

January 1985

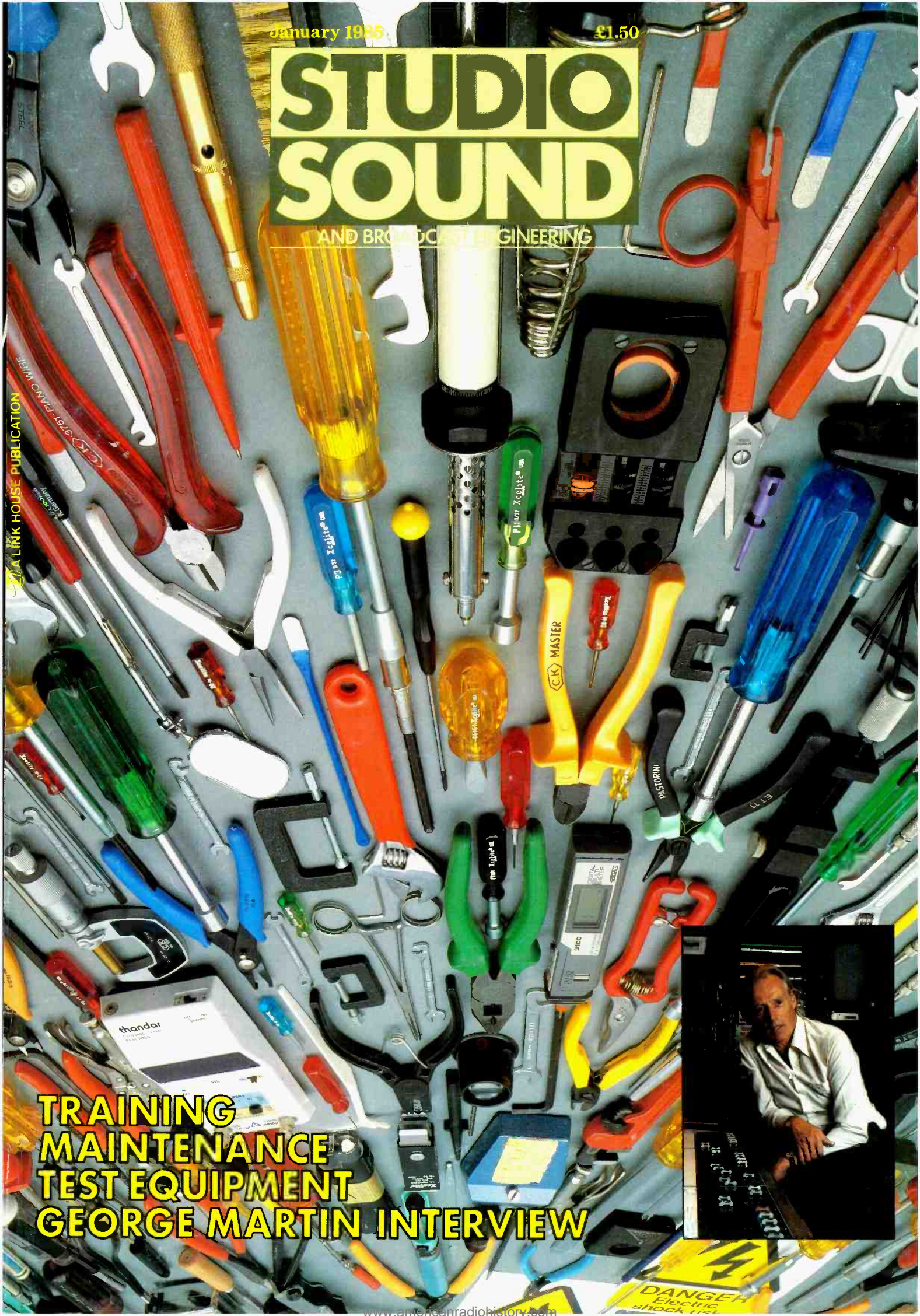
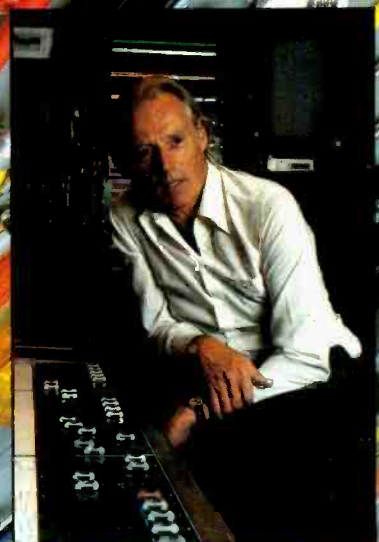
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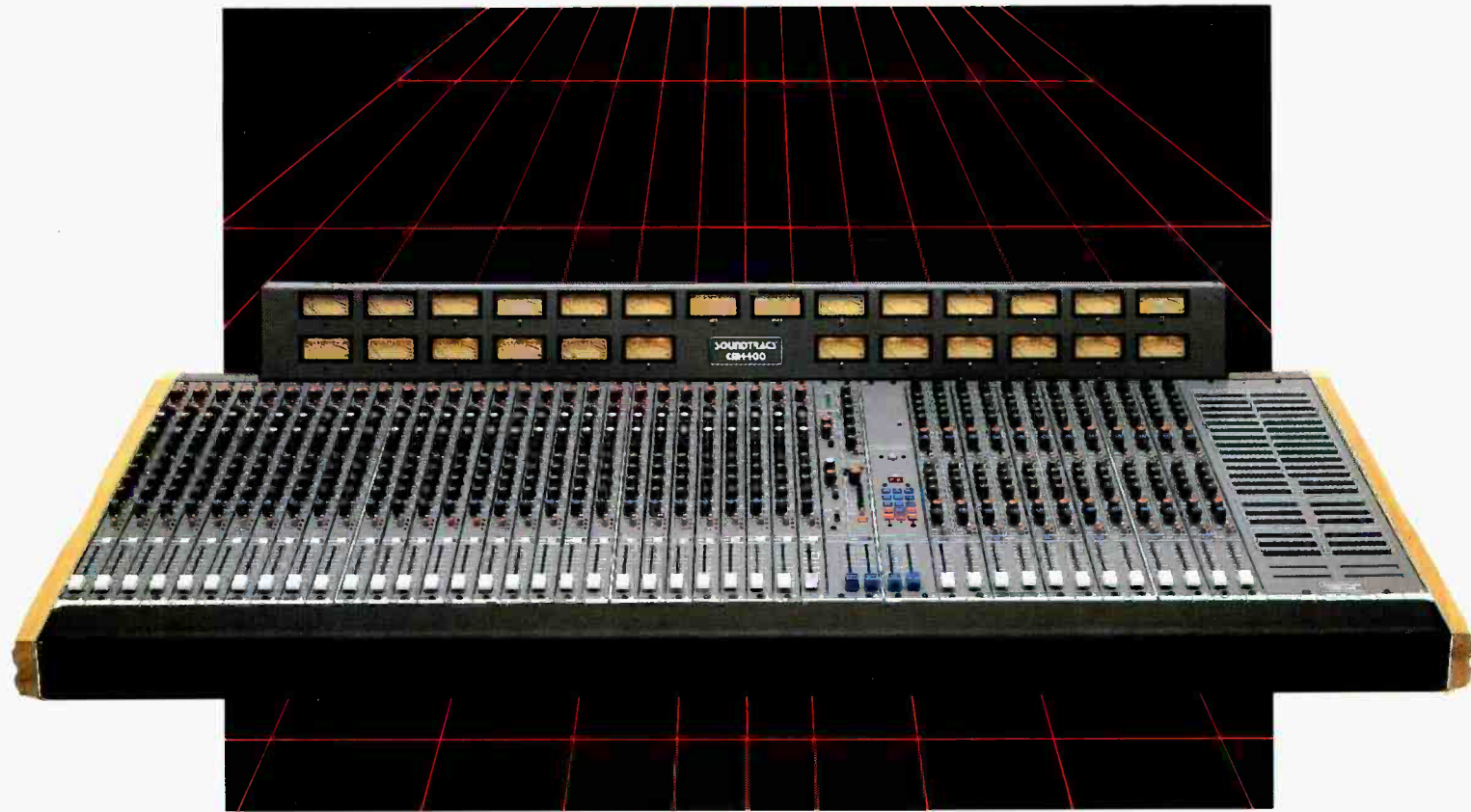
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**TRAINING
MAINTENANCE
TEST EQUIPMENT
GEORGE MARTIN INTERVIEW**



CM4400

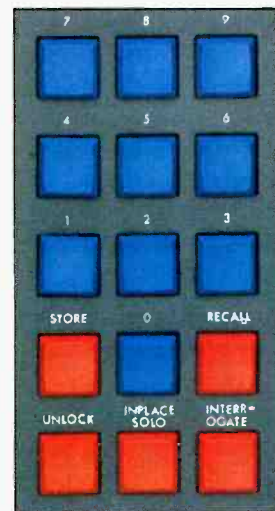
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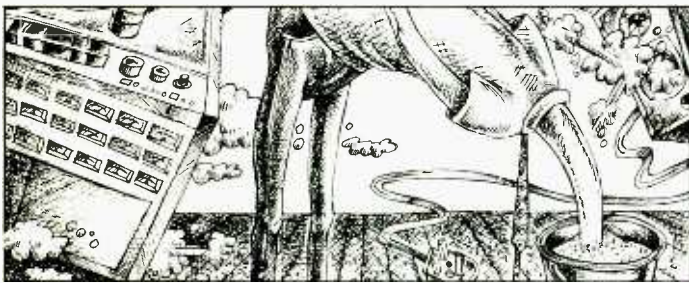


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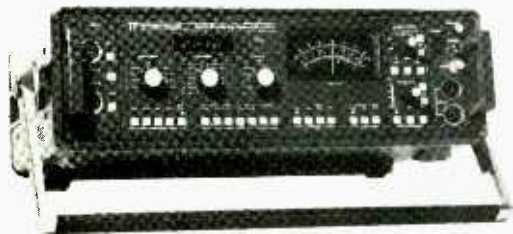
SPECIAL FEATURES

- 34** **Training—Tonmeisters in industry:** Janet Angus finds out how some of the graduates of the University of Surrey's Tonmeister course have been getting on
- 40** **The role of maintenance:** Maintenance engineer Pete Clark demonstrates the need for a good back up department to keep studio equipment in working order...



- 44** **Tooling up:** ... and to help keep things running smoothly, Tony Arnold tells us we need the proper tools

REVIEWS



- 72** **Technical Projects MJS 401D:** An audio measuring system reviewed by Hugh Ford
- 80** **Neutrik Audiograph 3300:** Hugh Ford reviews this audio/acoustic analysis system
- 90** **Wayne Kerr AMS1:** A user report from Martin Colloms on this item of test equipment

FEATURES

- 48** **Electronic assistance for film scorers:** The *Rhodesystems II* is a newly developed program to take care of the calculations necessary when post-synching, by Robin Lumley
- 56** **The producer series—George Martin:** One of the world's best known producers talks to Ralph Denyer in part one of this two-part feature
- 70** **Insights:** Richard Elen comments on the use of computers in the modern studio

REGULARS

- 5** **Editorial:** Education or training—is there a difference and do they have any place in the industry?
- 30** **New products:** B&K test equipment—Bel BD80 addition—Gripmate third hand—Eventide Harmonizer—SSL broadcast 5000—Quad power amps
- 50** **Diary:** Music scoring system—SSL for China Records—Direct supply for Peavey—QEW Eastern US office—Address changes—Forthcoming events—Contract—People—Soundcraft/GML and Amek/GML agreements—AES Convention policy—In brief—Agencies
- 52** **Business:** Product launch—LA digital
By Barry Fox
- 68** **Studiofile:** Cabaletta Recording in Hertfordshire specialises in speech and classical music



EDITORIAL

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Ann Horan

Consultant:
Hugh Ford

Contributing Editor:
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COMMERCIAL MANAGER
Phil Guy

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Editorial and advertising offices:
LINK HOUSE, DINGWALL
AVENUE, CROYDON CR9 2TA,
GREAT BRITAIN
Phone: 01-686 2599
International: +44 1 686 2599
Telex: 947709

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A LINK HOUSE
PUBLICATION

Publisher and consultant to
APRS for Studio Sound's
Producer's Guide to APRS
Members 1984/85

January 1985 Number 1
Volume 27 ISSN 0133-5944

Graham Gouldman has recorded in the world's best studios.

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Graham Gouldman, as a leading member of 10cc, has recorded in many world-famous studios, and certainly knows what makes a good recording, and also when he's achieved one. "But," he says, "I've always felt that the most creative recording environment is at home, in one's own space and in one's own time."

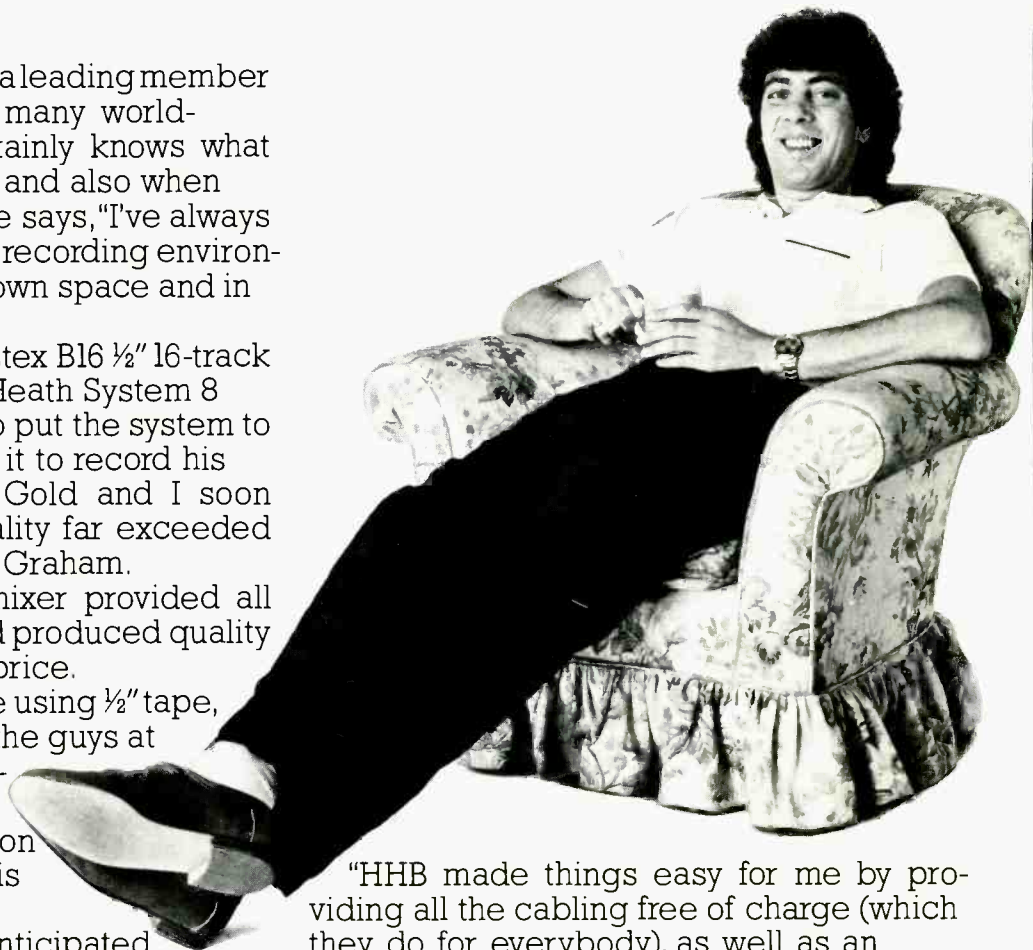
When he bought a Fostex B16 ½" 16-track recorder and an Allen & Heath System 8 16/16 mixer, he decided to put the system to the ultimate test and use it to record his current album. "Andrew Gold and I soon found that the sound quality far exceeded our wildest dreams," says Graham.

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EDITORIAL

EDITORIAL

This month's comment from Keith Spencer-Allen

Education or training

Those of you who consider yourself to be at the 'sharp' or 'creative end' of the recording business may consider the topics that we cover this month to be of only passing interest. It should not take more than a few seconds of your time to be convinced that test equipment may not have the glamour quotient of the average outboard digital signal processor but it enables your creativity to maintain technical standards; and likewise, maintenance may seem just an unpleasant necessity but it allows your creativity to be regularly realised. All basic points really that need little further labouring.

The third topic this month is training and here I would tend to agree with the boys at the sharp end. Training is something that magazines write articles about and associations discuss while the majority of the industry expresses only a passing interest as they proceed with the business of making a living. It often seems that the only people who pay any more than lip service to training are those who stand to gain in some way, either in the form of knowledge or financially from providing that knowledge; in other words, the teachers and the taught.

Although I used to quite enjoy passing on any knowledge I had to junior colleagues in the studio, the concept of training as such never held any real interest—that was for those trying to get into the industry—we were in it! My attitude has changed somewhat from this stance over the last couple of years for two quite differing reasons.

The first is that an increasing number of engineers are non-technical often having come from a musical background (all engineers should do to a degree) and wear their non-technicality proudly. Although there is little to prevent such people being excellent engineers, there may be problems when such engineers are required to pass on their knowledge in the training of new staff. Often limited styles of working and bad practices are passed on and perpetuated. There is also the added problem of the distinct lack of house engineers at some studios to pass on any knowledge—good or inaccurate. It seems that there is a need for some improvement of this situation.

The second reason I have come round to the value of training in some form, is that I did not care greatly for some of the things I saw being passed off as training by either ill-informed or unscrupulous parties outside the industry. This state of affairs has become so because of the lack of interest expressed by us within the industry to these goings on. Of course not all courses are bad experiences but it is too easy for anyone to set themselves up as a school for recording knowledge, there being so many desperate potential students who are willing to be parted from large amounts of money (in some cases) in the belief that courses will in some way make entry into the recording industry easier. There is little done to tell these potential students that the reality just isn't like that. The one thing positive about the traditional in-studio practical training and the extreme difficulty experienced when searching for such an opening within a studio, is that it at

least matched supply and demand for recording engineers which training programmes external to the industry cannot hope to do no matter what they claim.

I am therefore now of the belief that it is essential for the recording industry to become involved in training schemes of some form although quite what form this should take I am not sure. A few weeks ago I was discussing this topic when a comment, a very obvious comment, was made (I'd credit the person if I could remember who and when it was) that really explains and clarifies the situation. 'Don't confuse education with training' was the statement—it stares you right in the face.

Training is of course the preparation of a person for a specific task or job. I can see little point in training in this specific form without the end result being employment in one's trained field.

Education I see as a far less channelled discipline that goes beyond simple single-role training and covers theory, associated subjects, practicalities in such a way as to give far broader grounding in the recording sciences. As with the more academic courses/degrees offered by all forms of higher education it is often seen that such a course could be an end in itself and not required to be a high powered pre-employment scheme. We do however live in the real world and graduates of such a scheme will be of use only when their knowledge and abilities can be assimilated and used in a practical manner by the industry which often has no specific demand for such trained people at present. They must also only be presented to the industry in numbers that they can usefully integrate. A further point is that many studios have very specific personality requirements of potential employees and there is no reason for these requirements to be waived just because they have some specific training/education.

It seems that the industry has to take more of an interest in tuition in some form although it may be that obtaining a definite job offer may have to be a prerequisite for training. More general educational courses will also have their place although perhaps as the industry stands, unless this type of course also comprises a high degree of practical experience, graduates may find it more difficult to obtain industry employment than someone with little to offer beyond a willingness to learn.

This issue sees the start of an occasional series in which we look at various education/training courses that we feel have something to offer both to the student and the industry. The first is a follow up to the article on Tonmeister training (June, 1983) at the University of Surrey in which the relationship of the course to the industry is studied. Future articles will cover other approaches although there are *definitely* no plans for regular Studiofile-type write-ups of courses.

The very mention of training in an editorial always brings a vast mail response—*always* from the course operators. I hope for a response from the industry itself. It may now be time. □

**STUDIO
SOUND**
AND BROADCAST ENGINEERING

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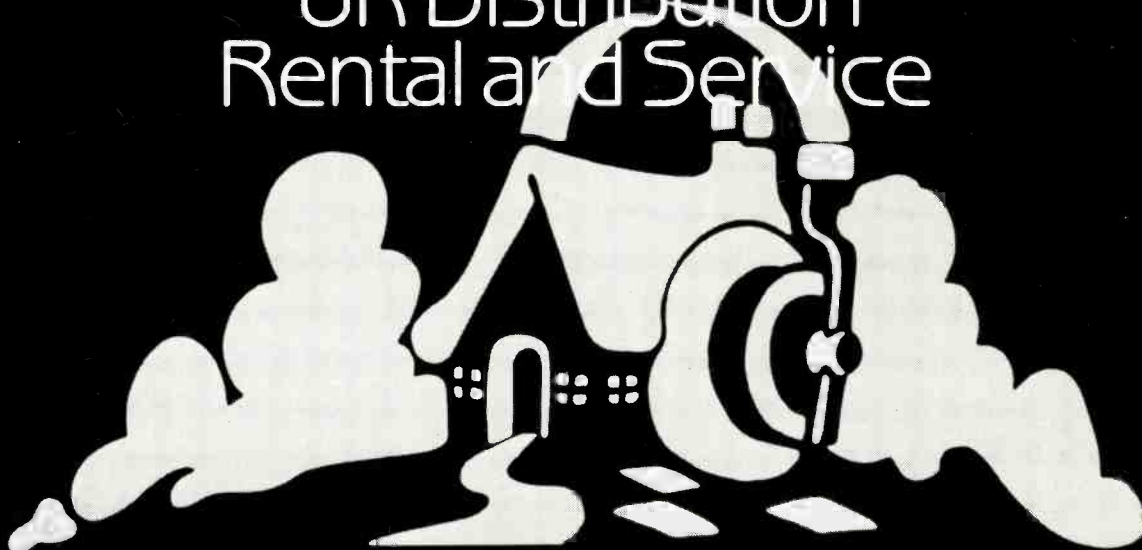
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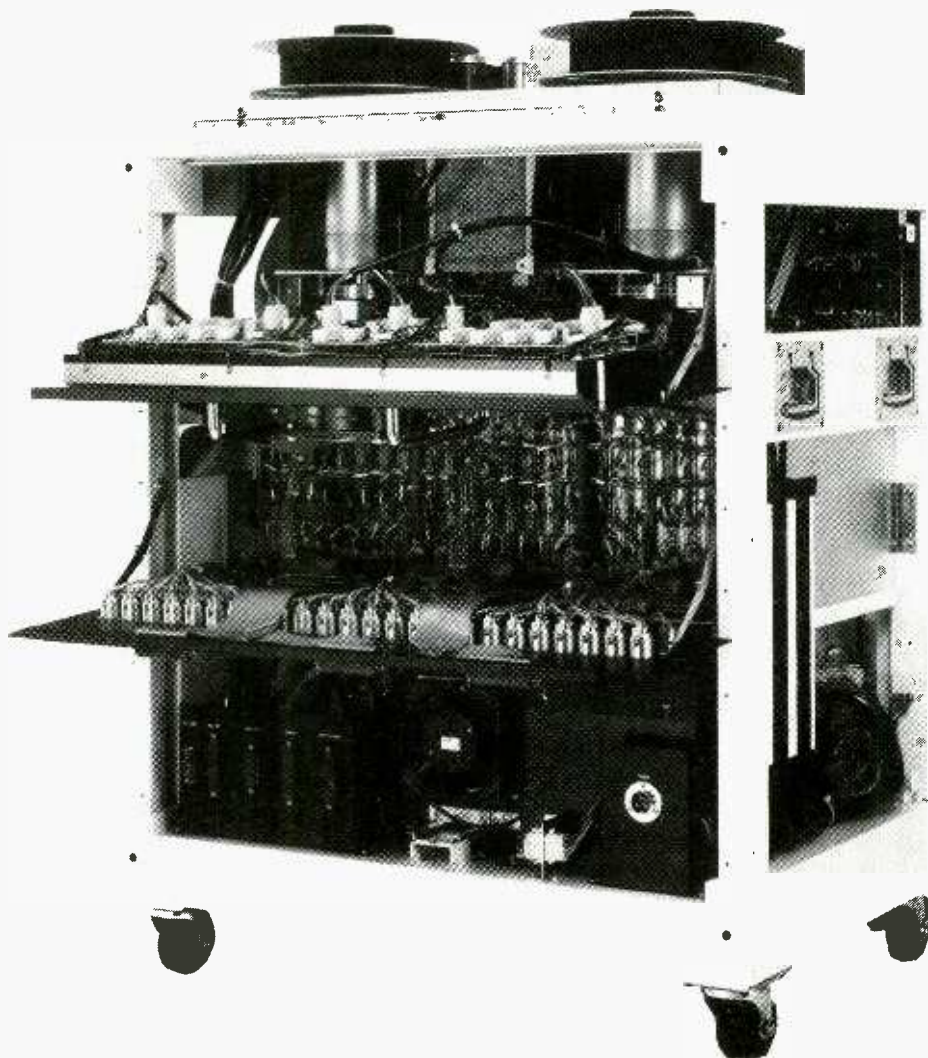
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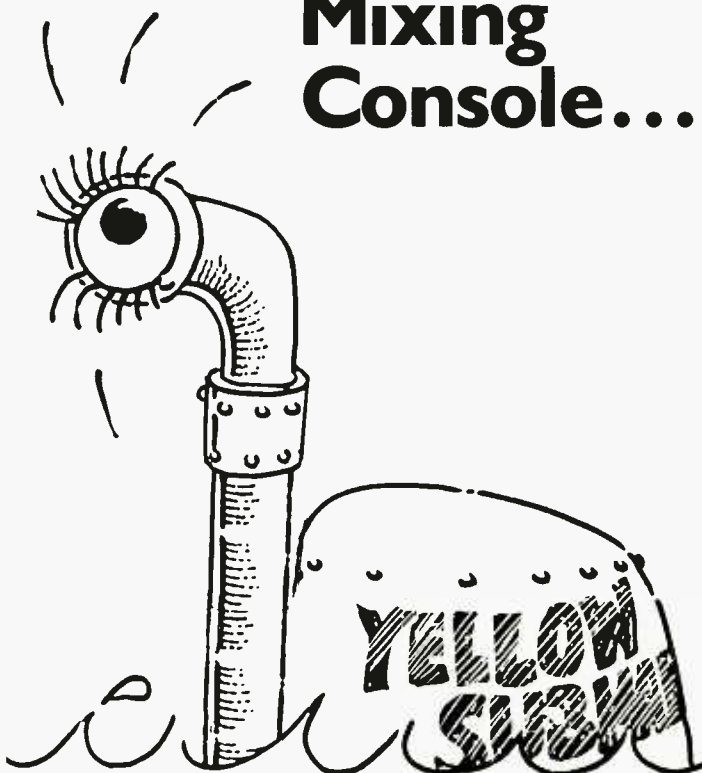


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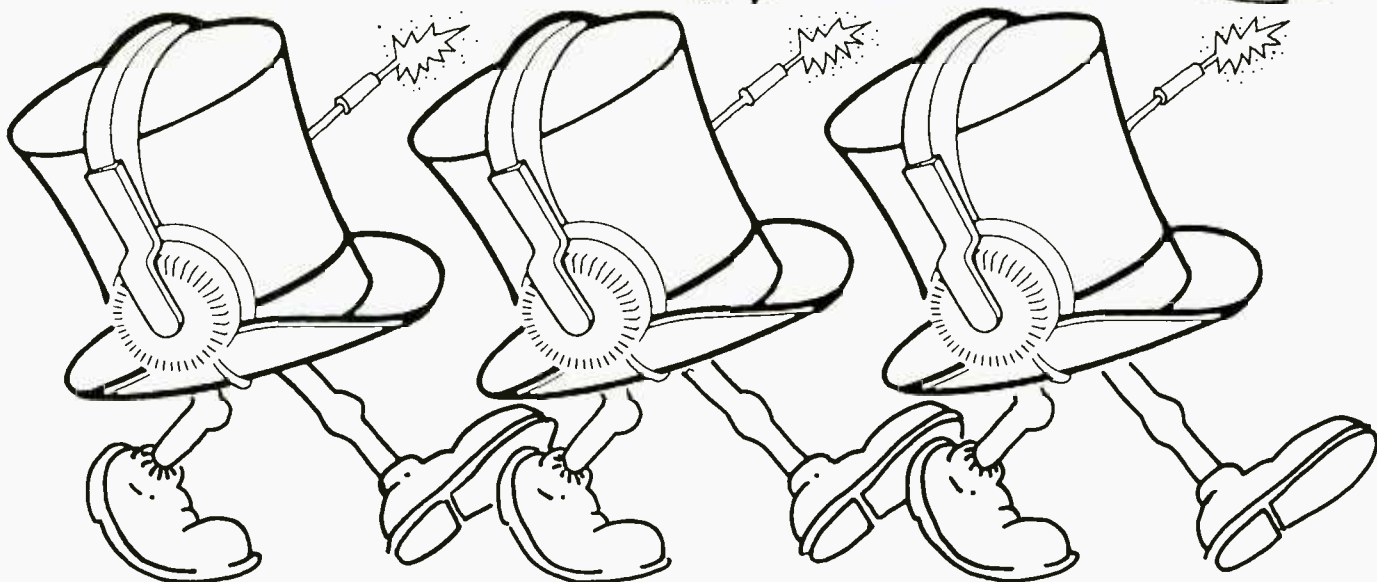
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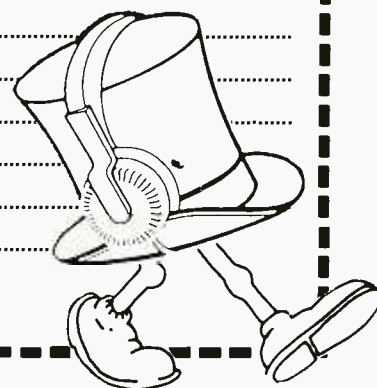
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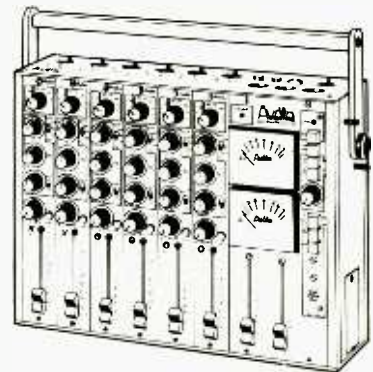




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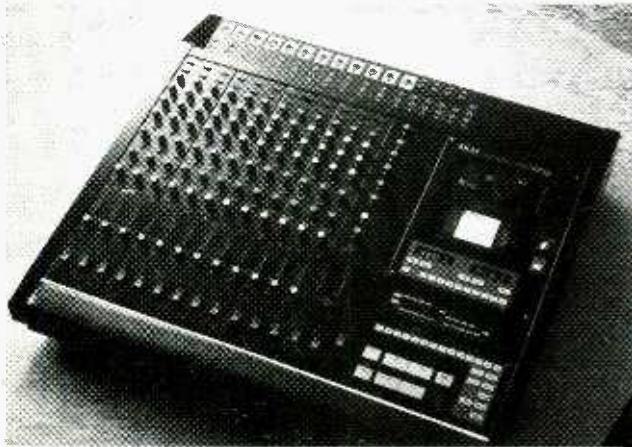


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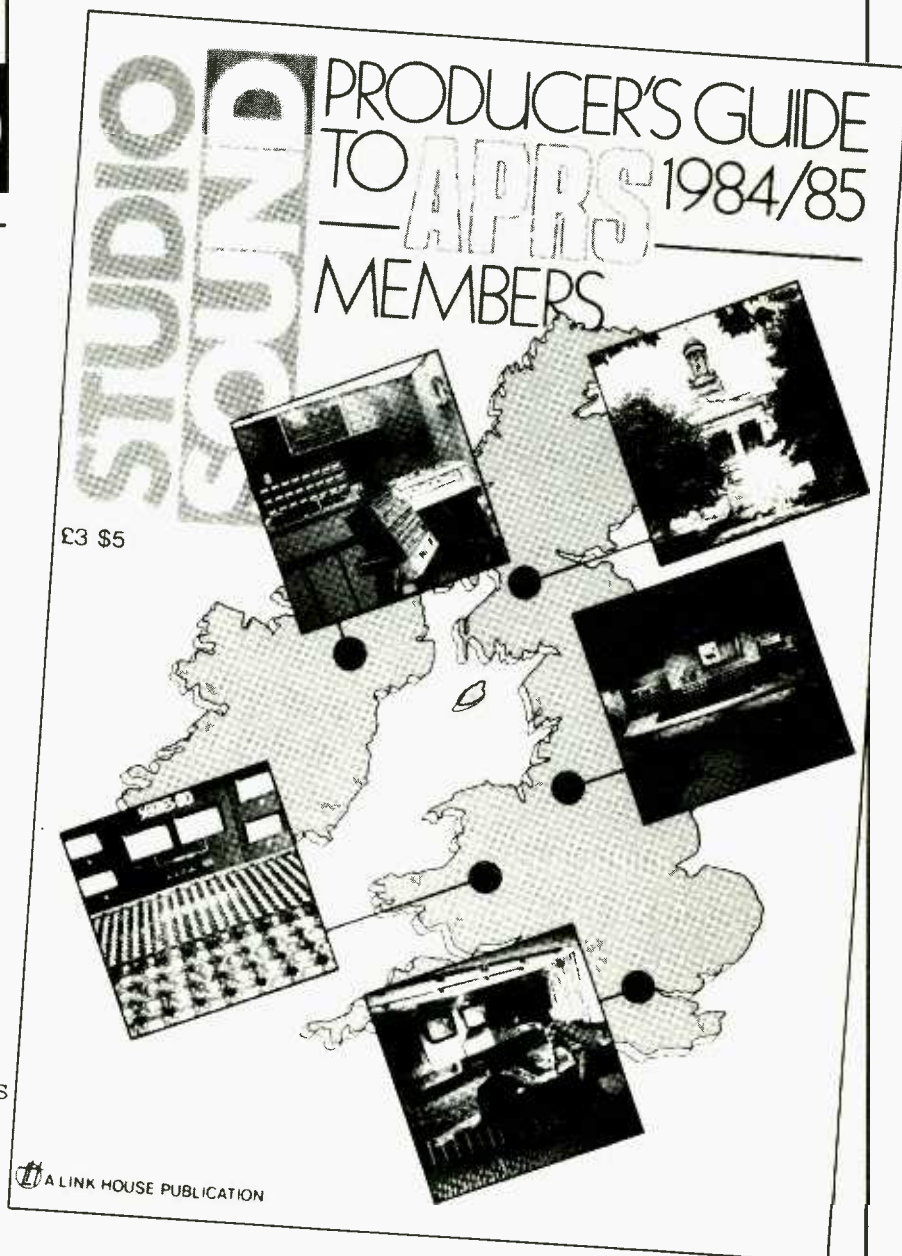
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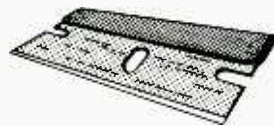
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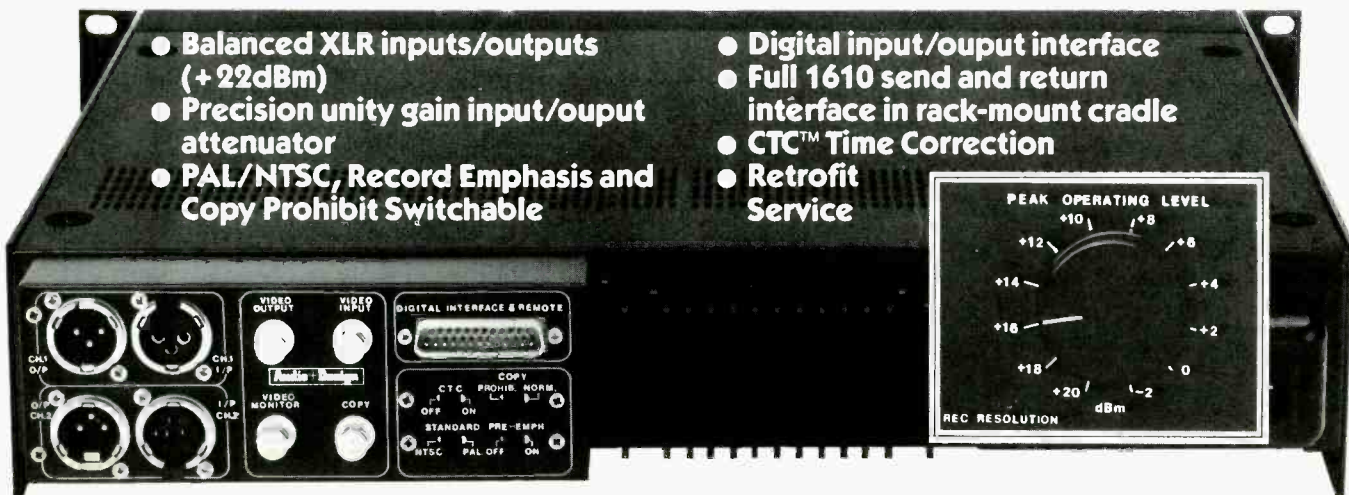
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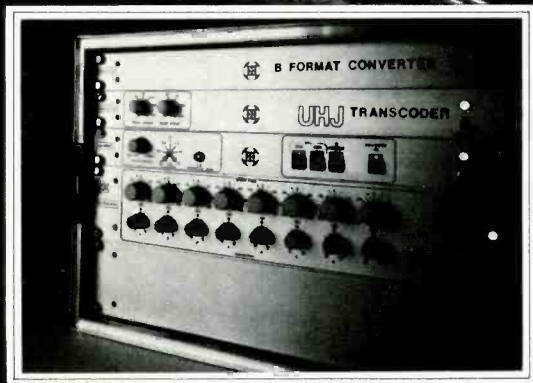
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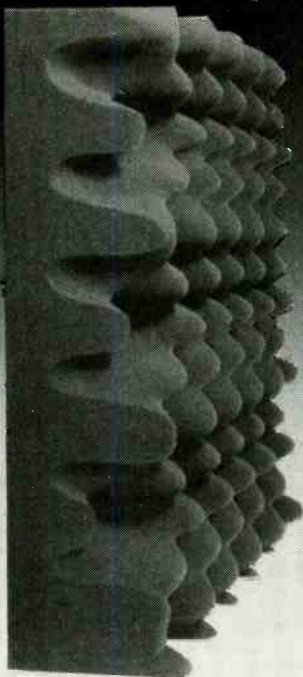
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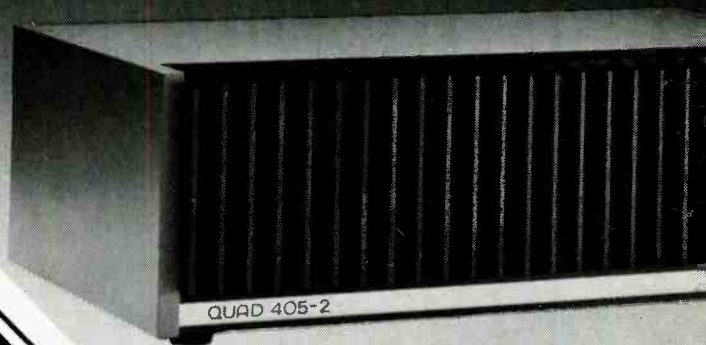
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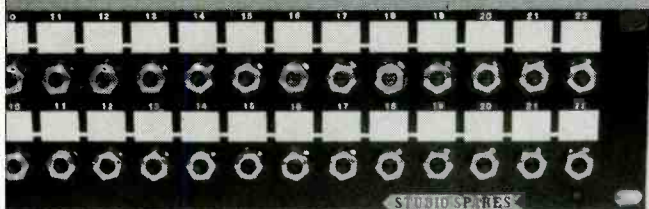
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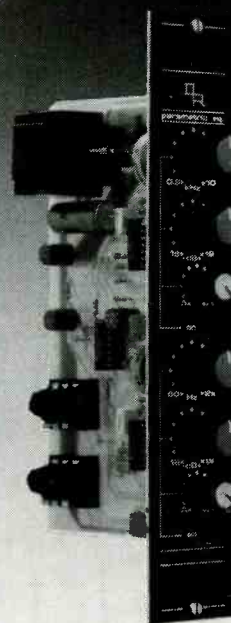
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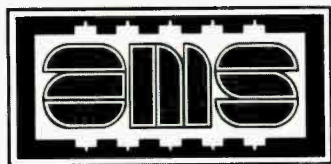
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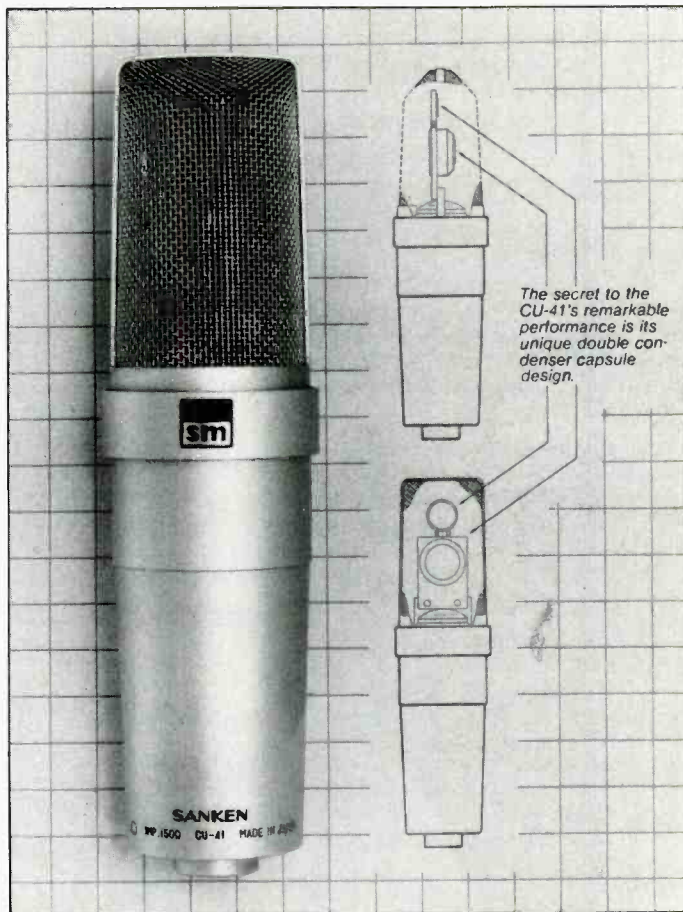
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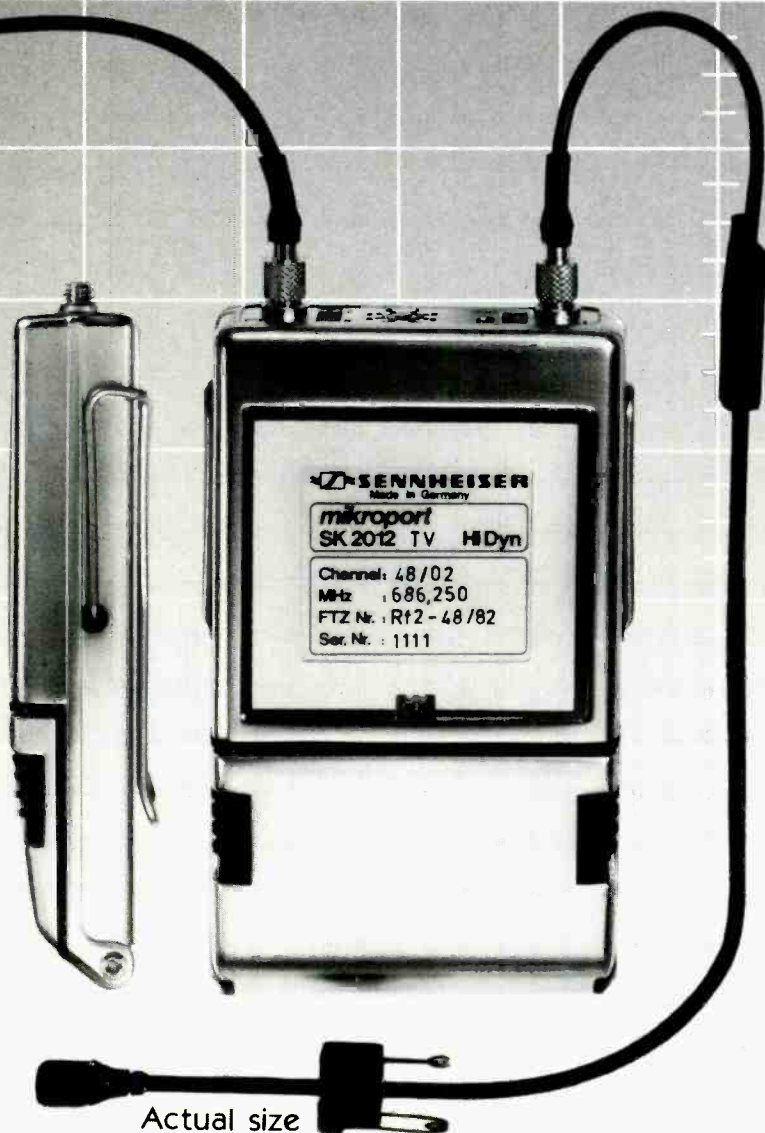
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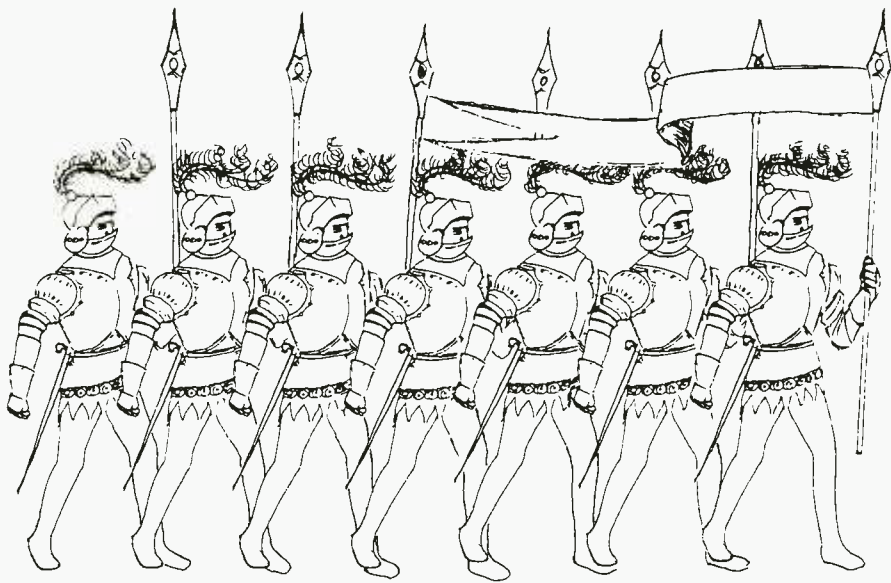
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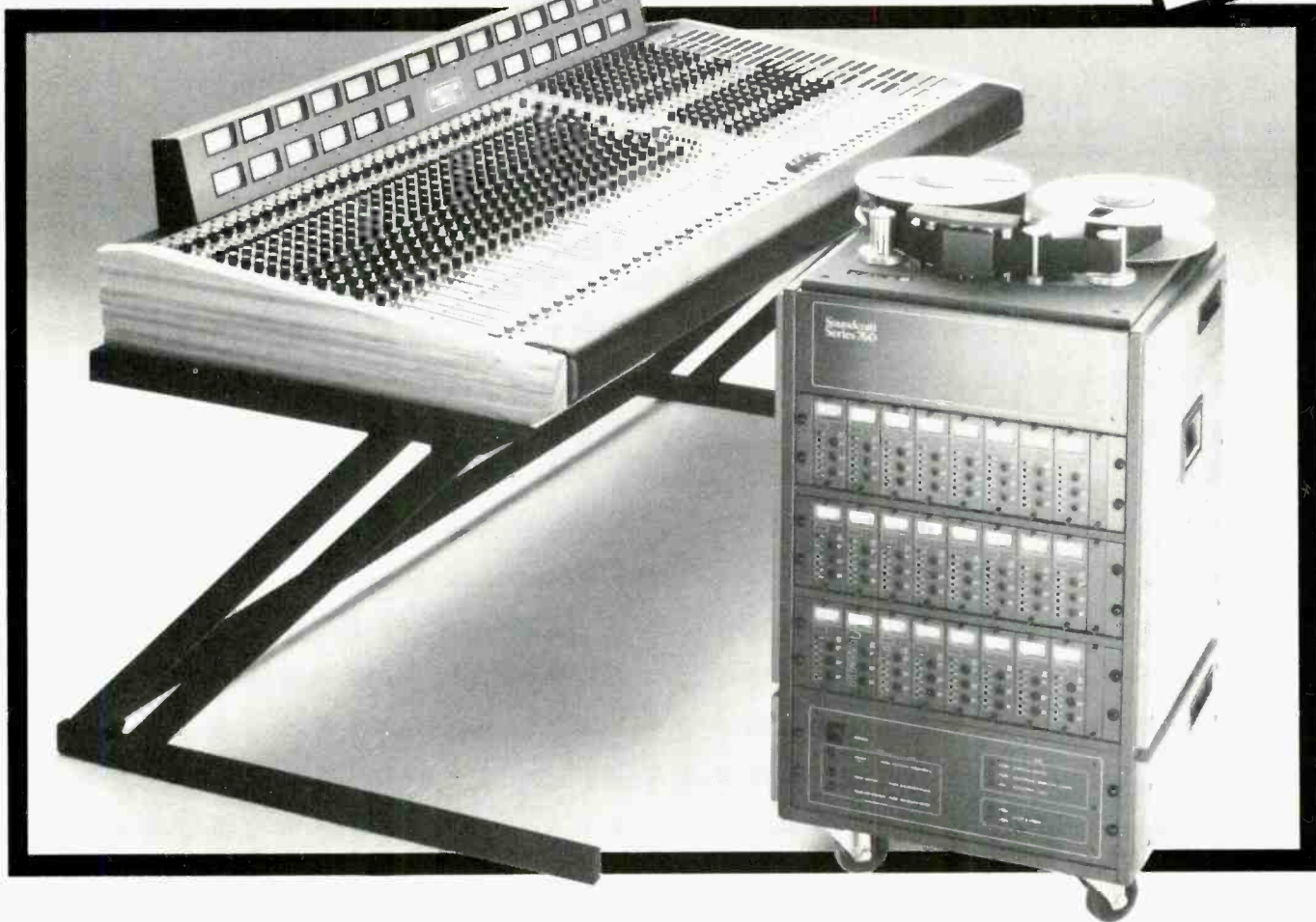
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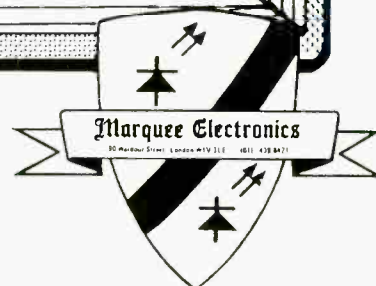
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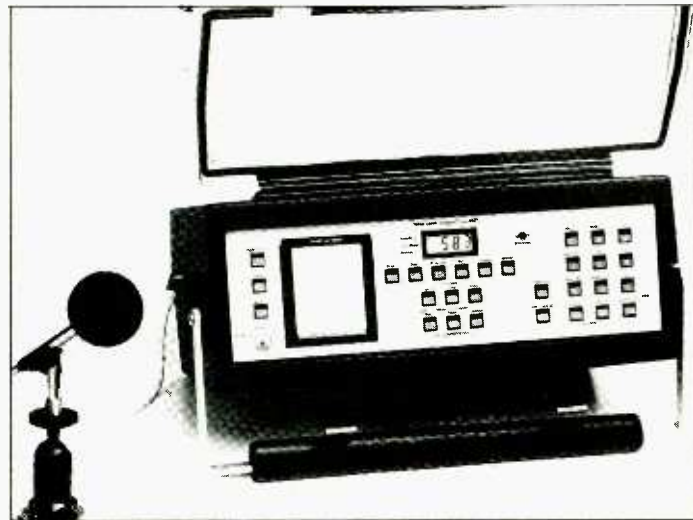
Type 4224 is a robust portable sound source consisting of a speaker with built-in amplifier and pink noise generator. It is capable of delivering up to 115 dB from 100 Hz to 4 kHz from its internal rechargeable batteries or up to 118 dB from a mains supply.

Kit type 3527 is a combined noise and vibration measuring kit that fits in a portable case. The kit comprises sound level meter 2230, 1/3-octave filter set, a vibration meter type 2513, a sound calibrator, adaptor, extension cable and portable meter mounting tripod.

Bruel & Kjaer A/S, DK-2850 Naerum, Denmark. Tel: 02 80.05.00. Telex: 37316.

UK: Bruel & Kjaer (UK) Laboratories Ltd, Cross Lances Road, Hounslow TW3 2AE. Tel: 01-570 7774.

USA: Bruel & Kjaer Instruments Inc, 185 Forest Street, Marlborough, MA 01752. Tel: (617) 481-7000.



B&K 4427 noise level analyser

Bel BD80 addition

Bel Marketing have announced that they have added a new facility to the BD80 digital delay processor, in the form of a loop reset system. Two extra switches have been added to the front panel, the first of which selects external or internal trigger while the second selects normal or reset use.

This update allows the loop to be retriggered by manual or audio trigger at any time.

Bel Marketing, 2nd Floor, 29 Guildford Street, Luton, Beds LU1 2NQ, UK. Tel: 0582 452495.

USA: Peter Tempel Music, 230 El Camino del Mar, San Francisco, CA 94121. Tel: (415) 751 2355.

Gripmate third hand

Kemplant Engineering Services have recently introduced a simple but clever accessory device that could prove immensely useful in many workshop situations. The *Gripmate* is intended to provide those 'extra hands' and consists of a base block that clamps to a bench or similar of under 1½ in thickness. The base block has provision for four semi-rigid stay-put insulated wires each fitted with a crocodile clip to hold the work in-hand. Should one of the wires not be required for gripping, there are two alternative arms available—one ending in a 2.5× magnifying glass and the other a small magnet where that would prove a better method of retaining the work in question.

The *Gripmate* is currently only available in Australia and Sweden in addition to the UK where it is supplied directly by the manufacturers.



The basic four hand kit is less than £5 in cost with the accessories being only a small amount more.

Kemplant Ltd, Durfold Wood, Plaistow, Billingshurst, West Sussex RH14 0PN, UK. Tel: 048 649 344.



Eventide Harmonizer

Eventide have recently introduced a new *Harmonizer* model, the H969. The unit employs what Eventide refer to as a digital intelligent splicing algorithm system more compactly known as *ProPitch*, claimed to deliver cleaner performance without glitching over a wider frequency range than before. Eventide have also used 16-bit PCM linear coding for the first time in a *Harmonizer*. A dozen pitch change presets have been included enabling the user to instantly set a precise minor third, major third, fifth, seventh or octave of pitch change. Further, each can be selected as a sharp or a flat with additional separate coarse and fine controls. Full bandwidth delay has been increased to 1.5 s with a further increase to 3 s at half bandwidth. The user can

choose and save any five delay times for instant recall with the full delay range being available in repeat and reverse modes. The delay and pitch ratios are displayed on separate readouts. Doppler and flanging effects are also available.

The H969 is intended as an addition to the range and will not replace any models. Eventide say that the H949 will remain a popular unit and it is better suited to time compression applications.

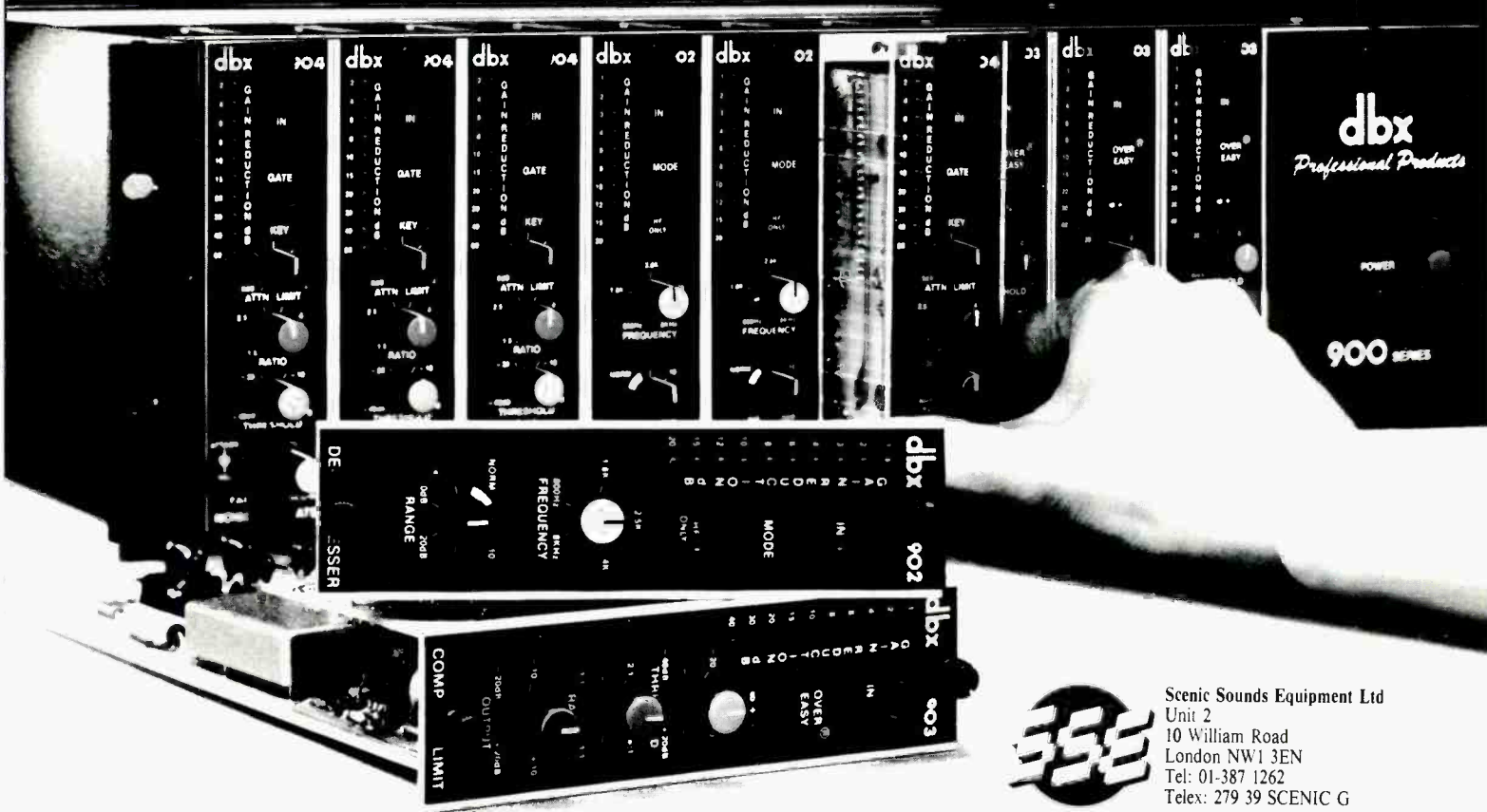
Eventide Inc, One Alsan Way, Little Ferry, NJ 07643, USA. Tel: (201) 641-1200.

UK: Feldon Audio Ltd, 126 Great Portland Street, London W1N 5PH. Tel: 01-580 4314. Telex: 28668.

UK: Marquee Electronics, 90 Wardour Street, London W1V 3LE. Tel: 01-439 8421. Telex: 894278.

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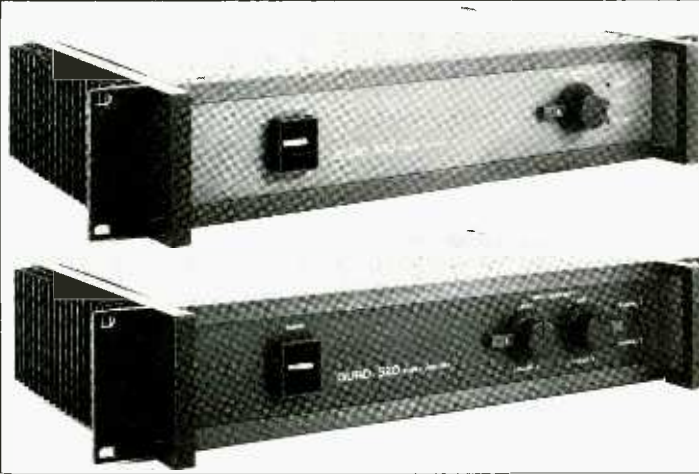
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NEW PRODUCTS

NEW PRODUCTS

Equipment, modifications, options, software



Quad power amps

Quad Electroacoustics have recently announced two new power amplifiers designed for professional applications. The 510 is a single channel amplifier with 600 Ω bridging input and a multiple tapped output transformer. It will deliver at least 100 W into any load from 2 to 100 Ω with the required matching being selected by a plug-in card; in addition to 70 and 100 V distribution systems. Both inputs and output are isolated so that the unit may be used as a power brick for linked

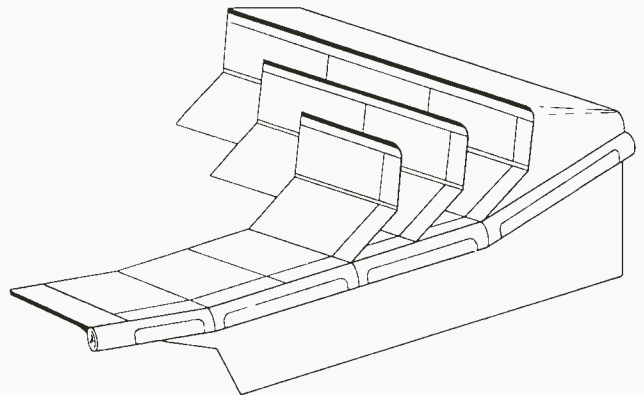
high power use.

The 520 is a 2-channel amplifier with power output of 100 W/channel into 8 Ω with optional balanced inputs. Both amps use a refinement of the Quad current dumping circuit. The construction is claimed to be capable of withstanding the most arduous use.

Quad Electroacoustics Ltd, Huntingdon, Cambs PE18 7DB, UK. Tel: (0480) 52561.
USA: Quad USA, 695 Oak Grove Avenue, Suite 3a, Menlo Park, CA 94025. Tel: (800) 227-9985.



SL 5000M Series showing expansion options



SSL broadcast 5000

SSL previewed their new range of broadcast consoles, the 5000 series, at the IBC Convention and AES New York. This was the first step in a completely new approach to console design for SSL and the 5000 should really be seen as a fully adaptable range/system rather than a single model. Although the SL 5000 M Series audio production system is intended solely for broadcast applications, it is worthwhile covering the major ideas behind this series.

At the heart of the 5000 is a new series of hybrid chips that replaces earlier 'op-amp plus components' type of sub-assembly. A single such SSL chip can provide a totally balanced and earth-free output capable of driving a 600 Ω load at +28 dBm and only takes about one tenth of the area previously required. This has enabled a substantial reduction in size, weight,

complexity and power consumption of the system. Further, the desks use a new audio control desk architecture with a system of modular mother boards distributing audio, logic and data buses throughout the console—that is, both horizontally and vertically. As a result main frames are available in standard widths between 16 and 56 mono or stereo input channels within a basic framework of three designs offering either 4, 5 or 6 horizontal buses.

The desk is modular but in the form of 28 different Eurocard audio and control cassettes. This together with the facility of horizontal and vertical busing, allows the user to specify virtually where every component is within the console. The compact size of the electronics has allowed control and data circuitry to be included within each basic cassette.

All switching within the console is electronic and this together with the busing arrangements means that the address lines to all cassettes can be master controlled regardless of their position within the console.

The range of cassettes and facilities available as part of the 5000 series will be more thoroughly covered in our sister publication, *Broadcast Sound*, however in basic terms the 5000 may be fitted with mono or stereo inputs, cassettes to allow up to eight stereo audio subgroups and four independent stereo outputs allowing for the creation of a number of mix minus feeds or splits.

The 5000 will be available with two levels of computer assistance. The first will be known as *Instant Reset* and allows the computer to store and reset all switch settings. The channel cassettes will also be addressable by the SSL *Total Recall* system allowing

settings to be stored and recalled. The SSL Studio Computer also interfaces allowing mixing level automation together with synchroniser and machine control. This means that the 5000 will be largely compatible with the 4000 and 6000 ranges.

The version of the SL 5000 M shown was only an example of the system and SSL have stressed that there will be many further developments within the system including more cassette modules for specific needs before any deliveries of complete systems are to be made in July 85 following the full system launch at the NAB Convention in April.

Solid State Logic, Churchfields, Stonesfield, Oxford OX7 2PQ, UK. Tel: 099 389 8282.
USA: Solid State Logic, 2633 Fifteenth Street NW, Washington DC 20009. Tel: (202) 797-0700. □

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TRAINING

TONMEISTERS IN INDUSTRY

The Tonmeister qualification sits rather uncomfortably at present in the UK. In Germany it is an accepted qualification, indeed a respected one to have, but the attitude of the UK recording industry towards training is rather different. Most studios prefer to train their engineers in their own house style through the tea boy tape-op route. To introduce a Tonmeister (be they graduate or undergraduate) into the hierarchy is obviously therefore a problem.

There are several studios around who consistently do take Tonmeisters in for their 'industrial' year, and quite often offer full-time jobs to come back to when the student is fully qualified, but even these have not really managed to find a satisfactory solution to the dilemma. One such studio is Air London. Studio manager David Harries has this to say: "The main difficulty with offering a job to a graduate Tonmeister is the fact that a studio can only offer a junior position; this naturally means at a lower rate of pay since the studio is already employing experienced non-graduate engineers who have grown with the company and have been trained by them in the studio's own house style. To take on a graduate in a higher position would cause some resentment as well as be unfair."

On the whole, the 20-odd graduates we contacted whilst researching this article seem to accept the situation without any undue resentment. They seem to feel that although the industry does not recognise their training they are in fact equipped to progress more quickly and therefore in the long run do not really lose out.

A big problem for the students is that often, usually from fellow tape-ops and engineers rather than management, there is a degree of resentment felt towards them, and they are automatically labelled with criticisms such as being over-confident, over-qualified, too academically trained, not enough practical experience, etc. So now, even though there are many extremely successful Tonmeister engineers and producers working in the recording industry one does not tend to hear about them since the degree is not something any of them would feel inclined to talk about. Even David Harries, who has employed many very successful students seems to have the usual criticisms uppermost in his mind and qualifies his position by saying that Air London has been very *lucky* in the people they have actually taken on. Why shouldn't it be that their people represent the norm rather than the exceptions that prove the rule?

The course, held at Surrey University, has been reported in detail many times before (see *Studio Sound*, June, 1983)

Further to our article in June 1983, Janet Angus put a few questions to a cross section of Tonmeister graduates, to find out what the industry thinks of them and how they have settled within it.

and I think most people are familiar with what it involves. We should also mention that just as the industry is constantly changing, so is the course curriculum. More of this later.

In the meantime, we managed to track down a large number of graduates ranging from the very first intake, to those who graduated in the last academic year. They each filled in a fairly lengthy questionnaire which sought to establish (a) what they themselves thought of their qualification, and (b) how they fitted into the industry when they actually got there, and (c) what problems they did or did not have to face. Was it all worthwhile? Only one reply said no, and he was from the very first year of the course when, presumably, it was still trying to find its direction. On the whole, the training was found to be very valuable indeed, but not something you shout about.

Here, in chronological order (of study, not necessarily age) are some of the thoughts that came back.

Andrew Peggie, who now teaches, writes and plays for a living embarked on the course because he "wanted a technical and musical background and training." It is, after all a music degree, and this was a fairly standard reply. Hardly anyone at the time of entrance to university knew anything of the more usual tape-op route—they all intended to gain a degree of some kind, and the music has been very important to all of them for many different reasons.

"I've never flashed my Tonmeister degree around as a way of proving that I know what I'm doing," was also fairly standard fare. Andrew did his industrial training at Advision where, he feels, "my added experience meant that I moved 'up' rather faster! The technical background has been continuously useful throughout my freelance career as a writer, teacher and performer. I don't

believe the Tonmeister course gave anyone enough 'hard' experience to enable them to walk into any engineering or production jobs. We all had to start again from scratch anyway—it's just that we could move faster. Degrees are no passport to anything. I think the 'industry' can only see the course in terms of its own relatively narrow requirements which are a tiny proportion of the technology related aspects of the music business."

Phil Chambon, now working at the London School of Contemporary Dance as A/V technician, and with music and dance group La Bouche, went to Surrey University because: "The Tonmeister course involves as much music as engineering and physics and I consider myself primarily to be a musician. I would say that if you want to be an engineer full stop then join a studio and work your way through. If you have musical interests and more of an entrepreneurial spirit then the course does allow for exploration."

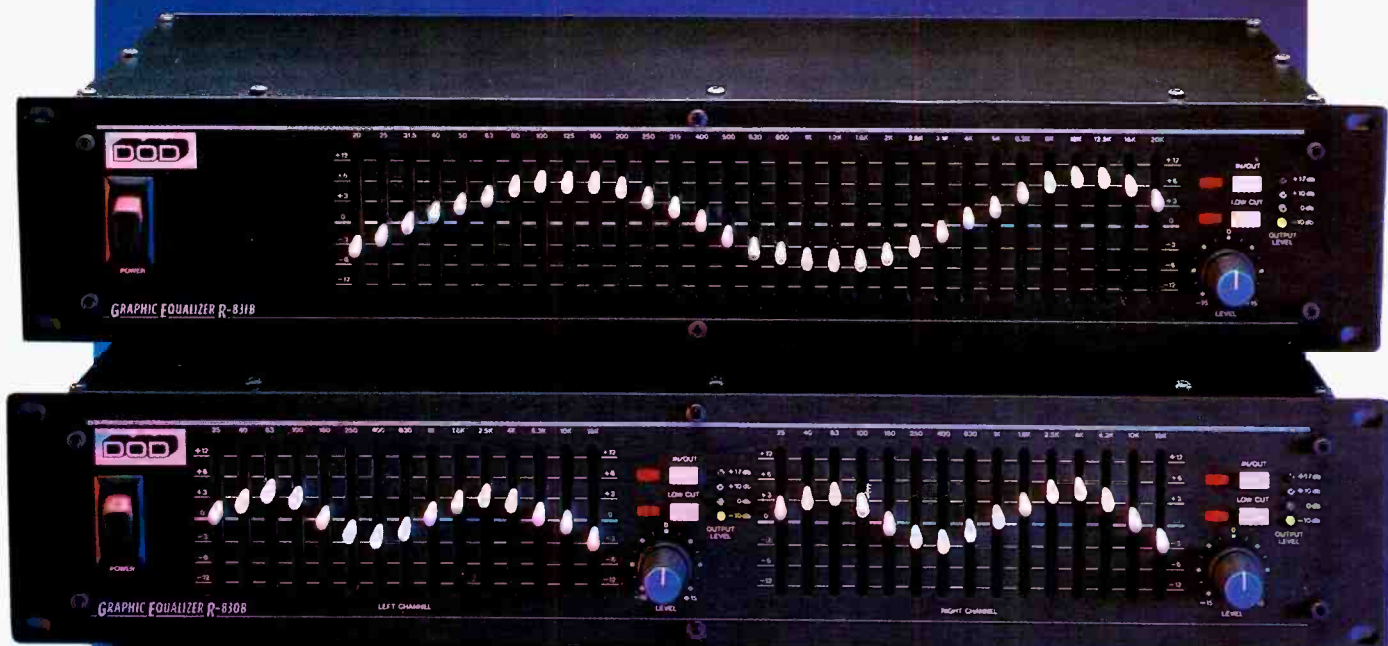
One rather obvious advantage of studying in a group of any kind is that you meet people of similar interests to work with and bounce ideas and experiments around with.

Andy Arthurs, who works with Phil on many producing and writing projects as well as La Bouche—the partnership being a direct result of Surrey—did know of the tape-op route but decided against it because "being a tape-op is a very narrow training and the Tonmeister course sets you up for an all round approach to music and recording. In the pop music area there is not much point in mentioning it but on the serious (classical) music side they understand that a broader training/education cannot hinder.

"Specialisation is quite important, but leaves you more vulnerable to changes in the industry. My broader education has enabled me to work in recording from rock to serious in live and studio situations and also to write and produce."

Mike Knowles is now a director of Martak A/V company. His time at Surrey included a period working for EMISON, followed by quite a lengthy spell at Abbey Road. "It is not always necessary to have a wide experience of techniques, eg a pop engineer does not need to know how to record a commercial or A/V track. The course offers a wide field of opportunity and if you are not sure what type of engineering you will find the most rewarding it offers the best basis to start this type of career. However, if you know what field you definitely want to work in you may get on quicker by starting as soon as possible. I think it really depends on the individual whether or not the course makes up for three years of

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experience. In my case I would say it did."

Terry Davies, although a graduate Tonmeister, is working in what may be to some a rather surprising field. He is a writer and arranger, often working major London shows, and obviously the music part of the degree was very important to him. His industrial year was spent at Chappell Studio (now closed—part of the PolyGram group) where his musical and arranging skills came into their own. "Yes people were intimidated (by the Tonmeister degree) and hence very defensive. My employer was 'sceptical'. I think most people would agree that it is good to have an engineer with musical ability and the standard of music on the course is often very high." It should be, since an entry requirement is (usually a top grade) 'A' level in music! "I found the music side of the course very good and stimulating... by attracting a large number of applicants and the intake being so small, the people working together were keen and all (or most) excelled in some area or other."

Andy Quick entered the BBC after graduating and went through their training scheme as well. Nevertheless, he doesn't seem to think he wasted his time. "As a BBC studio manager the degree helped me to acquire the 'job skills' more quickly than I might otherwise have done. As a music producer the music content of the degree has been of most use." The most advantageous thing about the course for him was the "freedom to pursue one's own interests, eg location recording and performance".

Brian Robson, who also spent his industrial year at the now defunct Chappell studio, is chief engineer at Paul Weller's Solid Bond Studio in London's West End. "I wanted to do a music degree which involved some aspect of the technical side of music, ie records, tapes, etc. The course provided in its (then) 4-track studio the opportunity to learn the basics with none of the 'time is money' pressures later to be encountered in a 'real' studio. This was probably the most useful part of the course with respect to engineering later on. I had no problems with regard to being over-qualified, because no-one takes any notice of that sort of thing anyway, unless you yourself make an issue of it. It was readily apparent that I had had some musical training but from a technical side we were all in the same boat," he said whilst talking about the problem of fitting in with the studio's other tape-ops and engineers. "The musical training did seem to be an advantage once the clients recognised it, and I did get sessions in preference to other engineers because of it—cheap arranger/keyboard player! One's experience depends on the sort of work you are involved in and if you are surrounded by *LinnDrums* and sequencers all day every day, then the sight of a real drum kit might reveal a gap in your experience. At the same time, they didn't have *LinnDrums* at Surrey and so that was something I had to learn about later. The point is that once you consider that your experience is complete and that you know everything

TRAINING

TONMEISTERS IN INDUSTRY

you might as well give up, and whether you've done a Tonmeister course or have come up through the ranks you should be gaining in experience and ways of doing things on every session you do."

The most advantageous thing Brian relates to the course was the availability of music students to experiment on with microphone technique. "Whether taking a Tonmeister course is good for everyone is debatable—certainly until the industry as a whole accepts the idea there is no real job-getting advantage as opposed to writing lots of letters and turning up on studio doorsteps."

Brian Mayhew spent his industrial year at the Music Centre. After a few years working in the industry he decided to change course totally and is now working in the computer field. All the same, the degree was very valuable to him and he has some pertinent thoughts: "In my case the studio concerned dealt heavily in television and film sound, both with many aspects not covered by the course" (then). "This, coupled with the all-pervading requirement of being people-wise and of attaining client acceptance and confidence, stands the Tonmeister in no better stead than his untrained colleagues. However, the wide-ranging training, both artistic and technical, which the graduate Tonmeister can draw upon allows him to progress quicker through the ranks, with the opportunity to diverge from operations to production, arranging, or (as in my case) to technical and maintenance work. It is in trying to short-cut the experience gathering process where the Tonmeister may lay himself open to criticisms."

That all important industrial year consisted of "the first half split between tape-opping and maintenance engineering. The latter soon crept in due to my interest in electronics, but the mixture proved to be a burden. When a session ground to a halt due to a fault, I was not only expected to keep the producer quiet with endless fresh coffee, but the over-burdened maintenance team (bless them) expected me to fix the 24-track as well! My employer's attitude to the course was favourable from the outset, but being a technical man himself he saw it mainly as the right technical knowledge placed in context by the rest of the course content." Summing up: "Overall I support the course as a means of launching people into all aspects of music and studio work... Due to the nature of the industry, however, the temptation to avoid the mundane coffee-making initiation into professional recording engineering has generally to be resisted to avoid such criticisms as 'over-qualified', 'over confident', 'academic', etc. But once you're there it comes into its own."

David Mitcham, now working at The Visual Connection, spent his industrial year following in the footsteps of Mike Knowles—first at EMISON and later at Abbey Road. "I see the degree as giving

me a bit of understanding which will come out in my work." The academic nature of the course "helps in problem solving. In A/V there is a lot of computerised machinery which our background has helped me to understand."

On a different tack "you need experience with people as well as equipment. It is important in an academic situation to get experience of studio work—the stressful environment.

"On the career aspect, actually *directly* in getting work it doesn't help because employers don't know what the qualification is. But carrying out that work you can understate the degree factor and just get on with it and because you have done the course you can do it. Currently, young engineers and tape-ops are exposed to very high technology immediately on joining a studio, whereas years ago mixers didn't have many knobs! There must be a tendency to start too high up and not fully understand why or how it works. A lot of rock engineers for example have never recorded someone talking. You need time to experiment and you haven't got that time in a studio—especially when you are recording jingles. Because you've got the industrial year you don't need all the equipment there (at Surrey).

"The course could do with a whole lot better relationship with the recording industry at large. The industry grudges will remain for a long time. There are one hell of a lot of good engineers who did not take further education, and there always will be. 75% of the Tonmeisters are bloody good at whatever they decide to do, but the way they've got to prove themselves is to go out and start again at the beginning. It's not a leg up into the industry and sometimes it's a leg down and it's wrong."

Ben Fenner, freelance engineer believes that "people take the tape-op route when they have this goal of being a 'sound engineer' or even 'producer' foremost in their minds," and, as we have seen, people taking the course do not necessarily have this.

"The studio world, and indeed the music business in general, allows a newcomer to that world the opportunity to prove himself without any prior prejudice be it technical or personal... A Tonmeister, when working in a professional studio for the first time (as in his industrial year) does have the advantage of being able to use the knowledge gained in his two years at university to progress quickly, but it must be progress made within the confines of the system in which he is working, ie based on his ability to do his job efficiently and effectively." Ben's industrial year was spent at Air London.

"From a musical point of view it has helped enormously—the sound theoretical and practical musical grounding helps not only in the treatment of the music I am recording, but also means that I can play on a track when needed, arrange, and also communicate very concisely with an arranger, producer or artist over matters concerning the music—these matters come up quite often in a recording studio!" As many of the graduates we talked to, Ben was quick to point out, "It is *not* a course for sound engineers, but actually a very broad-

IMPORTANT ANNOUNCEMENT

Sony PCMF1/SLF1



Sony PCM701ES/SLC9



To clear any confusion or misunderstanding about the above Sony Digital recording products, please be advised:

1 The Sony PCMF1 is still in production in Japan, and is available from HHB. The Sony SLF1 video recorder has indeed ceased production, but HHB has managed to secure limited numbers of these desirable machines.

2 It should also be borne in mind that an alternative system exists for applications where portability is not essential. This system comprises the Sony PCM701ES processor - identical in function and compatibility to the PCMF1 - and SLC9 video recorder.

3 HHB are pleased to announce ex-stock availability of CLUE (Computer Logging Unit and Editor) which provides editing facilities for PCMF1 or PCM701ES/Betamax recording, as well as intelligent autolocation and logging.

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based degree. Graduates can turn their hand to a great number of different aspects of the music/entertainment business. However, where sound engineering is concerned, the fact that it is to a large extent a music degree is of great importance. My Tonmeister training means that I can very easily relate most recording techniques eg mic placement, addition of effects, editing, etc, to their effect on the music itself through a greater understanding of that music both theoretically and in practice."

David Foister runs the A/V department of the Guildhall School of Music and Drama. He took the degree because he wanted a university education. "I wanted to learn generally about sound, not just get trained up specifically as an engineer. I liked the idea of bridging the gap between the musician and the technician—I had already encountered communication problems on small recording jobs."

During his industrial year at the National Theatre "there were problems with the other sound operators and technicians... they saw me as a bit of a know-it-all (on reflection I deserved some stick for my attitude), and as a threat to the way they had learnt their trade".

Of the course content (David graduated around five or six years ago) he said "Things I thought irrelevant at the time have turned out to be extremely useful. I've recently installed a brand new 16-track studio to my specification here at the GS of M&D, and have since been operating, administrating and maintaining it, and have often had to call on my Tonmeister training."

Jumping to the 'young engineers theme': "you only have to read some of the trade press interviews and letters to realise what enormous gaps there are in the knowledge of even quite successful engineers, and what peculiar prejudices and working methods these gaps have led to. Too many people view equipment as boxes with knobs on to be twiddled till a nice noise comes out; I feel strongly that a basic understanding of what's going on inside helps you find the effect you want more quickly and under your control, and the same goes for microphone technique. The course more than made up for this lack of experience, although I sometimes feel I wish I'd spent more time actually in studios doing things with experienced engineers—you pick up wrinkles that way that no course can teach you... I gained an overall understanding of the recording process musically, technically and practically... I felt at the time, and feel even more strongly now that the course should include the nuts and bolts of the music business—contracts, royalties, copyright, licensing, distribution, publishing and so on... a basic business course."

David Woolley, chief engineer at Trilion, thought my comparison between tape-oping and Tonmeister training totally out of place since the two set out to achieve totally different things. We begin to realise why!

"... It is study based, not employer based... it is not a 'youth opportunities' course. Tonmeister graduates are confidently trained. I think all successful

TRAINING

TONMEISTERS IN INDUSTRY

engineers and producers are confident, risk taking people."

A dilemma which many of the students have to face is whether they should actually leave their industrial year posts to go back to university and complete their degrees. The temptation to stay on, when they have jobs in studios is enormous, and pressure is often brought to bear on them by their employers too. But for David "the final year, however, was the most valuable because it juxtaposed the industrial experience against the academic theory. Knowledge of specifics can be gained anywhere in work experience. Knowledge of underlying thought processes and underlying principles can only be gained by study—not necessarily Tonmeister study.

"Why does anybody need to understand what they are doing? It is very satisfying to be able to speak to people from different sides of the industry in their own language, but not necessary."

The variety in the course is further illustrated by those who entered the manufacturing side of the industry. Graham Carter is currently employed at Dolby Labs. "In this context technical qualifications are very important." As for what we refer to as the 'industry opposition' "I do feel that this impression is changing—very slowly—as more graduates enter the industry and prove their worth practically."

Capital Radio is where we found Ed Stratton. "For a career in broadcasting where entry seemed more dependent on qualifications, it certainly proved useful to me. It also gave me confidence to tackle new and daunting situations as they arose.

"When you learn by watching others and by trial and error you may end up doing your job very well, but lack the versatility to cope with other types of work."

And finally, over at Dolby Labs we found another (brand new) Tonmeister graduate, Tim Partridge. On the Tonmeisters v tape-op route he was suitably squashing. "This is assuming that the end results are the same. They are not! They may be but if the course had been so narrowly vocational I would almost certainly not have applied."

As for those hackneyed criticisms: "Lack of practical experience is a

David Fisher is particularly keen to set up better communication with the industry. The course is a good location for A-B testing of product since every concert or recital is usually recorded by several students on different sets of equipment. If you have a product or design which you would like to work with the Tonmeister students on or you feel that you could offer a special lecture of any description you should contact David Fisher at the Music Dept, University of Surrey, Guildford, Surrey. Tel: 0483 571281.

popular one but when you are tea boy, tape-op, engineer, producer and often musician on most of your sessions you certainly think you are gaining it!"

As for the rest of the course: "Since the bread and butter of the recording industry is pop it would be an understatement to say that some tuition in pop techniques would be useful. The course is heavily classically orientated and all the knowledge of pop must be gained through trial and error. This is just one area where the people in the industry that are only too quick to condemn the course could do their bit to improve it by going down to Surrey to talk to the students." He did add "and get paid for it!" but I'm not sure of the facts on this!—it would certainly provide an added incentive.

Which brings us nicely round to David Fisher, who is the brand new head of the Tonmeister Course and who, when I spoke to him, was still finding his feet after only two months in office. I related some of the above thoughts to him and he was quick to agree whole heartedly with practically everything we have heard. But changes are afoot. "Although the course does not set out to solely produce engineers, engineering is obviously an important part of the course." His main priority at the moment is to make it broader based. At the moment it aims at the record industry and he will be introducing TV, film, radio and even possibly PA techniques into the curriculum. The rock element especially must be attended to and he has already implemented this into the second year timetable.

The most important purpose of the course, as he sees it, is to give as general an introduction to the recording industry as possible, not only in the styles but also in the medium. "But then I have the problem of being careful not to over diversify and end up just diluting the course beyond the point where it is useful.

"Because it is a music degree within a music department, there is naturally a lot of classical music around in the department to be recorded. Nevertheless I am anxious to provide as wide a range of work as possible. I have introduced some video and TV work into the final year, but so far it has taken the form of lectures. It is difficult to provide the right kind of practice because the equipment is so expensive." Is this an area where the industry could help out?

"We have a *reasonably* equipped studio with Sony PCM-F1s, 8-track, professional ¼ in machines, 16-channel Neve. I think it is at the right level technically from a recording point of view, although I wouldn't mind having a 24-track studio!" Well, who wouldn't?

So there we have it, the 'other' point of view. The course is obviously undergoing something of a revamp with many new ideas being introduced. In a constantly changing and developing industry, the demands on a course such as this are enormous and diverse. By seeking to embrace the industry as opposed to fighting it the Tonmeister course hopes to continue to grow. □

THE BREAKTHROUGH CASSETTE DECKS

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The majority of studios tend to feel that a maintenance crew is a waste of money. After all, what do they do? If they are doing their job properly they're not doing anything and when they do do something all you see is vast invoices coming in once a quarter when the new RS Components catalogue comes out.

The need for maintenance on electronic equipment tends to produce the familiar *bath-tub curve*. The initial sharp downward slope of the bath-tub curve is essentially taken care of by the manufacturer's/supplier's warranty.

A number of studios seem to feel that the year's warranty equals a year's free maintenance. Having worked for a dealer, I've got news for you: it isn't like that. Just because a card gets blown it does not mean that the dealer's crew will come out and fix every fault in your studio for free. It means that *the card* will be replaced for free. The dealer's crew are there as back up. Studios are meant to carry out their own first level servicing.

During the first few years' operation you find that generally the equipment has 'bedded-in' and there are few major problems. As the equipment gets older you tend to spend more and more time doing preventative maintenance. Things start wearing out; then you get to the stage where you are going to lose a client unless you do a major overhaul.

Many studios just don't want to face up to this. 'You mean to say that this is going to cost me £1,000 in components and probably a couple of days down time?' Well, I think that's a lot better than losing a whole week when a client walks out, and all the bad mouth that goes with that.

Maintenance is an insurance policy but having a good technical crew isn't the cheapest thing on the payroll in any way, shape or form. The return, however, is a continued income from the studio's operation.

The majority of the 'Division One' studios in London carry technical crew. They also carry a certain amount of test gear to verify performance of the equipment. And they don't shy away from having to make blanket changes or modifications to enhance the reliability of the studio facility.

I heard that Air had a classic problem where they had two consoles about a year apart in age. In the room with

THE ROLE OF MAINTENANCE

Peter Clark of Red Bus Studios in London describes maintenance from his viewpoint

the older board nobody smoked but in the other room the engineer and the tape op who primarily worked the room did. They had to change all the switches on the younger board. They went for gold-plated switches at some horrific price. The studio facility has to be prepared to do this or clients have a habit of not coming back.

Maintenance is not just a function, as in, 'We have a maintenance man.' I think it is a role within the studio facility, which is why I tend to refer to *the technical crew*. I certainly have as little to do with house maintenance as possible—I have been known to change light bulbs but air-conditioning? Pass.

As some of you may be aware, the idea is not to lose any studio time. I think that if you have more than four hours breakdown time per studio per month, when the client should be in but he can't work, then the management has every right to ask what the technical crew are doing for their money.

For a two studio complex like Red Bus you need one full-time technical guy but you do not need 24 hr cover. Once you have three studios working their tails off you do need two people working a shift system—their

own system, not one devised by the management. They can work it out for themselves, it's easy.

Whatever the set up, the requirement is for immediate service. It is not a lot of use if the technical guy lives a long way away and can't get in for three hours. It's also useful if he hasn't lost his driving licence. If you've gone home the studio still has to be able to get hold of you. That generally implies carrying a bleeper, and you accept that. Eleven o'clock one New Year's Eve, was I out celebrating? No, I was under the console. Sometimes you have to do awkward hours. That's what you're paid for.

All the client is concerned with is that he comes in; the place functions; he gets a good sound on tape. If things go wrong, he comes back the next day and they've either been fixed or there's a good reason why not.

If you've got long term clients it is occasionally necessary for them not to come in at 10 o'clock every morning. They may feel that they are going to work office hours and you are supposed to work at night. In that case the maintenance doesn't get done. It's quite simple.

If the studio is starting a long term project, you give the studio to the technical crew

the day before you start. They can do a full system alignment, look for any faults that the engineers haven't noticed. Then it's 'feet up, brain off' for the next few weeks (hopefully).

There is no reason why the technical crew need line up tape machines every day. At Red Bus the balance engineers and the seconds are taught to do this for themselves. I'm a firm believer in leaving things alone but you can't adopt Ostrich-mode forever as you would begin to give away too much of your 4-hr allowable down-time.

Although you've got your engineers or your seconds lining up the tape machines, you need to go down there every so often and do it for yourself. We all tend to say, 'That'll do, that's near enough for rock and roll.' But occasionally you have to say, 'I want this as good as possible.'

I believe that the more the balance engineer knows about the equipment he's handling, the better he handles and treats it and the higher the quality of product that comes out of the studio. If you've got engineers who are vaguely technical they are more likely to be able to define faults and describe symptoms. Someone who's actually had a go at finding out what the fault might be is much better than someone who just says, 'It doesn't work, man.'

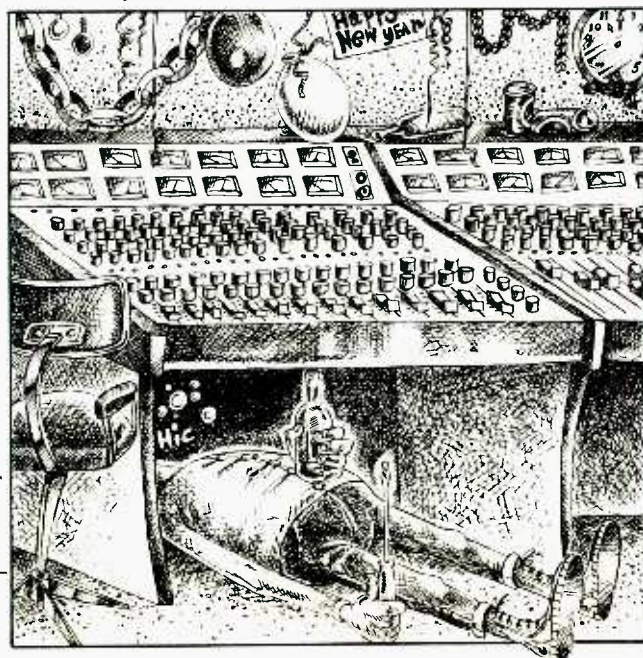
I have to say there are a lot of non-technical engineers who get a damn good sound—which is what the studio's all about—so you have to be able to live with both types of engineer.

There is one engineer in London who is guaranteed to find all the faults on your automation. He does it at every studio he goes to. He's done it at Marcus Music, and here at Red Bus, he's at Odyssey and he's done it at CBS... He finds *all* the automation faults but when you get there you have a hard job finding half of them.

The maintenance guy will not understand what's wrong in the studio if he doesn't know how the balance engineers use the equipment. It would be useful to have some experience as a balance engineer. I never have, but I enjoy records and I enjoy music enough to be interested as to whether something sounds good and how they got that effect. My interest in the equipment is certainly not Signal-to-noise ratios at 4 in the morning!—but very much, 'Does it sound good?'

An understanding of the system as it is used is of

Sometimes you have to do awkward hours



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THE ROLE OF MAINTENANCE

paramount importance, and that usage of the system has changed radically over the last three or four years. I've met seconds who have a hard time spelling *amp*. They can spell *DI* pretty well, but *bass amp* is a bit of a problem. *Bass DI* is all right.

There's a whole generation of young engineers out there who haven't got a clue how to record drums. If it doesn't have 'Linn' and jackplugs on it we're all done for—if it isn't *DI*'d the second can't spell it.

If the studio has reasonably technically orientated engineers, as we have at Red Bus, they don't go into Panic-mode if the slightest thing goes wrong. Quite often the engineer becomes your hands at the other end of a phone. Most of them can fix simple faults over the phone, even down to changing components—hopefully without turning the console into a random number generator. This does of course require that the studio has a *tool kit*.

Many studios do not carry a tool kit accessible to the engineers for one very good reason. Generous engineers tend to give Allen keys to guitarists and nutdrivers to drummers—all of whom have not turned up fully prepared—and... 'Oh dear! Half the tool kit's disappeared.'

You have to weigh up the convenience of not having to come in at 11 o'clock at night because they can do it over the phone against the thought that you'd better come in otherwise your tool kit's going to go missing.

The role of the technical guy is much more than changing fuses, changing transistors or cleaning out when somebody's poured coffee down the faders, and that sort of thing. The technical guy is an integral part of the studio operation. He has to represent the studio to the client when the crap has hit the fan because, usually, the crap hits the fan outside office hours and that generally precludes most studio managers being there.

You have to be able to walk into a potential 'omelette' environment—one where there are many eggs flying around waiting to land on people's faces. You've got to be able to walk in with an aura of confidence because you're supposed to know what the fault is. Above all you must be able to relate to the client's needs. The last thing you want is the client walking out and bad-mouthing the studio

because that's a reflection on you as the technical guy there.

In some cases you have to make the decision whether to blow out the session or not. The client is usually looking for recommendations and you must be aware of the artistic temperament in giving your advice. Can you justify them hanging around for an hour while you fix it, or do you just send everybody home? Besides they may not feel like doing it by the time you've finished.

If you walk in and say, 'You could hang around for an hour, but I can't guarantee that it's going to go,' that does not do the client, the artist or the studio any good. You may not necessarily know what the hell's gone wrong. If you don't know, you've just got to tell them that. This is where the technical guy may well end up being the proud wearer of the omelette.

It's much better if you give it to the client straight. You assume the Maintenance Position—flat on your back under the console—and say, 'I'm sorry, it's cock-up time. Things have gone distinctly "bang!" and it's going to take me some time to put them right.'

You don't try to hide it from the client because he'll hate you for it if in two hours' time when you still haven't fixed it and *then* he has to go home. In the end the prime consideration must be—is the studio harmed or not?

At no point in time must the client/engineer relationship be damaged. Thus the technical crew may have to carry the can for something that was not their fault. It *has* to be like that sometimes if the

client relationship is to be maintained, and that's what pays your wages.

If it is plainly the balance engineer's fault, you don't tell him so in front of everybody. That doesn't look good for the studio. You make out it was something else. You can call him a bozo later.

Even if it's the client's own freelance engineer you bite your tongue and say, 'There are one or two odd things about the way we are configured...' You just set it right, and live with it.

The technical guy has much more involvement in the studio running, and needless to say its politics, than the balance engineers. He is often the interface between the engineers and the management. Somebody has to present a cogent argument to management as to why they've got to fork out yet more money for state-of-the-art equipment. Then you may have to present management's economic considerations to the engineers because management, generally, tends not to explain these things to engineers.

I have worked at studios where the technical crew chose the equipment. I think that is completely wrong. The balance engineers should decide as they're the people who are using it and are more in touch with clients. I believe the role of the technical crew is to act as mediator, to advise on what is available and the reasons for buying it.

There are ways you can put it to try to get your own way in what equipment comes into the studio but, in the end, the decision on the equipment must come from the engineers and not from the technical crew just foisting their bigoted views on them.

In return there are some areas where I'm adamant that certain makes of equipment will not be bought.

The criteria for making that decision are practicalities. How much is the equipment going to cost and is it value for money? How reliable is it and is it easy to service? Does it sound good?

I'm rather blind to the faults of MCI tape machines because I think they are a fine example of a product for filling those criteria. They're not the most sophisticated machines in the world. They tend to look like sprayed pieces of bent welded metal—which is of course what they are—but they do sound good and they are reliable and simple to repair.

I might be able to live with the Ampex *ATR100* because it sounds stunning although it is a complete pain in the tail to fix. If you've blown the spooling motor transistors, the likelihood is that you've got to take the machine apart to repair it. I mean *apart*—the thing's got to come out of its pedestal.

That sort of design is, I feel, unacceptable in the studio environment because it eats into your 4 hr down time per month. The unit has got to be repairable within the hour. It's not a function of your not knowing how to fix it. It's the fact that you can't get the thing apart.

Invariably you have to climb round the back of the thing where there isn't any room. You've got to function under pressure from the client and the engineer to get their session going again, and from the management who see it as lost revenue. Some manufacturers think of this; other manufacturers don't.

I think we are particularly fortunate in London in that the technical guys are socially quite active.

Somebody's birthday or somebody leaving are good excuses to get together and trade notes on equipment and its reliability, the problems you've had and how you solved them. We tend to stay in touch with each other. Sometimes one of the other technical crews can land you a spare part when you need it urgently.

Availability of spare parts is another consideration in the choice of equipment. If it has loads of in-house parts: forget it, because the major agents are not there after 6 o'clock. You need to be able to get parts quickly.

With the exception of heavy duty metal parts and the obvious assemblies, there is absolutely no necessity to line

I'm a firm believer in leaving things alone but you can't adopt ostrich-mode forever



Simon Cooper

the coffers of the main agents. Nearly all the parts are available elsewhere, or substitutes will do the job with zero degradation all considerably cheaper. You can get them, provided you know what part number to ask for—there's the rub!

For instance, a lot of Japanese equipment is full of 4558 ICs. You can put TLO72s in—they work just the same. You can go, for example, to Sony and get a 74LS00 in a nice bubble pack. It's just cost you £1.20 (about \$1.50). You can go down the road to the local supplier and it costs you 25p (30c) for the same chip.

In the case of MCI boards, there's no point in buying EQ switches from a component supplier when they come pre-assembled from MCI. I know they cost a fortune but by the time you've sat and transferred all the resistors over...? That doesn't make sense to anybody.

On the other hand, there's no point in paying £250 (about \$300) for a quad control room monitor pot for a Harrison board when you can buy 10 of them from the component supplier and select them yourself. You spend an afternoon selecting them and it's cost you £50 (\$60) in time. You're still £100 (\$120) up on the deal and you've got 10 of them!

A studio has to carry heavy duty spare parts and they aren't cheap. Let's say it costs you the equivalent of a day's studio time to carry a heavy duty spares kit for your console and tape machine. That's a major investment in anybody's money and it's not returning any money whatsoever.

You've only got to have one breakdown where you would have lost the client for a day

The more complex stuff now requires specialist knowledge and it becomes cheaper to send it off to someone else to get it repaired.

There is another facet to this: with the advent of professional equipment rental companies in the UK over the last few years, the studios have saddled themselves with the burden of having to provide a complete range of toys. The client now expects

The technical crew may have to carry the can for something that was not their fault

and that one day's income has paid for *all* the heavy duty spare parts. The next time it happens and things go 'bang!', you're that day's studio time up on the deal. Make no mistake about it: things do go 'bang!' occasionally.

I've got mixed views as to whether the technical crew is meant to keep outboard equipment going. Straight forward equalisers, compressors and things like that are not particularly difficult with or without the circuit diagrams.

the studio to rent in order to replace faulty equipment. Obviously, the more complex the toy, the more expensive it's going to be to rent. At this point it's an easy choice: send it away, get it back as quickly as possible.

Many studios run fault books in the control rooms. This has the unfortunate side-effect of allowing smart-arse freelance engineers to indulge in their favourite hobby: has this or that fault been fixed? I have to say that the less they know, the better. Ignorance is bliss in this case. I prefer fault

report sheets that go with the session sheet. That's how we used to do it at CBS and I think that system works. Some people go to great trouble to file all the fault report sheets. I'm terrible with paperwork so I tend to throw them in the bin once the fault has been fixed. I'll remember what the fault was.

I have read that a lot of American studios tend to keep a record and analyse the trends in faults—they must be knee-deep in technical crew. In my own view there are much more interesting things you can be doing than filing all those bits of paper but I suppose there is a thought that that is the correct way to do it.

Good technical crews tend to be hard to come by and expensive. They're hard to come by because if they've got any brains they've gone off to video where the money's much better—fortunately some of us actually quite enjoy the audio industry. To be able to take responsibility for the sort of decisions you are supposed to be capable of making in front of the client requires experience, experience that determines the efficacy of the studio's maintenance insurance policy, a policy insuring continued income for the owners, and good insurance isn't cheap. □



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TOOLING UP

A world famous record company required a digital recording for a recent LP. The internationally successful artist preferred the calm atmosphere of a well maintained analogue studio to the 'excitement' of digital hi-tech.

Tracks were laid on a five-year-old Ampex *MMI200* 30 in/s 24-track at +8 dB with no noise reduction via a five-year-old Raindirk desk. The material was written and developed during the seven weeks of recording. Certain song parts with MIDI sync tone were mixed down to a 10-year-old Ampex *440B* 30 in/s 8-track with no noise reduction and then laid back to the 24-track for further fairy dust (Troggs' famous quotation).

As the recording progressed, tracks were bounced within the 24-track for cleaning and gating. The final mix was to an eight-year-old Ampex *440C* converted to 30 in/s AES twin-track on ½ in tape with no noise reduction. For about 30% of the material this was the fifth generation.

The artist was happy with the smooth, 'less synthetic' analogue sound and a *PCM-1610* stereo master was provided for the record company. This satisfied 'Mr Big Ears' of the A & R department—he had his digital recording.

There was a moment of alarm when a film company wanted the 'digital' multitrack to produce a 4-track version. The artist insisted that the multitrack master must remain at the studio where it was recorded as he could not rely on anyone else to look after it. The studio provided the required mix and the secret of the analogue 'digital' master was maintained.

That's what maintenance can do for you. It is surprising what good sounds can come from 'old fashioned' equipment so long as it's properly maintained.

Right tools

They say, 'A bad workman always blames his tools'. It is true that a good engineer cannot work without the right tools; high quality tools which are the right size and shape for the job in hand.

Tony Arnold covers the bottom line of studio maintenance—the tool kit; and the best way to build and protect it

I think the screwdriver is probably the most misunderstood tool there is. Most people just grab the nearest one. They use a *Pozidriv* to undo a Philips screw and then wonder why the head of the screw is now mangled, and most likely the screwdriver into the bargain.

People often ask, "Why aren't all screws the slotted type?" (Probably because it's easier to get away with using a screwdriver with the wrong size blade.) Even with the right tool, the slotted screws are less reliable and cannot be done up as tight as a crosshead screw. Everybody looks at a crosshead screw and calls it 'a Philips'; like we call vacuum cleaners 'Hoovers'.

Manufacturers of equipment do not usually state what tool is required in their service manuals. At last some Japanese manufacturers are listing the types of screws in the service manual. A good example of this is the manual for the Sony *TCD5* cassette recorder. Yet this machine is often brought to me for service and needs a new set of

crosshead screws because of the damage caused either by the user or at its last service by somebody who should be reading this article.

There are certain precautions you can take when approaching a doubtful screw. Check that you have the right size and type of tool by making sure that the fit is tight; that there is no play either horizontally or vertically, it seats perfectly.

If it does not reach the bottom but is tight side to side, you are most likely tackling a Philips with a *Pozidriv*. If it reaches the bottom but is loose side to side, you have a *Pozidriv* on the end of your Philips.

When you finally get it right, don't just start screwing away. Put your full concentration into it. It is similar to Karate; you must focus your energy and your mind to that point at the tip of your screwdriver, and be sure you are turning it anti-clockwise.

All this may seem a lot for one little screw, but good engineers learn from their

... a good engineer cannot work without the right tools



mistakes and quickly recognise the value of the right tool for the job—just as long as it's available—the right tool that is.

Allen (hexagonal) screwdrivers were at first only available as an L-shaped tool. Now they are available in a full range of sizes, imperial or metric, including special ball-end types for getting at Allen screws from awkward angles, to fit interchangeable handles, fixed or ratchet, straight or T-type, with extensions if required.

Having a larger *handle* doesn't necessarily give a screwdriver more leverage. The longer a screwdriver, the more leverage you get. Often mechanics use very long screwdrivers although the screw is right in front of them.

Do not magnetise your screwdriver to hold a screw on the tip. In fact, for obvious reasons, you must demagnetise your tools regularly. Proper mechanical screw-holding screwdrivers are available. Or you can simply put beeswax in the head of the screw, place the driver in position and the beeswax will hold the screw to the head of the screwdriver.

Screw removal

A lot of companies, both consumer and professional manufacturers, are now fitting tamper-proof screws. Unless you have the right type of tool these cannot be undone. Magna do a boxed set of 30 interchangeable heads with one handle. Magna also do a full range of head types to fit a hollow handle which will hold up to four 'most required' heads.

There are various ways of removing a screw that has been damaged. If a crosshead screw has a slightly mangled head you can often undo it more easily with a blade type screwdriver with a very hard tip.

To remove a counter-sunk screw you can either drill it out and re-tap the hole, or use a fine drill to make a notch at one edge of the head and then tap it round in the right direction using a watchmaker's punch. In 25 years these techniques have never failed.

I don't advise drilling a screw with a protruding head. Use a suitable set of ignition

pliers eg Proto 261SG, to grip the head of the screw. These will either turn the screw or shear its head off and release the item held in place. You can see a slot in the top of the headless shaft and unscrew it or, if it is cross-threaded, drill it out and re-tap.

Cutting jobs

Cutters come in a variety of types and, almost like a good sweet shop, the choice can be confusing. It must be approached from the type of work the cutters are required for. Use them on the wrong sort of material and they won't last long.

Prices range from £3 to £25 (about \$3.60 to \$30) and for a single production line job of, say, trimming component ends you would be wasting money at £10 (\$12). A & B Tools and OK Industries offer Italian stamped-out cutters which are case-hardened—£3 to £5 (\$3.60 to \$6) which are ideal for a production line or studio environment where they will only be used occasionally; nine times out of 10 to be lost before they are worn out.

For the travelling service engineer who doesn't want to carry all the different types because of space, I would advise one small and one large pair of cutters of good box-joint construction such as from Lindström, Xcelite, Bahco or CK. A good pair of cutters is worthwhile, some of mine are still cutting after ten years—cheap ones only last a month.

On the mechanical side, the Proto and Cooper tool ranges cope with most needs—from "Where the hell's my glasses?" circlip pliers, to "Give us a hand!" socket sets. Always remember that socket sets and spanners come in four different types—and we were worried about CCIR or NAB? They have AF, BA, Whitworth or Metric ranges, and to choose the wrong type can be nasty. The wrong EQ is painful on the ears—the wrong spanner, the knuckles.

For miniature work, small machinery such as VCR and personal stereo, a specialist company called Moody Tools do the Moody and Acu-Min ranges. One tool kit comprises 100 items including every type of screwdriver, miniature socket sets and spanners, taps and drills, extensions and interchangeable handles. Individual custom kits can be made up.

Greasing up

I learnt a lot about lubricants from my single-motor B & O

2000 recorder. I serviced and lubricated it after two years use, six months later it had poor rewind when cold. The fault was traced to the motor, so a new motor was ordered and fitted. There was some improvement but it was still not right. I finally rang B & O and spoke to an engineer who said the motor had most likely given up because the wrong lubricants and greases had been used on the gravity-type clutches. I assured him that we had used nothing but the best 6-in-2 oil. At this the whole workshop fell about laughing.

So we ordered Molycote G graphite paste, MS4 silicon paste, Singer Sewing Machine Oil and Esso No 532 grease; and we followed the instructions in the service manual to the last detail, with our spring scales to check the torque on those clutches. Ten years, and two more services, later that B & O recorder is still running on the same motor. Proper lubrication is most important and I suggest that the selection of lubricants I have mentioned are kept to hand.

Adjustments

How many times have you been doing a tape head alignment with one hand on a screwdriver for azimuth and the other on an Allen key for the rear adjustment; one eye on a scope for phase and the other on the VU for level—then a 63 Hz tone hits you.

You rewind the test tape, put it to play, replace your tools in their respective

positions and then think, "Was my left hand going clockwise or anti-clockwise? My right hand must do the opposite. It was clockwise, I'm sure." You start to turn... No, it was anti-clockwise—then 63 Hz hits your ears again.

For such applications 'working man's' test tapes are available in full-track, both ¼ in and ½ in, with 5 min of each tone—after all, what's the price of a bit of tape? A 'full accuracy' test tape can then be run through to verify line-up accuracy.

When I've finished a head alignment I always like to apply a little nail varnish—to the adjustment screws (and I ignore people's remarks). It's more effective than special locking fluid, and you can choose your own colour so you can tell if someone else has been at your screws.

Some head cleaners can actually push oxide into the head gap and leave it stuck there. Many a time a studio has claimed that a new tape head was required, but when I've used my head cleaning brush 10 kHz seems to have new life. Always use something like lighter fuel or pure alcohol which evaporates quickly—it doesn't stay on the heads to take oxide off the tape.

A white noise test cassette is an easy way to align the replay head but how about a white noise generator to align the record head on a three head machine? A stereo FM radio will provide white noise between stations and you just switch to mono to check the phase. The tuner I use is

You must focus your energy and your mind to that point at the tip of your screwdriver

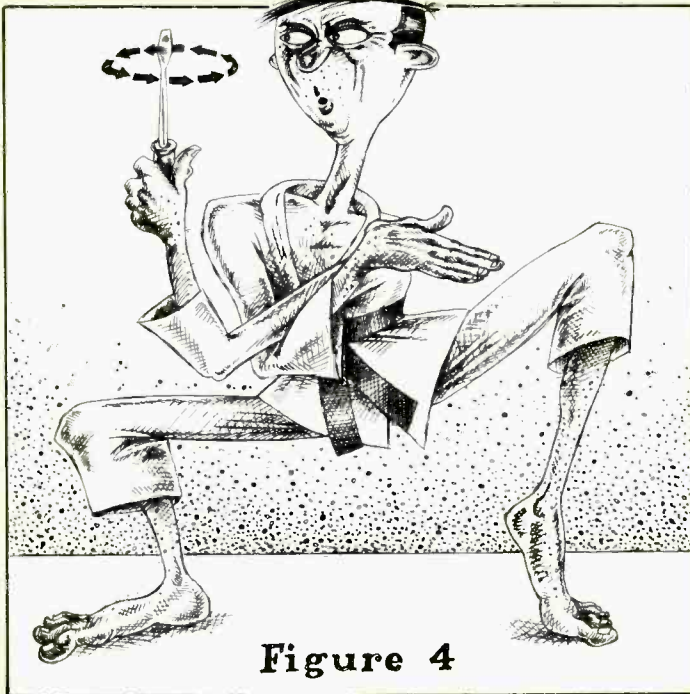


Figure 4

about half the size of an audio cassette.

Another useful little gadget is a miniature 'practice amp' with 220, 440 and 880 Hz tuning tones which you can use for general checking.

Have you stood a multi-meter vertical for easy reading, then tried to adjust the setting only to end up chasing the meter all around the bench? You lay it down, position the probes, and then find that your head is in a position where only a mirror on the ceiling would begin to make the scale visible. You crane your neck to read the meter and one of the probes comes off...

Brown Boveri has brought out a meter that is hinged like a book so that the meter display—analogue or digital—closes against the controls. With this meter the switching can be horizontal and the display vertical. It also has a strap so the meter can be slung round your neck to hang at your waist with the display looking up at you. Ideal for testing racks of equipment.

In any case

You may have thought of buying a tool kit but then realised that you would never use half of it. Empty tool cases are available in many shapes and sizes so your present set of tools could be cased, and any necessary new tools added. A comprehensive kit could be custom assembled for between £100 and £400 (about \$120 to \$480) by someone who understands the needs of the studio. A sophisticated kit should be capable of handling the whole studio.

A tool kit is a good investment—particularly if you are thinking, "Do we go digital or do we go maintenance?"

A warning: "The piano tuner went off with our cutters, a guitarist has our Allen keys and a drummer's got part of our socket set."

A suggestion: don't loan tools—sell them. At my studio we sell guitar tool kits which include two blade screwdrivers, two Philips type, two Allen keys, a piano wire cutter and a socket for tightening the ¼ in jack outlet. Price: £20 (\$24).

"Been looking for one of these for years," they say. Sometimes the guitar is in such bad mechanical condition that the bridge and the frets are out of alignment so you can't quite get it in tune. A few minutes work with the guitar tool kit and, "My £30 tuner works now," they remark. □

Shatter some illusions.



The new Series 500 and 600 from Soundcraft. Two ranges of mixing consoles that'll shatter a host of illusions about the standards you expect from a smaller mixing console.

Both are designed and built to the very highest mastering standards, with features, flexibility, technical excellence and audio quality that you could easily pay far more for.

A quality standard, in fact, that's in most respects the equal of our larger – and much more expensive – master recording consoles.

Signal-to-noise, for example, is a whisper at -80dB . Distortion, a smooth 0.009% at 1kHz . Crosstalk between channels is so low as to be virtually unmeasurable. And virtually all the inputs and outputs from the console are electronically balanced.

Both consoles are built into a rugged aluminium frame; and both are fully modular. You can buy full or part-filled frames.

Whichever console you buy, you have a choice of 16,

24 or 32 input channels. And, in the Series 500, you can add up to 4 extra input modules within the frame size.

All in all, these new consoles are going to give budget mixer makers quite a few sleepless nights. Because we've brought mastering performance to a whole new audience.

Series 600

The Series 600 is a 16 track recording console.

Unlike many low cost in-line mixers, it features a comprehensive 16 track monitoring and metering section, each channel of which is equipped with EQ and auxiliary sends.

On mixdown, the tape returns are normalised to the first 16 input channels – leaving the monitor channels available for use as effects returns.

There are 6 auxiliary buses for effects sends and cue mixes. There's 8-bus routing and module-mounted level matching links that let the 600 work with any multitrack machine on the market – including today's inexpensive



TS24 Master Recording Console



compact models.

The icing on the cake is Soundcraft's acclaimed 4-band equalisation that's in a class of its own (and sounds like it).

Series 500

An alternative console for live sound or 8-track recording, at a slightly lower price – the Series 500. The same technical excellence and features of the 600, with a different output module configuration.

You'll find the same superb EQ section on each input module, the same auxiliary sends, and the same master audio quality, with VU metering instead of the LED meters that we've incorporated on the Series 600.

And there are 8 additional equalised inputs which can be used for effects returns or 8-track monitoring.

The Soundcraft Promise

We believe that simplicity is the art of great engineering. It shows. For you, that means a pro-quality mixing console that's quite simply outstanding at the price.

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SS1

Soundcraft
APPROPRIATE TECHNOLOGY

ELECTRONIC ASSISTANCE FOR FILM SCORERS



I didn't know what to expect. I'd been telephoned a few days previously with promises of a remarkable new device that would make the lives of those musicians, composers, and engineers who attempted to record music to picture much easier. Mr Rhodes would not be drawn on the phone: "No, it's not a super synchroniser" . . . "No, it does not physically plug up to any synchronous device" . . .

I was intrigued, and duly turned up at the appointed time and place to find Roger Rhodes armed with an apparently normal Hewlett-Packard hand-held computer and print-out unit. "That's it?" I wondered. "That's it," he replied, and proceeded to demonstrate "it" in such a manner that after about half an hour, I wondered, as a musician who frequently writes music to picture, how I'd ever got along without a *Rhodesystems II* unit. For Mr Roger Rhodes has really done it.

What Roger has done is develop a program that can literally save one hour of studio time, writing time, and endless headaches, and build that microchip program into a hand-held Hewlett-Packard computer. The product is a tool that frees professionals working in the field of post-production and music scoring from the boredom of complicated maths, and allows them to use their time creatively.

If you're active in any of the above fields, you'll know about the horrors of drop frame SMPTE code, non-drop frame SMPTE code, EBU timecode, film frame counting, running time in minutes,

Robin Lumley looks at the Rhodesystems II program for the Hewlett-Packard 41CV hand-held computer

seconds and fractions of seconds, and being able to identify 'hit points' at any position on the film in question.

The *Rhodesystems* unit provides what is in effect an electronic slide rule that enables the user to embark upon the most abstruse calculations and conversions between the film standards prevalent on both sides of the Atlantic. A highly user-friendly program enables the user to ask questions of the device at each stage of any calculation, and be prompted into the next move without fear of error, or indeed the need for any computer literacy at all. If you can work

Robin Lumley

Robin Lumley is a record producer/composer/arranger currently specialising in keyboard/synthesiser music, TV commercials and music to picture recording. He is a graduate of the University of Exeter (B.Ed (TV)) and self taught keyboard player. He was a member of David Bowie's Spiders from Mars in 1972 and in more recent years, Brand X. As a musician he has received many prestigious awards. To date he has 23 album production credits from jazz/rock bands to Orleans.

your own pocket calculator, you can work a *Rhodesystems II* just as easily. But I'd better give you the benefit of the demonstration that Mr Rhodes gave me.

Roger Rhodes' background is that of a recording engineer and composer. He has worked for many moons in New York studios, and with a formidable list of star-named musicians, often in the field of post-syncing music to film tracks, be they features or commercials. Whilst engaged in this sort of activity, he constantly came up against the inherent difficulties of the genre; those of calculating the film frame positions, timing of sync (or 'hit' points) and overall running time problems. Thus he sat back and tried to create a computer program that would initially make his life easier. Not only did he succeed in this, but he realised that his program had far-reaching commercial possibilities that would apply to anyone working under the same constraints. Before the advent of Roger's system, there was no coherent system which could convert the various measurements of time to one another, and to allow the user to manipulate these additions and subtractions to meet the practical mathematical problems of the composer, or film and video tape editor.

The basic hardware is a Hewlett-Packard HP 41CV computer, coupled with an HP peripheral printer, into which has been absorbed the *Rhodesystems II* application module and overlay.

If we take a hypothetical case facing a composer, we could follow through (your attention notwithstanding) how the *Rhodesystems II* solves a number of problems: 'taking counts' is stage one in the preparation of a music score, which is simply watching the picture, and reading a mechanical footage indicator or time display to list the points where musical synchronisation may be required. Now, measuring time with film is very straightforward, for with a given gauge (say 35 mm) the speed at American standard is 24 f/s. This figure will alter under certain aspects of European standards. But on videotape, there are two forms of SMPTE coding in current use: drop frame, and non-drop frame. I don't propose to get into complex definitions of these terms, but suffice it for you to know that the difference between these measurements can become important for a running time of over 30 s.

If this all sounds very complicated, it's meant to because it is. The *Rhodesystems II* can jump in here and calculate the things that you, as a composer or editor, really need to know. Like how to convert one standard to another, and how to pinpoint amazingly accurately on the film or video the exact sync point or 'hit' that you are looking for. You've only to ask and...clickclickclick...out comes the printed answer.

And what about conversions from film to video? Film runs at 24 f/s, but video clatters along at 29.97 f/s—what a horrendous set of decimals for anyone trying to re-pinpoint a 'hit' point after transfer. But fear not, to transfer film to videotape, the film speed must be slowed slightly so that it matches on a frame by frame basis. This is done by '3-2 Pulldown', which is how 24 film frames are expanded into 30 video frames. Enter stage left the *Rhodesystems II* unit, which can immediately 'take counts'. Film counts are generally taken and used to fix the beat numbers in a musical score which would normally be recorded with a click track generator of some sort. Using a standard 24 f/s click track generator, a (say) 3 min music cue is recorded and then played back against the videotape.

Because of the differing f/s, the music will get slightly more ahead of the picture until at the end, it may be five video frames early. Not a lot, I can hear you say, but important if there's a cut or lap dissolve. But with the *Rhodesystems II*, it is possible to set the film speed to correspond exactly with videotape speed. This can be done by setting the film speed to 23.976 f/s (having derived this from the *Rhodesystems II*, calculator) and then one may cue in a series of 'hit' points (like arm movements, door slams, facial expressions, etc) that one may require the music to exactly match. If the film speed is then changed back to 24 f/s, one can list the hit points using timecode with the *same* start point that is on the video transfer. Thus using this process, and thanks to the calculations performed by Roger's program, the original 24 f/s film counts are converted

to timecode that exactly matches the videotape transfer.

It's difficult to know when to stop describing specific examples of the *Rhodesystems'* versatility. I don't want to get into a series of long descriptions of actual usage, but somehow wish to convey just how helpful this idea really is. Suffice to say that all conversions, be they between timecodes, or allied to metronomes or click track generators, are so easy to find with the unit that the time saved in operation is really worth having; let alone the peace of mind that comes with this little unit. Because of the printer, you've got a tangible record of every question and calculation performed in front of you, and so even if you're required to repeat a musical syncing operation much later (because of, perhaps, aesthetic dissatisfaction with the work done) you have a record of all sync points, beats

and hit points appertaining to that film footage immediately to hand.

Before I sing the praises of this unit any further, I must add that I am in no way connected business-wise with Rhodesystems Inc. I just think that the whole thing is such a worthwhile tool in this field.

"How much?" is the next question you're bound to ask. Well, with the present unfortunate balance of pound versus dollar (for non-dollar currencies), the answer has got to be slightly worse than it might be, but in the UK a system comprising the *HP 41CV* computer, the *Rhodesystems II* chip and printer will be well under £1,000. If you're working as a freelance film/television composer, or own or operate a studio where these sorts of activities occur frequently, I think you will find the investment is incredibly worthwhile. □

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DIARY DIARY

Facilities, events, addresses, contracts

Music scoring system

Clients at Music Media/Dalton Recorders in Santa Monica, California have been trying out Dirk Dalton's latest design: a high speed computerised sync and music scoring system. With this system an unlimited number of tracks can be used for feature films and television as well as records. Dirk Dalton's production of Barry Manilow's No 1 hit *Lookin' Hot* was mixed from over 100 tracks.

Direct supply for Peavey

Following the acquisition by Peavey Electronics Corp of the UK distributing company Peavey Electronics UK, a new reduced price list has been published along with a new dealer network. The company's musical products will now only be available through the appointed outlets, which will be backed by information, literature, and in-store promotion material and full spares and servicing support.

QEW Eastern US office

Quad Eight/Westrex have announced the opening of their eastern US sales office which is located at 2400 Crestmoor Road, Suite 327, Nashville, TN 37215, USA. Tel: (615) 386 7127.

Forthcoming events

- January 28 to February 1 MIDEM '85, Cannes, France
- February 1 to 3 NAMM Winter Market, Anaheim, California, USA
- February 19 to 21 Sound Eighty Five, London, UK
- March 5 to 8 AES Convention, Hamburg, West Germany
- May 3 to 6 AES Convention, Anaheim, California
- October 8 to 10 Internepon, Brighton, UK
- October 14 to 17, AES Convention, New York

SSL for China Records

China Records, the major government-operated record company of the People's Republic of China has placed a contract with Solid State Logic for three 40-channel *SL4000E* series Master Studio Systems. The desks will be installed in the Chinese company's three

multitrack studios located in Peking, Canton and Shanghai as part of a comprehensive modernisation programme.

A number of China Records' engineers came over to Solid State Logic's base in Oxford for training during the summer.

Address changes

● Beyer Dynamic recently moved countrywards from Haywards Heath to Lewes, East Sussex. The full address is: Beyer Dynamic (GB) Ltd, Unit 14, Cliffe Industrial Estate, Lewes, East Sussex BN8 6JL. Although there was a new telephone number at the time of the move, since then all Lewes telephone numbers and codes have been changed. You can now contact the company by dialling 0273 479411/2.

Contract

● CBS Records (USA) have taken delivery of two Sony *PCM-3324* digital multitracks in what they describe as the second phase of a plan to equip with all-digital facilities by the end of 1985.

The measure of success

Whether you need to prove or improve system performance and auditorium response ... Klark-Teknik's DN60 measures sound levels with almost laboratory accuracy right across the audio spectrum. The result is graphically displayed on 30 LED columns exactly matching the frequencies of the Series 300 equalisers. Features of this outstanding instrument include a clear LED display, three memories, peak hold function and built-in pink noise source.

To round-off we also offer the RT60, an ingeniously inexpensive plug-in unit that converts the DN60 to a graphically displayed reverberation analyser.

Specification includes:

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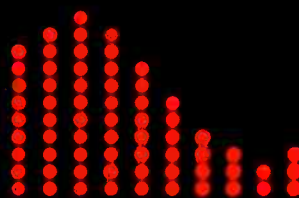
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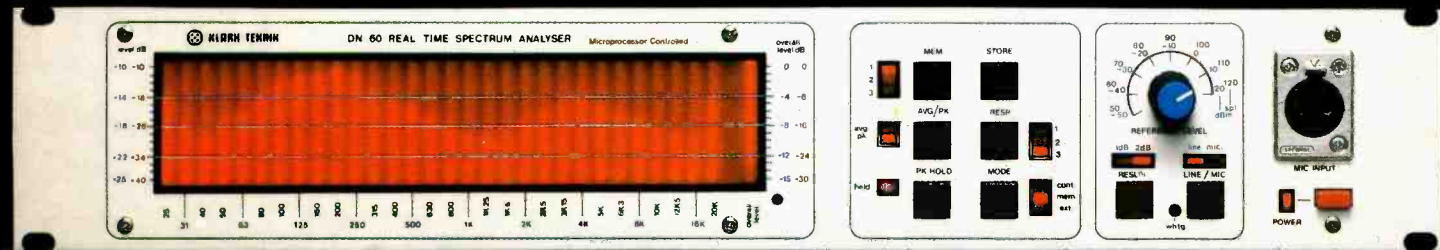


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DIARY DIARY

Agreements, AES, people, agencies

People

- Lexicon have announced the appointment of Lance Korthals as director of marketing and sales. He was previously director of marketing and sales for the professional products division of dbx Inc.
- Neve Electronics recently announced the appointment of Keith Smith as sales and marketing director. He was previously manager broadcast products with Sony UK Ltd and replaces Derek Tilsley who has left the company to pursue new interests.
- David A Purple has been appointed to the position of director of sales, eastern United States for Quad Eight/Westrex and will be based in Nashville.
- Soundcraft Electronics Inc have announced the appointment of Steve Smulian to the position of senior

technical engineer. He was formerly with AVC Systems in Minneapolis.

- Rod Duggan has left Sony Broadcast to take up the position of managing director of Totalsystems (Tendrashaw Ltd) who are a studio design and installation consultancy specialising in digital audio, currently having work contracts with Nova, Steve Levine and Tape One. Tendrashaw Ltd, 41 Windermere Avenue, Basingstoke, Hants RG22 5JH, UK.
- Pye TVT Ltd, the Broadcast Company of Philips, have appointed a new managing director in the form of David R Dean who has come from the US Philips fibre optic company of Valtec where for the last two years he was senior vice president.

Soundcraft/GML agreement

Soundcraft Electronics and George Massenburg Labs have announced an agreement contracting GML to design, test and implement a hard-disk based automation system for present and future Soundcraft consoles. The new system will use features of the current GML moving fader system. Soundcraft will also offer a tape based system developed by Soundcraft for

those clients not requiring a disk based system. A third option will be the *MasterMix* system developed by Audio Kinetics, UK.

Soundcraft Electronics Ltd, 5-8 Great Sutton Street, London EC1V 0BX. Tel: 01-251 3631. Telex: 21198.
USA: Soundcraft Electronics Inc, 1517 20th Street, Santa Monica, CA 90404. Tel: (213) 453-4591. Telex: 664923.

Amek/GML agreement

English console manufacturer Amek Systems and Controls Ltd and George Massenburg Labs Inc of Los Angeles, California, have entered into an agreement to provide the *GML* moving fader automation system, with customised enhancements for Amek consoles, using both VCA and moving faders.

The contract is the result of discussions between the two companies who are both confident that the co-operation will introduce some innovations in console design.

The *GML* system is based on two Motorola 68000 microprocessors using a *UNIX*-type operating system. The SMPTE driven hard disk based computer allows storage and editing of multiple mixes

within keyboard control. The *GML* computer is also powerful enough to handle the control of the dynamically resettable console currently under development for release by Amek during 1985. These consoles will feature full memorisation of the EQ and auxiliary settings.

The AES convention in Hamburg will be the venue for the first showing of the *GML* computer system with an Amek console.

Amek Systems and Controls Ltd, Islington Mill, James Street, Salford M3 5HW, UK. Tel: 061-834 6747.

USA: Amek Consoles Inc, 10815 Burbank Blvd, North Hollywood, CA 91601. Tel: (818) 508-9788.

AES Convention policy

After a series of reportedly very heavy meetings during the recent New York AES convention, the governors of the AES have formulated a policy regarding the frequency and locations of future North American AES conventions. The adopted policy is in line with polling of members and exhibitors and also agrees with previous resolutions.

In future years there will be only one convention/exhibition per year and this will be held in the autumn. It was also decided that the event will alternate between the East and West coasts and additionally alternate in location with the SMPTE Convention. It was resolved that these will be the only exhibition opportunities presented by the AES in North America although there may be subject meetings without exhibits. All exhibitors will also be polled

annually on future exhibition policy.

There was however a problem—with difficulties concerning convention locations and availability, AES were faced with the choice of having all conventions on the east coast and none on the west coast or vice versa for a period of three years if the system was to be instituted with an autumn convention in 1986 on the west coast. It has therefore been decided that for one year only there would be two exhibitions.

In 1985 there will be a spring convention in Anaheim and an autumn convention in New York. Although this was against the general expressed wishes of the exhibitors and members, it was considered to be the preferred plan enabling future proposed schedules to be met. The voting of the board of governors was 14 for and none against.

In brief

- Virgin Records (The Townhouse), London, has recently signed a licensing agreement with Teldec to master Direct Metal Mastering (DMM) records. This follows on from their recent order for a Neumann VMS 82 lathe for DMM cutting.
- Following the acquisition of the Crow Group of companies by Hudson Offshore Holdings Ltd, the trading name of the specialist technical vehicle operation has been changed from MVC-Crow to MVC-

Hudsons Ltd. The operation of the company is otherwise unaffected.

- Crown International have recently opened an additional manufacturing facility of 36,000 ft². This will increase the efficiency in the handling of raw materials and finished goods and allow the engineering department to expand. In percentage terms this increases Crown's square footage by 85% with room for a further 50,000 ft² at a later date.

Agencies

- Electrospace Developments Ltd have appointed Britannia Row Ltd as their sole distributor for the UK and Eire. This arrangement includes the *Time Matrix*, the newly launched *Spanner* stereo panning system and all other future products.
- Westlake Audio have appointed Britannia Row Ltd as UK distributor for the complete range of Westlake products including the monitor speaker systems and the range of accessory products.
- FWO Bauch Ltd have recently been appointed the UK representatives for Teldec

Direct Metal Mastering (DMM) technology.

- Elfa Radio & Television AB has signed an agreement with Electrolube Ltd to sell the company's chemicals for lubrication, cleaning, protection, and production of electronic equipment throughout Sweden.
- HHB Hire & Sales recently appointed Kema Marketing, a division of Amek Consoles Inc as US distributor of the CLUE (Computer Logging Unit and Editor) system. Kema Marketing, 10815 Burbank Blvd, N Hollywood, CA 91601, USA. Tel: (818) 508 9788. □

BUSINESS BUSINESS



Barry Fox investigates the facts behind the industry news

Product launch

There has to be a first time for everything. When Mission Electronics launched its new *Cyrus* amplifier and Compact Disc player, the company invited not just hi-fi buff journalists, but studio writers and engineers as well. To the best of my recollection, that's the first time any electronics company has recognised that consumer hi-fi and professional record production rely on each other for their existence. As far as I know it's also the first time that anyone at a press conference has been sent home for being naughty. During the tea break one of the hi-fi world's leading anti-digital guerrillas spoke frankly over a sandwich. Please go home, he was told.

Consensus of opinion was that it would have been better to talk it through. No-one, except Philips and Sony who launched CD with the daft promise of perfect sound for ever, could seriously have expected such a futuristic technology to be right from day one or even year one. As Mission boss Farad Azima puts it: "Even people who have bought the worst CD players are still getting far better audio quality in their homes than they ever got with an analogue turntable." John Eargle in America puts it another way: "If you have heard just one CD that sounds good, that proves the system works."

If someone has good technical reasons for believing that the CD standard is inherently and irredeemably bad then let's hear them, rather than send them out of the room. At the same time the critics of CD can remind the audio industry of what noise they made when Philips first announced CD, five years ago, with a 14 bit coding standard.

The Mission press conference was at a conference room in the Barbican, home of the concert hall with decidedly odd acoustics. Apparently another thing the Barbican designers forgot was to provide air conditioning in the conference room capable of cooling people on a hot day. Perhaps it is not so surprising. The Barbican must surely be the only place in the world where you have to take the lift up to the 7th floor to get to the underground tube station.

As a nice touch, Mission had laid on tickets for the evening concert in the Barbican Hall. Since writing my previous pieces on the Barbican acoustics, I've been to several concerts and found that without doubt the sound is much better at centre front of the stage in the first and expensive blocks of seats. As you move back, the field collapses into a muddled mush of mono. So if you want to hear live sound in stereo at the Barbican, you'll have to pay for the privilege.

As I said there's a first time for everything. Surely it must be the first time that a concert hall of Barbican

calibre, proud of having natural acoustics without electronic reinforcement, has left the house announcement-PA speakers switched on, all through a concert. Trevor Pinnock's English Concert ensemble was accompanied by a pair of wall-mounted speech speakers buzzing with characteristic thyristor noise. Does Barbican administrator Henry Wrong attend his own concerts? Can he not hear the sound of thyristor buzz in pp passages?

Sorry to end on another question, but can anyone please explain this? Trevor Pinnock led over 20 musicians, from his harpsichord, with only the most subtle nod of the head and shrug of the shoulder by way of conducting. Under normal circumstances there would have been a famous conductor waving his arms, leaping around and sweating like a pig. The next day the press would have said what a wonderful performance he squeezed out of the orchestra. I've always suspected that many of the people who go to classical concerts, and talk about fine performances, only notice if the soloist plays an obvious bum note. And then they would probably blame the conductor.

LA digital

Interesting to see the Mitsubishi stationary head machines on the way to becoming the *de facto* digital standard in Los Angeles and Hollywood.

About a year ago Kenny Rogers' Lion Share studio bought an *X-800* multitrack and became the unofficial demo zone for the area. Until then Mitsubishi had just been 'those wonderful people who gave us Zeros in the war'. At around the same time Mitsubishi 2-track *X-80s* suddenly became attractively cheap. The top man for US Neve quit to found his own company which was bought by Mitsubishi.

Jerry Barnes, general manager of United Western studios in Hollywood, and president of SPARS, went to London to do some recording and was very helpfully loaned Telefunken's *X-800*. He went back to LA, ordered one, got it two months early and didn't have to pay for free time. Now Burbank, Village Recorders and rental company Audio Effects all have Mitsubishi multitracks, and there are pushing towards a dozen 2-track machines. Disneyland used one to record the music for Donald Duck's 50th Birthday Parade, recently the central theme for the Disney amusement park at Anaheim.

The music for the LA Olympics was pre-recorded on an *X-800* and half the LA audio fraternity seems to have had a hand in or connection with it somehow. The brass band and chorus were live, but all the instrumental sequences pre-recorded and mimed on the night.

The Mitsubishi invasion isn't really to do with technology, although of course the system works and has none of the incompatibility problems encountered with early stationary head digital recording, when a tape made on one machine wouldn't play back on another of supposedly the same type. It's all down to marketing and Mitsubishi's clever use of the snowball effect.

I mentioned United Western in Hollywood. The studio has an interesting history, as the oldest left in town. Back in the '40s it was a radio theatre with 399 seats. When you hit 400, the union crew rules changed. Jack Benny broadcast from there, so did Cecil B de Mille for CBS. Then CBS built its own facility; incidentally, one studio is a clever design with a front wall that can be moved out to make the whole building bigger. The radio centre building became United Western, part of United Recording with ties to UREI. This was back in the early days of stereo, when the musicians under Petrillo went on strike for double pay when 2-track first came in.

There are four studios at UW with number one large enough to take a 55-piece orchestra. That's where Sinatra made *My Way* and Streisand *The Way We Were*. Crosby was a regular visitor too.

Studio 3 has even more history dripping off the walls. It's where the Beach Boys and the Mamas and Papas made all their early hits. There are clone copies of studio 3 all round the world because some musicians and producers still have a superstitious notion that it's how a studio looks that counts. When the Beach Boys went into UW3 a few years ago, they put up three speakers where the old Altecs used to be for 3-track recording. Then they put an old valve console on top of the new Neve.

Next door, in the voice studio, there's a dummy door in a frame. Stan Freberg uses it for commercials. The mic store is like a living museum. RCA ribbons and Neumann valve *U47s*. There was a time when people were selling the Neumanns off for \$100, just to get rid of them. Now they are priceless.

Bossman Barnes has some interesting thoughts on digital critics and heavy metal ears. "There are some producers in this business who have been left behind. They haven't learned to use digital equipment. So as a defence, they say things like 'digital messes up the sound'. But it's really because they feel intimidated. And there's no doubt that some of these people have ears that are shot. They work at 120 or 130 dB. We know when they are booked in that we are going to have to spend a thousand dollars on re-coning the speakers which they will blow, because those are the levels they now need. But that doesn't stop them saying digital doesn't sound right." □

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RECORD READY
EXECUTE CUT
MAKE DECK SAFE
STORE CUT TO LIST.

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+ DURATION

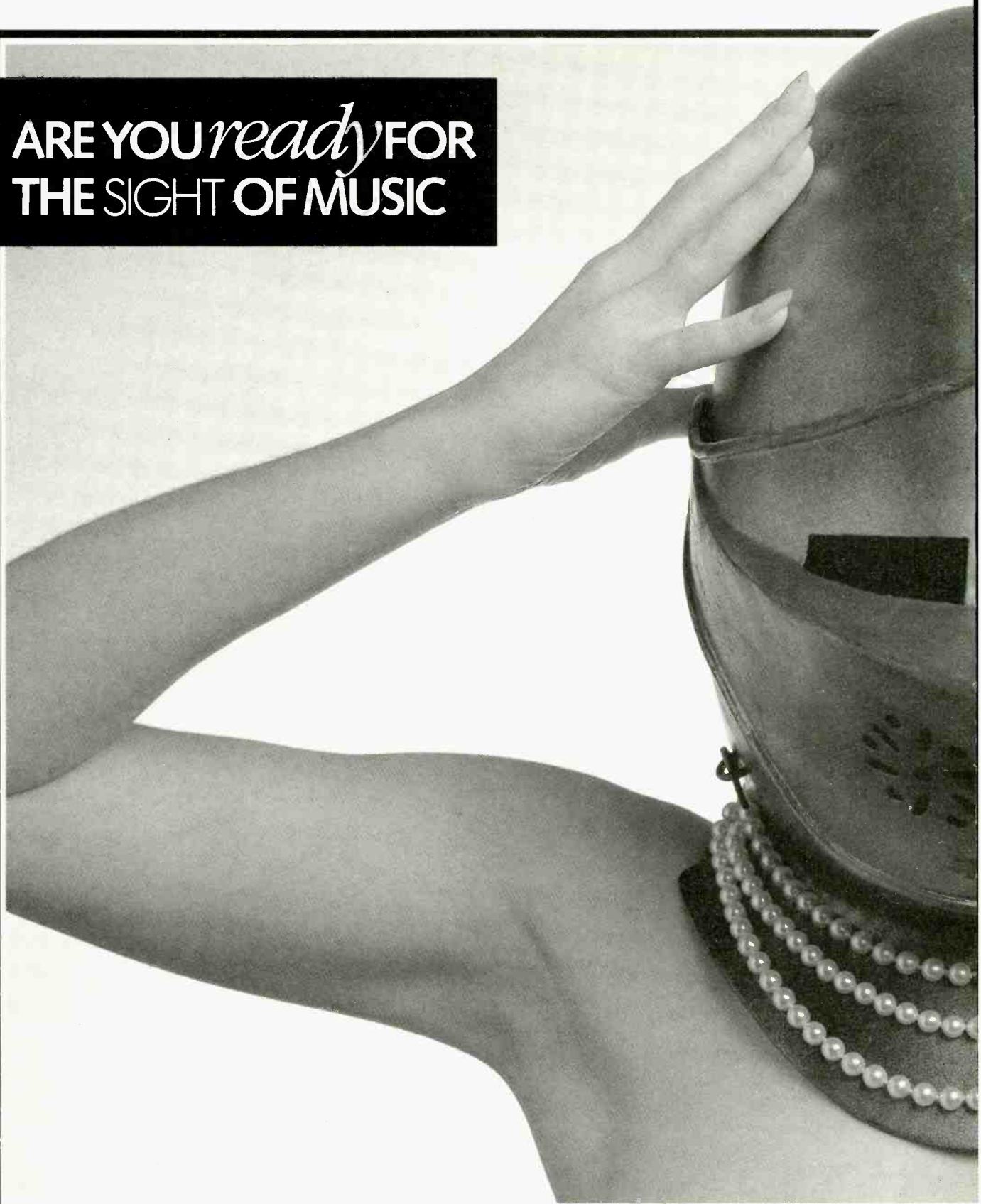
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MARK NEW RECORD OUT
SELECT RECORD DECK
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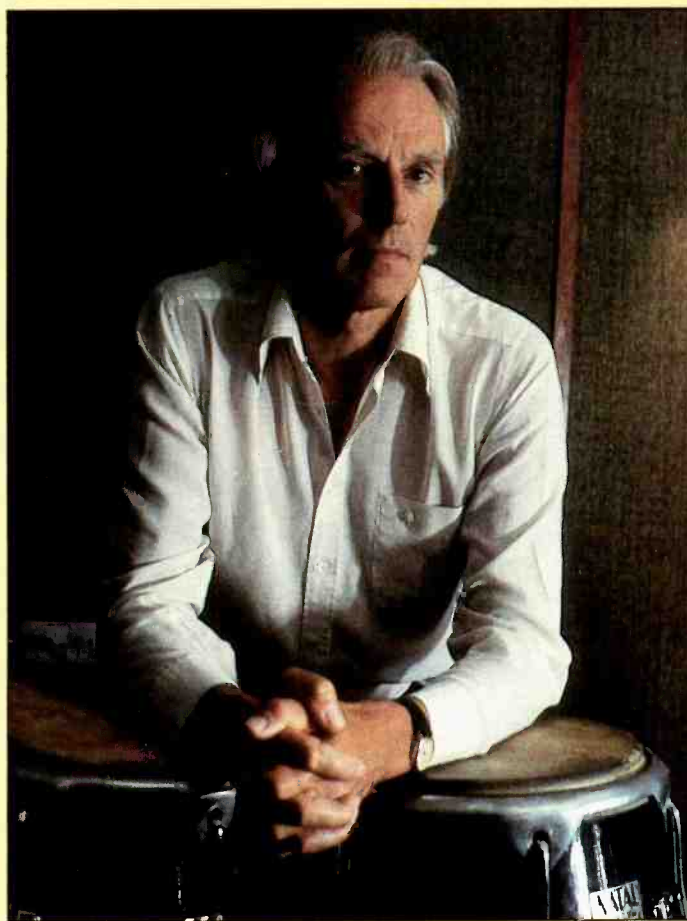
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GEORGE MARTIN PART ONE

Ralph Denyer interviews the producer responsible for defining and establishing the role of the record producer as we know it



George Martin arrived at Air Studios for the first of what was to be a number of mini-interviews, a little late and apologising. His hair was somewhat windswept as he had journeyed by the same mode of transport he'd used when making his way to Abbey Road on that chilly November morning to start out in the record business some 34 years ago—a bicycle. Nowadays it's more of personal choice rather than the economic necessity it was then.

On that morning during 1950, he was starting at a salary of £7 4s 3d as assistant to Oscar Preuss, at that time head of Parlophone Records. Opinions vary as to what exactly he was brought in to do but George gained the impression he was to develop the label's classical music catalogue. Another theory is that when Preuss saw that a head of one of the other 'gramophone recording' labels within the EMI conglomerate had acquired an assistant, he hired George so as not to be outdone. At the time, George only regarded the job as a fill in, as he had designs on a career as a classical pianist.

George's impact on the EMI catalogue was colossal. He ended up running the Parlophone label very successfully for a number of years and more importantly, with the Beatles he re-defined popular music and the art of record production. In keeping with the status quo in the music business at the time, his salary as an EMI employee was never commensurate with the creativity and amount of hard work he put in.

In 1963, the Beatles' second single, *Please Please Me*, went to No 2 in the singles charts and the following releases *From Me To You*, *She Loves You* and *I Want To Hold Your Hand*, all went to No 1. George worked almost round the clock that year. Records he produced held the No 1 spot for 37 weeks. He received his annual salary of £3,000 and was flatly refused any royalty whatsoever. It's not just a case of faulting EMI or anyone else; times change and George himself had—working hand-in-glove with the Beatles—extended the *modus operandi* of the record producer whose role would no longer be restricted to purely finding catchy songs for an artist, booking the studio and musicians and making sure the finished record was no longer than 2½ minutes.

George had been a major force in the recording industry for some time before he signed the Beatles to Parlophone in 1962 and, as the group's record producer, became an integral part of the force that was to

revolutionise popular music and produce rock music's masterpiece *Sgt Pepper's Lonely Hearts Club Band*.

The first official No 1 record he produced was the Temperance Seven's *You're Driving Me Crazy* in 1961 and most recent was Paul McCartney's *Pipes Of Peace* during 1983/4. He produced many many records prior to the Temperance Seven's but there were no really authoritative charts based on record sales when he started out, and documentation is sparse and

incomplete. Also record production was somewhat matter-of-course and part-and-parcel of George's job of running Parlophone Records. When he started, to have a sleeve credit as record producer was virtually unheard of and so he went uncredited on hundreds of titles.

His decision to leave EMI and form the Air production company in 1965, and subsequently open Air Studios in London's Oxford Street in 1970, was born mainly out of frustration and a desire to get himself into a financially

tenable and independent position.

George was still a little vexed about being 20 minutes late and apologised once again before we sat down to talk in the restaurant at Air. He was in the process of completing production, arranging and fulfilling his role as musical director of Paul McCartney's *Give My Regards To Broad Street* film and was fitting my interviews in around when recording commitments with Paul and the completion of the film. He turns down work that would have your average record producer drooling at the mouth. But of course, George Martin is not your average record producer.

He doesn't really seem to relate to his public image or professional reputation and indeed, is mildly amused by the *famous* George Martin, someone he sees as a mythical character. The flowery praise that is frequently heaped upon him makes him cringe. In his own mind, he's just a person who does his job to the best of his abilities. He doesn't really like doing interviews or being photographed but, once committed to this feature, he proved to be joyfully professional to work with. As I switched on my cassette machine he responded. "Studio Sound: Take One!"

George was born on January 3, 1926. His father was a carpenter and the decidedly working class Catholic Martin family lived in two gaslit rooms and an attic opposite the Sunlight Laundry in Drayton Park, North London. In those days a home entertainment centre was made of wood, metal, wire, ebony and ivory, and called a 'piano'. In many homes in the pre-television 1920s, the Martin's included, the instrument was the focal point of both family and social activity. Around the age of six years, George had eight piano lessons. Then his mother had a disagreement with the music tutor and he was left to pursue his musical interests under his own steam. It's possible that George could have gone on to become a virtuoso classical musician had the lessons not ended at that time because he displayed an aptitude for music from his earliest years. There again, there are a lot of ifs along that road. He used the piano as a tool with which to explore music.

Later, he realised that he would have had some difficulty with this type of musical exploration had he not had perfect pitch. He was exposed to classical and popular music at school and seems to have made little distinction between the

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two, as indeed was the case when he made the unprecedented move of bringing symphony musicians into the recording studio to play his scores on Beatles records.

His ability to listen to a piece of music, analyse its components and understand the structure, was illustrated by his facility for learning classical pieces purely by ear during his early teens. George Martin and the Four Tune Tellers was his first band, who played popular jazz and dance standards of the 1930s. George used the money he earned from the band to finance a resumption of piano lessons, which he returned to at the age of around 15. Realising that it was a little late for the virtuoso child prodigy bit, he began to see great appeal in the alternative of becoming a composer of serious music and writing scores for films.

On leaving school his application for a job as an aircraft designer was accepted but he didn't take it up because it meant moving away from home. One day in 1943, at the age of 17 and after a number of unfulfilling jobs he walked into a recruiting office in Hither Green, in South London and volunteered for service in the Fleet Air Arm.

After a radio course and flying training, he became a Naval Airman 2nd Class, progressing to Leading Naval Airman. He had stand-by training in gunnery, torpedo-dropping, radio-telegraphy and navigation but too young to make Sub-Lieutenant, he became Midshipman Martin. He had kept his hand in on the piano and played on a British radio programme called *Navy Choice*. A youthful Lieutenant (John) Pertwee tried to persuade Midshipman Martin to join him in the Department of Naval Entertainments but George decided to see the flying through. In early August 1945, just when his unit had been formed into an operational squadron, George realised his war was over before it had begun and was not altogether unhappy about it. In 1947, he left the service but what to be and what not to be was indeed the question.

During his spell with the Navy, George had maintained his interest in music and composition and in his first months of service, had gone to a concert by pianist Eric Harrison. After the performance, thinking everyone had gone home, George decided to have a little tinkle on the ivories. Harrison was still in the hall and after hearing George play one of his own

pieces, encouraged him to develop his compositional knowledge. Eric put George in touch with Sidney Harrison, who through the non-profit-making Committee for the Promotion of New Music, gave him continuous encouragement and advice by post. Soon after the end of George's naval service, during February 1947, Sidney Harrison—who was also a professor at the Guildhall School of Music—arranged for him to audition for a place at the school.

George passed and was to study at Guildhall for three years, completing a course in composition, conducting and all the related theory. He had to stop and think when he discovered he would have to play a second instrument in addition to the piano. He started out with practical criteria to aid him in

the decision. He wanted a relatively inexpensive instrument because he didn't have much money, one that could be mastered during the three year course so that he could earn a crust playing it when he left Guildhall, one that was portable and lastly, pretty much in demand with orchestras. The oboe fulfilled all these requirements. His only miscalculation was in not considering why oboists should be relatively thin on the ground. He found out the hard way that the oboe needs considerable stamina to play.

He left Guildhall and commenced his professional musical career as a jobbing oboist. He huffed-and-puffed his way through concerts on park bandstands and the like but soon decided to take out insurance in the shape of a day job working in the BBC Music Library. He had only been there a couple of months when he received a letter inviting him to an interview for a job in, of all things, the gramophone record industry. The letter was from Oscar Preuss who ran the Parlophone gramophone recording company from an office at EMI in Abbey Road, St John's Wood, London, NW8.

George thinks of mixing in terms of visual associations and creating a 'sound picture'. He first became involved with recording sounds in order create visualisations in the mind of the

listener when he produced comedy records by Peter Sellers and many others during the 1950s. Also interesting is the concept of the mixing desk being used as a musical instrument, and to extend an arrangement or orchestration.

"You mentioned the 'sound picture' idea first of all. In my mind, I think sound and vision are very closely coupled. And when I write, if I orchestrate, I do actually sort of see colours, or hear colours. The aural experiences are very close—in my reckoning—to painting a picture. It's rather interesting, I've just been finishing an animated film, *Rupert The Bear*, and doing all the background score. The correlation between music and vision is more evident in a cartoon than it is even in a real life film; because the cartoonist is painting with his

Aural experiences are very close—in my reckoning—to painting a picture

paintbrush, his lines, and the musician is painting with his music. The two do go together and heighten each other so that a visual colour becomes much more vivid when you hear a sparkling sound with it that duplicates the colour. And it's amazing how the brain picks this out. The brain will receive messages which the music will relate, coupled with that of vision and it will in fact change the vision. You can actually have a piece of film which is changed by the character of the music. I'm very conscious of that.

"As for using the mixing desk as an extension of your orchestration or arrangement—that is true. I'm not an engineer, I don't pretend to be and I never have done but obviously, you can't work in the business for 30 odd years without having a great deal of experience of working with engineers, and getting to know desks pretty well, and in fact getting to the point where you're telling console designers what you want from a desk. So I'm very conscious of the capabilities of a mixing desk during a mix and that if it is a complicated mix, then many hands may be needed to realise it.

"This multi-hand technique, if you like to call it that, started in the Beatles' time. We used to use it on their recordings even as early as Norman Smith's (engineer) day before Geoff Emerick came along—quite often we all put our oar in. Maybe Paul would decide to have a go at something, or I might, or

George might. We certainly used it when Geoff Emerick came along, by the time we got into 8-track (even though 8-track is simple compared to 24 or 46-track, non-computerised that is) with panpots and so on there was too much for one person to do. For example, *Tomorrow Never Knows* (the *Revolver* album) was a genuine experiment at painting pictures with sound and it was prompted by John wanting to do something weird for that particular song. We did use the board literally like an organ having established an original track of drums, tambora and voice.

"The difficult thing with John was trying to get inside his mind and find out just what he wanted. He wasn't terribly articulate. He would speak in vague terms about what he wanted and I think to this day, I never got what he really wanted in any of his things. I think I got pretty near but I think there was—deep down within him—a slight dissatisfaction at the records we made together. I think that he thought they could have been done better. And possibly they could, but I did try my best.

"Going back to *Tomorrow Never Knows*: he said, 'I want my voice to sound like a Dali Lahma singing from a mountain top.' Well, the way we got that of course—or what we eventually ended up with—was with something which is quite common nowadays: putting the voice through a Leslie speaker. I don't think it had been done before at that time. That was the voice sorted out with a fairly satisfactory weird effect. There was a tambora drone that went all the way through and Ringo banging away with his very distinctive drum sound."

So it wasn't a tape-loop backing track?

"No, no. That was a genuine track but the decoration—what I call the filling in—that was tape-loops. Now at this time, I think it was Paul who had sort of sparked off Ringo and George and to a lesser degree, John, with the enthusiasm to make little *musique concrète* sounds. In those days we didn't have cassette machines but they had open reel-to-reel machines, Grundig and that kind of thing. Paul found that by taking off or disconnecting the erase head and putting a loop of tape on and just making one sound—it could be a giggle, it could be a slap, breaking of crockery, or a guitar note—it would keep recording over itself until it reached saturation point. And then he would take the loop off and listen to it. It was a new thing, a silly little pastime they had. We listened to one or two of these things and they were quite

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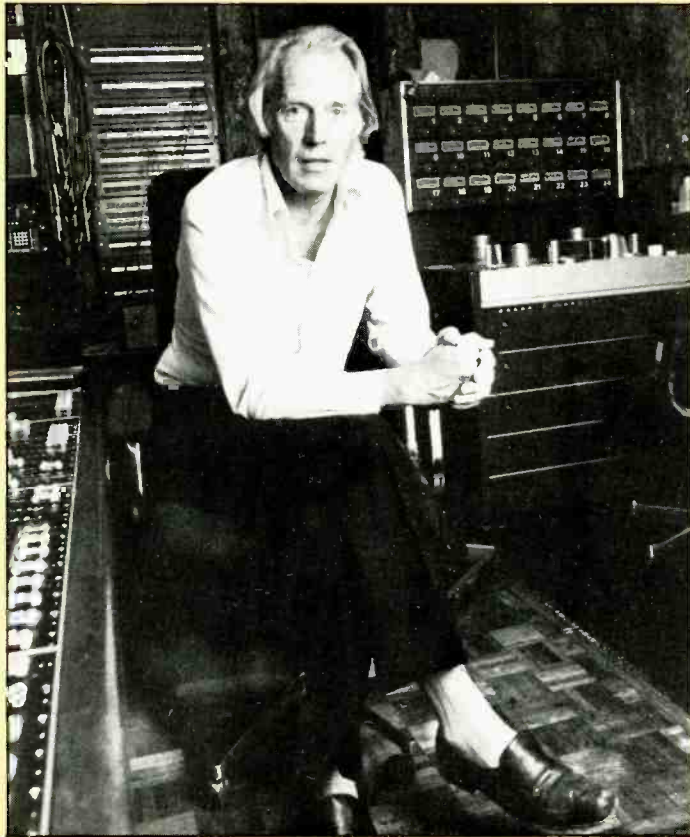
intriguing so I said, 'Look, you go away and do lots of these and bring them to me.' They all went away and eventually they brought in probably about 40 tape-loops, all different dimensions and all different speeds. I would listen to them all, reject some and say, 'that's quite interesting' or 'that one might sound better backwards', or it might sound better at half-speed or double-speed. Whatever. So we eventually ended up with 16 loops that we liked."

Tomorrow Never Knows is the closing track on the Beatles' seventh album *Revolver* and—leaving aside *A Collection Of Beatles Oldies* which EMI put out in 1967—was followed by *Sgt Pepper*. The backing track was at best recorded on a 4-track machine and with a 16-channel desk.

"We had our input from the multitrack with the tambora drone, the voice and the drums. Then I found eight mono machines that would take all these tape-loops and of course, they weren't all in the same room at Abbey Road Studios. We said: 'Right, this is an experiment we want to do,' and so we raided the whole of the studios."

With a chuckle George continued, "One of the things about being the Beatle producer in those days: it didn't give me a great deal of money but it did give me a great deal of clout. I was able to say, 'Well look, we want to do this.' And everybody would say, 'Yes sir! Yes sir! Three bags full sir,' or almost.

"Anyway, people were enthusiastic about it when they saw what we were up to. So I was able to commandeer machines from all over the building and have people standing by these tape machines, holding the loops out with bits of pencil and having the loops going all the time. We then fed these sounds through to No 3 control room, which we used for that particular mix and brought them up on the desk. By bringing up any fader, you had a sound that was going all the while. So you can see where the organ aspect comes in and this is where you need more than one pair of hands. Geoff Emerick was the engineer and he was responsible for the overall sound, for the level, the balance of the voice, drums and tambora and making sure the other noises didn't get in the way—the overall effect. And George, Paul and I were wiggling knobs, bringing in faders, panning the signals. One person can't pan and bring in eight faders *all* at the same time, that's why we needed more than one pair of hands. Then halfway through, we took all those loops off and put another set on and did the same thing again for the second



half. So that was how that record was made and so I think that's a fairly effective way of describing how you can use your desk as an extension of your arranging ideas."

Another interesting point about those particular effects on *Tomorrow Never Knows* is that they are fairly abstract so each listener can form his own images to go with the sounds.

"And of course, we liked doing that. I like to sit right in front of the desk, right *within* the triangle of the optimum stereo. So that you get the real feeling of sitting in a theatre or cinema, then shutting your eyes and hearing things. One of the fascinating things that I used to find, was when you panned something from left to right, it didn't just go straight across, it goes up in an arc *above* you. It was like going through a proscenium arch in a theatre. And you could then see—very vividly in your mind—what the sounds were doing as a stereo picture. We did the same thing of course with *Revolution Number 9*. That was a similar sort of exercise where we brought in sound effects and John was very tuned into that."

George remembers many experiments with great fondness: the peacock-tail endings on Beatle songs when they would have a whole galaxy of musical ideas and sound effects, often going way over the standard

3-min pop single format. And the question of the different takes and endings on some Beatle records?

"People say to me: 'Why was that record different to that?' Quite often there have been different takes issued, I believe, and quite often those have come about through errors of issue. Sometimes an ending was put on which was a mix which we'd done for something else. But we weren't deliberately trying to fool people. It was just the welter of stuff that we'd done."

These little vinyl ambiguities have of course been the subject of great debate over the years, particularly in the US where they tend to fanatically analyse and be fascinated by every minute aspect of Beatledom.

George seemed to actually be a little disconcerted about the obsessive aspect of fans. Understandable when you remember that it was an obsessive, albeit also deranged fan, who eventually murdered John Lennon. But we moved on to an altogether happier subject, and the recording of the song that featured what was perhaps the ultimate in extended endings, *Hey Jude*. Considering they did some pretty outrageous things on record, was George always convinced they'd done the right thing when he left the studio?

"In fact, no. In the case of *Hey Jude* when we were recording the track I thought that we had made it too long. It was very much a Paul song and I couldn't understand what he was on

about by just going round-and-round the same thing.

"And of course, it does become hypnotic. Then I realised that by putting an orchestra on you could add lots of weight to the riff by counter chords on the bottom end and bringing in trombones, and strings and so on until it became a really big tumultuous thing. So that was my only *real* contribution to that. The real credit goes to Paul for thinking up the song in the first place, and the riff and the way it extended. Even when we'd finished, I was terrified because it was so darn long. It was seven-minutes-something-seconds. No-one had ever made a single that long before, but of course, it was one of the biggest sellers of all time."

Abbey Road, as well as being the last piece of work the Beatles did together, is often cited as an album confining consummate performance and record production. I asked George to talk about the record, kicking off with the guitar sounds.

"Well, I can't really claim any credit for the guitar sounds. I'm not trying to be modest or anything but *Abbey Road* was *certainly* very much a production job. We were getting back to what I tried to do before and again, I worked very closely with Paul on that. Side Two—the sort of linked-up one—was really what I wanted to do all the time. I tried to get them to translate their ideas in making albums. I tried to tell them that we should look at the classical way of making music and the symphonic way of making music and we should put form into our records. There would be nothing wrong with making a complete movement of several songs, and having quotes back from other songs in different keys. And even running one song into another contrapuntally, but thinking of those songs in a formal classical way. Side Two of *Abbey Road* became that way because Paul got very enthusiastic about it. Side One was really a compromise to John who really didn't want to do that kind of record anyway. In fact he was going through a stage where he didn't like production with a capital P. He liked it to be: 'As it is, man. Let everything hang out and let's have a good old rock'n'roll record.' Which is fine, I'm all for that too.

"So that was a compromise to John and the other side became just a sequence of titles, of singles. But within those singles I think there was a great deal of invention. I mean, George's *Here Comes The Sun* was the first

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time he'd really come through with a really brilliant composition, and his musical ideas, you know, the multiple odd rhythms that came through. They really became commercial for the first time on that one.

"I was delighted to be back working the way we used to be. Because don't forget, *Abbey Road* came after *Let It Be*, which was the unhappiest record of all. There was so much tension and pulling apart. And everybody didn't like each other, and although the songs were great, one was left with a feeling. I thought it was the end at that time and when we got back together for *Abbey Road* it was a genuine attempt by all five of us to try to work as we used to, even though we knew the inevitability of the separation. We knew that John would go his own way, we knew that Paul would go his own way. But it was still a coming together."

Was that something John was expressing in his song *Come Together*? "Well I don't know," George replied with a smile, "it's for other people to work that one out. I was very conscious of the fact that we were all trying very hard to make this a good swan song. In John's song *Because* for example, that was a very simple song indeed and it was done very simply as well. What we did was lay down a track of John's original idea of the song. He played his basic accompaniment on guitar and all we did was to decorate it with choral effects. So we laid down a track of Paul on bass guitar, John on guitar and myself on electric harpsichord. In order to keep time—because I'm not renowned as the greatest keeper of time when I'm playing—Ringo played just a beat. We didn't have *LinnDrums* in those days or electronic sounds. Ringo just kept us in time but we didn't record him. Then we put down one set of voices with John, Paul and George singing in harmony and we then designed two more sets of trios to go on top. So we finished up with nine voices, nine sounds, that's all but it worked. It was very simple."

Apart from when a special effect was used on a Beatle voice, George recorded in such a way as to leave them sounding very natural and unprocessed. Electronic sounding vocals are now fairly commonplace yet the Beatle vocals stand up well beside them, not lacking in impact in any way.

"We've gone through all that, and people have distorted the voice enormously since those days. There are only so many variations on a theme. Again, the Beatles themselves always wanted to have more effects. John, in particular, *hated* his own voice. Or rather, he didn't

really appreciate it as much as I did, certainly. He always wanted something done to it like on *Tomorrow Never Knows*. He wanted it disguised in some way. He loved ADT when that came along. The original ADT we had was much better than anything we've ever had since. You know, the digital delays we use today aren't anything like as good as the original manual system. And that original ADT sound was something that John was always trying to recapture in later years when he was recording by himself."

So George is talking about a slightly out-of-sync tape effect?

"Yes it is. The original ADT system was devised by Ken Townsend (who is general manager of Abbey Road Studios now—he was just a backroom

couldn't do it live.

"If you brought it *perfectly* in line, of course it would be just the same image. If you took it slightly out-of-phase with itself within a certain parameter, you would get a phasing effect. If you took it a bit further you got ADT. If you took it right out, it became like a slap echo or a slap delay. We know now that what we were doing in those days was to effect a delay of something between 25 and 35 ms, as a rough parameter; 27 to 28 ms is my favourite, if we use it digitally. We had to do it by having a varispeed motor on an old tape machine, the old *BTR 2s* were the ones we used. And of course, the head spacing (the distance between the record/sync and the replay head) was the crucial factor because no

Abbey Road was a genuine attempt by all five of us to try to work as we used to

boy then) in answer to a plea from me because I was fed up with continually double-tracking manually. I used it so much, not just with the Beatles."

When the Beatles spearheaded the Merseybeat Boom during the mid 1960s, Liverpoolian groups and singers swarmed south and, with a little help from George, swamped the charts. Cilla Black, Gerry and the Pacemakers, the Fourmost, Billy J Kramer were produced by George, who must have been working round the clock to record them all.

"I never recorded Billy unless it was double-tracked and I said to Ken, 'Wouldn't it be lovely to be able to press a switch and do this?' He went away and thought about it; the way he originally did it was, obviously, by 'time slip'. Again, visually speaking, it is taking one image and then recording another and putting them slightly out of focus."

George went on to explain that Ken used two tape machines (plus mixdown) and took the replay signal from the sync head of the machine playing the master and copied it to the second machine whose output was monitored off tape. Dependent upon the tape speed and distance between the record and replay heads of the second machine, the off-tape signal could be varied in time from in front of, to behind, the replay signal from the first machine. In other words, you could only use your ADT on a mix—you

machines had the same spacing. Some machines were quite different from others. And so you had to up speed a machine in order to bring that "head gap" closer or further away. Are you with me so far? That could only be done manually in those days, you couldn't do it electronically or with computers because we didn't have them then. It had to be done with a bloke with a little *rheostat* governing the speed of the machine. And inevitably, human nature being what it is, it couldn't be dead accurate. Or if it was accurate, it didn't stay accurate. So it had to be continually monitored as the mix went on. Someone had to do that all the time with a vernier gauge control, making sure that the speed was just right. Now, the very fact that it *was* fluctuating gave it a variation in pitch as well, which is why it was so good. It was an infinitesimal variation of pitch and a slight variation of differential between the original image and the second image which gave you the effect of not only a delay but also blending in a harmonic effect like a harmonizer. All the effects units we've had since then have never been able to do it *quite* as well as those manual systems."

A feature of Beatles records is that they can at times convey an underlying sense of humour, even when a song is not dealing with a humorous theme. Certain aspects of the records, even the use of effects or the way in which an instrument is mixed, can raise a smile. Though initially rock'n'roll echoes were most definitely developed by

American musicians and producers, on Beatles vocals for instance, they were developed further and used with affectionate humour. It is a difficult quality to quantify, but was that something they were aware of when they were recording?

"Well sure, that was deliberate. We would like to have people slightly amused. But I think in the case of John, that was quite often of his volition because he had a great sense of humour and he liked that to come across in his records. And all those effects that did occur were in response to demands made on myself and Geoff Emerick by John, Paul or George at the time. And they would say: 'Come on, we want a better sound than that!' They were always very demanding and they were always looking for new sounds. I'm saying this because it wasn't me saying: 'Look John, you ought to have a weird echo on your voice here.' It was the other way round and I would almost sometimes be saying: 'Don't you think you're going a little bit over the top, John?' I was the cautionary one perhaps, rather than saying: 'Yeah! Let's go overboard!'"

"I liked to contain it so that it was still listenable and still commercial if you like, but still also what I liked."

Considering that George's background was in classical music, he went boldly forth in his use of stereo. He was not inhibited by a climate in which a very formal attitude to stereo prevailed.

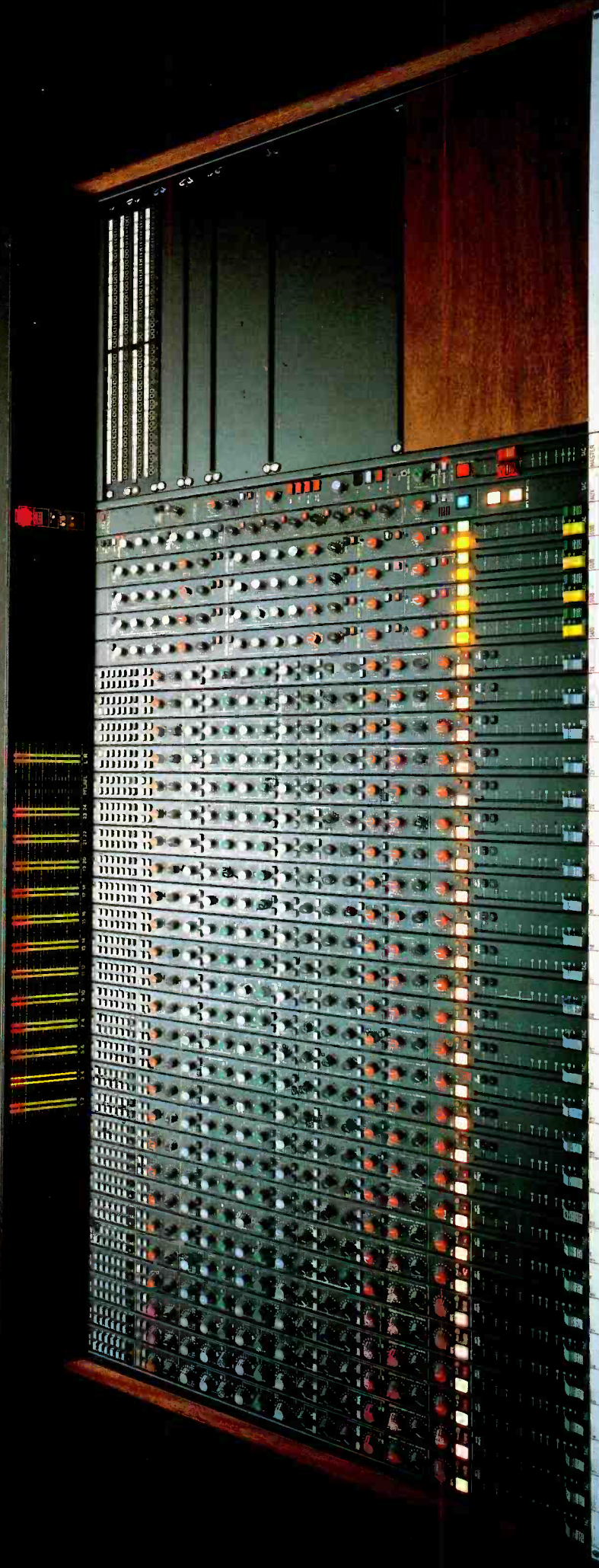
"Oh, I'd abolished that long ago."

We went on to talk about his use of relatively extreme stereo effects.

"Oh well, I was very excited about it. I always thought that stereo should be used creatively and shouldn't just be a representation of musicians sitting in a studio. And I didn't see anything wrong with wild pans and placing things differently. We did some pretty far out things, looking back on it. Some of them, I don't think were successful. You know, putting bass on one side and drums on the other, that kind of thing: which we did deliberately for effect."

"There were a lot of deliberate odd stereo things like that but there was also a lot of misuse of records. EMI put out a lot of twin-track recordings with all vocals on the other, which they never should have done. I don't know if they ever recanted on that. That was a frightful omission. Originally, in the very early days, I made mono records

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using a stereo machine as a twin-track. I used one track for all the backings, even on live recordings, and one track for all the voices in order to give me a little more time; when they all went home I could compress the two together to get a really punchy sound. It gave me just a little bit of delayed option. Otherwise it would have meant just recording a live thing like a BBC broadcast. But later on after I left EMI, some people dug up these tapes and—on the premise that Beatles stuff should never be changed—they issued them as stereo records which was an appalling gaff. It was terrible. I heard one of them the other day and it made me wince.”

The intended stereo effects were even more dramatic when listened to on stereo headphones, a pastime that became popular concurrent with the Beatles' peak of popularity.

“Well of course, the *Walkman* has changed people's way of thinking too, hasn't it? So many people listen now with a *Walkman*. I've often thought that if you use one as a definitive answer to stereo, then you've got to re-think your stereo.”

I had been listening to *Sgt Pepper* on headphones while travelling to Air on the tube that morning, with Paul's vocal coming from the left and the brass from the right.

“It wasn't designed for headphones I must say, but it became quite effective. Here's Paul, How are you?”

“Fine George,” replied the world's most successful living songwriter, I've just come to wreck your interview.”

George had left a message for Paul that we were in the restaurant and to let him know when he arrived. A few years ago, when Paul had asked George to produce him for the first time after the infamous split-up of the Beatles, George said words to the effect of: Why end a beautiful friendship? The friendship seems to have survived the renewal of the working partnership.

Paul chatted on for a while. After a few minutes, seeing that I had left a copy of the book *Making Music* on a table (edited and contributed to by George) Paul said: “What's this then George? Flogging your tome again?” George explained to Paul that he had forgotten our appointment—perfect material for Paul to continue gently kidding him.

“He's so big time. He's just flash these days, you know what I mean?” After a few more minutes chatting, they made

their way down to the studio.

The resumption of our interview on the Friday morning marked the end of the months of George's present collaboration with Paul. This had involved him writing and arranging and recording the entire score for the full length *Rupert The Bear* feature, Paul having acquired the rights to Rupert some time ago. He had also been musical director, arranger and record producer for *Broad Street*.

At the foundation of the relationship between George and the Beatles was a great empathy, even though almost a generation apart. Goon humour was virtually a national pastime. Does George feel that the fact that the Beatles knew he worked with some of the Goons, in particular Peter Sellers, endeared him to them early on?

“Yes, undoubtedly. That was one of the things. Well, the Goons were the Monty Python of their day. They were very popular and their sense of humour was something that was peculiarly British, I think. You wouldn't have found it anywhere else in the world. And of course the boys' humour is very distinctive anyway. It's anarchic and has a lot in common with the Goons.”

As a lot of George's early history has been well documented not least of all in his own 1978 book *All You Need Is Ears*, I suggested we concentrate on other areas.

The McCartney albums *Tug Of War* and *Pipes Of Peace* seem to me to indicate that the George Martin style of production from the Beatles days appears intact and rules that served him well then, continue to do so.

“I don't consciously go for a style. It's just that you do what you do the way that you do it, and I don't know any other way. It's as simple as that really. It's not any desire to achieve a trade mark or anything, it's just the way I go about making records.”

George obviously has great musical empathy with rock musicians, a vast knowledge of

instruments and his beautiful string arrangements all being important elements in his work.

“I think orchestration is a different thing in a way. Production and arranging are two different jobs, even though they go hand-in-hand. If you can score, if you can orchestrate, it's obviously a tremendous help to realise the production ideas that you have. You know what to write in order to get the right sound in the studio. Similarly, if your production end tells you what you need to write, you're working hand-in-glove with yourself so to speak. And that's where your orchestrating style affects your production style. They are two different things. If I'm doing an arrangement for someone, or I score a film—which I don't often do these days—obviously I write in the way that I know. Unless I'm going for a particular sound and I'm trying to imitate someone, I write the way I feel is my own way. Of course my work has a particular style although I don't deliberately try to choose a style. But you can't write for a number of years without developing something of that sort which is inherent in you.”

George's production and arranging skills were adeptly applied with great artistic and commercial success when he got together with Jeff Beck for *Blow by*

Blow. It is an album which stands the test of time and one that Beck has never really been able to equal since, even when he and George went into the studio to record the follow up album, *Wired*. The timing had been just right.

“I think timing is always important. I think that when people start working together, whether you have a sort of mystical thing about it (laughs) and you say the gods are looking down on you in the right way, or whether the timing is just right. That you're in the right mood for each other, and your talents do actually complement each other. That was true in the case

of *Blow By Blow* because we were rather unlikely bed partners, in a way. In fact, a lot of people told me that I shouldn't do it, but I loved his guitar work and I *did* want to work with him. And I was quite flattered and surprised when he asked me to produce a record. So it was a coming together of his wonderful sense of guitar work, the way he can handle a guitar, like nobody else I know of—including the really great ones. He has a style; he has something which is unique to him.”

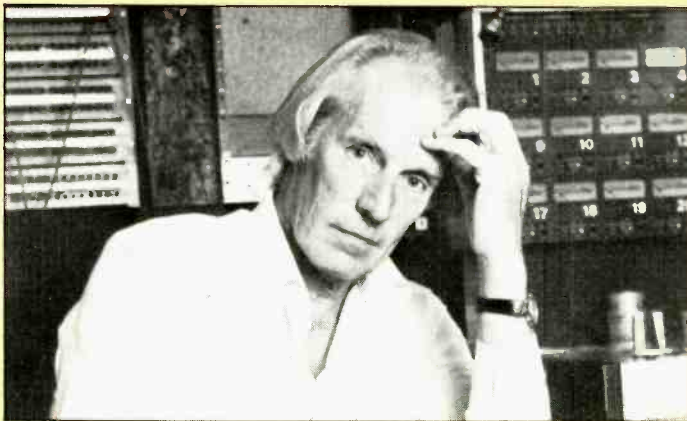
He can go the whole gamut from outrageous rock'n'roll sounds to the most sophisticated of musical endeavours.

“Absolutely. It was interesting because I'd worked with John McLaughlin as well, who again, is a brilliant guitar player and a brilliant musician but quite quite different from Jeff. The two of them went on tour actually, and I visited them in various parts of the States. It was interesting watching their styles on stage. Of the two, Jeff was of course more popular with the fans because his style of music was what I call 'gut' music. It was stuff that was very emotional that really touched people, that really came from the heart and went to the heart. I'm not saying that John's didn't have any emotion with it but his music was a little more cerebral. He tended to think things out in a bit more detail and be a bit more complicated in fact. Very, very musical and a wonderful sense of melody, harmony and rhythms but a little more, dare I say, highbrow than Jeff?”

“But at the time I worked with McLaughlin, I was right for him and he was right for me and we were very happy together. And similarly, later on with Jeff, I was in the mood for something like Jeff and it worked well. So I think that timing is of the essence. And if you meet your right subject, or object—however you want to look at it—at the right time in your life, then I think you do a good job. You do a better job than you would otherwise.”

The facts that the 1975 *Blow By Blow* and McLaughlin's 1974 *Apocalypse* albums both feature a guitarist and are produced by George Martin are just about the only things they have in common. *Apocalypse* features the Mahavishnu Orchestra and the London Symphony Orchestra conducted by Michael Tilson Thomas. The album was recorded at Air Studios mostly with McLaughlin's band in one studio, while the LSO were in the famous Studio 3. Beck's album featured a funky little team led by the most rhythmical Max Middleton on keyboards, with the strings on the album arranged by George.

“I realised that making a



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record with Jeff had to be very simple. And also obviously, it had to be musical, the subject matter we were recording had to be chosen very carefully. And I did very much want to make a good modern rhythmic record. In other words, I wanted to take influences from black music, which Jeff was very keen on anyway and had a great affinity to."

The album was innovative in that Beck found a particular, and there's no other word quite so applicable, 'groove'. The influences are clear but the music had something fresh and new.

"And the way the rhythms went, I also wanted to make it very much a foot-tapping party kind of record so I ran a lot of the tracks together except in cases where it wouldn't work. It was almost like a disc jockey exercise.

"Jeff really used to paint music with his guitar too. He thought of it in that way, with sounds as well as notes. And the extraordinary thing was he used to be able to do it with the most primitive of weapons too. His axes weren't the best in the world sometimes but he just used to make them sing."

Was there anything George felt was relevant with regard to recording technique on those tracks?

"No, they were all very straightforward, we did it all here at Air Studios, in Studio 1. The engineer on the first album was Denny Bridges who's no longer with us—now he runs another London studio. He hadn't done a tremendous amount of work at the time but he was very enthusiastic and he wanted to experiment with a clean sound with Jeff. There was really nothing clever about it, just straightforward recording."

The point which George makes about timing being of the essence is underlined by the fact that when he went into the studio with Jeff to record *Wired*, although a good record, it just didn't measure up. Jeff is apparently a sensitive and volatile character and at one point on the *Wired* sessions he even wanted to take the tapes home and record his solos alone.

"On reflection, I don't think it was as good an album as *Blow By Blow* but we did try very hard. Jeff also was much more inhibited. He had much more to lose when we made *Wired*. When we started *Blow By Blow* he hadn't made a solo album for a long time and he was starting from scratch and if it didn't work out, people would say: 'We told you that it wouldn't work with those people anyway,' so it was no real problem for him. But *Blow By Blow* was such a success that everyone was saying: 'Right! What's the next

album going to be like?' and in a way, that worried him. He got more inhibited about his solos and about the way he was playing. He also teamed up with Jan Hammer and it really wasn't my cup of tea. I much preferred the cleanliness and the Max Middleton stuff. So it wasn't quite the kind of record that I wanted to make for the second album and I think the sales reflected that too."

That was basically to do with Jeff's frame of mind?

I didn't find working with Ultravox as alien as people would have thought

"And that I felt the material wasn't so good, to be honest. But there again, it's very difficult to find great material."

The recording of the McLaughlin *Apocalypse* album was apparently quite a spectacular affair. They originally tried to record with both McLaughlin's amplified band and the LSO in Studio 3 at Air but had to have a re-think.

"The scale of decibels between one and the other was ridiculous. Michael Waldon's drumming was louder than any instrument in the LSO, much louder. So we had to put them in separate studios. The sections of music that required the bands together, we did that way. We laid down tracks and overdubbed the LSO: we laid down LSO and overdubbed band, which is a strange way of doing it but there were long *colla voce* or *legato* sections which the LSO were recording that didn't require a rhythmic emphasis. That could be laced in afterwards. John McLaughlin worked very closely with Mike Gibbs, who was the orchestrator, and he in turn worked very closely with Michael Tilson Thomas, who is a classical conductor. It was really quite complicated but beautiful music. There's one favourite piece of mine which is a very, very slow thing, *Smile Of The Beyond*, in which his pianist, Gayle Moran, was singing. She has a lovely voice, she's a beautiful soprano. Being a keyboard girl in the band, she

was in one studio and the orchestra were in another. It just happened to be that way because we were going into something that required rhythm. She had to sing her part in one studio while the orchestra were in another. In fact the track you hear on the record is the first or second take. She wanted to do more but I was so pleased that I went ahead with it. I thought her rendering under such circumstances was incredible. She was singing to a 'non-

existent' orchestra that she could hear on cans and that was it."

Paul McCartney had come in a few minutes earlier and had been playing the 'Space Invaders' machine as George and I carried on talking. In an exaggerated voice he said: "Well, I'm thinking of starting work myself!" Again, Paul exchanged pleasantries with us and they explained about working until 2.30 in the morning and having to wrap things up that day. Paul was quite amused to see George looking anything less than immaculate with a little stubble on chin and remarked, "This is very becoming, George."

Paul went to the studio and George continued talking for a few more minutes. I asked him about the string arrangements for *Diamond Dust* on Beck's *Blow By Blow*.

"Diamond Dust was in 5/4 but actually it had a funny beat. It had a 10 quaver, or eighth-note beat with an accent coming half way through so it was a five and five within the bar. That was a beautiful one, and it flowed. It was set up by a kind of arpeggio pattern by Max on the keyboard and then had a very broad tune over it. I had the idea of just using the strings stating the tune in canon, and having the upper strings and the cellos—the lower strings—coming in later in the same style, then weaving with just two lines of sound. When you have really good

performers, you don't need more than two lines if they're interesting. Therefore the strings formed a counterpoint to Jeff's melodies and similarly later on, they played with each other, so to speak. I deliberately kept the scoring very simple and very strandy and I think that was what made it work. The fact that I used strings came as a surprise to some people, not least of all Jeff, I think. But he realised it did work on such a super piece of material. You couldn't do it with everything."

In sharp contrast, I asked how George enjoyed producing *Quartet* for Ultravox in 1982, his first foray into machine music, accepting that there was quite a lot of real drums on the record.

"In fact, it was almost all real drums but it was very much keyed to the *Linn*. I quite enjoyed it and I get on very well with them. Billy Currie is very good. He thinks kind of orchestrally with his synthesiser work. I didn't find it as alien as people would have thought. I've heard some of their recent stuff and it does worry me when I hear that machine-like rhythm that is unrelenting in its breathing. It's not human. But that didn't seem to worry me too much when I did *Quartet* and we were able to create some quite human stuff. We did quite a lot of choral work at one point. *Hymn* for example, required a certain amount of jiggery-pokery which was quite fun to do. We did that in Montserrat (Air Studios) and that was very nice working over there. In fact I saw Midge the other night and he said: 'I'd love to go back there, it was such good fun.' We all had such great fun together, that was a very happy album, *Quartet*."

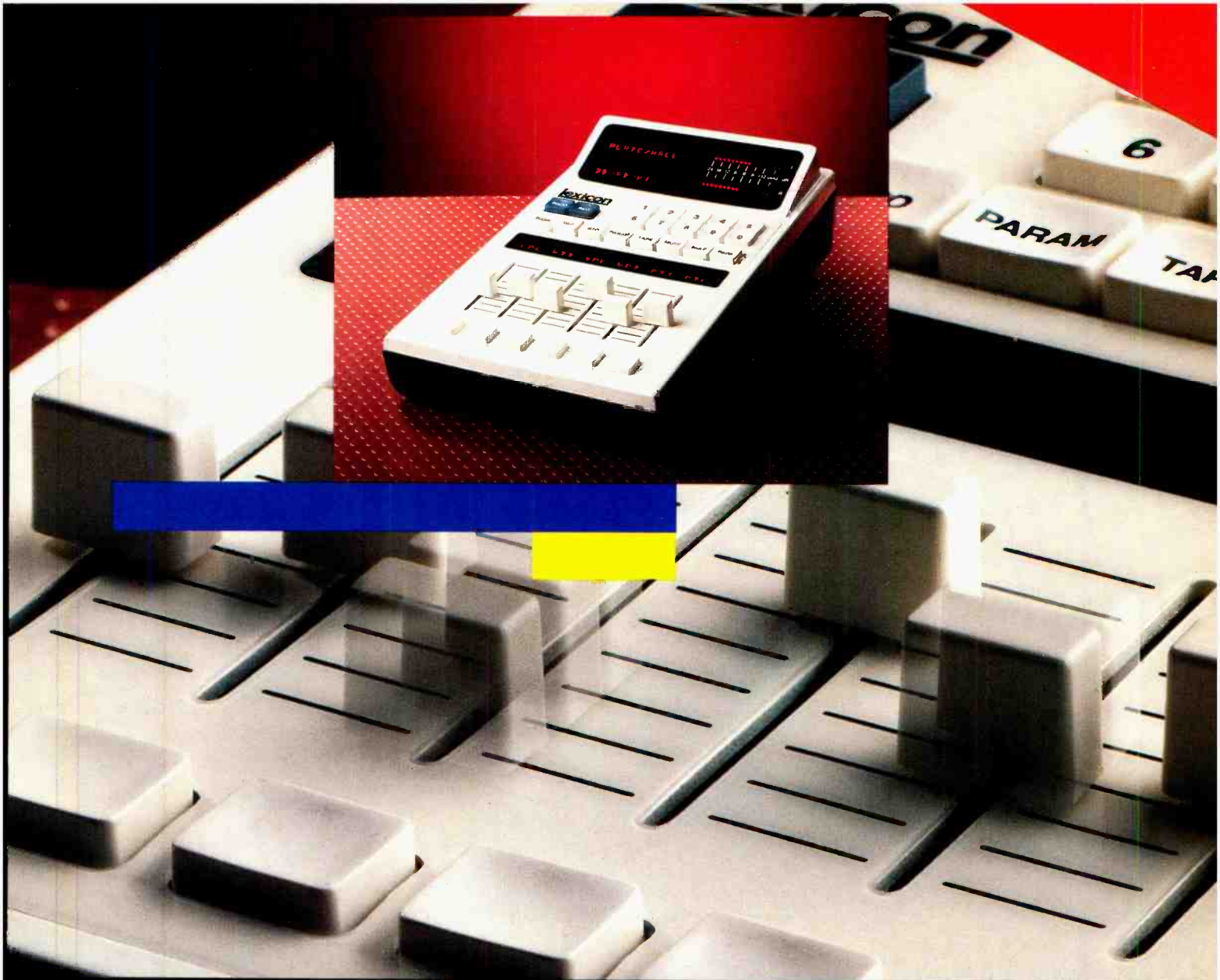
I could have kicked myself when I realised I was half way through a hypothetical question but too late. Had they been invented, would they have used a *LinnDrum* on Sgt Pepper? I had asked the question because the tracks are so human and un-machine like.

"We wouldn't have done in fact. I use *LinnDrums* with Paul now but only for particular things. And if you listen to the albums we've done recently, we've always had *LinnDrums* since Stevie Wonder gave one to Paul which was when he came down (to Montserrat) for *Ebony and Ivory*. But we use it I think with a certain amount of circumspection. It's great for disco and rigid beat things. Marvellous for that."

Ebony and Ivory was, especially considering it was recorded by just two people with a load of instruments and machines, a very human sounding record.

"Because it was real drums and real people." □

Part two will contain more about the Beatles days, George Martin's feelings about re-recording Beatle songs on *Give My Regards to Broad Street*, his early period in the music business, his all time favourite Beatles record, as well as many other subjects, including his criteria for working with musicians nowadays. In the meantime, please don't send him any tapes.



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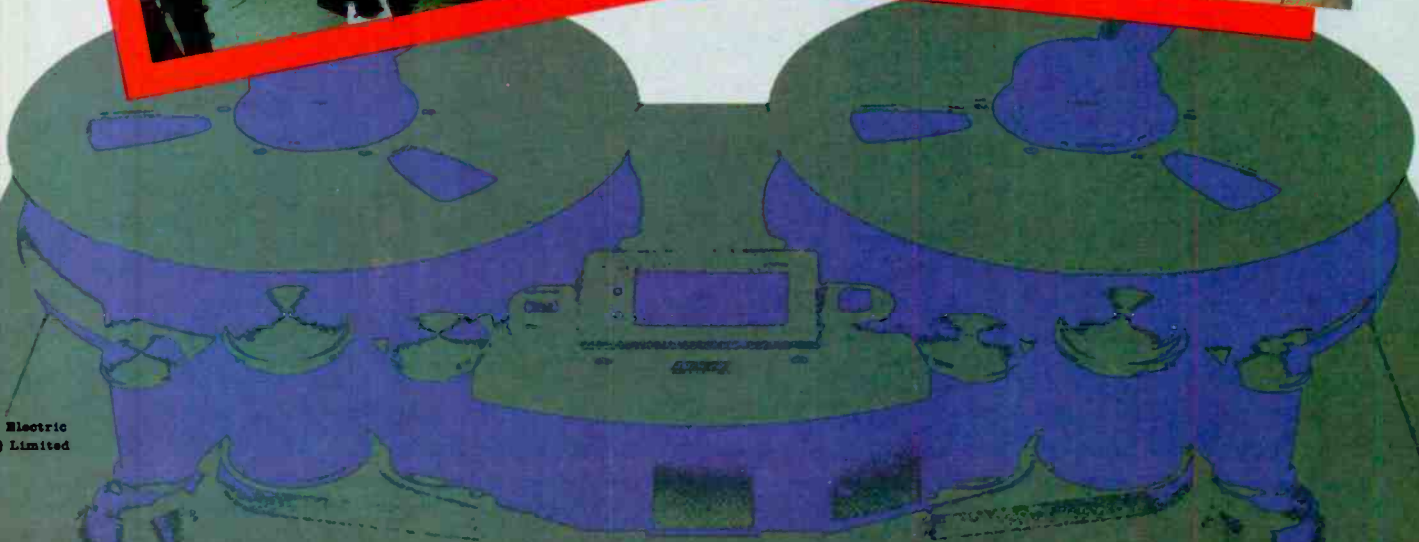
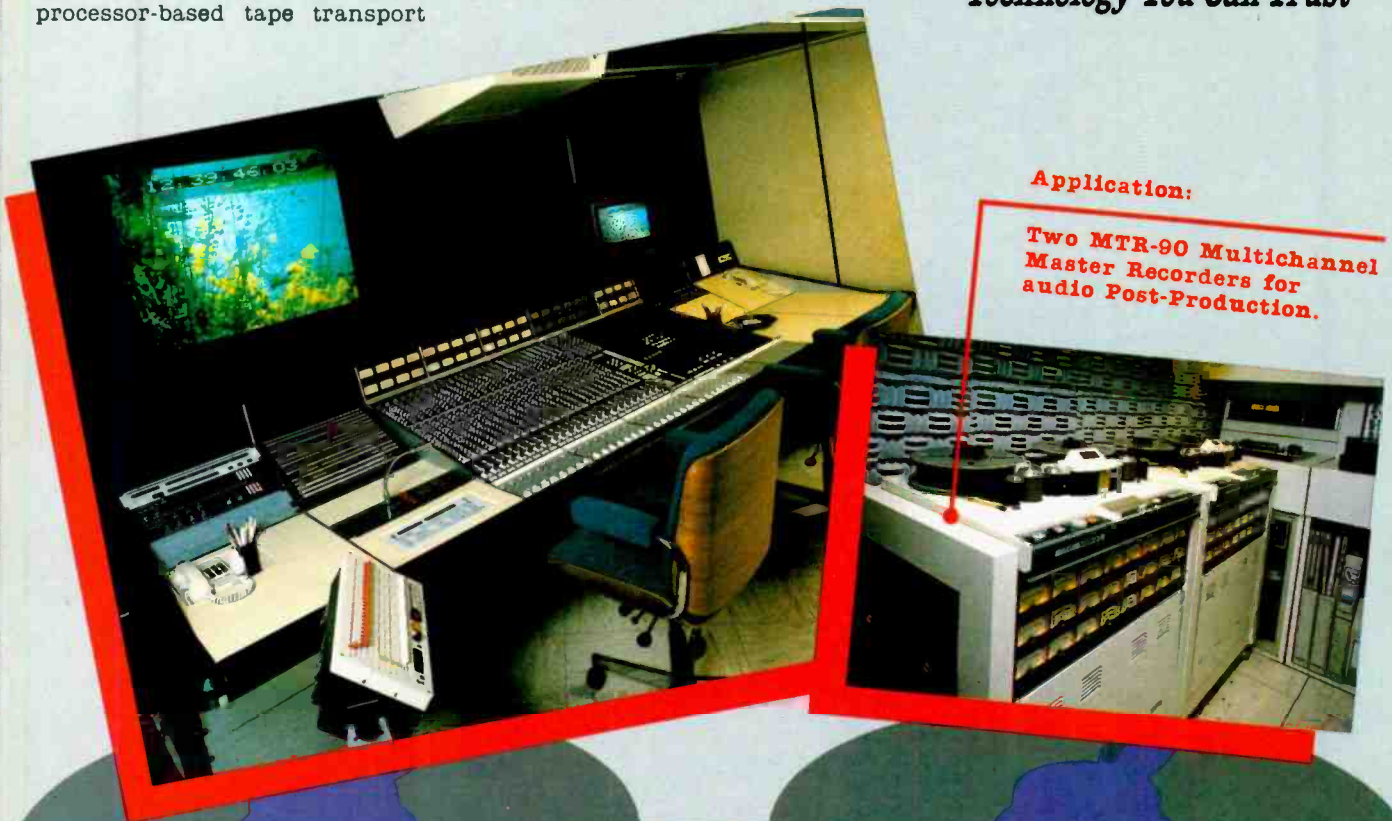
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STUDIO FILE

STUDIO FILE

Fowlmere House, home of Cabaletta Recording, is to be found in the middle of a sleepy picturesque village near the Hertfordshire/Cambridgeshire border. 'Formerly The Rectory, Fowlmere House was designed in 1853 for the Honorable and Reverent Arthur Savile by the eminent architect Henry Edward Kendall Jnr.', quoth the literature, and it shows.

The Hon & Rev Savile, being the 6th son of the Earl of Mexborough, and feeling that he ought to have a suitably grand abode, demolished the old Elizabethan rectory and built on the site of the Tithe barn.

Located, naturally, directly opposite the parish church in Fowlmere High Street, the house is imposing, both in its size and its setting. The studio occupies what used to be the servants' hall, kitchen, scullery, pantry and back stairs—as you can imagine, it is quite large.

Cabaletta belongs to Hugh Richardson and represents the realisation of a long term ambition. The fact that he is himself a singer should give you a clue to the studio's name. *Cabaletta*: A short operatic song in popular style, characterised by a rather uniform rhythm in the vocal line and accompaniment.

In the late 60s Hugh was working at Pye as a maintenance engineer, and it was here that his interests and ambitions recording-wise were born. He left Pye to study for two years at the London Opera Centre, and went on to spend the next 15 years working as a professional singer, including five years in the chorus of the Royal Opera. Having acquired Fowlmere House some 11 years ago, Hugh has finally taken the plunge and built his studio. The acoustic design is that of Rupert Neve and is geared specifically and solely towards the recording of classical music.

The recording area is approximately 36 by 22 ft—although none of the walls is quite straight—and as it was originally four rooms there is a steel joist going across the middle of the ceiling supporting a main wall above it. In addition to the non-parallel nature of the walls, there are three chimney

Cabaletta Recording, Hertfordshire



Studio looking towards the back stairs to the control room

breasts which further break up the line. The room is extremely light and sunny, looking out on two sides on the acre of land surrounding the house. There are four very large double glazed windows (approx 4x8 ft).

The acoustic treatment is extremely simple, and very effective indeed. The room has a comfortable feel, and sound appears well under control. Hugh commented that at the studio opening party back in September, although the room was full of people, they could all converse at an easy level.

Walls and ceiling (the latter incidentally, is 10 ft high) are totally covered in cardboard boxes which are half filled with 4 in fibreglass. These serve to EQ the room and get rid of flutter echoes. At the time of our visit, the boxes were still exposed to the human eye, although when final decoration is complete these surfaces will be covered in a light hessian type material.

The floor is covered in an attractive hard wood called 'Merbau' whose origins I am unable to discover. Hugh doesn't know much about it either, except that he spent many idle hours tapping and testing various samples of wood and this one appeared to be the hardest! The entire floor area is treated with the wood, on top of which are two 'living room size' carpets which may be moved around, taken up, put down as required.

The Bosendorfer 9 ft grand piano, naturally, stands on the bare wood.

The only other apparent acoustic-type treatment in this room is the curtains. The vast expanses of window have to be damped down now and then, particularly whilst recording speech, and the curtains are specially made with wool interlining. Hugh has not, however, needed to employ them for any instrumental recording so far.

The acoustic screens, four absorbing and two isolation, were quickly snapped up during a sale at Decca. The dealer who was buying all the equipment apparently rejected the screens, probably because of their enormous size! Not every studio can accommodate several 5x10 ft screens.

The control room is found through the back of the studio, up the stairs above the old dairy to a suite of rooms which were added to the building in 1868 at a mezzanine level. The stairs had to be re-routed to make optimum use of the space available, and the control room itself is open plan in that the three doors separating it from the studio are downstairs at ground level.

The room is long and thin—approx 11x22 ft—and at the time of writing acoustic treatment was not complete. It is planned to deaden the room as much as possible with the same Rupert Neve 'boxes' as used downstairs. It will not be practical to implement these entirely, especially in areas such as the stairwell, and so where necessary, they will be using carpeting.

Opening off the control room is a pair of rooms which, when

fully finished will house tape store and copying, and workshop and coffee facilities.

Because of Cabaletta's very specific interest in the recording of classical music, its equipment requirements are rather specialised too. The mixing desk is of Rupert Neve origin from his new company Neveco, and is designated the *Philipian*. It has eight input channels and two out, with VU metering. Hugh has brought in two separate PPM meters as he prefers these for his purposes. The desk incorporates EQ on every channel and two mic line insertions per channel. "I have actually got 16 lines in and one talkback line and four for foldback—although I've never used all four yet. The most I've used so far is two."

Cabaletta's tape machine is a Telefunken M15A and on order is a Telefunken M21 principally as a standby but also for tape copying. There is also a Revox A700. Noise reduction is Dolby A—"I have two sets so that I can listen off tape." Compression is with an ADR Express Limiter. Monitoring in the control room is on 15 in Tannoy Lancasters, and in the studio, playback is on Yorks.

The nature of Cabaletta's work calls for good copying facilities and to this end they have a bank of 10 Aiwa cassette machines linked to a custom built monitoring console for real-time copying.

Being at mezzanine level, the control room commands a very good view of the studio, and vice versa. (Mezzanine is an extra storey between the ground floor and the first floor). The control room window, although small, is more than adequate and consists of double glazing with 10 mm glass.

"I've got a mains filter to avoid mains borne interference with 14 capacitors and three chokes, and there's another one down in the studio on the microphone power supplies. There is also a power supply for the cue lights which used to belong to the Moody Blues!" Rather an obscure claim to fame I think!

In a studio of this kind (or should I say *particularly* in a studio of this kind?) microphones are of the utmost importance. Hugh had just

STUDIO FILE

completed a recording of tenor and piano in which he had been experimenting with a figure-of-eight pair of Beyer CK708s out on approval. "I do try and get a natural sound—not multi-miked. I've got these Beyers on approval but I like them so much I'm definitely going to buy them. The rep said that these microphones were the tortoise of the microphone industry—they're not pushy, they don't push the sound at you. I find that my Neumann (M79) colours the sound, and that for tenor and piano the Beyers being very clean are more suited. Transistor mics have improved tremendously although I find that the earlier FETs distort on the high transients."

Other microphones in the collection include two AKG D224s, Neumann SM69 (valve) and U67, two Sennheiser MD441s, MD421, two Beyer M69s and two M260s.

Cabaletta, that is Hugh, does a lot of location work and the

equipment his system involves is inherently portable—simple and effective. Indeed, during those years of his singing career he was making recordings and records all over the place just as, after this interview, he dashed off to a singing engagement in London.

Cabaletta came into its own round about May 1984, although it wasn't by any means finished! The official opening took place in the following September when, essentially, all the acoustic treatment was complete. Work so far has come almost entirely by word of mouth. He does a lot of audition tapes, particularly for singers. Other regular work includes language tapes for organisations such as the EF Institute, and recording of conferences (eg for the Soroptimists, and Hugh has many a tale of peculiar incidences with ladies from that organisation!).

Instrumental work tends to be with small ensembles. The most he has had in there to date is nine musicians, although the studio will easily accommodate at least 20 musicians comfortably. The studio does actually house a few hundred of those stacking chairs for recitals and concerts which are held there from time to time.

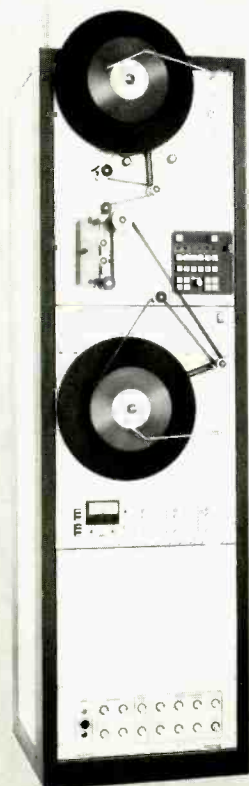
Hugh Richardson does have a very good reputation for his recordings already. He has had his own record label since 1968 when he made a mono record of a Welsh soprano. "We only made 99 copies because, if you made any more than that you were charged purchase tax!" A location recording of Bruckner Motets was nominated as a record of the month and a recording of *Radcliffe Songs* by Robert Tear accompanied by Philip Ledger was reported in *Gramophone* magazine as being 'unobtrusively well recorded'. Cabaletta Records

are distributed by Gamut Distribution in Cambridge, and a catalogue is available from the studio. More recent recordings will be available on cassette as well.

Quite apart from all this Fowlmere House is a veritable treasure trove in itself with all sorts of ancient recording appliances hidden in dark corners, including a wind-up gramophone with an enormous horn, amplifiers out of the ark, and speakers too. And I hear the apple trees produce a good yield!

Cabaletta is a one man show and is therefore relatively peaceful! There is none of the hustle and bustle one usually encounters on arrival. The atmosphere suits the setting perfectly. I'm off to listen to a Cabaletta recording of antique musical boxes! **Janet Angus Cabaletta Recording, Fowlmere House, High Street, Fowlmere, Royston, Herts SG8 7SU, UK. Tel: 076382 453.** □

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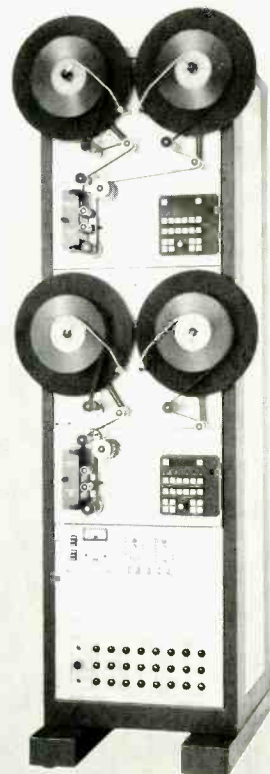


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INSIGHTS

INSIGHTS

Recording industry comment by Richard Elen

Our high-tech industry being what it is, it's at first sight surprising that so little space in the magazines has been devoted to the topic which seems to occupy the minds of many businessmen in other fields, namely that of the impact of computers on their businesses.

Looking more closely, there is perhaps less cause for surprise. Computers have five main areas of application in a business: text processing; numeric processing; information processing; communications; and what we might call 'task automation'. In the task automation field we have been talking about computers for years: your autolocator, half your outboard gear, and especially your console automation system, are all representative of this kind of computer system. No shortage of words on that subject.

The other fields are the ones in which there is a lack of discussion in the trade press (with the notable exception of an excellent article in *The Mix* some months ago). Why?

Maybe it is because many of the applications for business microcomputers in the recording studio environment are by and large the same as they are for any business. And you don't need recording magazines to run articles on word-processing, do you?—not when you can get far more data from the specialist magazines which have the time and space to discuss the topic far more exhaustively.

But there are indeed areas where the special requirements of recording studios are suitable for computerisation, be it track sheets, bookings, or integrated invoicing systems, but unfortunately the market is so small that few software producers will examine it. The task will fall upon people in studios (or in the music business in general) who develop their own software and feel there might be a market for it outside their own company. There appears to be well under a handful of such people at the moment, and we don't seem to be able to get hold of many of the programs to talk about in the UK, as they are mainly produced by very small American companies. Hence the lack of coverage.

However, there is certainly plenty of sense in studio managers and staff being computer literate. The question is, what does 'computer literate' really mean in the studio? And what sort of computers and systems is it worth being literate about?

People seem to have a decidedly curious view of what said literacy actually means. Britain is thought to be one of the most computer literate countries in the world, but I must say that I don't equate literacy with the sales of jumped-up pocket calculators which are good for little more than

Computers in the studio

entertainment, and have as much likelihood of long term use as the original home video games. I suspect gaming is still a primary reason for buying a 'home' computer, which is fine as long as you don't expect a machine for around £100 to do anything else, with its silly slimy little keys.

The British public seems to have two other reasons for buying 'home' computers, one being no reason at all (hopefully they will make one up later after the novelty has worn off) and the other being the unfortunate idea that being able to press chiclet keys and generate instant BASIC keywords in some kind of order will either secure a job or prevent the loss of one.

Unfortunately (or perhaps fortunately, to look at it another way), life isn't like that. Programming is probably not much to do with computer literacy, and as it is the latter to which the studio owner and his or her staff should be aspiring, we had better consider what it is rather than what it *isn't*.

Computer literacy to me does not mean programming, in BASIC or any other language. It means being unafraid of computers (and technology in general—technofear must be one of today's least profitable phobias, whether it be aimed at Compact Disc players or console automation systems) and it means being able to use *other people's* programs successfully.

Computer literacy is not the ability to write three lines of BASIC which print 'HELLO' forever scrolling up a screen in bright red. Instead, it might be the ability to use *Wordstar's* INSTALL program to configure the word-processor for your new daisy-wheel printer. Or model your studio operation's finances in *Visicalc*. Or arrange your spares and their suppliers in a *PFS* database. Or set up your communications package to send a telex via *Dialcom*. Even, perhaps, to be able to find out how to do any one of the above by reading the manual.

In the same way as the modern recording engineer may not know the exact passage of the electrons through the board (but can still get some great stuff on tape), the studio manager need not be an ace programmer to use a computer effectively.

Operational knowledge is what is needed in both cases, and lack of it in either case means that a studio will not make the best use of its capital equipment. I hate to think what the percentage is of balance engineers in SSL-equipped studios who don't know how to drive the clever bits, for example.

And I am continually surprised at the number of people who ask me to set up a communications software package simply because they didn't read the manual (not because they couldn't understand it, note).

But beyond questions of attitude there are certainly stumbling blocks caused, by and large, by bad software and bad hardware (just like in the control room).

On the hardware side, some computers are just not up to it, whatever their manufacturers may say. Computers that are up to it will have a 'real' keyboard that will make it easy to enter things (plus maybe a mouse or a touch-screen to make it even easier). They will have a rapid-access mass-storage medium, commonly floppy disks of one size or another, so you will not have to wait for ages while loading or saving programs and data. They will have a good selection of ports to talk to the outside world, especially for a parallel printer and a serial modem. They will run software that is generally available and well-supported. Finally, the machines themselves will be well-supported: you will be able to get them fixed easily.

On the software front, the considerations are less straightforward. A studio operation may be sufficiently different from a normal business to require specialised software: and, as suggested earlier, there isn't very much around. If you employ expensive consultants to generate specialised applications for you, there is always the potential problem of the longevity of the consulting outfit, and what happens if their star programmer leaves and no-one else understands what he wrote. But equally, there are some excellent ones.

Perhaps it is worth using a commercial integrated package which is designed for you to develop specific unique applications, and learning how to do just that. With some such packages you can produce stand-alone programs which you might be able to sell to other studios. For other, more straightforward applications, there are a relatively small number of 'famous names' which have generally become so with good reason.

Whatever computer and software you choose, there will no doubt be a plethora of information from the computing magazines, some of which might do you some good. But what they *won't* know about is the application of that gear to the studio environment. Which standard packages are good enough, or not nearly good enough? And conversely, when are special packages worth the money and when are they a waste of everybody's time and effort? Those questions will be answered from experience—perhaps some computerised studios will be tempted to share theirs? □

MIXING MASTERS?

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REVIEW REVIEW

Hugh Ford tests an audio measuring system

TECHNICAL PROJECTS MJS-401D

The *MJS-401D* is a multi-purpose instrument specifically designed for the manufacture and maintenance of audio equipment with simplicity of use being a major factor in the design. As standard the unit measures level, automatically measures total harmonic distortion and noise from 18 Hz to 22 kHz and selectively measures crosstalk over the same frequency range. In addition the incoming frequency is digitally displayed and noise measurement filters are included together with the appropriate meter rectifier characteristics and ballistics. Optionally, measurement of SMPTE type intermodulation distortion can be included as can a novel type of low distortion oscillator, but these features were not included in the review sample.

As the instrument is digitally controlled so far as all front panel controls (except the power on/off switch) are concerned, remote control of all functions is possible by an optional IEEE interface. This makes the instrument

eminently suitable for production line testing by unskilled personnel.

A further important feature is that this is a portable instrument housed in a very good quality case complete with a very substantial (optional) carrying handle which doubles as a tilting stand which locks positively into position. In addition there are tilting feet below the instrument. Whilst the controls are not protected for portable use both a 'protecto-muff' and a flight case will be available.

The only features to the rear are the combined IEC power connector, power fuse and tap changer, and blanked off holes for the optional IEEE interface connector and an auxiliary connector.

The front panel layout is excellent—the bright yellow controls contrasting against a brown front panel with white and yellow identifications—and logically arranged with the inputs to the left proceeding to the right through function selection, filtering and metering to the outputs from the measuring section and the outputs from the oscillator. These

sockets are fitted even without the optional oscillator as they double as inputs for some measurements.

To the left are two balanced inputs at *XLR* sockets (optionally jacks or European type connectors) with the desired input being selected by a momentary pushbutton which illuminates a red LED by the selected input. Two further momentary buttons select a high impedance input or a 600 Ω termination, the latter being indicated by red LEDs next to the switches.

Along the bottom of the instrument four groups of pushbuttons, each with a red LED above, select the measurement function, filtering, the rectifier characteristic and the meter scaling.

In order to eliminate meaningless settings the internal microprocessor interlocks the settings, however, the interlocking can be tailored to customers' requirements. The standard arrangement eliminates such settings and CCIR weighted distortion but allows high-or lowpass filtered distortion.

The first set of five buttons sets the

MANUFACTURER'S SPECIFICATION

Volts/dB input level

Ranges: between -95 dBm and +45 dBm input level, to read '0 dB' (centre) on the 24 dB (PPM) scale; between 30 μ V and 100 V, to read full scale on the 0 to 3 or 0 to 10 scale; input sensitivity switchable in both 10 dB and 1 dB steps.

Accuracy: ± 0.2 dB in 10 dB steps, ± 0.02 dB in 1 dB steps.

Frequency response: +0.1/-0.2 dB, 20 Hz to 20 kHz. +0.2/-3.0 dB, 15 Hz to 100 kHz; meter reading 0 dBm on 24 dB (PPM) scale.

Frequency measurement

Frequency range: 10 Hz to 499.9 kHz.

Accuracy: better than ± 10 PPM.

Display: four digits or 0.01 Hz, whichever is the lower resolution

Display type: 10-character vacuum fluorescent display with contrast-enhancing filter, the display also indicates units and decimal points.

Update rate: approximately five readings per second, decreasing to three readings per second at 10 Hz.

Total harmonic distortion measurement

Input range: -20 to +50 dBm.

Frequency range: 18 Hz to 22 kHz.

Residual distortion: 0.002% max, 0.0008% typical.

Auto-set level accuracy: $\pm 1.5\%$ within 2 s, 1 s typical.

Crosstalk measurement

Frequency range: 18 Hz to 22 kHz.

Bandpass characteristic: 2nd order, Q=5.

Centre frequency accuracy: $\pm 2\%$ of incoming reference signal frequency.

Tuning: automatically tuned by frequency measurement system.

Pre-filter overload margin: better than 32 dB.

Noise measurement

Measurement standard: CCIR recommendation

486-1 CCIR/ARM recommendation 468-2, CCIR; ARM 22 Hz to 22 kHz band limited. The meter scale and drive characteristics, eg ballistics, and the appropriate filters can be independently selected.

IMD/TIM measurement (optional)

Provision is made for optional filter/demodulator boards to be fitted to measure IMD/TIM to several international standards. In all cases, level setting and any tuning will be performed completely automatically.

Filters

400 Hz highpass: maximally flat, 6th order, 36 dB/octave rolloff rate; passband ripple less than 0.2 dB, -3 dB at 400 Hz.

30 kHz lowpass: 36 dB/octave rolloff rate, same specifications as the 400 Hz highpass filter.

22 Hz to 22 kHz bandpass: consists of two sections, the highpass section having an 18 dB/octave rolloff rate below 22 Hz, and the lowpass section is a 22 kHz, 36 dB/octave type, with the same specification as the highpass and lowpass filters.

Meter

'Ballistic' characteristics of the meter section are selectable to the following standards.

Peak programme meter: meter movement and drive electronics performance to BS 5428.

Quasi peak: meter scale as above (PPM) but ballistics to CCIR recommendation 468-2.

Expanded scale: expands the scale length of the meter to indicate 3 dB of range about the central '0' instead of the 24 dB. In this mode, the meter automatically reverts to the PPM (24 dB) scale, if the signal level increases or decreases by more than 2 dB away from the central '0'.

Average-reading: scaled to indicate the RMS value of a sinusoidal signal.

True RMS

Accuracy: PPM (24 dB scale length, 4 dB steps)

± 0.2 dB of reading 'Expanded' scale (3 dB length, 0.5 dB steps) ± 0.03 dB of reading 0.3 V scale $\pm 1\%$ of FSD; 0.10 V scale $\pm 1.5\%$ of FSD.

Oscillator

Provision is made for a plug-in precision oscillator on the right hand side of the instrument.

Frequency range: 15 Hz to 150 kHz, sinewave or squarewave.

Output level: -70 dBm to +30 dBm.

Output matching: balanced, isolated and floating; source impedance 1 Ω switchable 150 Ω and 600 Ω .

Distortion: 0.002% max, 0.0008% typical.

Level stability: ± 0.1 dB max, ± 0.05 dB typical

Settling time: less than 500 ms at all frequencies.

Connections

Inputs: according to version ordered *XLR*, 6.3 mm stereo jacks or European Broadcasting Standard.

Outputs: oscillator as inputs; oscilloscope BNC; headphone 6.3 mm jack.

Mains: IEC 3-pole.

IEEE 488/IEC 625 control interface

Provision is made for optional control interface for both test set and oscillator allowing integration into automatic test systems. Connections supplied according to options ordered.

General

Power requirements: 110 V to 120 V or 220 V to 240 VAC; 50 to 60 Hz, 25 VA approximately.

Operating temperature range: 5°C to 35°C.

Dimensions: (whd) 470 \times 140 \times 390 mm (including handle)/18.5 \times 5.5 \times 15.5 in. The handle is an optional extra.

Weight: 10 kg approximately.

Manufacturer: Technical Projects Ltd, Unit 2, Samuel White's Industrial Estate, Medina Road, Cowes, Isle of Wight, UK.

REVIEW REVIEW

level measuring mode, the total harmonic distortion plus noise mode, the SMPTE intermodulation distortion mode (subject to the option being fitted), the selective crosstalk mode or the oscillator output level.

The next set of buttons to the right selects filtering including CCIR quasi-peak or CCIR/ARM noise measurement with automatic selection of the correct metering characteristics. Further filters include a 22 Hz to 22 kHz CCIR unweighted bandpass filter, a 400 Hz highpass filter for hum filtering and a 30 kHz lowpass filter plus two optional filters. All the latter may be selected in any combination.

Two switches are reserved for extra filters which can be an optional IEC A-weighting or a rumble filter in addition to user designed filters.

Across the panel the next four buttons select the metering characteristic which may be average calibrated RMS, true RMS, CCIR quasi-peak or the standard British Standard peak programme meter.

The final three buttons select the metering scale in a rather cunning way using the illuminated meter which has a black scale plate with clear white legends scaled for very good readability. The two upper scales are calibrated in decibels from ± 12 dB in 1 dB steps and ± 1.5 dB in 0.1 dB steps with the two lower scales being calibrated 0 to 10 and 0 to 3.16 for voltage and distortion measurements. Each scale has an associated red LED to show which scale is in use and these work in conjunction with the three pushbutton switches and the metering function switches. The three switches select a voltage/% scaling or two decibel scales. This may be the ± 12 dB scale or the expanded ± 1.5 dB scale but if the meter is out of range on the latter it automatically reverts to the ± 12 dB scale with the scale indicating LED flashing. Once suitable action has been taken to put the meter back into the expanded scale's range the meter automatically reverts to the expanded scale—a very nice feature with the 0.1 dB calibrations being extremely useful and clear to read.

Having dealt with the possible

functions there remain three rotary switches which send digital signals to the microprocessor control and a 10-character vacuum fluorescent display. The latter normally indicates the frequency of the input to four digits but it also displays various messages. For instance in the distortion mode it can indicate LEVEL LOW or in the level mode FREQ LOW if the frequency of the input is out of range.

Of the three switches the centre one, dB COARSE, operates in the level, read oscillator and crosstalk modes giving full scale sensitivities between 100 V and $30 \mu\text{V}$ ($+40$ dBm to -90 dBm) in 10 dB steps.

A second attenuator calibrated ± 5 dB in 1 dB steps comes into operation in the decibel meter reading modes with the exception of the total harmonic distortion and noise. This attenuator is useful for relative measurements but I would have liked the addition of a variable attenuator for very fine level setting.

The final section to the far right of the instrument houses the two XLR plugs for the oscillator, a level potentiometer for the internal monitoring loudspeaker which monitors the selected input, a BNC socket for monitoring the input to the metering section on an oscilloscope and the power on/off switch.

Last of all a $\frac{1}{4}$ in jack socket allows headphone monitoring whilst muting the internal loudspeaker.

Within the substantial and well finished case all front panel controls mount on to a single printed board behind which is the microprocessor and control board. After these the base of the unit contains a mother board which has places for up to 12 vertical daughters, eight of these being present in the review unit. All boards are to a very high standard with socketed integrated circuits and clear component identifications.

To the far right a vertical toroidal transformer supplies the power with an adjacent fully screened compartment accepting the optional plug-in oscillator modules. Like the oscillator compartment the input section at the far left of the unit is also fully screened. The use of \blacktriangleright

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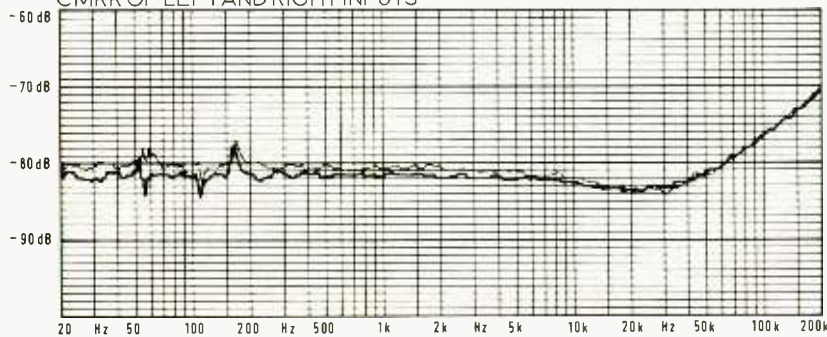
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FIG.1
MJS-401D
CMRR OF LEFT AND RIGHT INPUTS



REVIEW REVIEW

FIG. 2
MJS-401D
CROSSTALK

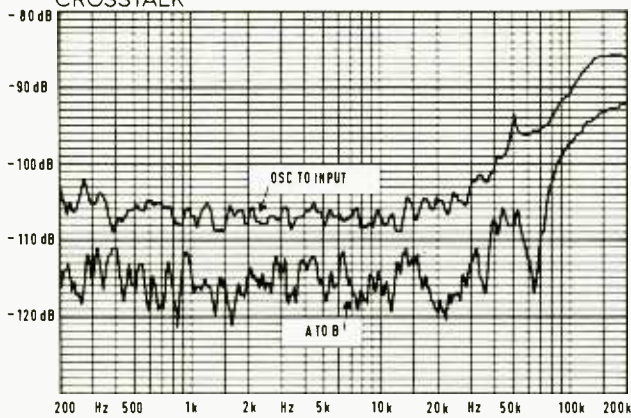


FIG. 4
MJS-401D
400HZ AND 30KHZ FILTERS

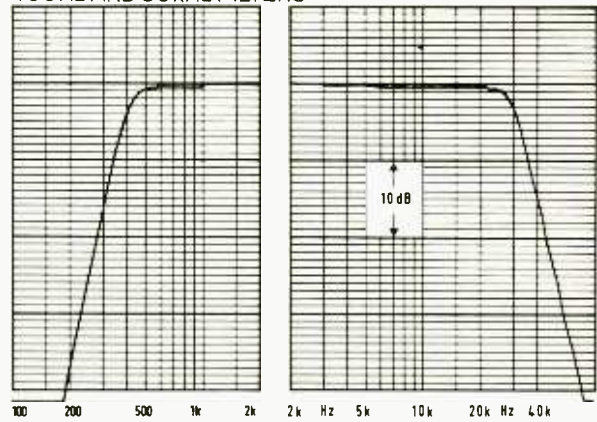
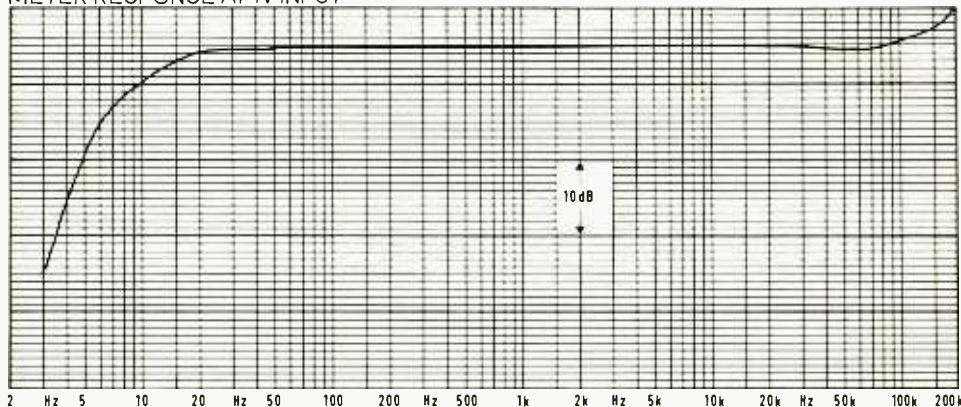


FIG. 3
MJS-401D
METER RESPONSE AT 1V INPUT



digital switching eliminates any mechanical switching of audio signals and thus reduces crosstalk and interference problems. It also eliminates the critical requirements of the switches.

Inputs and outputs

Under test the normal left and right inputs offered a 95.7 k Ω in parallel with 40 pF input impedance with the switched terminations being 602.8/603.8 Ω with a good common mode rejection ratio shown in Fig 1 up to 200 kHz. This impedance remained constant with all gain settings with the unselected input having an impedance in the order of 600 k Ω when unterminated.

In the crosstalk measuring mode the oscillator connections are used as a reference for tracking the filter and the impedance here was 66.5 k Ω in parallel with 160 pF when in use, all the input impedances being satisfactory for use with professional equipment. They might, however, be on the low side for use with some domestic equipment.

Crosstalk between the wanted and unwanted inputs was excellent as shown in Fig 2 for the left and right (A/B)

TABLE 1

Actual +	Nominal setting	Actual -
0 dB	0 dB	0 dB
+1.002 dB	1 dB	-1.002 dB
+1.988 dB	2 dB	-2.005 dB
+2.994 dB	3 dB	-2.988 dB
+3.997 dB	4 dB	-3.992 dB
+5.002 dB	5 dB	-4.997 dB

inputs and the oscillator connection to the signal inputs.

The oscilloscope monitoring output delivered 0.245 VRMS for 0 dB meter indication from a source impedance of 50 Ω with the headphone output being capable of delivering 12.1 VRMS at clipping from a source impedance of 72 Ω with the volume control having a wide range—possibly too much gain as it was easy to clip the output amplifier.

Frequency measurement

The frequency indication provided 4-digit resolution from 10 Hz to 499.9 kHz for any input level greater than 1 mV with the accuracy for a sine wave input being within the resolution of the display. This is not in fact a conventional frequency meter, which would require a long gating period for indicating the lower

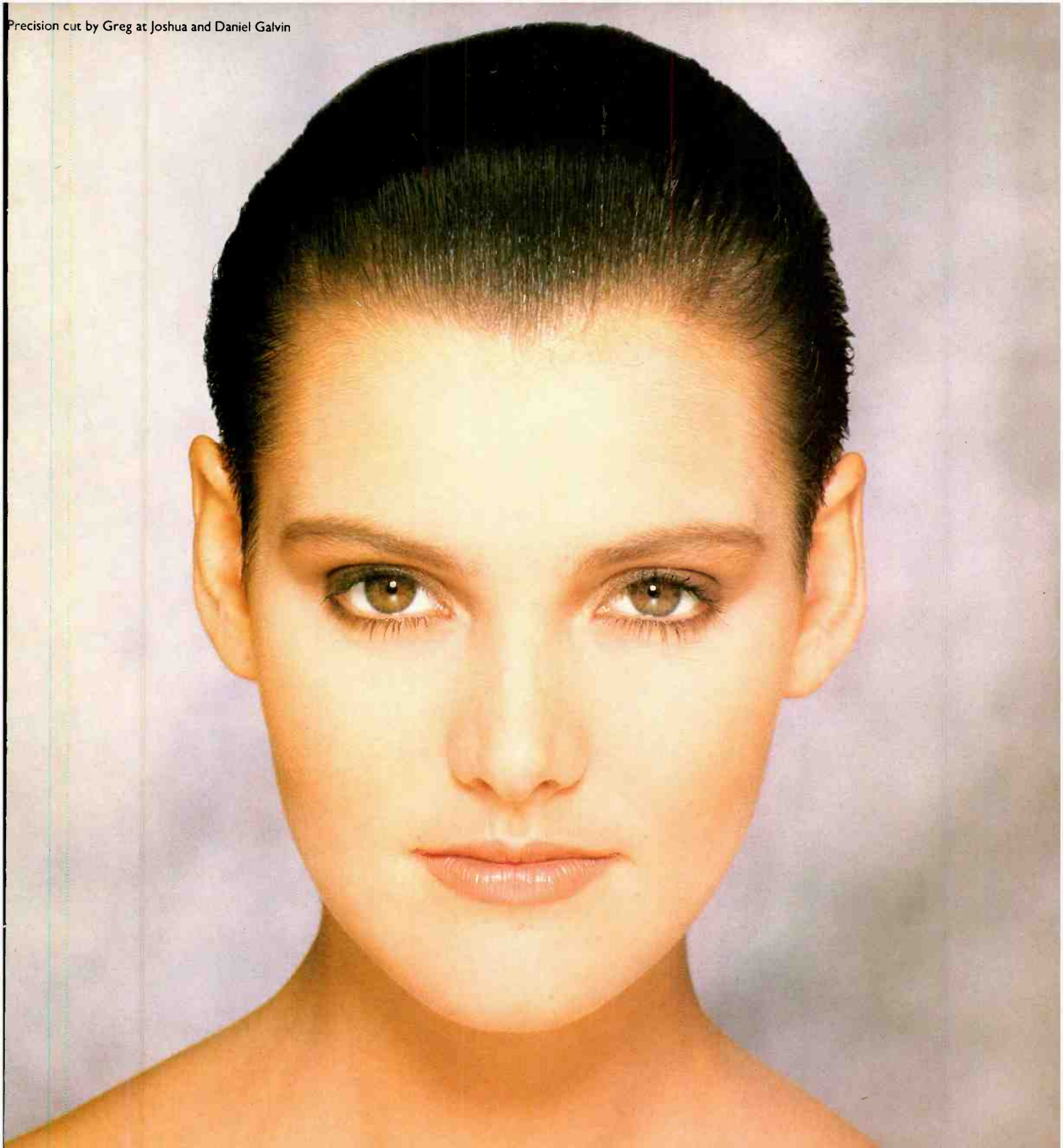
frequencies to 4-digit resolution, but measures the period of the waveform and computes the frequency.

As a result the accuracy on symmetrical waveforms is good but deteriorates with asymmetrical waveforms. Whilst this is of unlikely consequence for pure audio work it might matter for such measurements as aligning servo systems. This is, of course, a penalty to pay for a rapidly updating display which was found to be completely insensitive to 30% amplitude modulation. The application of frequencies less than 10 Hz or greater than 499.9 kHz produced an out of range display.

Level measurement

The accuracy of the metering was measured at 1 kHz for 0 dB indication it being found that the meter indicated 0.12 dB too low—probably a matter of simple adjustment as the indication at 10 V input was within the readability of the meter.

Alignment of the four metering characteristics was within 0.05 dB with the CCIR noise filter being aligned at 1 kHz to within 0.2 dB and the



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REVIEW REVIEW

CCIR/ARM characteristics introducing a 5.7 dB drop in gain against the nominal 5.6 dB.

The accuracy of the 10 dB step attenuator was measured throughout its range with an impressive maximum error of only 0.02 dB with the ± 5 dB control having an even better performance as shown in Table 1.

Frequency response

In the level measuring mode the frequency response was as shown in Fig 3 irrespective of the attenuator settings being within 0.1 dB from 20 Hz to 100 kHz.

The performance of the 400 Hz highpass filter and the 30 kHz lowpass filters are shown in Fig 4 to be accurately aligned in frequency with a roll off at 36 dB/octave. The highpass filter offers very good attenuation of power line frequencies and their harmonics with the lowpass filter being useful for removing the influence of such things as tape machine bias frequencies when measuring noise or distortion.

The actual measured -3 dB points were 399 kHz and 28.8 kHz for these filters and 22.4 Hz and 21.9 kHz for the bandpass filter the performance of which is shown in Fig 5. This filter falls well within the limits of the CCIR unweighted measurement filter with its 36 dB/octave lowpass section and 18 dB/octave highpass section.

The final filter in the review sample was the CCIR noise weighting filter used in both the CCIR quasi-peak measurement and the CCIR/ARM measurement. The shape of this filter is shown in Fig 6. However more detailed measurements were made to check that the accuracy of the filter was within the stringent CCIR requirements—all well here.

Metering section

The linearity of the meter in the decibel mode, both with and without the expanded scale function, was found to be within the readability of the scales. In the expanded scale mode this approximates 0.02 dB—a creditable performance.

Automatic switching between the expanded scale mode and the dB normal mode, when the indication became out of range, was a very nice feature which worked extremely well without any hunting between modes.

The RMS characteristic was found to give accurate reading with crest factors up to 10 with the average rectifier characteristic being correct and calibrated, as is conventional, to the RMS sinewave values.

Checking the quasi-peak characteristic to the CCIR recommendations using bursts of 5 kHz tone gave the results shown in Table 2 within the CCIR

FIG.5
MJS-401D
22Hz TO 22kHz FILTER

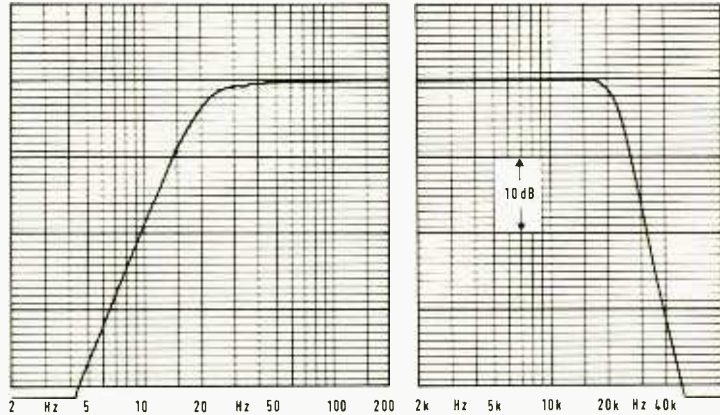


FIG.6
MJS-401D
CCIR WEIGHTING

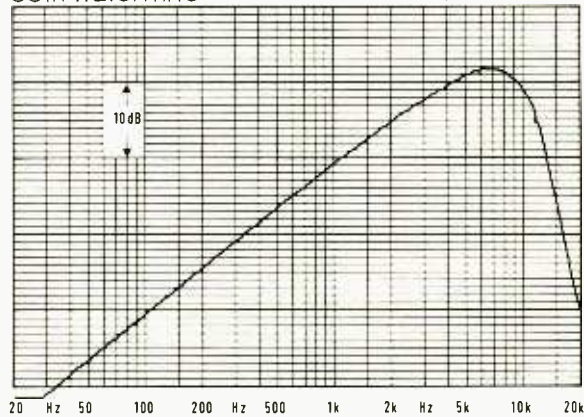


TABLE 2

Burst length	10 ms	20 ms	50 ms	100 ms	200 ms
% full scale reading	53%	58%	65%	71%	84%
CCIR limits	41/55%	44/60%	50/68%	58/78%	68/92%

requirements, but close to the faster limit.

Dynamic tests using 5 ms bursts at a 10 Hz repetition rate also showed the instrument to be well within CCIR requirements as was the overload capability at 30 dB.

In the peak programme meter mode

the unit was similarly to specification but again the meter was close to the faster limits.

Noise measurement

The weighting and metering aspects of noise measurement have already been

BROADCAST MONITOR RECEIVER 150kHz-30MHz



Reviewed in
Broadcast Sound
March/April

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REVIEW REVIEW

dealt with, so the inherent noise performance remains of interest in various modes.

Overall the noise performance was very good with unweighted noise being less than $1 \mu\text{V}$ in any filtered mode using a lowpass function and with any metering characteristic.

In the wide band mode with the inputs shorted both inputs had the same noise performance being $7 \mu\text{V}$ RMS or average or $18 \mu\text{V}$ quasi-peak. Terminating the inputs with 600Ω slightly increased these figures with a mild difference between channels as shown in Table 3.

When using either the CCIR-468 or CCIR/ARM networks there was some interaction between the monitor loudspeaker and the noise performance, so care is needed to have the monitor loudspeaker at a low level or to use headphones if the optimum noise performance is to be attained. With this proviso the CCIR-468 inherent noise was $2 \mu\text{V}$ and the CCIR/ARM noise less than $1 \mu\text{V}$ with the CCIR-468 noise increasing to $9 \mu\text{V}$ with the monitor loudspeaker turned up.

Distortion measurement

In the total harmonic distortion and noise mode the fine and coarse level control are locked out leaving the % DISTORTION the only level control to be operated. Provided that the input level is in excess of -20 dBm (77 mV) level setting is completely automatic with LEVEL LOW being displayed when appropriate.

Any filters and any rectifier characteristic may be chosen in the distortion mode and a beauty of the instrument is that it remembers these matters for each function. Thus switching between distortion measurement and level measurement will automatically revert to the last setting of filters, rectifiers and meter scale selection in use. In the distortion

mode the automatic nulling of the notch filter was extremely fast taking less than 2 s at 20 Hz and about half this time at higher frequencies.

Fundamental rejection was within the 0.002% (94 dB) specification at any input level or frequency within the acceptable range of approximately 18 Hz to 22 kHz at which points a high or low frequency warning was displayed. In practice far better fundamental rejections were obtained at some input levels subject to some internal range switching arrangement.

The accuracy of the measurement of the second and third harmonics was within $+0, -0.5 \text{ dB}$ at any frequency. The characteristics of the rejection notch are particularly clever and a typical frequency response at 1 kHz is shown in Fig 7 which shows that frequencies below the fundamental are attenuated with those above the fundamental having a slight boost before levelling for the second harmonic upwards. This characteristic follows for all notch frequencies making the use of the highpass filter unnecessary for many measurements even in the presence of quite severe power line hum.

As the unit is self nulling, using the input signal to determine the notch frequency, it can be used for measuring lines with a remote oscillator or with test discs or tapes as no reference frequency is necessary.

Crosstalk measurements

The crosstalk measurement requires a reference frequency in order to tune the internal selective filter and uses the oscillator connections for this purpose. If the internal oscillator is used this

connection is automatic but external references are also applied to these connections and used in conjunction with the READ OSC button to set the reference level using the two attenuators.

Once the crosstalk function is selected a selective filter is placed in the metering circuits, with the filter having the characteristics shown in Fig 8 irrespective of the incoming frequency within the same range as the distortion measurements.

This filter clearly gives a significant attenuation of noise, for instance, 20 dB attenuation of white noise at 1 kHz or 30 dB at 100 Hz. Tracking of the centre frequency was fast with the relatively low Q of the filter allowing it to be used with tape recorders, etc, where wow and flutter eliminates the use of high Q filters.

The accuracy of the crosstalk measurement depends upon the noise content of the input but so far as the test set is concerned, the instrument is accurate to within 0.2 dB at all operating frequencies.

Summary

Being very quick and simple to use in addition to giving an excellent performance the MJS-401D measuring system is an excellent instrument for maintenance and production line work. All levels and functions are well contrived for working with professional audio equipment and the unit reviewed was very good. However, I look forward to the optional oscillator which is of novel design, with or without the SMPTE type intermodulation distortion facilities.

For routine or production line work the IEEE computer interface will be a great asset. Indeed, computer assisted measurements may well find their way into studios for routine maintenance of desks and multitrack tape units. □

TABLE 3

Metering	Wideband noise	
	Input A	Input B
RMS	$10 \mu\text{V}$	$12 \mu\text{V}$
Average	$9.5 \mu\text{V}$	$11.5 \mu\text{V}$
Quasi-Peak	$21.5 \mu\text{V}$	$24 \mu\text{V}$

FIG. 7
MJS-401D
THD NOTCH FILTER

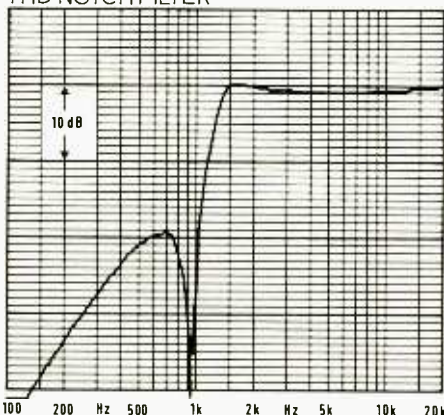
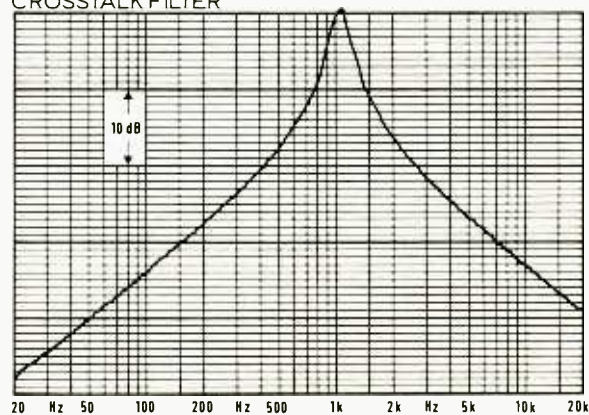


FIG. 8
MJS-401D
CROSSTALK FILTER



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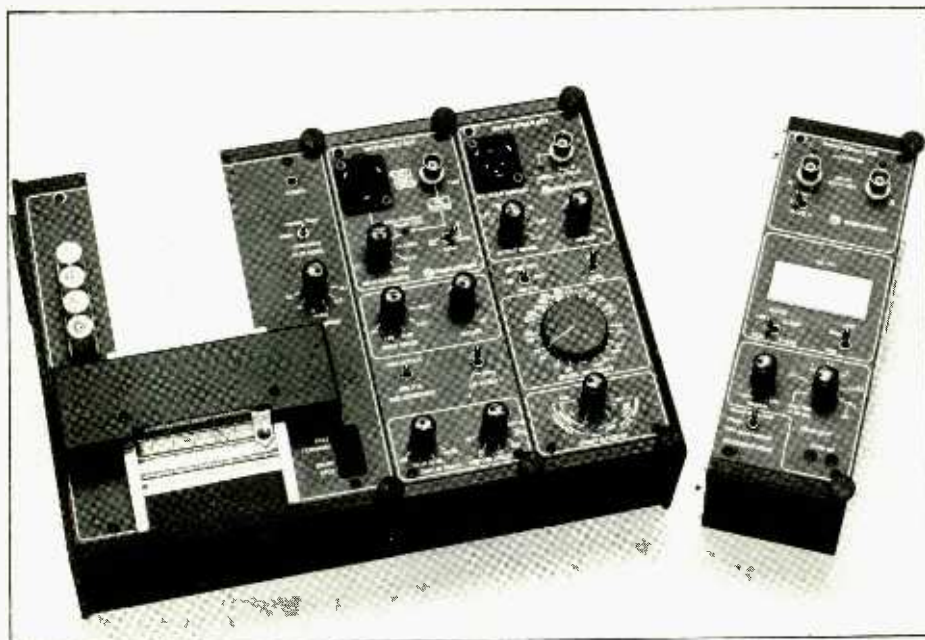
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REVIEW REVIEW

Hugh Ford reviews an audio/acoustic analysis system

NEUTRIK AUDIOGRAPH 3300



Whilst Neutrik are no newcomers to the manufacture of level recorders with synchronised oscillators, the *Audiograph 3300* system is completely new.

The core of the system is a mainframe which contains the writing unit and power supplies plus the digital control system and basic audio frequency generator.

Whilst this unit is primarily intended for use with Neutrik modules, it may be used with other equipment provided a suitable interface is constructed.

Connection to the mainframe is via a 32-way connector which includes ± 15 VDC supplies for operational amplifiers and ± 8 VDC lines for power output stages; all these supplies being stabilised.

The simplest form of interface just uses the recording section as a level versus time recorder but there are many, far more complex possibilities. The various

3302 Mainframe

Maximum writing speed: approximately 750 mm/s.

Paper speed: 0.1/0.3/1/3/10/30 mm/s, $\pm 0.5\%$; 30 mm/s for reverberation time measurement.

Resolution of paper transport: 0.14 mm.

Recording paper: chart cards or paper roll with approximately 150 chart grids, paper width 68 mm, vertical scale 50 mm, frequency scale 50 mm/decade (according to IEC 263).

Writing pens: long-life pens, with colours red, black, green, blue.

Connections to the modules: mechanical—quick-lock system; electrical—common system bus with 32-pin connector according to DIN 41612, style b.

Mains power connection: 220 V/120 V AC $\pm 10\%$ 50 to 60 Hz, 50 VA.

Ambient temperature: 0 to 40°C (operating).

Dimensions: (wdh)

160×210×85 mm/6.3×8.27×3.35 in.

Weight: 2.6 kg/5.73 lb.

Operating position: horizontal, vertical or tilted on carrying hinges.

3311 Standard input module

Measurement range: -80 dBV to +10 dBV (0.1 mV to 3.16 V).

Indicating scale: 50 dB, logarithmic.

Input attenuator: 40 dB, continuous, with calibrated positions at -40 dB and 0 dB (1 V or 10 mV) for 0 dB indication on graph.

Input: unbalanced, BNC female jack.

Input impedance: 100 k Ω /50 pF switchable power supply.

Frequency response: 20 Hz to 40 kHz, ± 0.2 dB; 50 Hz to 20 kHz, ± 0.1 dB/-3 dB, at approximately 150 kHz.

Detection: true RMS detection, crest factor 7, dynamic response corresponding to selected writing speed.

Writing speeds: 20, 100 and 200 mm/s symmetrical, linear rise and decay (for reverberation-time measurement, automatically 500 mm/s).

MANUFACTURER'S SPECIFICATION

Indication accuracy: typically ± 0.2 dB, maximally ± 0.5 dB.

3312 Professional input module

Measurement range: -80 dB to +40 dB, linear to 100 V.

0 dB reference: switchable 0.775 V for dBm, 1 V for dBV.

Input attenuator: four 20 dB steps +20 dB to -40 dB, ± 0.1 dB.

Vernier attenuator: minimum 20 dB, 0 dB position calibrated.

Indicating scale: logarithmic 10, 25 and 50 dB, linear.

Inputs: unbalanced—BNC female jack, impedance 1 M Ω /60 pF, 47 k Ω when microphone power supply switched on; balanced—XLR female connector, electronically balanced, impedance 100 k Ω , 10 k Ω , 600 Ω ; 2 k Ω when phantom power supply for measuring microphone switched on.

Frequency response: 20 Hz to 40 kHz, $\pm 0.5\%$, 50 Hz to 20 kHz, ± 0.1 dB.

Highpass filter: 50 Hz, 12 dB/octave.

Detection: true RMS detection, crest factor 7, dynamic response corresponding to selected writing speed.

Writing speeds: 10, 20, 50, 100 and 200 mm/s symmetrical linear rise and decay (for reverberation time measurement, automatically 500 mm/s).

Indication accuracy: typically ± 0.2 dB, maximally ± 0.5 dB.

3321 Standard output module

Frequency range: 20 Hz to 40 kHz.

Frequency accuracy: (conformance of generator frequency to frequency scale on recording paper) better than $\pm 1\%$.

Frequency stability: $\pm 2\%$ between 0 and 40°C.

Amplitude variation: ± 0.1 dB from 20 Hz to 20 kHz, $\pm 0.15\%$ dB from 20 Hz to 40 kHz.

Harmonic distortion: 100 Hz to 10 kHz, maximum 0.7%. 20 Hz to 40 kHz, maximum 1.5%.

Output signal: logarithmic sweep warble capability with $1/6$, $1/3$, $1/2$ -octave bandwidth, 5 Hz modulation frequency or switchable in $1/3$ -octave steps (34 $1/3$ -octave mid-frequencies according to ISO).

Outputs: unbalanced—BNC female jack 2.4 W into 4 Ω (3.16 V=10 dBV, unloaded), impedance maximum 0.1 Ω ; balanced—XLR male connector maximum output level 3.16 V=10 dBV, unloaded, impedance maximum 15 Ω .

Attenuators: five 10 dB steps, ± 0.1 dB (+10 dB to -40 dB) vernier attenuator, minimum 10 dB.

3322 Professional output module

Frequency range: 20 Hz to 40 kHz.

Frequency accuracy (generator to paper scale): better than $\pm 1\%$.

Frequency stability: $\pm 2\%$ 0 to 40°C.

Amplitude variation: ± 0.1 dB from 20 Hz to 20 kHz, ± 0.15 dB from 20 Hz to 40 kHz.

Harmonic distortion: 100 Hz to 10 kHz maximum 0.7%. 20 Hz to 40 kHz maximum 1.5%.

Output signal: logarithmic sweep, warble capability with $1/6$, $1/3$, $1/2$ -octave bandwidth, 5 Hz modulation frequency or switchable in $1/3$ -octave steps.

Outputs: unbalanced BNC female jack, 2.4 W into 4 Ω (3.16 V), source impedance 0.1 Ω maximum. Balanced XLR male connector, maximum output level 3.16 V, source impedance 15 Ω maximum.

Attenuators: 10 dB steps ± 0.1 dB (+10 dB to -40 dB) plus vernier attenuator, minimum 10 dB.

3332 Phase and group delay time measuring module

Frequency range: 20 Hz to 40 kHz, continuously variable without switching.

Input voltage range: 20 mV to 20 V autoranging, independent for both inputs, out of range indication (20 V, 20 mV) combined with automatic pen-lift.

REVIEW REVIEW

additional Neutrik modules plug into the 32-way connector and are locked to the mainframe, and to each other, by locking pins on the end of long screws to form a very solid modular system.

Optional modules offered at the time of writing were standard or professional input and output modules plus a phase and group delay module. Both types of output module offer a maximum of 3.16 V RMS sinewave output capable of delivering 2.4 W into 4 Ω for driving a loudspeaker in acoustic measurement applications, the frequency range being 20 Hz to 40 kHz in both cases with either a straight swept frequency or warble tone output. The standard module has a 40 dB variable attenuator while the professional module has a 10 dB step attenuator offering maximum levels of +10 dBV to -30 dBV and a variable attenuator.

Additional features of the professional module are a floating output at the same level as the unbalanced output and the facility to vary the warble tone output in $\frac{1}{6}$ -, $\frac{1}{3}$ - and $\frac{1}{2}$ -octaves on the standard ISO $\frac{1}{3}$ -octave steps.

The standard and professional input modules differ more significantly. The standard module has an unbalanced high impedance input with a fixed 50 dB chart indicating scale covering -80 dBV to +10 dBV in conjunction with a variable calibrated attenuator. The professional module has high impedance unbalanced and switched impedance

balanced inputs with phantom microphone powering facility. In addition the input range extends from -80 dBV to +40 dBV in conjunction with a 20 dB step attenuator and a variable attenuator with a calibrate position.

Whilst the standard module has a fixed 50 dB full scale chart range the professional module offers 10 dB, 25 dB and 50 dB ranges. Similarly the standard module offers three pen writing speeds (20, 100 and 200 ms) with the professional module having an additional slow speed covering 10, 20, 50, 100 and 200 mm/s. In addition to these general

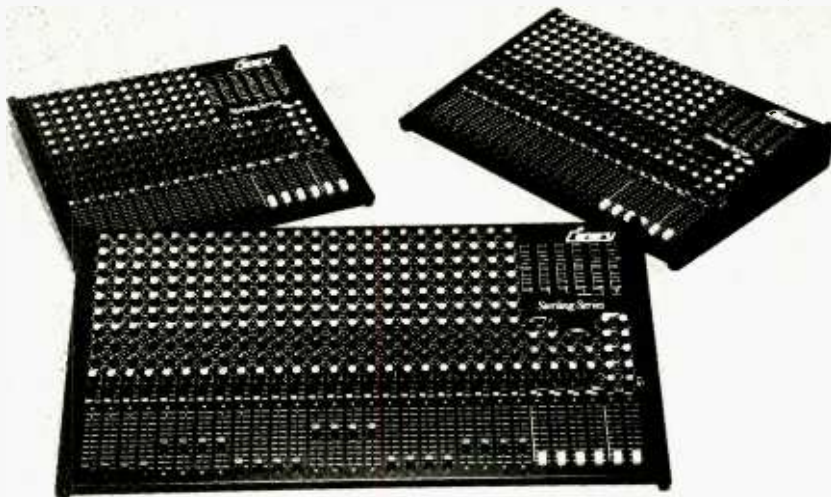
purpose speeds both modules operate the recorder at 500 mm/s for reverberation time measurement.

Other than an empty module for constructing special user design units there just remains the phase and group delay module. This automatically levels inputs over the range 20 mV to 20 V and provides a liquid crystal display of the phase angle between the inputs over the switchable ranges 0 to 360°, $\pm 180^\circ$ (0 to 6.28 radians, ± 3.14 radians).

The output may of course be fed to the plotter with the additional ability to insert a delay in channel A input for

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Inputs: input A: reference phase, selection of triggering on positive or on negative slope (=initial phase of 0° or 180°); input B: unknown phase, to be measured relatively to A.

Input impedance: 100 k Ω /50 pF, BNC connectors.

Digital display: LCD, 12.5 mm, 2½ digits. Range 0 to 360° (0 to -6.28 rad) or 0 to $\pm 180^\circ$ (0 to ± 3.14 rad). Resolution: 1° (0.01 rad). Indication of signal B lagging or leading signal A. '-' sign or no sign. Accuracy: error of analogue output plus ± 1 digit.

Analogue output: (to mainframe 3302 pin 20 on System bus) ± 10 V for $\pm 180^\circ=0$ to 360° for full swing of pen (50 mm).

Accuracy (25°C): $\pm 1.5^\circ$ (50 Hz to 20 kHz), $\pm 3^\circ$ (20 Hz to 40 kHz).

Allowed noise floor: depends on nature of noise, pen lifts automatically, if no more meaningful measurements possible (eg if noise floor at input B is too high).

Response time (for 90% of final value): approx 50 ms for frequencies below 150 Hz, approx 250 ms for frequencies above 150 Hz, automatically adjusted.

Delay unit: switchable into channel A.

Switch selected values: delay 0, 1.46, 2.91, 4.37, 5.82, 7.28, 8.73 ms; distance 0, 0.5, 1, 1.5, 2, 2.5, 3 m in air (20°C, 101 kPa).

Variable delay: fine adjustment of $\pm 10\%$ from selected values, non-calibrated.

Group delay time: calculated from slope of phase variation with frequency $T_g = \frac{d\phi}{d\omega}$. Operates only with paper speed of 3 mm/s on Mainframe 3302.

Frequency range: 100 Hz to 10 kHz, automatic pen lift if out of range.

Measuring range: ± 10 ms.

Accuracy: $\pm 5\%$ FSD.

Manufacturer: Neutrik AG, FL-9494 Schaan, Furstentum, Liechtenstein.
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correcting for the delay of sound in air for acoustic measurements covering 0 to 3 m in distance or 0 to 8.73 ms switched in 0.5 ms (1.46 m) increments.

The mainframe can support the phase and group delay module plus one output and one input module of either type, the use of two input modules or two output modules is not possible.

The construction of the modules is particularly clever with the back and front of each one being formed from a heavy machined and/or extruded alloy section to which are secured with screws the 2.5 mm thick front panel and similar rear panel.

These components form a very solid box section with six locating pins in the left side of each module fitting into locating holes in the right side of its neighbour. The centre pin in the back and front sections is drilled with a vertical hole into which a pin is inserted by the neighbour module by means of a knurled knob on the front panel operating a threaded pin.

Within the front and back sections three horizontal slots locate three printed circuit boards interconnected by fixed ribbon cables. The bottom boards simply have the 32-way connectors for interconnecting modules, the centre board contains electronics with the top board having further electronics plus all front panel controls which protrude through holes in the clearly identified front panel.

Vertical slots at either side of the front and back sections are used to locate inter-module screens which have holes to give access to internal pre-set components.

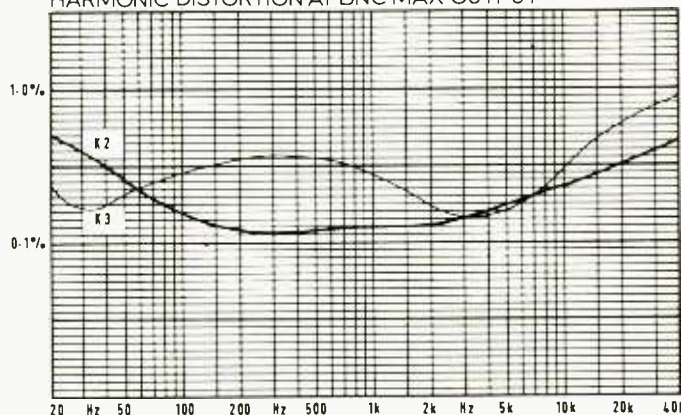
Generally the standard of mechanical and electronic construction is excellent and whilst the printed circuit boards do not have component identifications the owners' manual includes full circuits, board layouts and a functional description of modules.

Professional 3322 output module

The front panel of this module divides logically into three sections: output, frequency selection and mode. At the top of the unit the balanced (actually floating) output is at a recessed *XLR* plug identified with its maximum output and source impedance with the unbalanced adjacent BNC output having similar identifications with an adjacent red LED giving overload warning.

Below the outputs a 6-position rotary switch selects the maximum output level in 10 dB steps between +10 dB and -40 dB in conjunction with a vernier potentiometer with a calibrated position. Next two miniature toggle switches select the output reference level as dBm (0.775 V) or dBV (1 V) or mute the outputs. A fairly large diameter knob

FIG.1
AUDIOGRAPH 3300
HARMONIC DISTORTION AT BNC MAX OUTPUT



with 360° freedom of rotation selects the frequency for the start of the recorder chart of the idle frequency with clear calibrations from 20 Hz to 40 kHz. Finally a 6-position rotary switch at the bottom of the module selects the output mode. This can either be a continuous sinewave with $\frac{1}{2}$ -, $\frac{1}{3}$ - or $\frac{1}{6}$ -octave warble tone, a sinewave without modulation or a sinewave stepped in $\frac{1}{3}$ -octave ISO increments with $\frac{1}{3}$ -octave warble tone or without modulation.

Examination of the outputs showed the unbalanced BNC output to deliver a maximum of 3.127 V (0.9 dB below nominal) at 1 kHz from source impedance which remained below 0.06 Ω over the entire frequency range. At the *XLR* connector the output was floating and transformer coupled, delivering a maximum of 3.110 V (0.14 dB below nominal) from a source impedance below 14 Ω . Switching between V and dBm output changed the level by 2.1889 dB which is within 0.03 dB of the theoretical change with the stepped output attenuator being extremely accurate within 0.03 dB at any frequency.

The range of the vernier output level control was 12.6 dB giving an overall

output range approximating 200 μ V to 10 V.

Whilst the lowest available output will satisfy most professional applications the maximum output of 10 V is inadequate for some applications. The low source impedance of both outputs is, however, a useful feature with the full output being available into loads greater than 3 Ω .

The flatness of the BNC unbalanced output was within +0, -0.1 dB over the full frequency range with that of the floating *XLR* output being within a creditable +0, -0.15 dB.

Changing frequency, even over very wide ranges, produced a minimal amplitude bounce of short duration such that transient overloading of equipment driven by the oscillator will not be a problem.

At maximum output either from the floating *XLR* connector or the unbalanced BNC connector the second and third harmonic distortion was similar with the performance being shown in Fig 1.

As with most digital generators which synthesise a sinewave a substantial amount of 'rubbish' including harmonics of the fundamental emerges in the

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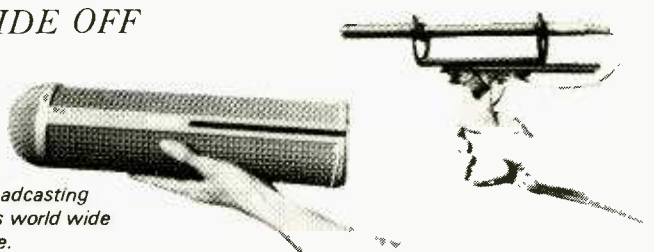
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output. Fig 2a shows a spectrum analysis of the output when the fundamental frequency is set to 1 kHz; Fig 2b shows the same situation at 10 kHz. There are both harmonic and non-harmonically related components at significant levels particularly in the 1 kHz case. Thus this, like many digital generators, is unsuitable for the subjective testing of systems. From the point of view of measuring frequency response and phase these components are of little significance, but the generator should not be used in conjunction with total harmonic distortion meters.

Another matter which is revealed by Fig 2a is that mains frequency components in the output are at very low

levels. However, in the muted condition, which may be used for signal to noise measurement, it was noted that a high frequency output approximating 700 kHz was always present in the muted output. This was little affected by the variable or step attenuators remaining between 3 and 5 mV in the unbalanced output and about 2 dB lower in the floating output.

The setting accuracy of the frequency dial was quite adequate for many purposes as shown in Table 1.

In the stepped mode the frequency should automatically step in the standard ISO series of 1/3-octave centre frequencies, with Table 2 showing the satisfactory accuracy.

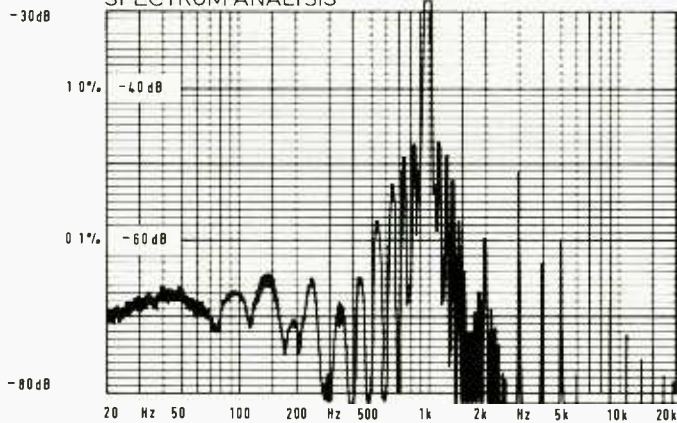
The warble tone facility had a

modulation frequency approximating 5 Hz. Checking the maximum frequency deviation for the 1/6-, 1/3- and 1/2-octave switched deviations showed these to be approximately met. This is however of little consequence because there is no requirement for accurate frequency deviation for normal acoustic measurements.

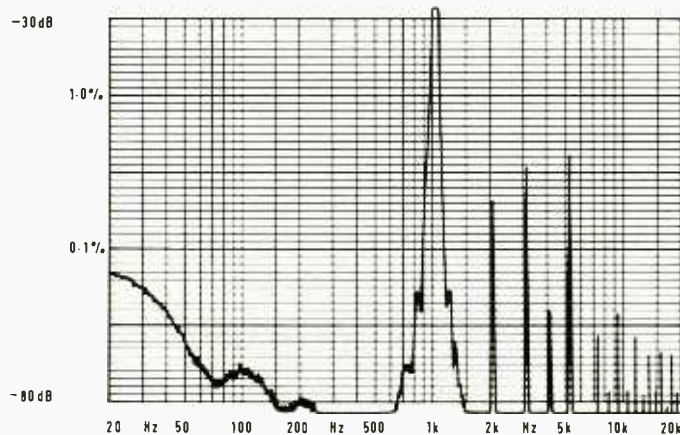
The relation between frequency and time in the sweep mode was checked when running at a paper speed of 1 mm/s corresponding to 50 s per decade and found to be an accurate logarithmic sweep within the readability of any chart.

Whilst a linear sweep function is useful for certain measurements such a function is not provided. However, it would be little used by many customers.

FIG 2
AUDIOGRAPH 3300
SPECTRUM ANALYSIS



(a) 1 kHz OUTPUT



(b) 10 kHz OUTPUT

TABLE 1
Dial setting

Dial setting	Actual
20 Hz	20.1 Hz
50 Hz	50.4 Hz
100 Hz	99.5 Hz
200 Hz	200.0 Hz
500 Hz	506.0 Hz
1 kHz	1.008 kHz
2 kHz	2.048 kHz
5 kHz	5.321 kHz
10 kHz	10.564 kHz
20 kHz	21.228 kHz
40 kHz	39.208 kHz

TABLE 2
Nominal

Nominal	Measured
20 Hz	20.1 Hz
25 Hz	25.2 Hz
31.5 Hz	31.7 Hz
40 Hz	40.0 Hz
50 Hz	50.4 Hz
63 Hz	63.4 Hz
80 Hz	79.9 Hz
100 Hz	99.5 Hz
125 Hz	126.6 Hz
160 Hz	159.4 Hz
200.0 Hz	200.0 Hz
252.5 Hz	252.5 Hz
317.8 Hz	317.8 Hz
400.1 Hz	400.1 Hz
503.7 Hz	503.7 Hz
633.8 Hz	633.8 Hz
797.7 Hz	797.7 Hz
1000.4 Hz	1000.4 Hz
1263.4 Hz	1263.4 Hz
1589.9 Hz	1589.9 Hz
2.000 kHz	2.000 kHz
2.516 kHz	2.516 kHz
3.168 kHz	3.168 kHz
3.985 kHz	3.985 kHz
5.014 kHz	5.014 kHz
6.304 kHz	6.304 kHz
7.932 kHz	7.932 kHz
9.973 kHz	9.973 kHz
12.535 kHz	12.535 kHz
15.747 kHz	15.747 kHz
19.796 kHz	19.796 kHz
24.857 kHz	24.857 kHz

Professional 3312 input module

Like the output module, the functions of the input module are located in logical sections covering the input configuration, input sensitivity and chart recorder display.

At the top of the module is the input configuration section having an unbalanced high impedance connection at a BNC connector and a balanced connection at an XLR socket, a miniature toggle switch selecting the desired input.

A 4-position rotary switch selects the input impedance of the balanced input which may be 100 kΩ, 10 kΩ or 600 Ω. In the case of the balanced input the fourth position of the switch selects 15 V phantom powering with a load impedance of 2 kΩ for the optional measuring microphone when the toggle switch is set to the balanced input. Setting the toggle switch to the unbalanced input selects this with a fixed high impedance.

The next section sets the input voltage sensitivity by means of a 5-position rotary switch in the form of a 20 dB step attenuator covering +20 dB to -40 dB in addition to an input grounding connection. In addition to this there is a variable control with a calibrate position at maximum input gain.

Two miniature toggle switches select the input reference to either dBm (0.775 V) or dBV (1 V) with the second switch inserting a 50 Hz highpass filter to minimise the effect of line frequency hum in any input signals.

At the bottom a 4-position rotary switch selects the vertical scale on the recorder chart with full scale corresponding to 50 dB, 25 dB or 10 dB logarithmic scaling. In addition a linear scaling may be switched into operation.

Finally a rotary switch selects the recorder's writing speed with the options being 10, 20, 50, 100 or 200 mm/s covering the common requirements for

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level recording. Measurement of the actual input impedance at the balanced input showed it to be close to the nominal value as given in **Table 3**.

In the phantom powering position, which is the only position where the unbalanced input can be selected other than at high impedance, +13.8 VDC was present for powering the optional ¼ in microphone.

It is not quite clear operationally that the unbalanced input impedance is nominally 1 MΩ in all other positions of the loading switch, the actual impedance being measured at 980 kΩ in parallel with 35 pF in all positions of the loading switch.

Measuring the actual level calibration showed that both the volts and dBm ranges had precise calibration with the nominal input giving a deflection of 80% of the chart width on all logarithmic ranges with full scale on the linear range corresponding to 1.2 V with the attenuators at unity.

Scaling of the decibel ranges was very accurate, to within the readability of the chart on all ranges with the attenuator's 20 dB steps being precise at frequencies up to 20 kHz and within ±0.1 dB at 40 kHz.

The variable attenuator had a 20.6 dB range adequately overlapping the switched steps with the common mode rejection at the balanced input being better than 50 dB up to 11 kHz and then falling to 43 dB at 20 kHz and 32 dB at 40 kHz.

Fig 3 shows the variation in the frequency response of the recorder and input section with the switched attenuator setting, it being seen that there is very little error up to 40 kHz which is the specified upper limit frequency.

The switched highpass filter had a characteristic as shown in **Fig 4** with the -1 dB point at 80 Hz falling to -3 dB at 40 Hz with the normal 'flat' frequency response falling to -1 dB at 2.6 Hz.

The recorder's writing speed which is controlled from the input module was found to be within 10% of the nominal values with a symmetrical rise and fall time and no overshoot in the normal modes. However in the reverberation time mode where the writing speed automatically increases to 500 mm/s there was a small degree of instability on step function inputs. As is desirable the rectifier characteristic was true RMS using the AD536 RMS converter chip which copes with a crest factor up to 7.

Phase module 3332

Like the others, layout of the phase module is divided into logical sections with the two BNC input connectors at the top, these automatically handling between 20 mV and 20 V, both having out of range indicator LEDs and the reference input having a phase inverting toggle switch.

The next section includes a 3-digit liquid crystal display with ½ in high numerals which are easily read. Beneath the display one miniature toggle switch selects a display of degrees or radians with a second switch selecting 0 to 360° or ±180° (0 to 6.28 radians or ±3.14 radians) for both the numeric display and the recorder.

Below the metering section is a delay which can be inserted into the reference channel for correcting, for instance, for the delay of sound in air when doing loudspeaker measurements. This section has two controls, a 7-position rotary switch for selecting delay off or 1.46 to

8.73 ms delay in steps of 1.46 ms corresponding to respectively 3 m and 0.5 m distance in air under normal conditions. The second control is a variable delay control giving a nominal ±10% variation in addition to which an external reference may be used.

Finally at the bottom of the module is a 3-position miniature toggle switch which selects on/off position where the recorder is connected to the adjacent module, a phase plotting position and a group delay measurement position. In the latter position group delay is calculated from the rate of change of phase variation according to Blauert and Laws with the plotted range being ±10 ms, in this instance the chart speed being restricted to 3 mm/s.

Checking the two unbalanced inputs showed them to have an impedance of 91 kΩ in parallel with 35/40 pF with the minimum input voltage up to 60 kHz being just under 20 mV for the out of range LEDs to be extinguished. The reference channel phase inverting switch was accurate at frequencies up to 100 kHz.

The accuracy of the plotted phase and that of the digital display was within the appropriate readability from 10 Hz to 40 kHz becoming degraded at 100 kHz but still useful. The speed at which the recorder could follow phase variations depended upon frequency being about 300 ms at high frequencies and increasing to seconds at low frequencies.

The accuracy of the delay time inserted into the reference channel was good, with the available range being as shown in **Table 4**.

From limited tests it appeared that the group delay measurement system gave accurate results, the delay in the reference channel also being operational

Nominal	Resistive	Capacitive
100 kΩ	98.6 kΩ	93 pF
10 kΩ	9.98 kΩ	100 pF
600 Ω	598 Ω	—
2 kΩ phantom	1.99 kΩ	—

Nominal delay	Actual	Minimum	Maximum
1.46 ms	1.44 ms	1.31 ms	1.72 ms
2.91 ms	2.92 ms	2.58 ms	3.44 ms
4.37 ms	4.39 ms	3.89 ms	5.17 ms
5.82 ms	5.83 ms	5.16 ms	6.89 ms
7.28 ms	7.33 ms	6.50 ms	8.61 ms
8.73 ms	8.83 ms	7.78 ms	10.33 ms

FIG. 3
AUDIOGRAPH 3300
FREQUENCY RESPONSE RECORDER/INPUT SECTION
WITH SWITCHED ATTENUATOR SETTING

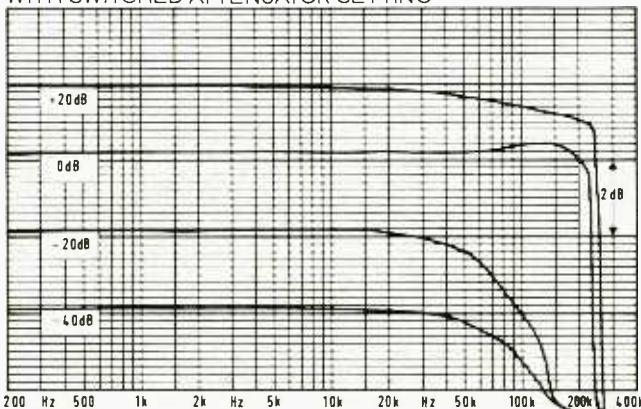
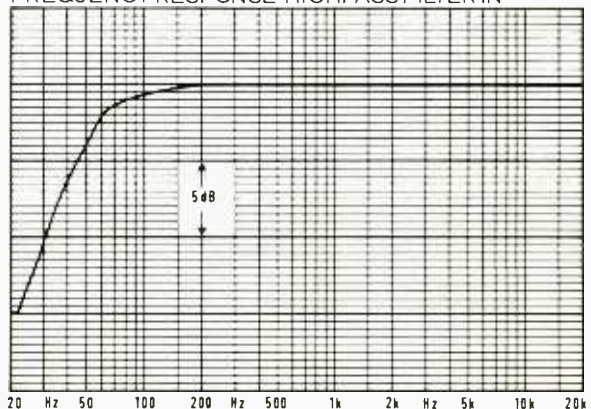


FIG. 4
AUDIOGRAPH 3300
FREQUENCY RESPONSE HIGHPASS FILTER IN



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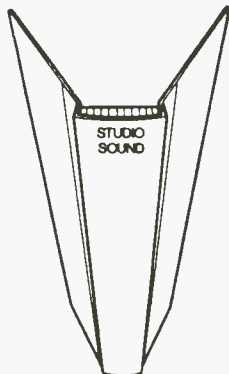
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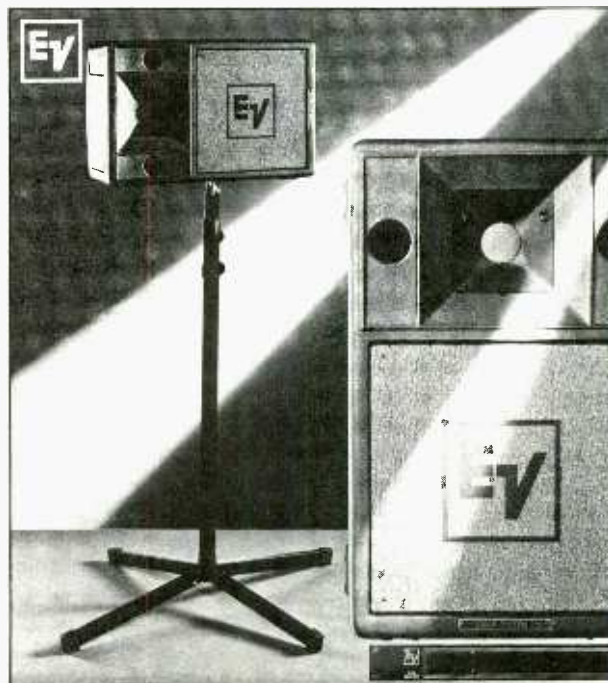
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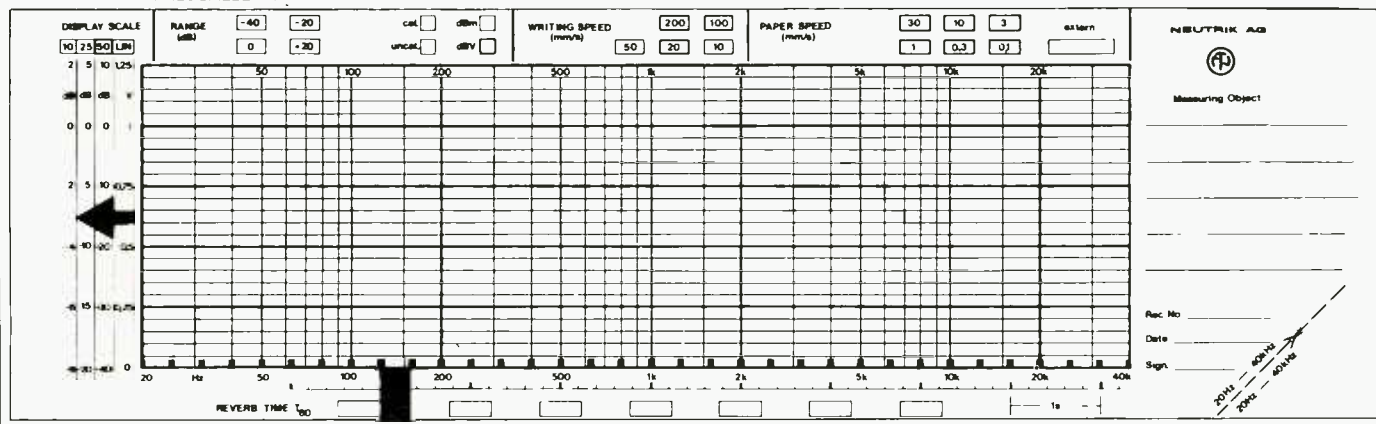


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REVIEW REVIEW

FIG 5 NEUTRIK PRESCALED SHEET



in the group delay mode where the chart speed has to be set to 3 mm/s.

A slight nuisance in the phase and delay modes is that in many circumstances the oscillator output has to be fed externally to the phase module. Whilst no instruction manual for this new phase module was available at the time of writing I could find no way of feeding the input module internally to the phase module—a very useful connection for many measurements.

Recorder section model 3302

The pen recorder which uses special felt tip pens available in four colours has the minimum of controls. The pens screw into the writing arm of the recorder and may be stored in tapped holes in the case of the recorder which is a potentiometric type of device.

For many purposes pre-scaled sheet paper will be used (see Fig 5), but roll type paper is also available. In the case of the scaled paper vertical scales are printed for all ranges in addition to which there are boxes to be marked for all other module settings.

Normally the paper drive, which is by means of a stepper motor, is synchronised with the oscillator and runs from the frequency set on the output module up to 20 kHz. However, cutting off the bottom right corner of the paper sweeps up to 40 kHz.

Alignment of the sheet paper is completely automatic with an optical detector setting the start point by means of a black marker on the paper.

Normally once inserted the paper is moved on to the scale and stopped. From there pressing the start button drives the paper at high speed to the start frequency and lowers the pen, then the paper proceeds at the paper speed set on the input module until the end of the frequency sweep when high speed is again engaged to eject the paper. Alternatively the paper can be stopped or started by the momentary stop/start button or advanced rapidly by the momentary fast forward button.

As the paper is fairly thick, insertion into the two guides is very simple and the paper drive appears to be completely foolproof.

The remaining controls on the recorder are the paper speed switch covering 0.1 to 30 mm/s in a 1:3 sequence, this function being automatically overridden as necessary—for instance for reverberation time measurement.

The remaining control is a 3-position toggle switch selecting the single sheet mode, a continuous drive mode and the reverberation time mode. In the latter mode the paper speed is set automatically to 30 mm/s with the oscillator being stopped automatically just over half way along the paper.

In all modes the pen is automatically lifted where appropriate, thus avoiding nonsense plots such as when the phase meter runs out of range.

Model 3382 microphone

Two types of microphone are available for use with the professional input module, the 3382 ¼ in microphone and the 3381 ½ in balanced microphone also usable with the standard input module.

The ¼ in microphone supplied for review has a 2 m long lead fitted with a BNC plug which fits the professional input module. Supplied with the

microphone is a stand adaptor and a calibration plot giving the frequency response and sensitivity at 1 kHz stated to be 3.66 mV/μbar.

Very approximate laboratory measurements made the microphone 1.5 dB more sensitive with the frequency response following the manufacturer's curve to a +2 dB boost around 8/10 kHz on axis.

As no noise weighting is included in the input module only wideband microphone noise could be evaluated, this being about 30 dB below 1 μbar—quite adequate for most purposes.

Summary

The Neutrik modular system offers a remarkable value for money in comparison with all other systems with similar capabilities. Being a modular system which is extremely well made it can cater for individual needs and in addition is readily portable for field measurements.

The accuracy of all modules was beyond reproach and far better than is needed for routine production line work or normal servicing workshops.

Operation by unskilled labour should not present any problems as the recorder is remarkably quick and simple to operate. □

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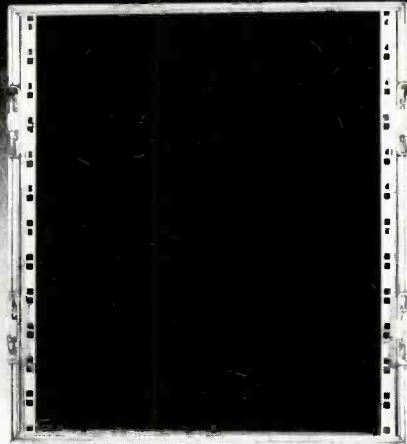


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REVIEW REVIEW

A test set user report by Martin Colloms



WAYNE KERR AMS1

As an audio consultant and technical reviewer, with a special interest in consumer audio, I have been subjecting a piece of British test gear to extended field trials. My brief was to concentrate on what it could do and how it worked in practice, rather than undertake a detailed lab report but I confess to carrying out some lab checks in order to verify elements of the specification, as well as gain confirmation of its basic accuracy.

The Wayne Kerr *AMS1* is a comprehensive test set made by a company with a long and respectable reputation for lab instrumentation, especially for measuring bridges. Through various company tie ups, Wayne Kerr absorbed the Ferragraph instrument division. Engineers familiar with the latter's long established *RTS* series will see some of that inheritance reflected in the *AMS1* which to some extent picks up where the *RTS* left off, continuing a trend towards greater performance and enhanced facilities.

I shall attempt to cover the unit's comprehensive facilities by first analysing the various classes of instrument that it represents:

- An audio range oscillator covers 15 Hz to 150 kHz with monitored output level plus frequency read out. It offers a level range from +20 to -90 dBm (7.75 V to 25 μ V). Sinewave distortion at 1 kHz is typically -86 dB with source impedance 50 Ω (optional balanced output 600 Ω via transformer). There is also a squarewave output.
- An audio voltmeter (25 μ V to 100 V range) covers -92 to +42 dBm (600 Ω or 1 m Ω termination) with readings in RMS, volts or dBm, the latter on a linear scale. Watts (8 Ω) 1 mW to 1,000 W are also provided.
- There is an audio programme and noise meter with RMS, quasi-peak, VU

and PPM responses, according to selected measurement and noise filter characteristic. A number of filter types may be selected of which two may be installed.

- There is a digital frequency meter in the form of a simple 4-digit Hz or kHz selectable monitor.
- A wow and flutter meter is included, to CCIR 409-2 with readings to 0.003%, weighted and unweighted, carrier output 3 or 3.150 kHz.
- Turntable rumble can be assessed (DIN B-weighted and unweighted) from +42 to -92 dB.
- Total harmonic distortion at five pre-selected frequencies can be measured—normally 80 Hz, 1 kHz, 5.6 kHz and 16 kHz to typically -80 dB, with per cent or dB scaling.
- Filtered level measurement can be carried out, for crosstalk, etc, at the pre-selected distortion measurement frequencies.
- Phase metering is possible—auto ranging and auto phase invert with a 2° resolution and with a $\pm 120^\circ$ basic range over the overall bandwidth.

Just for the hell of it I worked out an approximate costing for an average group of separate instruments that would more or less cover this set of facilities and arrived at a total of around £1700. The *AMS1*, however, costs approximately half that (at current UK prices) in its basic form, and if the performance and other facilities are satisfactory then clearly it is going to be a winner.

Its sheer versatility could, in fact, be its biggest problem as on occasion I forgot it could also perform less common tests such as phase response and special meter response measurements, while on other occasions I must admit to sufficient unfamiliarity with all its numerous options to select an incorrect meter ballistic, for example, for a particular noise reading on one test. It is essential

to play extensively with such an instrument in order to understand and become conversant with its operation and its facilities. Without this, many of its resources will be neglected. A major advantage is the integration of so many facilities under one roof, offering a saving in bench space and simplification of switches and cable connections.

Operation

This is a rack mounting unit with height 5.3 in (134 mm) and depth 9.8 in (250 mm). I ran this instrument for some months in my lab, alongside my usual equipment and in a number of secondary applications it proved most useful, for example as a backup when another unit was out on loan or faulty. The noise meter function proved more comprehensive than most and the CCIR ARM option also showed a fine dynamic range, capable of readings better than -115 dB ref 2 V 1 kHz, which is necessary for some of the latest CD machines. I used the phase meter for channel phase differences on CD players as well as matching transformers, while both the tape and turntable functions—wow and flutter and rumble—worked well, being frequently pressed into service, especially with the convenient linear dB scaling.

The PPM programme function was also useful for checking other programme meters in machines under evaluation. Spot checks on performance gave the following results: oscillator distortion at 2 kHz was better than 90 dB down at 7 V output, with a generous maximum level of 8 V RMS; the 20 dB output level attenuator on the variable control was accurate to 0.1 dB while the 30 and 60 dB combinations had a constant 1 dB error, this backed up by the rather better accuracy of the integral output level monitor; the wide band voltmeter

REVIEW REVIEW

can be switched to pad the oscillator (the latter was typically of the $\pm 1\%$ (0.1 dB) accuracy degrading, to $\pm 2\%$ at the two or three most sensitive ranges where input noise becomes a factor); the internal distortion factor meter could read down to -85 dB at the 5.6 kHz position which is good enough for many basic linearity checks. Conveniently, the set 100% switch is independent of the range setting allowing easy reference comparison.

Comment

Nothing in this life is perfect and I do have some criticisms. Frequency setting is not too easy with the small and coarsely calibrated knob provided, and to add insult to injury, the frequency meter is rather slow being of the non reciprocal variety; in fact it is painfully slow for setting low frequencies. I most definitely miss the open dial of the older *RTS* instrument and feel that either the *AMS1* should be fitted with this or have the existing dial meter improved to speed frequency setting. The meter is, of course, fine at monitoring an external fixed frequency.

Another minor nuisance is the FSD setting for distortion which gave a lot of electrical backlash in conjunction with the apparent meter ballistics. The S/N ratio and overload margins on the headphone monitor output were poor, but I am still glad of their inclusion. Finally my understanding of the system circuits suggests that the oscillator output earth is essentially connected to the case and chassis earth and thence to the earth wire of the connector power cable. The inputs at measuring terminals are thus left floating, though internally the earth rails are taken to a common earth connection at the power regulator.

With high gain or high output current systems under test, eg power amplifiers, due care must be taken with earth loops. For example, joining the *AMS1* straight to a power amp is likely at best to give misleading results, and at worst may induce instability and possible power amp failure. Here an isolating transformer should be used on the oscillator but in most situations one can break the earth loop produced by not connecting the ground return on the measurement side or alternatively on the oscillator side, whichever gives the best result. Ideally, both inputs and outputs should be active floating balanced terminals, but this would add to the cost.

Conclusion

Notwithstanding the minor criticisms, the *AMS1* presents an admirably versatile, compact and decently accurate test set which would be a valuable asset to any measurement facility. For basic technical assessment one hardly needs anything else—it is very good value and thus highly recommended.

Postscript

Since compiling this review Wayne Kerr have agreed about the frequency setting problem and provided a marginal improvement by fitting a multiturn potentiometer giving finer user control of setting frequency.

Shortly to become available is a fully balanced unit—an active, wide band design deriving power from the *AMS1*, and mounting neatly beneath it. Properly floated balanced output and

input connections are provided, adding some £200 to the cost, and making it suitable for most studio applications.

Finally on top of the basic unit price come additional filter cards; it is also rumoured that the distortion/narrow band unit frequencies can be changed, for example to encompass the 20 Hz and 20 kHz points. □

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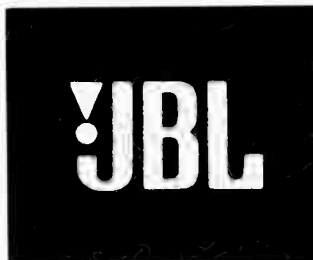
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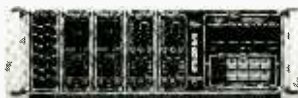
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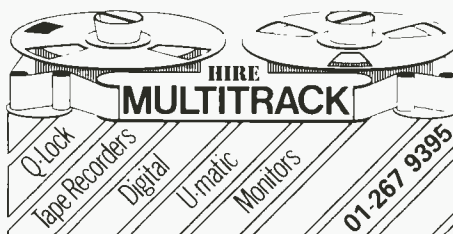
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INDEX TO ADVERTISERS

APRS	6
Abacus Electrics	89
Adams-Smith	85
Advanced Music Systems	23
Allen & Heath/Brenell	79
Amek Ltd	61, IBC
Aphex Systems Ltd	33
Applied Microsystems Ltd	87
Arny's Shack	85
Atlantex	35
Audio & Design (Calrec) Ltd	18, 20
Audio Developments	12
Audio Kinetics	71
Audio Ltd	8
Audio Service Co.	6, 98
B.F.E.	8
B & W Loudspeakers	24
Britannia Row	63
Bruel & Kjaer	41
Capitol Magnetic Products	75
Connectronics	22
D.E.A.F.	10
Don Larking Audio	15, 27, 85
Eardley Electronics	22, 43
Future Film Developments Ltd	8
FWO Bauch Ltd	OBC
Hardware House	6
Hayden Laboratories Ltd	25
HHB Hire & Sales	4, 37
H.H. Electronics	19
Hill Audio Ltd	49
Hilton Sound	89
ITA	16, 17
Jensen Transformers	83
Klark Teknik Research Ltd	50
Lennard Developments Ltd	87
Marquee Electronics Ltd	26, 29, 85
Northern Audio	73
Otari	66, 67
Pan Communications Inc	23
Pangbourne Musical Distributor	20
Perfectone	69
Professional Recording Co	91
Regent Port Ltd	81
Rycote Microphone Windshields	82
Scenic Sounds	31, 53, 65
Shuttlesound	26, 87
Simmons Electronics	89
Sony Broadcast Ltd	59
Soundcraft Electronics Ltd	46, 47
Soundout Laboratories	IFC
Spectrasonics	28
Studer	OBC
Studio Spares	21
Surrey Electronics	76, 88
Syco Systems Ltd	54, 55
Tandberg A/S	39
Technical Projects	77
Televic SA	18
Trad Sales & Service	77
Trebas Institute of Recording	24
Turnkey	7, 9, 11, 13



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The console is an AMEK M2500 with a 56-input chassis configured 48/48, and with special overbridge for outboard equipment. The world's best-selling mid-price console, the M2500 features the most musical and responsive equalizer available, a 4-band fully-parametric unit with swept high and low pass filters, on all i/o modules. The M2500 is automation-ready with a VCA-fader system and 10 DC subgroups.

A complete solo system, with mono and in-place solo with solo grouping facilities, gives the engineer full control at all points in the signal chain. Two metering system, either VU and LED-display with switchable ballistics and spectrum analysis, are available.

Chassis sizes range from 36-input through to 56-input, and the mechanical construction is absolutely unequalled for strength, precision and rigidity.

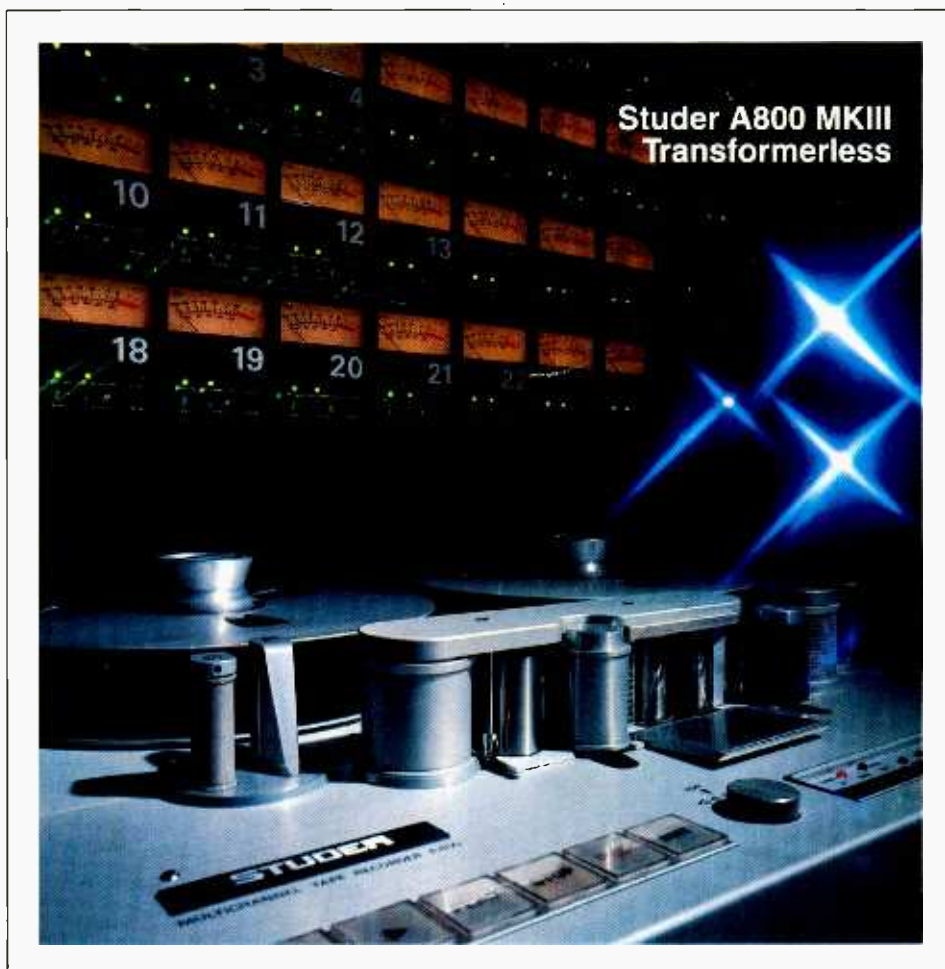
The choice of recording studios and post-production houses worldwide, AMEK M2500 is part of a large range of ultra-high quality audio products from one of the world's recognized leading manufacturers.

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Sales office:
AMEK SYSTEMS & CONTROLS LTD
Islington Mill, James Street
Salford M3 5HW, England
tel: 061 834 6747
telex: 668127 AMEK G

In the USA:
AMEK CONSOLES INC
10815 Burbank Blvd
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CH-8105 Regensdorf Telephone (01) 840 29 60

F.W.O. Bauch Limited

49 Theobald Street, Boreham Wood, Hertfordshire WD6 4RZ
Telephone 01-953 0091, Telex 27502