s, $7\frac{1}{2}/3\frac{3}{4}/1\frac{1}{2}$ in/s, $3\frac{3}{4}/1\frac{1}{2}/\frac{3}{8}$ in/s.

Frequency response: ± 2 dB, 30Hz to 20kHz at 15in/s.

Noise: 60dB unweighted (ref 2% distortion) at 15in/s.

Wow and flutter: 0.08% at 15in/s; 0.1% at $7\frac{1}{2}$ in/s; quasi peak.

Features: full logic control with motion sensing and command memory, remote control of all main functions; variable speed spooling; digital turns counter; damped tape tension arms; very fast start on Run (0.1s for correct speed); 3 motors, 3 heads, 3 speeds; VU meters; tape/source switching; headphones output; optional 10W per channel with loudspeakers and/or Dolby B noise reduction. Range of accessories available including dust cover remote control unit.

Price: £649 (\$1,700) for basic machine; amps/speakers £89 (\$240), Dolby B £100 (\$260).

IEM (USA)

International Electro-Magnetics Inc, Eric Drive and Cornell Avenue, Palatine, Illinois 60067, USA.

Phone: (312) 358-4622.

1100A SERIES

Tracks/speeds: 1 or 2 on $\frac{1}{2}$ in, 4 on $\frac{1}{4}$ in, or 8 on 1in; $7\frac{1}{2}/15/30$ in/s.

Frequency response: ± 2 dB, 30Hz to 15kHz, overall at 15in/s.

Noise: 70dB below peak record level.

Wow and flutter: 0.05% rms in the band 0.5-250Hz.

Features: full logic control and motion sensing;



Enertec F462



Neal/Ferrograph SP7



Leavers-Rich Proline 2000 TC

crystal-controlled servo capstan with $7\frac{1}{2}$ to 30in/s varispeed; servo-controlled spool motors; plug-in headblocks; console or portable construction.

LEEVEES-RICH (UK)

Leavers-Rich Ltd, 319 Trinity Road, Wands-worth, London SW18 3SL, UK.

Phone: 01-874 9054. Telex: 923455.

PROLINE 2000TC

Tracks/speeds: 1 or 2 on $\frac{1}{2}$ in; $3\frac{3}{4}/7\frac{1}{2}$, $7\frac{1}{2}/15$, $15/30$ in/s.

Frequency response: ± 2 dB, 30Hz to 18kHz at 15in/s; ± 2 dB, 30Hz to 16kHz at $7\frac{1}{2}$ in/s.

Noise: 60dB for mono and 58dB for stereo; both at 15in/s.

Wow and flutter: 0.05%, peak-weighted, at 15in/s.

Features: full TTL logic interlock; twin dc servo-controlled capstans with crystal reference; dc spooling motors with constant velocity, variable speed spooling; 5.9 to 32in/s varispeed; dump edit, constant tape tension in all modes, speeds and reel sizes; NAB/DIN (IEC) switched eq; LED tape timer display; plug-in open face headblock and modular electronics; provision for external capstan drive; various control panel options for TV, radio and recording studios; remote control option.

Price: on application.

PROLINE 1000/SC

Tracks/speeds: 1 or 2 on $\frac{1}{2}$ in; $3\frac{3}{4}/7\frac{1}{2}$, $7\frac{1}{2}/15$, $15/30$ in/s

Frequency response: ± 1 dB, 100Hz to 10kHz at $7\frac{1}{2}$ and 15in/s.

Noise: 58dB, overall unweighted, for stereo at 15in/s.

Wow and flutter: 0.05%, peak-weighted, at 15in/s.

Features: mains-locked capstan motor on 1000, or servo-controlled on 1000SC; motion sensing interlock; servo tape tension control; variable speed spooling; plug-in open face headblock; modular electronics; varispeed for 1000SC; NAB/DIN (IEC) switched eq; electronic adjustment of starting tensions and specially-designed air damping for optimum starting and spooling conditions; remote control option; available in console, transportable or rack-mount versions, or transport only.

Price: on application.

E200

Tracks/speeds: 1 or 2 on $\frac{1}{2}$ in; $3\frac{3}{4}/7\frac{1}{2}$, $7\frac{1}{2}/15$ in/s.

Frequency response: ± 2 dB, 40Hz to 18kHz at 15in/s.

Noise: 60dB, overall unweighted, for stereo at 15in/s.

Wow and flutter: 0.06%, peak unweighted, at 15in/s.

Features: 'logic semi-interlock'; modular tape transport and electronics; servo-controlled tape tension; plug-in headblock; NAB or DIN (IEC) eq on plug-in cards; remote control option; available in Lowline console, standard or rack-mount versions, or transport only.

Price: on application.

MCI (USA)

MCI Inc, 4007 NE 6th Avenue, Fort Lauderdale, Florida 33304, USA.

Phone: (305) 566-2853. Telex: 514362.

UK: MCI (Professional Studio Equipment) Ltd, 54-56 Stanhope Street, London NW1 3EX.

Phone: 01-388 7867. Telex: 261116.

JH-110A SERIES

Tracks/speeds: 1 or 2 on $\frac{1}{2}$ in, 4 on $\frac{1}{4}$ in, or 8 on 1in; $3\frac{3}{4}/7\frac{1}{2}/15$, $7\frac{1}{2}/15/30$ in/s.

Frequency response: ± 2 dB, 50Hz to 20kHz at 30in/s.

Noise: 67dB, unweighted, at 30in/s.

Wow and flutter: 0.02%, DIN-weighted, at 30in/s.

Features: full logic interlock and motion sensing; servo-controlled dc spool motors; crystal-control-LED dc capstan, externally controllable by dc voltage or frequency; variable speed rewind; remote control and autolocator options; digital clock and return-to-zero facility; tape velocity indicator; available in console or rack-mounting versions.

Price: from \$3,580 mono, \$4,214 2-track, \$5,651 4-track $\frac{1}{2}$ in.

MECHLABOR (Hungary)

Electroimpex, PO Box 296, H-1392 Budapest, Hungary.

Phone: 321330. Telex: 225771.

STM-600 SERIES

Tracks/speeds: $7\frac{1}{2}/15$ in/s or $3\frac{3}{4}/7\frac{1}{2}$ in/s, mono, stereo, 2-track.

Frequency response: 15in/s 30Hz to 18kHz —3dB, $7\frac{1}{2}$ in/s 30Hz to 16kHz —3dB.

Noise: 15in/s stereo 62dB, $7\frac{1}{2}$ in/s 61dB.

62 ▶

SURVEY: 2 and 4-TRACK

Wow and flutter: 15in/s 0.035%, 7½in/s 0.065%.
Features: remote control, relay logic control, electronic tape tension, optional digital real-time readout, auto end stop, electronic editing, optional varispeed.
Price: on application.

3M (USA)

3M Company, Building 224 BW, 3M Centre, Saint Paul, Minn 55101, USA.
Phone: (612) 733-1110. Telex: 297434.
UK: 3M UK Ltd, 3M House, PO Box 1, Bracknell, Berks RG12 1JU.
Phone: 0344 26726. Telex: 849371.

Digital Mastering System

Channels/speed: 4-channel on ½in, 45in/s. Full specification next month. Two preview units are available for disc cutting applications, one providing 0 to 1.3s delay, and the other 0 to 1.96s delay (both digitally inserted before the D/A converter).
Price: £25,000/\$35,000. 1.3s delay \$5,500, 1.96s delay \$7,400.

NAGRA (Switzerland)

Kudelski SA, 1033 Cheseaux-sur-Lausanne, Switzerland.
Phone: 021 912121. Telex: 24392.
UK: Hayden Laboratories Ltd, Hayden House, Churchfield Road, Chalfont St Peter, Bucks SL9 9EW.
Phone: 02813 88447. Telex: 849469.
US: Nagra Magnetic Recorders Inc, 19 West 44th Street, Room 715, New York, NY 10036.
Phone: (212) 661-8066.

IV-S

Tracks/speeds: 2 plus *Nagrasync* on ½in; 3½, 7½, 15in/s.
Frequency response: ±1dB, 30Hz to 15kHz at 7½in/s; ±1dB, 30Hz to 20kHz at 15in/s.
Noise: 74dB for *Nagmaster* or 71dB for NAB or CCIR equalisation at 15in/s.
Wow and flutter: 0.05%, DIN-weighted, at 15in/s.
Features: portable machine, mains or battery-powered; mic/line inputs; twin-needle peak reading meter, switchable to read sum and difference; built-in reference oscillator; NAB or CCIR switchable eq; line and headphone outputs; variety of options and accessories available, including large-reel adaptor, microphone pre-amplifiers, and Dolby noise reduction unit.
Price: from 9,097 Swiss francs.

4.2LSP

Tracks/speeds: 1 plus *Neopilot* on ½in; 3½, 7½ and 15in/s.
Frequency response: ±1.5dB, 30Hz to 15kHz at 7½in/s; ±1.5dB, 30Hz to 20kHz at 15in/s.
Noise: 73dB for NAB or 72dB for CCIR, A-weighted, at 7½in/s.
Wow and flutter: 0.05%, DIN-weighted, at 15in/s.
Features: similar to those for IV-S.
Price: from 8,548 Swiss francs.

E

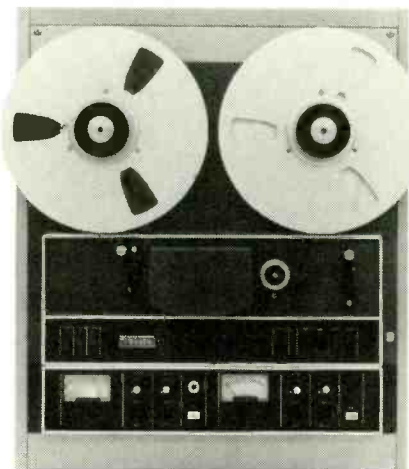
Tracks/speeds: 1 on ½in, 3½in/s.
Frequency response: ±2dB, 50Hz to 15kHz.
Noise: 62dB 'weighted'.
Wow and flutter: 0.1% to DIN 45507.
Features: low-cost mains or battery-powered portable derived from 4.2 transport; mic and line input; NAB or CCIR equalisation; includes circuit diagram and a selection of spare parts for field maintenance.

SN

Tracks/speeds: 1 (with or without pilot-tone) on 0.15in tape; 1½in/s and 3½in/s.
Frequency response: ±2dB, 80Hz to 15kHz at



Otari MX-5050-B



Scully 250



Revox B77

3½in/s.
Noise: 60dB, A-weighted.
Wow and flutter: 0.1% to DIN 45507.
Features: miniature battery-powered portable; 10Hz *Pilot-tone* system; mic and line inputs; variety of accessories available. Model SNS is a ½-track, 1½ and 1½in/s cm/s version.
Price: from 5,065 Swiss francs.

SNST

Stereo version of Nagra SN, record only.

T-I

The Nagra T-I is an instrument recorder with 4 channels designed to operate to the IRIG Intermediate band specification, twin capstan drive, full logic control, built-in Auto locator, search to zero, plug-in channel amplifiers for AM or FM recording switchable constant amplitude/linear phase.

Tracks/speeds: 4-channel on ½in, 60/30/15/7½/3½/1½in/s.

Frequency response: direct module (AM) 30in/s 100Hz to 125kHz, 39dB S/N; 15in/s 150Hz to 60kHz, 40dB S/N; 7½in/s 100Hz to 30kHz, 40dB S/N; 3½in/s, 100Hz to 15kHz, 40dB S/N; 1½in/s 100Hz to 7kHz, 41dB S/N; ¾in/s 100Hz to 3.75kHz, 41dB S/N; ½in/s 100Hz to 1.87kHz, 41dB S/N. FM module frequency response from dc in all cases, 30in/s to 10kHz, 46dB; 15in/s to 5kHz, 46dB; 7½in/s to 2.5kHz, 46dB; 3½in/s to 1.25kHz, 44dB; 1½in/s to 625Hz, 42dB; ¾in/s to 312Hz, 40dB; ½in/s to 156Hz, 38dB.

Price: £5,000 to £6,000 depending upon facilities.

T-RVR

Tracks/speeds: 1 or 2-track + timecode track on ½in; 7½/3½/1½/¾in/s.

Frequency response: 7½in/s not specified, 3½in/s 170Hz to 15kHz, 58dB S/N; 1½in/s 170Hz to 10kHz, 55dB S/N; ¾in/s 170Hz to 5kHz, 50dB S/N.

Wow and flutter: 0.09% at 3½in/s.

Features: rack mounting logging recorder. High speed search facility on playback x4 or x16, power required 20 to 30V dc accessories include second track, timecode track, timecode generator, with master clock to IRIG B standard, continuous self-check circuit, time corrector x0.5 to x2 with pitch alteration.

Price: from £1,900.

OTARI (Japan)

Otari Electric Co Ltd, 4-29-18 Minami Ogikubo, Siginami-Ku, Tokyo 167, Japan.

Phone: 03 333-9631. Telex: 26604.

UK: Industrial Tape Applications, 1-7 Harewood Avenue, London NW1.

Phone: 01-724 2499. Telex: 21879.

US: Otari Corporation, 981 Industrial Road, San Carlos, Cal 94070.

Phone: (415) 593-1648. Telex: 910-376 4890.

MX-5050-B

Tracks/speeds: 1 or 2 on ½in tape; 3½/7½ or 7½/15in/s.

Frequency response: ±2dB, 30Hz to 20kHz at 15in/s.

Noise: 65dB, weighted, at 15in/s.

Wow and flutter: 0.05% at 15in/s.

Features: motion-sensing control logic; 4-head option-erase, ½-track record and replay, plus ¼-track replay; sync facility and remote control; NAB eq with EIA, CCIR and IEC options; available in cabinet, road-case and rack-mounting versions. dc servo capstan with variable speed; XLR connectors.

Price: £795.

MX-5050-QX

Tracks/speeds: 4-track on ½in tape; 7½/15in/s.

Frequency response: ±2dB, 50Hz to 20kHz at 15in/s.

Noise: 65dB, NAB-weighted, at 15in/s.

Wow and flutter: 0.05%, NAB-weighted, at 15in/s.

Features: motion-sensing control logic; dc servo capstan with varispeed; interface for dbx or Dolby; separate transport and electronics module; sync facility on all channels; plug-in head assembly; available in portable, console, or rack-mounting versions.

Price: £1,385.

SCULLY (USA)

Ampro Scully, Newton Yardley Road, Newton, Penn 18940, USA.

Phone: (215) 968-9000.

UK: Lee Engineering, Napier House, Bridge Street, Walton-on-Thames, Surrey KT12 1AP.

Phone: 09322 43124. Telex: 928475.

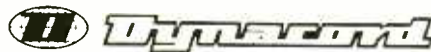


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SURVEY: 2 and 4-TRACK

280B SERIES

Tracks/speeds: 2 on $\frac{1}{2}$ in or 4 on $\frac{1}{4}$ in; $3\frac{3}{4}$ / $7\frac{1}{2}$ / $15/30$ in/s.
Frequency response: ± 2 dB, 50Hz to 20kHz at 30in/s.

Noise: 68dB, NAB-weighted, for 4-track at 30in/s.
Wow and flutter: 0.04% for dc servo capstan, ANSI-weighting, at 30in/s.

Features: dc servo or ac capstan; logic control and motion sensing; $\pm 20\%$ varispeed; remote control and *Varisync* options; available in console or electronics plus transport versions; *284B Series* accepts 14in reels.

Price: on application.

MODEL 250

Tracks/speeds: 1 or 2 on $\frac{1}{2}$ in; $3\frac{3}{4}$ / $7\frac{1}{2}$ / 15 in/s.
Frequency response: ± 2 dB, 50Hz to 18kHz at 15in/s.

Noise: 66dB, NAB-weighted, for 2-track at 15in/s.
Wow and flutter: 0.06%, ANSI-weighted, at 15in/s.
Features: logic control and motion sensing; hysteresis synchronous capstan; remote control option; available in rack-mounting or portable versions. *Model 255* is a $3\frac{3}{4}$ / $7\frac{1}{2}$ in/s, replay-only version for broadcast use.

Price: on application.

SONY (Japan)

Sony Corporation, PO Box 10, Tokyo Airport, Tokyo, Japan.

UK: Sony (UK) Ltd, 134 Regent Street, London W1R 6DJ.

Phone: 01-439 3874. Telex: 264149.

US: Sony Corporation of America, 9 West 54th Street, New York, NY 10019.

Phone: (212) 371-5800.

TC766-2

Tracks/speeds: 2 on $\frac{1}{2}$ in; $7\frac{1}{2}$ / 15 in/s.
Frequency response: ± 3 dB, 30Hz to 22kHz at 15in/s.

Noise: 64dB on FeCr tape.

Wow and flutter: 0.018% wrms at 15in/s.

Features: logic control; closed loop dual-capstan drive with ac servo control; four heads including $\frac{1}{2}$ -track playback; mic/line inputs; remote control option.

Price: £705.35.

TC880-2

Tracks/speeds: 2 on $\frac{1}{2}$ in; $7\frac{1}{2}$ / 15 in/s.
Frequency response: ± 3 dB, 25Hz to 35kHz at 15in/s.

Noise: 65dB on FeCr tape.

Wow and flutter: 0.02% wrms at 15in/s.

Features: similar to *TC766-2*, plus 'optical monitoring' with switchable VU, PPM or peak hold; calibrated input and output controls; varispeed.

Price: £1,482.20.

TC510-2

Tracks/speeds: 2 on $\frac{1}{2}$ in; $3\frac{3}{4}$ / $7\frac{1}{2}$ in/s.
Frequency response: ± 3 dB, 30Hz to 20kHz at $7\frac{1}{2}$ in/s.

Noise: 64dB on FeCr tape.

Wow and flutter: 0.05% wrms at $7\frac{1}{2}$ in/s.

Features: battery or mains-powered portable; mic/line inputs; stop, record and playback on 3-position 'click-stop' switch; varispeed.

Price: £552.

STELLAVOX (Switzerland)

Stellavox, 2068 Hauterive, Neuchatel, Switzerland.

Phone: 038 33.42.33.

UK: John Page Ltd, Wesley House, 75 Wesley Avenue, London NW10 7DA.

Phone: 01-961 4181. Telex: 24224.

SM8/SQ7

Tracks/speeds: 2 (*SM8*), 4 (*SQ7*) on $\frac{1}{2}$ in, $7\frac{1}{2}$ and



Studer A67

15in/s.

Frequency response: ± 2 dB, 20Hz to 28kHz at 15in/s.

Noise: 70dB (*SM8*) or 66dB (*SQ7*), A-weighted at 15in/s.

Wow and flutter: 0.04%, DIN-weighted, 'typical'.

Features: battery or mains-powered portable; built-in loudspeaker; twin PPM or VU metering; single transport control; mic/line inputs. 12/48V mic powering, mic attenuators.

Price: £2,998 *SM8*, £4,910.50 *SQ7*.

SP8

Tracks/speeds: 1 or 2 on $\frac{1}{2}$ in; $3\frac{3}{4}$, $7\frac{1}{2}$ and 15in/s.

Plug-in head blocks.

Frequency response: ± 2 dB, 30Hz to 18kHz in stereo mode at $7\frac{1}{2}$ in/s.

Noise: 65dB, A-weighted, at $7\frac{1}{2}$ in/s in stereo mode.

Wow and flutter: 0.07%, DIN-weighted at $7\frac{1}{2}$ in/s.

Features: similar to *SM8* with 50/60Hz pilot generator and cue track playback amp of synchroniser; EBU time code recording option also available.

Price: £2,137 less head assembly (£200 up).

TD88

Tracks/speeds: 1 (with or without *Neopilot*) or 2 (with or without *Synchrolone*) or $\frac{1}{2}$ in, 2, 4 or 8 on $\frac{1}{2}$ in, and *Perfoltape* for 16mm magnetic tape; $1\frac{1}{8}$, $3\frac{3}{4}$, $7\frac{1}{2}$, 15 and 30in/s, plus 24 and 25 frame/s.

Features: battery or mains-powered semiportable; logic control and motion sensing; interchangeable head blocks; remote control and varispeed options; electronic counter; available in free-standing or rack-mounting versions. Plug-in head/electronics units.

Price: on application.

STUDER/REVOX (Switzerland)

Willi Studer, Althardstrasse 150, CH-8105 Regensdorf, Zurich, Switzerland.

Phone: 01 840.29.60. Telex: 58489.

UK: FWO Bauch Ltd, 49 Theobald Street, Borehamwood, Herts WD6 4RZ.

Phone: 01-953 0091. Telex: 27502.

US: Studer Revox America Inc, 1819 Broadway, Nashville, Tenn 37203.

Phone: (615) 329-9576. Telex: 554453.

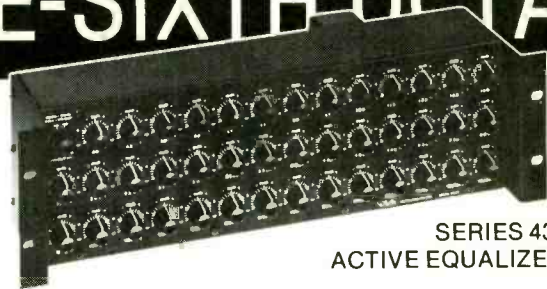
B67

Tracks/speeds: 1 or 2 on $\frac{1}{2}$ in; $3\frac{3}{4}$ / $7\frac{1}{2}$ / 15 in or $7\frac{1}{2}$ / $15/30$ in/s.

Frequency response: ± 1 dB, 60Hz to 15kHz at 15in/s.

Noise: 62dB, NAB-weighted, at 15in/s in stereo format. 66 ▶

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- 1/6 Octave** offers TWICE as much TUNING RESOLUTION as 1/3 Octave.
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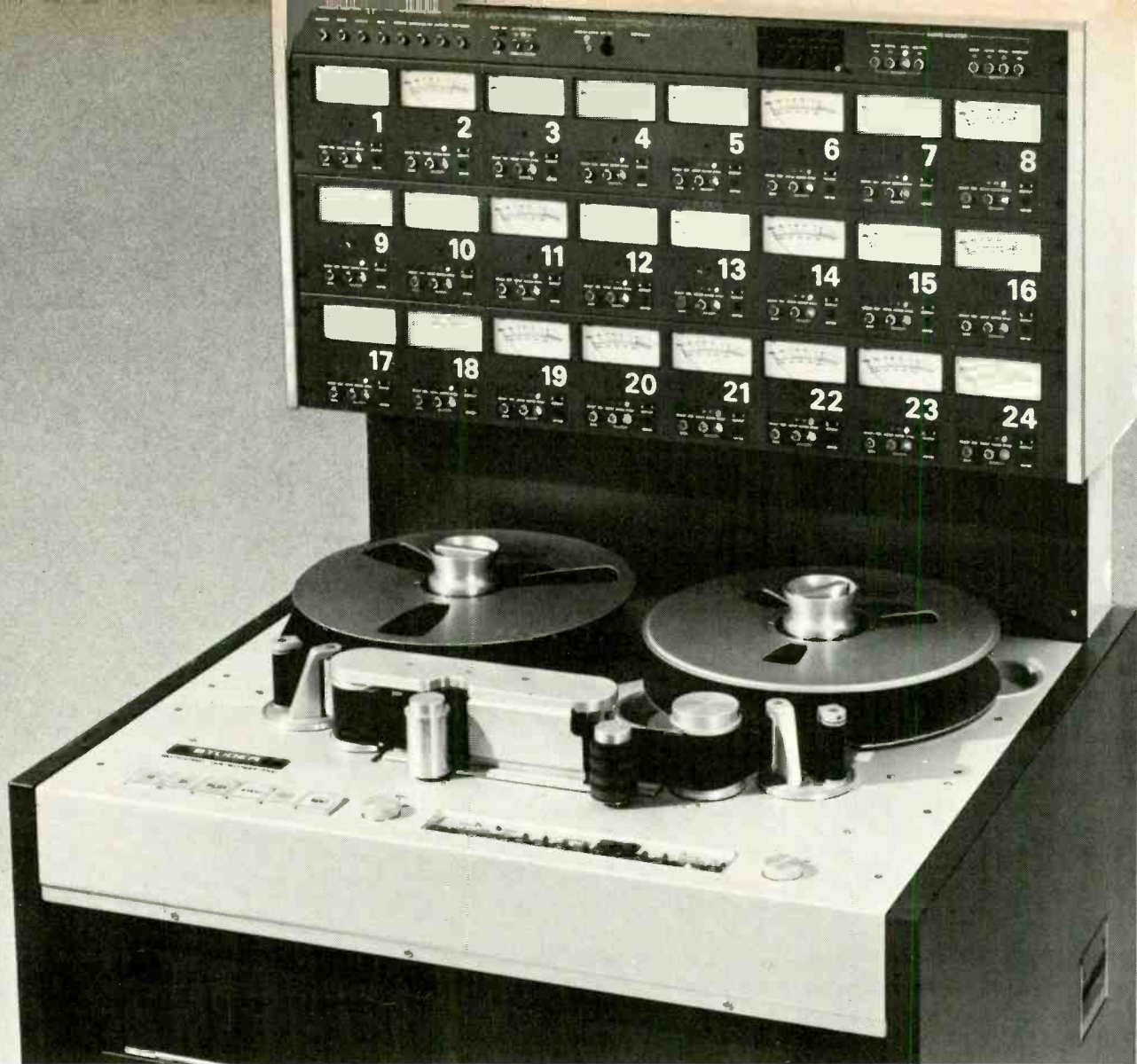
problems tend to rise in frequency. Models 4310 and 4311 offer 29, **1/6 Octave** Bands from 180 Hz through 4.5 kHz plus 12, 1/3 Octave bands from 31.5 Hz through 160 Hz and 5000 Hz through 10 kHz.

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SURVEY : 2 and 4-TRACK

Wow and flutter: 0.06%, weighted, at 15in/s.

Features: full logic control with tape tension and motion sensing; remote control, varispeed and 'fader-start' options; NAB or CCIR eq on plug-in cards; sync facility; VU meter panel; digital tape timer; tape dumping (motor off); console, portable or rack-mounting versions available.

Price: £1,832 to £2,832.

A80/RC

Tracks/speeds: 1 or 2 on $\frac{1}{2}$ in; $3\frac{3}{4}$ / $7\frac{1}{2}$, $7\frac{1}{2}$ /15, 15/30in/s.

Frequency response: ± 1 dB, 60Hz to 15kHz at 15in/s.

Noise: 62dB, NAB-weighted, at 15in/s.

Wow and flutter: 0.04%, weighted, at 15in/s.

Features: full logic control with motion sensing; remote control and varispeed options; NAB or CCIR eq on plug-in cards; variable spooling in edit mode; electronic tape timer plus 'zero locator'; chassis or console mounting versions available.

Price: £3,339 to £4,363.

A80/VII MkII

Basically similar to A80/RC plus pre-wiring for autolocator and comprehensive remote control unit. Special version with pre-listen facilities available for cutting rooms.

Price: £4,334 to £5,744.

A700

Tracks/speeds: 2 ($\frac{1}{2}$ or $\frac{1}{4}$ -track) on $\frac{1}{2}$ in; $3\frac{3}{4}$ / $7\frac{1}{2}$ /15in/s.

Frequency response: ± 1.5 dB, 50Hz to 18kHz at 15in/s.

Noise: 65dB, A-weighted, at 15in/s.

Wow and flutter: 0.06%, DIN-weighted, at 15in/s.

Features: full logic control with motion sensing;

crystal-controlled capstan; four mic inputs plus mixing; slide sync; varispeed and remote control as options; available in portable and rack-mounting versions.

Price: £1,323.

B77

Tracks/speeds: 2 ($\frac{1}{2}$ or $\frac{1}{4}$ -track) on $\frac{1}{2}$ in; $3\frac{3}{4}$ / $7\frac{1}{2}$ or $7\frac{1}{2}$ /15in/s.

Frequency response: +2, -3dB, 30Hz to 20kHz at $7\frac{1}{2}$ in/s.

Noise: 66dB, A-weighted, at $7\frac{1}{2}$ in/s.

Wow and flutter: 0.08% at $7\frac{1}{2}$ in/s.

Features: logic control and motion sensing; self-sync; slide sync, varispeed and remote control option.

Price: £600 to £700.

TANDBERG (Norway)

Tandberg Industrier A/S, PO Box 21, Bogerud, Oslo 6, Norway.

Phone: 472 29.54.00. **Telex:** 11886.

UK: Tandberg (UK) Ltd, Farnell House, 81 Kirkstall Road, Leeds LS3 1HR.

Phone: 0532 35111. **Telex:** 557611.

US: Tandberg of America Inc, Labriola Court, Armonk, NY 10504.

Phone: (212) 892-7010.

TD20A

Tracks/speeds: 2 ($\frac{1}{2}$ or $\frac{1}{4}$ -track) on $\frac{1}{2}$ in; $3\frac{3}{4}$ / $7\frac{1}{2}$ /15in/s.

Frequency response: 15Hz to 34kHz at 15in/s, 15Hz to 30kHz at $7\frac{1}{2}$ in/s.

Noise: 69dB $\frac{1}{2}$ -track, 67dB $\frac{1}{4}$ -track.

Wow and flutter: 0.06%, DIN-weighted, at 15in/s.

Features: logic control, phase correction network, selsync, front panel bias, optional infra-red remote control, 4 motor drive, reel tension switch, mic att.

Price: £770 ($\frac{1}{2}$ -track), £710.46 ($\frac{1}{4}$ -track).

TEAC (Japan)

Teac Corp, 3-7-3 Naka-cho, Masashino, Tokyo 180, Japan.

UK: Harman (Audio) UK Ltd, St John's Road, Tylers Green, High Wycombe, Bucks.

Phone: 049481 5331. **Telex:** 83651.

US: Teac Corp of America, 7733 Telegraph Road, Montebello, Cal 90640.

Phone: (213) 726-0303. **Telex:** 677014.

A3440

Tracks/speeds: 4-track on $\frac{1}{2}$ in; $7\frac{1}{2}$ /15in/s.

Frequency response: 25Hz to 24kHz at ± 3 dB at 0VU and 15in/s.

Noise: 55dB at 3% distortion.

Wow and flutter: 0.04% at 15in/s (NAB).

Features: logic controlled transport, function and output select, headphone monitor, $\pm 5\%$ varispeed, optional RX9 dbx noise reduction.

Price: £868.70, RX9 £390.43.

A2340SX

Similar to A3440 but $3\frac{3}{4}$ / $7\frac{1}{2}$ in/s with slightly different features.

Price: £694.78.

35-2

Tracks/speeds: 2-track on $\frac{1}{2}$ in; $7\frac{1}{2}$ /15in/s.

Frequency response: 40Hz to 22kHz ± 3 dB at 15in/s.

Noise: 60dB overall, 100dB with dbx.

Wow and flutter: 0.03% at 15in/s (NAB).

Features: separate transport and electronics, built-in dbx, 4-track playback head included, front panel bias and eq adjustment.

Price: £1,250.

A6100 MkII

Tracks/speeds: 2-track on $\frac{1}{2}$ in; $7\frac{1}{2}$ /15in/s.

Frequency response: 25Hz to 28kHz ± 3 dB.

Noise: 60dB at 3% distortion.

Wow and flutter: 0.03% at 15in/s (NAB).

Features: full editing facility, 4-track playback head, output level select.

Price: £888.



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Teac A-3440

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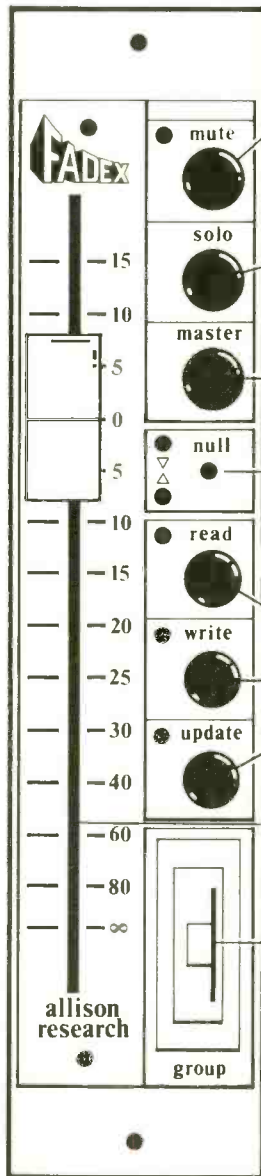
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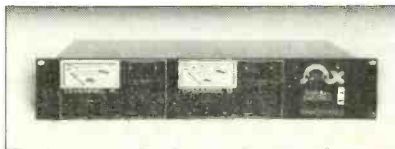
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*Source: Studio Sound, Effects Survey, Sept 1979.

reviews

Enertec F462 2-track tape machine



MANUFACTURER'S SPECIFICATION

Tape speed: 15 and 7½in/s ±0.2% quartz controlled. Other speeds upon request. (Variable speed from -50% to +200% by optional varispeed unit.)
Wow and flutter: less than 0.04% at 15in/s or 0.06% at 7½in/s to IEC peak weighted measurement.
Tape capacity: 3333ft standard play tape on 11.5in diameter reels, all types of tape, centres and hubs to CCIR, NAB, cine.
Tape tension: 90g ±10g, less than 700g maximum in braking mode.
Starting and stabilisation time: less than 0.5s at 15in/s for 0.1% flutter, peak value weighted.
Braking time: 2s in forward or backward winding.
Rewinding time: less than 150s for 3333ft tape.
Audio inputs: +12dBm/15kΩ (0dBm or +6dBm on request), balanced inputs on transformer, gain adjustment from - infinity to +10dB by potentiometer with calibrated position on version with VU meter panel.
Audio outputs: +12dBm (0dBm or +6dBm on request), internal impedance 50Ω on transformers, gain adjustment from - infinity to +10dB by potentiometers with calibrated position on version with VU meter panel.
Recording standard: CCIR or NAB, with continuous adjustment by potentiometer on broadcast version. CCIR/NAB, Bi-standard by a switch on the front on version with VU meter panel.

Signal-to-noise ratio in record/replay:

CCIR standard with		15in/s		7½in/s		Distortion at mid frequencies
		Unweighted	Weighted	Unweighted	Weighted	
Afga PER 525						
Full-track	320nWb/m	61dB	61dB	61dB	60dB	1%
Stereo	2.75mm 510nWb/m	61dB	61dB	61dB	60dB	2%
Dual-track	2mm 320nWb/m	57dB	56dB	56dB	55dB	1%
NAB standard for 3% distortion with Ampex 456 (1040nWb/m), 3M 256, Agfa PEM 468						
Full-track		75dB	73dB	74dB	72dB	3%
Stereo	2.75mm	71dB	69dB	71dB	69dB	3%
Dual-track	2mm	70dB	68dB	70dB	68dB	3%

Frequency response: ±2dB from 40Hz to 18kHz at 15in/s or from 40Hz to 15kHz at 7½in/s. ±1dB from 50Hz to 12kHz at 15in/s or from 60Hz to 10kHz at 7½in/s.

Crosstalk at 10kHz: in stereo format 40dB. In dual-track format 46dB.

Erase: 80dB at 1kHz.

Remote controls: by permanent contact (the machine can be controlled directly from a console channel or from a remote control unit).

Counter: in minutes and seconds in realtime for each speed. Maximum capacity 99mins 59s. Precision ±1 digit on display. Display by external counter.

Power supply: 240/220/127/115V ±10% 50/60Hz by selection on power supply transformer. 200 VA.

Connections: standard plugs Cannon XLR type.

Dimensions (wdh): 721 × 620 × 874mm without VU meter panel. 721 × 650 × 1155mm with VU meter panel.

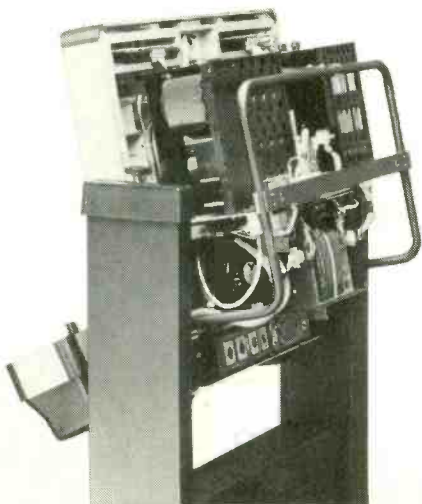
Weight: 84kg (plus 4kg with VU meter panel).

Note: unweighted noise = linear 40Hz-15kHz-rms 0.2s. Weighted = CCITT curve-rms 0.2s.

Price: £4,240

Manufacturer: Enertec, Department Audio-professional, 296 Avenue Napoléon Bonaparte, BP 226-92505 Rueil-Malmaison Cedex, France.

UK: Clive Green & Co, Britannia House, Leagrave Road, Luton LU3 1RJ.



THE Enertec *F462* is a new professional recorder intended for studio and broadcast use and available in a number of versions. The review sample, which was a prototype, is the basic recorder equipped for stereo record and replay and mounted onto a console equipped with wheels. Alternative headblocks are available for mono and twin-track with 0.75mm inter-track spacing in addition to the facility of a pilot head.

An optional penthouse VU meter panel is also available and this incorporates two VU

meters and knobs for switching the equalisation between CCIR and NAB. In addition there are input and output level controls with a switched calibrate position, A/B switching for the meters and safe/ready switches.

Other options include an internal monitoring loudspeaker (included in the review sample), a pre-listen version for disc cutting, a tapemarker, tape cutter, a remote control unit, a varispeed unit and an autolocator.

The tape transport itself is based on a heavy

18000 Hz, 0.9 mV/Pa = 60 dbm, 153 dbm, 200 ohms, > 10000 ohms

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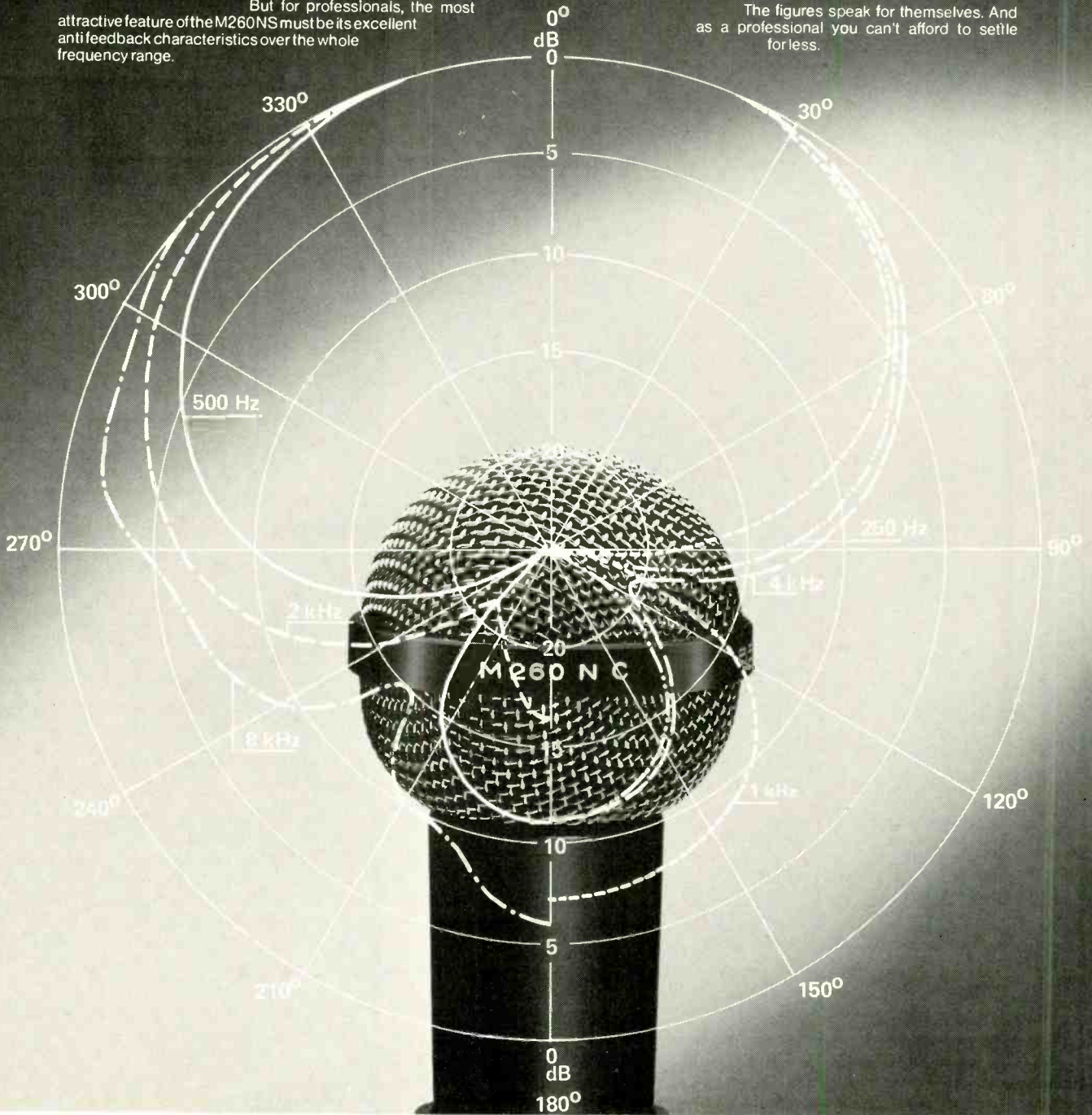
But for professionals, the most attractive feature of the M260 NS must be its excellent anti feedback characteristics over the whole frequency range.

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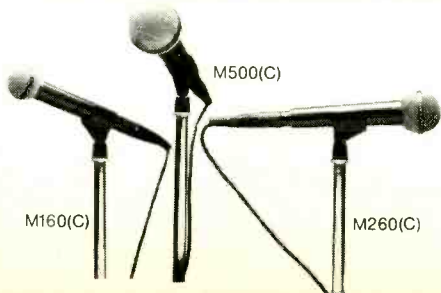
The M260 NS is only one of the range of ribbon microphones made by Beyer Dynamic.

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duty alloy casting which is machined on the top surface only to provide a reference face for the tape transport components. With the exception of the three motors all transport components fit on the top surface of the casting with the motors fixed to precision studs, which pass through the casting to provide a reference face below the casting for the motors. The electronics and power supplies are mounted in cages below the tape transport, the base of the unit is protected by a fibre cover and the transport surface is covered by a thin alloy plate.

Both spool motors are ac giving a direct drive but running at a low temperature to avoid tape damage due to heat; solenoid operated brakes of an interesting design provide braking and protect the tape in the event of a power failure in any transport mode. The braking mechanism consists of a rubber covered wheel on the spool drive shaft which is brought into contact with a further rubber covered wheel during braking. This second wheel provides braking by means of a friction material on its side, the friction of which is adjusted by tensioning the wheel's spindle. The tape is wound onto both spools at constant tension by the reel servo system which operates from a sprung tension arm which is equipped with a position sensor. The amplified dc output from the position sensors is used to shunt a bridge rectifier in the motor circuit and thus control tape tension in all transport modes.

CCIR, NAB or cine spools may therefore be used without any tension adjustment, the machine is provided with suitable adaptors and the quality of spooling is excellent. From the payoff spool the tape passes over a guide roller, over the ceramic tension arm and then to a large diameter roller guide at the entry to the plug-in headblock. This consists of an alloy casting which references onto the main transport casting at three precision machined points and is secured by two screws. The heads are suspended from the top of the headblock with the erase head being fixed and the record and replay heads adjustable in azimuth but fixed in zenith. Azimuth adjustment is excellent, the heads are mounted onto split plates which are tensioned by the azimuth adjustment screws.

At the entry to the headblock the tape passes a photo-electric tape presence detector and then over a fixed guide comprising a spacer with ceramic washers forming an edge guide. There follows a scrape flutter roller and then the three heads and a further similar fixed guide. Ceramic tape lifter pins lift the tape from the heads in the fast wind modes but only in the variable speed wind mode when the wind button is depressed; this mode is useful for editing.

From the headblock the tape passes to the direct drive capstan which is driven from a dc printed motor equipped with an inbuilt tachometer disc referenced to a crystal, to control the capstan motor speed by a phase locked loop. The design of the capstan itself is unconventional in that whilst the drive is direct, the capstan motor shaft is fitted with a sleeve to form the actual capstan. This sleeve is a cone fit onto the motor shaft and is machined in situ, thus allowing the capstan itself to be replaced without replacing the complete motor. As with other rotating parts, the capstan motor is preloaded to avoid end float on the shaft with the large diameter pinch roller being

solenoid operated on a long arm—the pressure is adjusted by means of a screw accessed through the side of the machine.

From the capstan to the takeup spool, the tape path is identical to the input to the headblock, with the exception that the guide roller nearest the spool is equipped with two tachometer disc arrangements. These sense tape direction and drive the tape timer which indicates time in minutes and seconds corrected for tape speed.

The tape motion controls are illuminated pushbutton switches electronically interlocked at the front on the top surface of the machine, and comprise the normal fast forward and reverse, replay and record controls. Additionally a variable speed spool button operates in conjunction with a potentiometer. The tape timer, at the right of the machine, works in conjunction with two pushbuttons, one the set zero button and the other a locate button. If this button is pressed in any mode except record, the tape fast winds backwards to just before the tape timer zero and then proceeds to the zero timer setting in the replay mode. With the prototype this function only worked when rewinding to zero and not going forward to zero, but, I am told that this shortcoming will be modified in production.

The remaining features on the tape transport are the tape speed change locking pushbutton switch, a headphone jack socket and the volume control for the internal monitoring loudspeaker which is located underneath the tape transport cover.

Underneath the tape transport are two printed circuit card frames, one for the audio system and the other for the tape transport functions, each has independent power supplies. The audio electronics consist of two record amplifiers and two replay amplifiers, each of which has a level control and a high frequency equalisation control for each tape speed; the record amplifiers also have a bias control for each tape speed.

The tape transport card frame contains six printed circuit cards for logic, tape timer, winding motors, master oscillator, capstan servo and power supplies; the latter has four LED indicators to show the presence of the four power supply rails. In addition there are two properly identified metric size fuses and the power on/off switch on the card frame. All components are clearly identified for servicing and the quality and layout of the cards is excellent. Overall, the construction of the complete recorder is such that any component can be replaced in a few minutes with all sub-assemblies connected by plugs and the electronics card frames are readily removable and operable when removed. So good is the construction from a servicing point of view that the tape transport can be easily stripped down to the basic casting within an hour. Whilst the instruction manual for this model was not completed at the time of the review a sample manual for another machine showed that the standard of the manual should be excellent with complete servicing information circuits, exploded diagrams of mechanical parts and parts lists.

In operation the machine was very quiet and the tape handling performance outstandingly good. Threading the tape was quick

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C	21-30	£0.28	£0.26	£0.24	£0.23	£0.22
C	31-40	£0.30	£0.28	£0.26	£0.25	£0.24
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and foolproof and access to the heads for cleaning or editing was excellent as there was no replay head humscreen to get in the way. The console mount provides three positions in which the machine may be locked—one is in a partially inverted position for servicing. Whilst the console is provided with lockable wheels two of them are fixed in direction making it awkward to manoeuvre the machine—the idea of the fixed direction wheels is that one machine may be extracted from a row of machines without lateral collisions.

At the back of the machine are XLR connectors for the audio signals, two multi-pole sockets for remote functions, an earth terminal and the mains power connector, which is of a peculiar type that I do not consider to be electrically safe, but is apparently to a standard used by French Radio.

Two remote units were provided with the machine, a remote control and a varispeed. The remote control unit has a local/remote toggle switch which disables the transport controls with fast wind, play, record and stop controls. Also the tape timer is duplicated on the remote control unit together with the set zero and locate pushbuttons.

The varispeed unit is a simple device with a variable/calibrated speed toggle switch adjacent to a digital display indicating the percentage of nominal speed in one percent units. The speed variation is set by a coarse and a fine potentiometer allowing a speed range from 50% to 200%, of nominal, at either 7½ or 15in/s tape speed. Checking the accuracy of the display showed that it was within one digit.

The replay performance

Checking the replay frequency response to the CCIR standard of 35µs at 15in/s tape speed, and 70µs at 7½in/s tape speed, by means of BASF calibration tapes, showed that the frequency response was within +0.5dB -1.0dB from 63Hz to 18kHz at 15in/s or within +0.3dB -1.0dB from 63Hz to 18kHz at 7½in/s—a creditable performance with the more than adequate range of the replay equalisation as shown in fig 1.

At the normal setting on this stereo machine, the output level for a tape fluxivity of 320nWb/m is +8dBm (equivalent to +12dBm for 510nWb/m) with the range of adjustment being from +4dBm up to +11dBm and the maximum output level at the onset of clipping being +23dBm at any gain setting.

At normal settings this corresponds to 15dB above 320nWb/m which is adequate for any current tape types. Table 1 indicates that the machine replay noise was extremely low, the hum in the output was insignificant and the output free from other spurious tones. Comparison of the machine noise with that of Agfa PER 525 tape (used for the review) demonstrates an enormous margin between machine replay noise and tape noise. As both the channels showed virtually identical performance the two channels are not quoted separately.

The record replay performance

Figs 2 and 3 show the overall record/replay frequency response using Agfa PER 525 tape, with the bias set to the -3dB over bias point at 10kHz. Both figures show good flat responses but possibly a slight lack of low frequency

FIG. 1 ENERTEC F462 REPLAY EQUALISATION RANGE

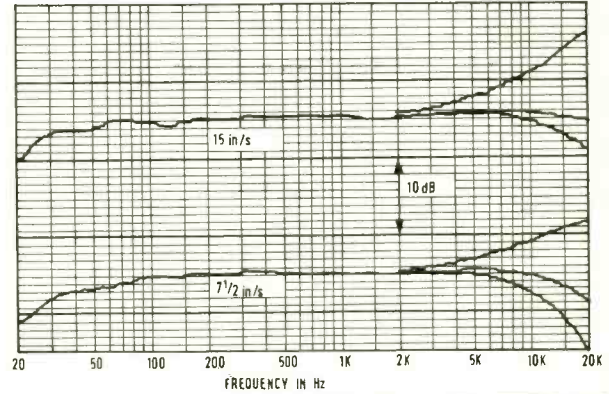


FIG. 2 ENERTEC F462 RECORD/PLAY FREQUENCY RESPONSE AT 15 in/s

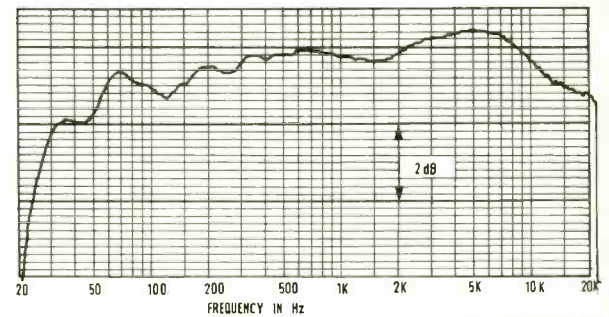


FIG. 3 ENERTEC F462 RECORD/PLAY FREQUENCY RESPONSE AT 7 1/2 in/s

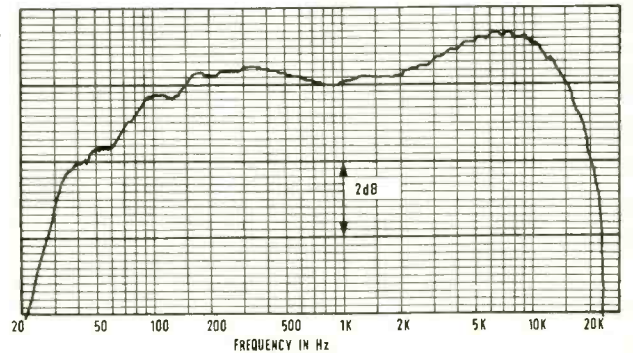


FIG. 4 ENERTEC F462 RECORD EQUALISATION RANGE

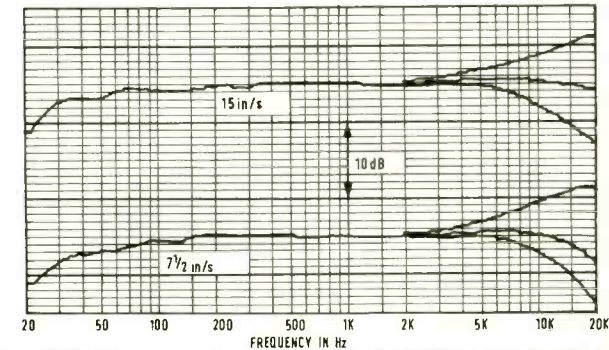
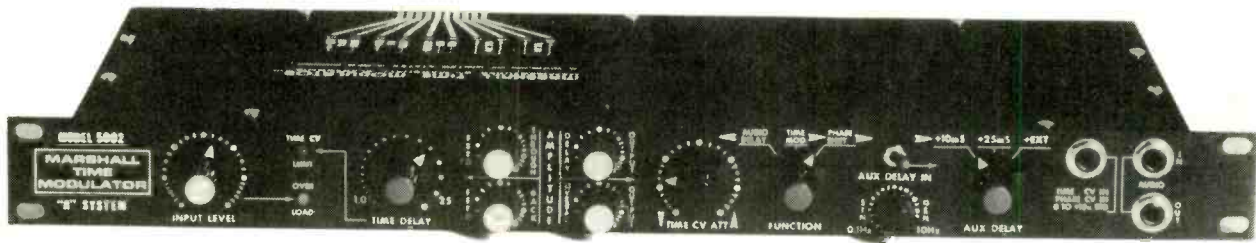


TABLE 1

	REFERENCE LEVEL (320nWb/m)		TO-NOISE-RATIO	
	15in/s		7½in/s	
	with tape	machine only	with tape	machine only
Band limited 22Hz to 22kHz rms	58.0dB	66.0dB	56.0dB	65.0dB
A-weighted rms	60.5dB	76.4dB	59.0dB	74.0dB
CCIR-weighted rms ref 1kHz	51.5dB	69.5dB	50.0dB	67.0dB
CCIR-weighted quasi-peak ref 1kHz	47.5dB	65.5dB	46.0dB	62.5dB

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Allison Research's 65K second generation programmer accepts and processes control voltages in the range 0 to 5.6 VDC from VCA type faders. These analogue control voltages are converted by the 65K programmer to data words which can be stored on any non-critical tape medium. Upon replay of the data the original DC levels are re-created accurately and unerringly.

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response which may be evident if noise reduction systems are used.

The record equalisation had an adequately wide range as fig 4. For the two tape speeds the bias range was also quite adequate and both bias and equalisation was easy to adjust, in spite of normal potentiometers—I prefer multi-turn potentiometers.

As seen in the above table the noise performance is absolutely excellent and distortion is limited by the tape type in use. The Agfa PER 525 gave the results shown in Table 2, in terms of third harmonic distortion, the second order and higher harmonics are insignificant:—

Record Level	Third Harmonic Distortion at 1kHz	
	15in/s	7½in/s
510nWb/m	1.4%	1.93%
320nWb/m	0.56%	0.71%

Checking the record amplifier drive capability showed that saturation did not occur until a level corresponding to +19dB above the level required to record 320nWm/B at 1kHz on Agfa PER 525 tape was reached, and this should be more than adequate for any tape types currently envisaged.

Erase was also good, a 1kHz tone at 15in/s on the Agfa tape was erased by 88dB and recorded clicks when dropping in or out were at a low level.

The relation between frequency and crosstalk between the two channels is shown in fig 5 which demonstrates a good performance particularly at low frequencies and whilst the squarewave performance shows slight ringing as fig 6 there is little to complain about.

Wow and flutter

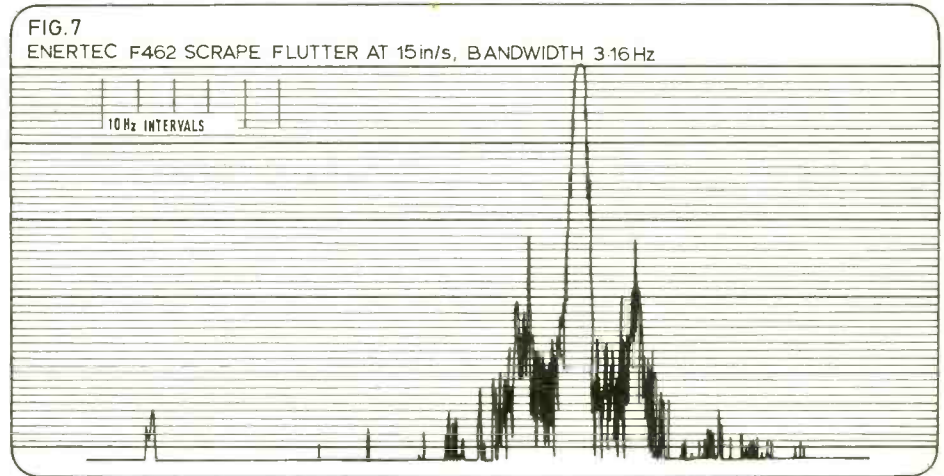
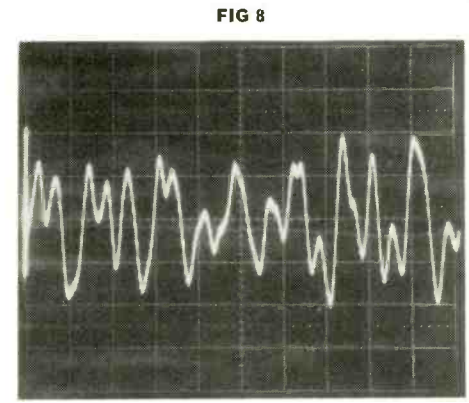
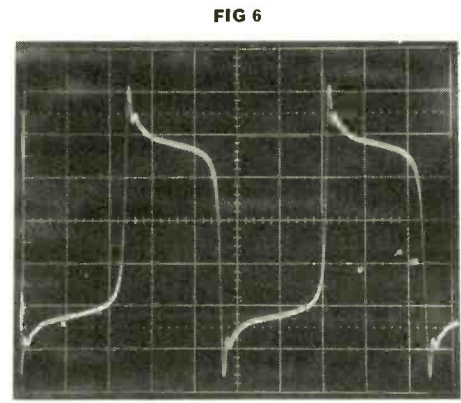
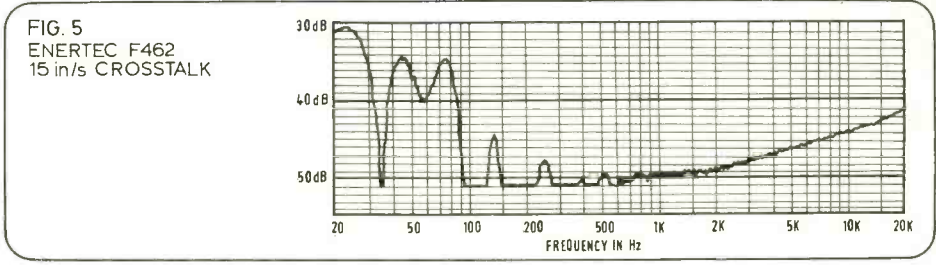
Measurement of wow and flutter to the IEC peak weighted standard at the beginning, middle and end of a NAB reel of tape at both speeds, showed that the machine was far better than specification see Table 3.

SPEED	WOW AND FLUTTER		
	Beginning	Middle	End
15in/s	0.02%	0.025%	0.025%
7½in/s	0.03%	0.03%	0.025%

As shown in fig 7, a narrow band spectrum analysis of a 10kHz recorded and replayed tone, the scrape flutter performance is unusually good with little troublesome evidence of flutter sidebands. Also, as shown in fig 8 the phase jitter between the tracks is exceptionally small.

Inputs and outputs

The audio inputs and outputs are transformer-isolated. The inputs have a common mode rejection ratio in excess of 80dB at 100Hz and below, falling to 60dB at 1kHz and 40dB at 10kHz. The input impedance was very high at about 270kΩ with the level to record a fluxivity of 320nWb/m being variable from +6dBm to +11dBm.



The impedance of the two line outputs was adequately low at 27Ω, the output level for a recording at 320nWb/m was variable from +4dBm to +11dBm. The stereo headphone output is identical in level to the line output with a fixed series resistance of 1,200Ω. Whilst the monitor loudspeaker level is variable over a wide range, I feel that it is most unfortunate that there's no level control for the headphone output.

Summary


Clearly this machine has been built with simple and quick maintenance in mind and in this

respect and many others it is excellent. It's simple to use and set-up, with ready access to all controls which have well chosen ranges of operation.

While some users might prefer a more versatile equalisation system, the frequency response is adequately flat with proper use of the existing controls, and the noise performance is outstanding.

Overall the mechanical and electrical quality is very good and this machine represents very good value for money as a general purpose broadcast or studio recorder.

Hugh Ford



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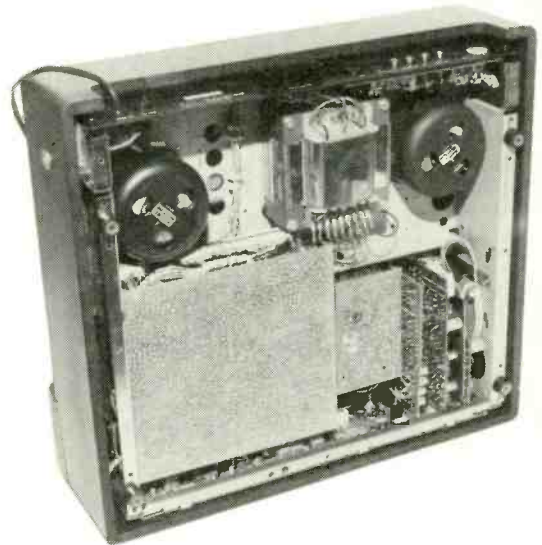
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reviews

ASC AS6002/38 2-track tape machine



MANUFACTURER'S SPECIFICATION

Drive mechanism: three motors. Ball bearing, outer rotor, asynchronous winding motors. Tape drive by electronically controlled dc motor.

Tape speeds: $3\frac{1}{2}/7\frac{1}{2}/15$ in/s or $1\frac{1}{2}/3\frac{1}{2}/7\frac{1}{2}$ in/s.

Spools: up to 10.5in diameter.

Tape tension: opto-electrically controlled. Tape damping roller.

Rewind time: about 160s for 3,600ft of long play tape.

Deviation from nominal speed: 0.7%.

Brake system: electronically controlled.

Drive mechanism: electronically remotely controlled by interlocked keys, repeat key, cue function.

Tape end switch: optical sensor or by right sensing lever.

Tape length indicator: calibrated in decimetres. Indication by five 7-segment LED indicators.

Heads: 'Recovac' replay and record heads. Double gap ferrite erase head. $\frac{1}{4}$ -track tone head for slide synchronisation.

Equalisation: NAB for replay and record. DIN studio standard for replay.

Inputs and outputs (figures in brackets for full modulation): controlled headphone output $U_a = 2V$ (5V). Microphone input $U_e = 0.2-150mV$ (0.5-150mV). $R_i = 1.4k\Omega$. Radio input 0.04-34mV/k Ω . $R_i = 1.8k\Omega$. Radio output $U_a = 0.775V$ (2V) $R_i = 3k\Omega$. Line input $U_e = 22mV-11V$ (55mV-11V) $R_i = 220k\Omega$. Tape output $U_a = 0.775V$ (2V) $R_i = 470\Omega$. Mixer connection—output $U_a = 100mV$ (250mV) $R_i = 120\Omega$,—input $U_e = 100mV$ (250mV) R_i for record less than or equal to 17k Ω .

Frequency response to DIN 45500 sheet 4: $15/7\frac{1}{2}$ in/s 20Hz to 25kHz, $3\frac{1}{2}$ in/s 20Hz to 18kHz.

Background Noise Related To Full Modulation:

	15in/s	7½in/s	3½in/s
To DIN 45511 twin-track	60dB	60dB	59dB
full-track	56dB	56dB	55dB
To IEC 94 twin-track	68dB	68dB	67dB
full-track	64dB	64dB	63dB

Signal-to-noise Related To Full Modulation:

	15in/s	7½in/s	3½in/s
To DIN 45511 twin-track	56dB	56dB	56dB
full-track	52dB	51dB	51dB
To IEC 94 twin-track	59dB	59dB	59dB
full-track	55dB	54dB	54dB
Wow and flutter to DIN 45507:	0.04%	0.05%	0.1%

Decrease in dynamic range at 10kHz related to full modulation at 333Hz:

	15in/s	7½in/s	3½in/s
	3dB	5dB	13dB
Distortion at 320nWb/m:	0.6%	0.6%	0.8%
Maximum replay level for 3% distortion at 333Hz:	+8dB	+8dB	+8dB

Erase to DIN 45500 sheet 4: greater than 70dB.

Crosstalk to DIN 45521, DIN 45511: $15/7\frac{1}{2}$ in/s 65dB at 1kHz or 55dB between 500Hz and 6.3kHz.

$3\frac{1}{2}$ in/s 48dB at 1kHz or 43dB between 500Hz and 6.3kHz.

Dimensions (hwd): 155 × 430 × 395mm without spools.

Weight: approx. 20kg.

Price: £599 for stereo version.

Manufacturer: ASC Electronic, Erlenmeyerstrasse 1, D-8750 Aschaffenburg, West Germany.

UK: Audio Systems Components, 32 Crown Lane, Theale, Berkshire.

THE ASC AS 6002/38 is a semi-professional stereo recorder with three tape speeds: $15/7\frac{1}{2}/3\frac{1}{2}$ in/s and has the capability of handling either cine or NAB spools, up to a diameter of 10½in. The tape transport is of a 3-motor design. The Papst outer rotor motors are used for spooling by direct-drive with the spooling tension electronically controlled by a signal from tension sensing arms in the pay-off and take-up tape paths.

The capstan is belt-driven from a variable speed dc motor, which is servo'd to an oscillator and to which the capstan is locked for the three tape speeds; a large flywheel is used to stabilise the capstan speed.

The majority of the tape transport and support for the electronics is constructed from sheet metal but, the area around the headblock and capstan drive is formed from an alloy casting in order to provide accurate tape guidance around the heads which are contained in a plug-in assembly.

From the pay-off spool the tape passes to a spring loaded tension sensing roller, which also acts as an initial tape guide, and is not very accurate as it is mounted on a rather flimsy arm. The tape then passes to the plug-in headblock which is bolted onto the main casting by two screws that are not retained within the headblock. Initially, within the block the tape passes a fixed metal guide before the 2-track ferrite erase head and is followed by a movable flutter roller which is mechanically linked to the arm supporting the pinch roller. Following this are the metal record and replay heads to the twin-track format, which are mounted on small castings with azimuth adjustment, achieved by the spring load and 3-screw mounting method. Then the capstan and solenoid operated pinch roller—the pinch roller arm brings the tape

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

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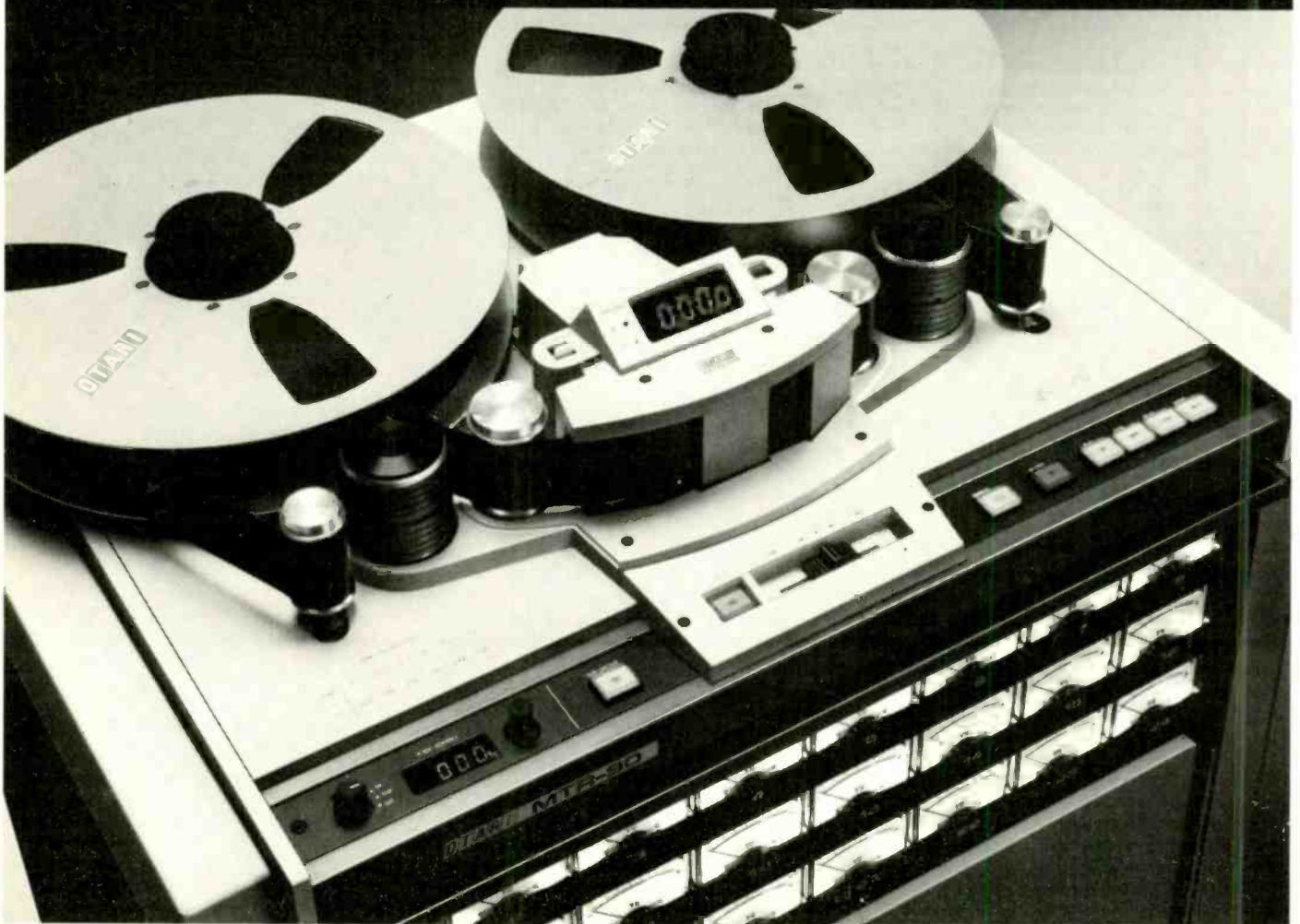
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into contact with the heads by means of the previously mentioned flutter roller, and also brings a replay head screen into position.

Either side of the capstan are fixed metal tape guides with space after the capstan for an extra head before the exit guide. A large diameter rubber covered roller follows which operates the tape length indicator by means of a tachometer arrangement, after which the take-up section is identical to the pay-off section. The tape length indicator is an unusual feature incorporating a 4-digit 7 segment display, giving tape length in decimeters, irrespective of tape speed. Whilst this is certainly an improvement on the basic tape counter it would appear that little extra cost is required to provide a proper tape timer, which is far more useful.

Another odd feature is that when the pinch roller is disengaged, it rests on a metal pin under light spring pressure. Given time it is possible that this might deform the roller. In operation the tape transport is very quiet and there is little tape snatching when changing modes of operation. In the event of power failure the tape comes to a gentle halt, with the aid of the solenoid operated band brakes on the spool motors but, I noticed that a substantial amount of dust accumulated around the brakes during the course of this review.

Tape handling varied widely according to the tape in use. Backed tapes such as Agfa PEM 468 handled very well and shiny backed tapes such as Ampex 406 gave a poor wind under the

low winding tension, of only 30g in the play mode and somewhat more in the fast modes.

The metal chassis of the recorder supports a variety of printed circuits all of which are interconnected by leads equipped with plugs and sockets. Generally good domestic quality boards are used with reasonably tidy component layouts but there are no component identifications even for the internal fuses. On the other hand layout diagrams are provided in the manual together with circuits. The complete recorder mounts into a wooden cabinet which may be equipped with feet for vertical operation and also a carrying handle.

Beneath the tape transport is the control panel with 3/4in jack sockets to the left for the two unbalanced microphone inputs and the monitoring headphone output, with an adjacent level control potentiometer. Then a twin level meter calibrated in 'VU meter style' which is illuminated in the record mode. Underneath there are three input level controls—a co-axial control for microphone level, a co-axial control for radio/line input level and a single knob master level control. This arrangement permits the mixing of two inputs for each channel with a master level control following the mixdown.

Beneath the headblock is a hinged door for gaining access to the heads and whilst this allows easy cleaning of the heads, the access to the replay head for editing is not good. Below the door are four toggle switches. A 3-position switch allows monitoring from either source

or tape with a choice of equalisation. Equalisation is fixed to the 90µs and 3180µs standard at the tape speed of 3 3/4in/s but may be switched at the higher two speeds between the NAB and DIN standards, but I regard this identification confusing as there are two DIN standards at 7 1/2in/s and it would be more correct to refer to the IEC standard. A further switch allows stereo operation or recording on either of the single tracks whilst replaying the other. This feature can operate in conjunction with a third switch which provides an echo effect utilising the time between the replay and record heads, or a sound on sound function where a new source is added to the track being replayed and recorded on the other track—a distinct domestic taste about these features. The fourth switch selects the tape speed extinguishing the tape length display if the capstan motor is not at the correct selected speed. However the length display is unaffected by this and continues to indicate the correct length when the capstan speed becomes correct, unless the reset button is pressed.

A cue lever is provided to put the tape in contact with the heads for locating sections in the fast wind mode—the cue is defeated once the machine is put into replay again. In addition to the normal tape motion buttons (which are electronically interlocked) there is a repeat button which, whilst depressed, does a fast rewind with the machine returning to the play mode when the button is released. Finally the

TABLE 1

FREQUENCY	3 3/4in/s DIN		7 1/2in/s DIN		7 1/2in/s NAB		15in/s DIN		15in/s NAB	
	L	R	L	R	L	R	L	R	L	R
31.5Hz	-2dB	-2.3dB	-1.2dB	-1.2dB	-0.6dB	-0.8dB	0dB	0dB	+0.6dB	+0.6dB
40Hz	-1.9dB	-2dB	-0.5dB	-0.5dB	-1.0dB	-1.0dB	+1.4dB	+1.2dB	—	—
63Hz	-1.4dB	-1.6dB	+0.2dB	+0.3dB	-0.5dB	-0.5dB	+1.0dB	+1.0dB	+0.4dB	+0.3dB
125Hz	-0.3dB	-0.3dB	+0.4dB	+0.4dB	-0.2dB	0dB	+0.8dB	+0.8dB	+0.5dB	+0.5dB
250Hz	+0.1dB	+0.1dB	+0.5dB	+0.7dB	0dB	+0.2dB	+0.6dB	+0.6dB	+0.6dB	+0.6dB
500Hz	+0.2dB	+0.2dB	+0.4dB	+0.2dB	+0.2dB	+0.3dB	+0.2dB	+0.3dB	+0.6dB	+0.6dB
1kHz	0	0	0	0	0	0	0	0	0	0
2kHz	-0.8dB	-0.7dB	-0.9dB	-1.0dB	-0.3dB	-0.4dB	-0.2dB	-0.3dB	-0.4dB	-0.9dB
4kHz	-1.8dB	-1.8dB	-2.4dB	-2.4dB	-1.4dB	-1.6dB	-0.2dB	-0.6dB	-0.7dB	-1.3dB
6.3kHz	-2.3dB	-1.8dB	-3.0dB	-3.0dB	-1.8dB	-2.0dB	-0.4dB	-1.2dB	—	—
8kHz	-2.6dB	-2.5dB	-3.4dB	-3.7dB	-2.2dB	-2.2dB	-0.2dB	-1.2dB	-0.9dB	-1.8dB
10kHz	-2.0dB	-2.3dB	-3.8dB	-4.2dB	-2.8dB	-3.2dB	0dB	-1.2dB	-0.8dB	-1.8dB
12.5kHz	-1.8dB	-2.3dB	-3.9dB	-4.4dB	-2.6dB	-3.2dB	0dB	-2.0dB	-1.0dB	-2.2dB
14kHz	-1.4dB	-2.8dB	-4.0dB	-4.6dB	-2.6dB	-3.2dB	-0.2dB	-2.6dB	—	—
16kHz	-1.0dB	-3.3dB	-4.4dB	-5.5dB	-3.2dB	-3.2dB	0dB	-3.0dB	-0.8dB	-2.2dB
18kHz	—	—	-4.4dB	-5.5dB	-3.4dB	-3.7dB	+1.0dB	-2.8dB	—	—
20kHz	—	—	—	—	—	—	—	—	-0.7dB	-2.2dB

FIG. 1 AS 6002/38 OVERALL FREQUENCY RESPONSE (LEFT)

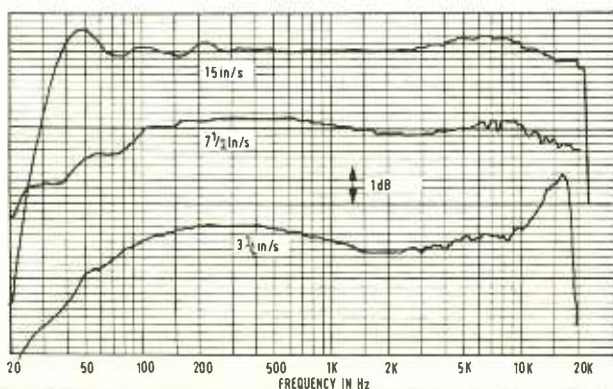
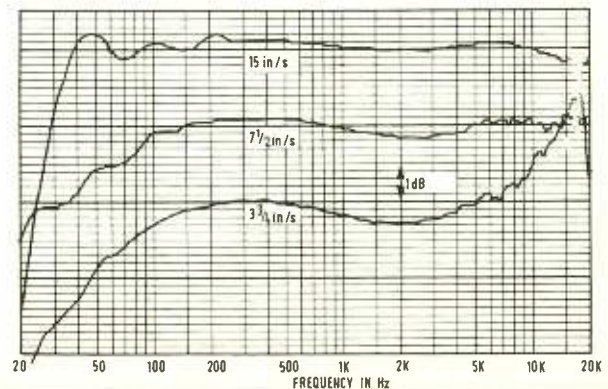
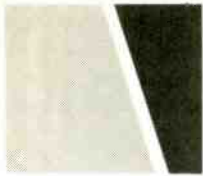


FIG. 2 AS 6002/38 OVERALL FREQUENCY RESPONSE (RIGHT)





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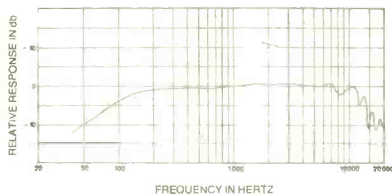


SM59

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Some like it essentially flat...

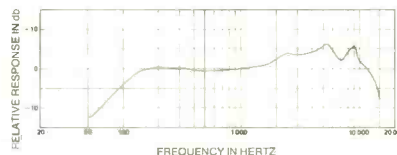


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power on/off pushbutton switch with an adjacent green power indicator.

The remaining features are at the rear of the machine and include the fixed main power lead and an adjacent mains fuse; which is properly identified in type and value. A shuttered remote control socket allows connection of the optional remote control unit and two further connectors (unwired in the review machine) allow the addition of the optional slide synchronisation devices.

Line inputs and outputs for the two channels are provided as phono connectors and in addition there is a DIN 'radio' connection and a mixer connection in the form of a DIN socket, which is normally fitted with a dummy plug. The socket allows noise reduction systems or other equipment to be inserted after the recorder's internal mixing system and before the record amplifier.

The replay performance

The replay equalisation of both channels was initially checked at all three tape speeds and at both replay equalisations for the two higher tape speeds. BASF calibration tapes were used with the exception of the 15in/s NAB equalisation where a Magetic Reference Laboratory tape was used. Table 1 shows the results were very variable and as no adjustment has been fitted, except for a peaking coil, cannot be corrected.

The output level at the line output for a recorded fluxivity of 320nWb/m at 1kHz for the two higher tape speeds was +2dBm, with the output for a recorded fluxivity of 250nWb/m at 3 3/4in/s and 315Hz being 0dBm. Unfortunately the maximum replay output at the onset of clipping was only +11.5dBm, or 9.5dB above 320nWb/m, which is completely inadequate for high output tapes. It follows that it was impossible to replay such tapes as Ampex 456 without severe distortion on peaks.

Noise in the replay chain was measured with respect to a fluxivity of 320nWb/m without tape and with machine recorded Ampex 406 tape which was recorded without an audio signal with results as Table 2.

From Table 2 it can be seen that the noise performance in terms of unweighted or A-weighted noise, differs between the two channels and I found that this difference was due to power frequency hum pick-up which was as Table 3 for all speeds using NAB equalisation. The 50Hz performance is 4db worse using the IEC equalisation.

In other respects the noise performance is satisfactory but the hum levels in the left channel are far too high.

The record/replay performance

The overall frequency response for the two channels at the three tape speeds, using Ampex 406 tape as recommended, is shown in figs 1 and 2 with a good performance at the two higher tape speeds but an unnecessary high frequency peaking at 3 3/4in/s. As with the replay chain there isn't any equalisation adjustment but only bias adjustment which makes alignment for optimum tape performance impossible for alternative tape types.

The maximum output level for 3% third harmonic distortion for the Ampex 406 tape was +8dB above 320nWb/m at 1kHz for the

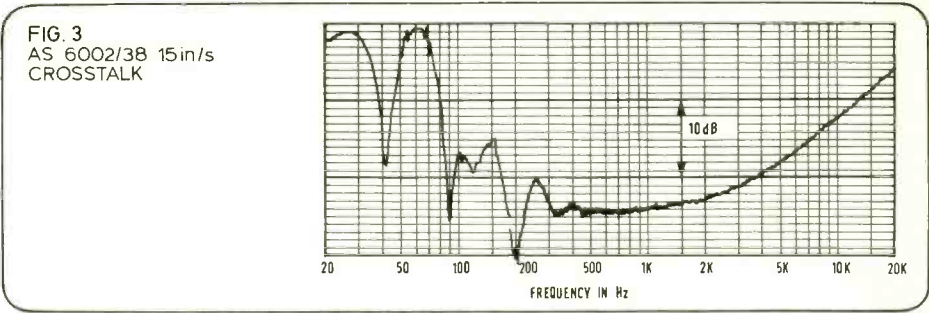


TABLE 2

Measurement method NAB equalisation without tape	15in/s		7 1/2in/s		3 3/4in/s	
	L	R	L	R	L	R
22Hz to 22kHz rms	48dB	52dB	50dB	54dB	51dB	55dB
A-weighted rms	67dBA	71dBA	68.5dBA	72dBA	67dBA	69.5dBA
CCIR-weighted rms ref 1kHz	65dB	66.6dB	65.5dB	67dB	63dB	64dB
CCIR-weighted quasi-peak ref 1kHz	61dB	62.5dB	61.5dB	62.5dB	59dB	60dB
With recorded tape						
22Hz to 22kHz rms	47dB	49dB	48dB	51.5dB	50.5dB	55dB
A-weighted rms	61.5dB	62.5dB	62.5dB	64dB	62dB	62.5dB
CCIR-weighted rms ref 1kHz	53.5dB	54dB	55.5dB	55.5dB	54dB	54dB
CCIR-weighted quasi-peak ref 1kHz	49.5dB	50dB	51dB	51.5dB	49.5dB	50dB

TABLE 3

Frequency	Hum level Reference 320nWb/m	
	Left	Right
50Hz	-50.5dB	-55dB
100Hz	-64dB	-77dB
150Hz	-58.5dB	-65dB

TABLE 4

Recording level at 1kHz	Third harmonic distortion		
	38cm/s	19cm/s	9.5cm/s
510nWb/m	1%	1%	1.1%/1.8%
320nWb/m	0.25%	0.3%	0.6%/0.9%
250nWb/m	0.15%	0.2%	0.2%/0.4%

TABLE 5

	Radio line input	Microphone input
20Hz to 22kHz rms	-53dBm	-45dBm
A-weighted rms	-56dBm	-53dBm
CCIR-weighted rms	-47dBm	-44dBm
CCIR-weighted quasi-peak	-42.5dBm	-40dBm

TABLE 6

Speed	Beginning	Middle	End
NAB spools			
15in/s	0.025%	0.035%	0.045%
7 1/2in/s	0.03%	0.025%	0.035%
3 3/4in/s	0.05%	0.045%	0.06%
Cine spools			
15in/s	0.025%	0.025%	0.04%
7 1/2in/s	0.022%	0.04%	0.03%
3 3/4in/s	0.05%	0.07%	0.065%

higher tape speeds, corresponding to the performance of this tape type with the maximum output level at 3 3/4in/s being 8.5dB above 250nWb/m at 315Hz.

Third harmonic distortion at lower levels was satisfactory, Table 4 shows the results obtained.

While there were variations between the two channels at the higher tape speeds these were far smaller than the variation shown above at

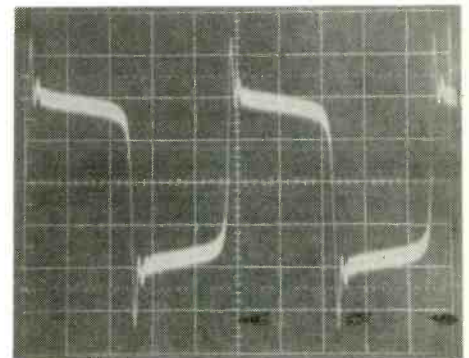


FIG 4

3 3/4in/s and it is suspected that this is due to differing bias between the two channels, this also accounts for the difference in frequency response.

The drive capability of the record amplifiers was such that the Ampex 406 tape could be driven to +18dB above 320nWb/m but clearly this amount of drive cannot be used due to the limitations of the replay chain.

The noise performance of the record amplifiers was checked for the line inputs and the microphone inputs with the equivalent noise at the replay output for the inputs being at maximum gain see Table 5.

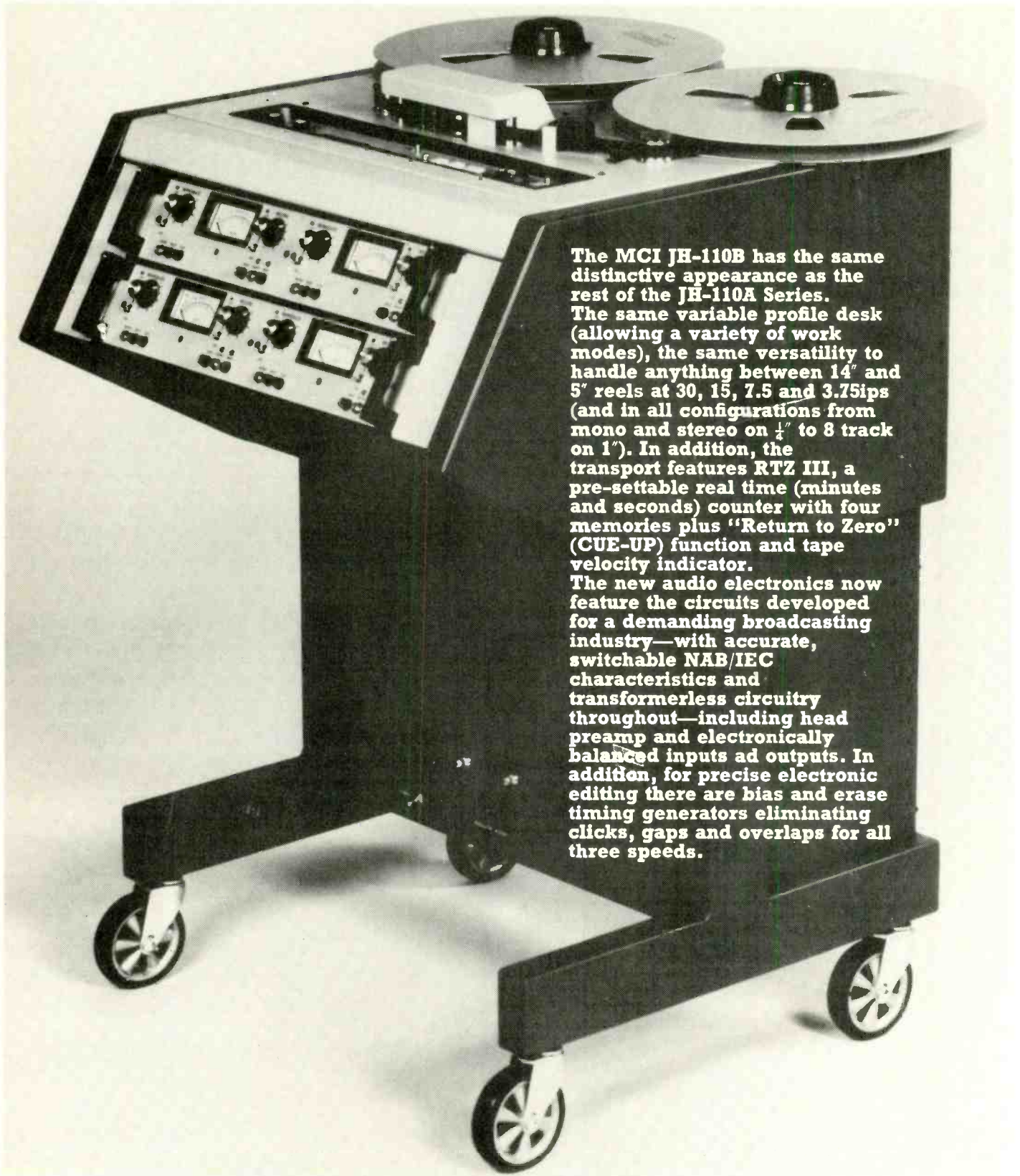
Bearing in mind the microphone's input sensitivity, the amplifier noise is reasonable but the noise from the radio/line input is excessive as a result of a high value series resistor in the input circuit.

The crosstalk between tracks in relation to frequency is shown in fig 3 illustrating a reasonable performance for a twin track machine. I found however that the level of 130kHz bias in the outputs was rather high at -33/-35dBm for the two channels.

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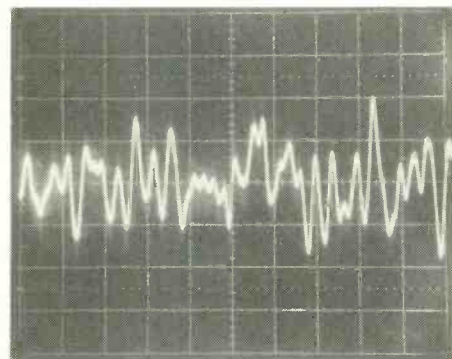
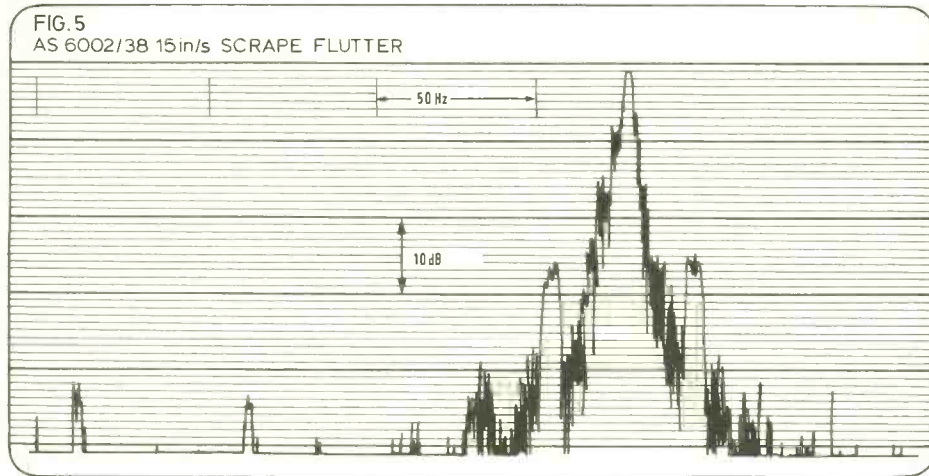


FIG 6

1kHz squarewave (fig 4) shows a little ringing in addition to the high level of bias output.

Wow and flutter

Measurement of the IEC peak weighted wow and flutter using both cine type and NAB spools produced good results as shown in Table 6.

The actual tape speed was 0.5% fast with long play tape, with the drift from one end to the other of a NAB spool, in the order of 0.1%.

A spectrum analysis of a 10kHz tone recorded and replayed at 15in/s shows that whilst the scrape flutter performance is good by many standards there are distinct flutter sidebands approximately 25Hz from the carrier which would correspond with the rotational speed of the capstan motor (see fig 5).

Checking the phase jitter between tracks at 10kHz with a tape speed of 15in/s showed that phase jitter was minimal as shown in fig 6.

Inputs and outputs

The main line output provided a level of +2.7dB for a recorded level of 320nWb/m, this is controlled only by an internal preset control, the output impedance being 480Ω, which is adequately low. The maximum headphone output level was 1.8V for a recorded fluxivity of 320nWb/m with the output impedance having a maximum of 140Ω, at maximum headphone gain and falling with reduced gain.

For recording a fluxivity of 320nWb/m on

Ampex 406 tape the microphone input sensitivity was 260μV and that of the line input 11mV and the radio input 80μV. Input impedances were sensibly 1.35kΩ for the microphone input, 1.785kΩ for the radio input and a crazy 215kΩ for the line input resulting from a series resistor. Overload margins for all inputs were satisfactory.

Alignment of the level meters was such that zero indication corresponded to an output of +7dBm, which was satisfactory for the peak reading meters, having an attack time of 15ms and a fall time of 2.5s—it was however noted that the meters were wired after pre-emphasis.

Summary

This machine has both good and bad features. Generally the mechanical features were good and the standard of construction satisfactory. Electronically there are a number of shortcomings and I particularly dislike the lack of equalisation controls. However you get what you pay for and the price is most reasonable for a machine of this type.

Hugh Ford



It was cold and windy and wet in Sydney on November 1, but that didn't stop a heroic group of strikers and protesters from parading up and down in front of the ABC's Gore Hill complex—the site of television station ABN2.

As we said, it was cold and windy and wet—and very exposed on the footpath beside the busy highway.

But they were not as alone and forlorn as they might have looked. We have it from employees of nearby Dick Smith Electronics that, through the gate, came a figure, complete with trolley and wherewithal.

What looked very much like the ABC tea lady!

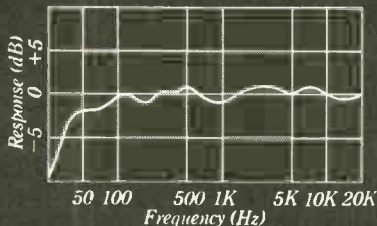
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REVIEWS

Soundcraft SCM-381 8-track tape machine



MANUFACTURER'S SPECIFICATION

Reel size: 10½in.
Speed: 15in/s.
Varispeed: +15%, -50%.
Speed stability: 0.1%.
Wow and flutter: 0.03% to IEC.
Start time: 0.5s to 0.1% wow and flutter.
Wind time: 100s for 2,400ft.
Equalisation: NAB (options available).
Power requirement: 500VA.
Supply requirement: 100/120/220/240V ac (internal links for intermediate supply voltages).
Record/replay frequency response: +1, -2dB from 30Hz to 20kHz.
Record/sync frequency response: +1, -2dB from 100Hz to 20kHz. ±2.5dB from 30Hz to 100Hz.
Replay signal-to-noise ratio: 68dB unweighted 10Hz to 100kHz reference 510nWb/m.
Bias frequency: 100kHz crystal locked.
Reference level (0VU): adjustable from 180nWb/m to 640nWb/m.
Inputs: -10dBm to +20dBm, 10kΩ impedance for 0VU.
Outputs: -10dBm to +10dBm at 0VU, +22dBm maximum, 600Ω load impedance.
Sync line output bandwidth: 16kHz.
Line output bandwidth: 22kHz (including sync mode).
Audio connections: ¼in switchcraft jack or D range multipin.
Dimensions: 21 x 15 x 15in (power supply 19in x 5.25in rack mounting).
Weight: 100lb including power supply.
Price: £5,250.
Manufacturer: Soundcraft Magnetics Limited, 9-10 Great Sutton Street, London EC1.

THIS SOUNDRAFT 8-track on line machine is a very compact recorder in two parts, the recorder and its electronics with a separate power supply connected by two leads. Thus the unit is readily portable and may be carried by one person. It is however a shame that carrying handles are not fitted to the recorder which, whilst not being particularly heavy, is awkward to carry without handles.

The power supply unit, which is a 19in rack mounting module, is fitted with professional

Cannon connectors for the mains supply and two 3m leads to the recorder which is also equipped with Cannon connections for the power input. To the front of the power unit are carrying handles which provide a degree of protection for the various indicator lamps, the power on/off switch etc.

Mains voltage selection for the common power supply voltages is by means of recessed and screwdriver operated slide switches adjacent to which are power indicator lamps for the mains power and for the feed to the

two spool motors. Four additional lamps show the presence of the various dc feeds to the recorder. A single mains fuse fitted to the front panel but is not labelled as to what type or value of fuse should be fitted.

Within the power unit the construction was found to be very tidy and workmanlike with a large toroidal transformer providing all the supply rails, and virtually all connections being by means of push fit connectors.

Turning to the recorder, the tape transport is based on a thick alloy plate formed from a ground casting which hinges at the rear and may be left at an angle for servicing by means of two friction props. Papst outer rotor type motors equipped with band brakes drive the spools directly with the spools being secured by means of screw caps, each spool hub being fitted with a rubber O ring which may be placed in one of two slots to provide proper centralisation of the spools which may have a maximum diameter of 10½in.

From the payoff spool the tape goes over a tension sensing arm mounted coaxially with a roller with the damped sensing arm servoing the payoff tension by means of a driven potentiometer. The tape then enters a fixed metal guide forming part of the headblock before moving over the heads, and another fixed guide (which is also part of the headblock), in addition to which there is a further fixed guide between the record and replay heads which are of metal construction. The headblock is formed by a metal plate which secures to the top of the entrance and exit guides with the heads being suspended—the plate has a decorative trim plate fitted to hide the azimuth and zenith adjustment screws. Head mounting is by the common spring loaded method with the azimuth adjustment being satisfactorily fine. However, it was found that securing the decorative trim made minor variations in azimuth. Upon investigation by the manufacturer, this fault was found to exist because the head leads were not correctly routed through the deck plate, and the rear of the head cover was actually applying pressure to the head leads, forcing the record head out of line.

Solenoid operated tape lifting pins are located between the heads with the same mechanism operating a removable screen over the record and replay heads. After the headblock, a dc servo operated capstan motor drives the back of the tape with a large diameter pinchroller on a short arm applying the necessary pressure controlled by the usual solenoid and spring method. There remain in the tape path a further roller and tension arm before

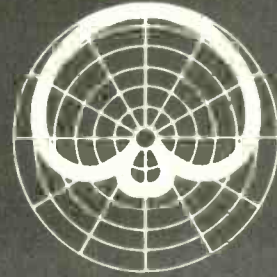
88 ►

AKG

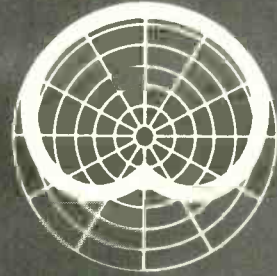
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the takeup spool which is driven at constant torque, the roller being equipped with an optical tape motion sensor which also drives the tape timer.

In operation, the tape transport was very smooth with the fast wind modes not being too fast. In the normal motion modes the tape is driven up to nominal speed by the spool motors before the pinch roller is brought into contact with the tape—a nice feature providing a smooth start without snagging the tape. Access to all tape transport components was excellent as was access to the heads for editing or cleaning. The only controls on the tape transport itself are the two fast wind buttons, a play button, a stop button and an edit button which removes the tape lifters from the tape for editing.

Very few electronic circuits are included in the tape transport, the logic and other control circuits being housed on a printed circuit board to the rear of the cabinet. This board is connected by ribbon cables to the transport and the remainder of the recorder and may be hinged out to the rear to give excellent access for servicing. Also at the rear of the cabinet are the audio inputs and outputs in the form of unbalanced ¼in jack sockets which are paralleled with a multi-way D type connector which contains all eight input, sync and

replay connections. In addition there is a second D type connector for remote control and a DIN connector for the varispeed unit. Finally at the rear there is a rather noisy cooling fan and its air filter.

Turning to the front the upper half contains the control unit and the varispeed unit, both of which may be removed by two knurled screws and used remotely via the rear connections. The lower part houses the eight plug-in audio channels plus an extender board for servicing.

Each audio module has a VU style meter, which is not claimed to be a VU meter, and which gives level indications for alignment and a red record LED indicator. Screwdriver operated potentiometers are provided for the adjustment of level and high frequency equalisation for record, replay and sync plus a control for bias. Further controls adjust the levels related to the line input, the line output and the sync output.

With these modules, as with other parts, the board layout is clean and uncluttered and good quality components are used. As this is a new product the components are not identified on the boards, but, it is understood that the manufacturer has this in mind as well as the preparation of proper servicing data.

Reverting to the control unit, this contains

the tape timer in the form of a plasma display indicating minutes and seconds which works in conjunction with two pushbuttons, a reset to zero button and a search for zero button. Pressing the latter initiates a fast wind with the tape slowing as the timer approaches the zero indication whereupon the tape stops at zero unless replay or record have been selected, in which case the appropriate function is initiated when the timer reaches zero indication. Next to these buttons there is a mute defeat button for use when it is required to listen to tape in the fast modes when the replay signal is normally muted as a safety precaution. Next, underneath these features, are the transport control buttons in the form of illuminated pushbuttons for the two fast modes, replay, record and stop. These functions together with the buttons of the tape transport are electronically interlocked, but it was thought unfortunate that it is possible to enter the record mode with the varispeed function in action, there not being an obvious indication that varispeed is in use. Also a peculiarity of the record interlocking is that when entering the record mode it is necessary to simultaneously press the record and replay buttons and then release the record button before the replay button.

To the right hand side of the control unit are the track selector switches with eight buttons with nearby red indicator lights selecting record, it being possible to punch in or out with these buttons if the record mode has been selected. Above these are a further eight track selector buttons in horizontal array with red, yellow and green lights above in vertical array in line with 'line', 'sync' and 'rep' pushbuttons.

This matrix selects the source of the replay output connections with any track in the sync mode automatically reverting to the line input if record is selected. A further useful feature is a 'master' button which switches all tracks to the source selected by the line, sync or replay buttons when pressed. A second pressing returns all tracks to their previous status.

Finally there is the varispeed unit which has a toggle switch for selecting normal or varispeed but as mentioned earlier no obvious indication when the unit is in varispeed. A fine and a coarse potentiometer control set the desired speed over a nominal range +15% to -50% from the standard 15in/s.

Replay performance

The replay frequency response was checked on several channels using a flux loop and found to be satisfactory within ±1dB of the NAB standard equalisation from 200Hz to 20kHz. The range of the high frequency equaliser was also satisfactory as shown in fig 1 which shows the overall record/replay frequency response at various positions of the replay equaliser.

As supplied a recorded fluxivity of 320nWb/m gave an output level of +4dBm with all channels having been properly aligned by the manufacturer in both the replay and sync modes. The available range of adjustment of the output level was from -9dBm to +16dBm with the replay amplifier having a clipping point 18dB above 320nWb/m which is completely satisfactory.

Noise in the replay output was measured in the replay and sync modes for several tracks

FIG. 1
SOUNDCRAFT SCM-381
REPLAY EQUALISATION
RANGE

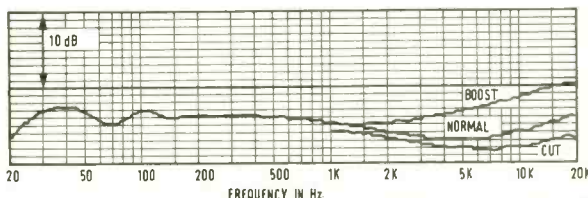


FIG. 2
SOUNDCRAFT SCM-381
RECORD/REPLAY
FREQUENCY RESPONSE

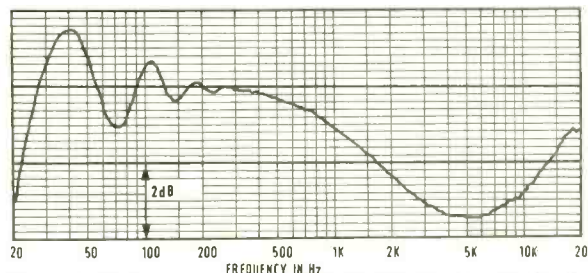
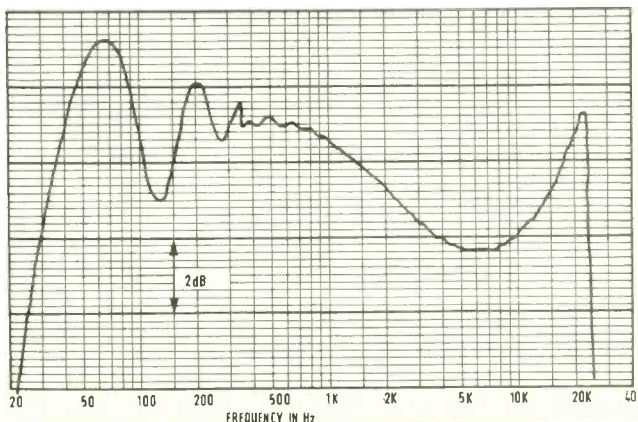
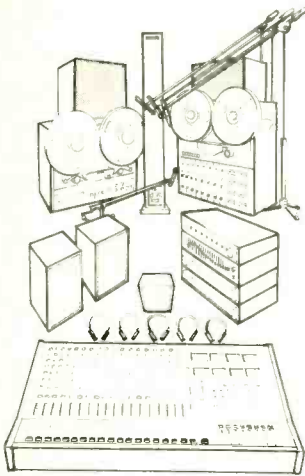


FIG. 3
SOUNDCRAFT SCM-381
RECORD/SYNC
FREQUENCY RESPONSE



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As with speaker systems, the choice of microphones is very much one of personal preference and we stock a range to satisfy most requirements. Our current favourites are the new **CSE** range by **AKG**. This is a system (in similar lines to the revolutionary **C451** range some years ago) of interchangeable bodies and capsules. As electret technology is used, the prices are correspondingly low.



delay and graphics are second to none. **Roland** of synthesiser fame, have introduced their 'Studio Series' of rack-mount units, including a phaser/flanger with extensive control facilities. We also have the budget **ACCESSIT** range.

ACCESSORIES

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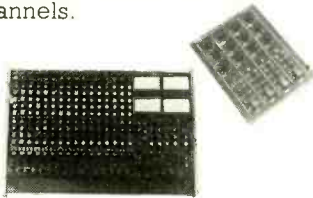
Take for example our 'Great British Spring' - a high quality stereo reverb developed for the budget conscious studio.



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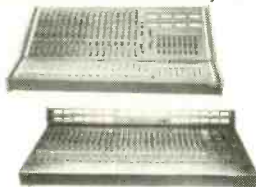
MIXERS

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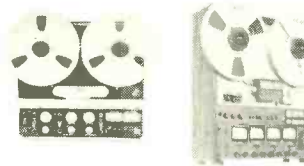
SOUNDCRAFT is well known for its' state of the art performance. We have extensive experience of the Series Two, 16 by 8.



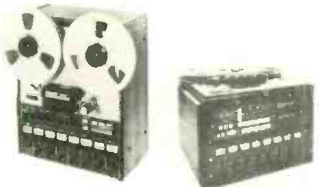
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and found to vary little between tracks. The following table shows average reference level (320nWb/m) to noise ratios for the machine without tape and also with BASF *SPR50* tape which has been recorded on the machine with bias but without any audio signal, Table 1.

As can be seen from the above the machine replay performance gives an adequate margin on tape noise with the performance of the sync mode being better than many machines. No

TABLE 1	Without tape		With tape	
	Replay	Sync	Replay	Sync
22Hz to 22kHz rms	63dB	60dB	57dB	56dB
A weighted rms	72dB	67dB	61dB	60.5dB
CCIR weighted rms ref 1kHz	66.5dB	61dB	53dB	53dB
CCIR weighted quasi-peak ref 1kHz	62dB	57dB	50dB	49dB

trouble was experienced with mains hum or other unwanted tones in the output.

Record/replay performance

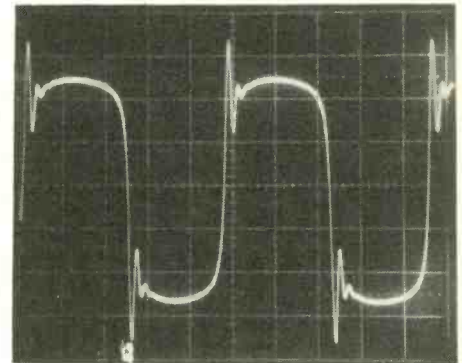
The machine was at first aligned for BASF *SPR50* magnetic tape to be over biased by 3dB at 10kHz, it being found that the bias control had an adequate range and like other preset controls was not too sensitive in operation.

The overall record / replay frequency response was then measured at optimum record equalisation with typical results for the record replay frequency response being shown in fig 2 which shows a response in the order of ± 2 dB over the audio frequency spectrum. As expected the overall response in the sync mode as shown in fig 3 is not as good but no cause for complaint. Generally it is felt that the overall record / replay frequency response could be improved if attention were paid to the record equalisation which anyway has an inadequate range in terms of high frequency boost, fig 4.

3% third harmonic distortion at 1kHz was found to occur at +9dB above a fluxivity of 320nWb/m which corresponds to the specification for this tape type with the record amplifier having enormous reserves of drive capability. Distortion at a recorded fluxivity of 320nWb/m varied slightly from one track to another but was satisfactory in the order of 0.3% at 1kHz.

Crosstalk in the replay mode was checked by recording a tape on tracks 3 and 5 and then replaying track 4 to measure the worst case crosstalk with the excellent results being shown in fig 5. Similarly crosstalk in the sync mode was good with the result of recording track 5

Fig. 7



and replaying track 4 (a stringent test) being shown in fig 6. Recording and replaying a 1kHz squarewave resulted in fig 7 which shows a small degree of ringing.

Erasure of a 1kHz tone was found to be in excess of 80dB which is entirely satisfactory and entering or dropping out of the record mode appeared to be click free.

Wow, flutter and speed

Peak weighted wow and flutter to the IEC standard was found to be consistent at 0.03% throughout a full reel of tape with the speed drift being 0.02% from the beginning to the end of a reel—a good standard.

A spectrum analysis of a 10kHz recorded and replayed tone as shown in fig 8 shows that the flutter sidebands exist at ± 50 Hz from the tone but at a low level, these sidebands probably being created by the ac spool motors. 92 ▶

FIG 4
SOUNDCRAFT SCM-381
RECORD EQUALISATION
RANGE

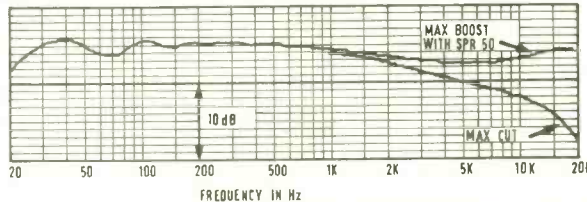


FIG 5
SOUNDCRAFT SCM-381
CROSSTALK

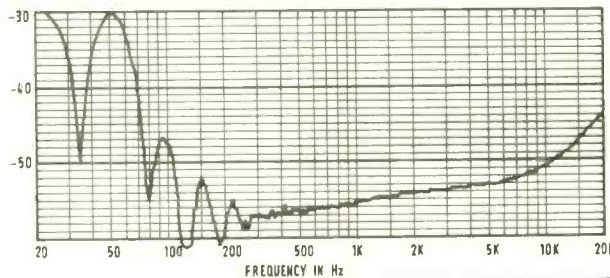
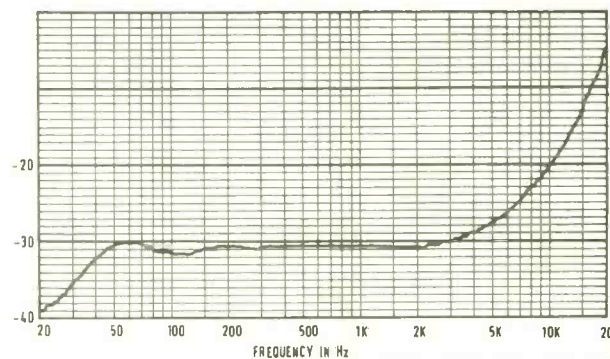


FIG 6
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Checking the varispeed unit showed that the fine potentiometer control has a range of $\pm 1.5\%$ with the overall range available with both controls being $+16\%$ to -59% . However, if the speed was set slow, it was not possible to start the recorder without the tape throwing a loop and tripping the interlock.

The phase jitter between the outer tracks is shown in fig 9 from which it is to be seen that there is a cyclis component at approximately 0.5Hz with the peak to peak jitter approaching 70°, the cause of this jitter not being obvious.

Other matters

When in the editing mode at the beginning of a roll of tape, the tape tended to creep slowly onto the take-up spool, an irritation which may be solved by adjusting tape tensions. In practice the tape tension was about 80g in the play mode, this being on the low side for lin tape.

It was found that the level meters were peak reading instruments aligned so that zero dB indication corresponded to 320nWb/m fluxivity—a satisfactory alignment for such slow tape meters.

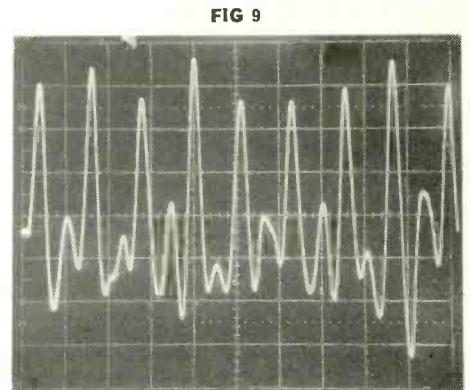
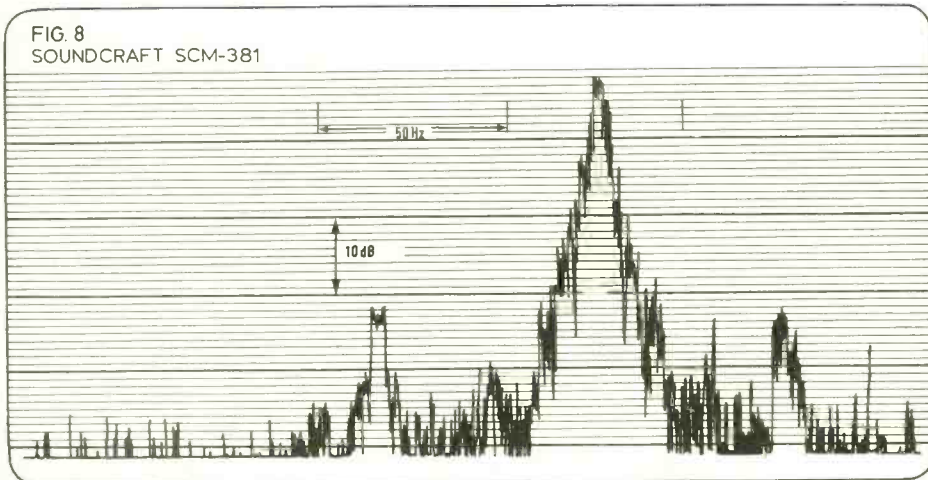
The input impedance of 10k Ω was adequately high with the output impedance of the replay and sync outputs being adequately low in the order of 15 Ω or less.

Summary

Having regard to the price of this machine it offers very good value for money in spite of the few limitations which have been found. It is a well made machine using sound engineering principles and designed for quick and easy maintenance.

It is hoped that the manufacturer will modify a few details in production which will make this a first class machine with little competition in terms of price/performance ratio.

Hugh Ford



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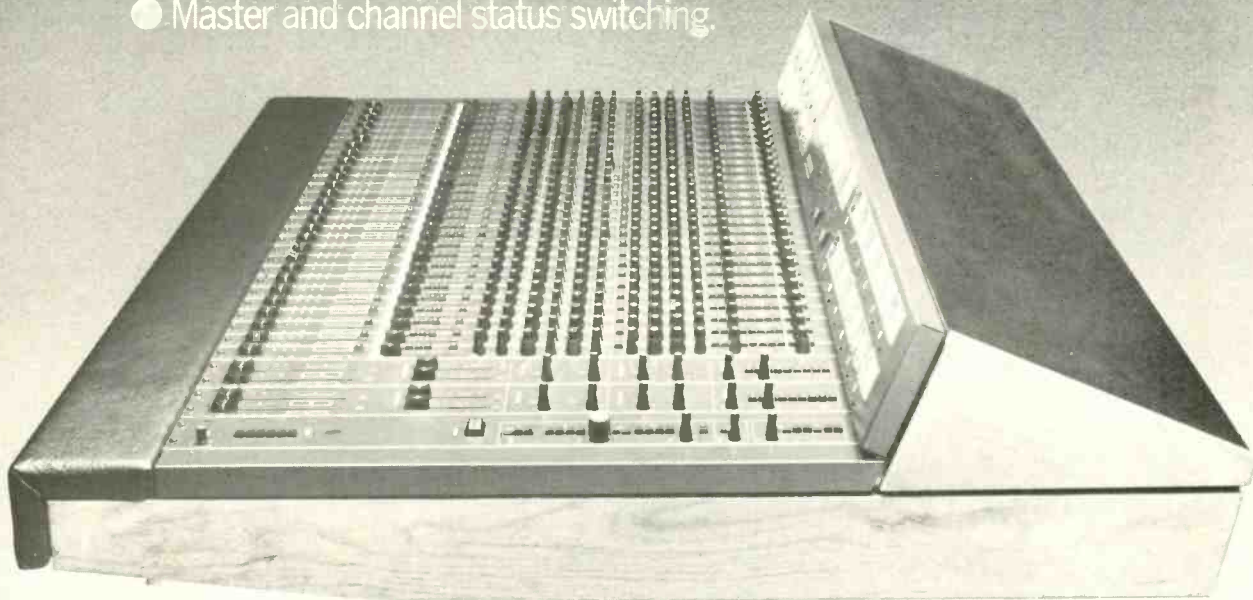
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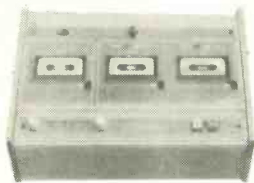
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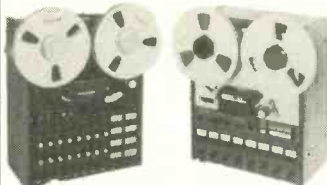
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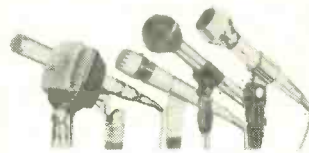
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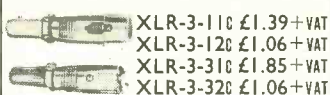
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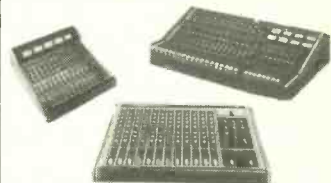
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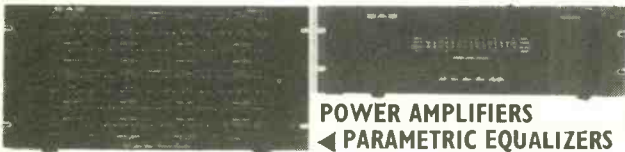
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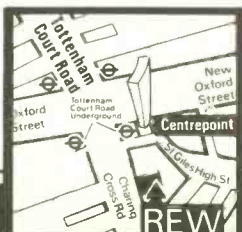
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