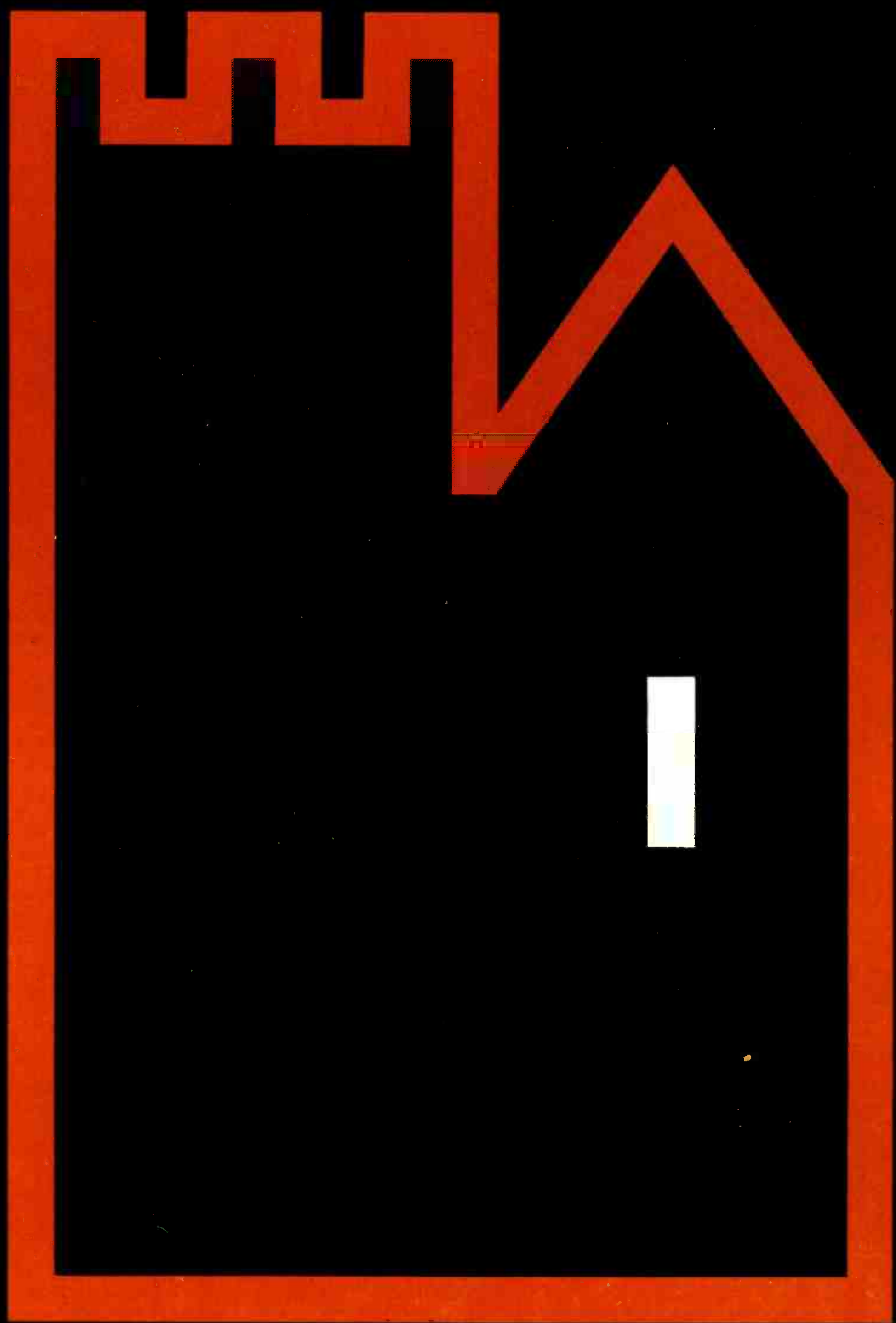
May 1975 25p

# studio sound
AND BROADCAST ENGINEERING



## HONKY CHÂTEAU

# studio sound
AND BROADCAST ENGINEERING

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

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MAY 1975 VOLUME 17 NUMBER 5


This month, synthesizers come round for their turn in the survey. Since their relatively recent introduction, application and development have moved more quickly than with any other item of studio equipment or musical instrument. Until even more recently, the extensive use of voltage control was not wide in mixing fields. Now, with the improving designs of low distortion voltage control amplifiers, such mixing is becoming a viable proposition.

Another aspect of recent developments is the processing of audio signals in digital form. Such uses are becoming almost commonplace, limited only by their relative cost, although this should naturally reduce with wider application and manufacture. The relearning necessary extends beyond the simple understanding of the mathematics and electronics; new conventions of description are necessary for the different strengths and weaknesses of these systems over conventional analogue forms. For example, the 'crumbling' distortion which is the objectionable result of choosing too few quantising levels for conversion is more offensive than a similar percentage of analogue harmonic products, which are not generated while the information is in digital form. Similarly, noise has no meaning, since for this format its generated spectrum, for example if the 'crumbling' is treated as such, has variable frequency distribution.

Applications to electronic music have been farthest ahead in their exploitations of these two techniques. On the one side is the composer working with a combination of real-time (voltage controlled) and classical (tape) techniques, on the other the composer using modified computer techniques. (We hope to publish articles by two prominent workers in these fields shortly.) The boundaries between the two are ambiguous, but are often taken as clear. Hybrid systems, possibly also with some form of fm storage, will eventually be the norm, certainly at all levels of electronic music creation but perhaps in studio functions themselves; the possible transition from pure analogue forms must take time, any progress being step-wise as befits a real world.

Nik Condron's article this month illustrates the merging of the instrument and recording functions which the intelligent use of a vc synthesizer can provoke. In many respects, these two fields have been coming closer together in a technical sense since the invention of the electric guitar. The next few years are likely to see a steady merging as people from both sides familiarise themselves with the enormous increase in possibilities. Such combination must also influence the way in which future studio technology will develop. As for the time scale, that's anybody's guess.


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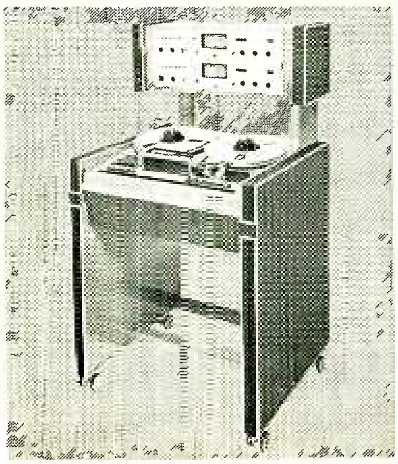

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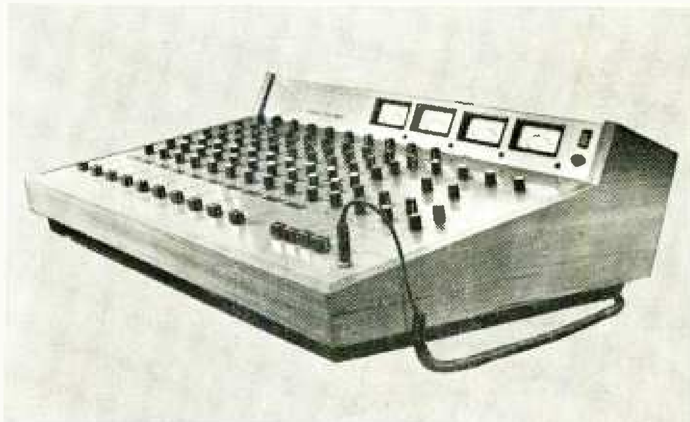

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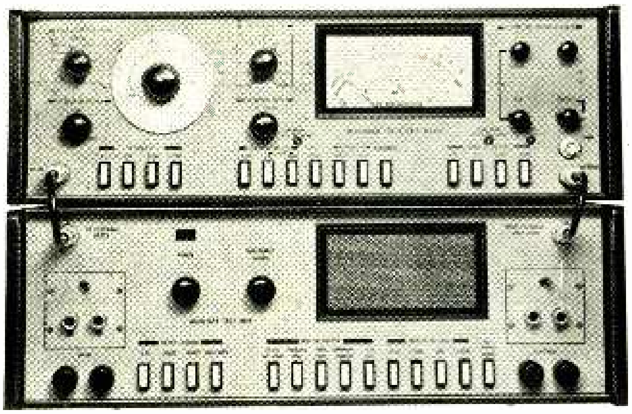

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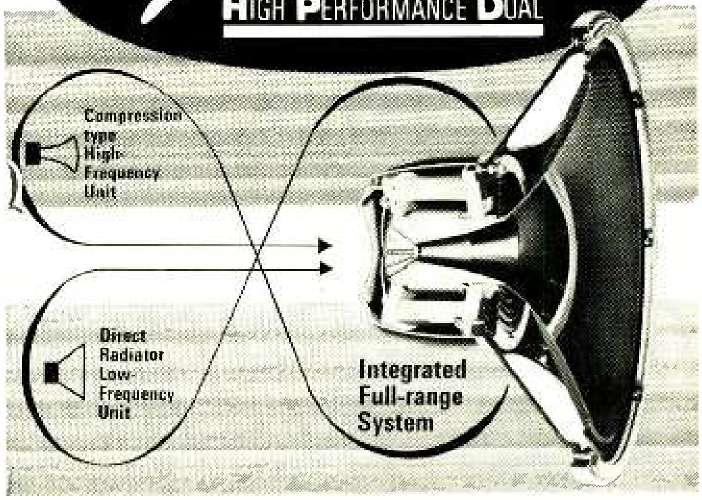


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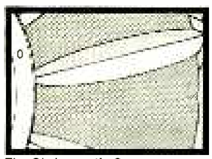

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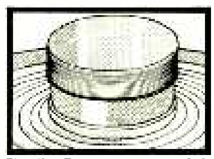

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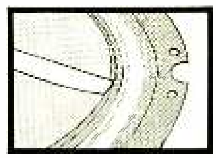

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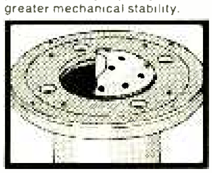

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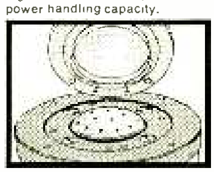

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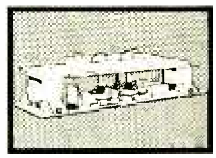

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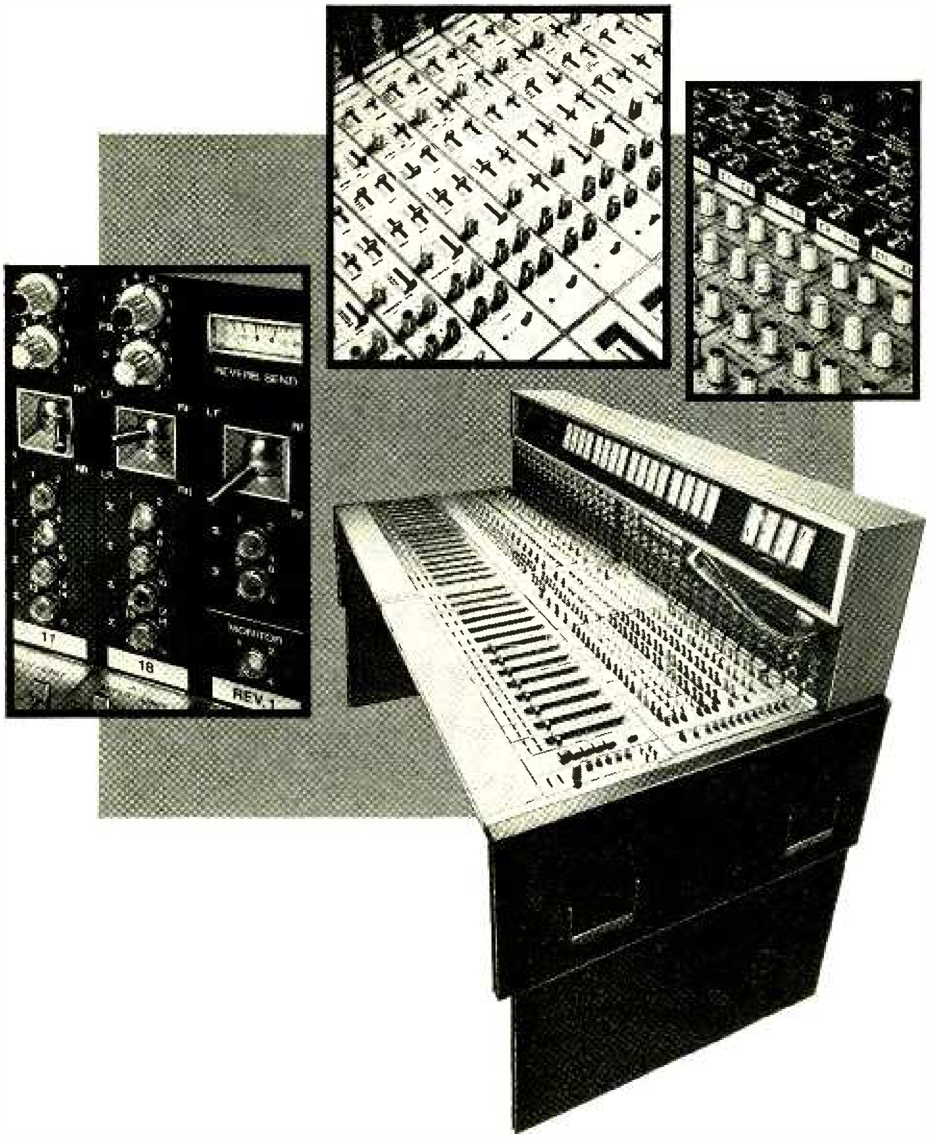

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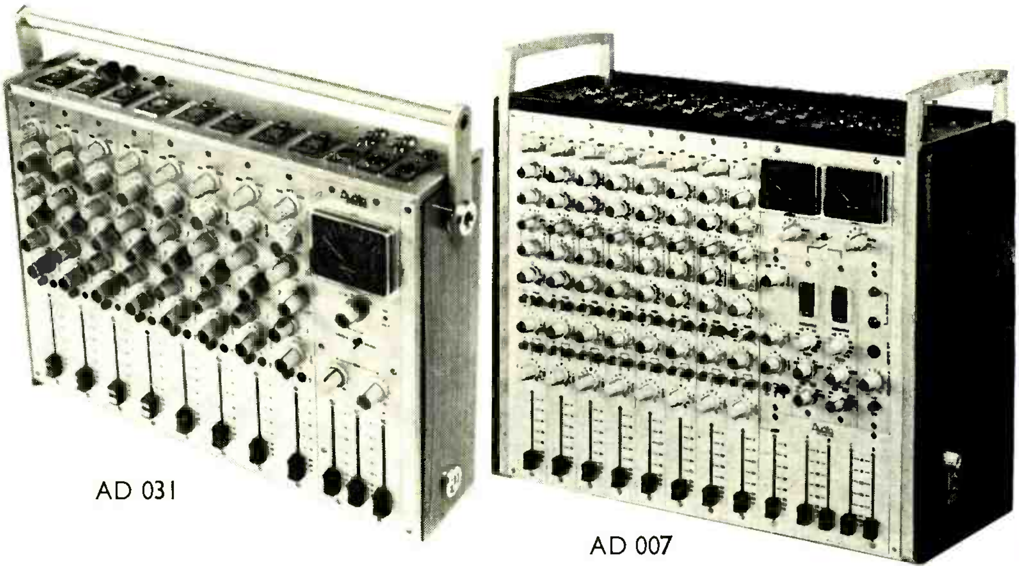

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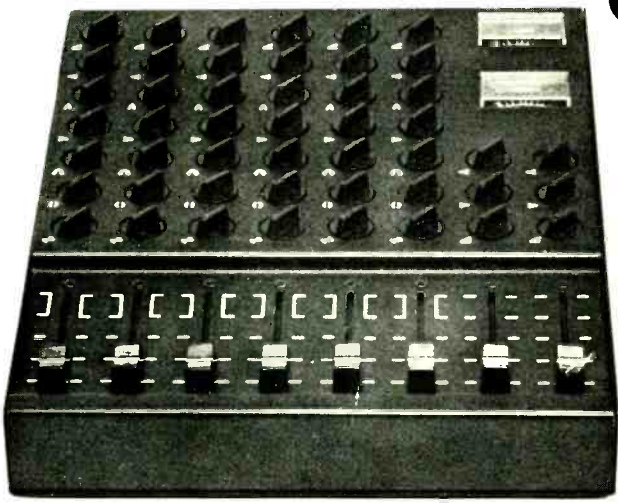

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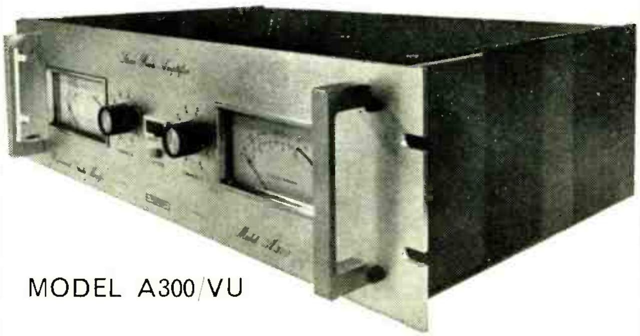

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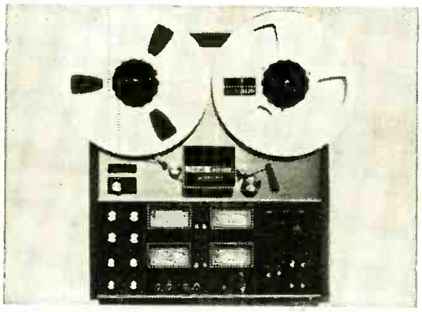

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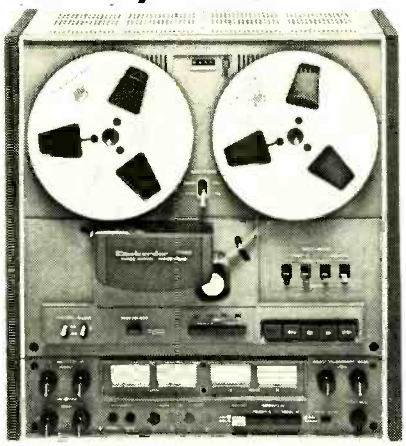

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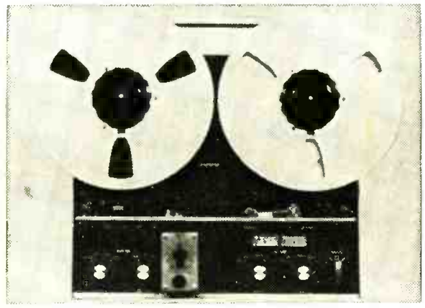

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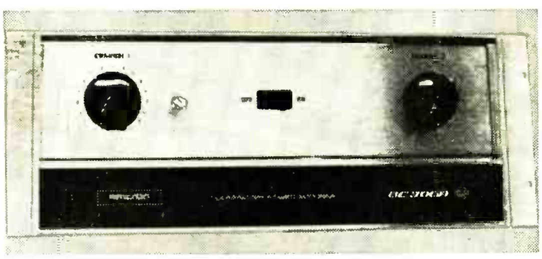

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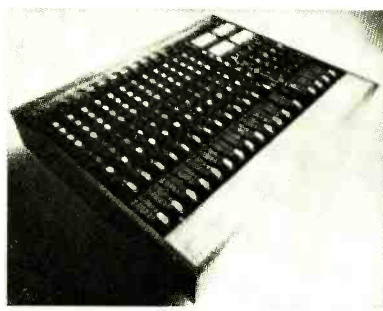

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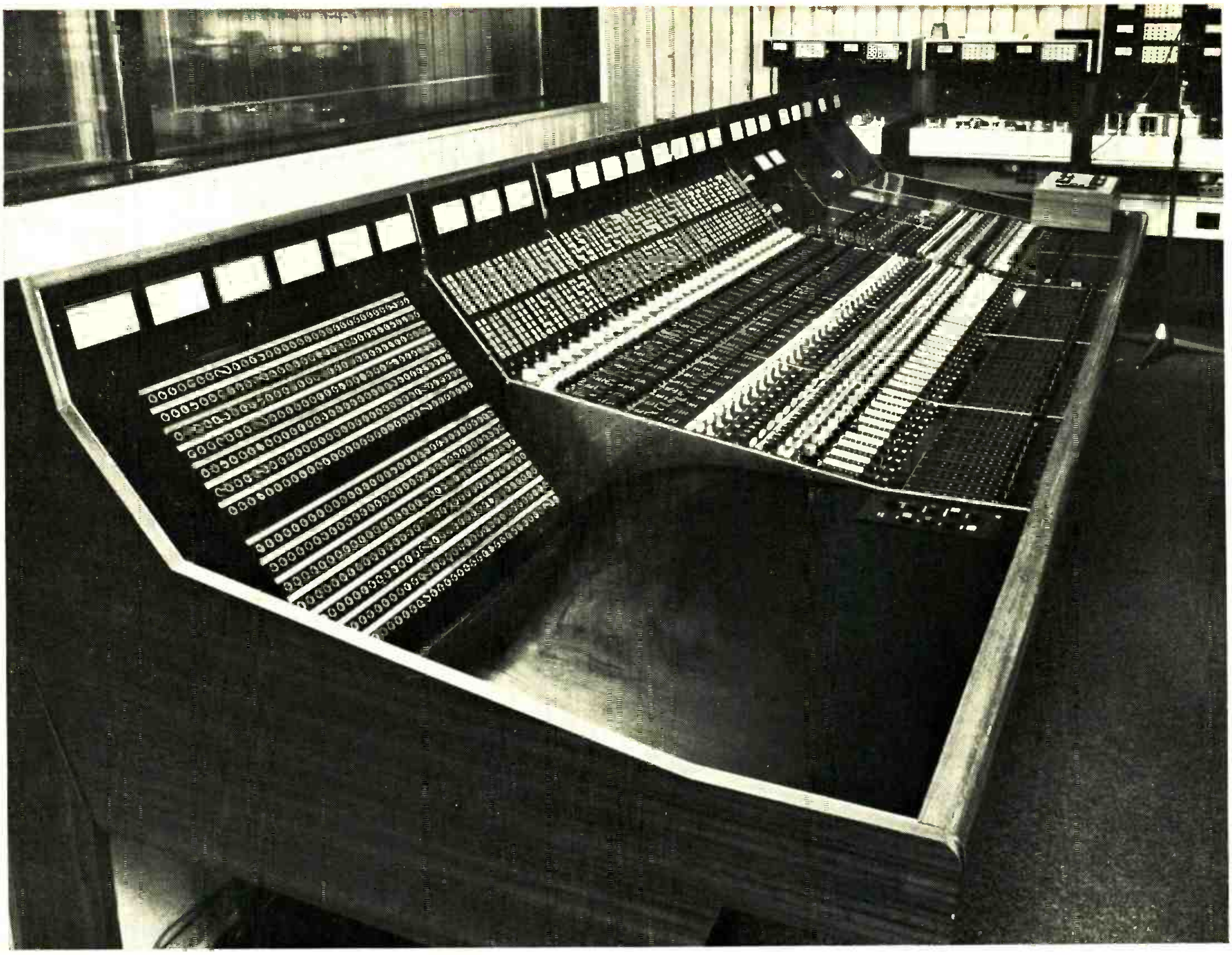

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The most forward thinking studios in Denmark.

It's fully quadrophonic and they're using it in conjunction with their Studer A80 24-track recorder.

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battery compartment
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Optional (internal) extras :
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Automatic level control
Reference generator
Crystal generator
3 different meter
characteristics

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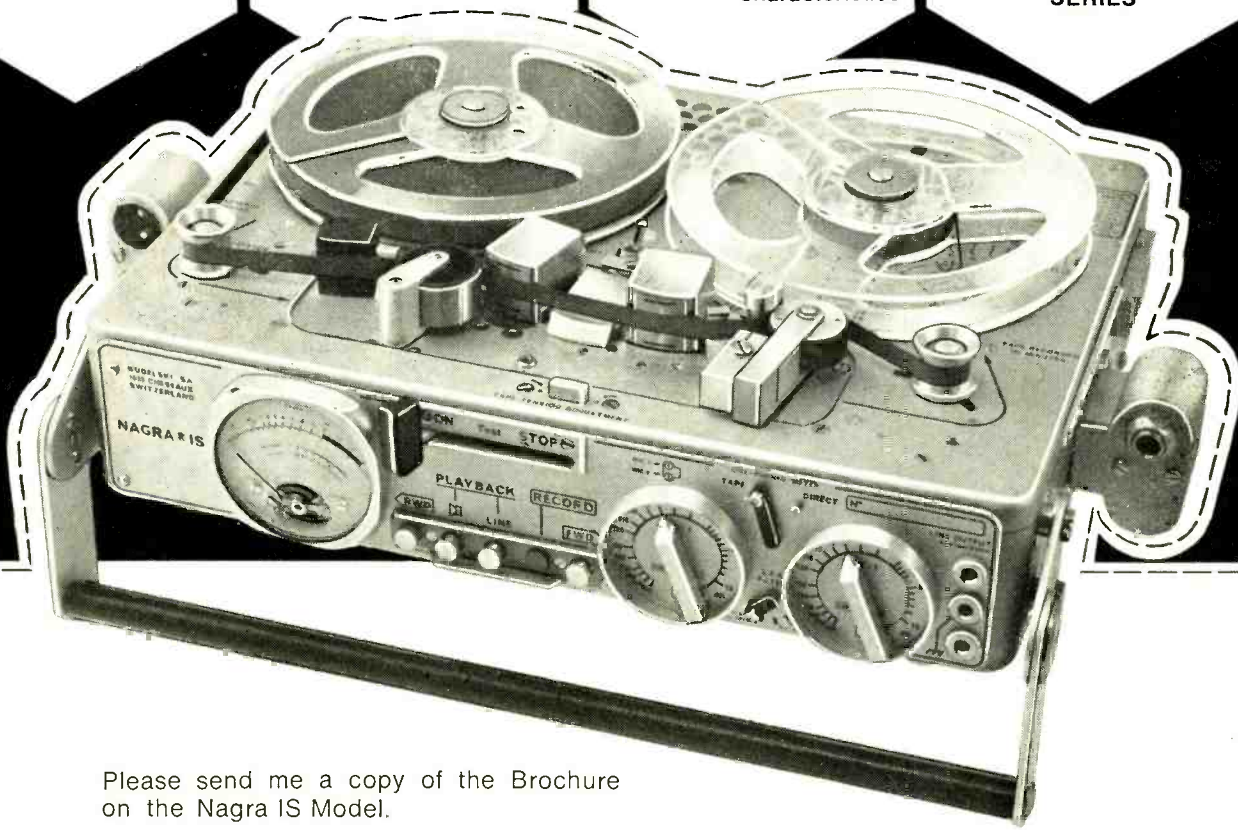


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# NEWS

## Din bins

MANUFACTURED BY RSE, a wholly owned subsidiary of C. E. Hammond, a new range of stage gear offers a choice of a 200 or 600W stereo pa set-up integrated with a 200W stage foldback system. The basic control mixer can be supplied with 10, 15 or 20 channels each including bmt controls, trim, rotary pan and ppm. The output forms two groups of two; pa amp/speaker bins and the angled stage monitor speakers.

The bins for the 200W system each house two 50W slave amps; the first drives the folded horn bass unit (45 Hz cutoff) via an active crossover, the second powers the horn loaded middle and high frequency drivers. An overload limiter is fitted.

The 600W system speakers each incorporate three 100W amplifiers; the first couple provide power to drive two 38 cm Electrovoice speakers loaded into hybrid horns with the remaining amplifier powering a JBL midrange and upper horn through acoustic lenses. Signal splitting is by active crossover between the bass and mid/treble combination, with a passive network between the last two.

The monitor system consists of four upwards slanting speaker units driven from four separate 50W power amplifiers giving a potential foldback power of 200W total.

C. E. Hammond own Cambridge Audio, the consumer audio company, and also import and distribute Revox tape recorders and Sound Technology audio test gear from Lamb House, Church Street, London W4 2PB. Phone: 01-995 4551.

## Four stack ppm

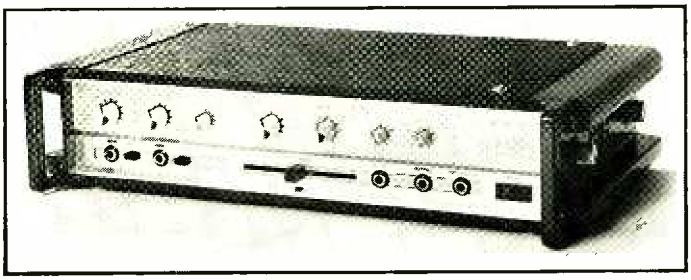
AVAILABLE FROM Quad/Eight Electronics of California, a console top package of led ppms offer four channels of self-powered monitoring in the vertical display format. The meter bank, designated type *PKM400*, hooks into the programme lines via Cannon *XLRs*.

For updating existing vu meters to the full ppm specification, Q/8 offer bolt-on electronics which fit to the back of the meter. The circuit board, type *PK100*, has presets for fine adjustment of integration time and built-in connectors. Quad/Eight Electronics, 11929 Vose Street, North Hollywood, California 91605, USA. Phone: (213) 764 1516. UK: Feldon Audio, 126 Great Portland Street, London W1. Phone: 01-580 4314.

## Reference level generator

AVAILABLE FOR COMMERCIAL exploitation by interested manufacturing companies, a new BBC design of battery-powered audio reference level offers a low distortion 400 Hz nominal output at 0 dBm level (0.7746V rms) ±0.25 dB.

The output level, stabilised and protected against environmental changes, remains constant throughout the life of the twin dry batteries.



*H/H echo unit*

A low output impedance ensures stability into varying output loads. Intended for the calibration of vus and ppms etc, the generator incorporates an 'auto switch off' after a ten-minute period preventing the unintentional discharge of the batteries.

Within the same timer circuitry is an extra circuit to disable the unit when the battery pd falls to a level where output error could occur. Designs Dept Liaison Unit, BBC, London W1A 1AA. Phone: 01-580 4468 Ext 4345.

## H/H to manufacture echo unit

IT LOOKS USEFUL for stage and studio and costs only £123.82. Developed by H/H, the echo offers single or multiple repeat, reverberation and built-in complimiter to provide protection against input overload. Echo delay and inter-repeat can be continuously varied by a front panel slider control—between 80 to 720 ms. Mr J. Harrison, founder partner of H/H, stated that the unit offers a signal-to-noise ratio with full echo of 70 dB over a bandwidth of 10 Hz to 10 kHz, a creditable performance. Using a tape loop (as opposed to cartridge) Harrison claims a tape life of about 100 hours; at this point, echo output level drops by 3 dB at 15 kHz and 2 dB at 4 kHz. The unit can be used with or without cleanfeed to the output.

Another new piece of H/H hardware comes in the shape of 12 channel transportable mixing console for pa, recording and broadcast applications. Designated the *PM12/2*, it incorporates two output groups monitored by twin vu meters of an led display type. An unusual feature is the electroluminescent panelling on channel and group controls.

Each channel offers input trim between −3 and −57 dB, bmt eq controls, echo, pan, foldback and pfl monitor. H/H claim noise performance of −127 dBm relative to input overall sourced to 200 ohms, and 0.09% thd at +20 dBm on output. H/H Electronic Industrial Site, Cambridge Road, Milton, Cambridge CB4 4AZ. Phone: Cambridge (0223) 65945/6/7.

## IERE meeting

THE COMMUNICATIONS GROUP of the institution has organised a meeting with the theme 'Recent developments in high quality sound'. Topics to be covered will include quadraphony, psychoacoustics, high fidelity broadcasting techniques, service planning for high fidelity broadcasting, improvements in magnetic tapes and cassettes, and noise reduction techniques.

The meeting will be held on May 28 in the Engineering Theatre, University College, London from 14.00 to 22.00. Admission charges will be made and registration is necessary.

## Theatre mixers

THESE TRANSPORTABLE consoles manufactured by the Cambridge Electronic Workshop, offer facilities said to suit the needs and environment of the theatre. Special design features include a simple system of colour coding of control groups with bold markings for visibility under low light conditions, two built-in sets of tape remote control units, cue lights, extensive monitoring and pfl.

On the standard desk there are ten channels, stereo wired, incorporating variable presence frequency centres, a bass tip-up filter, separate line and mic inputs and pre and post switching on all ten channels. The desk returns a claimed overall input noise figure of −126.5 dB ref input while maintaining 30 dB of headroom throughout the system relative to normal operating levels.

Cambridge Electronic Workshop have just announced the award of a contract by Theatre Projects (Consultants) to equip and install the sound system in the New Derby Playhouse.

Workshop contacts: Dan Everard or Steve Hayes at 8 Perowne Street, Cambridge CB1 2AY. Phone: Cambridge (0223) 68439.

## Dolby shuffle

RECENT MARKETING POLICIES, mainly in the direction of noise reduction for the film industry, have resulted in personnel changes at the London and New York offices.

Elmar Stetter, erstwhile technical sales manager, takes on the new post of European sales manager. This move emphasises the new marketing drive in the Eastern bloc countries for professional noise reduction equipment. This leaves marketing manager Ioan Allen and applications engineer Steve Katz relatively free to promote Dolby encoded optical soundtracks. Steve will now be based in Hollywood.

Ian Hardcastle replaces Adrian Horne as licensing manager for the consumer products division servicing 50 licensees who have introduced 200 product lines sold to over 2 000 000 people. Adrian takes over as head of advertising and information, replacing Bob Berkovitz, now resident with Acoustic Research. He will have special responsibility towards promotion of Dolby 'B' in fm broadcasting. 1133 Avenue of Americas, New York 10036, USA. Phone: (212) 489 6652. UK: 346 Clapham Road, London SW9. Phone: 01-720 1111.

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### Component show

AN INTERNATIONAL SHOW of major status, the London Electronic Component Show, scheduled for Olympia from May 13 to 16, already has 400 exhibitors from 16 countries, reflecting the importance of the event in the electronic industry's calendar.

With the opening hours between 09.30 to 17.30, the show is sponsored by the Radio and Electronic Component Manufacturers' Federation and organised by Industrial and Trade Fairs Ltd, New Oxford Street, London WC1A 1PB. Phone: 01-242 9011.

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### Filmways umbrella

MR RICHARD BLOCH, president and chairman of Filmways Inc, has merged the interests of Broadcast Electronics, manufacturers of Spotmaster jingle machines and video monitors, and Wally Heider Recording Studios of Hollywood. The new combine, known as 'Broadcast and Sound Services Group', has Andrew Szegda, the current president of Broadcast Electronics, as president of the new group. Filmways Inc, 1800 Century Park East, Suite 300, Los Angeles, California 90067, USA. Phone: (213) 552 1133.

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### Agency change

ACOUSTIC ENTERPRISES have been appointed the sole UK agency for the following product ranges: Dokorder (tape recorders and cassette decks), Jensen (loudspeakers), Fuji film tapes (magnetic tape and cassettes), and Jecklin Floats (electrostatic headphones). The announcement follows the loss of the Teac agency to AR and the Bose agency to a UK subsidiary of the parent firm. Acoustico Enterprises Ltd, Unit 7, Space Waye, North Feltham Trading Estate, Feltham, Middlesex TW14 0TZ. Phone: 01-751 0141/4. Acoustic Research International, High Street, Houghton Regis, Bedfordshire LU5 5QJ. Phone: 0582-603151. Bose (UK) Ltd, Sittingbourne Industrial Park, Crown Quay Lane, Sittingbourne, Kent. Phone: 0795-75341.

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### Independent local radio

FOUR NEW STATION franchises have been announced by the IBA: Bradford, Portsmouth, Wolverhampton and Belfast.

The Bradford contract goes to Bradford Community Radio, chairman Richard Denby. The managing director of the consortium is Stephen Whitehead, a director of a local textile company who once worked as a feature writer, and later as business manager of *Time Out*. Phone: 0274-21134.

The Portsmouth contract goes to Sound Broadcasting (Portsmouth) Ltd under the chairmanship of John Brogden, an erstwhile Mayor of the city, a director of Portsmouth Football Club and a member of Chichester Festival Theatre Society and other local groups with dramatic interests. The company plans to start broadcasting towards the end of 1975. Enquiries to the chairman on 0705 20726.

The next contract concerns the Wolverhampton and Black Country area. The successful group, Beacon Broadcasting Ltd, will be chaired by Mr Alan Henn, JP, a local jeweller and deputy chairman of Wolverhampton Magistrates. Enquiries to the chairman on 0902-29409.

Of the two applicants for the Belfast contract, the successful consortium, Community Radio Services Ltd, includes the pentathlete Mary Peters. The chairman of the group is James Osborne-King, an estate agent and underwriting member of Lloyds. Enquiries to the chairman on Crossgar 491 or in London 734 7701. Also Mr Timothy Willis on Belfast 21242.

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### Lee Engineering men

THERE ARE TWO new appointments to the company—both senior salesmen. Norman Broad takes over responsibility for broadcast sales following a successful career in the broadcasting and audio-visual industry. He has worked at Philips Electrical and Elliott Automation; more recently he has been engaged on television production and engineering.

Lawrence Hobbs takes on the industrial products for the South of England. Having worked an apprenticeship at the erstwhile Ministry of Aviation, he spent about five years with Mullard on semiconductor products. Since then, he has worked at MEL, Plessey and Bell & Howell. Hobbs is a member of the Institute of Electronic and Radio Engineers.

Regarding new work, Tom Lee announced contracts to supply three more local radio stations with jingle equipment and other hardware — Teesside, Plymouth and Trent. Lee Engineering, Ashley House, Ashley Road, Walton-on-Thames, Surrey KT12 1JE. Phone: Walton-on-Thames 28783/4.

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### Dial move for Capital and LBC

AFTER OPERATING for about 18 months on 539 and 417m, the station frequencies have been moved to 194 and 262m respectively. The frequency change follows the completion of a new transmitting station at Saffron Green, Borehamwood, Herts. Using much higher erps into a highly directional aerial, the programmes are beamed south-east across London offering better reception, particularly after dark, for most listeners in the service area.

The need for the change arose because, at the time of the launch, no permanent transmitting site was available. This difficulty had been foreseen during the planning stages in 1972 resulting in a temporary installation at Lotts Road, Chelsea with a simple T aerial strung between the twin chimneys of the London Transport power station. This measure enabled the October 73 launch date to be realised with low power gear (0.5 kW) and an omnidirectional radiation pattern. To have used the 194 and 262m wave lengths (which are also common to other BBC and IBA local radio stations) would have resulted, without a directional aerial, in excessive mutual interference.

The vhf service remains unchanged.

# AES LOS ANGELES 51st CONVENTION PREVIEW

The 51st Audio Engineering Society Convention will be held in the Los Angeles Hilton, 930 Wilshire Boulevard at Figueroa, downtown Los Angeles. Dates are May 13 to 16, the papers beginning at 09.30 on Tuesday. At a late press date a comprehensive list of exhibitors was not finalised, nor were the admission charges. Further details are available from the AES at 60 East 42nd Street, New York, NY 10016. Phone (212) 661 2355.

The full list of papers and authors is given below, divided as usual into particular connected sessions.

Tuesday May 13
09.30 hrs
**Advances in Sound Recording/Reproducing Technology**
Chairman: Carl S. Nelson, Magnasync/Moviola Corporation, North Hollywood, California

- A-1 *Evolution of the new mark III cutting System for CD-4.* Toshiya Inoue and Masahiro Fujimoto, Victor Company of Japan, Tokyo, Japan; and John Eargle, JME Associates, Los Angeles, California.
- A-2 *Digital bias/erase yields low noise and insert magnetic recording.* Carl Nelson, Magnasync/Moviola Corporation, North Hollywood, California.
- A-3 *Overcoming record warp, low-frequency turntable rumble and acoustic feedback in phonographs.* K. Clunis and M. J. Kelly, 3M Company, St. Paul, Minnesota.
- A-4 *Development of an improved modulator for discrete quadraphonic discs.* Yukinobu Ishigaki, Victor Company of Japan, Tokyo, Japan; Kiyotake Fukui, Matsushita Electrical Industrial Co, Osaka, Japan; and Gregory Bogantz, RCA Records, Indianapolis, Indiana.
- A-5 *A low-frequency speaker-amplifier system.* Keith O. Johnson, Consultant, Woodland Hills, California.
- A-6 *PEM 468: a new mastering tape with high-output, low-noise and low-print characteristics.* W. Singhoff and A. Vogeding, Agfa-Gevaert, AG, Munich, West Germany.
- A-7 *Slew rate limiting recovery characteristics of low cost ic opamps.* Robert Orban, Parasound, Inc., Menlo Park, California.

Tuesday May 13
14.00 hrs
**Signal Processing**
Chairman: David E. Blackmer, dbx, Inc, Waltham, Massachusetts

- B-1 *A wide dynamic range program equalizer.* Richard S. Burwen, Burwen Laboratories, Burlington, Massachusetts.
- B-2 *An autocorrelator noise reduction system.* Robert W. Carver, Phase Linear Corp, Lynnwood, Washington.
- B-3 *A new approach to two quadrant multiplier design.* Douglas R. Curtis, Beloit, Wisconsin.
- B-4 *Unity sum electronic crossovers.* Steven J. Gunderson, California Polytechnic State University-San Luis Obispo, San Luis Obispo, California.
- B-5 *Audio frequency application of integrated circuit analog delay lines.* Bernard Hutchins and Walter H. Ku, School of Electrical Engineering, Cornell University, Ithaca, New York.
- B-6 *An automatic stereo separation control.* W. J. J. Hoge and Kevin L. Anderson, Nashville, Tennessee.

Tuesday May 13
19.00 hrs
**Audio in Broadcasting (AM/FM/TV)**
Chairman: Donald McCroskey, American Broadcasting Company, Hollywood, California

- C-1 *A hard look at four-channel sound.* Robert E. Berglas, University of California, Berkeley, California.
- C-2 *Noise reduction encoding with fm pre-emphasis reduction—a preliminary report on audio processing and average modulation changes.* Morley Kahn, Dolby Laboratories Inc, New York, New York.
- C-3 *A versatile, high-speed 'off-line' sweetening system for television audio post production.* Ron Estes, National Broadcasting Company, Burbank, California.
- C-4 *An audio control facility for a tv 'on air' control room.* Donald C. McCroskey, American Broadcasting Company, Hollywood, California.
- C-5 *Broadcast cartridges—past, present and future.* D. M. Kalmokoff, Western Broadcasting Co Ltd, Aristocart Division, Vancouver, BC, Canada.
- C-6 *Mathematical theories of the QS system and their application to the latest QS encoding method.* Ryosuke Ito, Susumu Takahashi, and Kouichi Hirano, Sansui Electric Company Limited, Tokyo, Japan.

Wednesday May 14
09.00 hrs
**Sound Reinforcement**
Chairman: Edward S. Jones, Brigham Young University, Provo, Utah

- D-1 *A novel stadium sound system.* Eugene T. Patronis, Jr, Georgia Institute of Technology, Atlanta, Georgia.
- D-2 *Experiments in the enhancement of the artist's ability to control his interface with the acoustic environment in large halls.* Ron Wickersham, Alembic, Inc, Sebastopol, California, and Don Davis, Synergetic Audio Concepts, Tustin, California.
- D-3 *Practical considerations of touring rock pa systems.* Robert G. Heil, Heil Sound, Marissa, Illinois.
- D-4 *The 'ideal' central cluster design.* Charles Boner, Boner Associates, Austin, Texas.
- D-5 *Sound reinforcement and equipment interface for the academy awards.* Laurence H. Estrin, Hollywood Sound Systems, Hollywood, California.
- D-6 *Model studies of 'practical' multi-transducer low-frequency loudspeaker arrays.* Richard D. M. Negus, Purcell+Noppe+Associates, Inc, Chatsworth, California; and Bruce E. Walker, Westlake Village, California.
- D-7 *Directional characteristics of phased audio reproducers.* W. Herbert Hartman, Research Derivatives, Inc, Sacramento, California.

Wednesday May 14
14.00 hrs
**Electronic Music**
Chairman: Robert Moog, Moog Music, Inc, Williamsville, New York

- E-1 *A systems design approach for more effective utilization of voltage control in music synthesizers.* Douglas R. Curtis, Beloit, Wisconsin.
- E-2 *Recording synthesized instrumental music.* David Friend, ARP Instruments, Inc, Newton, Massachusetts.
- E-3 *Dynamic spectrum changes of orchestral instruments.* David A. Luce, Moog Music Inc, Williamsville, New York.
- E-4 *Experimental fourier series universal tone generator.* Howard A. Chamberlin, Jr, Raleigh, North Carolina.
- E-5 *Live electronic music in large auditoriums.* Roy A. Pritts and J. Robert Ashley, University of Colorado at Denver and Colorado Springs, Colorado.
- E-6 *A polyphonic keyboard for a voltage-controlled music synthesizer.* Carl A. Hovey and David A. Seamans, Washington State University, Pullman, Washington.

Wednesday May 14
19.00 hrs
**Special Applications in Audio**
Chairman: William L. Cara, La Jolla, California.

- F-1 *Automatic microphone mixing.* Dan Dugan, Design & Engineering, San Francisco, California.
- F-2 *The development of diamond cutting styli.* Katsuya Goh and Isao Owaki, Victor Company of Japan; and Shigeru Namiki, Namiki Precision Jewel Company, Tokyo, Japan.
- F-3 *What's so sacred about exponential horns?* D. B. Keele, Jr, Electro-Voice, Buchanan, Michigan.
- F-4 *An autobiography of a monitor speaker and its big brother.* W. Rex Isom, RCA Records, Indianapolis, Indiana.
- F-5 *Standards and design parameters for architectural acoustic analyzers.* Gifford White White Instruments, Inc, Austin, Texas.
- F-6 *New low-cost real-time audio-analyzer* David Johnson and Victor Hall, Communications Company, Inc, San Diego, California.
- F-7 *The V-fet: a new generation of audio amplifiers.* Hisashi Suwa and Nick Morris, Sony Corporation of America, New York, New York.

Thursday May 15
09.00 hrs
**Sound, Hearing and the Environment**
Chairman: Robert Gales, Naval Undersea Center, San Diego, California

- G-1 *Pathophysiological effects of noise.* Robert W. Cantrell, Dept. of Otolaryngology, Naval Regional Medical Center, San Diego, California.

30 ▶

# The modular mixer

Take a good look at this mixer. Under that eye-catching console is a system that reflects the technical expertise gained from years of experience in the studio sound business.

Here, at last, is a mixer tailor-made to your requirements, but costing no more than a standard production model.

It's the Schlumberger UPS 4000, giving you real state-of-the-art technology at your fingertips. Fully modular, with plug-in units made of die-cast aluminium alloy to ensure highest accuracies, it's the system that has everything – integrated circuits, field-effect transistors, printed circuit cabling.

And modularity means you get the facilities you need now . . . with the flexibility you could need later.

Just specify your system requirements, and leave the rest to us. We custom-build the mixer you want. At a price you can afford. With filters, reverberation, foldback and much, much more.

Find out about this new concept in studio mixers. Contact Schlumberger, now.

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# PATENTS

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

**February 5**

**1387370** Honeywell Information Systems Italia SPA
Cassette or cartridge type tape recorder.
**1387371** Polaroid Corporation
Film cassettes.
**1387427** Communications Satellite Corporation
TV communications system.
**1387428** Communications Satellite Corporation
Filtering system.
**13877437/8/9** Televerkets Centralforvaltning
Mobile radio communications system.
**1387450** Marconi Co Ltd
Dipole aerial arrangements.
**1387453** Matsushita Electric Industrial Co Ltd
Electrostatic electro-acoustic transducer.
**1387476** Ontario Research Foundation
Ultrasonic transducers.
**1387501** Siemens AG
Vidicon camera tubes.
**1387545** Kabel Und Metall-Werke Gutehoffnungshutte AG
Mounting device for a radiating high-frequency line.
**1387547** Siemens AG
Vacuum buffer chambers for magnetic tape equipment.
**1387677** Asahi Glass Co Ltd
Liquid crystal cells.
**1387679** Wallace, D. A. R.
Antenna.
**1387712** Philips Electronic & Associated Industries Ltd.
Electro-optical devices.
**1387928** Matsushita Electric Industrial Co Ltd
Display devices.
**1388011** Communications Patents Ltd.
Transformer arrangements for wired broadcasting systems.
**1388062** Burgess Micro Switch Co Ltd.
Snap-action switches.
**1388071** Philips Electronic & Associated Industries Ltd
Frequency synthesiser.
**1388077** NCR Corporation
Manufacture of a liquid crystal device.
**1388114** Elliott Bros (London) Ltd
Aerial arrangements.

**February 12**

**1388190** Sansui Electric Co Ltd
Multi-directional sound system.
**1388207** Motorola Inc
Tape cassette player-recorder with mode selector disengage mechanism.
**1388230** Bendix Corporation
Frequency extension of circularly polarized antenna.
**1388233** Hughes Aircraft Co
Digital scan converter.
**1388243** RCA Corporation
Electrical connections for liquid crystal cells.
**1388277** Owens-Illinois Inc
Acousto-optical device.
**1388288** Office De Radio-Diffusion-Television Francaise
Method and apparatus for replacing a part of a first television image by a part of a second television image.
**1388339** Orion Research Inc
Electrochemical cell.
**1388363** American Videonetics Corporation
Tape transport apparatus with end of tape sensing control.
**1388429** Geratewek Lahr Gmbh
Gramophone switching devices.
**1388471** Xerox Corporation
Detection system.
**1388553** Plessey Telecommunications Research Ltd
Supervisory systems for telecommunication line transmission system.
**1388667** Philips Electronic & Associated Industries Ltd
Optical relay.
**1388698** Philips Electronic & Associated Industries Ltd
Closed vessel comprising a digital light deflection system.
**1388734** Sony Corporation
Single crystal magnetic transducer heads.
**1388752** Xerox Corporation
Imaging system.
**1388827** Were, F. G.
Electronic musical instruments.
**1388832** Pye Ltd
Television signal monitoring systems.
**1388865** Ricoh, KK
Electrostatic recording arrangements.
**1388925** Thomson-Csf
Electrically-controlled graphic reproduction system.

**February 19**

**1388975** Wolff, H. H.
Wide angle display system.
**1388981/2** Minnesota Mining & Mfg Co
Slide identification clip.
**1389044** Minnesota Mining & Mfg Co
Belt driven tape cartridge.
**1389041** Sued-Atlas-Werke Gmbh Ges Fur Textverarbeitung
Magnetic tape recorder.
**1389087** Siden (Soc Industriell De Developpement Electronique et Nucleaire)
Cassette for a recorder tape.
**1389113** Soc Italiana Telecomunicazioni Siemens Spa
Optical focussing system.
**1389168** Bauerfeind, H.
Capodastrum or 'capo' for stringed instruments.
**1389202** RCA Corporation
Signal processing stage.
**1389204** Plessey Co Ltd
Electromagnetic radiation radiating arrangements.
**1389257** British Aircraft Corporation Ltd
Pulse generators.
**1389258** International Business Machines Corporation
Acoustical deflection apparatus for electromagnetic waves.
**1389378** Somers, S. B. L.
Cassette containing two hubs carrying a magnetic tape for use with recording/reproducing apparatus.
**1389382** United States Atomic Energy Commission
Computer generated optical sound tracks.
**1389385** Digital Equipment Corporation
Magnetic head mounting system.
**1389397** Minnesota Mining & Mfg Co
Microstrip antenna.
**1389520** International Standard Electric Corporation
Cabinets.
**1389599** International Standard Electric Corporation
Two-wire to four-wire conversion circuit.
**1389560** International Standard Electric Corporation
Active two-wire to four-wire coupling circuit.
**1389611** Fujitsu Ltd.
Time division multiplexing multiple—access communication systems.
**1389617** Westinghouse Electric Corporation
System for transmitting and receiving a plurality of pictures on a line sharing basis.
**1389667** McCrory, C. F.
Mains safety isolating device.

**February 26**

**1389723** Information Storage Systems Inc
Pulse oscillator.
**1389733** Plessey Co Ltd
Gramophone record players.
**1389739** Sony Corporation
Magnetic recording and/or reproducing apparatus.
**1389831** EMI Ltd
Production of records.
**1389964/5** Koshin Denki Ltd
Pick-up arm assemblies for record players.
**1390009** Westinghouse Electric Corporation
Method and apparatus for radiating low-frequency radio waves.
**1390075** Philips Electronic & Associated Industries Ltd
Colour television display apparatus.
**1390081** General Corporation
Colour television receiver.
**1390084** Marconi Co Ltd
Signal transmission systems.
**1390121** Westinghouse Electric Corporation
Electrostatically deflectable light valves for projection displays.
**1390341/2/3** Dolby Laboratories Inc
Signal compressors and expanders.
**1390427** Siemens AG
Multiplexing arrangements.

# GUESS WHO JUST IMPROVED ON BASF LH TAPE?

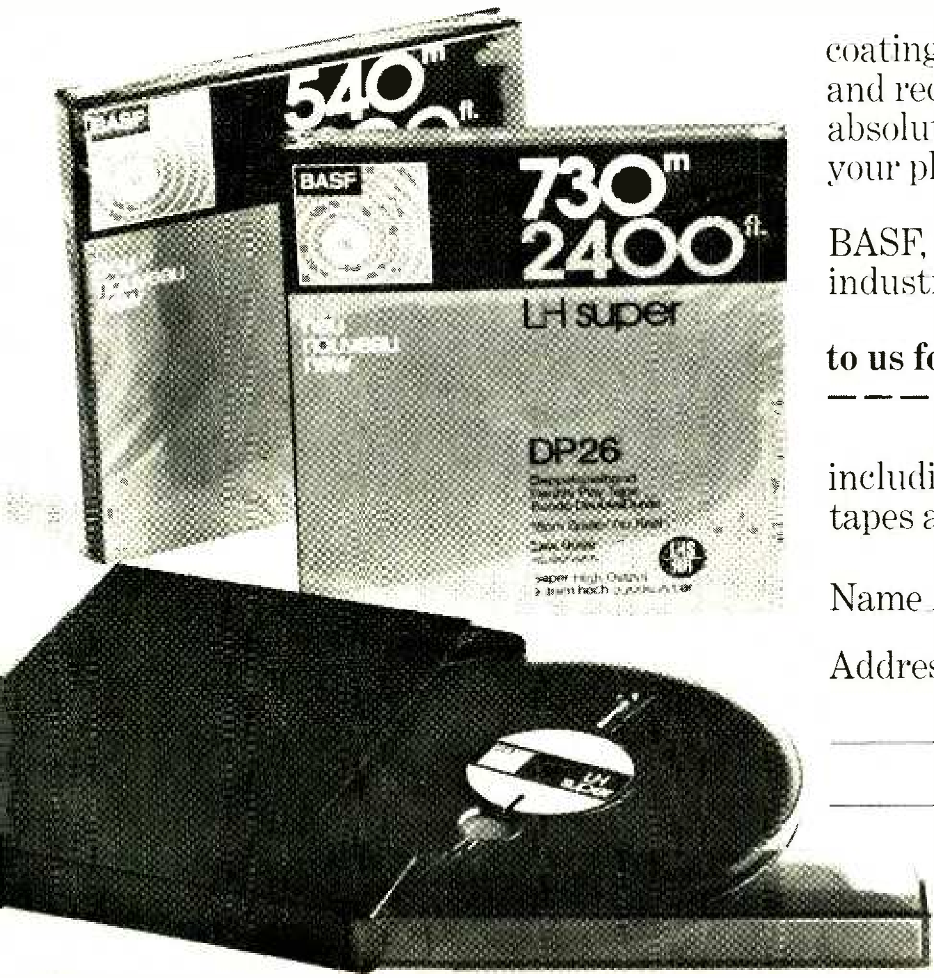
It's eight years ago now since BASF invented Low noise/High output (LH) tape.

And BASF LH tape quickly became the country's best-selling reel-to-reel tape. Small wonder – it was also the best tape money could buy.

But no more. Because although everyone else was delighted, BASF kept searching for something better still.

And (eight years of research later) here it is: BASF LH Super tape.

The principle is exactly the same as LH tape. Smaller particles for less noise, packed in at a greater density for higher output. So the signal-to-noise ratio is widened in both directions.




But instead of the normal ferric oxide, LH Super uses a refined oxide called Maghemite, which has smaller and more evenly-sized particles.

And with the completely new High Density Coating process, it improves on both sides of the LH principle.

The result is a 3dB higher maximum recording level and some 2dB less noise than BASF LH tape (measured at 5% harmonic distortion, as per Din 45 500).

Or taking a different parameter, LH Super gives a mere 2½% distortion at OVU recording level. (The Din standard allows 5%). And that means a full 50% increase in sound quality.

LH Super also has a much smoother coating that virtually eliminates drop-out and reduces recording head wear to an absolute minimum. So both the tape and your playdeck last much longer.

LH Super. It just had to come from BASF, the people who started the tape industry forty years ago.

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Please send me full details, including prices, for the BASF range of tapes and cassettes.

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# Honky Château

ADRIAN HOPE

**OVER RECENT YEARS,** the Château d'Hérouville has become something of a legend. Elton John has recorded there several times and Tony Palmer filmed him. One of Elton John's lp titles gave the studio its nickname—Honky Château. David Bowie was there with Mick Ronson to make the lp *Pinups*. But whereas Elton John stayed for a month, David Bowie stayed for three. *Pinups* was made in the summer; I can imagine anyone staying at Hérouville at that time of year for as long as their record company was prepared to foot the bill.

The Grateful Dead have also recorded there and the 200 or so local villagers still shake their heads over a coffee and cognac and reminisce over that incredible summer's night when the Grateful Dead played a free concert in the grounds of the Château. There are 16 track tapes and photos to prove that while the Dead played like never before or since, the local fireman swam fully clothed in the swimming pool and the schoolteacher danced the polka with a priest. Was the free food and drink spiked with unusual substances? No one is saying, but everyone has their guesses.

All this, and a list of the other artists who have recorded at the Château over the past few years (Julie Driscoll, SME, Bill Wyman, Canned Heat, Memphis Slim, Buddy Guy, Magma, Slam Stewart, Milt Buckner and many more) would excuse anyone for imagining that the Château is the craziest studio in the western world. Add to this the original publicity material that was put out (never less than three beautiful girls in minis, hot pants or boots per photo) and the general feeling that France is the world's centre for wine, women and song, and the imagination starts boggling overtime. The Château even had its own wine, complete with *risqué* label. And then there are the stories about how the studio had become the centre of social life for the young (mostly female) local population.

If after all this your mouth is watering over the thought of an expenses-paid trip to Hérouville, let me set the record straight. Yes, it probably all was the way the legend has it. But things—including the original name Strawberry—have changed at the Château and business has taken over from the pursuit of pleasure. And as the record business really is a business, with a high casualty rate in bankruptcies, the future of the Château in its currently subdued style looks brighter now than ever before. The Château is now simply the Château, rather than Strawberry (doubtless to the relief of the long-established Manchester studio of the same name) and it is run very tightly. The hangers-on have been cast off, the vast residential areas (two wings, at least 30 bedrooms and numerous kitchens and dining rooms) are being redecorated and the studios are being re-equipped and rewired. All this is being tackled by a resident team or 'family' which has now been whittled down to less than ten. Everyone has their own job to do and they do it. There are no daily orders, and the driving enthusiasm which binds the family together ensures that what needs doing gets done. The working week is seven days, 24 hours a day; recording is usually six days a week and maintenance on Sunday. The family live, eat and sleep Hérouville and the only comparable situation I have ever seen is that at the New York radio station, WBAI. But then both BAI and Hérouville have in common a permanent need to treat money with respect.

Have you ever thought what it is like to run a studio in a vast chateau an hour or so out of Paris but effectively in the deep country? The French châteaux date back to the days of the French kings, and Hérouville very obviously has an aristocratic pedigree. There are two wings to the main body of the building and a large complex of outhouses that were probably stables. These outhouses now house two studios, one (as yet unnamed) under construction and one (Chopin) under repair. When I visited the Château last October only the third studio (Sand), at the very top of the main right wing, was operational. Even the Sand studio was, in fact, not really open, but (like The Who's Ramport studio) was remarkably busy all the same. Hérouville has clearly been built at different times by different gentry, and there is a haunted bedroom in the left wing which is kept permanently locked. The right wing houses the Sand studio, the offices and the family living accommodation; the left sign houses the echo chambers (large rooms with their windows bricked up), dozens of single bedrooms for accommodating visiting musicians, a 'star name' residential suite where the likes of Elton John and David Bowie stay, several vast kitchens, a huge restaurant, and a fun-room for the musicians. Thus, on the whole, those booking the studio live in the left wing and those running the Château in the right.

Outside in the grounds there is a swimming pool, a fascinating complex of rock pools and fountains, a couple of brick-built caves which were probably wine stores 100 years ago, and a miniature castle surrounded by a moat seething with goldfish. And of course there are acres and acres of greenery. Round the Château are even more acres of cornfield and the few sleepy houses that make up the village. I went for one day, stayed over to make it two, and then stayed over again to make it three. It's an escape route from the city and every day in the village has a feel of Sunday about it. Small wonder that the Château is at constant risk of filling up with hangers-on.

To rewind in time by a few years, the idea of a studio in the Château was conceived in 1968 by Michel Magne, a talented French film music composer who wanted his own studio and had over the years gradually bought up parts of the Château. Having equipped the Sand studio with a Dutch-built Difona desk, some Lockwood monitors, Ampex two and four track machines, a Studer four track and a Scully eight track, Magne went into business. By 1970 there was an MCI desk and a Scully 16 track machine, and in 1971 the first two Dolby A units went in. Later that year a full range of 20 Dolbys was installed, and in 1972 the second studio (Chopin) was opened. Elton John came in to record *Honky Château*, which was the first real hit in the USA for Hérouville. From then on the snowball kept rolling, and the image of the Chateau as a fun palace blossomed.

But towards the end of 1972 Michel Magne became exhausted by the whole business and rented Hérouville to a Paris studio syndicate for a year. To cut a long story politely short,

*The road to Herouville village, drive slowly or you will miss it.*

there were 'problems'. When I was both in Germany and France at around that time I was told there was 'trouble' at Hérouville; and when I wrote to the Château soon after asking if I could do an article for STUDIO SOUND I heard nothing in reply. Squabbles over money and maintenance and so on resulted in a complicated web of court actions. There is good reason to believe that at or around that time both Virgin and Trident thought of taking over the Château, but then thought again. At the end of 1973 the two studios closed, the glamorous image of the Château started to decline, and a fair amount of equipment that was once there was suddenly no longer in evidence. Even the desk hand built for the outhouse studio Chopin by Maurice Cornelius van Hall (24 in, 16 out, with, rather surprisingly, 32 VU meters) on which Elton John made most of *Goodbye, Yellow Brick Road* was somehow, somewhere along the line, mysteriously demolished. Modules were ripped out, multicore cables cut and the desk, now beyond repair, awaits replacement.

Fortunately only the desk was seriously damaged, so the Chopin studio itself is still used for rehearsals. While I was there the French group Magma was using it to prepare for a forthcoming British tour. The studio is fascinating in its design. Firstly it has (or more accurately, *had*) the most sophisticated lighting control I have seen this side of Electric Ladyland in New York. The whole mood of the studio can be set by banks of coloured lights under thyristor control from the desk. What's more, the studio was superbly designed by Michel Magne. ('Did he take acoustic advice?' I asked. 'Michel Magne never takes anyone's advice,' I was told.) At one end a vocal booth is raised at high level to leave a cave-like percussion recess underneath. At the other end two plinths, rather like American loft beds, are built to take a Hammond organ or piano. Under these raised plinths there are more cave-like recesses where drums, other percussion or amplifiers can be sited. This

honeycomb multi-level setup provides extreme separation between individual instruments on separate tape tracks, even though the studio is both small and live. If anyone has in mind the design of a studio which must be both small and suitable for discrete tracking, he would be well advised to spare a thought for the Hérouville Chopin studio layout.

The Chopin studio is also a dream for musicians to use because it backs on to a vast courtyard from which there is direct loading through the massive studio doors and down a few steps on to the studio floor. All the doors at Hérouville, incidentally, are equipped with vast, locking handles which were originally designed, not for studio use, but for securing the doors of massive cold stores. Again a point well worth bearing in mind for anyone with a studio to design.

Above the Chopin studio, in the same outhouse, there is the half-built shell of what will eventually be the third studio. Alongside Chopin is the half-built shell of what was to have been a night club; another relic of the old days of a few years ago. It will now most likely eventually become extra living accommodation.

Because Hérouville is a quiet village, which does not lie under an airport flypath, and because the grounds are so vast that neighbour complaints are virtually unheard of, it is often the case that some instruments are recorded inside the studio and others out in the open or elsewhere in the Château. For instance, to get the right sound on one girl singer's voice, she was given headphones and left singing in the well of the stairs of the residential wing, while her backing musicians played in Chopin. Another time Eddie Louiss and his organ were parked out in the courtyard outside Chopin with his drummer inside. Then again some whole groups are recorded outside, with studio-to-garden control via walkie-talkies.

The present team took over Hérouville in the autumn of 1974 after the studio had been closed for the best part of a year. During that

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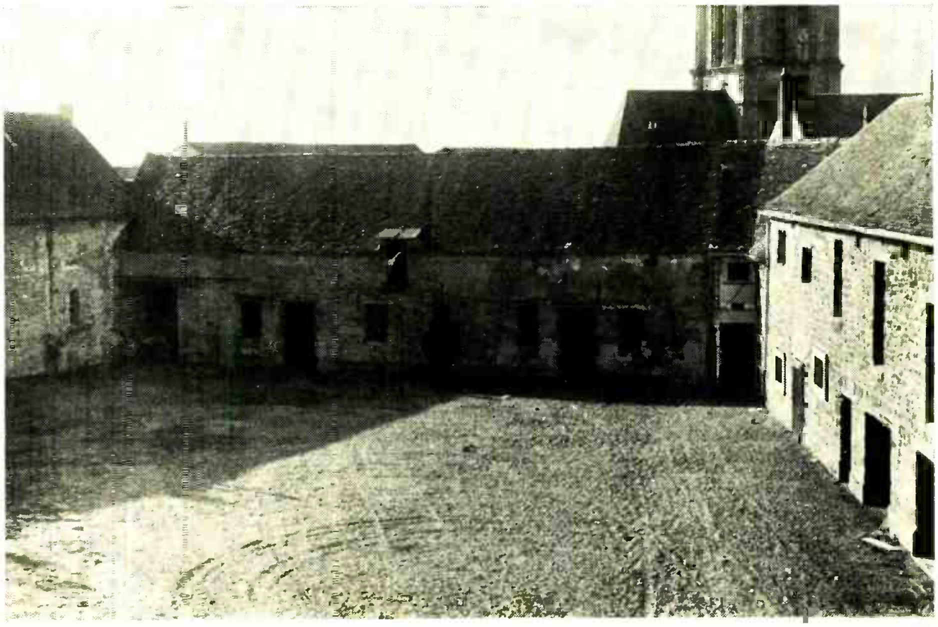
**Top:** *Claude Harper engineers in Sound Studio.*

**Middle:** *Sad end to Yellow Brick Road—all that remains of the custom built desk in Chopin—soon to be replaced with a Triad perhaps.*

**Right:** *The courtyard with outhouses contain Chopin studio; in the photo the studio o/h is on the right.*



time nothing had been operational except for a 16 track truck which British studio engineer Claude Harper put together and took out on the road with the French Canadian group, Offenbach. Claude Harper had come over at the tail end of the Château problems and has stayed on to become part of the present family. Laurent Thibault, Jean-Claude Delaplace and Pierre Aupetit are the three partners now responsible. Thibault is the musical and artistic director, Delaplace is the business manager and Aupetit is in charge of the commercial running of the studio. Although Laurent Thibault is the man who actually signs the cheques, no one signs anything without Jean-Claude's say-so. Complete opposites in character, Jean-Claude hard and businesslike and Laurent in an artistic world of his own, they make a formidable combination. 'I'd like a studio looking out on the Mediterranean,' says Laurent. 'You'd get sand in the mikes,' is the reply. When I was at Hérouville Claude Harper was still the only other engineer (Laurent Thibault handles some sessions and Claude Harper the others) but a maintenance man was due in the next week to take that burden off Harper's shoulders. Also expected was a general odd-job man to spread the load even further. 'It's a full time job just changing light bulbs in a place this size,' says Harper.

Two girls, Catherine-Marie Durand and Catherine de Moussac, do half-a-dozen jobs between them. But essentially Catherine-Marie helps cook the superb meals that appear on the farmhouse table alongside the log fire and is organising complete internal redecoration of the Château. Catherine de Moussac describes herself as 'the police' and is what every studio needs if it is to run as a business. She types, runs the switchboard and is firm with would-be parasites. She also cuts off the dozens of telephones around the castle every night and during the day watches the switchboard lights like a hawk. Now STD has come to Hérouville, a châteauful of musicians from the USA could break the bank in just one day of telephoning home for a few hours' chat. Lights, heating and cooking gas are also a problem. It costs a fortune to centrally-heat and light a building the size of the Château and Catherine de Moussac is continually chasing doors left open and lights left on. Even though cooking is by gas and central-heating is by oil-fired burners, the last quarter's electricity bill alone was still £1000.

The final member of the team is Jean-Pierre Huser, an artist-cum-musician-cum-ski instructor from Switzerland, who helps with anything that needs doing, in between producing a continual stream of extraordinary line drawings. The idea is eventually to make the studio independent in all respects, including record sleeve artwork. Already Jerry Garcia has taken some of Jean-Pierre's work back to the States for probable use on a Grateful Dead cover.

Sorry—I almost forgot Dingo, a pleasantly mad mongrel, Nuit, a friendly white dog, and Gaston, a very female cat.

In France, musicians are normally paid around 200 francs (£20) per three-hour studio session, with extra for solos and doubling. But rates are flexible. On one of the days that I was at the Château, Michel Magne was recording an lp with a group that included bassist Janik Toppe, who was originally with the group, Magma; the musicians had all come out from Paris for the day and as top session men were receiving 1000 francs (£100) each for the day's work. The cost of hiring the Château studio is 5500 francs (£550) per day, which includes nine or ten hours' recording before midnight, with food and accommodation thrown in free for up to ten musicians. For studio time after midnight the cost is 700 francs (£70) per hour. The cost of tape is extra, and this is a big item in France. A roll of 50mm 3M *206* costs 700 francs (£70) over there!

The Sand studio now has the first Audiotronics desk in Europe, with 18 channels in and 16 out. They are considering buying a Triad for Chopin. There is provision on the Audiotronics in Sand for another eight-channel module to make it 26 in, 16 out. This desk replaces the MCI console that was previously installed. The Sand 16-track machine is a Scully, with Ampex and Scully stereos. A massive auto transformer provides a choice of 110 or 240V to cope with British or American equipment in the control room and studio. There is now full Dolby A facility, and Lockwood monitors. But the Château still has record producers phoning up from Paris asking whether they have Dolby, equalisation and multitrack 'out there in the country'. In France there seems to be an even greater obsession with multitrack machinery than in the UK or USA. Everyone seems to regard 24 tracks as essential, and when Chopin is put back together again for use, it will have a 24 or 32 track desk and machine.

Currently there is much discussion over the dinner table and round the log fire on the relative merits of different desks. All in all the evenings have a very sociable atmosphere. There is no television as few people are endeared with French tv programmes, but there are plans to install a high aerial mast and British sets to receive BBC. Otherwise it's audio talk, Monopoly (British version) or finger football when the table is cleared of food. Finger football, for the uninitiated, is a very French exercise which involves all participants round a table kicking a football of screwed-up paper with their fingers. There don't seem to be many if any rules and the only object is to get the ball past someone else and off the table. It may be childish, but it is better than the French equivalent of *Coronation Street*.

Although there are a few portable radios around the building and there is a hi-fi setup in the artists' restaurant over in the other wing, music in the family wing tends to stay in the studio. We were up there half one night listening to original Magma master tapes on the control room gear. I almost wish I hadn't. When you've spent a few hours under the original wooden beams of a real live French château, listening to master tapes through Scully, Audiotronics, Quad power amps and Lockwoods, it's hard to come to terms with a London flat and domestic setup ever again. Actually, those lovely old wooden beams created awful acoustic problems to begin with. Although the acoustics of the Sand studio itself have been ideal all along, the Sand control room was very dead in the bass end. All attempts at equalisation and flattening out the room characteristics failed until finally the acoustic wall tiles were stripped off; there behind them was a large cavity, like a priest's hole, which had been gobbling up the bass frequencies. Once this was filled there were no further problems.

Wherever possible the Château engineers try and record as flat as possible, ie without equalisation on the desk, even on a drum kit. But with most artists having days rather than weeks or months to spend at the Château, pressure of time often prevents this. The studio microphone setups are really much as usual with *D224C* on drums, AKG *C12A* or AKG *224* on piano, and sometimes those little Sony condenser mikes or Neumann *U87*s on snare or top kit. Cans used are Beyer, *DT100* or *900*.

On the day that I watched Michel Magne record, Janik Toppe was producing a very curious recorded sound for his bass by using a high-powered Ampex amplifier and a deliberately overdriven small cabinet of the wrong impedance. If it's not a contradiction in terms, the result was a clean fuzz of a very individual character. Available in the studio for musicians' use are a full-sized Fender *88*, one of the lovely old large Hammonds with two of the original Leslies, and an Ampex bass amp feeding a Sunn horn cabinet. There is a Farfisa, a Steinway grand, timps, marimba, spinet and clavinet. Separation in the studio is with screens and to aid this the Steinway piano has an interesting box-like cover which completely encases the open top.

As I mentioned previously, the echo system is by means of walled-up rooms of the Château, and although only one is currently in operation there are several more available for use when the need arises. A nice idea is to identify each room (residential and utility) by its colour. Thus the black echo chamber has a reverb time of around five seconds, and the red chamber next door somewhat less. A single Altec speaker is used in the black room, with a Blumlein pair of AKG *224C*s.

Claude Harper is currently the only British member of the Château family team, but he (born of a French mother) speaks fluent French. Thus most of the normal working conversation is in French. But everyone seems perfectly happy to work in English where necessary. Certainly, because my French was far worse than everyone else's English, most conversations involving me were in English. Every time I make a trip to a foreign studio it becomes clearer to me that English is all set to become the international studio language, just as English is the international airline language.

For obvious reasons it was Claude Harper who showed me round most of the time, and flew me to and from the airport in his extraordinary Ford Anglia van with its 70 bhp of modded engine under the bonnet. He started, like so many others in the studio world, at EMI, 'mending vacuum cleaners and toasters out at Hayes for four years'. From there on he went to Abbey Road, where he worked on some of the original Beatles albums, and then on to Apple, before moving to Scorpio.

'By then I'd had London up to here,' he said, 'and disappeared to France, finally ending up in Hérouville after pursuing a few dead



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## HONKY CHÂTEAU

ends elsewhere'. EMI, it seems, is in many ways like the BBC, a large establishment that trains people up the hard way and perhaps unwittingly equips them for the best jobs in independent studios. Would-be engineers should take note of the respected studio names that have passed through EMI's hands over the years.

When I left the Château the immediate job in hand was to record Alain Kan, probably best described as a French David Bowie. He had arrived the day before on the offchance of taking up some spare studio time, but there had been none, and he was last seen wandering in the local cornfields community with nature. Presumably he turned up again in due course.

By now the locals must have grown used to the oddest of characters wandering in and out of the great, cast-iron gates to the drive that leads up to the Château. Unless something goes awfully wrong, I should imagine that some of the most famous names in pop music will be passing through them for many years yet. The future is fairly clearly laid out, and with Jean-Claude's steadying hand nothing is likely to move too fast and bring the whole enterprise tumbling down like a pack of cards. The next step is to buy the studio from Michel Magne (it's currently only leased, and he still lives in one of the outhouses). The Chopin studio will soon be brought back into action and then the new studio above it finished. There are plans to equip one of the vast spare rooms in the family wing as a remix room and to convert some of the garden caves into echo chambers. Much of the original audio wiring will need to be replaced and Claude Harper has already remade numerous dry joints and inverted dozens of wrongly-phased balance-line connections—all a legacy of the trouble period when there was no real maintenance going on. But to keep the studio operational new wiring must be laid before the old is axed. Available space is one thing that is no problem; nor is soundproofing. Most of the stone walls are several feet thick. The real problems are finding the time, the money, and the right equipment in France. Perhaps most awkward of all is getting hold of spare parts for foreign equipment.

'In England you tend to get blasé about servicing,' says Harper. 'If a tape machine develops a fault you phone up the maker's agent and an engineer comes right out and fixes it. Here in France there is always a train of excuses, followed by a botched repair, and then a long wait for a fresh part. Even an ordinary GPO jack costs £2.'

On my last day at Hérouville we went a few miles out to the little village of Auvers and saw the tiny, miserable room where Van Gogh finally committed suicide. It was Sunday, and it was the first few non-working hours that anyone had had away from the studio that week. Apart from wine with meals and an occasional beer there is very little drinking at Hérouville. There is certainly no partying and most nights everyone is far too tired to stay up late. The only booted beauty with hot pants that I saw was in a photo on one of the old studio brochures.

'I'll bet,' says Jean-Pierre Huser, 'that when you go back to England and tell them what a staid place the Château is now, no one will believe you'.

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## AES 51st CONVENTION LOS ANGELES

G-2 *Community noise ratings.* Karl S. Pearsons, Bolt Beranek and Newman Inc, Canoga Park, California.

G-3 *Psychoacoustic problems in noise control.* John C. Webster, Naval Electronics Laboratory Center, San Diego, California.

G-4 *Aircraft noise reduction.* Alan H. Marsh, Douglas Aircraft Company, Long Beach, California.

G-5 *Highway noise-evaluation and control.* Ben H. Sharp and Kenneth J. Plotkin, Wyle Laboratories, Silver Spring, Maryland.

G-6 *San Diego noise abatement and control program.* James E. Dukes, City of San Diego, San Diego, California.

Following the presentation of papers, the authors will form a panel to discuss environmental noise and will welcome questions from the audience.

Thursday May 15
14.00 hrs
**Physics of Sound and Music and Human Perception**
Chairman: Sanford Fidell, Bolt, Beranek and Newman, Inc, Canoga Park, California

H-1 *Geometry of sound perception.* Richard C. Heyser, Cal Tech Jet Propulsion Lab, Tujunga, California.

H-2 *On the meaningfulness of noise measurements in audio systems.* Sanford Fidell, Bolt, Beranek & Newman, Inc, Canoga Park, California

H-3 *Statistical room acoustics.* David Lubman, D. Lubman & Associates, Woodland Hills, California.

H-4 *A study of time domain speech compression by means of a new analog speech processor.* Ian M. Bennett, Stanford University, Stanford, California.

H-5 *Brain signs of auditory information processing in man.* Jackson Beatty, University of California at Los Angeles, Los Angeles, California.

H-6 *Resonances in wind instruments and their musical significance.* John Backus, University of Southern California, Los Angeles, California.

H-7 *The perception of speech.* Peter Ladefoged, University of California at Los Angeles, Los Angeles, California.

Friday May 16
09.00 hrs
**Architectural Acoustics and Room Design**
Chairman: Richard Boner, Boner Associates, Austin, Texas

J-1 *Reverberation times of churches: a survey and evaluation.* David L. Klepper, KMK Associates Ltd, White Plains, New York.

J-2 *More accurate calculation of the room constant.* G. L. Augspurger, Perception Inc, Los Angeles, California.

J-3 *The effect of arena acoustical design on temporary and permanent sound reinforcing systems.* Charles Boner, Boner Associates, Austin, Texas.

J-4 *A comparison of the acoustic quality of a sound recording with that of the original: the experience in Hesslscher Rundfunk Studio 1.* E. J. Voelker, C. L. Mueller and D. Kittler, Hessischer Rundfunk, Germany.

J-5 *Reverberant field energizer and electronic forestage canopy system.* Donald E. Gilbeau, Delta Industrial Communications & Engineering, Inc, Sacramento, California; and Christopher Jaffe, Jaffee Acoustics, Inc, Sacramento, California.

J-6 *A systems approach to the loudspeaker in a monitoring environment.* J. Robert Ashley and W. J. J. Hoge, University of Colorado, Colorado Springs, Colorado.

Friday May 16
14.00 hrs
**Audio Measurements and Standards**
Chairman: Juergen Wahl, United Recording Electronics Industries, North Hollywood, California

K-1 *Structures and spheres of interest of the standards organization.* W. Rex Isom, RCA Records, Indianapolis, Indiana.

K-2 *Meaningful standards do something for you.* Stephen F. Temmer, Gotham Audio Corporation, New York, New York

K-3 *Interpreting field measurements of directivity factor and their relation to the proposed standard method of measuring the directivity factor of loudspeakers used in commercial sound work.* Don Davis, Synergetic Audio Concepts, Tustin, California, and Cecil R. Cable, Cecil R. Cable & Assoc, Edmonton, Canada

K-4 *Some new audio measurements.* Richard C. Heyser, Cal Tech Jet Propulsion Lab, Tujunga, California

K-5 *Noise measurements in audio.* Alastair M. Heaslett, Ampex Corporation, Redwood City, California.

K-6 *Evaluating open plan acoustics.* Herbert T. Chaudiele, Robin M. Towne & Assoc, Seattle, Washington.

K-7 *Gas laser applications and acoustic modelling.* Jack B. C. Purcell, Purcell+Noppe +Associates Inc, Chatsworth, California.

Friday May 16
19.30 hrs
**Jazz/Rock Synthesizer Concert**
(No registration fee required)
Sponsored by ARP Instruments, Inc, Newton, Massachusetts.

## BIAS TAPE RECORDER

Angus McKenzie

**MANUFACTURER'S SPECIFICATION**

**Speeds:** 9·5 and 19 cm/s, 19 and 38 cm/s, 38 and 76 cm/s.
**Speed stability:** better than ±0·2%

| Wow and flutter | peak weighted | rms |
|---|---|---|
| 76 cm/s | 0·05% | 0·06% |
| 38 cm/s | 0·05% | 0·06% |
| 19 cm/s | 0·1% | 0·08% |
| 9·5 cm/s | 0·15% | 0·1% |

**Spool capacity:** maximum spool size 29 cm. Will accept NAB European and cine centres.
**Rewind time:** at maximum speed 2 400 ft in 100s.
**Start time:** at 38 cm/s, to rated speed less than 0·1s. To 0·1% wow and flutter, 1s.
**Tension control:** electronic servo back tension controlled by sensing arm and damped by a fluid dashpot. Tension maintained to within ±10g over NAB spool.
**Tape counter:** reads in minutes driven by the tape. Corrected at 38 cm/s. Division or multiplication required for other speeds.
**Frequency response:** overall response within ±2 dB between 40 Hz and 18 kHz at 38 cm/s, 40 Hz and 16 kHz at 19 cm/s, 40 Hz and 10 kHz at 9·5 cm/s.
**Cross talk:** stereo better than —40 dB, twin track (ferrite heads) better than —54 dB.
**Noise:** overall unweighted below 320 nW/m, mono —60 dB for the transportable machine or 62 dB for the console. Overall unweighted below 510 nW/m, stereo —60 dB for both models.
**Equalisation:** switchable NAB or CCIR. At 19 cm/s, NAB is 50 µs+3 180 µs. CCIR is 70 µs. At 38 cm/s, NAB is 50 µs+3 180 µs. CCIR is 35 µs.
**Bias frequency:** 100 kHz.
**Line input:** balanced floating. 10k ohms input impedance. Source impedance 200 to 600 ohms. Nominal input level 0 dBm. Minimum input level —20 dBm.
**Line output:** balanced floating. 50 ohms output impedance. Load impedance 600 ohms. Nominal output level 0 dBm. Maximum output level +20 dBm.
**Heads:** high quality laminated or ferrite record and replay heads. Ferrite erase head.
**Track widths:** mono full track 6·25 mm, stereo 2·75 mm, twin track 2·2 mm.
**Manufacturer: Bias Electronics Ltd, 572 Kingston Road, London SW20 8DR. Phone: 01-540 8808.**

**OVER THE YEARS** a number of smaller British companies have entered the professional tape recorder market, and without doubt one of the more successful has been Bias Electronics, who first started trading in the spring of 1971. The company has two joint managing directors, Peter Lindsley (technical director) and sales director Tony Costello; both have worked very hard indeed to establish their company in the professional field against very stiff opposition from established European and American companies. Bias Electronics aims particularly at the professional studio and public broadcasting fields, and as a policy decided not to expand too quickly in order to concentrate on 6.25 mm and 12.5 mm tape transports. They saw the price of imported machines rise rapidly; certainly there is a considerable need for a British-made machine which is reasonably priced, reliable and well built. In general they have achieved their design aims, although a few points need attention, which they have readily agreed to consider.

The basic deck can be supplied in a number of different forms and special requirements can be met within reason. Bias can produce portable or console versions; the 6.25 mm machine reviewed was a console type which will be dealt with in detail, whereas the 12.5 mm machine was a customised portable unit.

The deck is a quality aluminium die casting 6.3 mm thick, but webbed to a depth of approximately 37.5 mm; this makes the deck solid and robust. Two Papst motors type *ROT* provide ample torque for spooling and forward and back tension, the main capstan motor having an outside rotor (type *HSKZ*) as the capstan shaft integral in its construction. The spool motors can be raised or lowered to set the correct spool platform height, all the motors being mounted on the main die casting by large bolts easily undone in the rare event of failure.

Power connection to the motors is by plug and socket, the same applying to the large capstan motor. Because the main tape drive capstan is integral with the motor, it is necessary to replace the entire unit if the capstan is damaged or worn. Bias claim a fast replacement service in such an event. The push-buttons, deck relays and logic circuits are all in one section, again fitted with plugs and sockets for easy servicing and this is one of the best features of the machine. All the tape rollers are mounted on ball races, the idler wheel actually having two of these; with the exception of the tape timer roller, all can be adjusted for accuracy of tape height throughout the transport. The head block is connected by a plug with a mating socket on the chassis, and can be quickly withdrawn by unscrewing two bolts. Tape guides are mounted each end of the block and the three heads hang downwards from the top of the block, being mounted in an arc to give the correct wrap round. The tape from the left spool first traverses a very thin metal post, unfortunately with the oxide side against its surface, and then passes over a movable guide of the same diameter bearing against the other side of the tape in order to control the back tension throughout a NAB spool at 80±10g. The movable pin is damped by a dash pot and the servo mechanism works with a lamp and photoelectric system—a change of light falling on the cell is made to alter the back tension with the usual circuitry. These first two guides seem too small in diameter, the sharp radii providing a possible cause of damage to tapes traversing them. Particularly unfortunate was the slight jolting effect produced by long edits passing through them which occasionally resulted in a slightly audible speed variation. The tape continues round a fixed guide roller (oxide inwards again) followed by another roller guide on a spring mechanism holding the tape against the heads on play or record, which withdraws during spooling. The tape then passes through the capstan assembly with the idler wheel driven from the back of the tape, finally passing around the timer roller and on to the take-up spool. All the deck pins and guides are of non-magnetic 'stainless alloy', which would appear to be rather soft and quick wearing. Significant flats had formed on both the 6.25 mm and 12.5 mm machines; when told about this Bias Electronics commented that they would immediately investigate the matter. The tape timer is calibrated in minutes and seconds, and would have been more useful if it had been accurate. When a NAB tape was spooled through and then reversed back to the beginning, the clock showed an error of 51 secs, which was, frankly, poor. In general use we soon learned to treat the clock only as a very rough guide.

All the motors are fed from tapped transformer secondaries through the deck switching, thus isolating the motors completely from the mains. Furthermore, no dropping resistors have been used, with the sole exception of one in the idler wheel solenoid circuit. When play or record functions commence, the dropping resistor is bypassed, allowing a higher voltage to be fed to the solenoid to increase the tension against the capstan for approximately 1¼ seconds, after which the relay removes the short circuit. This allows the tape to reach the correct operating speed in a fraction of a second, and after several trials an estimate that the wow and flutter specification is reached in

**FIG.1**

BIAS BE1000
IEC REPLAY RESPONSE
38cm/s

REF 1kHz -20dB
AGFA 38 TEST TAPE
CCIF GLEITTON
LEFT CHANNEL
POT RANGE: 10dB
RECTIFIER: RMS

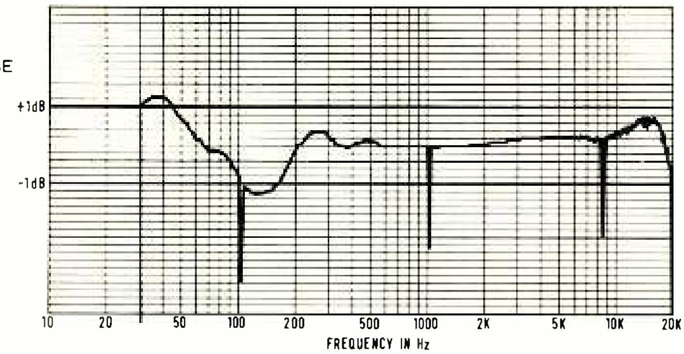



**FIG. 2**

BIAS BE1000
OVERALL IEC RESPONSE
38cm/s

BASF SPR50 LH TAPE
LEVEL -20dB REF
320nW/m AT 1kHz
RIGHT CHANNEL
POT. RANGE: 10dB
RECTIFIER: RMS

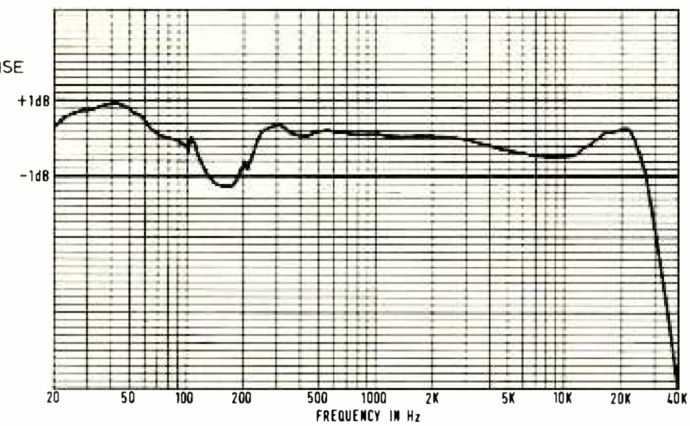



**FIG. 3**

BIAS BE1000
OVERALL IEC RESPONSE

BASF SPR50 LH TAPE
LEVEL -20dB REF
320nW/m AT 1kHz
LEFT CHANNEL
POT. RANGE: 10dB
RECTIFIER: RMS

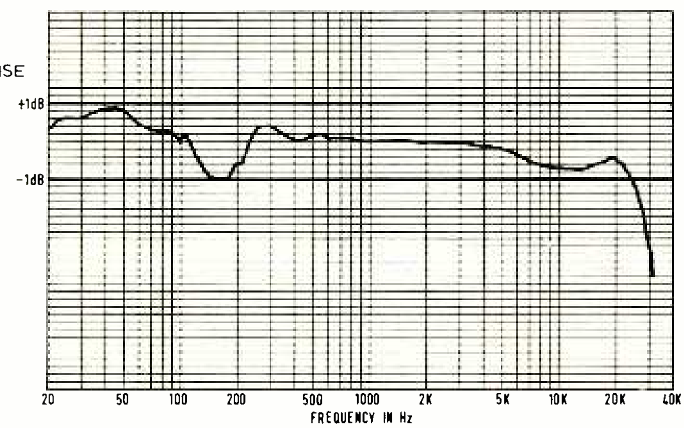
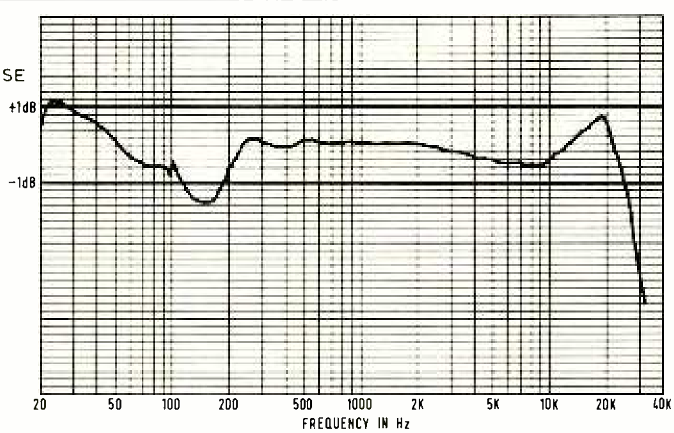



**FIG. 4**

BIAS BE1000
OVERALL NAB RESPONSE
38cm/s

BASF SPR50 LH TAPE
LEVEL -20dB REF
320 nW/m AT 1kHz
RIGHT CHANNEL
POT. RANGE: 10dB
RECTIFIER: RMS




about one second. On a continuous run, the wow and flutter measured an average of 0.018% at 38 cm/s and 0.03% at 19 cm/s, remarkably good figures for a machine of this type. These figures are DIN peak weighted, and are the average of three measurements at the beginning, middle and end of a NAB spool. Figures were also taken using 18 cm cine spools, with similar results at the appropriate tension. There was hardly any noticeable difference in reading throughout the whole spools used and we were agreeably surprised to find that the speed accuracy was well within the tolerance of our calibration test tape, our measurements showing both speeds as indicated within 0.1%; the test tape itself has a specification of ±0.2%. The spooling time (full speed) for a NAB reel of standard play tape was 1 min 15s from left to right and 1 min 11s in reverse; the spooling appeared to be satisfactory, no ridging occurring with a semi matt backed tape. The wind was firm, but not over-tight. As would be expected, shiny-backed tapes did not spool anywhere near as well, slight ridging occurred occasionally when spooling at high speed. When adjusted to operate at a slower spooling speed, I was very impressed with the wind, even with shiny-backed tape, showing that the spooling motors had been very carefully vertically aligned, with no eccentricities evident in the spool platforms.

Below the tape transport, four main pushbuttons operate, from left to right: record, spool, stop and play. It is necessary to press both record and play for recording. It is also possible to drop from play to record, a most useful feature, which may be done without any click being put on the tape. A safety switch can be added which will prevent operation of the record erase circuits, and while this was not present on the 6.25 mm machine it was on the 12.5 mm model. An additional pushbutton entitled 'edit' brings an idler wheel close to the capstan and places the tape in contact with the replay head, allowing the operator to rock the spools backward and forward during editing. It also activates the rotating guide on the left of the head block to improve tape guidance at the same time.

The tape deck is hinged at the rear and can be pulled up quite easily to expose the workings for maintenance; the deck can be propped in this position without any danger of it falling down. The raw dc power supply for the recorder is mounted under the deck and this is fed down to an appropriate edge connector on the erase oscillator and bias circuit board, which also contains the complete feed back type dc regulator circuit. The entire electronics are of modular construction, separate modules being provided with runners to push them in and out of the frame at the back, where are placed the edge connector sockets. There are separate modules for record, erase and replay circuits, each module having pre-sets on the front for normal use. Internally, but easily accessible, are DIN/NAB equalisation switches for both record and replay modules. The record modules have independent 100k ohm pots for record gain for the two speeds, which are directly driven from the secondary of a 1:1 input transformer. A three-stage amplifier is driven by the switched output from these record gain controls, and includes a feed back circuit for pre-set treble lift controls for the

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two speeds. This feeds a two-stage amplifier having switchable fixed 3180 µs bass lift circuit and also a 3 dB shelf cut circuit for NAB correction at 38 cm/s. At this speed, having set the treble lift, it therefore becomes possible to change the tape characteristic by operating this switch, no further adjustments being necessary. However, to keep the cost down the manufacturers omitted a relay which could have given a 3 dB treble shelf boost for 19 cm/s NAB curve, and this is rather unfortunate. The audio signal then feeds into the record head driver stage, which includes three transistors with a *pnp/npn* combination acting as the output pair. In this, the *pnp* transistor acts as a load on the *npn* one, and the two joined collectors feed the head directly through a parallel bias trap.

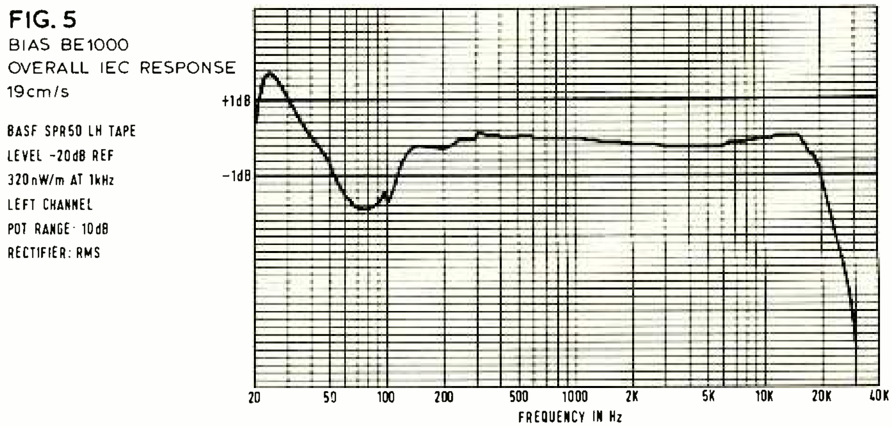
The erase and bias oscillator incorporates six transistors and oscillates nominally at 100 kHz (on both the machines we measured 101 kHz). The entire erase oscillator transformer secondary feeds the erase head, but is connected to earth through a one ohm resistor, allowing the total erase and bias current to be pre-set to suit the particular erase head installed. The manufacturers normally supply either Bogen or Branch & Appleby erase heads of 2 mH inductance, and on the 6.25 mm machine, the record and play back heads were stereo narrow guard band ferrites. Unfortunately, the erase head of the 6.25 mm review machine was not as effective as it might have been, an erase of only 67 dB being measured below signal on a tape recorded at a 3% distortion level. Considerable attempts were made to improve this by very careful orientation of the head, and adjustment of the bias current, within the manufacturer's permitted tolerances, but no improvement could be made.

Two pairs of bias pots are switched by the speed relays to avoid undue additional loading of the transformer secondary. These act against ground, and their sliders are also switched directly and independently through a capacitor to the top of the record head. A considerable amount of bias variation was possible at both speeds to accommodate all the professional tapes that have been evaluated by us, and I noted that the bias noise was consistently clean and low. No detectable kinks in the waveform could be seen, and the bias distortion, such as was present, was virtually all odd harmonic. The replay head (70 mH), damped by 18k ohms, was fed directly into its pre-amplifier, although 47k ohm loading is used for mumetal heads when required. The replay pre-amplifier includes four transistors of which one is a Darlington pair incorporated in a single package. This gives a very high forward gain to allow a flat replay equalisation curve down to very low frequencies, at the same time as preserving a considerable amount of feed back throughout the audio range. This holds the distortion levels down even when very high record levels are played through it, the test tape being BASF *SPR 50 LH*. Using the DIN 35 µs curve, 3% third harmonic distortion was reached at 8.5 dB above 320 nW/m agreeing almost precisely with the results obtained in the tape tests in which a more expensive machine was used. Several higher output tapes were tried, but we failed to cause any noticeable clipping in the pre-amplifier. This amplifier contains only the standard time constant circuits for the two speeds which are switched by relays. The next stage, preceded and succeeded by bias traps, contains the treble equalisation to compensate the hf response accurately. Separate replay level controls, also switched by the speed relay in the same manner as the treble equalisation controls, are brought out on the front panel, with a bass correction pre-set for each speed mounted internally on the printed circuit board allowing a compromise adjustment to be made for head contour effects. The line out amplifier feeds straight into a balanced output transformer and has the potential to provide a very high output level. The clipping level into 600 ohms was 11V but into 20k ohms just over 13V were available, enough to cope with the highest possible record levels on tape. The output source impedance measured 51 ohms, and this is certainly low enough to drive all normal external equipment. This low impedance permits 600 ohm headphones to be jacked across the output externally on programme without any noticeable effect.

Vu meters (optional extra) were provided switchable to 'line in' or 'line out', driven by a single transistor fed in turn by an appropriate level setting pot, one for record and one for replay. These were fed by a transformer which bridged either the balanced input or output from the machine; switching the meters from output to input caused a decrease of approximately 0.5 dB in recording level when the input was driven from a 600 ohm source. Although the transformers were designed to load 10k ohms, the recorder's input impedance measured as high as 56k ohms, although this decreased to 16k ohms when the vu's were switched to read the input. This is unsatisfactory, and upon investigating it was found that the input transformer secondary was only loaded by the two 100k ohm potentiometers. I suggested to the manufacturers that it would be better to do away with the vu meter drive transformer, and bridge the secondary of the input transformer or the primary of the output transformer into the meter circuit, in addition to applying the correct damping resistor. They have agreed to make this modification, but point out that they can supply vu's which directly bridge a balanced line input and output. To avoid any possibility of the vu meter's rectifiers causing distortion on line with a 600 ohm or higher source impedance, they can fit a meter-off position, such a system being incorporated in the four track 12.5 mm model also tested. In this model, distortion was quite apparent on the input when fed from a 600 ohm source, which entirely disappeared when the vu meters were switched to line out; this particular point is worth bearing in mind if you use passive vu meters in your studio.

The replay response on the two tracks of the 6.25 mm machine was measured at both speeds and for both equalisations, Agfa test

FIG. 5
BIAS BE1000
OVERALL IEC RESPONSE
19cm/s




**REPLAY RESPONSE BIAS ELECTRONICS BE 1000**

| | 38 cm/s | | | | 19 cm/s | | | |
|---|---|---|---|---|---|---|---|---|
| | DIN | | NAB | | DIN | | NAB | |
| | L | R | L | R | L | R | L | R |
| **31·5 Hz** | +·6 | +·8 | +·6 | +·1 | +·3 | +·7 | +1·7 | +2·1 |
| **40 Hz** | +·4 | +·5 | — | — | —·4 | 0 | — | — |
| **63 Hz** | —·8 | —·8 | —·5 | —·5 | —2 | —1·7 | —1·6 | —1·2 |
| **125 Hz** | —1·9 | —2 | —1·5 | —1·5 | —·1 | 0 | 0 | +·2 |
| **250 Hz** | —·2 | —·3 | +·4 | +·5 | —·2 | —·1 | 0 | 0 |
| **500 Hz** | —·2 | —·3 | 0 | +·2 | 0 | 0 | 0 | 0 |
| **1 kHz** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **2 kHz** | +·3 | +·2 | +·2 | +·1 | +·5 | +·6 | 0 | +·2 |
| **4 kHz** | +·4 | +·2 | 0 | —·2 | 0 | +·3 | —·9 | —·4 |
| **6·3 kHz** | +·1 | 0 | — | — | —·3 | +·5 | — | — |
| **8 kHz** | +·2 | 0 | —·5 | —·8 | —·6 | +·8 | —2·4 | —1·9 |
| **10 kHz** | +·2 | 0 | —·5 | —·9 | —·1 | +·4 | —3 | —2·4 |
| **12·5 kHz** | 0 | 0 | —·4 | —·8 | 0 | +·2 | —3 | —2·8 |
| **14 kHz** | +·7 | +·6 | — | — | 0 | —·1 | — | — |
| **16 kHz** | +1 | +·8 | —·5 | —1 | +·7 | +·2 | —3·4 | —3·4 |
| **18 kHz** | +1·4 | +1 | — | — | +·6 | —·2 | — | — |
| **20 kHz** | — | — | —1 | —2 | — | — | —4·2 | —4·5 |

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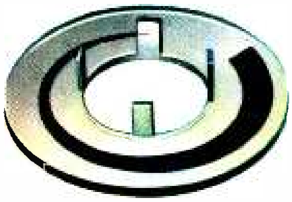
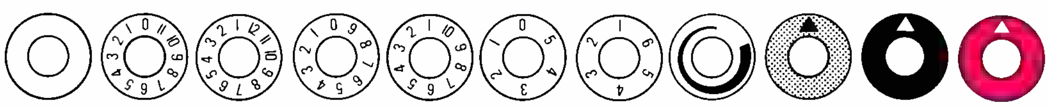
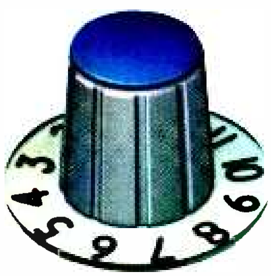
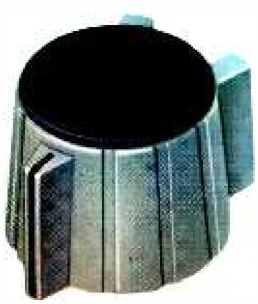


All items in the Sifam range of collet knobs and accessories are packaged in tens and clearly identified. The knobs are supplied in blister packs as illustrated. All other accessories are supplied in transparent polythene bags.

| | **10mm** for shaft sizes 3mm, 4mm and 1/8in | **11mm** for shaft sizes 3mm, 4mm, and 1/8in | **15mm** for shaft sizes 3mm, 4mm, 6mm, 1/8in and 1/4in | **21mm** for shaft sizes 3mm, 4mm, 6mm, 1/8in and 1/4in | **29mm** for shaft sizes 3mm, 4mm, 6mm, 1/8in and 1/4in |
|---|---|---|---|---|---|
| **Short knobs** in black, red or grey with or without line | ✓ | ✓ | ✓ | Not available | Not available |
| **Standard knobs** in black, red or grey with or without line | Not available | ✓ | ✓ | ✓ | ✓ |
| **Wing knobs** in black, red or grey with or without line | Not available | Not available | ✓ | ✓ | ✓ |
| **Nut covers** in black, red or grey with or without line | Not available | ✓ | ✓ | Not applicable. In the 21mm and 29mm sizes, the base of the knobs is large enough to include a nut recess | |
| **Caps** in black, red, grey, green blue or yellow with or without spot | ✓ | ✓ | ✓ | ✓ | ✓ |
| **Pointers** (not applicable to wing knobs) in black, red, grey, green, blue or yellow | ✓ | ✓ | ✓ | ✓ | ✓ |
| **Figure dials** (not applicable to wing knobs) in the various markings illustrated below. Special markings to order. | Not available | ✓ | ✓ | ✓ | ✓ |







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**REPLAY NOISE 12·5 mm REF OVU 185 nW/m NAB**

| | 38 cm/s | | | | 19 cm/s | | | |
|---|---|---|---|---|---|---|---|---|
| **Track** | 1 | 3 | 2 | 4 | 1 | 3 | 2 | 4 |
| **15 kHz** | —54 | —56 | —54 | —56 | —52 | —56 | —54 | —51 |
| **CCIR Weighted** | —56 | —61 | —61 | —60 | —58 | —61 | —60 | —59 |

**OVERALL NOISE 6·25 mm 320 nW/m**

| | 38 cm/s | | | | 19 cm/s | | | |
|---|---|---|---|---|---|---|---|---|
| | DIN | | NAB | | DIN | | NAB | |
| | L | R | L | R | L | R | L | R |
| **CCIR** | —56 | —56 | —55 | —55 | —56 | —56 | —58 | —58 |

**OVERALL NOISE 12·5 mm REF OVU 185 nW/m NAB**

| | 38 cm/s | | | | 19 cm/s | | | |
|---|---|---|---|---|---|---|---|---|
| **Track** | 1 | 3 | 2 | 4 | 1 | 3 | 2 | 4 |
| **CCIR Weighted** | 6—4 | —47 | —48 | —47 | —48 | —50 | —49 | —48 |

**REPLAY NOISE 6·25 mm REF AGFA DIN OP LEVEL=320 nW/m**

| | 38 cm/s | | | | 19 cm/s | | | |
|---|---|---|---|---|---|---|---|---|
| | DIN | | NAB | | DIN | | NAB | |
| | L | R | L | R | L | R | L | R |
| **15 kHz** | —58 | —60 | —62 | —63 | —53 | —60 | —58 | —64 |
| **CCIR** | —69 | —69 | —68 | —69 | —67 | —67 | —70 | —69 |

tapes being used for the IEC/DIN characteristics and MRL for the NAB ones. The response was measured as set by the manufacturer, and on the IEC positions at both speeds the high and response was extremely good, considering minor differences between one test tape and another. After adjustment the extreme top end was improved and the high end response could not be criticised. The high end correction for NAB was very good, and the slight differences in response, particularly for 19 cm/s NAB, partly explained by the NAB tapes having slightly less top than the Agfas, after an appropriate time constant correction. However, I feel that Bias Electronics could, with advantage, slightly increase the time constant resistors in the NAB position at 19 cm/s. At the low end, the correction was not quite right since a considerable hole was noted at 125 Hz at 38 cm/s, and 63 Hz at 19 cm/s; this seems obviously connected with head contour effect. If the bass correction pre-sets had been altered to try to correct this, the 31 Hz response would have gone well outside specification. This type of effect is fairly common with normal ferrite heads, but not normally so serious with hyperbolic front mumetal heads which can be supplied as an alternative. The replay response figures are shown in the table.

The replay noise figures were extremely low, since both the head damping and the bias reject filters are designed to cut off the response, and therefore noise, fairly sharply above about 30 kHz, beginning to fall well below this frequency. Very little difference in output noise was measured when limiting the measurements to 20 kHz instead of the passband extending up as high as 100 kHz. Unfortunately some noticeable 50 Hz hum was measured on the left channel picked up from the right-hand spool motor, when in operation. I noticed that when this motor was allowed to free run with the machine set to play back but with no tape, the 50 Hz hum on the top track measured several dB worse.

I think the manufacturers should improve the replay head screening, although this would not probably be so necessary with mumetal heads. The main component of the replay hum was at 50 Hz; even as the machine stands the hum level is satisfactory, particularly since most engineers peak several dBs over DIN level of 320 nW/m, thus allowing 4 dB improvement to be added to the indicated figures. It should be remembered that the unweighted figures are almost completely determined by the hum level, thus the 50 Hz response of the pre-amplifier, which of course varies between DIN and NAB curves. The CCIR weighting curves were very clearly the comparison of the subjective noise of the replay chain, and are very satisfactory. The bias breakthrough on replay under normal bias conditions is exceptionally low, and not likely to cause any trouble in operation and, furthermore, allowed response measurements to be taken with ease at all normal levels. The left channel breakthrough on the output of the machine when set to normal +8 dBm for DIN level was only 1.5 mV, whilst the right channel measured 750 μV breakthrough, quite the lowest I have ever measured on any tape machine.

The overall noise measurements are given in the table, and only CCIR weighted figures were taken since these are the only relevant ones in practice, which gives a good indication of subjective noise, particularly with different tape speeds. These figures were very good indeed, and I was particularly struck by the complete lack of even a trace of bubbling that one gets with insufficient head to tape contact, or poor wrap round. Note too that the 19 cm/s overall noise, using the NAB equalisation, was a few dB lower than the equivalent 38 cm/s noise. This has often baffled people, but relates to higher noise being created by twice the number of oxide particles passing the replay head each second for the same replay equalisation. It is therefore ironic that the overall noise of the 38 cm/s NAB curve is actually worse than the lower speed noise, and also 38 cm/s DIN, and this should be borne in mind if you wish to use the higher speed with NAB curve for programmes having a wide dynamic range and when noise reduction is not in use.

The overall responses are shown in the accompanying pen charts, and show the machine to give an excellent overall response which I found to be consistent throughout the entire time that I used the machine. The back tensioning was so good that, coupled with the fact that all the rollers were engineered to a high accuracy, no drop outs were encountered at either speed with all makes to tape tried during the review period. I was extremely pleased to find that exceptionally high levels could be recorded on to some of the newer, very high output tapes. It would seem that the tape was virtually the limiting factor at the highest levels of third harmonic distortion, although at these levels some second harmonic distortion became noticeable. Using BASF *SPR50LH* tape, which has its 3% third harmonic distortion point at 8.5 dB above 320 nW/m (ref +8 dBm), 1% third harmonic was reached at +13 dBm, whereas the second harmonic was 0.25%. At 18 dBm off the tape the third harmonic distortion reached 4.5% with 0.8% second harmonic. This shows that the record amplifiers were more than adequate to drive high output tapes. The machine in use did not appear to magnetise up at all, although we nevertheless demagnetised before playing any test tapes at any time.

The 6.25 mm review machine had male input Cannon sockets and female output ones, and whilst this convention is used on the Continent and also by a few British studios, probably more users prefer the opposite. Bias Electronics can fit them the other way round if preferred. The back panel, containing these sockets, also contains a Cannon mains socket, making the machine very easy to plug up. It worked most reliably, although the beginning of a slight loop was thrown between the left spool and the first guide every time the machine was set to play back or record. This loop disappeared after a second or so, and did not seem to cause any trouble; nor, surprisingly, was any jolt apparent apart from the starting one in the first fraction of a second or so. The variable spooling potentiometer spooled from left to right when turned clockwise and vice versa, and I cannot really comment on this convention, since all engineers have their own fads. In any case it can very easily be rewired to work in the opposite direction. The machine spooled well, with the brakes pretty well adjusted on the 6.25 mm machine although on the 12.5 mm machine, a reel was damaged once when the stop button was depressed, the tape rewinding at just below full speed. The edit function was extremely useful; the machine can be thrown directly into replay from edit without any problem arising. Also very useful was the facility of going direct into spool from edit, thus retaining the tape in contact with the heads. The tape could not then be withdrawn from the heads until the stop button was depressed. The record button will not activate the erase and bias circuitry, or any relays, unless the replay button is pressed simultaneously; thus the user pressing the record button when the tape is against the heads on edit cannot damage a master with a blip. This is all too common a failing on some other machines. The front panel of the machine, in addition to having switched vu meters, also contains the NAB/cine tension switch and a remote control switch, all the functions including variable spooling externally controllable with an optional accessory control

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## ■ BIAS TAPE RECORDER

box unfortunately not supplied with the review sample.

I consider that the machine is generally neat but basic in appearance, and is clearly designed to be functional rather than impressive to those who might be seeing it for the first time. The appearance could be improved, but this would obviously add considerably to the price. All the plug-in modules are behind a panel which screws across the front with four bolts. The console model has ample space underneath for noise reduction units or other equipment, and is fitted with castors. The console is constructed from steel, extremely robust and neatly designed. Bias Electronics have sold a large number of these machines to the IBA local broadcasting stations, and I understand they find them reliable. For their price, they are a good buy and fill a very obvious gap. It could be preferable to buy two of these machines for the same price as one imported one, which would have a very similar specification, but would probably be rather better in appearance, and may benefit with a better guidance system between the left spool and the head block.

On one occasion we took both machines to a recording location, together with our own Philips *PRO 36*, and we ran the 12.5 mm Bias for quadraphonic recording, and the 6.25 mm as a safety back up. Halfway through the session we had a complete breakdown on the Philips, and therefore continued with the Bias as the main machine. We did this with complete confidence, the machines working extremely well, giving no trouble of any kind.

A number of measurements were taken on the larger machine, which was built to special order, having a full track erase head and Branch & Appleby record and replay heads. A larger Papst capstan motor was fitted to provide the extra torque required for the wider tape, and interchangeable roller guides were fitted to allow the different head blocks to be used. This interchange takes about five minutes or so for a reasonable tape height alignment, but approximately 20 minutes is required if the job is to be done properly before recording on a different head block. The wow and flutter figures on this deck were not as good as the 6.25 mm review model, the 38 cm/s peak weighted DIN figure measuring 0.04%, whilst at 19 cm/s the figure was 0.06%. These figures are considered reasonable for 12.5 mm tape, expecially when one considers again the very fair price of the larger model. The amplifiers were virtually identical, except that they incorporated an early design of bias trap for replay, this being a single parallel tuned circuit. Separate replay amplifiers were supplied for the 6.25 mm blocks, since these were ferrite, and thus required the change of damping resistor referred to, as well as slightly different equalisation settings. The extra modules are stored in two extra compartments on the extreme right, with the whole machine supplied in a portable form rather than console; this makes it by far the most portable 12.5 mm NAB open reel professional recorder that I kno . The replay and overall responses were virtually identical to those obtained on the review sample, with the exception that the bass errors were not so pronounced on the 12.5 mm block. The overall and replay noise figures are given at the bottom of the noise table. This machine has been used now for about 12 months, and one or two problems have arisen, but the manufacturers have always given prompt attention; the pressure idler wheel was changed for a better type, and also the small diameter tape guidance pins have been changed because of the grooving and wear referred to. The spooling of 12.5 mm tape is not quite so neat, but is adequate on matt backed tape; however, shiny-backed tape did on one occasion give rise to a drop out on an edge track caused by leafing. Bias can supply a sel sync version with a multi track erase head. They can also supply 9.5/19 cm/s versions of any of their machines, and are apparently willing to customise models to meet unusual purposes. However, they have emphatically stated that they cannot produce a 25 mm tape transport, let alone wider. Knowing the headaches that one British manufacturer, now no longer trading, had run into with wider tape width transports, with insufficient development, I think that Bias are very wise indeed to have made this decision.

I hope sincerely that Bias will attend to the problems mentioned but these are relatively minor criticisms of a well-designed basic machine, which will satisfy many users.

---

## TELEFUNKEN M12

Hugh Ford

**MANUFACTURERS' SPECIFICATION**

**Tape transport**

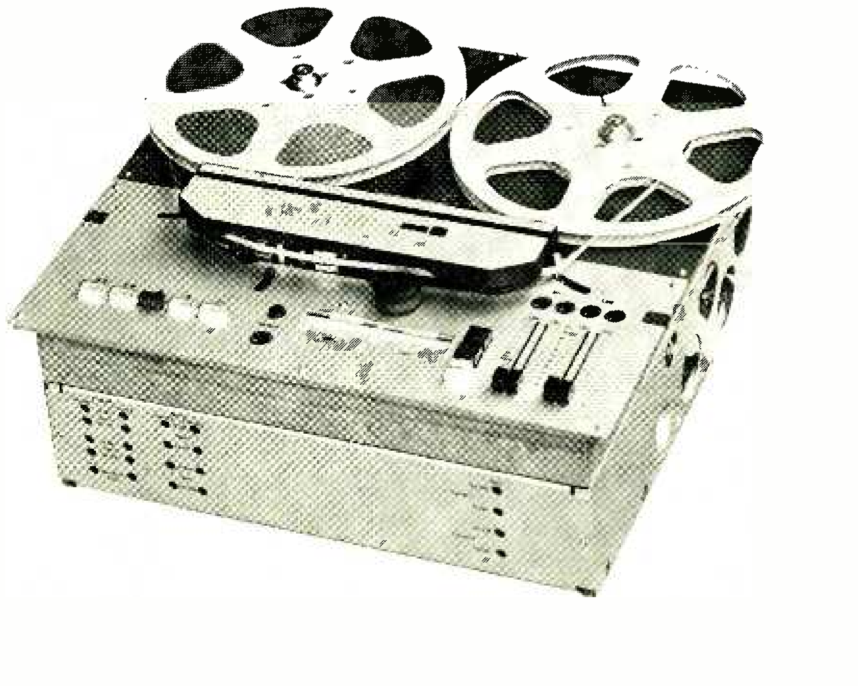
**Position of operation:** horizontal or vertical.
**Tape drive:** indirect, one synchronous motor, pole-changeable.
**Reel drive:** two six-pole special torque motors.
**Tape speeds:** 38/19 cm/s or 19/9.5 cm/s.
**Wow and flutter:** 38 cm/s≦0.08%. 19 cm/s≦0.10%. 9.5 cm/s≦0.20%.
**Slip:** 0.1%.
**Tape width:** 6.35 mm.
**Tape type:** std, lp, dp.
**Reel size:** up to 267 mm.
**Hub engagement:** three-slot (CCIR), NAB with adaptor, AEG hub with plate.
**Starting time:** 0.2s for reaching nominal tape speed; 1s for reaching the indicated wow and flutter values.
**Rewind time:** ≦180s for an lp tape of 1006m.
**Stopping time:** ≦5s out of fast wind. ≦2s with counterdrive.
**Tape time:** three digits, indication of min and 1/10 min.
**Accuracy of tape timing:** ≦1%.
**Remote control:** record, playback, stop, fast forward and rewind.

**Head assembly**

**Full-track head block:** with full-track erase head, full-track record head, full-track playback head.
**Pilot head block:** as above, but with additional push-pull pilot head.
**Stereo head block:** with full track erase head, stereo record head, stereo playback head (0.75 mm track separation).
**Two-track head block:** with two-track erase head (overlapping erasure) two-track record head, two-track playback head (2 mm track separation).

**Amplifiers**

**Equalisation:** 38 and 19 cm/s version: 50+3180 µs according to NAB, or 35 µs at 38 cm/s—and 70 µs at 19 cm/s-according to CCIR.



**Models without mixer**
**Input:** balanced and ground free, +6 dBm, max +12 dBm, with an impedance ≧5 kΩ.
**Output:** balance and ground free, +15 dBm, max +18 dBm, with load ≧600Ω or +6 dBm, max +12 dBm, with load ≧200Ω.
**Mixer models**
**Inputs:** balanced and ground free.
Two line inputs: —18 to +12 dBm with an impedance of ≧5 kΩ. Or to +21 dBm with an impedance of ≧5 kΩ.
**Two microphone inputs:** —74 to —10 dBm for 200Ω microphones.
**Playback output:** balanced and ground free, +15 dBm, max +18 dBm, with load of ≧600Ω, or +6 dBm, max +12 dBm with load of ≧200Ω.
**Mixer output:** unbalanced, +6 dBm for a load of ≧5kΩ.
**Earphone output:** unbalanced, +3 dBm for a load of ≧200Ω.
**Level indication:** two VU meters, switchable direct/tape, lead 6 dB. Accuracy 1.5%.
**Pilot model**
**Pilot frequency:** 50 Hz.
**Pilot input:** —8 to +12 dBm, with an impedance 1 kΩ.
**Pilot output:** +6 dBm for a load of ≧150Ω and for a magnetisation level ≧60 pWb/mm.
**Overall characteristics**
All values for version 38/19 cm/s refer to tapes *PER525* at 38 cm/s and *PES40* at 19 cm/s; for version 19/9.5 cm/s values refer to tape *DP26* at either speed.
**Frequency response:** 38 cm/s ≦ ±1.5 dB from 30 to 16 kHz. ≦ ±1.0 dB from 100 to 16 kHz. 19 cm/s ≦ ±2.0 dB from 30 to 16 kHz. ≦ ±1.0 dB from 100 to 12 kHz. 9.5 cm/s ≦ ±3.0 dB from 30 to 16 kHz. ≦ ±1.0 dB from 100 to 10 kHz.

| Signal-to-noise ratio: | Full-track (320 µW/m) | Stereo (510 µW/m) | Two-track (320 µW/m) |
|---|---|---|---|
| 38 cm/s | ≧58 dB | ≧58 dB | ≧55 dB |
| 19 cm/s | ≧53 dB | ≧56 dB | ≧51 dB |
| 9.5 cm/s | ≧54 dB | ≧54 dB | ≧50 dB |

Measured according to DIN 45 405 weighted peak-to-peak. Respective better values will be obtained by the use of low-noise tapes.
**Harmonic distortion:** Version 38 and 19 cm/s. Full-track and two-track: ≦1% at 1 kHz and 320 pWb/mm, with equalisation CCIR. Stereo: ≦1.5% at 1 kHz and 510 pWb/mm for 38 cm/s. Version 19 and 9.5 cm/s. ≦1.5% for 19 cm/s at 1 kHz and 320 µWb/m. ≦3.0% for 9.5 cm/s at 1 kHz and 320 µWb/m.
**Crosstalk:** ≧38 dB at stereo at 1 kHz measured to DIN 45 521. ≧45 dB at two-track at 1 kHz measured to DIN 45 521. ≧60 dB at half-track mono at 1 kHz measured to DIN 45 521.
**Ambient temperature:** +5 to +45°C.
**Mains voltage:** 110/120/125/220/240/250V +5, —10%.
**Mains frequency:** 50 or 60 Hz (convertible).
**Power consumption:** max 120 VA.
**Dimensions and weight**
**Chassis h x w x d (outlines):** 208 x 483 x 444 mm. 25 kg.
**Chassis h x w x d (submerged dimensions):** 165 x 443 x 442 mm.
**Case h x w x d:** 295 x 533 x 474 mm. 10 kg.
**Price:** £1347 for basic stereo model with mixer as reviewed.
**Manufacturers: AEG-Telefunken, 775 Konstanz, Bucklestrasse 1-5, Germany.**
**UK Agents: Hayden Laboratories Ltd, 17 Chesham Road, Amersham, Bucks.**

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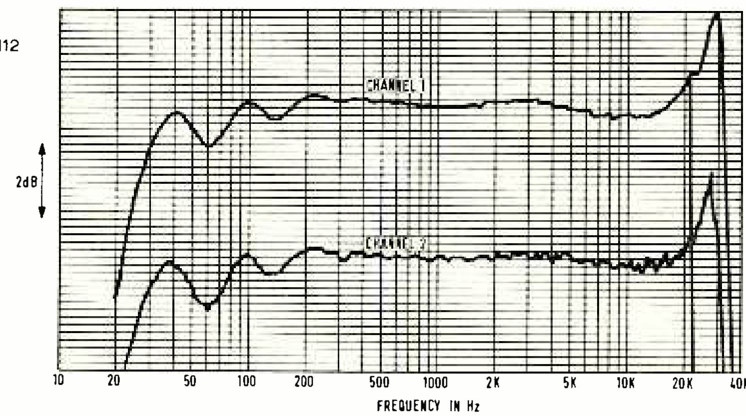
**RECORDERS MANUFACTURED** by Telefunken have always had a reputation for competent engineering and reliability, and the new type *M12* is certainly no exception; it is in fact grossly undersold by the specification and the performance of the review sample far exceeded many of the published parameters.

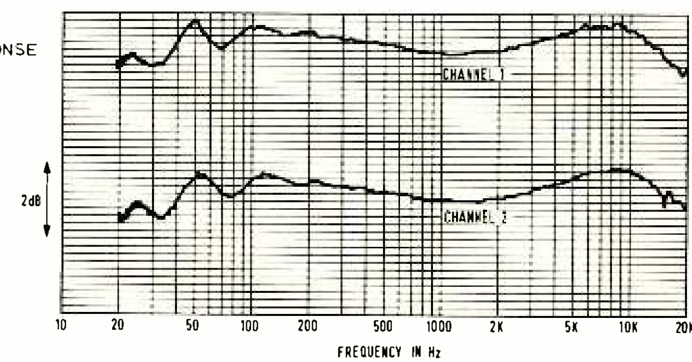
The review version of the machine was a 38 cm/s and 19 cm/s stereo machine with input mixing facilities, but as is to be seen from the manufacturers' specification other versions are available with or without input mixing facilities and with alternative tape speeds and head configurations.

FIG.1
TELEFUNKEN M12
FREQUENCY
RESPONSE



38 cm/s record/play

FIG. 2
TELEFUNKEN M12
FREQUENCY RESPONSE



19 cm/s record/play

The main body of the tape transport is a substantial alloy casting on to which the motors and other mechanical components are mounted. The dimensions of this main casting are most impressive, the thickness being about 1 cm in parts; the casting has heavy ribs which must give enormous strength.

The machine provides for a maximum spool diameter of 267 mm, the spool drive being by means of two Papst outer rotor type motors with cine hubs. Adaptors are available for NAB and European type spools and ingenious push-fit devices are supplied for retaining the spools when the machine is operated in the vertical plane. Constant tension winding is achieved in all modes of operation by means of tension arms operating on band type brakes, and while this method of control may strike one as being rather old fashioned it is clearly most effective, as is to be seen from the almost incredible wow and flutter performance.

Tape drive as such is by a large diameter capstan and a solenoid-operated pinch roller, the capstan being indirectly driven from a large and well shielded motor. All tape guidance is within the headblock casting, which is itself attached to the main casting by two captive screws, the electrical connections being by means of an edge connector. After leaving the payoff spool tension sensing arm the tape is guided on both edges either side of the double gap ferrite erase head. It then passes over the record head to a precision flutter roller which appears to have been dynamically balanced. Following this there are lower edge guides either side of the replay head which, like the erase and record heads, is also of ferrite.

The entire construction of the headblock is to the best standards of mechanical engineering, and is such that it would be a very simple task for the user to fit alternative heads. Access to the heads for editing is extremely good and the tape is in contact with the heads in all but the fast wind modes when a tape lifting arm is actuated. This arm may however be manually operated in any mode, so that fast wind listening and dropping in in the record mode are possible.

A tape timing indicator is fitted, and is a simple numerical indicator calibrated in minutes and tenths of a minute at the lower tape speed of 19 cm/s. In spite of the fast

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## TELEFUNKEN M12

fixed speed winding the overall quality of the tape winding was outstandingly good with both BASF type *SPR50 LH* tape and 3M type *207* tape, but the spool braking at the end of a reel was rather slow.

Unfortunately all good things have to come to an end, and the shortcoming of the machine is the interlocking (or lack thereof) between functions. Tape speed selection is by means of a three-position rotary control, the centre position of which disconnects the incoming mains: the remaining transport functions are controlled by means of five illuminated push-button switches, the illumination of the record switch being red and the remainder white. The first trouble that was noticed here was that when returning from a fast wind function to the play function it is first necessary to actuate the stop switch before play is actuated. Perhaps this is not too bad, but if one presses stop and then play before the tape is static (stopping can take five seconds) precarious loop slinging occurs.

An even more lethal shortcoming is that if the record button is pressed alone the record function is activated (including the erase head) thus damaging any recorded material that may be on the machine. Albeit that the record actuation is 'soft' and click free, damage to recorded material still occurs even if the tape is not moved—any tape movement by hand produces an even worse disaster.

Other than this, I have one other minor criticism of the mechanics, which may only apply to the review sample. This is that the socket head mounting screws are too long; the use of slightly distorted spools leads to the spools hitting the mounting screw head. In all other respects this is a first-class tape transport, and is well behaved and quiet running.

### Electronics

The general arrangement of the electronics is with individual sections accommodated on high quality plug-in printed boards, such that boards may be changed to provide alternative equalisation characteristics and such. The individual boards plug into sockets on a mother board, the connectors being mechanically coded so that boards cannot be inserted in incorrect sockets.

Preset controls are located on the boards for adjustment of bias, record and replay level, and record and replay equalisation, the controls being screwdriver - operated potentiometers which are readily accessible and clearly identified.

In the review sample which was provided with mixing facilities, all the main audio inputs and outputs were floating transformer-coupled connections fed from Preh type sockets on the rear plug panel; however, Cannon connectors are also available. The two line outputs are permanently connected to the replay amplifiers and provide a fixed level output, while a further 'mixer' unbalanced output, the metering and the variable level headphone output are switched between source and tape by means of a 'monitor' switch.

At the input end there are two microphone inputs and two line inputs, one for each channel, which operate in conjunction with slider type faders and also finger-operated preset gain controls.

The remaining facilities are a remote control socket, an earthing link for isolating the electronics from the mains earth and the IEC type mains connector, with the associated power supply fuses which are of the 20 mm variety and clearly identified. Adjustment of the mains operating voltage is not provided as an operator function, and requires internal manipulation.

### Replay performance

Investigation of replay frequency response in terms of BASF calibration tapes *DIN38* and *DIN19S* to the CCIR equalisation characteristic showed that the replay frequency response at both tape speeds of 38 cm/s and 19 cm/s did not deviate more than a total excursion of 1.5 dB between 31.5 Hz and 18 kHz. This performance is far better than the calibration tape tolerances, and could be further improved by adjusting the replay equalisation presets.

Azimuth alignment was precise, and attempts to upset the azimuth adjustment by rocking the replay head only served to demonstrate that the head mounting was mechanically rigid.

The following table shows the outstandingly good signal-to-noise performance of the replay amplifiers, the figures relating to a reference level of 320 nW/m and being obtained with all motors running but without tape (right):

The hum levels in the outputs were also extremely low, with the 50 Hz component

FIG. 3
TELEFUNKEN M12

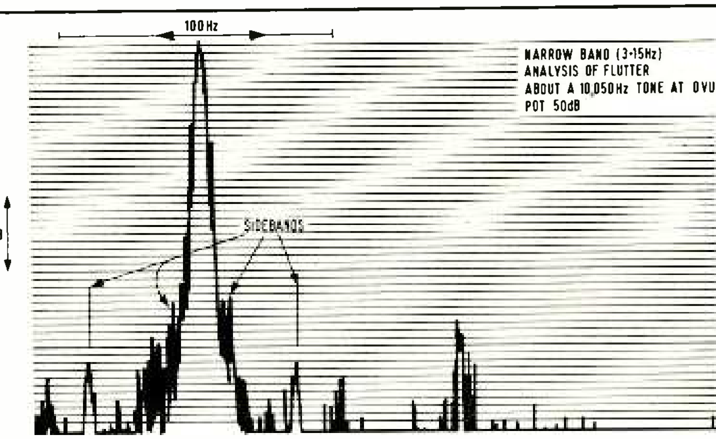
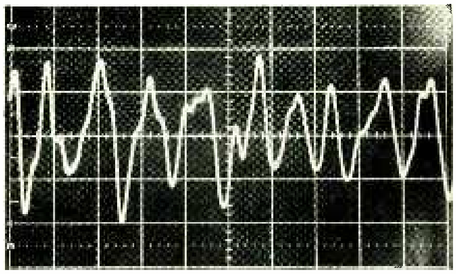


**FIG. 5**



better than –65 dB relative to 320 nW/m, and the higher harmonics being more than 80dB down.

At the other end of the scale, the internal amplifiers did not clip until the tape fluxivity at 1 kHz rose to +15 dB relative to 320 nW/m, which is far in excess of the capability of modern tapes.

**Record replay performance**

The overall frequency response using BASF type *SPR50 LH* tape, as was used for the remaining measurements, is shown in **figs 1** and **2**. At both tape speeds the response is within ±1 dB from 30 Hz to 20 kHz (reference 1 kHz) which is a very high standard of performance. Using the higher tape speed of 38 cm/s the useful response extends to 30 kHz where the response peaks a little excessively at between +2 and +3 dB. At low frequencies the head contour effects are minimal, and throughout the audio spectrum the balance between channels is first class.

Again using BASF type *SPR50 LH* tape, the following table shows the reference level to noise ratio with the tape bulk erased and with the tape erased and recorded by the machine with all inputs shut (below):

The margin between the above figures and those for the replay function alone demonstrate a very large margin between machine replay noise and tape noise for a modern low noise material. A further improvement in the bias oscillator might coax an extra 1 dB(A) out of the tape, but one then reaches the limit.

Third harmonic distortion when recording the reference level of 320 nW/m at 1 kHz was found to be respectably low at 0.8% at the speed of 19 cm/s or 0.5% at the higher tape speed, while 3% third harmonic distortion occurred at +7 dB and +5.5 dB above reference level at the tape speeds of 38 cm/s and 19 cm/s respectively.

Measurement of the intermodulation distortion to the SMPTE method with 50 Hz and 7kHz tones mixed in the level ratio 4:1 gave the following results, which are typical of tape:

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| record level Equivalent peak sinewave | im distortion |
|---|---|
| 320 nW/m | 4% |
| —10 dB | 1.5% |
| —20 dB | less than 0.5% |

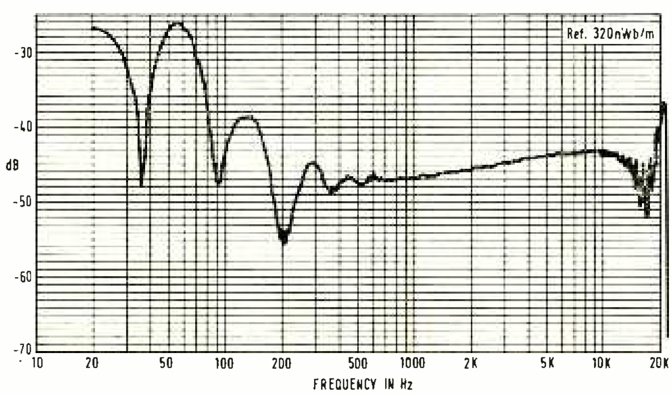
| Tape speed | Unweighted rms 20 Hz to 20 kHz | 'A' weighted rms | CCIR weighted reference 1 kHz rms | CCIR weighted reference 1 kHz DIN peak meter |
|---|---|---|---|---|
| 38 cm/s | 64.9 dB | 77.9 dB(A) | 72.8 dB | 65.2 dB |
| 19 cm/s | 64.1 dB | 72.1 dB(A) | 67.7 dB | 62.0 dB |

Figures are the average of both channels.
Add 4dB for a reference level of 510 nW/m

| Tape speed | | Reference level (320 nWb/m) to noise ratio** 'A' weighted rms | CCIR weighted reference 1 kHz rms meter | CCIR weighted reference 1 kHz DIN peak meter |
|---|---|---|---|---|
| 38 cm/s | bulk erased | 66.8 dB(A) | 60.5 dB | 55.3 dB |
| | machine erased | 62.9 dB(A) | 55.3 dB | 50.3 dB |
| 19 cm/s | bulk erased | 64.7 dB(A) | 57.3 dB | 52.1 dB |
| | machine erased | 60.7 dB(A) | 52.9 dB | 47.9 dB |

The figures are the average of both channels which were virtually identical.
**Add 4 dB for a reference level of 510 nW/m.

FIG. 5
TELEFUNKEN M12
CROSSTALK



## TELEFUNKEN M12

**Fig. 3** shows a narrow band spectrum analysis of a 10,050 Hz tone recorded at 38 cm/s at 0 VU and shows an unusual freedom from flutter sidebands which would occur at non-harmonically related frequencies to the high frequency carrier.

The good control of the tape is further emphasised by the relative freedom from dynamic phase shifting between the tracks. It is to be seen from **fig. 4** that at a tape speed of 38 cm/s the total phase deviation of a 10 kHz tone is less than ±4° as measured with a Bruel and Kjaer type *2971* phasemeter which has a very fast slewing rate.

Crosstalk between tracks as depicted in **fig. 5** was quite adequate for stereo recording, but is not particularly a strong point, as may also be said of the erasing capabilities which were measured as a 69 dB reduction in a 1 kHz tone recorded at a level of 320 nW/m.

#### Wow, Flutter and speed

The wow and flutter as measured to the DIN weighted quasi-peak method was the lowest that I have ever encountered, consistent readings of ±0.01% being obtained throughout the length of a NAB spool of tape at 38 cm/s, the result at 19 cm/s being only slightly worse at a remarkable 0.013%.

When using cine type spools, the recorded wow and flutter was of course a little higher, particularly at the end of the spool, but it never exceeded 0.03% under any conditions at either tape speed. Similarly impressive was the tape speed stability within a reel—worse case drift was 0.03%. Absolute tape speed was checked as being 0.08% slow which is so much tighter than the tolerance on the reference tape that the figure is effectively meaningless!

The final check in the field of wow and flutter was the time required to reach the rated wow and flutter and speed from pressing the start button. The time to 0.08% wow and flutter at 38 cm/s was a remarkable figure of 700 ms with a full NAB spool of tape.

#### Inputs and Outputs

With the sole exception of the mixer output, the functional inputs and outputs are floating, thus much reducing possible earth loop problems. The input level setting for both the line and microphone inputs is in two parts, a finger-operable preset control and a slider control; it is essential to use the preset control for adjusting the approximate maximum input level if clipping is to be avoided. The slider control is then used as the functional gain control for record level adjustment.

For recording the reference level of 320 nW/m, the sensitivity of the line input at maximum gain setting of the slider control could be varied from −42 dBm to −2 dBm with the capability of accepting inputs at least up to +20 dBm and an associated input impedance of 200k ohms.

For the same conditions, the sensitivity of the microphone inputs could be varied from −70 dBm to −31 dBm with a clipping point at −2 dBm input which is on the low side under some practical conditions. The input impedance of 540 ohms at the microphone input is also too low for 200 ohm dynamic microphones and for many capacitor microphones. This defect is probably brought about by the 48V phantom powering which is included in the recorder.

On the output end the line output was set to give +3 dBm output when replaying the reference level of 320 nW/m, and offered a most satisfactory low output impedance of 22 ohms. The mixer output was found to give +11 dBm output at reference level from a source impedance of 40 ohms and the headphone output was found satisfactory for all normal types of headphone.

#### Level meters

Investigation into the meter performance in terms of the standard for VU meters confirmed that the rectifier characteristics and frequency response were correct. Ballistic testing showed that while one meter was to specification, the other meter was a little on the fast side and also exhibited excessive overshoot.

The setting of the level meters was found to be such that a 0 VU indication occurred at between 8 dB and 9 dB below the 3% distortion point on tape which is generally satisfactory and to the NAB recommendations for the use of VU meters.

#### Summary

For its price, this is potentially an extremely fine recorder which is beautifully made; however, Telefunken must put right the lethal recording interlock arrangement (*which has since happened. See* Letters, *p.*62—**Ed**), and should in practice be a very simple modification. I would also suggest that attention is brought to the low impedance of the microphone inputs, and to the tape control when starting replay from a rewind function.

In other respects I have a great deal of praise for the *M12* machine: it offers really excellent frequency response and noise performance and, I believe, unsurpassed wow and flutter performance.

If it were not for the matters which I have just mentioned, I would consider this machine to be in the very highest class, and to offer serious competition to machines costing considerably more.

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## AGONY COLUMN

Customer relations being as important as they are, the engineer in the London studio took the effusively French record producer fairly calmly. After all, he came across very often and spent a good deal of money on what was a reasonably straightforward session apart from the social peripherals. For the French producer fancied the engineer rather a lot, which was pleasing except that engineer wasn't that way inclined.

The session went fairly well, albeit with a little shrieking and a few tears, but overtures became a little heavier with wandering hands down the back of shirt collar and other first-base attempts. So he went in to his boss and explained the rather delicate situation, which showed signs of ranging outside usual public relations limits.

Boss was perfectly understanding. 'Humour him as far as you can, but it's at your own discretion. Don't let it get out of hand, but try and keep him happy'. Thus enlightened, the engineer returned to the renewed advances of the producer in the control room. And politely rejected them. Among other things, the spoken language was perhaps less suitable for communicating than the more universal language under discussion: 'You see, it's not so good for me because, er, you're a man and, er well, I don't prefer it just like, er, that. Now if you were a beautiful, er, woman, it would be different, but you're not and I'm really sorry if it upsets you'.

Disappointed, the producer returned home, but at least he promptly booked another session some months later. He arrived complete with normal entourage, but in addition to them was accompanied by what has been reliably described as 'the most beautiful girl in the world'. She then proceeded to be very friendly to the engineer in the usual conventional ways. After a confused half hour of session, the producer announced gleefully that, since he had satisfied the conditions, why didn't all three all go off now altogether, and enjoy life to the full.

Whereupon the engineer said excuse me, went into see boss, and resigned.

# Professional Studio Tape Recorders.

# AEG-Telefunken Second to none.

The rapidly rising cost of magnetic tape is inducing professional tape recordists to consider recording music at 7 1/2 i.p.s. instead of 15. For this purpose Telefunken Model M.12 is ideal because of its exceptionally good skew performance at 7 1/2 i.p.s., thereby offering excellent mono-stereo compatibility. Typical performance figures for phase displacement between tracks are : ± 10° at 10 kHz (speed 7 1/2 i.p.s.) *

Other notable features of this completely new tape recorder are :

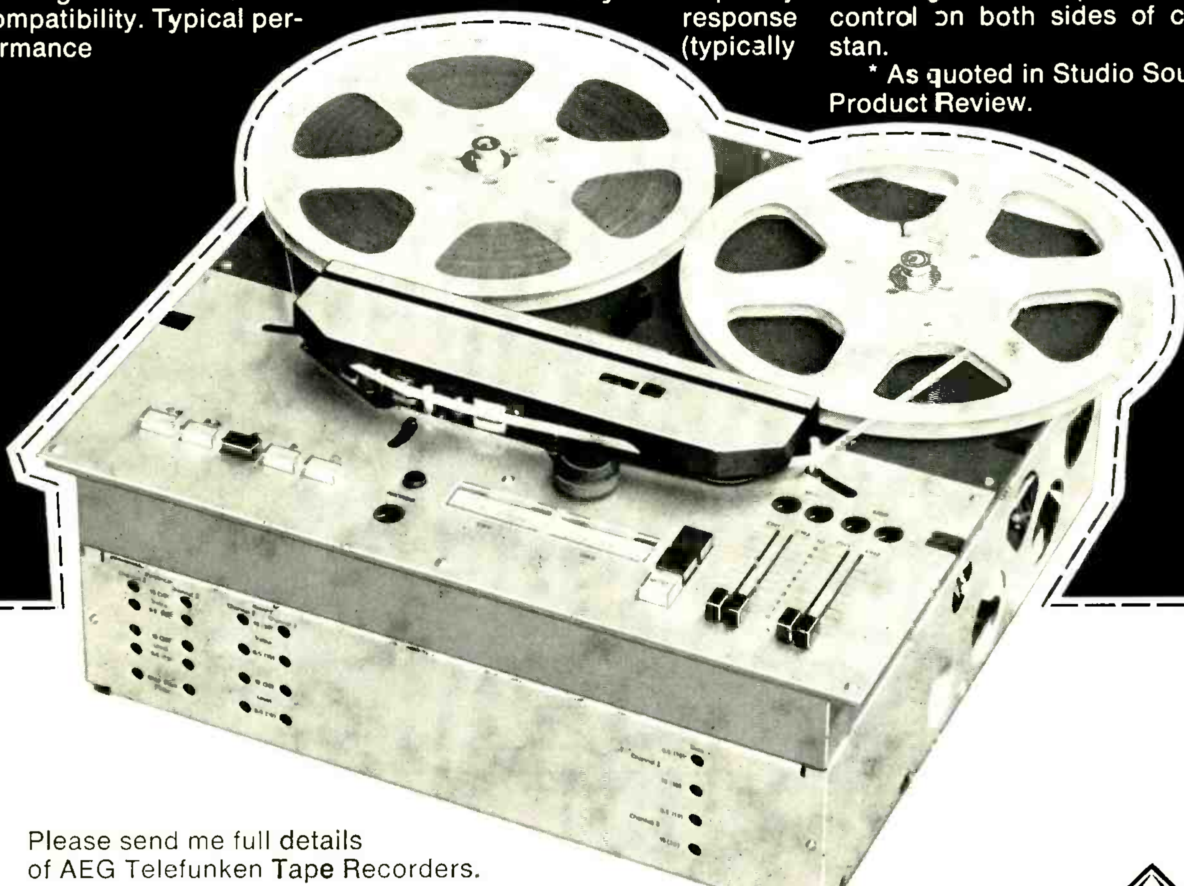
Wow and flutter so low as to be almost unmeasurable, typically 0.015 % at 7 1/2 i.p.s.*

Very flat frequency response (typically ± 1 dB 20 Hz, to 20 kHz at 7 1/2 i.p.s. *).

Wear resistant tape guides of sintered ceramics. Ferrite heads of extreme density. Interchangeable plug-in electronic sub-assemblies accessible from the front.

Accurate timing counter resulting from tape tension control on both sides of capstan.

* As quoted in Studio Sound Product Review.



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*Recently, there has been a lot of interest in dummy-head or binaural recording for reproduction via headphones. This has been presented by some as 'the answer to quadraphony', and some ill-informed comment has thoroughly confused people as to the advantages and disadvantages of binaural techniques. Issues and available information are summarised, together with an indication of areas of doubt.*

# Dummy Head Recording

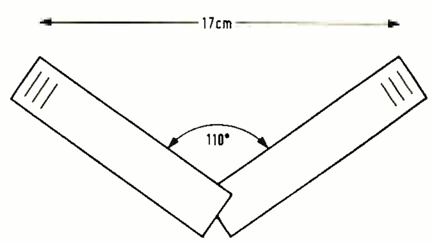
MICHAEL GERZON

**FIRST, IT SHOULD BE** emphasised that binaural recordings, ie recordings made for reproduction via headphones, contain three main types of sound-localisation cue that is absent from conventional stereo, and that there has been some conflict of opinion as to which cue is most important. The first cue is that of time delays between the ears. It is clear that a sound from, say, the left will arrive at the left ear before the right ear. For a sound on the extreme left, this time delay at the right ear is about 0.62 ms, and for a sound arriving from (say) 30° from the left of front (or back, or up, or down), the time delay is about 0.24 ms. Clearly, the time delay cue cannot distinguish front from behind from above from below. All it indicates is the angle of arrival of the sound from the axis of symmetry of the ears. One technique of binaural recording makes use mainly or only of this cue, and that is the ORTF technique of using a pair of microphones spaced apart by about 17 cm. In order to improve compatibility with stereo loudspeaker reproduction, the microphones are directional ones pointing to the left and right respectively, angled about 110° one from the other (see **fig. 1**). For this application, cardioids are to be preferred, as the anti-phase lobes of hypercardioids tend to give exaggerated width requiring a smaller spacing.

It is important that the spacing not greatly exceed 17 cm, as otherwise the time delays are too large and everything is concentrated at the extreme left or right. Certainly, ear-spaced binaural recording gives much sharper defined images via headphones than ordinary stereo, even when recorded with a pair of omnidirectional microphones. An indication of the importance of time delays between the ears is given if one makes one channel of a binaural recording 10 dB louder than the other. Surprisingly, the image shift thus caused amounts at most to a few degrees, since the time delays are unaltered. Time delays around 0.5 ms are much less important in speaker reproduction, and this leads to the possibility of an amusing paradoxical recording in which a sound appearing on the left via headphones appears on the right via speakers. Simply record a sound on the left of a pair of omni mics spaced 17 cm apart, and turn up the gain of the right channel about 10 dB.

The second cue for headphone reproduction is the fact that the head casts an acoustical shadow across each ear for sounds from the opposite side. This effect is significant only in the treble (above about 500 Hz). Many early workers in binaural sound, such as de Boer and Blumlein, considered that this head obstruction effect was important in sound localisation, and some experimenters still do. However, as will be explained, the evidence seems to suggest that this is by far the least important cue. Indeed, experiments in which a mono sound is fed to both ears but with differing gains show that a relative gain of as much as 15-23 dB is required to create an illusion of a sound coming from 45° from the front, which is much more than the difference in the level at the two ears caused by a live sound from this direction. Moreover, if the ears have just previously been exposed to sounds with natural time delays between the ears, such a panned mono sound can seem to

**FIG.1** ORTF TECHNIQUE




come from only about 15° off front. In other words, not only do the ears make poor use of differences in level, but when they are provided with other cues, they almost entirely disregard these level differences.

The third cue is the effect of the pinnae, which is the name for the flaps on the ears. The various ridges on the pinnae reflect and refract the sound waveform before it enters the ears, and the coloration thus produced varies according to the direction of arrival of the sound. This coloration, which mainly affects frequencies above 5 kHz, is now known to be of vital importance to the ears in localising and positioning sounds, although the way in which this coloration is used by the ear to provide information is still not understood.

An intriguing experiment of **Batteau** (described in *ref. 1*) demonstrates this in no uncertain fashion. In one room, he set up 16 loudspeakers (see **fig. 2a**) in a circle around a pair of microphones spaced apart by ear distance. The outputs of these were fed to a subject sitting in another room via headphones. The various speakers were then fed with sound and the subject was asked which of the 16 directions the sound appeared to be coming from. This test was performed both using ordinary omni microphones, and with microphones fitted with accurate replicas of human pinnae, but with no dummy head used in either case. When no pinnae were used, the subjects found it difficult to localise the sounds, assigning them to more-or-less random positions. However, with the pinnae fitted to the microphones, localisation was correct with no confusion between front and rear.

Other experiments have also demonstrated that pinnae are of vital importance for correct localisation. Roffler and Butler (*ref. 2*) describe experiments in which a subject's head was fixed, so that he could derive no clues from head movements, and in which a sound source was moved in the plane of symmetry of the subject's head, so that it could be above, below, in front or behind. Since the sounds reaching the two ears is then identical, conventional theories of stereo hearing would suggest that height effect cannot be heard under these conditions. However, Roffler and Butler found that a change of the sound source elevation as little as 5° could be clearly heard. On the other hand, if the subject wore a 'pinna mask' which covered up the pinnae but allowed sound to enter the ears, then no change of elevation could be heard.

So we see that the pinnae play an essential role in locating sounds, and that they should therefore be accurately modelled (preferably by taking moulds from human pinnae) if used with a dummy head. It seems that most of the recent commercial dummy head recordings have used inadequately-accurate pinnae for optimal effect. We also see that the complication of an actual dummy head between the microphones-with-pinnae may be omitted, thereby improving the visual appearance of the microphones as well as reducing some of the coloration if the sound is played via speakers. Alternatively, a very idealised 'dummy head', such as a simple baffle to separate the microphones (as suggested by Blumlein, *ref. 3*), may be used.

Dr Edmund Rolls, of the Department of Psychology, University of Oxford, has recently been conducting experiments in dummy head recording, using small microphones placed in the ears of actual people (although one conjectures that they may resent being termed 'dummies'). This microphone technique, so purist that advocates of Blumlein technique must blush with shame, is capable of giving very superior binaural results, as would be expected with such accurate dummy heads. Recognising the importance of the pinnae described above, Dr Rolls has suggested a simple, ingenious and effective method of reproducing dummy head recordings via loudspeakers.

The trick is to reproduce the dummy head recording via stereo loudspeakers placed either to each side of the listener (A in **fig. 3**), or at least angled widely apart (B in **fig. 3**). I have found that angles θ (see **fig. 3**) of more than 110° work well. The listener listens wearing a pinna mask. (For listening tests, it is adequate to use the hands to cover the back part of the pinnae.) Since the sound has been past the pinnae once during the recording, and since it is prevented from going over them again by the pinna masks, the ears hear just the pinna coloration inherent in the recording, and hence hear a correct directional effect, including sounds from behind or above. I have used this to demonstrate dummy head recordings to an audience of about a dozen via loudspeakers.

Correct localisation is not the only benefit produced by pinna coloration. It is well-known that headphone reproduction always gives the effect of in the head localisation (ihl). This has been explained as being due to the fact that a dummy head cannot move in the original sound field in the same way as the listener's head is moving, and it has been supposed that it is the information produced by such movements that prevents ihl and allows front and back to be distinguished. While head-movement information is undoubtedly of some importance in these regards (see *ref. 4*), the pinnae also are capable both of localising sounds (as we have seen) and of externalising them outside the head, without any help from head movements. Thus the conventional explanation of ihl is wrong (see also *ref. 5*, if you can read German).

A dramatic illustration of the ability to place sounds outside the head is obtained if one takes one channel only of a good binaural recording, and feeds it to *both* earpieces. Despite the fact

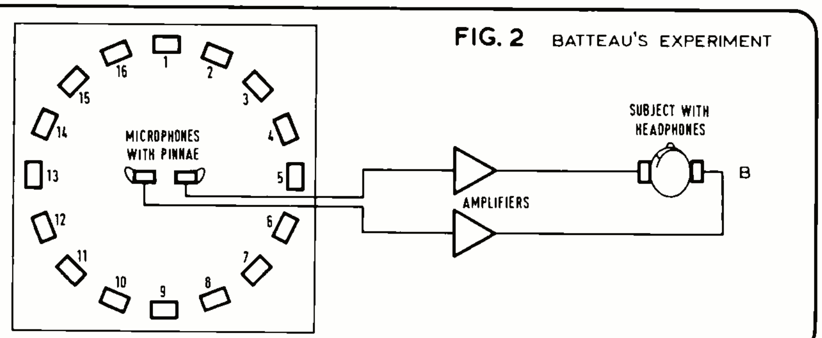
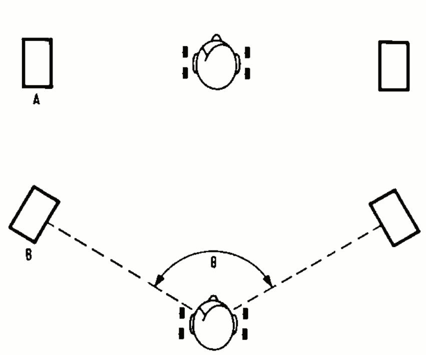



**FIG. 2** BATTEAU'S EXPERIMENT

that both ears are now hearing the same thing, the pinna coloration still allows front and back to be distinguished to some extent. Even more intriguing is what happens if such one-eared recording is made to pick up a sound to the side of the dummy head. Since the information reaching the two ears of the listener is identical, it is impossible for him to place the sound at either side, and it is difficult to say precisely where it is. Yet despite this, the sound is heard as being definitely external and not in the head at all! The experiments of Batteau mentioned above showed that this externalisation occurred if no dummy head was used so long as pinnae were affixed to the microphones.

However, dummy head recording is not without its serious problems, both in its imperfections and in the technical and commercial problems. The worst problem, assuming that an accurate dummy head is used (or at least accurate pinnae), is that the least accurately defined positions tend to be at the front, just where accuracy of location is most required. In the absence both of the visual cue present live or the cues given by the effects of small head movements, frontal sounds given half a chance tend to appear to be either in the head or even slightly behind the listener. This pulling in of the frontal sound stage is disliked by most listeners, who find difficulty in being sure that frontal sounds are front or back, although back sounds are quite unambiguously at the back. If the recording contains strong clues as to when a sound is at the front (eg marked differences in room acoustics, or a commentator telling you where he is), then the ambiguity disappears. This is why on the

**FIG. 3** LOUDSPEAKER LAYOUTS FOR LISTENING TO BINAURAL RECORDINGS WHILE WEARING A PINNA MASK.




Sennheiser Dummy Head recording No. 1 (see *ref. 6*) it is better that you listen first to the German side (assuming *now* that you *don't* understand German!) before listening to the English.

This tendency of front sounds to be localised behind is not unique to dummy head; recording anyone with practical experience of quadraphony will have experienced similar difficulties. However, with a well-made quadraphonic or ambisonic recording, suitably reproduced, the ability to move one's head often provides sufficient extra information to lock sounds at the front without ambiguity.

We can obtain some understanding of why front sounds are so unstable, and of why

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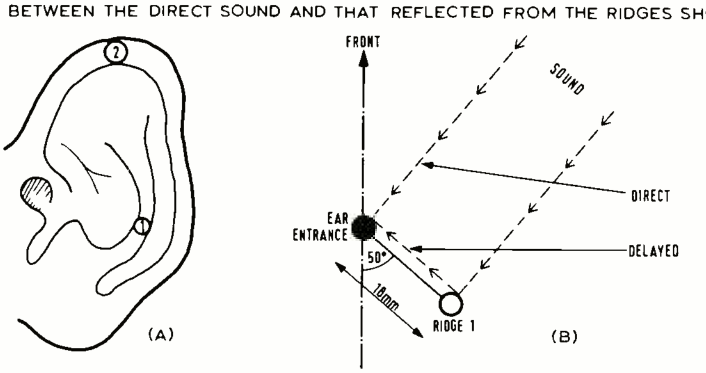
**FIG. 4** (A) THE PINNA, SHOWING REFLECTING RIDGES 1 AND 2 THAT RESPECTIVELY DETERMINE HORIZONTAL AND VERTICAL SOUND DIRECTION THROUGH THE DELAY BETWEEN THE DIRECT SOUND AND THAT REFLECTED FROM THE RIDGES SHOWN IN (B)



headphone reproduction tends to pull sounds behind the listener, if we study the effects of the pinnae in more detail. If we examine the pinna (**fig. 4**), we see that there are two main ridges from which incident sound is reflected or refracted before entering the ear, marked **1** and **2** in **fig. 4**. The effect of these ridges is for a sound impulse to arrive at the ear followed a few tens of microseconds later by delayed impulses reflected off the ridges. The delays, of course, depend on which direction the sound arrived from in the first place. These delays have been measured by Batteau and others (see *ref. 1*) for various sound directions, and the results are shown in **fig. 5**. This shows the delay of the reflected impulse after the arrival of the original impulse both for sounds (**fig. 5a**) in the horizontal plane, and (**fig. 5b**) in the side to side vertical plane. It will be noted that the vertical displacement of sounds causes much larger delays (of the order of 200 μs) than horizontal displacements, which cause delays only of the order of 50 μs.

Because 50 μs is the duration of only half a cycle at a frequency of 10 kHz, the ear gets rather little information about horizontal position from the pinna effect, and so we would expect ambiguities to be worst in this plane. Moreover, sounds from the back involve no delayed impulse reflected from ridge *1* in **fig. 4**. Thus, if a sound is not perceived as having a delayed impulse delayed by around 15-100 μs, then it will be heard as coming from behind.

This explains why normal stereo reproduced via headphones tends to seem to be slightly behind the listener in many cases, because such sound lacks any delayed impulses. However, ordinary stereo via headphones is not very convincingly right behind the listener, but rather in his head, which presumably is a result of such a sound not having the second vertical information reflection from ridge *2* (**fig. 5b**) either. One presumes that if suitable delayed impulses according to **fig. 5** were supplied in such cases, then the headphone reproduction would tend to be externalised.

However, since the short delays of the first delayed impulse for horizontal frontal sounds are difficult to disentangle from the complexities of the sound waveform, one expects the ear to miss the presence of the first delayed impulse altogether in many cases. When the delayed impulse is not detected by the ear, one would expect the ear to assume that the sound is behind the listener, since back sounds lack such a first delayed impulse altogether (see **fig. 5a**). This explains why back sounds are always heard at the back, but front sounds tend to be heard at the back with some degree of uncertainty. The much larger delays involved in vertical discrimination (**fig. 5b**) are much easier to detect and thus give more reliable localisation.

We thus see that the poor localisation of front sounds is inherent in headphone reproduction. For live sounds, the extra clues derived by moving one's head seem to be vital in confirming that a sound is in front. We do not have a complete understanding of how the delays caused by reflection from the pinna are actually pulled out of the sound waveform information by the ear. The processing involved is still something of a mystery, so that the above explanation must still be regarded as incomplete. In effect, we are saying that *if* the ear can use the delay information, then we can explain the behaviour of binaural recordings, but we don't know *how* the ear can use this information.

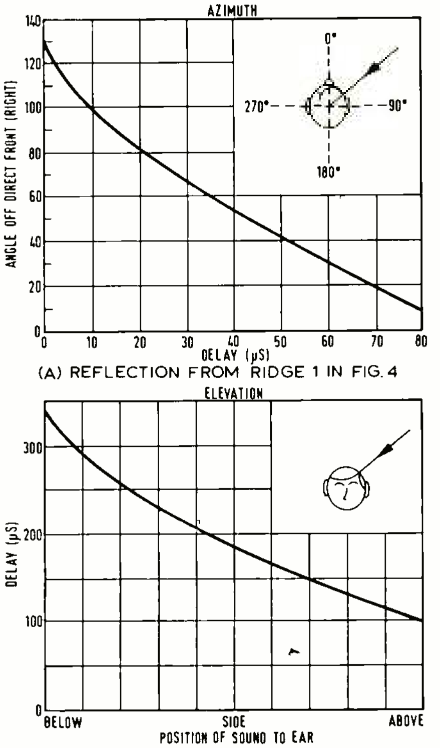
It is a matter of experience that if one adds the two channels of a good binaural recording together to get mono, then the overall quality of the mono obtained is very poor, certainly poorer than the mono consisting of one ear channel only. As explained earlier, the one-eared mono fed to both ears during reproduction still retains all the pinna reflection information required to externalise sounds correctly. The sum-signal mono, however, combines two separate signals, one from each ear, each with its own time delays. The extra time delays thus introduced not only cause unpleasant signal colorations, but also so confuse the listener that no sense of externalisation is obtained. Thus we see that binaural recordings inherently have very poor mono compatibility, which virtually rules out the use of binaural recording techniques for most public broadcasting applications, unless the majority of mono listeners are to be sacrificed. (Indeed, some say that the ORTF are doing just that with their preferred classical microphone technique.)

When reproduced via loudspeakers, binaural recordings also tend to give a poor stereo effect, which is unstable in the bass and rather unsharp and colored in the treble. This is partly caused by the very frequency-dependent polar diagram of dummy heads in the treble. Since we have seen that the precise form of the dummy head is unimportant providing that the pinnae and the intermicrophone spacing is correct, one could presumably choose the form of the microphone baffling very carefully so as to optimise the sharpness and quality of stereo speaker reproduction in the treble. Clearly, the design of a suitable intermicrophone baffle is very complex, and is probably as much an art as conventional loudspeaker design. For this reason, we have to leave to the interested reader the problem of designing a dummy head baffle with good stereo compatibility and retaining good binaural reproduction.

One might consider getting a good stereo image by fitting an ear-spaced pair of *directional* microphones (such as those of **fig. 1**) with replica pinnae, but there is a serious problem with this proposal. For correct effect, all the sound should enter the microphones after first having passed over the surface of the pinna. But directional microphones obtain their directionality by having more than one entrance through which the sound gains access, and they lose this directivity if some of the sound entry points are covered up. Since the pinna only has one point at which sound is allowed to gain access, we can only use replica pinnae effectively in conjunction with omni-directional microphones.

Despite their overall effectiveness, binaural recordings are seen to pose severe problems as regards mono and stereo compatibility. Added to these problems is the poor localisation of frontal sounds binaurally (unless additional clues are given to the listener), and the difficulty of achieving a binaural mixdown of multimic recordings.

**FIG. 5** THE DELAY OF REFLECTED IMPULSES FROM THE PINNA (A) IN THE HORIZONTAL PLANE AND (B) IN THE SIDEWAYS VERTICAL PLANE.




(A) REFLECTION FROM RIDGE 1 IN FIG. 4

(B) REFLECTION FROM RIDGE 2 IN FIG. 4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5. Plenge, G. Uber das Problem der Im-Kopf-Lokalisation (in German), Acustica, Volume 26, pp.241-252 (May 1972).
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The above Sennheiser record and the Sennheiser Dummy Head Stereo Record 2 are both available from Hayden Laboratories Ltd, Hayden House, 17 Chesham Road, Amersham, Bucks HP6 5AG. An article on dummy head recording has appeared in the September 1974 'Wireless World'.

Two more recent articles of interest on dummy head recording have been published in French and German:

Wilkens, H. *Kopfbezugliche Stereophonie—Ein Hilgsmittel fur Verglach und Beurteilung verschiedener Raumeindrucke,* 'Acustica' Volume 26, pp.213-221 (April 1972).

Céoen, Carl. *La Perception Periphonique—Casque ou Haut-parleurs?,* Conférences des Journées D'Etudes, Paris Festival International du Son Haute Fidelité Stéréophonie Editions Radio, Paris, 1974.

# WORK

## STRAWBERRY

**VERY CONGENIAL.** That sums up a recent visit to Strawberry Studios up in Manchester. The studio has been covered in much detail by John Dwyer (see July 74) which means that apart from the installation of a single seater ladies lavatory and a Dolby *E2* cinema equaliser, there is no change in the hardware situation. This makes repetition of facilities unnecessary.

Pete Tattersall, director, studio manager and mixing engineer, stumbled into the reception area looking like a washed out version of Sancho Villa; the man had been on an all night session with 10 cc for the *Original Soundtrack*. After a few cups of coffee, he was in suitable condition to offer a guided tour the studio pointing out new features mentioned above. The benefits of the lavatory are obvious; the Dolby equaliser deserves rather more explanation. Originally developed for use with *364* cinema noise reduction module, the *E2* unit offers a basic 27 third-octave bands for full spectrum eq. In the Strawberry installation, the equaliser processes the signal to the monitor amps resulting in a control room with artificially flat acoustics. On the *E2*, the bands are adjusted by presets contained on cards mounted within; they seldom need adjustment. After setting up on pink noise with the measurement mic above the desk, the 'flat' area extends for the length of the console, more than sufficient for an energetic mixdown man. The studio floor was strewn with instruments, boxes, mics, cans and other wreckage of protracted endeavours from the previous night. Returning once more to the control room, pungent oriental spices greeted the nostrils. The 10 cc men had shown up for work laden with take-away Chinese nosh.

The meeting was adjourned to a fine hostelry offering a choice of Robinson's most excellent ales. Over and after a few, Pete told of the future plans for the studio. It's going 24 track. He wasn't quite certain when but it should be in the near future. Strawberry people don't like to rush into things, they won't let themselves be tied down by merchant bank cash. Hence, they earn money before they spend it. This philosophy built the studio from a mono tape recorder and it's still good when expanding from 16 to 24 track. Asked about the need for a larger system, Pete parried with an example of engineering on a recent album by 10 cc. On one track, there were no fewer than 253 over dubs to get the final mix. A 24 track machine would represent quite a time saving on a job like that. Problems of noise didn't appear to worry him very much; he displayed considerable faith in Dolby and modern tape to cover up all but the nastiest buildups. About automated mixing he wasn't quite so sure. 'It's the cream on top of the cake. Nice, but not essential.'

**Frank Ogden**

*Strawberry Studios—Pete Tattersall at the controls*

## MARQUEE

**THE LATEST** UK studio to go 24 track is the Marquee, the Soho studio run by Harold Pendleton, Simon White and Gery Collins. Decided upon in November, installed and running by the beginning of January, the 24 updated to 32 input MCI desk now runs into a 24 track machine of the same make supplied and fitted by Feldon. According to Gery, director and studio manager, the pressure to go 24 track came from the clients. Before the conversion, the studio had the good word for 16 track and hence lots of work. Now things are even better; with the extra work brought in by the extra tracks, the bookings are long and the prospects are excellent.

What about the engineers who have to operate the system? This is what it means to Geoff Calver who, along with Will Roper and Phil Dunne, handles session engineering at the Marquee. In respect of setting up for takes, the extra eight tracks makes very little difference. It only amounts to pressing a few more routing buttons and doing eight more balance checks if there are that many inputs. The real problems start at the multi-track reduction. Although the set-up is new which means that he hasn't had much time to get to grips with it, Calver reckons that it's going to be a widespread case of doing a dynamic double act—or the rapid installation of automated mixdown hardware.

Geoff's well pleased with the equipment situation at the Marquee. However, he pointed out one of the chronic grumbles among the engineering fraternity—the freedom to specify the gear that they have to use. He commented that all too often, engineers were lumbered and handicapped by equipment chosen at best from purely economic motives or at worst, with no user knowledge at all. He made his point in a positive way by describing the virtues of the desk and the new tape machine. Installed two years ago, the desk sported a 24/24 format; room for expansion had been allowed so that no problems were encountered in fitting the extra eight channels into the console.

Even with the increased capacity, routing remains a comparative joy over some desks. The output groups are selected by 16 individual push buttons on each channel; on one side of the mixer, the numbering goes from 1 to 16, on the other 9 to 24. The state of these buttons can be taken in at a glance since they remain depressed in the 'committed' position. This renders button illumination unnecessary and something less to go wrong. Little things like the Auto locator on the tape machine; punch in the desired time/position onto the calculator type keyboard, wait for a few clicks and whirrs and there you have it, right on the nail. Press the correct buttons and when it reaches the right spot, it goes into play. All this without leaving the pilot seat; the chap who ordered this hardware must have been a recording engineer.

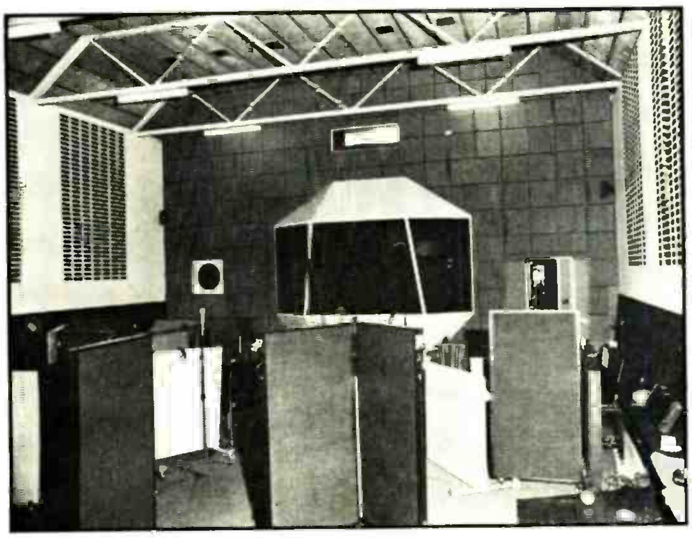
Because mixdown is all about getting tracks of music together, and with 24, even more of them, there was quite a lot to say about engineer/producer relationships in respect of work division. He expressed vague irritations about the way some producers left the balance men to act as unpaid mds—in effect if not by intention. This comes about through the producer concerning himself more with the individual performance of the pet superstar and rather less with the overall effect created. It's a question of communications; studio staff are expected to 'know' instinctively what the producer requires, but this can only be attained if there is some sort of two-way dialogue between all concerned. The maestro perhaps, finds balance rather time consuming and a bit of a bore. Or in the words of one great man 'Shit producers have helped more engineers to fame and fortune by leaving the whole lot to the engineer . . . '

**Frank Ogden**

*Marquee Studios*

*Island desk*

*Inside Island*



## ISLAND

**FUNNY SORT OF** place to have a recording studio, standing in a street of faded Victorian houses running parallel to Portobello Road. Nevertheless, there resides an image of the sixties and a very active acknowledgement of the seventies embodied in the Basing Street, formerly Island, Studio. The sixties connection comes about through the man in charge, Muff (as in Mervyn) Winwood, brother of the perhaps better known Steve; at one time, they used to play together in the Spencer Davis Group until Muff went into studio management for Island and Steve created *Traffic*. Along the way, Muff Winwood turned his hand to producing and subsequently displayed considerable proficiency in this field. An example of his work can be heard in the intricate vocals performed and recorded by *Sparks*. This background puts the man in an ideal position to manage—and talk about—the operation and problems of a modern recording studio.

No doubt about it, business at the studio is very brisk. Muff stated that they were having to work on a round-the-clock basis to keep up with the pressure of work. Asked about this unusual phenomenon in such times of economic gloom, Muff reckoned that people needed and wanted something to take their mind off everyday worries and that music, even though it costs, filled the bill perfectly. He commented that in addition to the record companies risking their money only on proven superstars, they also insisted that work was engineered by studios with a known track record. Hard on budding talent and some small studios and even a few larger ones but a fact of commercial life at the moment.

For Island, who own the Basing Street Studio, not everything is perfect. Muff reports that the 24 track mobile only has a one day a week utilisation—this is nowhere near enough for economic operation. The feeling is that this is a case of lack of finance on the part of the potential users rather than a fundamental absence of enthusiasm for this type of recording. He explained the situation as it affected Island. 'In the past year, we have lost about 30 bookings from gig promoters . . . the idea is that they used to book the names in halls around the country and then make bread at two levels: from the booking office and from the production and sale of the record of the event. Recently, however, things have been going wrong; the cash receipts from seat sales dropped causing a dearth of money available for other things. The result is that about six days before, the promoters ring up and cancel the mobile booking. What can you do? It seems these days, the promoters can't make enough money to finance the basic event—let alone fringe things like mobile recording . . . gigs are a financially bad scene.' He went on to say that the future of the Island mobile is not in doubt—'It's simply the best mobile around . . . Stevie Wonder uses it when he's in this country.'

How does quad figure in the plan for Island and Basing Street? The answer came promptly back 'Not at all'. Expanding, he commented that, like many other people in the business, he wanted to wait until the systems game had been played out and a unified standard instituted. Only then could a new, creative approach be taken towards quad record production. He thought that the production problem went rather deeper than a simple remix of existing multitrack masters; the problem didn't lie so much in the way that they were recorded but had a less obvious cause—unsuitable material. 'The composer writes the material in the back of his mind knowing roughly how its going to sound in stereo. He takes unconscious account of the balance between, say, percussion and brass and writes the score accordingly.' This implies that the same score will sound rather awkward in quad.

Leaving aside the problems of quad (Winwood does) the Basing Street Studio seems to be rather image conscious in much the same direction as the parent company. This isn't the declared intention; the name was recently changed from the better known 'Island Studios' in a search for a more personalised identity. The studio management wanted potential users to feel that the studio was open for all comers and not just Island super-

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stars. The interior gives away the origin; it is clearly a case of *je ne sais quoi* . . . or perhaps it's the ten foot tall Island insignia standing in the spiral staircase well. In some ways, Muff encourages the impression. On being shown the man's office, a spacious top floor room furnished in a manner guaranteed to raise the eyebrows of anyone in the business, the first thing he did was to point out the large, circular structure covered in telephones at the far end of the room explaining 'that's the famous Island desk.' One wondered about the problem of mixing . . .

The whole organisation gives the impression of glitter touched with quite a lot of humanity. The actual fixtures, fittings and facilities are everything that one could hope for in a modern studio. The upper studio (the lower studio had a session going on) measures 25 x 19 x 8m; Muff mentioned that occasionally after all night sessions, the 'rough necks' (clients) would clear the floor of mic stands, gear and all but two screens and have an instant game of five-a-side football.

A bent pipe organ bears silent testimony to this youthful exuberance.

**Frank Ogden**

## MOTORING BROADCAST

IF ONE RAISES the hypothetical question 'How would you turn a mono tape recorder into a successful business?' most people would answer in terms of a mobile or a one track demo studio; there might even be those who would attempt to capture rare birdsong half-way up a mountain in the Andes for *Time-Life*. Dennis King, Stirling Moss, Mike Kemp and Cris Bickerton took a different approach.

It started off as little more than a hobby. At the time, four years ago, Dennis was studio manager at Stagesound and Mike was motoring correspondent for the *Daily Mail*. The idea came about through the then new network of BBC local radio stations; it couldn't have worked without them. Mike and Dennis realised the problems that the stations had in dealing with the vast torrent of press releases originating from organisations and companies, some of which were connected with the motoring industry and all requiring presentation before air time could be given. It wasn't just the business of removing the more blatantly partisan aspects of some of the material presented, but the actual job of turning written statements into a prerecorded package suitable for programme insertion. So this was the idea, made even more viable by the advent of the independent local radio network—to offer industry a news packaging service of quality and relatively unbiased content suitable for use by the local and national networks, prerecorded on 6.25 mm tape. It is then up to the station producers to use this material if, and how, they wish without any added strain on over-stretched programme budgets.

Until recently Cris Bickerton, an ex-BBC producer, handled the production of programme items, and from the beginning lent the professional touch to all material recorded, either on location or at Motoring Broadcast's own studio situated on the top of the Press Centre in Shoe Lane, London. He has now returned to the Corporation, leaving production to Raymond Fox and Dennis King.

Mike Kemp, the managing director, still handles the copy writing; this is a task that requires great skill and tact due to the sensitivity of both the BBC and the IBA to partisan interests even if well disguised. This necessary policy can lead to a strange confrontation of interests. Even though a single organisation may pay the piper, it can't always call the tune; occasionally, the piper makes a very discordant noise. Dennis recalled a couple of examples to illustrate the point. Some time ago, a car accessory manufacturer asked the company to produce a news item for distribution to the networks concerning yet another 'miracle device' for saving petrol by the gallon. Being aware about things mechanical (Stirling Moss is a director of Motoring Broadcasts) they found that the petrol saver didn't. The subsequent refusal cost them the client.

The other example is more serious; someone produced a £22 kit to convert a car to lpg, a petrol substitute. Conventional kits cost about eight times as much; it seemed a good buy. Mike Kemp went to have a look and found that although it worked perfectly well, the lpg tank was such that, in the event of a rear collision, the car and things around it would have gone up in a violent explosion. A story was taped and distributed at the expense of Motoring Broadcast.

Originally, the company relied almost exclusively on the motoring industry; it now accounts for only about 35 per cent of work handled, the remainder coming from other publicity fields. It is rather ironic that in hard economic times, pr work is stepped up. The reason appears to be that when industry cuts back on advertising, public relations becomes far more important resulting in a search for media offering the greatest exposure/cost ratio. Although Dennis King would shy from the term 'advertising' for his service, he claims the very widest coverage by reasoning: the Motoring Broadcast tapes are used by the BBC and IBA local stations and, occasionally, by the national networks thus offering more potential coverage than any single medium.

Future plans of the company include a new audio-visual facility based out of London, operating in the European markets.

**Frank Ogden**

## NAME GAME

AT ADVISION, they're still rolling about with glee over the automated mixdown system recently installed in Studio 2. One of the latest customers is Greg Lake who is producing for the Italian rock group Banco. Another client of international status is the Dutch band Alquin who booked in to mix their fourth album *Nobody can wait for ever*, produced by Roger Baine for Dutch Polydor. It was this band that christened the Compumix desk 'Fritz' for reasons best known only to themselves. Other work recently handled in Studio 2 includes a Shirley Bassey single and a few tracks for Barclay James Harvest.

On the recording side, Advision report attendance by Snafu, following a successful tour with Status Quo, and David Essex who is laying down a few tracks for CBS with Jeff Wayne. Finally in the name stakes Slim Whitman, the self-styled 'Yodelling Cowboy' of the fifties, checked in during his British revival tour to record a follow-up to a recent chart entry. Slim gained fame with such records as *When I'm calling yoooooooou*, *Cattle Call* and the *Indian love call*.

Still on the subject of cowboys—this one's a brown dirt variety—Marquee Studios are clearly pleased with the Gus Dudgeon production of the latest Reg Dwight, perhaps better known as Elton John, album *Captain Fantastic and The Brown Dirt Cowboy* mixed with Phil Dunne on the new 24 track hook up.

The same studio boasts the custom of four top women musicians in Lynsey de Paul, Stephanie de Sykes, Kiki Dee and Lesley Duncan. Geoff Calver, who engineered most of Lynsey de Paul's work in 1974, is now working on a new single for Stephanie de Sykes while Lesley Duncan has just finished a new album produced by Jim Horowitz and engineered by Will Roper. Kiki Dee and her redoubtable band are in the middle of recording a new single under the guidance of Gus Dudgeon following the last single and lp *The Music In Me*.

Other visitors to the studio in the first month of the year included Alvin Stardust, Gilbert O'Sullivan and Rod Stewart.

**Frank Ogden**

# Survey: Synthesizers

## ARP

**Arp Instruments, 320 Needham Street, Newton, Massachusetts 02164. Phone: (617) 695-9700.**
**UK distributors: F W O Bauch Ltd., 49 Theobald Street, Boreham Wood, Herts WD6 4RZ. Phone: 01-953 0091. Telex: 27502. Boosey & Hawkes (Musical Instruments) Ltd., Deansbrook Road, Edgware, Middlesex HA8 9BB. Phone: 01-952 7711. Telex: 923300.**

### ODYSSEY 2800

Self-contained portable instrument with integral keyboard.
**Oscillators:** two; sawtooth, square and pulse output; phase lock on one oscillator; pulse-width modulated output. Additional lf oscillator for vibrato, repeat etc
**Noise generator:** pink or white: also random generator sample 2nd hold.
**Glide:** variable portamento control; pitch bend control.
**Keyboard:** nominally three octaves C to C; transport control ± two octaves.
**Ring modulator:** 'digital'.
**Mixer:** combines two oscillators and noise/ring modulator.
**Filters:** one vc variable, including foot pedal concontrol; high pass.
**Envelope generators:** two, one full trapezoidal, one simple attack/decay.
**Power:** 110/120V or 220/240V operation.
**Size:** 570 x 450 x 130 mm.
**Weight:** 9 kg.
**Price:** £795

### PRO-SOLOIST 2701

Preset synthesizer, portable instrument incorporating integral keyboard.
**Control switching:** labelled as orchestra etc.
**Additional controls:** volume, brilliance, keyboard touch sensitivity, portamento speed.
**Keyboard:** nominally three octaves C to C; transposition ± one octave.
**Power:** 110/120V or 220/240V operation.
**Size:** 820 x 300 x 125 mm.
**Weight:** 8 kg.
**Price:** £595

### EXPLORER 2900

Preset, portable synthesizer incorporating integral keyboard. With some adjustable controls. Switchable between 'preset' and manual.
**Oscillator:** sawtooth, rectangular, variable mark/space.
**Noise generator:** pink.
**Filter:** variable vc filter, adjustable resonance. 24 dB per octave roll off.
**Envelope generator:** trapezoidal functions, preset or manual.
**Additional controls:** volume, tuning, repeat, lf oscillator speed, vibrato depth and delay, bender glide.
**Keyboard:** nominally three octaves C to C.
**Power:** 110/120V or 220/240V operation.
**Size:** 820 x 300 x 100 mm.
**Weight:** 8 kg.
**Price:** £399

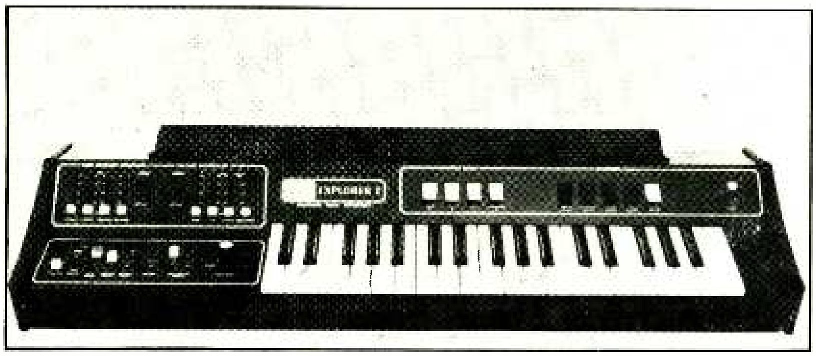
### 2500

Extensive studio synthesizer, in cabinet. May be used in conjunction with one or two keyboards.
**Oscillators:** three vcos; sine, triangle, rectangular, sawtooth waveforms. *1004* vco module has coarse/fine frequency, three frequency control inputs (1V per octave); rectangular wave mark/space 2% to 98%. *1023* dual vco module similar *1004*; .03 to 16k Hz in two ranges.
**Noise sample generator:** *1036* sample and hold/random voltage module contains two sample and hold circuits, two noise generators and two vc pulse generators; *1040* oscillator/noise generator module contains one white noise source, one pink noise source, one random voltage generator and vco similar *1023* module.
**Envelope generator:** *1033* dual delayed exponential envelope generator module contains two identical envelope generators; attack/decay, sustain and final decay times adjustable; gate delay 1 ms to 3 delay in envelope application; times variable 1 ms to 3s, sustain from 0 to 10V; sustain pedal connected via jack socket. *1046* quad envelope generator has four generators, similar to *1033*, but two without gate delay and other features.
**Filters:** *1006* filtamp module contains four-input mixer, vc 24 dB per octave low pass filter, and vca; cut off external or internal vc; low pass 20 to 20k Hz, with variable resonance; vca lin or log; *1045* voltage controlled voice module contains vco, vc filter, vca and two exponential envelope generators; sections in-line or switchable (eg as from vco) as appropriate; *1047* multi mode filter/resonator module is a combination low pass, high pass, band pass and notch filter; ½ to 512 variable; cut off frequency 16 to 16k Hz, coarse and fine adjustment; 12 dB per octave cut off, notch 40 dB.
**Sequencer:** *1027* module is ten-step counter with three variable voltages on each; repetition rate ⅓ to 400 per second; *1050* mixsequencer module contains two four-input mixers with electronically switched inputs.
**Power console:** 110/120V or 220/240V operation.
**Size:** 800 x 450 x 160 mm.
**Keyboard:** nominally five octaves C to C, 870 x 250 x 150 mm.
**Weight:** 26.5 kg.
**Price:** depending on format

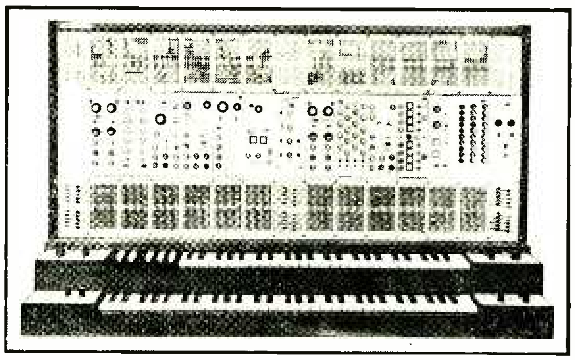
### 2600

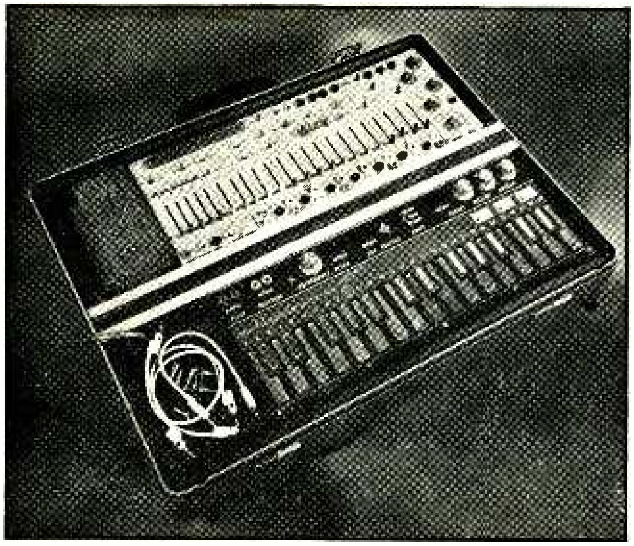
Compact portable synthesizer with optional keyboard. Additional pre-mixed 'performance' patches may be by-passed by patchcord insertion. Particular specifications similar *2500* series.
**Oscillators:** three vcos, 0.03 to 20k Hz in two ranges; triangular, sine, re tangular waveforms.
**Filters:** one vc low pass, variable resonance, dc coupled.
**Ring modulator:** ac or dc coupled.
**Envelope generators:** two.
**Envelope follower:** one.
**Noise generator:** one, variable white to pink;

*Arp Explorer 1*

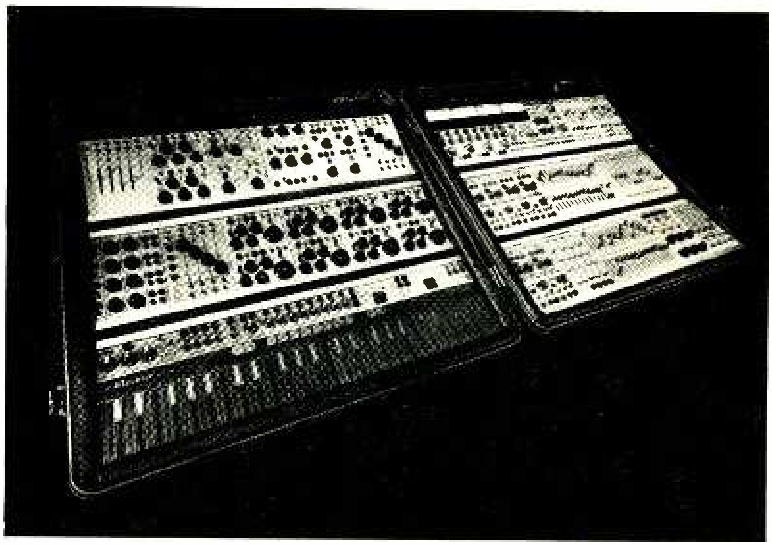



*Arp 2500*





*Buchla System 200-081 (Music Easel)*



*Buchla System 200-361*

sample and hold module with internal clock.
**Sequencing:** one simple switch, bidirectional.
**Reverberation:** stereo, uncorrelated.
**Keyboard:** nominally four octaves C to C, with variable tuning, portamento, tone interval, and memory circuit.
**Additional controls:** general purpose mixer and panpot; one voltage processor with variable lag; two voltage processors with inverters; two integral monitor amps with speakers and 8 headphone jack outlet.
**Size:** console 800 x 450 x 220 mm; keyboard 870 x 250 x 150 mm.
**Weight:** 9 kg, keyboard 7.2 kg.
**Price:** £1750

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## BUCHLA AND ASSOCIATES

**Box 5051, Berkeley, California 94705, USA.**
**Phone: (415) 452-4136.**

Series of modular systems presented in standard formats or provided to customer requirements. Standard cases are available, and patchcords and filler panels are provided with systems at no extra charge. Discount of 3% is given on systems totalling more than $3500. Special modules can be supplied for projection and lighting control, computer interfacing, monitoring and video synthesis; auxiliary studio equipment is readily recommended and supplied. Prices given are fob Berkeley. Materials and workmanship are guaranteed for three years.

### MODEL 205 MATRIX MIXER

Two 5 to 4 mixers with full cross-routing gain control. Commoned outputs provide 10 to 4 capability.
**Price:** $480.

### MODEL 206 DUAL MIXER 3

Two three channel mixers with separate and common outputs. Input channels each with level control and program and monitor switching.
**Price:** $120.

### MODEL 208 STORED PROGRAM SOUND SOURCE

Extensive module using as primary signal source a 'complex oscillator'. Fundamental rectangular, triangular or sawtooth can be used subsequently to amplitude and frequency modulate this source. Pitch, timbre and waveshape are voltage controlled. Signal enveloping with two lo pass gates which may gate in the frequency domain, the amplitude domain, or both simultaneously. Control voltage section includes five position sequencer with four uncorrelated voltage outputs. Envelope generator has voltage controllable attack, sustain and decay times. Vc 'pulser' gives trigger pulses and additional envelope voltages. Provides capability for permanent storage and immediate retrieval of complete or partial instrument patches by plug-in cards. Preamplifier for mike, instrument or line input includes envelope follower. Output section provides for mixing, reverberation, monitoring and final level adjustment, together with headphone outlet.
**Price:** $1600.

### MODEL 214A, 215, 215A POWER SUPPLIES

For appropriate casing systems; operation from 110V ac or 12V dc.
**Price:** $250.

### MODEL 227 SYSTEM INTERFACE

For equalisation, location, mixing, monitoring and routing of audio signals in four channel studio or performance environments. Twelve signal inputs: four primary, with associated bass, treble, echo send, pan and routing. Remainder two groups of four for typical line operations. Both program and monitoring are full four channel outputs. Monitor function switchable, status indicated by led. Four vu meters driven from monitor bus. Internal spring reverb unit.
**Price:** $1600.

### MODEL 230 TRIPLE ENVELOPE FOLLOWER

Three channel follower, decay time 0.1 to 5s. Dc coupled mode provides for pulse output activation for control voltages greater than 6v. Transient coupling permits detection of attack transients over wide amplitude and background noise variations.
**Price:** $180.

### MODEL 248 MULTIPLE ARBITRARY FUNCTION GENERATOR

Provides for extended control of waveshapes above conventional parameter arrangements. Functions defined as point-to-point interpolations, with voltage and interval time specified for each segment. Time variation from 1 ms to 120s, with maximum 16 or 32 segments depending on mode. Individual segments may be externally voltage controlled. Programmed output pulses may accompany functions in any desired patterns. Each output section contains a time base multiplier and necessary logic for local clock start and stop functions via programme control, panel switch or applied pulses. Stage selection manually or by control voltage application. Additional outputs include voltage ref time function, reference ramp, and two programmed pulses. The unit may be described as a memory with 16 or 32 addressable storage locations and a number of output ports, each of which may give the information from any part of the memory. Operation may be asynchronous, ie different output sections may generate simultaneously identical or dissimilar functions with completely different time scales and/or phase relations. Several versions available, of varying densities, as follows:

| Version | stages | outputs | price |
|---|---|---|---|
| 1602 | 16 | 2 | $1550 |
| 1606 | 16 | 6 | $2800 |
| 3206 | 32 | 6 | $3250 |
| 3210 | 32 | 10 | $4500 |

### MODEL 257 DUAL CONTROL VOLTAGE PROCESSOR

Two identical sections, each of which applies several control voltages to one signal such that $V_aK + V_b\bar{M}$ $MV_c + V_{offset} = V_{out}$. Algebraic manipulations possible include addition, subtraction, scaling, inversion and multiplication. Control voltage M may transfer control from one applied voltage $V_b$ to another $V_c$.
**Price:** $450.

### MODEL 258 DUAL OSCILLATOR

Two independent vcos, frequency range 5 to 20k Hz. Each has two processing inputs and fm input. Waveshape continuously variable sine to saw (osc 1) and sine to square (osc 2). Comprehensive control variations.
**Price:** $600.

### MODEL 265 SOURCE OF UNCERTAINTY

Generates two continuously varying random voltages, two pulses actuated random voltages and audio noise with three available weightings. Bandwidth of random functions from vc ref .05 to 50 Hz, ie 1000:1.
**Price:** $560.

### MODEL 270 QUAD PREAMPLIFIER

Four separate high gain, low noise preamps with line and mixed outputs. Input switched: mikes hi/lo, pickup from instrument.
**Price:** $250.

### MODEL 280 QUAD ENVELOPE GENERATOR

Four independent envelope generators with variable attack and decay. Range 1 ms to 10s. External trigger facility, with output pulse control if required.
**Price:** $350.

### MODEL 285 FREQUENCY SHIFTER/ BALANCED MODULATOR

Vc frequency shifter, control voltage internal or external. Frequencies above and below reference

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simultaneously available. Separate vc balanced modulator included, providing all stages between unmodified to amplitude modulated and ring modulated signals.
**Price:** $790.

**MODEL 291 DUAL VC FILTER**
Two bandpass filters with vc centre frequencies and bandwidths. Range 30 to 15k Hz, bandwidth one semitone to four octaves. Modulation inputs, resonance controls.
**Price:** $600.

**MODEL 292 QUAD VC LOPASS GATE**
Four independent gates with selectable amplitude-dependent spectral characteristics. Settings and control voltages determine levels and cutoff frequencies. Summed output for vc mixing. Spatial localisation and movement may be controlled.
**Price:** $380.

**MODEL 294 FOUR CHANNEL FILTER**
Bandpass filter with sharp cutoff slopes 20 dB per octave at crossover frequencies of 250, 1k and 4k Hz. Individual filtered outputs unattenuated; summed output frequency characteristic variable.
**Price:** $150.

**MODEL 295 TEN CHANNEL FILTER**
Ten channel comb filter, with variable gain on each band pass.
**Price:** $450.

**MODEL 218 KEYBOARD**
29 note, nominally 2⅓ octave chromatic touch keyboard. Three-valued preset section may be used independently or to shift pitch output voltage by octaves or preset intervals. Pressure, pulse and vc portamento outputs included.
**Price:** 7750.

**MODEL 219 KEYBOARD**
Nominally four octave touch sensitive keyboard with eight separate sections and 38 outputs. Monophonic and polyphonic voltage, pressure and pulse outputs. Outputs may be offset or modulated by applied control voltages or audio signals. One eight key section has individually tunable keys, separate and common pulse outputs, equal interval voltage output and status indicators. Two xy joysticks provide two parameter control. Additional resources: three keys with individual pulse and pressure outputs and bipolar control voltage output. Buffered digital outputs for interface with digital processors also provided.
**Price:** $1480.

**MODELS 202, 203-08, 203-18 PORTABLE CASES**
**Prices:** 202 $350, 203-08 $250; 203-18 $320.
The above modules are available in suggested formats in casing as follows:

**SYSTEM 200-081 MUSIC EASEL**
1 of 208-8; 1 of 208; 1 of 214A; 1 of 218.
**Price:** $2850

**SYSTEM 200-141**
1 of 203-18; 1 of 206; 1 of 208; 1 of 215a; 1 of 218; 1 of 248-1602; 1 of 265.
**Price:** $4990.

**SYSTEM 200-181**
1 of 203-18; 1 of 206; 1 of 208; 1 of 215A; 1 of 218; 1 of 248-1602; 1 of 257; 1 of 258; 1 of 265; 1 of 291; 1 of 292.
**Price:** $6960.

**SYSTEM 200-242**
1 of 202; 1 of 206; 1 of 215; 1 of 218; 1 of 227; 3 of 258; 1 of 265; 1 of 248-1606; 1 of 285; 1 of 291; 1 of 292.
**Price:** $9700.

**SYSTEM 200-361**
2 of 203-18; 2 of 206; 2 of 215A; 1 of 219; 1 of 227; 1 of 230; 1 of 248-3206; 1 of 257; 4 of 258; 1 of 265; 1 of 270; 1 of 280; 1 of 285; 1 or 291; 2 of 292; 1 of 294; 1 of 295.
**Price:** $14 200.

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## EMS
**Electronic Music Studios (London) Ltd., 277 Putney Bridge Road, London, SW15 2PT. Phone: 01-788 3491/2. Emsa Inc, 460 W Street, Amherst, Mass 01002 USA. Phone: (413) 256-8591. 7257 Ditzingen/ Heimerdingen, Finkenstrasse 4, West Germany. Phone: 07152 53273.**

**PITCH-TO-VOLTAGE CONVERTER**
'Adaptive filter' provides tracking of fundamental down to strengths of 10% of total signal energy. Chooses lowest note of chord.

Output may reproduce envelope of incoming signal, or related envelope shape. Signal channel gives manually preset mixture of original input signal with tuneable internal oscillator which tracks input in pitch and loudness. Control voltage output can be pitch or loudness (envelope) following. Reference oscillator enables accurate tuning.

Envelope triggering pulse can give steady level wherever input is above trigger threshold, or 20 ms (approx) pulse wherever input rises to threshold.
**Input:** minimum level for gate operation 10 mV peak-to-peak (low range) or 100V peak-to-peak (high range).
**Output:** 18V peak-to-peak maximum.
**Pitch voltage:** 1V (±0.15V) per octave (invertible).
**Internal oscillator:** 256 Hz ±24%. Octave function precise.
**Trigger output:** average +4V, maximum unloaded 12V.
**Envelope voltage:** 1V (±0.15V) per 6 dB gain. (Log/lin, both invertible).
**Noise and hum:** —60dB ref max output.
**Connectors:** Jack sockets on front, multi-way connector at rear.
**Power:** 240/115V, 50/60 Hz (+10%, —23%).
**Size:** available in afrormosia case or rack mounting (standard 483 mm x 44 mm).
**Price:** £280.

**EIGHT OCTAVE FILTER BANK**
**Input:** 6V peak-to-peak maximum.
**Gain:** 10 dB ± 1.5 dB maximum.
**Filter gain:** 9 dB ± 3 dB maximum.
**Filter frequencies:** 63, 125, 250, 500, 1k, 2k, 4k, 8kHz.
**Filter tuning:** centre frequencies to ±10%.
**Filter slope:** 12 dB/octave maximum.
**Crosstalk:** —60 dB between channels.
**Hum and noise:** —80 dB ref. maximum gain.
**Power:** 240/115V, 50/60 Hz (+10%, —23%).
**Size:** available in afrormosia case or rack mounting (standard 483 mm x 44 mm).
**Price:** £200.

**TWO-VOLTAGE RANDOM GENERATOR**
**Outputs:** two staircase type. Steps occur randomly range and time variance controllable. Outputs change simultaneously.
**Time control:** Internal clock may be: free running, subject only to manual control; pulse controlled (manual or external); free running such that mean rate controlled by external voltage. Time variance control may range from zero (mean rate constant) to maximum (random variation more than 100:1, rectangular distribution).
**Control output:** ±2.5V maximum.
**Trigger output:** +4V.
**Time range:** mean 0.2 to 20 events/second.
**Power:** 240/115V, 50/60 Hz (+10%, —23%).
**Size:** available in afrormosia case or rack mounting (standard 483 mm x 44 mm).
**Price:** £200.

**SYNTHI DK2 DYNAMIC KEYBOARD**
Conventional keyboard with dynamic control.
**Outputs:** two voltages proportional to the pitch interval of the notes played (keyboard voltage); one voltage proportional to velocity of key depression (dynamic voltage); sawtooth wave from keyboard oscillator, pitch and loudness controlled by the keyboard; trigger signal every time key is depressed, to be connected to synthesizer envelope shaper.

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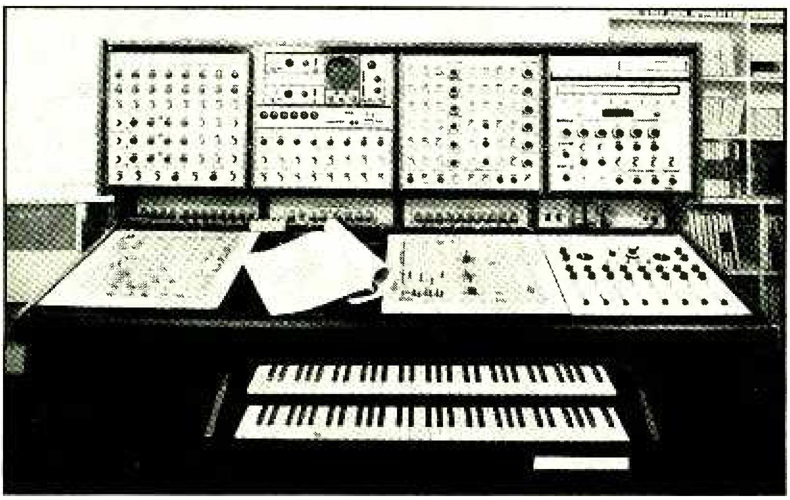
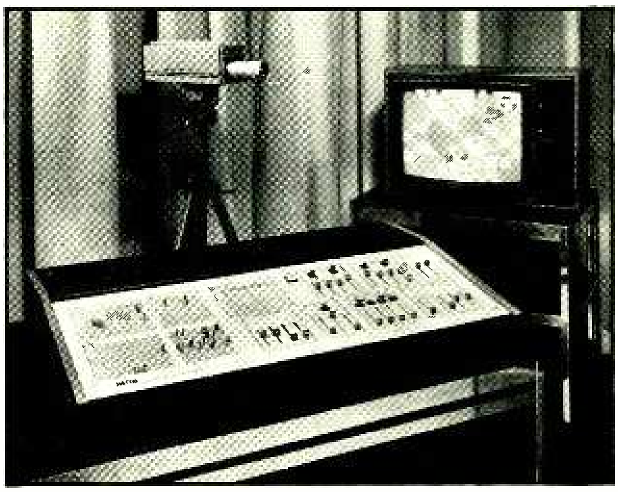
*EMS Synthi. 100*



*EMS Spectron*



**Range:** three octaves (nominal), C to C.
**Keyboard voltages:** ±1.5V at 1V/octave.
**Dynamic voltage:** ±1.5V, range adjustable.
**Sawtooth voltage:** 30-2000 Hz fundamental. Maximum output 10V peak-to-peak. Tuning position and spread controls.
**Power:** +12V and —9V connected by multicore cable from synthesizer power unit.
**Price:** £200.

**SYNTHI KS DIGITAL SEQUENCER KEYBOARD**
Touch keyboard incorporating simple sequencer.
**Outputs:** one direct from keyboard section, one from output of sequencer memory.
**Range:** 30 notes of conventional keyboard format. Capacitative touch keyboard, plastic coated for humidity and mechanical protection.
**Sequence length:** 1536 (=256 x 6).
**Memory:** shift register.
**Keyboard pitch voltage:** 1V per octave adjustable, mean.
**Sequencer pitch voltage:** 0.32V per octave adjustable, mean.
**Sequencer ripple:** worst case 30 mV peak-to-peak.
**Controls:** clock rate, pitch spread, trigger select.
**Touch pads:** record, play, random voltage, transpose (semitone, major third, perfect fifth).
**Power:** +12V and —9V connected by multicore cable from synthesizer power unit.
**Price:** £200.

**SYNTHI SEQUENCER 256**
Fast access digital storage unit incorporating analogue-to-digital and complementary converters. Designed to provide convenience of sequence editing of up to three simultaneous parameter pairs (such as pitch/loudness). Sequencer refers each event to one standard time, as opposed to a previous event, so that individual segments may be updated without affecting adjacent data.
**Outputs:** ten signal and control voltages, at individual jack sockets or multiway connector.
**Storage:** maximum 256 events, each of 42 bits. Total 10 752 bits.
**Tracks:** three, with fourth available for pulse data only.
**Byte arrangement:** 13 bits start time, 13 bits end time, 12 bits controlled parameters divisible between two parameters depending on resolution required.
**Sequence:** time resolution enables reference to common time.
**Access time:** maximum 0.01s.
**Clock rate:** 0.1 to 200 Hz. Clock functions may be operated remotely.
**Range:** five octave (nominal) dynamic keyboard of conventional layout.
**Compatibility:** automatic offset control for use with equipment other than EMS.
**Price:** £2 500.

**SPECTRON**
Video synthesizer for use with external colour monitor, using self-generated or camera source signals.
**Image sources:** X and Y counters, producing vertical and horizontal bars; slow counter gives six square waves which change state during frame flyback; four shape generator outputs, each of which is one of 16 basic shapes—shape selection may be manual or voltage controlled; video comparator divides grey scale of external monochrome signal into seven levels, each of which may be individually processed—level spacing may be voltage controlled.
**Image modifiers:** four overlay gates; four inverters; edge generator with four outputs for variable thickness; delay, for image shift singly or in combination; two flip-flops for horizontal image frequency division; invert, nine inputs for X and Y.
**Outputs:** A and B, with four luminance bits and three bits for red/blue bias; colour swap; two control outputs 'to acm' give filtered versions of video signals to be fed across to the analogue control matrix.
**Control sources:** two oscillators with sine plus square outputs; two random voltages; three audio inputs—bass envelope, treble envelope and signal; two low or high frequency filtering inputs 'from dsm'; four voltage control slider inputs; one external input.
**Control inputs:** two shape generators; one video input with luminance and red/blue bias controls; comparator level spacing input.
**Panel controls:** four voltage control slides; two oscillators, 0.2 to 30k Hz giving high/low range, coarse/fine frequency, deviation, level and mode control; audio input level and frequency split control (500-5k Hz); random-generated slow level, mode and rate control (0.1-100k Hz); two independent shape generators; video input comparator level spacing, video output control of luminance and red/blue bias.
**Colour system:** normally PAL, but conversion to NTSC available.
**Separation outputs:** red, green, blue; 0.7V with blanking to drive 75Ω bandwidth greater than 5 MHz.
**Composite output:** 1V peak-to-peak (0.7V video, 0.3V sync).
**VHF output:** 600 MHz approx, suitable for driving any commercial colour receiver aerial socket.
**Video input:** 1V peak-to-peak composite monochrome.
**Audio input:** 1V approx.
**External control input:** ±5V.
**External digital inputs:** two, for various subsequent processing.
**Power:** 240/110V, 250 VA approx.
**Size:** 180 x 530 x 970 mm.
**Price:** £4000.

**SYNTHI VCS3 Mk2**
Voltage-controlled unit with facility for connection to external keyboard.
**Outputs:** Two of 2V peak-to-peak into 600Ω with filters and panning; two of 10V peak-to-peak into 50Ω (headphones etc); two of ±5V dc into 10 kΩ.
**Inputs:** Two of 1.8V ac maximum into 50 kΩ; two of 2.5V dc maximum into 50 kΩ; two of 5 mV ac into 600Ω (microphone).
**Oscillators:** three: 1 to 10k Hz, sine and ramp; 1 to 10k Hz rectangular, and ramp; 0.025 to 500 Hz, rectangular and ramp.
**Noise generator:** white-pink noise variable.
**Filter:** adjustable Q and frequency: up to 20 and 5 to 10k Hz respectively.
**Cut-off:** 18 dB per octave maximum.
**Ring modulator:** ic, transformerless. Input rejection —60 dB.
**Envelope shaper:** attack 2 ms to 1s; decay 3 ms to 15s. Variable gain with trapezoidal ouptut.
**Sequencer:** 256 event storage.
**Reverberation:** dual spring. Reverb/direct mix 0 to 100%.
**Joystick:** any two parameters in x-y modes.
**Meter:** level or sequencer readout.
**Auxiliaries:** may connect directly to *KS*, *DKS* or *DK1* keyboards or other EMS modules.
**Size:** 438 x 444 x 419 mm.
**Power:** 240/110V, 50-60 Hz.
**Price:** £680.

**SYNTHI-AKS**
Compact, portable voltage-controlled unit comprising Synthi *VCS3 Mk2* facilities and *KS* touch keyboard.
**Weight:** 11.34 Kg.
**Price:** £790.

**SYNTHI 100**
Extensive system incorporating various of above modules and additional facilities.
**Oscillators:** 12: six of sine/ramp, 1 to 10k Hz, with sync input; three of square and triangular, 1 to 10k Hz, with sync input; three of square and triangular, 0.025 to 500 Hz, with sync input.
**Noise generators:** two, with variable frequency envelope.
**Random generator:** two outputs, rectangular distribution, time variance 1:1 to 100:1; mean time 10 ms to 10s.
**Envelope shapers:** three; five triggering modes; each section of dual trapezoidal output variable 2 ms to 20s
**Filters:** four of low pass to resonance; four of high pass to resonance: range 5 to 20k Hz; Q up to 20; cut-off 12 dB per octave for first octave then 18 dB per octave; eight of fixed narrow bandpass filters, octaves between 62.5 and 8k Hz.
**Reverberation:** two, spring.
**Slew limiters:** three, 1 ms to 10s.
**Ring modulators:** three, ic transformerless; input rejection 60 dB.
**Sequencer:** as for Sequencer *256* module (see above).
**Output:** eight vc amplifiers each with fader, pass, variable filter.
**Joysticks:** two, x-y type, any parameter pair.
**Keyboards:** two, nominal five-octave dynamic.
**Patching:** two of 60 x 60 pin matrix patchboards.
**Input:** eight ac/dc input amplifiers. Maximum 1.8V ac rms or ±2.5V dc.
**Frequency-voltage converter:** 1V per octave.
**Envelope followers:** two, 1V ac per 6 dB.
**External ties:** four send and return.
**Oscilloscope:** double beam.
**Meter:** digital frequency meter/timer/converter.
**Connectors:** Cannon.
**Size:** 2m x 950 mm x 837 mm (without stand).
**Price:** £11 000.

**MOOG**
**US distributor: Norlin Music Inc., 7373 N Cicero Avenue, Lincolnwood, Illinois 60646, USA.**
**UK distributor: Moog Technical Services 17 St Ann's Road, Harrow, Middlesex. Phone: 01-863 8836.**

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# It makes sound sense to invest in Neve's new 8024

This is the year when money really counts. You want to get the best that money can buy. That is why it makes sound sense to invest in Neve's new 8024.

We have put a lot of value in to this console. The 8024 has the standards of technical performance, reliability and quality that you have come to expect from Neve. It is designed to provide comprehensive recording and mixdown facilities for up to 24 tracks in a minimum of space with a maximum of flexibility that makes sense to the smaller as well as big studio concerned about real economy.

**A few sound points about the 8024**

- 24 fully equalised input channels with outputs for up to 24 track recording
- 8 auxiliary mixed outputs for reverberation, cue, sub-grouping and other auxiliary functions
- Individual channels providing comprehensive overdub facilities
- Channels switched by single control from record to playback
- Every channel equipped with a quadraphonic panning system
- Comprehensive metering and monitoring for 24 track, and simultaneous quadraphonic, stereo and mono outputs
- Solo system automatically switched to the auxiliary meter
- A console of modular construction with all amplifiers enclosed and shielded for maximum reliability and performance.

The 8024 is a lot of value for the money. It is an investment backed by Neve's reputation for service to people whose business is sound everywhere.

**Neve**

The Sound of Neve is Worldwide

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

**SYNTHESIZER 15**

Portable, modular constructed synthesizer. May be operated in conjunction with *952* (included) or *951* keyboards, *1120* foot pedal controller, *1150* ribbon controller, portable sequencer or touch sensitive percussion controller. A carrying case is available. Modules available as follows:

**Inputs:** four-input mixer with +re and —re outputs, jack multiples.

**Oscillators:** *921* vco, range .01 to 40k Hz; fine and coarse tuning control, sine, sawtooth, triangular and rectangular forms; six switch-selectable auxiliary waveforms; three frequency controlled input jacks; waveforms sync at any point in the cycle. *921A* vco driver, providing controls for associated *921 Bs*; fine and coarse tuning control; three frequency control input jacks; rectangular waveform control 5% to 95%; two rectangular width control input jacks; *921B* vco, range 1 to 40k Hz; sine; sawtooth, triangular and rectangular waveforms; ac and dc coupled frequency control input jacks; phase lock sync input.

**Amplifier:** *902* vca, 80 dB dynamic range, linear or exponential switchable response; three control inputs.

**Noise generator:** *923* white and pink; low and high pass filters, cut off frequency variable from 10 to 20k Hz.

**Filters:** *907A* fixed filter bank; separate gain control of 10 ranges; half-octave bands between 250 and 2800 Hz; *904A* vc and manual low-pass filter; frequency variable 60 to 20k Hz; three control inputs.

**Alternators:** *995* panel.

**Envelope generator:** *911*; separate control of rise/decay, sustain level and final decay time.

**Module complement:** 2 of *902*; 1 of *904A*; 1 of *907A*; 2 of *911*; 1 of *921*; 1 of *921A*; 2 of *921B*; 1 of *923*.

**Keyboard:** duophonic, nominally four octaves C to C.

**Patchcords:** 10 of 30 cm audio cords; 8 of 60 cm audio cords; 2 of 30 cm switch trigger cords; 1 of 45 cm switch trigger cords; one switch trigger Y-chord.

**Power:** 110-125V ac, 50-60 Hz, 130W. Conversion for 220/240V available.

**Size:** 450 x 630 x 240 mm (portable cast)

**Weight:** 37 kg (shipping).

**Price:** £3 800.

**SYNTHESIZER 35**

Modular constructed synthesizer for studio use. May be operated with auxiliary modules as Synthethesizer *15*. Includes *951* keyboard. For details of modules see above.

**Filters:** additional *904B* vc highpass filter, vc or manual control, 60 to 20k Hz. Module complement: 3 of *902*; 1 of *904A*; 1 of *904B*; 1 of *907A*; 3 of *911*; 1 of *921*; 2 of *921A*; 4 of *921B*; 1 of *923*.

**Keyboard:** *951*, nominally five octaves C to C.

**Patchcords:** 10 of 30 cm audio cords; 6 of 60 cm audio cords; 4 of 90 cm audio cords; 4 of 120 cm audio cords; 2 of 150 cm audio cords; 2 of 30 cm switch trigger cords; 2 of 90 cm switch trigger cords.

**Power:** 110/125V or 220/240V ac, 50/60 Hz, 180W.

**Size:** module housing 1.22m x 400 mm x 37 mm; keyboard 1.08m x 110 mm x 240 mm.

**Weight:** 59 kg (shipping).

**Price:** £4 700.

**SYNTHESIZER 55**

Largest vc studio synthesizer of range, housed in three walnut cabinets. Includes *951* keyboard. For module details see above.

**Trigger delay:** *911A1* delay periods from 2 ms to 10s, alternative delay periods running sequentially or concurrently (switch selected).

**Sequencer:** *960* sequential controller, three independent programmable voltage sequences; vc internal clock, manual and voltage control of start/stop; voltage trigger in and out for each sequence step; indicator light for operational status and sequencer state; *961* interface; *962* sequential switch selects up to three input signals; sequence stepping by external voltage trigger.

**Module complement:** 5 of *902*; 1 of *903A*; 1 of *904A*; 1 of 904*B*; 5 of *911*; 1 of *911A*; 1 of *914*; 1 of *921*; 2 of *921A*; 6 of 921*B*; 1 of *960*; 1 of *961*; 1 of *962*; plus additional interface and control modules.

**Keyboard:** *951*, nominally five octaves C to C.

**Patchcords:** 14 of 30 cm audio cords; 8 of 60 cm audio cords; 6 of 90 cm audio cords; 6 of 120 cm audio cords; 4 of 150 cm audio cords; 2 of 30 cm switch trigger cords; 3 of 90 cm switch trigger cords.

**Power:** 85-130V or 171-260V ac, 50-60 Hz, 350W.

**Size:** main cabinet 1.22m x 390 mm x 350 mm; upper cabinet 1.22m x 250 mm x 220 mm; keyboard 1.08m x 110 mm x 240 mm.

**Weight:** 85 kg (shipping).

**Price:** about £5 900.

**SONIC SIX**

Portable small synthesizer. Self contained in high impact case with integral keyboard and monitor amplifier/speaker. Connections are internal, operated from front panel switches.

**Oscillators:** two, sawtooth, triangular and rectangular waveforms; switch calibration for fine tuning. Also two 'waveform generators'.

**Ring modulator:** provides for modulation of signal with internal waveforms.

**Noise generator:** switch selects white or pink.

**Envelope generator:** simple in/out module shaping basic signal into final envelope patterns.

**Filters:** lo pass filter, resonance control lo pass to resonant.

**Keyboard:** nominally four octaves, C to C with high/low note priority and polyphonic capability.

**Additional controls:** glide rate, master loudness, pitch bend.

**Outputs:** two signal output jacks.

**Input:** one audio source input.

**Power:** 110-125V ac, 50-60 Hz, 40W maximum. 220-24V converter available.

**Size:** carrying case 850 x 310 x 150 mm.

**Price:** about £680.

**MINIMOOG**

Small, portable performance instrument available with integral keyboard and collapsible into small carrying case.

**Oscillators:** three; range 0.1 to 20k Hz in six overlapping ranges; triangular, sawtooth and rectangular with differing combinations.

**Noise generator:** white or pink, switchable.

**Input:** 10 mV to 2V; 100 kΩ.

**Filters:** wider range low-pass with variable-height resonance at cut off, 24 dB per octave. Frequency cut off 40 to 20k Hz.

**Amplifiers:** two vcas, dynamic range 80 dB.

**Envelope shapers:** two, in-line; attack/decay 10 ms to 10s, sustain 0 to 100% of contour peak.

**Outputs:** high 0.5V, 3 kΩ; low 15 mV, 1 kΩ; headphone 0.3V maximum into 8Ω.

**Additional control inputs:** pitch, filter, amplifier and trigger.

**Keyboard:** nominally 3½ octaves, F to D. When lowest key only depressed, it controls oscillators and filter; contour generators activated whenever single key depressed.

**Additional facilities:** pitch bender wheel, modulation injector wheel, A440 *'electronic tuning fork'*; five input mixer combines oscillator, random and external sources.

**Power:** 100-135V, 50-60 Hz, 10W maximum; 220-240V converter available.

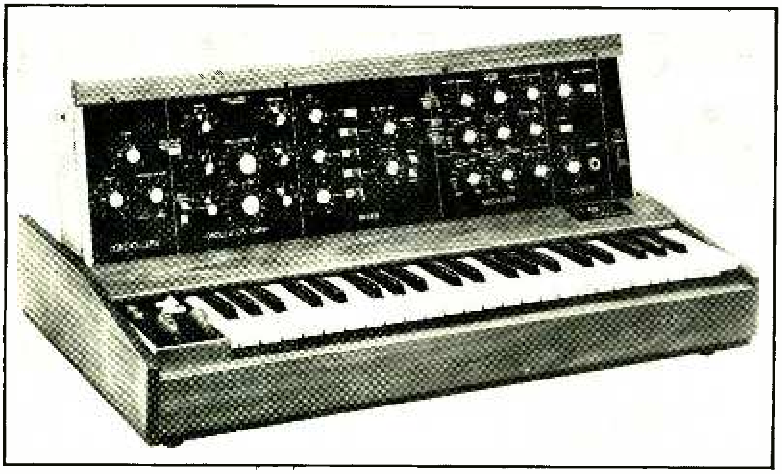
**Size:** 610 x 400 x 140 mm.

**Weight:** 12.5 kg.

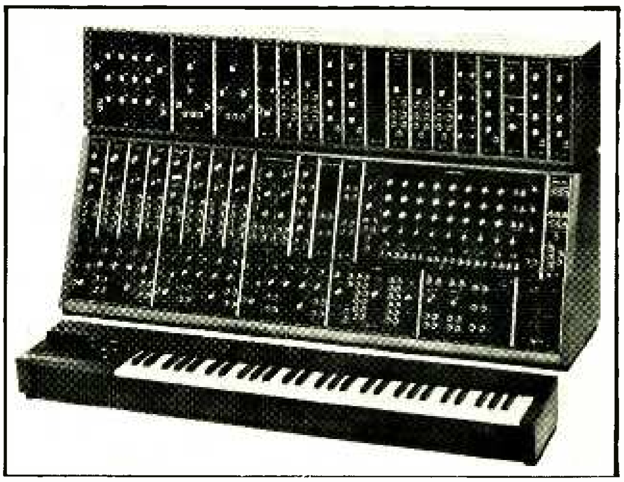
**Price:** £700.

Models *15* and *35* are available without the filter banks reducing the purchase price by about £400 in each case. These versions are the *15A* and *35A* respectively. The model *55A* is identical with *55* but is delivered without the *960* sequencer unit. The price comes down by about £700.

*Minimoog*



*Moog System 55*



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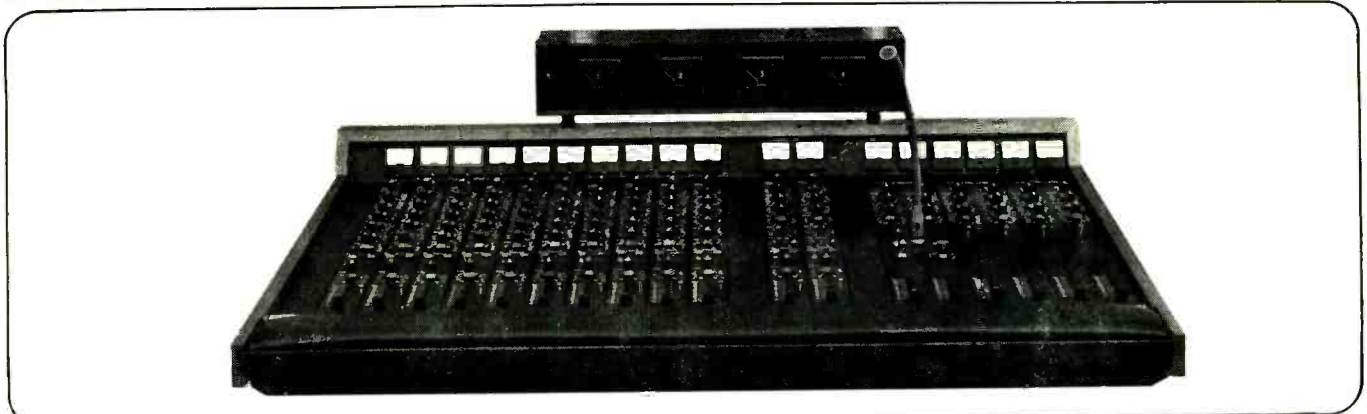

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*Some uses of a large, complex synthesizer are described, in the very different situations of stage and studio. With a rock band, musical techniques must evolve to make best use of its facilities. In the recording studio it may be used as a convenient signal processor as well as versatile instrument. The author's own equipment is basically an extended Moog 3c, with dual sequencer units and extra processing/mixing equipment, including an EMS pitch-voltage converter and an external trigger generator built from the Moog keyboard circuit. However, the comments may be extended to other proprietary makes.*

# The synthesizer on stage and in the studio

NIK CONDRON*

**Part 1: Synthesizer on stage**

'Heaven Spy-Finger' is a four-piece rock band. The line-up is fairly conventional—bass, drums, lead guitar and synthesizer. I play no other keyboard instrument than the Moog—this is perhaps the one departure from the norm. It may surprise readers to know that I play neither piano nor organ. The reason for this is that I was born and bred on a synthesizer keyboard, and the feel of this kind of keyboard is as far removed from that of piano or organ as a Steinway is from an accordian. Also, most modern synthesizers are either monophonic or at best very clumsily duophonic. This means that the synthesizer is conventionally capable of only single lines or simple effect noises in a live situation. The available apparatus relies to a large extent on the sequencer bank to build up a polyphonic sound. The large Moog is also complemented with a *VCS 3* coupled to a duophonic keyboard.

The *3c* (the forerunner of the current *55*) has three banks of three oscillators each, plus one additional oscillator usually used for control voltage work at low frequencies. In order to maximise the available signal outputs from the Moog this oscillator is normally used on its own, controlled by a separate keyboard and envelope/amplifier circuits. This can give clear and distinctive lead lines or solo passages above the remaining signals from the Moog and leaves the three banks of oscillators each with its own oscillator-controller to provide the basis for each section of music. As a rule, two of these banks are linked to the sequencers, one usually providing a bass pattern—here, saw-tooth waves can give a full, rich timbre. The second bank is tuned an octave above the first one, and the three oscillators can occasionally be tuned to conventional triadic chords. This bank acts as a good mid-range signal especially through a voltage-controlled filter. The third bank is used for the main melodic ines—operated from the main keyboard. Once again vc filtering does a lot to give an overall sound that suggests an overdubbed recording. Many people have asked how much of the sound they hear is coming from the synthesizer and how much is pre-recorded on tape. It's a little depressing to think that with all this complicated set-up people still think the performer is 'cheating' and playing along with a tape machine.

**Mixer into pa**

There are altogether seven or eight separate sound sources coming from the Moog and the *VCS3* at any given time, and these have all to be mixed to give a balanced stereo signal through the pa system. For this, I had designed and built a six input, stereo, rack-mounted mixer. Since I use at any one time no more than five or six discrete signals, the six inputs of the mixer are adequate for all my on-stage requirements, the six signals being selected by switching circuits on the Moog itself. To use more than six faders would mean that attentions would be divided to such an extent that I would be half Moog-player, half balance engineer, and this is obviously not a very viable proposition for a live performer on stage.

The mixer has all the necessary basic functions which have been cut down to a minimum. These are simply a fader per channel, one for the echo return and two for the stereo output. Each input has pan, basic equalization (±12 dB at 150 and 10k Hz respectively), aux send which is used for echo, and a channel mute button which is illuminated and switchable remotely from the keyboard, enabling complex on-stage signal interchanging. The mixer output signal is fed directly to the pa mixer at line level. On-stage echo is provided by a conventional tape-loop device which I find most effective for this kind of instrument.

In practice we found that normal miking-up of the Moog via on-stage cabinets did not work successfully due to the distortion inherent in such a system. Our reason for trying this system in the first place was to give the sound a more realistic 'live' feel, but we quickly learnt that complex multiple sounds need to be heard as clearly and distinctly as possible, and that the cabinet system destroyed all carefully panned stereo synthesizer images. Also, by the time foldback was added for the other members of the group the on-stage interference between the amps at the back of the stage and the foldback system in front and to the sides of the band (not to mention the delayed signal from the pa stacks at the front of the hall) made any semblance of musicianship impossible and gave our sound engineer several nervous breakdowns.

Therefore, we decided to put the Moog directly into the pa—thus dispensing with the amp/cab configuration explained previously. We cut the 'on stage' amplification to a minimum, with no instrument stacks at all, and relied for our on-stage sound on foldback monitors which were specially designed for exceptional clarity. These are used in pairs—so that the full Moog stereo effect can be heard by each musician. The sound results for an audience are greatly superior to the usual on-stage stacks plus pa as used by a lot of other bands, but the set-up is more expensive because of the special custom monitors and the necessarily greatly modified live mixer.

The difficulties of playing on stage with three other musicians and a sequencer-operated synthesizer are exceptional, because not only is there a fixed tempo which all the musicians, including the synthesizer player, have to keep to, but also the sequencer notes are of equal intensity. A manually played instrument such as an organ, with an equal intensity of sound regardless of manual pressure, can be made to accent certain notes by, for example, time length, and a sequencer cannot do this. There is therefore a tendency at best for the musicians to naturally speed up as they play, and at worst to lose the guide sequence, and lay the accents on the wrong part of the cycle. This is especially difficult when more complex time signatures are used, but even a straight 4/4 can give problems.

For this reason I use a separate guide pulse triggered by the sequencer on the accented beats—and fed exclusively to the on-stage fold back system. This pulse is made particularly penetrating with appropriate eq so that the drummer has no difficulty in hearing it and being able to set the time and beat for the rest of the band. Our drummer has even tried using headphones with just this pulse in it and technically this worked quite well, but it had the effect of excluding the drummer from the audience and thus making it hard for him to feel the music in any other way than a rather

*Streetnoise Synthesizer Studios

clinical one. We solved this problem by having a separate foldback amp situated near him, with just the pulse coming from it. You could not help feeling, looking at our drummer with his cans on, that he was actually not listening to our music but more likely Capital Radio.

All musicians when they play have a tendency to speed up, especially when playing live. We overcame this problem by having the speed control oscillator worked externally by a foot pedal covering a very narrow controlled voltage range, just sufficient to speed up or slow down the cycle by a small amount. As a keyboards man plays faster he tends to lean forward slightly—and if one foot is on this pedal he need not consciously move his foot at all—it will happen quite naturally as he leans forward. The only other piece of gadgetry to make live playing easier is a remote box which is being designed and built for me by Phill Pearce of PJ Electronics, who has given a great deal of help and advice on my various problems with this set-up. This box includes remote triggering circuits, microswitch portament control, remote switching for the mixer, and two xy controller joysticks for activating specific functions on the Moog. This means that I rarely need to touch the machine itself during a performance, as all the most important functions are mounted on the keyboard and are well within the reach and vision of the musician.

Quite often the other instruments in the band are fed through the synthesizer varying their sound in terms of pitch, frequency range and dynamics. Using a pitch to voltage converter our guitarist can play the machine himself, although this requires a great deal of careful setting up and is limiting to a guitarist's style.

### Part 2: Synthesizer in the control room

In the second half of this article many of the less conventional ways in which a large studio synthesizer can be used are covered. I have included a few suggestions that the engineer/synthesizer player will find practical, given the right synthesizer set-up and an adequately equipped control room. These suggestions are given with the hope that they will stimulate the engineer/musician in this field to experiment in a less conventional direction, extending the uses to which such machines have hitherto been applied.

A few examples are mentioned which I have used myself on many occasions and can vouch for their feasibility. Specific 'patches' have been omitted, as have control settings, because many of these are more easily set by ear and there are often slight discrepancies in knob positions between machines of the same type. I should like to make it clear that although my own synthesizer is the only one that I have worked with in this capacity, there is no reason to suppose that the same schematics would not work for any other sufficiently well equipped studio synthesizer, such as the larger ARP, the EMS Synthi *100*, or the less familiar RCA or Buchla-box synthesizers. My own preference for the Moog is based on its physical durability (it has spent many hours in the back of trucks getting bumped around and being handled by unsympathetic roadies, and has always been perfectly in tune and in full working order on being hooked up at its destination). The other points in its favour are the dependability of its electronic circuitry under many different temperature and humidity changes and conditions produced under stage lights—and also its ease of maintenance and accessibility, and its simple but effective patching system. I am not one of those to complain about the working areas of the machine being covered by a mass of 'spaghetti', a complaint I've heard many times about the Moog and have always ignored; however, I have modified my own machine with internal switching to cut down this mass of cables to a certain extent. The only trouble found is when patching a complex figure on the sequencers when many cables are needed, and they all tend to hang down in front of the upper bank of electronics.

Not all the sections of the conventional synthesizer are of use to the engineer. The oscillators and vc filters, command and audio-voltage mixers are of little use except in more conventional music-patching. The devices with which this article is primarily concerned are the level changing ones—the voltage-controlled amplifiers. These, when used with particular control sources such as the envelope-generators, pitch to voltage units and low frequency oscillators, become very efficient level-contouring devices. The design of the *3c* is such that the inputs and outputs of all the modules are at standard line-level, the vc amps having an input impedance of 10 kΩ and an output at 600Ω at line voltage. Thus there is no problem with interfacing with a conventional mixer-desk patch-bay.

The amplifiers can be used either in balanced or unbalanced mode. Both inputs and outputs are so designed that the phase of the input signal can be split for control-voltage purposes, the pattern being the conventional 'push-pull' configuration. The advantage here is that unbalanced signals can be put in or taken out of either side of the amplifier, or balanced signals processed directly. The maximum voltage gain is 6 dB, the range being greater than 80 dB. There now follow some suggestions which can be developed to suit individual requirements. All are concerned with remixing, and have been used with great success on a number of different sessions.

### Automatic panning

For this, the signal to be panned is split into the inputs of two vc amps (**fig. 1**), the output of each being taken to left- or right-hand side of the stereo image. A low-frequency oscillator tuned to about 1.5 Hz is fed into both control inputs, having first been split into phase and anti-phase so that the positive going cycle is triggering amp one, while the negative going cycle is muting amp two, and vice-versa. For a clean sweep across the stereo image, a sine waveform must be used, but it is worth experimenting with other combinations, especially pulse or squarewaves, as these can switch from right to left very effectively, although some circuits give rise to audible clicks as the amps are switched in and out.

60 ▶

FIG.1 AUTOMATIC PANNING

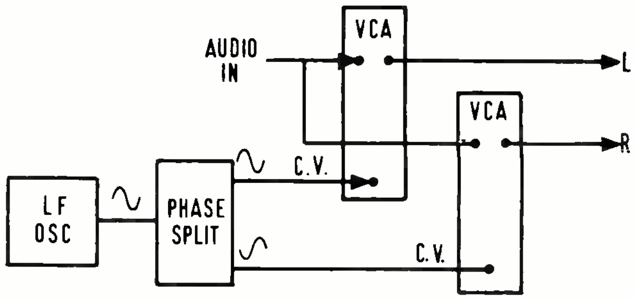



FIG.2 NOISE GATE

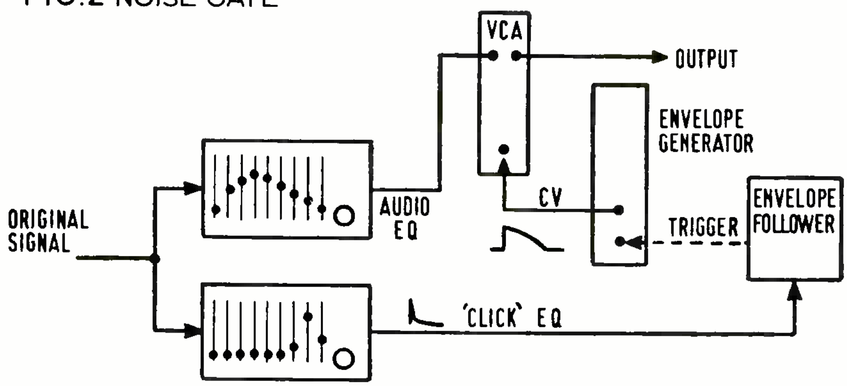
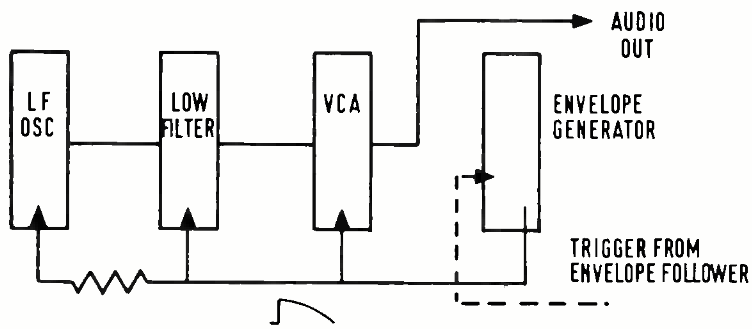



FIG.3 BASS DRUM




**Noise gate**

For this application, the vc amplifier is triggered by an envelope generator (see **fig. 2**). This device has been found in practice to allow for a far greater sensitivity and variability of release-time etc than conventional commercially-available noise gating devices such as the Kepex. The envelope-generator must be triggered in the normal way, either by an externally applied 'keying' voltage, or the direct signal itself. This is done with an envelope-follower such as that available on the *3c*, or the one in the EMS pitch to voltage device. The latter has the advantage of an indicator-light that shows the input trigger-point sensitivity, a very useful feature omitted from the Moog design.

An example in which this circuit was used was when presented with the difficult problem of re-applying a respectable contour to an over-limited bass-guitar. The bass guitar signal was split into two equalizers, the first to give the normal equalisation for the bass (if necessary), the second to exaggerate the plectrum or finger 'click' at the beginning of each note. This click-signal is the one used to trigger the envelope generator and start the contour-cycle. Although experimentation was with an ordinary noise-gate, a single release control was found insufficient for providing a natural-sounding contour to the guitar signal.

**Replacing snare or bass drums**

There are unfortunately many times when one is faced with a mix involving an unsalvageable bass or snare drum, usually due to the quality of the drum used in the original recording. The only thing left to the engineer is often total replacement of the track. Another unfortunate situation arises when the rhythm of the bass drum is not as accurate as it could be. It is often the case with very tall drummers that, although the rest of the kit is in perfect time, the nervous impulses take so long to reach their feet that the bass drum is completely out of time . . .

In using the synthesizer to manufacture a new bass-drum sound (see **fig. 3**) the signal can be manually re-applied to the track using a trigger, usually the keyboard. If it is only the sound of the bass drum that is wrong, the old track being replaced can be used automatically to trigger the Moog (this supposes the rhythm to be correct). To use the original bass-drum rhythm, the individual beats must be converted from the audio signals of the multitrack tape into trigger-signals which are needed to start each cycle. The same principle is used to re-make a snare drum, although the patch is rather more complex, and must be devised to match the overall sound of the kit in order to sound authentic. Despite its misleading name, a synthesizer cannot successfully duplicate any musical instrument, merely approach a similar timbral quality.

**Effects**

As an effects box, a studio synthesizer has no equal. Using a pitch to voltage converter, the pitch or level of an instrument, providing that it has a fairly low harmonic content, can control any variable parameter of the synthesizer. It will become obvious that, using this principle, the pitch or level of an instrument on one track of the multitrack tape can control the level or filter frequencies of another.

Further sound treatments using voltage controlled filters can be very effective, for example a string or brass section through a low-pass vc filter with a high regeneration setting, or through a high-pass and a low-pass filter with coupled control signals. In this patch, the filter frequencies and bandwidth should be carefully adjusted to suit the programme. This is a very exciting sound, its one drawback being that there is only one filter input and one output available when coupled.

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Dear Sir, I understand Hugh Ford has commented adversely in his review of the AEG Telefunken Professional Studio Tape Recorder Model *M12* machine in respect of two shortcomings in the logic circuits associated with the pushbutton controls.

These shortcomings manifest themselves as follows: a) the unintentional pressing of the 'record' button energises the erase and record heads, thereby possibly damaging a master recording; b) when, in the fast spooling mode, the stop button is pressed and the play button is pressed immediately thereafter a tape loop is thrown.

The purpose of this letter is to inform you that our Principals, AEG Telefunken of Konstanz, West Germany, have notified us, in response to these criticisms, that steps have now been taken to eliminate these shortcomings on forthcoming production models. Such models will incorporate the 100 per cent foolproof logic system of the *M15* series of machines.

The incorporation of this refined logic control system into the *M12* machine will now make it possible for us to supply equipment which will combine unrivalled electrical performance with a pushbutton control system fulfilling the most critical user requirements.

I very much hope that you will be able to append a suitable footnote to Mr Ford's report.

*Yours faithfully*, K. E. Owens, Managing Director, Hayden Laboratories Ltd, 17 Chesham Road, Amersham, Bucks. UK agents for AEG Telefunken.

*Sorry. In principle we should have checked this information, which was accepted at face value*—**Ed.**

---

Dear Sir, In your February issue a description of the equipment installed at Grosvenor Studios refers to a failure of KEF tweeters in Spendor *BC*3 Monitors. I should like to make it clear that KEF tweeters have never been fitted in any Spendor Monitor Speakers and could not therefore have been responsible for the premature failure and inadequate power handling capacity referred to in the article.

*Yours faithfully*, Raymond E. Cooke, Managing Director, KEF Electronics Ltd, Tovil, Maidstone, Kent.

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Dear Sir, I discovered that there were errors in two of the diagrams which accompanied my article in the April 1975 issue of STUDIO SOUND, for which I apologise.

These were: Fig. 11, $TR_{12}$ and $TR_{22}$ emitters should have been shown as connected to the output line. $TR_{21}$ and $TR_{22}$ are BC212 and MPSL-51 respectively, the 1k pot in the emitter circuit of $TR_5$ should have been labelled 'set quiescent current to 60 mA', and a 220 pF capacitor should have been shown connected between $TR_7$ collector and $TR_7$ emitter.

Also, in Fig. 1, the phase correcting capacitor in the first stage anode circuit should have read 2 nF not 2 μF!

*Yours faithfully*, J. Linsley Hood, British Cellophane Ltd, Bridgwater, Somerset.

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## THE SYNTHESIZER ON STAGE AND STUDIO

It's worth experimenting with separate uncoupled filters with a common command signal, but the stereo image might become a little lopsided unless the overall panning is done with great care. A more conventional use for these types of vc filters is the straight 'wow' or 'skying' effect, depending on the polarity and frequency of the filter notch.

### Automatic mixing

This is a brief account of how a large studio synthesizer is able to perform this dramatic-sounding operation. There are many limitations involved—far be it for me to suggest that merely by hooking a Moog up to your mixing console you will achieve results equal to the wildest dreams of the boffins responsible for the API and Quad/Eight systems, but given enough Moogs, you could certainly get very close. All we are here concerned with, however, is level.

The number of tracks you can re-mix using this system depends on the number of voltage controlled amplifiers and sequencers you have at your disposal. The sequencers provide the root of this particular function. The patch described here uses only one of the two sequencers available on my own machine, which is more or less a standard model still.

Twenty-four preset levels are available, divisible between three tracks (more amps, more tracks). During the course of a single mix it is therefore possible to control the levels of the three most frequently varying tracks over a range of 80 dB—sufficient for most mixing purposes, hopefully. Using only one sequencer, these three tracks can change levels at eight predetermined points (16 if two sequencers are used). These points can either be triggered manually by the engineer or, if there is a track free on the multitrack tape, they can be logged by an audio tone burst. This would be converted into a trigger pulse by the interface device on the Moog.

Each control on the sequencer becomes the level control for its respective amplifier when that column is energised. Each vertical column of three is energised manually by pressing the relevent button during the initial setting-up. Once the levels are determined for that particular mix (+dB, −dB or no-change) the sequence is 'shifted' as the tape is run. A small drawback is that these controls are only very simply calibrated—the normal use of these being to set pitch enabling the sequencer to 'play' a cyclic melodic pattern. A white light appears above each column as it is energised in turn, the device being designed so that no two columns may energise simultaneously. Thus, each programme point is distinctly visible as well as audible as the sequence is run.

This in its barest form is the method by which the Moog can assist in the actual mixing process itself. For what it does, the equipment used is very expensive, although not much more so than conventional automatic devices. The modules used in the Moog design are all 'studio-quality' (whatever that means) and all are held to demanding specifications. The principles laid down here can be developed and experimented with at will by experienced and adventurous engineers in the pop field, these few simple ideas being only the skeleton of the available possibilities.

The synthesizer operator is at the beginning of a great new age, when it comes to the expanding possibilities available using voltage control techniques. Far from being the beginning of a musical Industrial Revolution with its threat of computerization and mass unemployment for studio staff, voltage and digital devices will make the engineer's life more interesting in terms of his capability. All right, so it does mean more little knobs to twiddle and meters to disturb our peripheral vision, but at the end of the session we aren't judged by how many ornate black-boxes we can harness together, or how few, but what the master sounds like. I welcome anything that could make that sound a little bit better, a little bit easier to arrive at.

I would like to thank Valac de Vine, lead guitarist with Heaven Spy-Finger, for his very considerable help in getting this article together.

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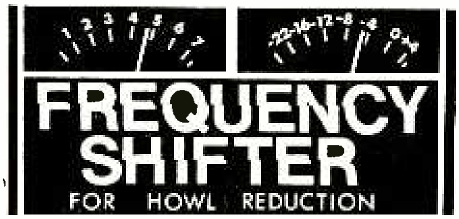


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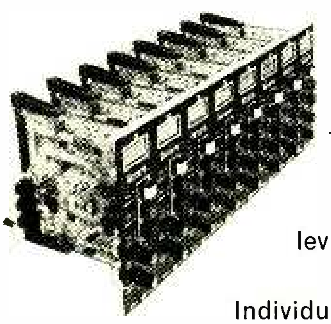

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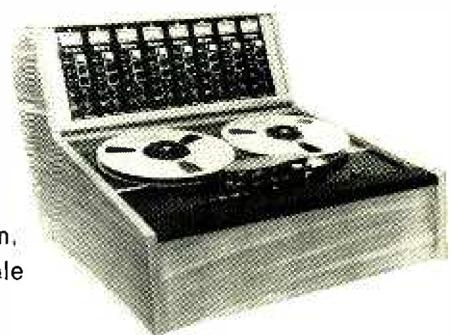

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