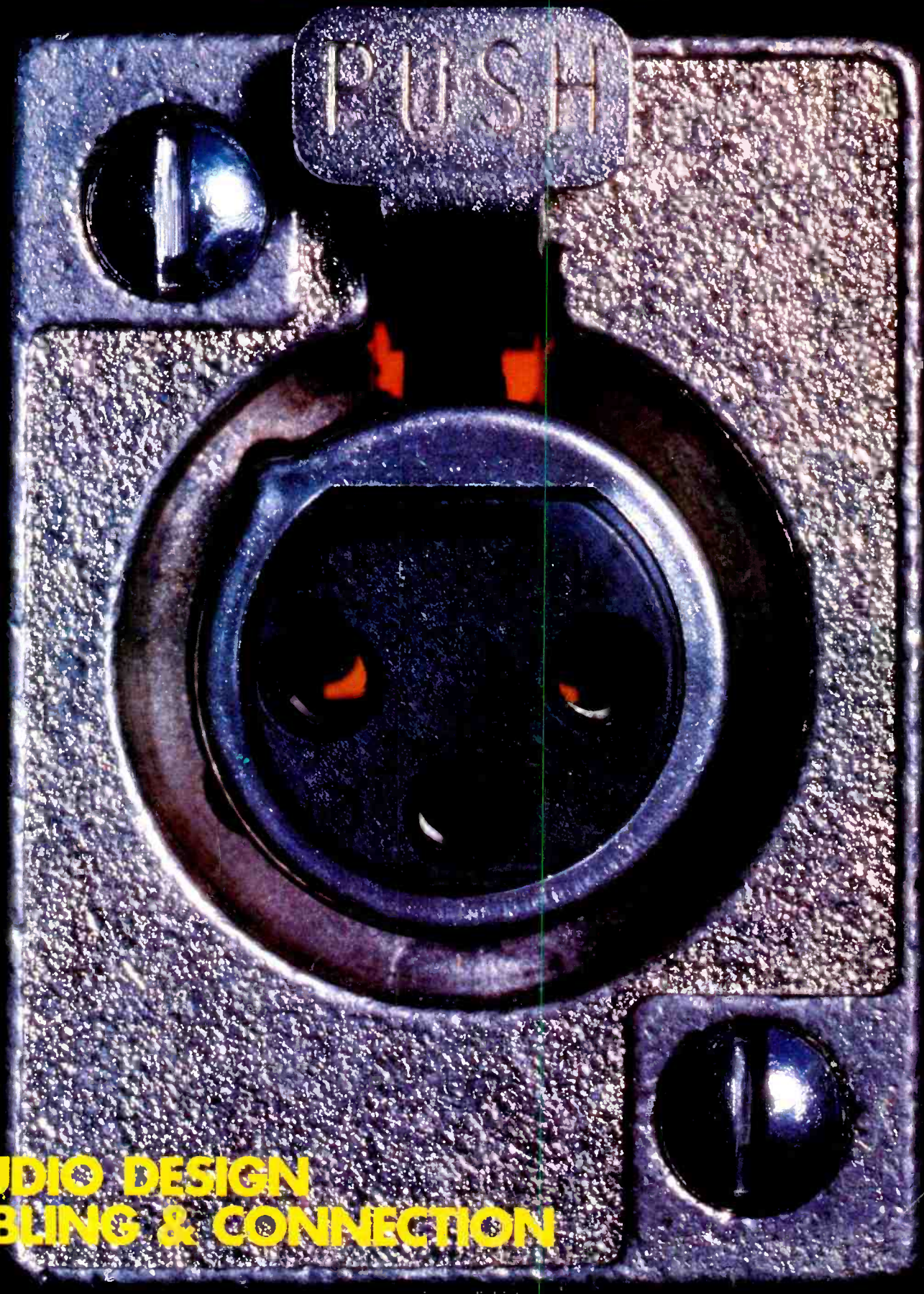
June 1986 £1.50

STUDIO SOUND

AND BROADCAST ENGINEERING

A LINK HOUSE PUBLICATION



STUDIO DESIGN CABLING & CONNECTION

"IT'S BRILLIANT."

Advision have just completed an impressive refurbishment of Studio Three, to complement their two SSL rooms.

In the process, they've created the largest control room in London.

Their choice of mixing console? The Soundcraft TS24.

Owner Doug Hopkins says:

"We bought the TS24 because it sounds so incredibly clean, uncoloured and neutral – which is essential when you're recording digitally.

"Technically it's right up there with the very best desks; and it'll command the same rate as the other rooms.

"The in-line concept is beautifully clear – so much so that everyone feels at home on the desk very quickly.

In fact, we've decided to buy another one immediately for a studio project in Madrid".

Senior engineer Dave Jacobs is equally enthusiastic.

"We've recently recorded The Little Shop Of Horrors soundtrack onto digital with the TS24. It was a dream to use – if I had my own studio I'd definitely buy one".

Producer Steve Hague, who was in recording tracks for the Pet Shop Boys' new album, said between sessions that he felt the sound of the desk was "really outstanding".

But the last word goes to Dave Jacobs, who summed up the TS24.

"It's brilliant".

Soundcraft TS24

Soundcraft Electronics Ltd., Unit 2, Borehamwood Ind. Park, Rowley Lane, Borehamwood, Herts. WD6 5PZ, England. Tel: 01-207 5050. Tlx: 21198 SCRAFT G Fax: 01-207 0194
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SPECIAL FEATURES

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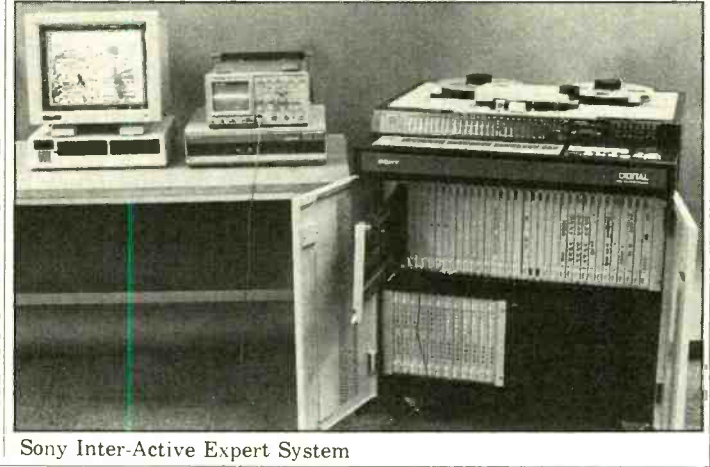
Bel BDE-3200



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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

June 1986 Number 6
Volume 28 ISSN 0133-5944

Digital Mastering Rentals.

HHB are pleased to announce that they've re-equipped their digital rental service with the new Sony PCM 1630 processor and the purpose-built DMR 2000 recorders.

The PCM 1630 is the successor to the PCM 1610 and maintains the CD format compatability which has made Sony the undisputed digital masters.

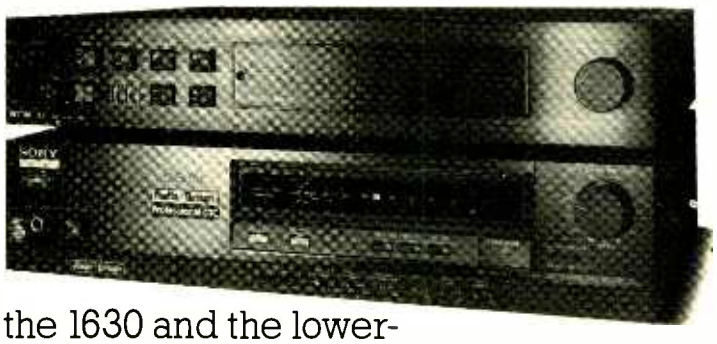
The PCM 1630 employs a superior 'oversampling' technique, resulting in even greater sonic accuracy, and the metering has been improved now giving essential 'over' and 'peak-hold' indication.

The DMR 2000 is the first U-matic recorder specifically designed for digital audio. Among other advantages of this machine are an integral fast-reading time-code generator/reader, which allows assembly of a continuous stripe, and self-cleaning heads.

Another new service – often free of charge – is the use of Sony's tape analyser DTA 2000. This employs the status port of the PCM 1630 to provide a print-out of errors vs. time, thereby removing one of the uncertainties of the older systems.

These new machines, with the DAE 1100, form the heart of the digital mastering service that has made HHB leaders in the field.

Economic access to all this is afforded by a variety of interfaces that allow two-way digital communication between



the 1630 and the lower-cost PCM F1 and 701ES, thus significantly reducing post-production costs.

Not only do we supply and install mastering and editing systems where you want them, but we also provide full editing and copy facilities in-house, with skilled operators if required. Of course, this is backed up by HHB's trusted support service, with experienced Sony-trained engineers on 24 hour call-out.

By the way, it is not just our rental service that has expanded – we are now authorised Sony Broadcast dealers, handling their full range of digital and analogue products, as well as the lower cost processors.

And don't forget that we can also supply full studio installations, multitracks, consoles, video systems, signal processors, amplifiers, monitors..... in fact anything you need

For digital rentals, contact Richard Kershaw on 01-961 3295.

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EDITORIAL

EDITORIAL

This month's comment from Carl A Snape

A question of balance

Find a small stretch of deserted beach, dig a round hole about a foot across, kneel down and lower your head into the darkness. Most people would agree this is not the way to come to terms with technological change but I wonder how many are finding this solution attractive at least until 'after the storm has blown over' so to speak.

In the normal course of events sitting back and taking stock can prove extremely useful, the time however for the so-called silent majority to make its presence felt is now becoming increasingly overdue. Putting off the problem won't make it go away: it will only aggravate matters and leave the way open for others to make decisions on your behalf. Which is precisely what is happening.

The musical instrument industry has already decided that we are going to use MIDI to interface keyboards and related processing equipment in the studio. The consumer sector has laid down the specifications for CD and equipment such as the *FI, 701, 501*, etc. The home studio market continues to grow and in some ways threaten the viability of the smaller professional studio with improvements in recording quality. Record companies demand to know what console is being used.

Whichever way you look important decisions are being taken out of our hands. As an industry we are responsible for physically making the actual recording, we should not therefore neglect our collective responsibility to determine the future development of professional recording equipment.

Take the mess surrounding digital recording. If you were a professional studio a few years back and claimed there was no difference in sound between a cheap domestic open reel recorder and a professional machine you would have been laughed out of business. Yet today many studios' experience of digital is primarily via consumer products. Saying that domestic digital systems are as good as professional analogue machines misses a very important point. If domestic digital is excellent just how good could a really top notch professional system be?

We have professional digital multitrack machines of course. Everyone knows we really only need one system yet we have two. Normal market forces cannot be relied upon to prevail. With all the current changes there is simply too much capital at stake to risk being the studio to go with the least popular option. So the marketing gets stepped up a notch and the whole wonderful merry-go-round spins faster and faster. Some commentators, no doubt genuinely trying to find a way out of the problem, have suggested using one of the digital systems for multitrack recording and the other for mastering—that's like finding a dead body in the lounge and then trying to decide how to prevent the murder.

The damage has already been done. We now have two systems whether we like it or not and unfortunately we will have to live with it for the time being irrespective of how good or bad they both are. But what of the next generation or the one after that? What are we doing as a collective group to ensure the same thing doesn't happen again? Nothing—or at best very little.

The problem isn't just confined to open-reel digital recorders: it extends to consoles, digital interfacing, hard-disk recording and so on.

Although some of them try very hard to be, manufacturers are not mind readers. They will continue to research and develop products they believe are commercially viable. Whether they do this in isolation or head towards a common standard will depend to a large degree on just how determined we are to see a common standard prevail.

For the sanity of us all, is anyone prepared to set the ball rolling or is the tail going to continually wag the dog from here on in?

STUDIO SOUND
AND BROADCAST ENGINEERING

STUDIO SOUND is published on the second Friday of the preceding month. The magazine is available on a rigidly controlled requested basis only to qualified personnel (see back page for terms) or for an annual cost of **£18.00** UK, **$40** US surface mail, **$75** US airmail, **£24.50** overseas surface mail or **£46.50** overseas airmail to non-qualifying readers or where more than two copies are required in a studio or small organisation. New subscription enquiries should be sent to the Croydon address on page 3. All other enquiries should be made to **Studio Sound Subscriptions, Link House Magazines Ltd, Central House, 27 Park Street, Croydon CR0 1YD. Tel: 01-760 0054.**

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ABC

Who wants a stereo digital reverb with Midi for under £400?

The MIDIVERB from Alesis

At £395 including VAT, you may not believe it, but the MIDIVERB is a top-class device. So *good,* it will impress even the most difficult A&R man. *So quiet,* it will put the average mixing console to shame. *So powerful,* that you will wonder why people even *consider* anything else!

The flexibility is remarkable – 63 programmes in full stereo, everything from plates to massive halls, decay time from 0.2 secs to 20 secs, and nine gated and four reverse room programmes, *so clear,* they will astound you.

Easily interfaced with most mixing desks, instruments and home recording studios, the MIDIVERB can be used stereo in/stereo out or mono in/stereo out. The reverb programmes in the MIDIVERB can be changed rapidly either manually on the unit, or from another MIDI device through any of 16 selectable MIDI channels.

Specifications

Frequency response	20Hz to 10kHz
Dynamic range	80dB Typical
Programmes	63, Preset
Inputs	Stereo & Mono, Phono Jack, 50 Ohms
Outputs	Stereo, Phono Jack, 600 Ohms
Controls	Increment Prog/Midi Decrement Prog/Midi Midi channel select By-pass Mix (on rear)
Midi Connections	Midi In, Midi Through

New Digital Reverb Design

All this has been made possible by a new design approach, borrowed from the most recent trends in computer hardware: RISC Architecture (Reduced Instruction Set Computer). RISC designs provide the programmer with a very small set of possible instructions that execute very quickly as opposed to more complex machines that offer more apparent power but operate slowly. RISC machines are simpler and less expensive and even though at first glance seem to have limited power, they often out-perform their bulkier counterparts.

The MIDIVERB uses an extremely specialised instruction set that runs at 3 million instructions per second, much faster than most systems on the market today.

Contact Sound Technology for your nearest dealer, or send £1 for a demonstration cassette.

sound technology

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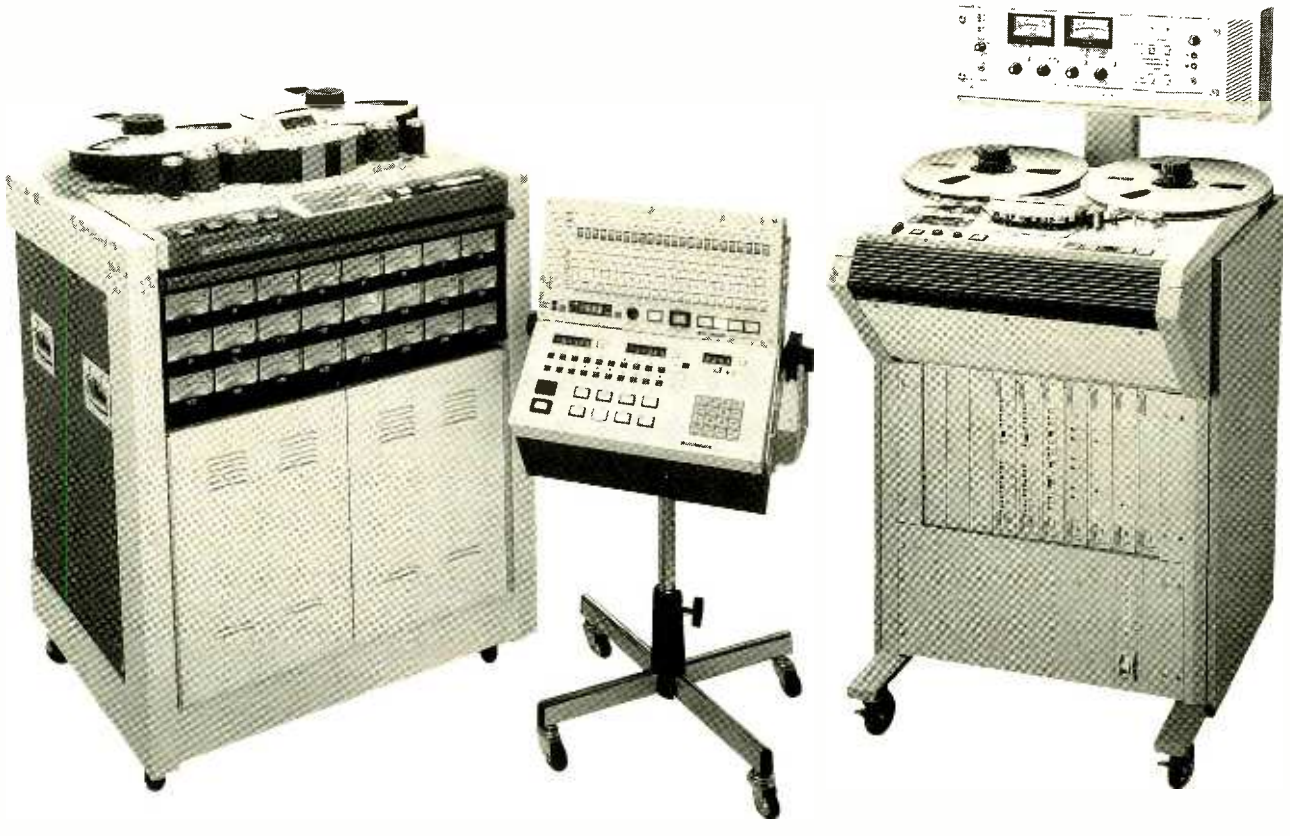
Otari Rentals



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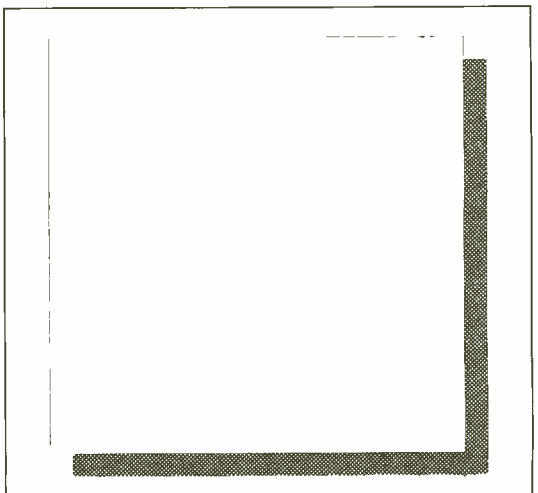
The Beatles record, the engineers strike and other revolutions.

WHEN YOU'VE HAD first hand recording experience like Trident Audio, it's not surprising that the Mixing Consoles you design reflect the kind of creative flair that went into recording the Beatles, David Bowie and James Taylor.

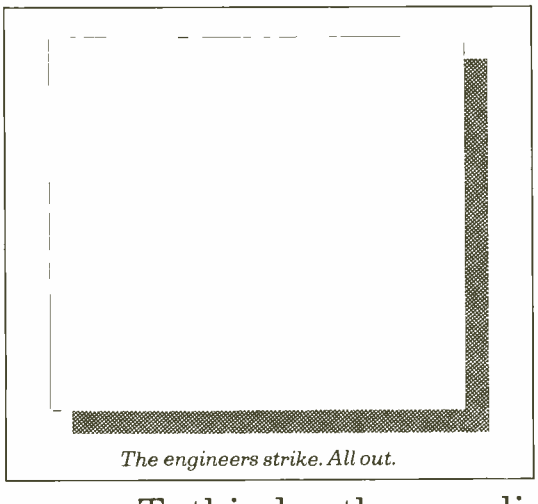
Innovations like the first console ever to feature EQ on Monitor, 4-band Graphic EQ and 10 Auxillary Sends on each channel made Trident's "A" Series a landmark in console design, when it was introduced in 1972.



Beatles White Album.

Most major studios in the UK boasted 'a Trident' in the early seventies and the word was spreading abroad, especially the States.

In quick succession new designs and further breakthroughs added to Trident Audio's reputation and success.



The engineers strike. All out.

The "B" Series, the 65, 75, 80B, the TSM and TIL put Trident's sound quality and reliability within the reach of studios of almost any size and budget.

Along with ingenious, yet utterly practical further innovations like Group Assignment, allowing 16-track recording from an 8-track desk; the use of the redundant monitor section as extra line inputs while mixing; and auto muting on all separate channels.

To this day, these earlier Trident consoles are much sought after as second-hand items and much treasured by the people who own them.

One of the original "A" Series desks, for example, was badly damaged in a studio flood just recently. But, rather than replace it, the studio asked us to restore it.

We even heard of one place where the engineers were threatening to go on strike when the management proposed ditching their Tridents in favour of something new-fangled.

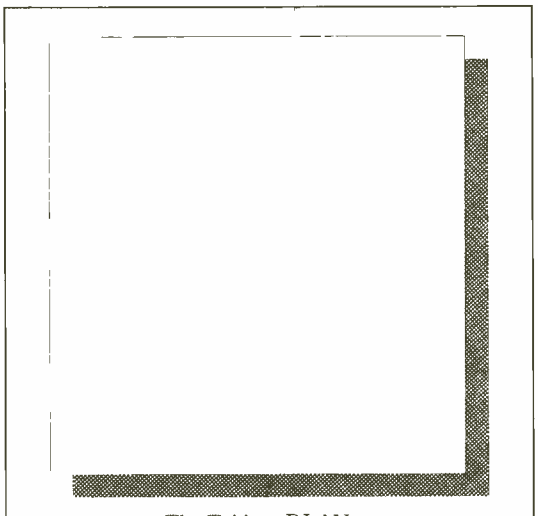
In the past few years, however, for a company accustomed to being in the forefront of studio advances, Trident have been surprisingly quiet.

Quiet, but by no means inactive.

For, while others have been pushing back the frontiers of traditional console design, Trident have once again been pioneering new territory.

The result of that exploration is the Trident DI-AN, a system that will quite literally change the shape of consoles to come.

It will be shown for the first time at the APRS show in June. And, even if you can't get along to see it, we guarantee you'll be hearing about it.



The Trident DI-AN.
Another revolution begins APRS, June 1986.

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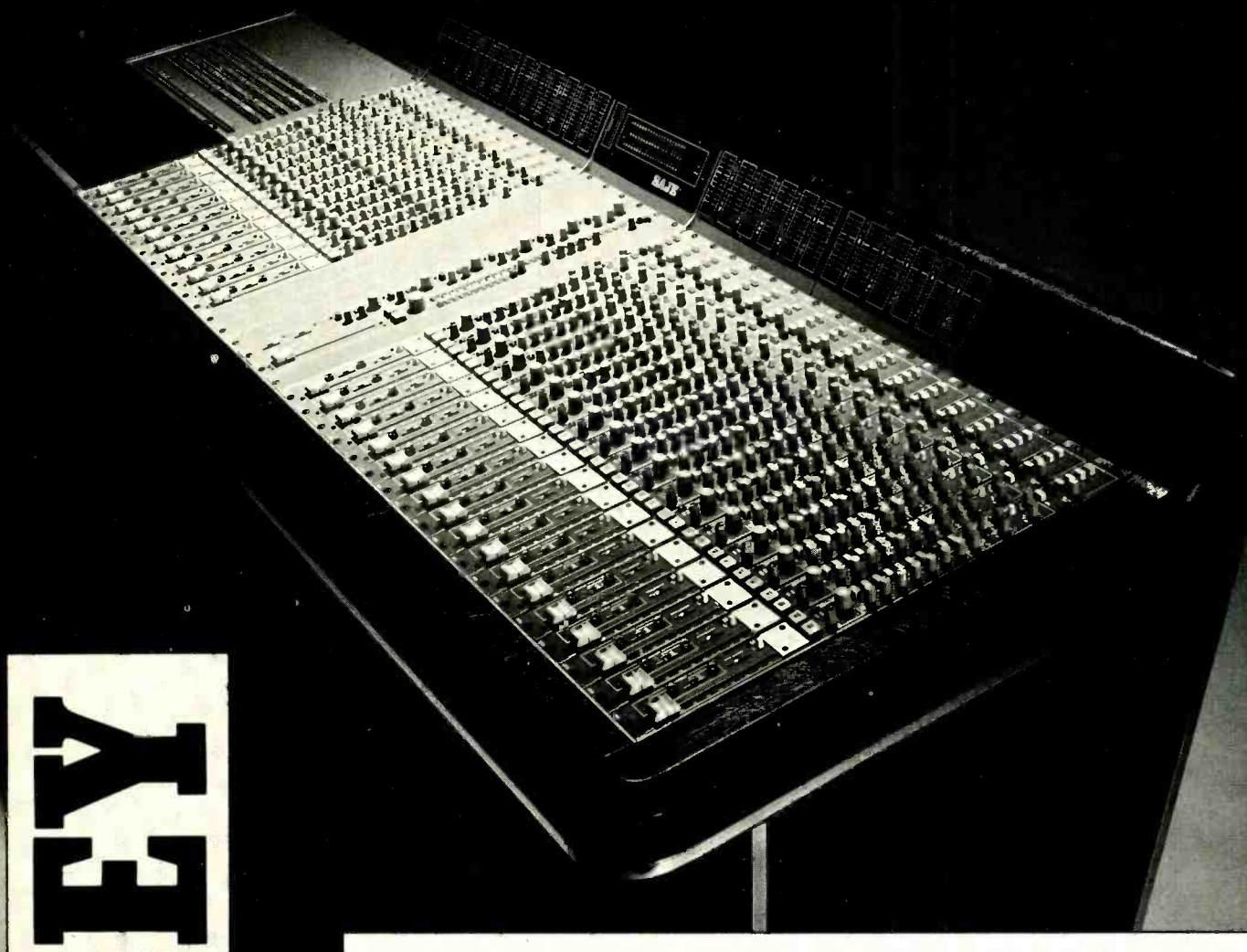

ODYSSEY

The De Luxe Odyssey console, a multitrack studio desk, has already found its vocation in many different fields, including video post-synchronization, video production, mobile audio recording studios, and for study of recording technologies.

Solidly built, ensuring trouble-free use even in mobile units, the quality of the components (gold plated switch contacts, potentiometers with Cermet tracks, professional faders), the excellent audio performance, the well-earned reputation for reliability and quality, made the Odyssey into the best selling studio console in France.
With the benefit of ten years valuable experience on the French market,we at SAJE are ready to prove to the world that we know how to put quality at your fingertips...

The design of the console, resulting from detailed ergonomic and artistic studies, was in itself an event among the consoles of 1985. The standard version of the Odyssey is supplied with 30 inputs, 24 outputs, 24 track monitoring, 6 echo sends/returns, 6 VCA subgroups, 3-band parametric EQ, vumeter/peakmeter and phasemeter on stereo outputs, automation system, LED power supply indicators. Three chassis configurations are available with 18, 24 or 30 inputs. Even the maximum configuration can be easily housed, for the Odyssey measures only 2 x 0.8 metres, including the 280 point patch-bay.

Odyssey is available with OPTIMIX or OPTIFILE automation, level automation system by VCA, synchronized by SMPTE or EBU code with mass-memory on disk.

SAJE

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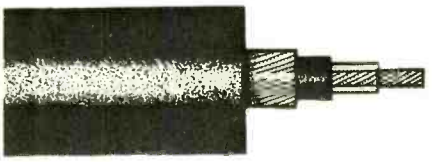

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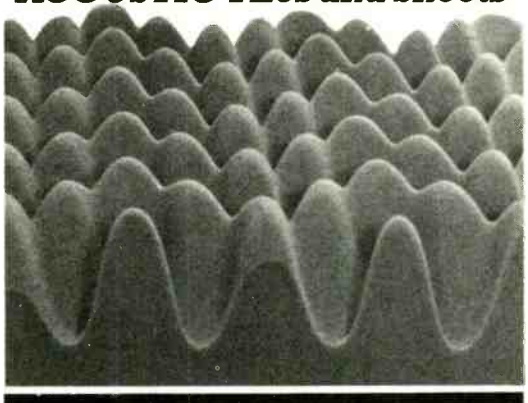

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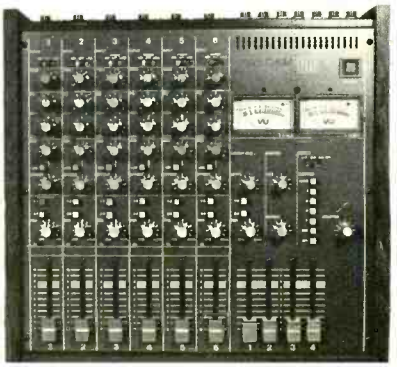
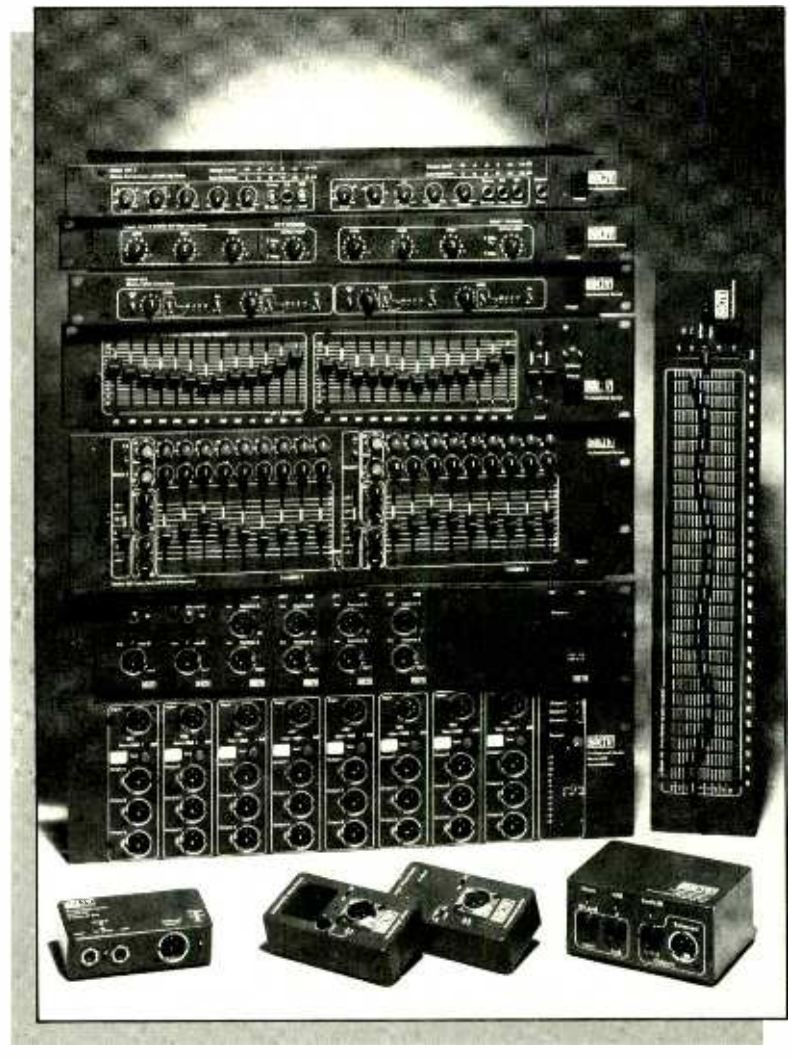


Our standards are even higher than yours



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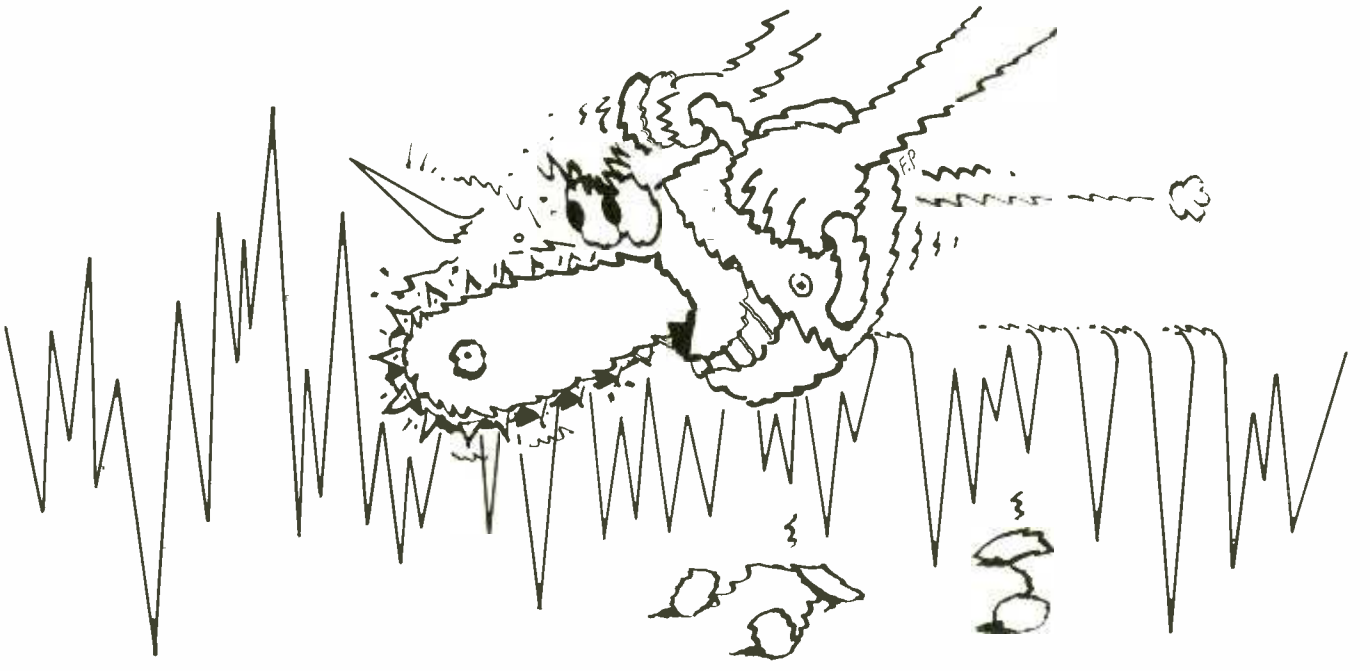
Tél. : (1) 863.22.11 Tlx : 212802
Contact : Richard Garrido



DOES YOUR LIMITER MASSACRE YOUR SOUND?

Most limiters are far from perfect... literally chopping up your sound. The new Aphex Dominator™ is the perfect solution.

Unlike dumb, over-threshold devices, the Dominator is an intelligent 3-band limiter with a proprietary circuit which varies the threshold for limiting. The result is an *absolute* peak ceiling while maintaining a transparent sound. Selectable crossover frequencies, plus high and low frequency drive controls allow creative flexibility.

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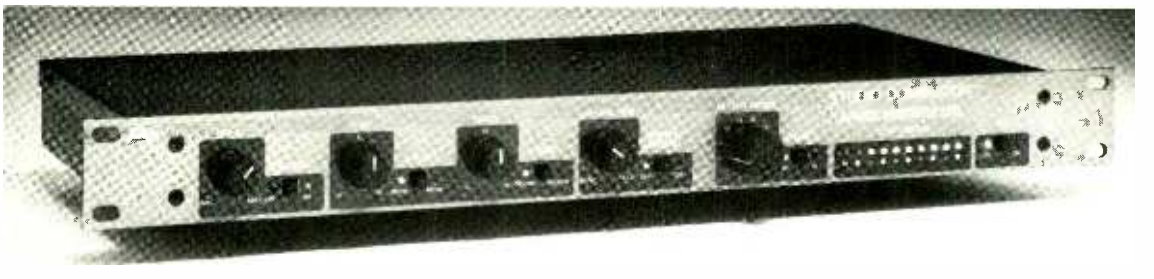

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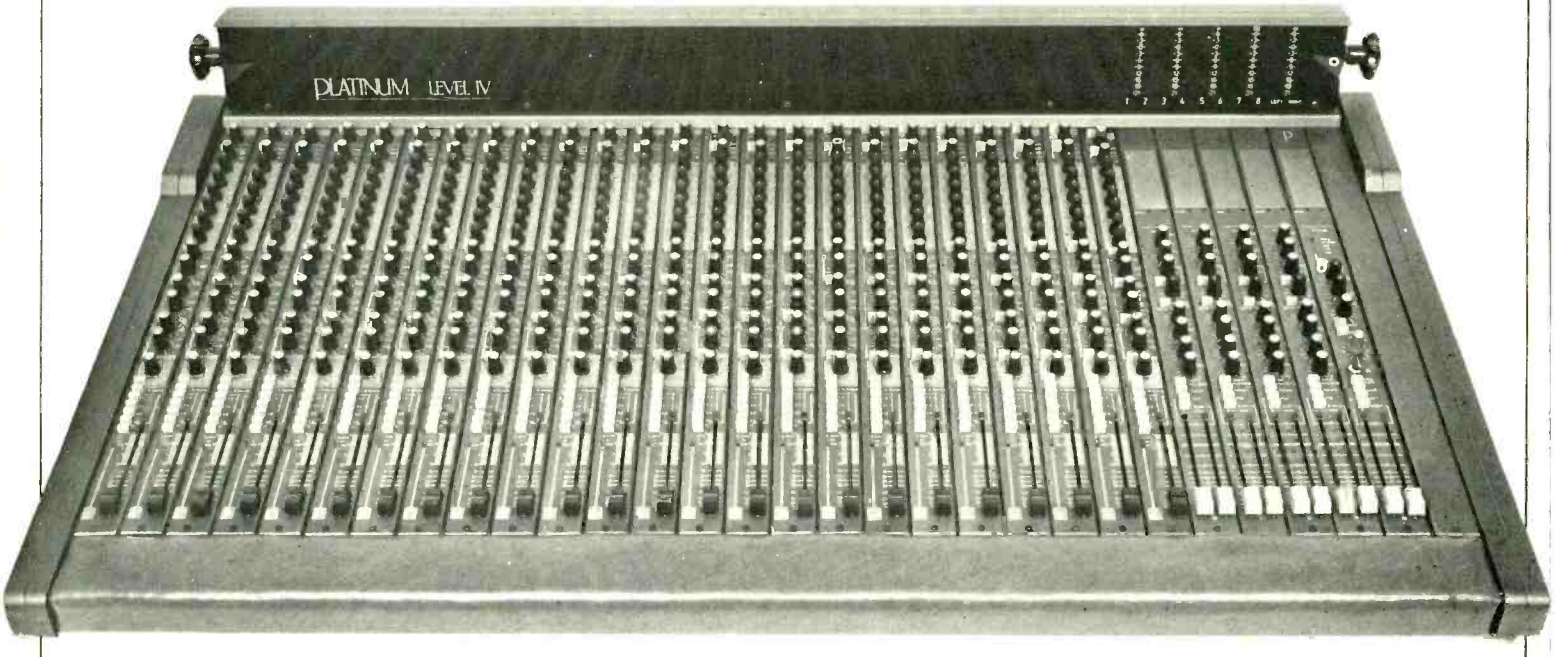

Stand Nö FB16 APRS, June, Olympia.

Platinum is a new name in the audio industry but it has a pedigree second to none.

Modular mixers come in all shapes and sizes but we at Platinum thought that it was about time that an 'In Line' based console should be available and affordable.

The unique module construction allows the modules to be made more economically and makes the frame construction more rigid. Modules can be changed in seconds and even serviced while still connected to the main frame.

Level IV is the first range to be produced and Levels III and V are on the drawing board. Level IV is basically configured as an 8 track desk although with split bussing it can be extended to 16 tracks.

Main frames come in three basic sizes (A, B, C,) to allow for 16, 24, 32 inputs + Mastermodules + 1 spare. Stabilized power supply units are external 19" rack mounting.

Meter bridges are available for all models and have bar graph displays for each channel or masters in any configuration.

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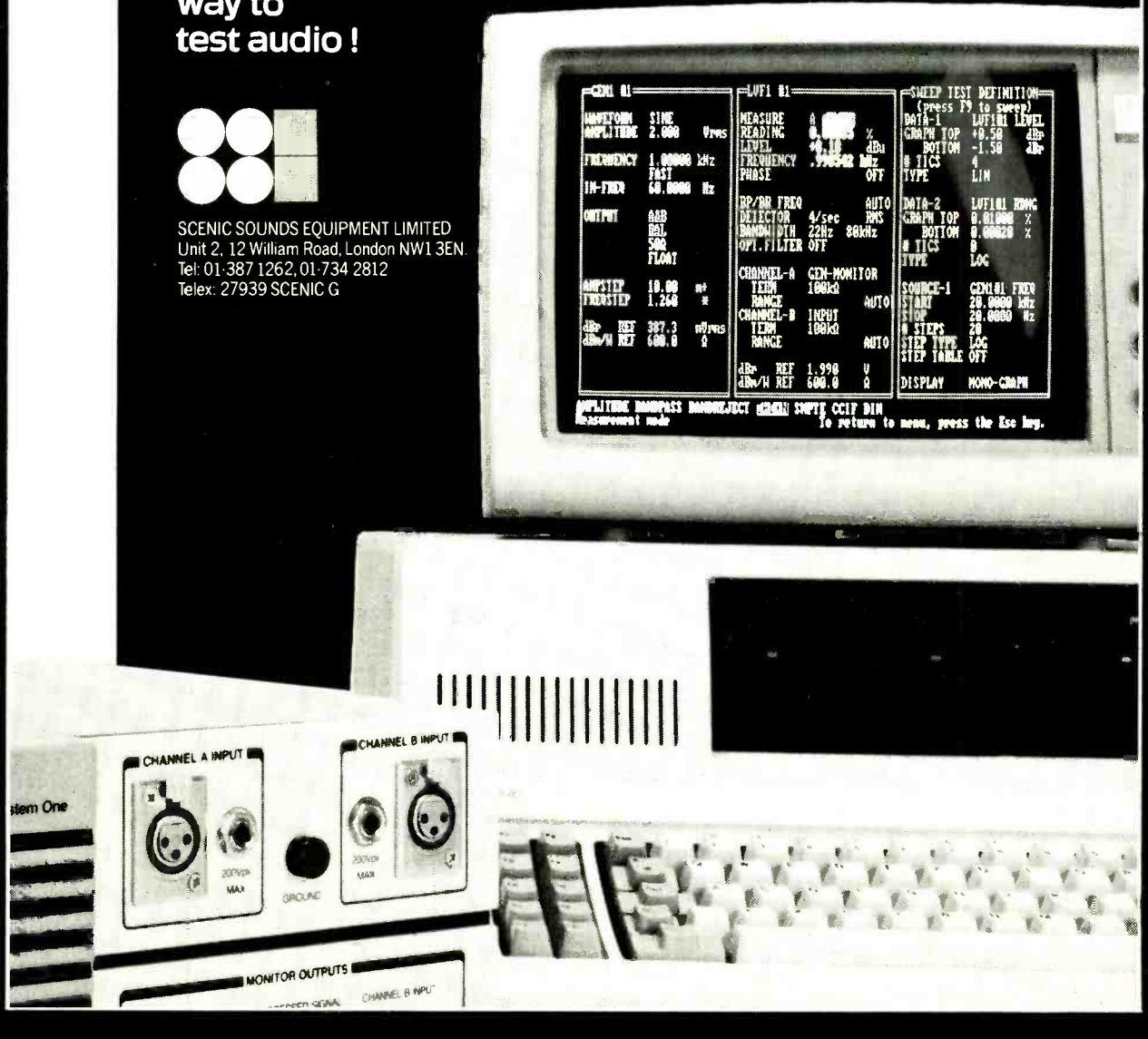


DIARY

People, events, services

New deal for SAJE

The SAJE *ULN* console which has until recently been exclusively handled by Shuttlesound in the UK will now be available solely from Stirling Audio. Having been approached by Andrew Stirling, Shuttlesound felt that this would provide a good outlet for SAJE studio products and the final arrangements were agreed with SAJE at the Montreux AES.

Shuttlesound continue to handle the SAJE *RACKY* broadcast range plus a new virtual live console, the *Memory*, which will be shown at the APRS show.

Agencies

- Shuttlesound has formally announced its split with the Sound Department. Shuttlesound continues to be the sole UK importers of E-V products and Rick Clarke will run the Sound Department from new premises at Unit 17, Sleaford Industrial Estate, Sleaford Street, London SW8.
- Stirling Audio Systems has been appointed exclusive marketing agent for all Valley People products in the UK. Stirling Audio has also been appointed exclusive UK agent for the Time Line *Lynx* synchronisers.
- Electronic Brokers Ltd has recently been appointed exclusive UK distributor for Grundig test and measurement equipment.
- Ronderdale Ltd, in an agreement with Kelsey Acoustics, is to manufacture and market the Psionic range of equipment. The *NG4 Mk II* has been re-engineered and will be known as the *NG1V*.
- Syco Systems has announced the availability in the UK of the *Midi-Mod* from Forte Music. The retrofit modifications will be done by Cristofori Pianoforti.
- George Massenburg Labs of Los Angeles has appointed Syco Systems as the UK representatives for the *Parametric Equaliser* and *Mic Preamp*.
- Cetec Gauss has announced the appointment of three new reps. Covering Texas, Oklahoma, Arkansas and Louisiana is Dimension 1X Corp, (Houston and Dallas); Pacific Northwest is covered by Gemini Electronics Marketing; Edmonds, WA and the Michigan area, Shalco of Ferndale.

IERE Conference

The Institution of Electronic and Radio Engineers' (IERE) 6th International Conference on Video, Audio and Data Recording was held at the University of Sussex, Brighton earlier this year. The event included a special tutorial day which proved very popular.

During the early part of the week (devoted to the tutorial, audio recording and digital) one of the main areas of interest was the development of vacuum coating techniques for pure metal and metal alloy tapes and disks. Some of this technology is already being used to create a new generation of magnetic tape and with the need for ever greater packing densities (a point made by Dr L Holt in his keynote address) this work will no doubt continue at an increasing rate.

Digital recording was another area covered in some depth and judging by the papers on digital television and broadcasting it doesn't appear that it will be too long before we see major changes in the broadcast world.

Peter Harris (CTS Studios) opened the digital sessions with a general overview from the studio point of view and W T Shelton (BBC Designs Dept) provided an interesting discourse on interfacing digital equipment. Perhaps one of the most interesting lectures as far as future development is concerned came from Y Shimpuku of Sony who gave some interesting background to the R-DAT (Rotary head-Digital Audio Tape) format including some experimental test results from the 16-bit *RD-80* consumer recorder.

Conference papers are available from the IERE, 99 Gower Street, London WC1E 6AZ, UK.

Audio-visual connectors

The British Standards Institute has published a new section (Part 3) to the *BS 5817 Audio-visual, video and television equipment and systems* document. No dimensional or electrical characteristics are dealt with in this standard which aims to ensure compatibility of connectors.

The new publication which is titled *Part 3 Specification for connectors for the interconnection of equipment in audio-visual systems* is identical to *IEC Publication 574-3:1983*. The specification relates to the following types of interconnection:

(1) by means of circular connectors—IEC Type 130-8 for audio systems.
(2) by means of circular connectors—IEC Type 130-9 for audio, audio-visual and video systems.
(3) by means of circular connectors—IEC Type 130-xx for audio systems.
(4) by means of coaxial connectors—IEC Type 169-2 for video systems.

Copies of *BS 5817: Part 3* may be obtained from the Sales Department, British Standards Institute, Linford Wood, Milton Keynes MK14 6LE. Price: £16.50 (£6.60 BSI subscribing members).

Forthcoming events

May 13 to 15 ShowTech 86, Berlin, West Germany.
June 25 to 27 APRS 86, Olympia 2, London, UK.
November 12 to 16 81st AES Convention, Los Angeles, USA.
November 19 to 22 14th Tonmeistertagung Munchen 86, Deutsche Museum, Munich, West Germany.

Tapeless recording

European distributor of *Synclavier*, Turnkey recently gave a 3-part introduction to the new *Synclavier* multitrack to disk recording system.

Based around the synthesiser-style keyboard of the *Synclavier* the new system is supported by a powerful *ABLE* high-speed computer developed by NED. Access time to any part of the music is almost immediate and editing is simply done at the touch of a button.

Recordings (through the keyboard and/or off mic) are made digitally and stored on high-speed Winchester type disks under computer control. With the information under software control previously impossible tasks such as simultaneously playing one track forward and another backwards is made relatively easy, as is editing. One interesting aspect of the system is the ability for example to go over a vocal track and correct out of tune notes electronically. It is even claimed that it is possible to adjust the dynamics or intonation of a note. Reconfiguring the multitrack to provide exactly what you require for a particular session is also possible.

For the London demonstrations a 4-channel system storing up to 5 min of data at 50 kHz with 16-bit resolution was used.

Initial specifications for the *Multi-Track-to-Disk* system include 110 dB signal to noise ratio (or greater); variable sampling rates—100 kHz, 50 kHz, 'stereo', 48 kHz or 44.1 kHz; greater than 18-bit A/D conversion; up to 16 channels (in 4-channel modules); no error correction techniques required; punch in, cross-fade splicing, SMPTE-base editing features and additional signal processing features achieved by routing signals out via the current polyphonic sampling voice cards.

Currently the *Multi-Track-to-Disk* system is only available as an option for the *Synclavier* but as of August 1986 it will be available as a stand alone system. Two *Synclavier* options are available, a 2/4-track system and a 4/8-track option. All provide 15 min recording time per track.

New England Digital Corporation, Box 546, White River Junction, VT 05001, USA. Tel: (802) 295-5800.
UK & Europe: Turnkey, Brent View Road, London NW9 7EL, UK. Tel: 01-202 4366.

Low-cost digital audio comes of age.

The Sony PCM series has now been available for several years. In this time recording and broadcast organisations, government, educational and industrial establishments, as well as individual users have all acknowledged the unique value of these units, and made them a new standard. It is the superlative quality of Sony PCM digital, coupled with extremely low cost that has brought about this professional acceptance of the range. This is borne out by the number of new ancilliary products from other manufacturers, that have further increased the flexibility and versatility of the range. Examples of these products are the 'CLUE' logging and editing system from HHB, as well as various interfaces which allow digital communication with the PCM 1610.

Sony has acknowledged that this acceptance by professional users necessitates a change of policy towards these products. Accordingly they have upgraded them from the domestic catalogue, and, realising the need for professional support and all that that entails, have appointed HHB as specialist dealers to represent them in the pro-audio market.

We are proud to announce this appointment, and happy to assure our customers of continued availability of the PCM range. The re-instatement of the PCM production line has been very largely due to pressure from end-users, who are after all the motivating force in the audio world. So if you are involved with audio recording and are still unfamiliar with Sony digital, then you owe it to yourself to call HHB – the No. 1 name in Digital Audio.

SONY® FROM HHB

HHB HIRE & SALES, UNIT F, NEW CRESCENT WORKS, NICOLL ROAD, LONDON NW10 9AX. TELEPHONE: 01-961 3295. TELEX: 923393.

THE SONY PCMF1 AND PCM701ES DIGITAL AUDIO PROCESSORS.

DIARY

People, events, services

Address changes

● Renkus-Heinz is moving a short distance to a much larger facility. Telex and telephone numbers will remain the same but the address is now 17191 Armstrong Avenue, Irvine, CA 92714, USA.

● The professional sales and hire company, ACT has new premises at 101 Grange Road, Guildford, Surrey GU2 6QD, UK. Tel: 0483 62932.

● Aerosonic Ltd has moved from the Mochdre Industrial Estate to Unit 9, St Giles Technology Park, Pool Road, Newtown, Powys SY16 3AJ, Wales. Tel: 0686 27355. Telex: 858893.

● K-Tek has purchased the entire rights to the M&A series *4* mixer kits and have moved to PO Box 172A, Surbiton, Surrey KT6 6HN, UK.

● Michael Sells has left Technical Projects Ltd to resume trading as MJS Electronics, Hill Cottage, Blythe Shute, Chale, Niton, Isle of Wight PO38 2HJ. Tel: 0983 730546.

Ted Fletcher leaves Alice

Having recently suffered a mild heart attack, Ted Fletcher, one of the founder members of the Windsor-based console manufacturer Alice is to take up a 'less strenuous' career with The Network Group.

The Network Group, which is a subsidiary of money brokers RP Martin supplies and installs communications equipment for banks and currency dealers. Much of the equipment has been designed and developed by Alice.

Ted Fletcher, who will be responsible for PTT-related product approvals and development will retain links with Alice as a consultant particularly in the development of digital control of audio systems.

Contracts

● Radio Nacionale de Espana SA has made the Aphex *Compellor* their standard compressor. Aphex has also completed sales of units to Turner Broadcasting, World Communications and Oceanic Cable in Hawaii.

Record breaking AES

The 80th AES convention in Montreux attracted 16% more manufacturers than the Hamburg convention and according to AES exhibition director Herman Wilms was larger in size and number of manufacturers than last year's Convention in New York. The convention drew nearly 4000 visitors, 10% more than Hamburg.

The conference sessions featured 60 papers, four of which had been specially invited for the occasion—an AES first. One of the papers, *Acoustics and Computer Science* was presented on video and discussed via an audio link across the Atlantic as the author, Prof Manfred Schroder of the University of Gottingen, was unable to leave his work at Bell Laboratories in New Jersey. The next European Convention will be held in London March 10 to 13, 1987.

Yellow 2 expansion

Additional recording capacity to meet increased demand from artists is one of the main reasons for Stockport-based Yellow 2 Studios acquiring Strawberry Studios. The studio which was formed in the early '70s by 10cc will continue to use the Strawberry name although it will become very much a part of the Yellow 2 group.

According to Nick Turnbull, head of Yellow 2 Studios, "It's taken time for us to convince record companies and musicians that there is life north of Watford but we have been gradually breaking the mould and establishing a firm reputation for quality recording at a very competitive price."

Yellow 2's expansion programme is set to continue with what is claimed to be the creation of the UK's first residential, fully-digital studio.

TLM 170 design

This article, published in the March 1986 issue, was based on a paper presented by Stephan Peus on the 73rd AES Convention 1983 in Eindhoven. The revised and modified text was translated by Stephen F Temmer.

Sony launch Inter-active Expert System at AES

With the growing problem of effective technical training and maintenance of increasingly sophisticated studio equipment Sony Broadcast were demonstrating an interesting solution on their stand at the Montreux AES.

Described as the *Inter-Active Expert System* Sony had chosen the *PCM-3324* digital recorder to show off the system's potential. Seven components are required for the complete system: *PCM-3324 Maintenance and Alignment Vol 1*, a touch screen TV monitor, laser disc player (Sony *LDP-180*), computer and disk drives, oscilloscope (Tek *2430*), IEEE 488 interface and of course the *3324*. The oscilloscope and IEEE interface are optional.

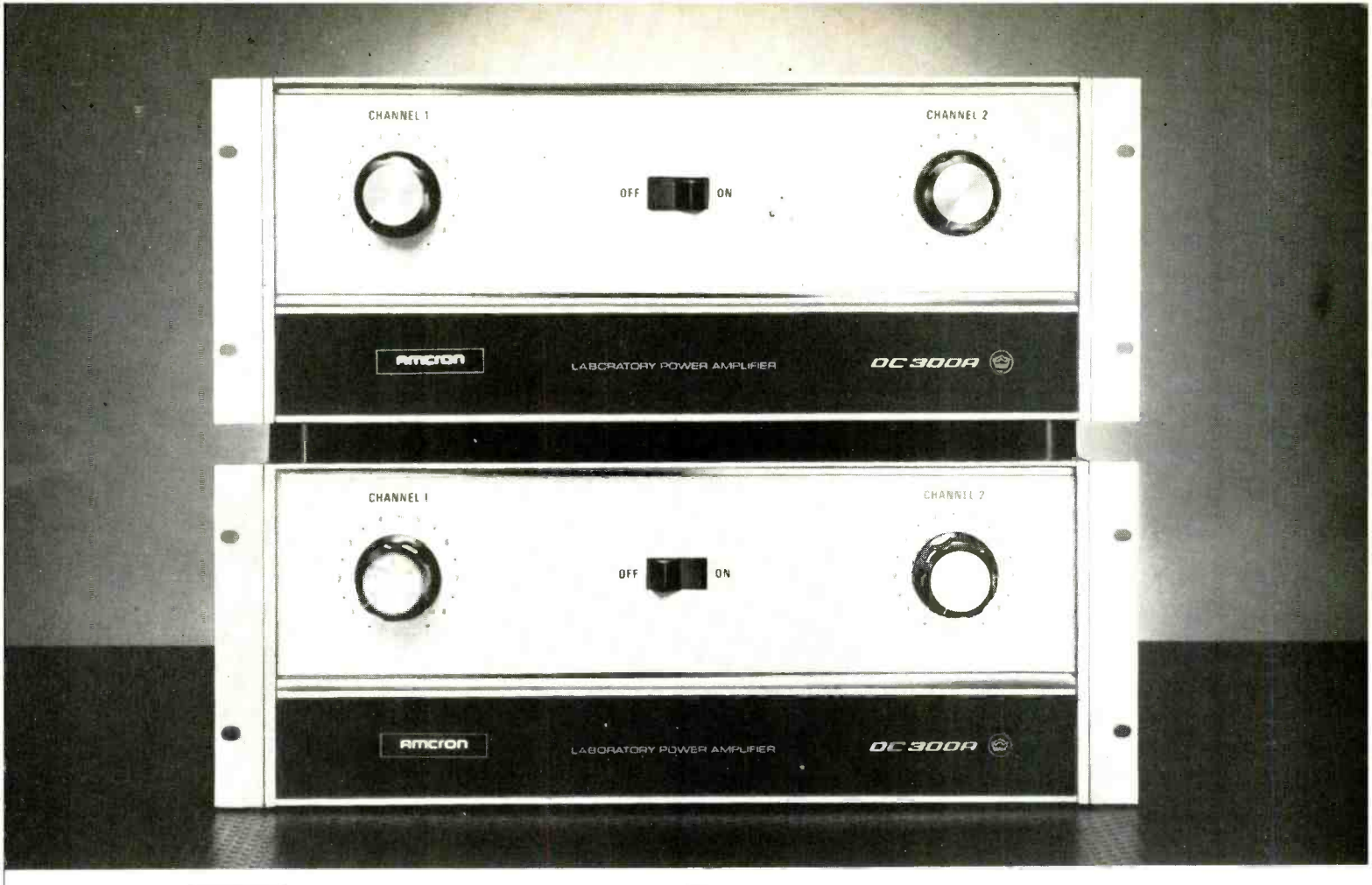
The basic *3324* 'manual' is packaged somewhat like a record album and contains the necessary computer disks and a 12 in laser disc. Instructions on how to connect and set up the system are provided on the sleeve after which the laser disc and the computer virtually take over. Two menus are offered, one containing all the *3324* pre-session checks and the other providing details of the 29 main recorder adjustments. There is no accompanying written manual or circuit diagrams: all the information you need is stored in the system and presented on-screen.

If for example the machine has developed a fault you will be asked a series of questions. Simply touching the monitor screen is all you need to do unless some form of measurement is required in which case the screen will display the relevant component board (a real video camera picture of the board not just computer graphics) with a visual indication of say the location of a trim pot that needs to be adjusted. When you have located the board the screen will display a close-up shot of the component and indicate suitable test points.

With the test points connected, using the complete system (Tek oscilloscope, etc) a reference waveform will automatically be displayed on the Tek. Adjustments are then made to match the measured waveform with the reference. If there is a certain degree of latitude the TV monitor will indicate the tolerances again visually on screen with real oscilloscope pictures not graphics. If it is impossible to match the two waveforms alternative tests will be suggested in order to locate the source and nature of the fault, the whole operation being guided by the TV monitor. In fact there is no need to operate the oscilloscope, the Tek *2430* is automatically set via the system—even if you fiddle with the oscilloscope controls during the test.

The strength of the system would appear to be its ability to provide accurate, unambiguous instructions (unlike a written manual which can be mis-read or misunderstood) whilst at the same time allowing less formally trained staff to feel confident in making what are essentially complex machine adjustments and diagnostic procedures. As recording equipment and systems grow in complexity the need for better training and maintenance is becoming more apparent. This kind of interactive solution points, perhaps, the way for the future. Further details from Sony Broadcast Ltd, Belgrave House, Basing View, Basingstoke, Hampshire RG21 2LA, UK. Tel: 0256 55011.

A paper, *Training of Tonmeisters and Audio Engineers* was given by L Strashun of Sony Broadcast at the 80th AES Convention, Montreux. This provides a basic outline on the expert system for the *3324*. □



This much power in this much amp.

The Amcron tradition of peerless performance was established with the introduction of the legendary DC300 series in 1967. Now, in 1985, on the back of modern technology and two decades of experience, Amcron bring you the Micro-Tech 1000 amplifier.

The Micro-Tech 1000 is the amp we've all been waiting for – lightweight, compact, and with more than enough punch to suit the increased power requirements of the digital age. These are the facts:

- ☐ 400 watts RMS per channel into 4 ohms.
- ☐ 500 watts RMS per channel into 2 ohms.
- ☐ 1000 watts RMS into 4 ohms – bridged mono.
- ☐ Safe operation at high power to 1 ohm.
- ☐ Reversible forced-air cooling.
- ☐ Amcron performance in 3½" rack space.

We believe that these facts, coupled with Amcron's reputation speak for themselves. But if you wish to know more about the Micro-Tech 1000 and how it can solve your headroom problems, call HHB Hire & Sales at: Unit F, New Crescent Works, Nicoll Rd, London NW10 9AX. Tel: 01-961 3295. Telex: 923393.

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NEW PRODUCTS

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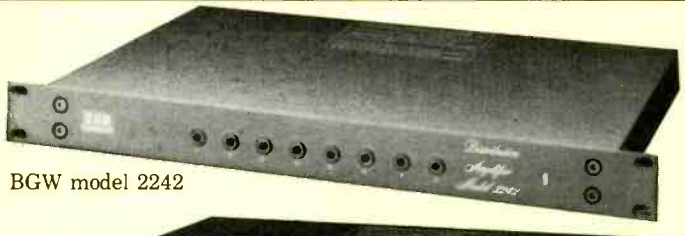


BGW model 2242

BGW model 750E

BGW amplifiers

BGW has introduced the third generation of *750* series professional power amplifiers. The new *750*s are claimed to be 7 dB quieter, with 4 dB more gain and five times greater bandwidth. Other improvements include greater sonic accuracy, designed to handle 2 Ω loads, improved long term reliability, reduced weight and improved serviceability. Two models are available, the *750E* and the *750D* the latter being identical except for the substitution of modulation and true loss of feedback clipping indicators for the display.

Also new is BGW's first distribution amplifier, the model *2242*. The 2-channel amplifier is 1 U high and features eight discrete output stages (one input/four outputs). Inputs and outputs can be balanced or unbalanced. The unit is claimed to have very low noise (−88 dBm), ultra high damping factor (4000) and very low distortion (less than 0.01%, 1 V RMS into 600 Ω 20 Hz to 20 kHz). Output is +27 dBm (+27 dBu into 15 Ω, +10 dBu into 50 Ω). Individual gain controls for each output is provided.

BGW Systems, 13130 South Yukon Avenue, Hawthorne, CA 90250, USA. Tel: (213) 973-8090.

Yamaha MZ microphones

Yamaha has developed a range of professional microphones for vocal and instrument use. Three vocal microphones, *MZ101, MZ102Be, MZ103Be* are being released along with a general purpose instrument microphone *MZ104* and the *MZ105Be* which has been designed specifically for use with drums and percussion instruments. All the microphones are dynamic types with the designation 'Be' indicating the use of Yamaha's beryllium diaphragm rather than a 2-layer polyester film.

The *MZ104* has a frequency response of 30 Hz to 17 kHz and the *MZ101* vocal microphone a response of 40 Hz to 17 kHz, this being extended to 18 kHz with the 3-layer laminated beryllium models (*MZ102Be* and *MZ103Be*) and the 2-layer instrumental version (*MZ105Be*).

All the microphones in the series are unidirectional, balanced (250 Ω) and feature diecast zinc bodies with wire-mesh windshields.

Yamaha Nippon Gakki Co. Ltd, Hamamatsu, Japan.
UK: Yamaha-Kemble Music (UK) Ltd, Mount Avenue, Bletchley, Milton Keynes, MK1 1JE. Tel: 0908 71771.
USA: Yamaha International Corp, PO Box 6600, Beuna Park, CA 90620. Tel: (714) 522-9105.

ARC Audio interfaces

ARC Audio, a division of Audio FX Ltd, has developed a number of special interfaces for Sony digital multitrack users.

The *AR 1000* provides tach and direction information between the Sony *3324* and any SSL console. The logic within the unit is powered by the tape machine and with the addition of an external (or optional internal) 24 V power supply the transport lamps on the control buttons can be illuminated.

The *AR 2000* provides all the above features including (1) remote control of the 24 digital tracks from the SSL (or any other switch closures); (2) as above but with both front panel and/or remote control from the console for both timecode and analogue tracks and (3) front panel control of master safe, all inputs and repro switching and a true auto Line In function.

The *AR 2000* is microprocessor based which means the Sony can also be controlled by a synchroniser and be operated at the deck itself. Two special functions keys are provided for the operation of custom software.

Other products include the *AR I-O* (Input/Output) interface providing digital transfer between multitrack and *1610* or *1630* or vice versa; *AR MI* multitrack PPM display fed to video monitor and *AR MS* a 32×32 cross point switching unit.

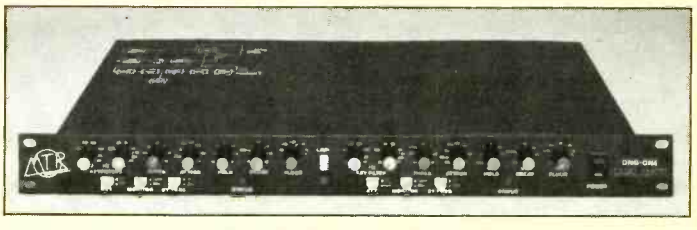
ARC Audio, 15 Elizabeth Mews, London NW3 4UH, UK. Tel: 01-586 9592.

Bel BDE series processors

Bel Electronics has introduced two new digital delay processors—the *BDE2400* and the *BDE3200*. The *BDE2400* provides 6 s of delay (18 kHz bandwidth) expandable to 24 s with optional memory cards and the *BDE3200* provides 8 s of delay (15 kHz bandwidth) again expandable with optional memory cards in this case to 32 s. The *BDE* series units are programmable processors with optional disk storage (separate 19 in rack unit) and remote control.

Sounds can be sampled individually, edited, reassembled, reversed, sequenced and pitch shifted at will. In all there are 99 program delay settings, 10 non-volatile. Samples can also be played on a MIDI keyboard and saved to disk.

UK: Studio Equipment Distribution, 29 Guildford Street, Luton, Beds LU1 2NQ. Tel: (0582) 452495.
USA: MCI Intertek Inc, 245 109th Street, Arlington, TX 76011. Tel: (817) 640-6447.
Export: Musimex, 46a Marlborough Road, London, N22 4NN, UK. Tel: 01-881 6060.



MTR DNG-ONE dual gate

The MTR *DNG-ONE* is a rack-mounted, dual channel noise gate intended for both PA and studio applications. It features internal/external triggering, variable high and low filters (25 Hz to 3.6 kHz and 200 Hz to 34 kHz), a 10 μs to 200 ms attack time, Hold from 350 ms to 14 s, Decay (10 ms to 32 s) and adjustable Floor from −70 dB to −1 dB for inclusion of natural ambience. The unit has provision for stereo linking to enable auto-panning, auto-fading as well as master mix gating.

MTR Ltd, Ford House, 58 Cross Road, Bushey, Herts WD1 4DQ, UK. Tel: 0923 34050.

Studer 961/962 Small Wonder

It's a wonder how a console so small can do so much... and sound so good!

The Swiss have a special talent for making great things small. A case in point: the new 961/962 Series mixers from Studer. In video editing suites, EFP vans, remote recording, and radio production, these compact Studers are setting higher standards for quality audio.

Sonic performance is impeccable throughout, with noise and distortion figures well under what you'd need for state-of-the-art digital recording. By refining and miniaturising circuits developed for our 900 Series production consoles, Studer engineers have squeezed a world-class performance into suitcase size.

The 961/962 Series is fully modular, so you can mix-and-match modules to meet your requirements. The 961/962 features stereo line level input modules with or without 3-band EQ, plus mono mic/line inputs and master module with compressor/limiter. Other choices include a variety of monitor, talkback, auxiliary, and communication functions. The 961 frame holds up to 14 modules, the 962 accepts up to 20.

Other new features in the 961/962 Series include improved extruded guide faders, balanced insert points, FET switching, electronic muting, Littlite® socket, and multi-frequency oscillator.

Thanks to its light weight, DC converter option, and sturdy transport cover, you can put a 961/962 mixer on the job anywhere. And, with Studer ruggedness and reliability, you can be sure the job will get done when you get there.

Packed with performance and features, 961/962 consoles will surely make a big splash in audio production circles. Small wonder. Call your nearest Studer representative for more details.

With the optional flight case it is road ready in seconds

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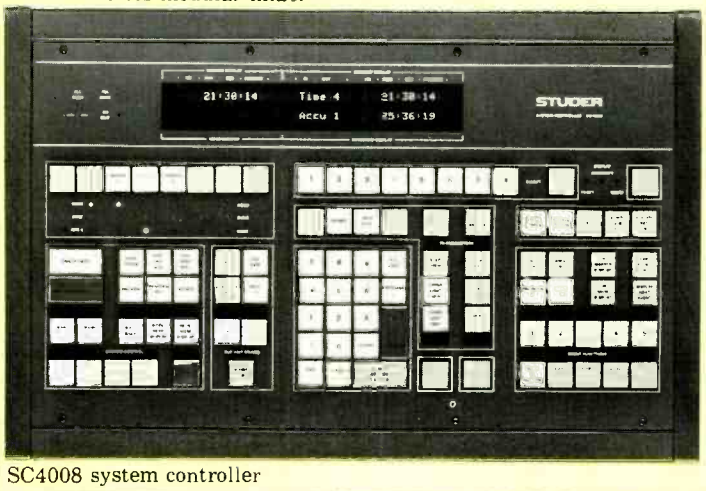
NEW PRODUCTS

NEW PRODUCTS

Equipment, modifications, options, software

961/962 series modular mixer



SC4008 system controller

A807 3-speed tape machine

Studer tape machines and consoles

Studer has announced two new analogue tape machines and various other tape machine options. The *A812* is an all new compact broadcast recorder designed for a wide variety of applications in broadcast, video post production and general recording studio use. It is available in all common ¼ in formats including 2-track with centre timecode. The new tape transport is based on a rugged diecast chassis which will accommodate reel sizes up to 12½ in. Microprocessor control, auto alignment, phase compensated audio electronics and up to four tape speeds are some of the features. Also of interest is the 19 in overall width which makes the *A812* suitable for rack-mounting.

The new *A807* has been designed for a wide range of broadcast applications. Although essentially a low cost machine it features three tape speeds, auto alignment, phase compensation and is available in a number of professional ¼ in formats. The machine can handle reels up to 11.1 in and is being made in portable form (with mic inputs and phantom powering), 19 in rack-mount version or console mounted options.

New options announced include ½ in stereo (*A820-2-1/2*) and ¼ in stereo with centre track SMPTE (*A820-TC*) versions of the *A820*. Also new is the *A810-2 TC/FM/NEO VUK*, a 2-track film dubbing version of the *A810* and the *A810-APV*, a special timecode machine equipped with a second reproduce head and an extended tape path providing a prelistening signal that corresponds to the tape speed and the film format for controlling a luminous countdown bar.

Also available are the new Studer system controllers.

Studer's latest line of compact mixing consoles is designed for video, radio production and location recording. The *961/962* series is a modular design easily configured to specific customer needs. The *961* frame accepts up to 14 30 mm modules, the *962* accepts up to 20. Features of the new consoles include improved faders, click-free muting, FET switching, peak LED indicators on each input, electronically balanced insert points, new proprietary mic inputs and stereo line level with or without 3-band graphic. Also included are PDM (Pulse Duration Modulation) comp/lims on the Master Input modules.

According to Studer the series *963* has been designed for use in locations where space is at a premium such as OB vans, theatre sound reinforcement and post production studios. The base frame can accommodate 12 30 mm modules. Combining base frames provides consoles with 16 or 28 inputs and up to 12 outputs (eight groups/four masters). Larger consoles are possible and five frames can provide 40 inputs, 40 direct outputs, eight groups, four masters, four auxiliary masters in addition to monitoring and injection path and a bantam jack for all insertion points. The *963* uses expanded *961/962* modules in the base frame.

Studer International AG, Althardstrasse 10, CH-8105 Regensdorf, Switzerland. Tel: 01/840 29 60.
UK: FWO Bauch Ltd, 49 Theobald Street, Boreham Wood, Herts WD6 4RZ. Tel: 01-953 0091.
USA: Studer Revox America Inc, 1425 Elm Hill Pike, Nashville TN37210. Tel: (615) 254-5651.

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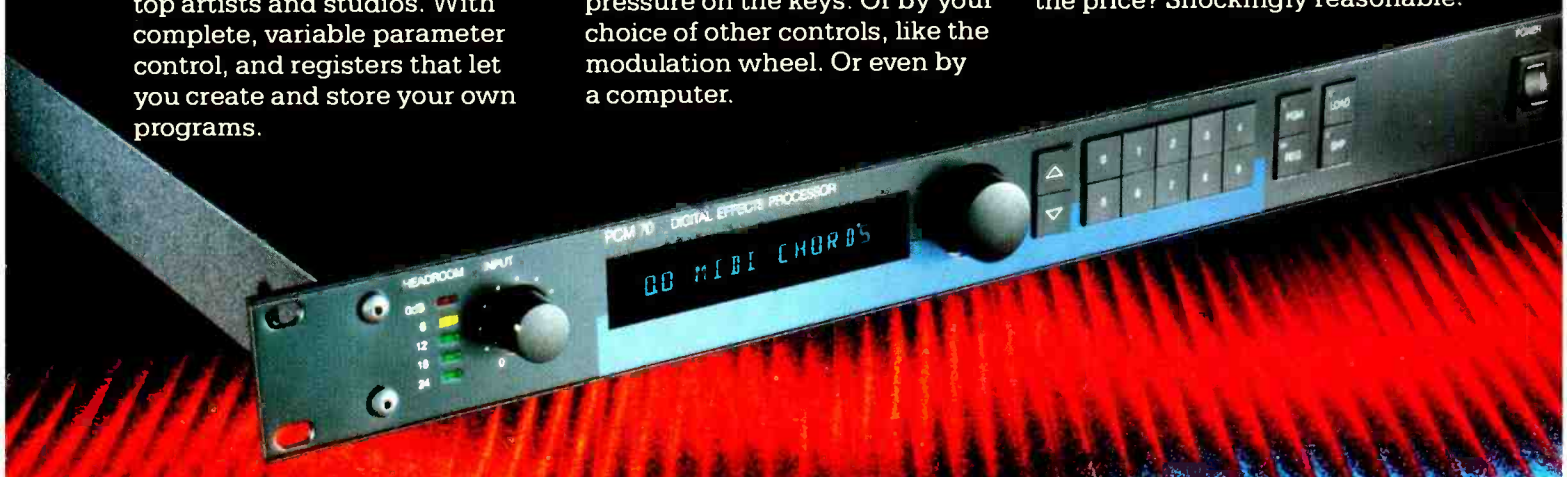

You'll want our detailed PCM 70 brochure. At your Lexicon dealer, or contact us. Lexicon Inc., 60 Turner Street, Waltham, MA 02154, USA. (617) 891-6790. Telex: 923468. Lexicon International, P.O. Box 122, 8105 Regensdorf, Switzerland. Telex: 59222.

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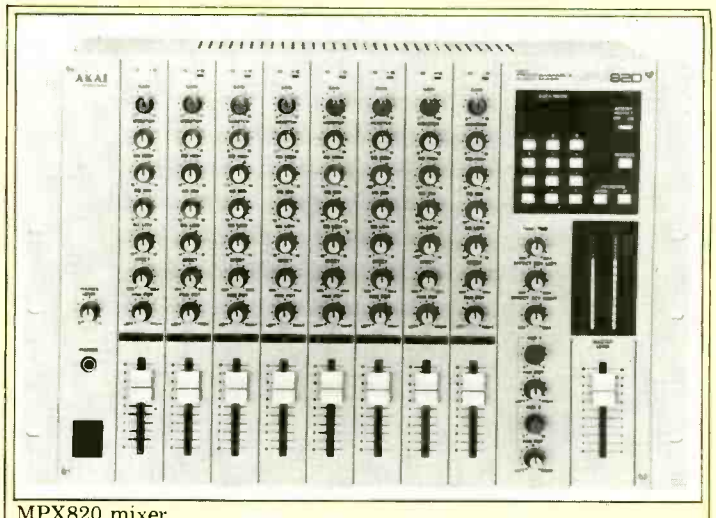


MPX820 mixer

Akai studio products

Akai has recently launched a number of new products some of which will be of interest to studios. The Akai *S900* is a 3 U high 8-voice polyphonic digital sampler. It uses 12-bit technology, includes a built-in 1 Mbyte 3.5 in disk drive, and in addition to the polyphonic feature can be used to sample eight individual mono voices.

Sampling times are 12 s (20 Hz to 16 kHz), 24 s up to 8 kHz and 48 s up to 4 kHz. Editing features include One Shot, Looping, Alternating with ADSR/Loudness, Velocity, Crossfade, Positional Crossfade, Attack Pitch offset, LFO, Filter and Sample Merge. Additional hardware and software options will enable the S900 to be used as a percussion controller, short-period digital recorder and/or harmonic generator.

The Akai *MPX820* is an 8-channel, rack-mounted fully programmable mixer complete with MIDI compatibility and SMPTE timecode options. Up to 99 front panel settings can be stored internally or down loaded to tape or personal computer. Levels, fades (40 ms to 15 s), pans, 3-band EQ, sends, returns, aux inputs and multiple effect loops can all be logged and called up at the touch of a button or as part of a MIDI sequence. According to the manufacturer the audio signal passes through fewer Op-amps than in a traditional mixer with the proprietary VCAs introducing the theoretical minimal levels of noise, distortion and CV feed through.

Other new products include the *GX912* cassette deck and the *MG14D* 14-track on ½ in cassette recorder which includes SMPTE and MIDI interface and *ML14* autolocator. All are rack mountable, the cassette recorder being 2 U high, the multitrack 5 U and the autolocator 3 U high.

UK: Akai (UK) Ltd, Haslemere Heathrow Estate, Silver Jubilee Way, Parkway, Hounslow, Middx TW4 6NF. Tel: 01-897 6388.

USA: Akai America Ltd, 800 W Artesia Boulevard, PO Box 6010, Compton, CA 90220. Tel: (213) 537-3880.

S900 polyphonic sampler

NEW PRODUCTS

NEW PRODUCTS

In brief

Electro-Voice has developed a new low frequency live sound speaker system. The *Thunderbolt (MTL-4)* uses four 18 in woofers and is the subject of several patent applications. Using what E-V describe as Manifold Technology, the new design is claimed to increase low frequency efficiency and reduce distortion. Performance specifications show an efficiency of nearly 20% over the range 40 to 250 Hz. Each enclosure has a long term power rating of 1600 W and is claimed to have a peak power rating of 6400 W providing sound pressure levels of 133 dB at 2 m and nearly 140 dB on peaks. A 20 kW low frequency system can be stored in a 5 ft length of standard truck floor. . . Ros Software has introduced the *Time Counter* a software-based system allowing the *Apple II* series computer to act as a timecode reader 10-point event controller and timecode locked frequency generator. The software requires at least 64k of memory and is available direct from Ros Software, PO Box 7321, New York, NY 10117, USA. Tel: (212) 594-6573. . . Sony has developed a cost effective synchroniser, the *BVR-90* for linking two tape transports together—one audio and one video providing the material in use has a timecode relationship. This eliminates a special interface between editor and synchroniser and provides a 'single' source for both audio and video signals when connected to a Sony editor. . . Ranson Audio has re-released the *SAE 5000A* impulse noise reduction system for eliminating 'pops' and 'clicks' from for example archival disc recordings. A high quality power supply has been added for maximum reliability and minimum external field. The unit is 1 U high and includes Sensitivity, Mono, Bypass and Invert controls. Ranson Audio Ltd, 2 Springbridge Mews, London W5 2AB, Tel: 01-567 7470.

IMS ADA-1000 converter

Integrated Media Systems has introduced the *ADA-1000* Laboratory Reference A/D-D/A converter system for digital audio recording and signal processing applications. The self-contained system can provide up to four channels of conversion in one 5¼ in rack cabinet including power supply and is fully compatible with AES/SMPTE/EBU/ANSI recommended practice.

Features include linear phase filters, multiple emphasis and clipping characteristic selection, real-time input monitoring, true 16-bit dynamic range, smooth noise floor and flat frequency response. The unit can be ordered with one of the following interfaces: AES/SMPTE, Sony *1610* or parallel port.

Modified *ADA-1000*s are being supplied on a OEM basis to the Droid Works for use in the *SoundDroid*.

Integrated Media Systems Inc, 1552 Laurel Street, San Carlos, CA 94070, USA. Tel: (415) 592-8055.

Ampex 467 digital audio cassette

Ampex has announced the introduction of *467* digital audio cassettes for PCM U-matic converters. The tape is claimed to be free of uncorrectable signal errors and Ampex PCM qualification specifies that there are zero occurrences of error concealment (uncorrectable errors) with each cassette.

The new tape features a special binder system to withstand repeated plays and subsequent error build-up and an anti-static cassette shell to prevent static attraction of contaminants.

Ampex Corp, 401 Broadway, Redwood City, CA 94063-3199, USA. Tel: (415) 367-3888.

UK: Ampex (Great Britain) Ltd, Magnetic Tape Division, Acre Road, Reading RG2 0QR. Tel: 0734 875200.□

MUSIC PAGE

MUSIC PAGE

Mark Jenkins on synthesis for the studio

Yamaha DX-27/DX-100

Based on the recently introduced *DX-21* the *DX-27* and *DX-100* FM synthesisers have almost identical specifications, the *DX-27* having five octaves of standard keys and the *DX-100* four octaves of miniature keys plus performance controls positioned for 'round-the-neck' use.

Each synthesiser has eight voices based on four FM operators. There are 192 preset voices and 24 programmable memories to store new sounds or modified versions of preset sounds. Pitch Bend, Modulation and Breath control effects are programmable and the synthesisers respond to velocity and pressure from MIDI In only. Sound storage is to cassette and full MIDI facilities are available; sound editing is through an LCD display.

Footswitch facilities expand the user's control over the synthesisers even if they are being played from external mother keyboards. The *DX-100* can be battery powered and both instruments feature a headphone socket.

Assessment

The *DX-21/27/100* voice is slightly less flexible than that of the industry standard *DX-7*, having (like the discontinued *DX-9*) only four FM operators but it retains the typical clarity of FM synthesis and contrasts markedly with the quality of sound from other keyboards which are superficially similar.

As a regular keyboard the *DX-27* is very useful, although the loss of key split as compared to the *DX-21* is unfortunate. However, the compact size and incredible price of the *DX-100* make it highly attractive as a velocity and pressure-sensitive expander unit, so it can be very heartily recommended as an entry into or extension of any studio's FM armoury.

UK: Yamaha-Kemble Music (UK) Ltd, Mount Avenue, Bletchley, Milton Keynes MK1 1JE. Tel: 0908 71771.
USA: Yamaha International Corp, PO Box 6600, Buena Park, CA 90622. Tel: (714) 522-9105.
Canada: Yamaha Canada Music Ltd, 135 Milner Avenue, Scarborough, Ontario M1S 3R1.

Sequential Prophet VS

The *Prophet VS* is a 'Digital Vector Synthesizer', with each of its eight voices composed of up to four oscillators. Each oscillator has 128 complex waveforms including white noise available, and the balance between oscillators can be controlled with a joystick. The resulting waveforms can be stored internally or on cartridge; 5-stage envelopes control the oscillator mix, filters and amplitude.

Real-time control is available over stereo panning, oscillator mixing, chorusing and parameter access. Sounds can be programmably split or stacked and the 61-key keyboard is velocity and pressure sensitive.

Voices may be placed in the stereo field relative to key velocity and position, and waveform data can be transmitted via MIDI. A powerful arpeggiator offers polyphonic voicing, rests and layering, and the *VS* is bi-timbric, supporting complex MIDI 'overflow' modes allowing another synthesiser to add to the eight voices of the *VS*.

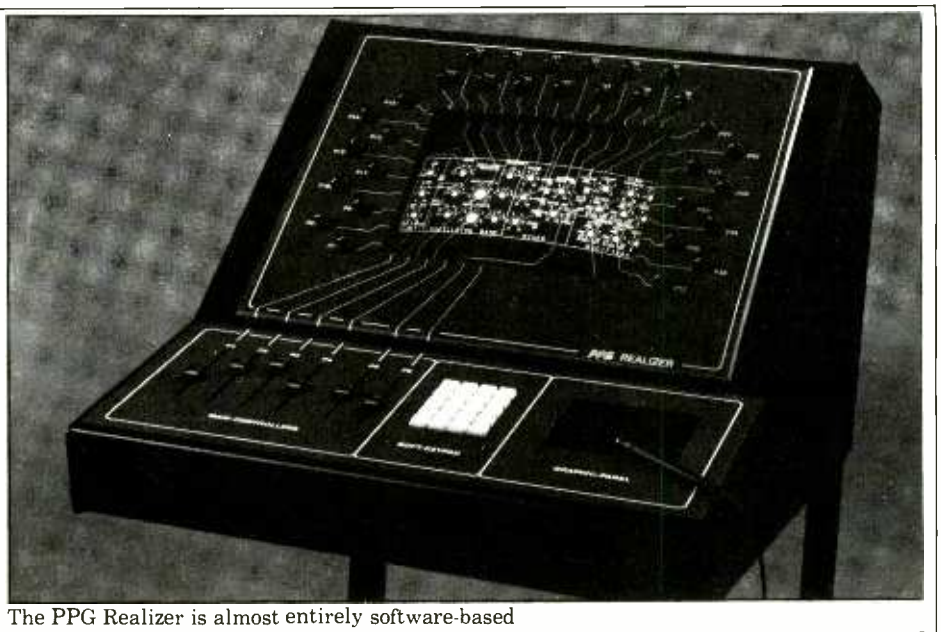
Assessment

The PPG *Wave* keyboards are one obvious point of comparison for the *VS* sounds. Although the *VS* does not use the same *Wavetable* sound system, it does offer many of the same sharp, metallic, 'digital' sounds. Sequential's philosophy is to provide a complete sound package with the *2000/2002* samplers and *VS* synthesiser, each offering sounds denied to conventional analogue synthesisers or even to the Yamaha FM keyboards. Thanks to its unique sounds and spatial effects, the *VS* could well become a highly popular studio instrument.

SCI, 3051 North 1st St, San Jose, CA 95134-2093, USA. Tel: (408) 946-5240.
UK: SCI, 11 Forth Wynd, Links View Estate, Port Seton, East Lothian, Scotland. Tel: 0875 813815.
Europe: SCI, Postbus 16, 3640 AA Mijdrecht, Netherlands. Tel: 2979 6211.

PPG Realizer

The most impressive event of the Frankful Fair was the debut of the PPG *Realizer*. Wolfgang Palm's system is almost entirely software-based, using a screen surrounded by 'soft' controls (the functions of which change according to the software displayed) and a rack-mounting section containing a hard disk unit (HDU) and eight signal processors.



The PPG Realizer is almost entirely software-based

The standard Texas Instruments processors are able to modify sound in almost any way depending on the software used for their *68000* control processor. One possible sound source could be sampled sounds from the HDU; this allows recording of 12 min of monophonic sound with over 16 kHz response, or 6 min in stereo, or 3 min in quad.

One software page simulates the control panel of a *MiniMoog*, the control knobs taking on the familiar functions of filter cut-off, oscillator, pitch, etc. This page allows the creation of analogue synthesiser sounds. Another page simulates an FM synthesiser with three operators to create Yamaha *'DX*-like' sounds. As yet uncompleted is a Wave page for PPG *Wavetable* sounds.

The Record page allows multitracking of four sounds along with 16 channels of MIDI information which can go to external synthesisers. Control can be from PPG's weighted PRK keyboard and other software pages will provide reverb, echo, harmonisation, reverse and other effects.

Up to four disk/processor units can be used for a total of 32 voices and the hard disc basis of the *Realizer* makes it possible for sampled sounds to be speeded up without pitch change, or changed in pitch without speeding up. Delivery is due in September 1986, with a UK price of approximately £30,000 for the 8-voice version.

PPG Musiccomputersysteme, Wandbeckerzollstrasse 87-89, D-2000 Hamburg 70, West Germany. Tel: 40 68 22 75.
UK: Turnkey, Brent View Road, London NW9 6EL. Tel: 01-202 4366.□

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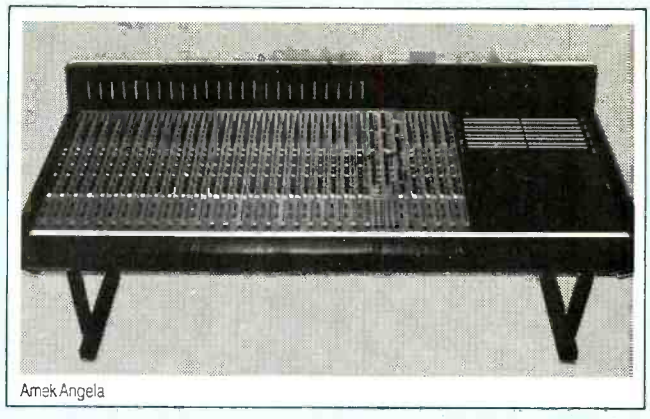

Amek Angela

The Amek Angela must be now nearly as well known as the MTR90. The attributes of the Angela are many and varied, but those most commonly-quoted are the highly musical eq section and general transparency of sound, the incredible flexibility of operation and the very high standard of mechanical construction.

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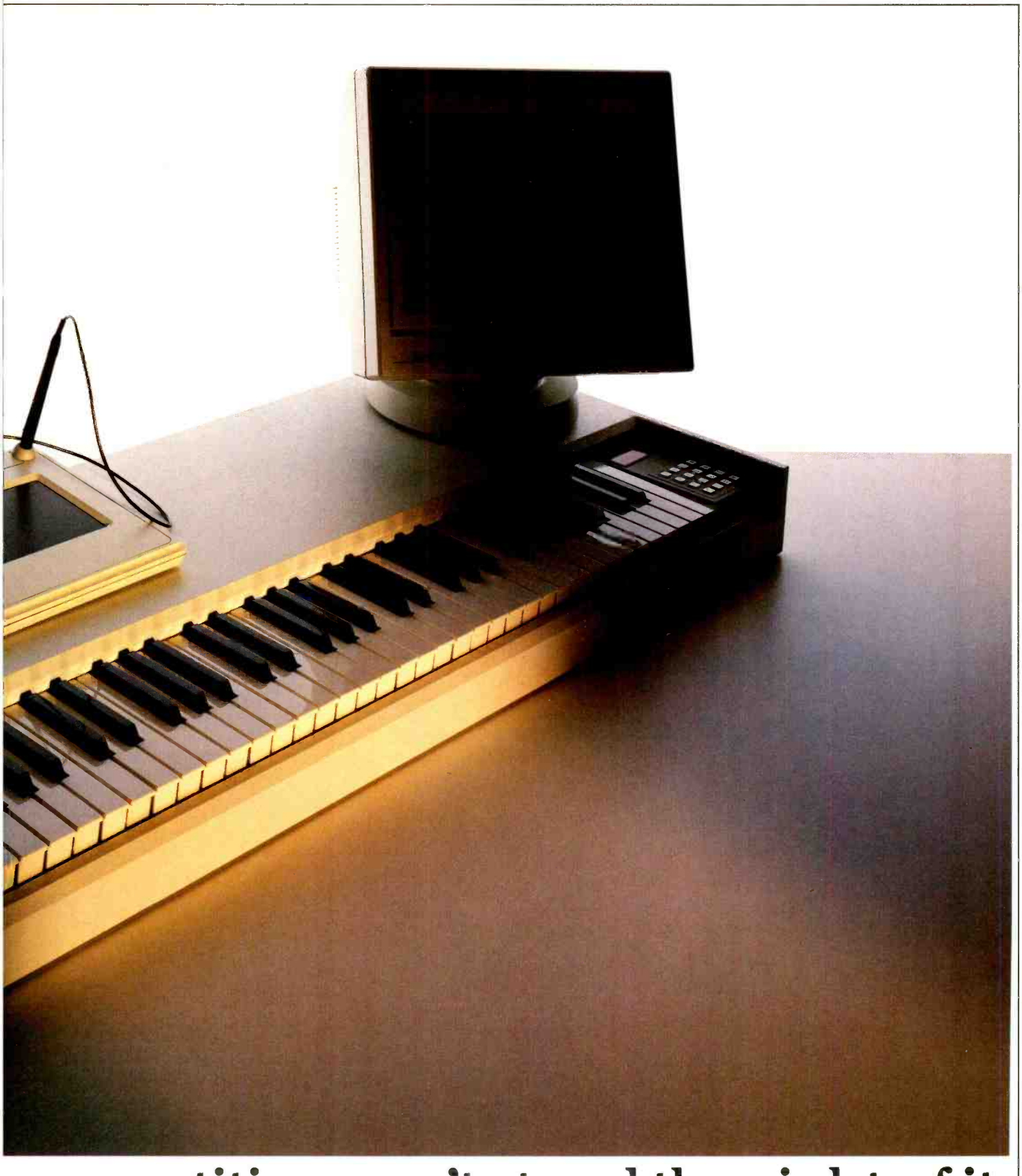

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DESIGN: TOWNHOUSE FOUR

Virgin's Townhouse studio complex, in London is an impressive building, its exterior painted with an imaginary facade which fools the eye into thinking it's real. Inside the building are four studios, the latest—Townhouse Four—having been conceived by Japanese studio designer Sam Toyashima. Townhouse Four is the first studio in the UK to be completely designed by Sam, although he is responsible for the control room at Genesis' studio and for the re-designed Park Gates facility. Richard Elen spoke to Townhouse's chief engineer, Alan Douglas, and to Dave Hawkins of Acoustical Construction Services, about the work that went into the new room

Townhouse Four was completed in August. Says chief engineer Alan Douglas: "It took some time: the interior was completed relatively quickly but a great deal of work had to be done on the structure of the building itself. It was originally a builders' yard, and we had to remove the interior—and having done that, we found that the exterior was likely to fall down! We had to pull it down and sink new foundations. As a result, the studio opened a year later than we had originally intended."

It has a distinctive appearance, with a predominantly blue fabric finish to the wall-coverings, interspersed with French Chestnut panelling and floors of Danish Ash. Dominating the spacious control room is a large SSL *4000* series console, with an extensive outboard equipment rack to its left. A long low alcove on the left of the control room houses the pair of *A800* multitrack machines, while the rear of the room has plenty of comfortable seating for clients. The wide window into the studio proper features triple-glazing—each sheet of glass in a different plane—in three angled sections.

The studio itself is equally impressive and two features immediately attract the eye: a tiered polygonal recess in the centre of the ceiling, and novel rotating acoustic treatment panels on the walls and ceiling, with a flat, absorbent surface one side, and a cylindrical, wood-panelled reflective finish on the rest. These cylinders can be rotated to change their acoustic characteristics by exposing as much of the reflective surface as desired, manually in the case of the wall-mounted units and by motorised drive systems for the ceiling.

The room is finished off by two recording areas adjacent to the main part of the room, one of which is a piano booth, live towards the open side of the piano, which can be screened off by use of a sliding wall of screens, running along a track in the ceiling. Lighting control is by switches actuating remote motor-driven rheostats.

The construction of the interior was remarkably fast, considering the problems of implementing an entirely new studio design. Says Alan, "Nobody in this country had ever made anything like this to such specifications. The whole dividing wall between studio and control room, for example, is three separately-suspended walls, all isolated from each other and the mechanics of hanging that were really complex."

Dave Hawkins and his team were responsible for implementing Sam Toyashima's design—"They were really great", says Alan—but the main problems concerned the shell of the studio. "It had to be properly isolated from the rest of the building, and we had to consider the roof lines and things like that."

A conspicuous aspect of Sam's design is the attention to detail. The rotating cylinders in the studio—an important part of the overall concept—were very complex to produce. They had to be just right and in just the right places. "We went to Japan to look at studios," said Alan, "and to listen. Most of Sam's rooms are out there, and the detail in the Japanese rooms is simply stunning. You don't think of it in terms of how much grief it's going to be to build—we just saw the rotating cylinders, for instance, and said, 'we'll have them'."

The curved parts of the cylinders are built up from individual, wafer-thin wood layers, cemented together and wrapped round the frame. The interior is filled with Rockwool. "Obviously, rotating one panel on its own makes little difference," Alan notes, "but if you rotate several, or alternate them, you can really hear the change in the acoustics." The ones in the ceiling are even more complex, each group having a motorised drive.

One part of the room, the piano booth, can be isolated with sliding screens. "They use this amazing system in Japan, and we used it to isolate this end of the studio," Alan continues. "They look like a thinner version of normal AK screens, and they concertina into a space in the wall. You just pull it out, on a track." Here again, there's the attention to detail: a rubber track guides the screens along the floor. When they are in position, you simply step on this track and it locks the screens into position.

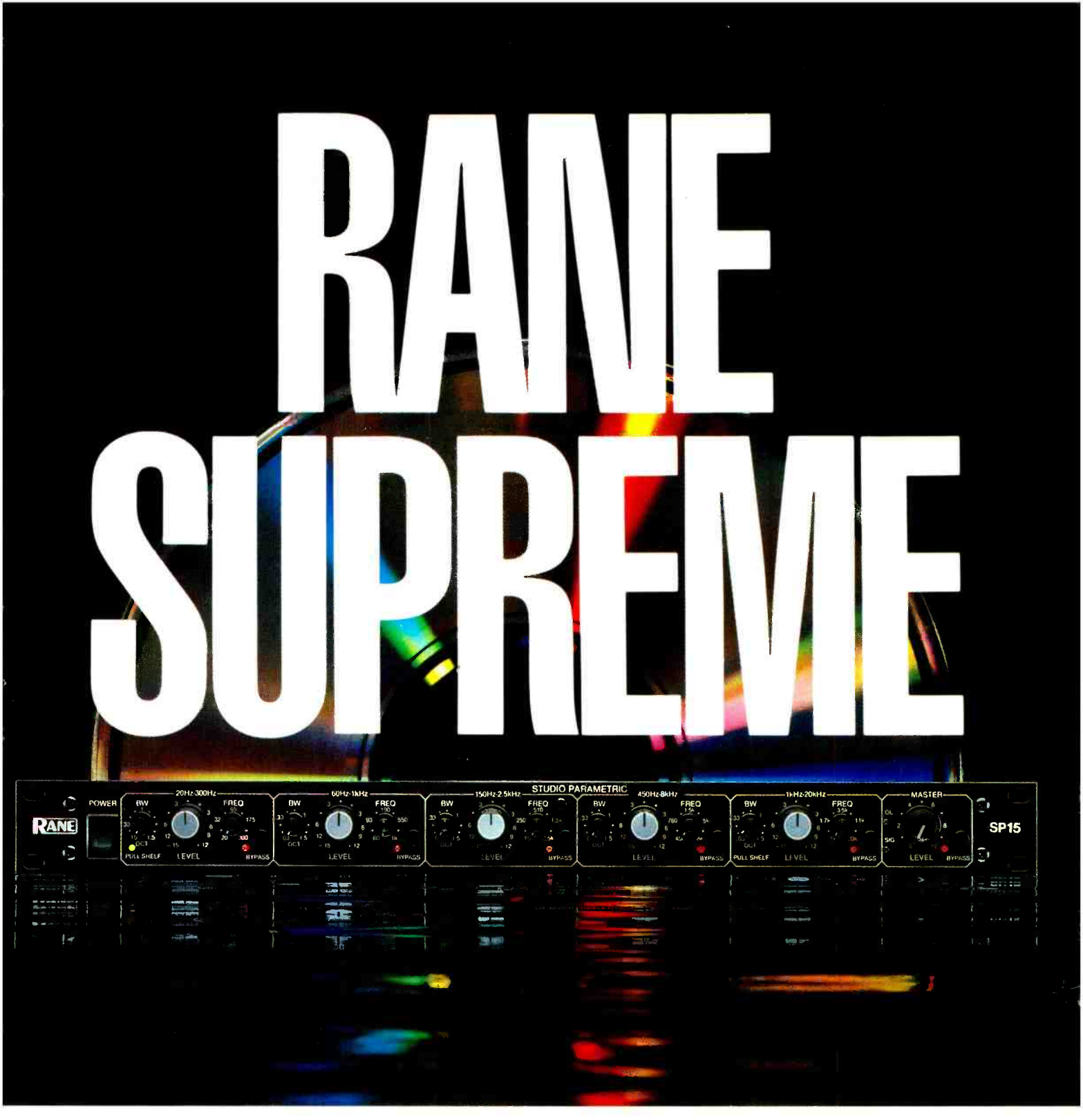
"That attention to detail, which characterises the Japanese rooms we saw, made the building of this room far more complicated than any other studio we've done. They must have craftsmen carpenters, for instance, who'll work all the hours God sends—and it's difficult to find people like that in this country. We were lucky to have Terry who works with Dave Hawkins. He's really good.

"Getting the right people had begun to worry us: the more we went into the design in detail, the more complex it began to look and we began to wonder if it was possible to do it. But they did a great job. Acoustically, we knew the design was good, that it would work. I was never worried about the performance: just about how it would end up looking. But in the end, it surpassed all our expectations."

How did Alan come to choose Sam's designs? "We were buying Sony digital machines for the new room," he notes, "and we wanted something good but different. The rooms we've got—Tom Hidley rooms dating from 1978—are great, and they work really well. But we thought it would be nice to have something new, a first, and we saw photographs of Sam's Japanese rooms which were simply stunning. In addition, Sam has plenty of industrial muscle behind him, enabling him to try out new ideas. He can think of a new trap, for example, construct it in the lab and test it under varying conditions, without worrying about rooms.

"That's always been the thing with acousticians: they ▷

RANE SUPREME



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DESIGN: TOWNHOUSE FOUR

experiment on you—they've got no choice. But the Japanese have a more 'R&D' approach. They'll try things out in labs and see if they work. Otherwise, a new idea will just work on paper until one has actually been built, in a studio. The Yamaha lab, which Sam uses, is big—big enough to build full-size models." One result of this work is that Sam Toyashima has been able to design more efficient traps, which take up less room. He was also able to specify the rotating cylinders, knowing exactly how they would behave.

Interestingly, however, Alan wanted a room which didn't sound too radically different from the existing studios in the complex. "People might come in here from Studio Two, for example, so the sound has to be in the same ball-park. In fact, it's turned out to be remarkably similar, broadly speaking." Apart from the acoustic design, part of the similarity is no doubt due to the monitors: they're the new Westlake *HR-1* units 4-way and quad amped. They feature a low-mid cone driver. "Perhaps because the bass units aren't covering such a wide range," says Alan, "they certainly sound a bit more 'relaxed' than the old-style cabinets but it's still the same basic sound." The monitors are driven by Crown *PSA-2*s.

"We were really impressed by Sam's designs," says Alan, "although we weren't able to implement absolutely all the details. They use the most amazing metal doors, for example, which we didn't go for. Instead, we've gone for a pretty standard sandwich construction."

The attention to detail extends beyond acoustic considerations. One idea is the use of indicator lights on the studio mic sockets to indicate whether a mic is already plugged into that input elsewhere in the room. "We always double up on our sockets, rather than having, say 1-8 in one part of the room, 9-16 in another, and so on. Each panel has all the mic inputs on it. So the lights tell you, during a long session, where the mics are that you plugged in earlier."

Ceiling construction is particularly interesting. As well as the polygonal recess in the studio, the control room ceiling has an unusual number of angles, each plane carefully calculated to obtain the desired results. "But it works," says Alan. "I really like the feel of this room, it isn't tiring to work in on long sessions."

On the technical side, the SSL is largely standard, with the exception of a 'VCA to monitor disable' button. In addition, the listen mic follows the autocue circuit. Out of the five rooms operated by Townhouse, four are SSL-equipped; the other, at the Who's old studio in Battersea, is fitted with a Helios—the last to be built.

Dave Hawkins runs Acoustical Construction Services—a company set up over a year ago specifically to build studios to other people's designs—although, of course, Dave is also well-known for his Eastlake connections. He was approached to organise the constructional work on the Townhouse project.

Says Dave, "Sam Toyashima provided conceptual drawings of the studio. More extensively detailed plans were not required, as Virgin retains a structural engineer, Maurice Cox, who was responsible for that side of the work. No construction team could be let loose without detailed drawings—how many fixings to be used, the plywood beams for the ceilings, the specifications for the windows, and so on. Sam had defined the interior geometry, the shapes and so forth and the isolation systems but we had to add the structural information. We also needed electrical lighting and power overlays for the subcontractors, and so on.

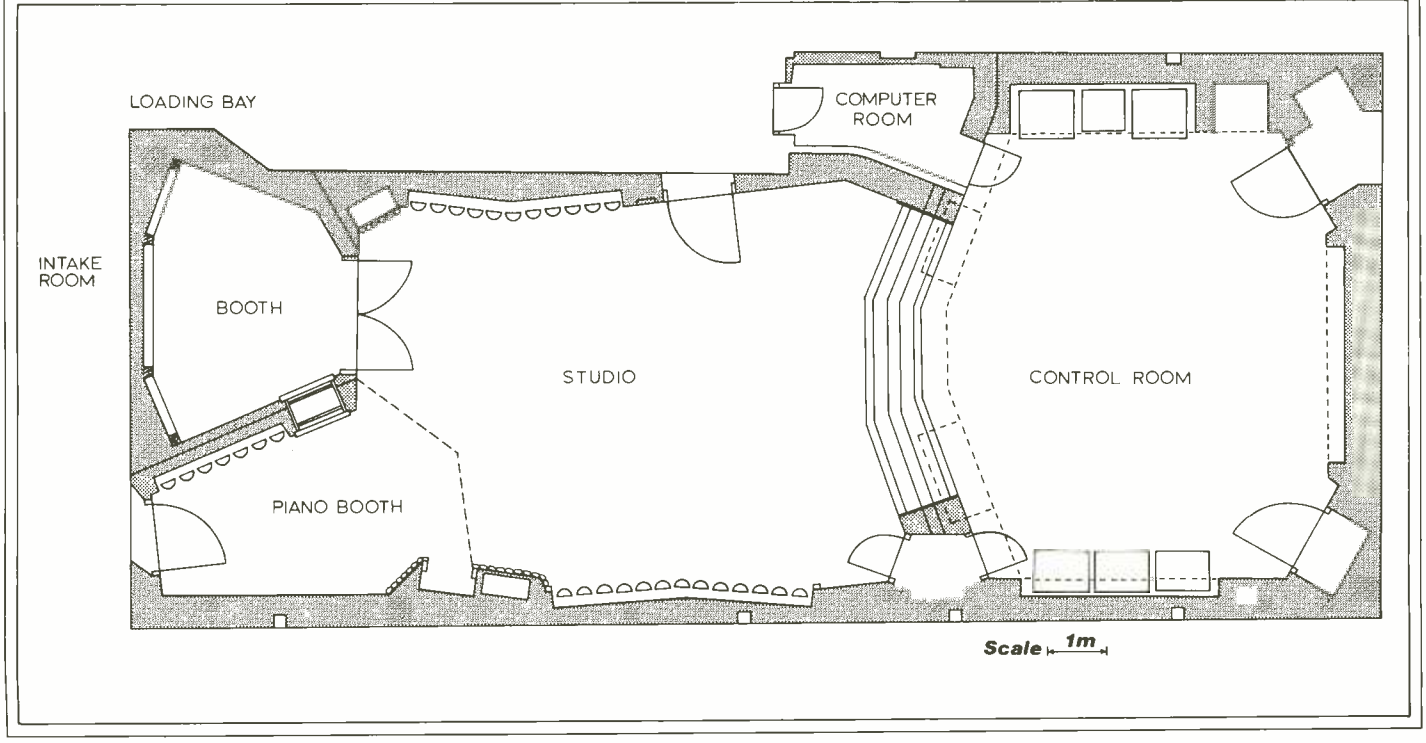
"The detailed drawings were done by Maurice Cox's office, which was interesting because normally, as Eastlake, we get very much involved in drawings and in this case we didn't need to at all!

"We worked to a 12-week timescale and it didn't give us any serious problems. Most of the major constructional work on the building itself had been done before we arrived. We went into a clean, prepared shell—as we usually do. Our specialists are not specialists in bricks and mortar: they specialise in isolation systems, interior geometry, that sort of thing.

"The cylinders in the walls and ceiling are an integral part of the design, and I thought long and hard about how to implement them. My first thought was that we could use a large-diameter plastic pipe, slice it along its length and bond ash veneer to it. I investigated that but I couldn't get a pipe with sufficient wall thickness. We went in the end for steam-formed plywood—rather more expensive than we had originally expected.

"For the ceiling systems, we had to cast around for a suitable drive system. We eventually decided to use bicycle chains, with double chain wheels, and increased the distance between the two cogs. The problem was to supply drive to the system and to make sure that all the cylinders in a section were synchronised with each other when they rotated. We used fractional horsepower motors with a worm drive—the cylinders only make about three revolutions per minute—providing pushbutton controls in the studio and not in the control room, as you wouldn't be able to see the cylinders from there."

The amount of surface area covered by the wall and ceiling cylinders is critical; there is just enough in the room to have a useful effect. As well as working effectively, ▷



sample excellence

BDE SERIES
DIGITAL SAMPLING & DELAY UNITS

Specification

BDE 3200	32 secs @ 15kHz bandwidth 64 secs @ 7.5kHz bandwidth
BDE 2400	24 secs @ 18kHz bandwidth 48 secs @ 9kHz bandwidth
EDIT MODES	Front, Back and Window
REVERSE MODE	Record or Playback
PROGRAMS	99 Delay settings (10 non-volatile)
SEQUENCER	4 Independent Programmable Patterns
MIDI	Keyboard control of Pitch and Pitch Bend
DE-GLITCH	Auto or Manual
MODULATION	Speed 0.05-6Hz
DYNAMIC RANGE	85dB Typical

OPTIONS:

FLOPPY DISK UNIT	Housing two disk drive
REMOTE CONTROL	For main delay & editing functions

The BDE Series represent the latest in studio quality delay/sampling.

Two versions are available so you can select the unit whose maximum delay/sample time suits your own needs and, if you take advantage of the x2 button, you get double the delay at no extra cost. That means a full 64 seconds on the BDE 3200 and 48 seconds on the BDE 2400.

As a regular delay line, the BDE Series offers all you would expect, with control of delay time, feedback and modulation speed for all those phasing, flanging and echo effects.

When you use the BDE Series as a sampling unit, you enter a whole new world of creativity. You can sample a sound into memory and then edit, reassemble, reverse, pitch shift and sequence it – yes sequence. The BDE incorporates four independent internal sequencers that allow you to edit the samples into as many as 99 different 'windows' and then sequence the playback order as you like. Samples can also be played via a MIDI keyboard and the whole lot – samples and sequences – can be saved to floppy disk for repeat performance at a later date or to build-up your own studio sample library.

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Studio Equipment Distribution

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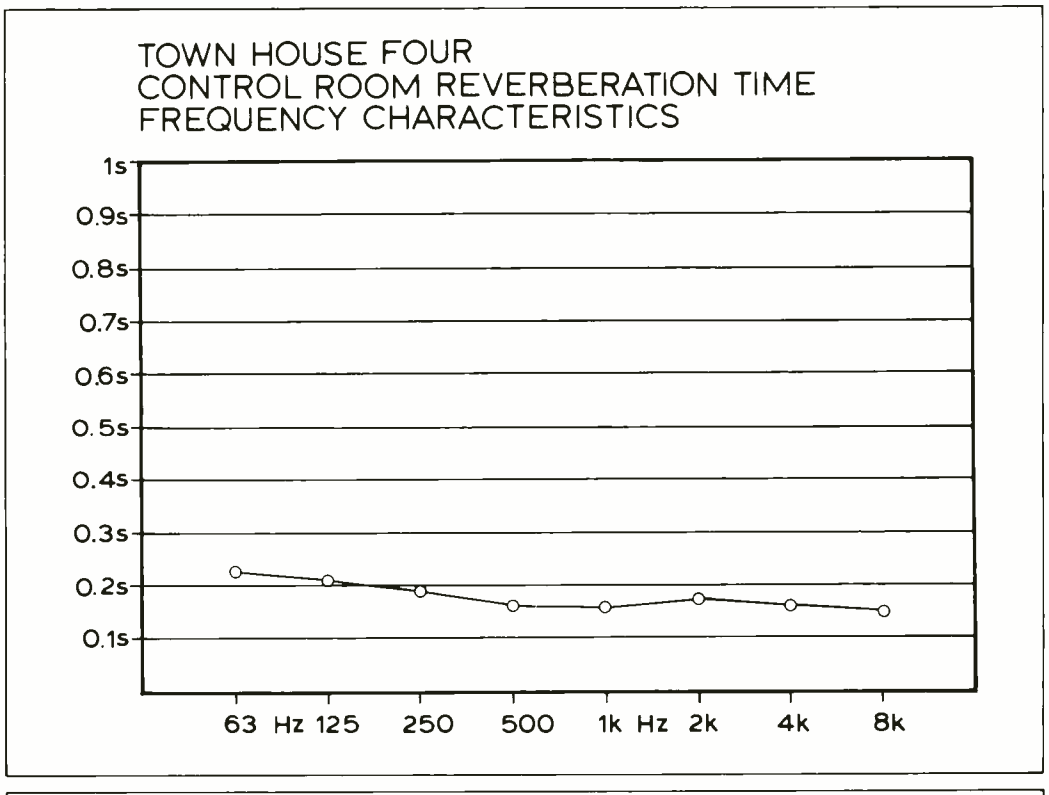
DESIGN: TOWNHOUSE FOUR

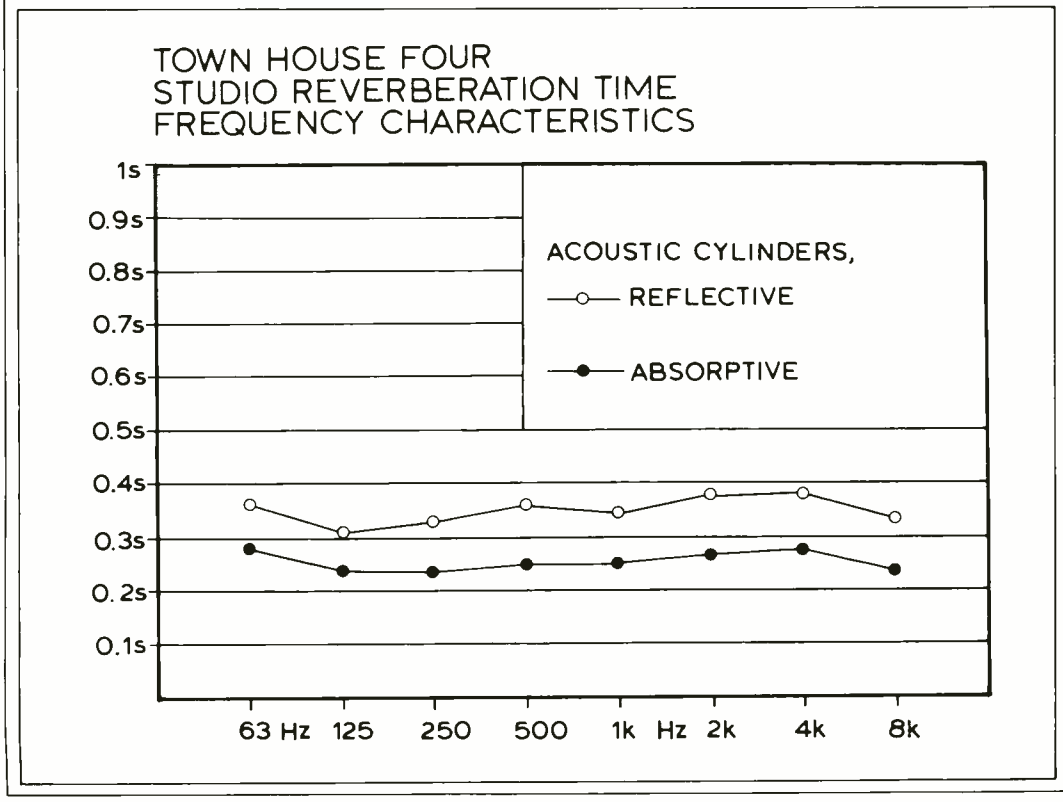
they are certainly eye-catching and will no doubt give clients hours of amusement. Rotating acoustic treatment has been done before—for example at IRCAM in Paris—but other examples have tended to use a series of flat panels with different absorbency, which are simply rotated into position. Cylinders are a new approach. "The thing that the radius gives you is an awfully diffuse reflecting surface," says Dave.

The inner doors are impressive and Dave supplied more information on how they were put together. "We used the standard Eastlake door. It was developed because we were fed up with making doors on site and having to come back and re-hand them. The door is made with a massive hardwood frame, and has a bevelled seal, so the length of the seal is longer than the thickness of the door. We fit foam rubber as the seal, covered with felt.

"The beauty of this sort of door is that when it's closed, there is sufficient friction between the compressed seal and the frame that the door doesn't need any kind of catch at all. You close it and it stays closed. We started using this about six years ago and on our earliest doors of this type, even today, the felt isn't worn.

"The door itself consists effectively of two solid-core doors with sound insulation board between and resilient fixings. It's about a 40 dB door. You need three ball-bearing hinges—each with two ball-races—to support a door like this. We make them and the frames in a cabinet shop, and deliver them to site. It takes about two hours for the carpenter to fit the doors and put the finishing touches to them and the door never needs to be looked at again."





Hawkins was not responsible for the floating floor at Townhouse. Maurice Cox located the suspension units, which consist of high density rubberised mineral fibre blocks. The weight distribution was calculated, the blocks put down, and then insulation was laid between the blocks. Plywood was then laid on the blocks. Finally, a concrete floor was cast on top. Notes Dave, "Each block was set up on a mound of mortar, and the level of the top of the blocks was very carefully verified using a laser sighting device. It's a very effective floor system.

"The weight of the walls is distributed on the floating floor," Dave continues. "Timber trusses were used for the ceiling, because we had the height to do it but in general we used standard isolation tactics. The only point of contact between the room and the outside world is the fibre blocks."

Overall, Dave Hawkins was impressed by Sam's design work, and his team of six people had few problems executing the work in the 12 weeks they had set themselves—with the possible exception of a few nightmares Dave suffered while developing the best way of implementing the rotating cylinders.

The result is an exceptionally impressive studio. Townhouse Four looks very good indeed and acoustically the room is an excellent balance of traditional and innovative design techniques. On the one hand, there is perhaps nothing particularly radical in the way the room sounds. On the other, every detail is there for a purpose, and the rotating cylinders give an extra degree of flexibility to a studio that is already very versatile. It looks great—and it sounds as good as it looks. □

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IN PERSPECTIVE

Back in the '60s when dinosaurs roamed the earth along with this columnist and vacuum tubes, there was a feeling that audio equipment and recording quality was 'as good as good gets'. The loss of the soft, warm and rounded sound from the vacuum tube equipment of that era is lamented today by many, especially the musicians amongst us.

The '70s, a time of social and political change as well as technological, were seen as producing a sound 'as rich as velvet'. Recordings of that era reflected the increasing revenues felt by all in the sound recording industry from record sales. The end of the '70s saw peak figures for record sales (and weighted revenues) that have never been surpassed. Studio time spent on the production of albums reached new heights as groups searched for elusive qualities on their recordings.

The '80s began with an extraordinary effort to obtain quality by maximising the digital recording and production process. Although per-album production budgets were down; the time spent in recording was still adequate in most cases and was dedicated towards the careful achievement of digital accuracy. The CD represented the ultimate in quality as perceived with its image of computer 'high tech' a 'jewel box' container, 'clean room' production standards and the reputation for delivering the virtual replication of the master tape performance unsullied—no matter how many times played.

During the same period, the motion picture sound recording process was a study of a task force of sound men operating complex magnetic film (and later magnetic tape) recording machines along with microphone operators and mixers standing before behemoth audio consoles (frequently used as props for early science-fiction pictures by the self-same studios). Re-recording and final mixing (today's post-production process) took place in caverns large enough to hold the enormous consoles and utilising projection VU meters nearly as large as today's projection TV images. Stereophonic sound to accompany visual entertainment was introduced as early as 1941 with *Fantasia*, and perfected in the early '50s with wide-screen processes. Television audio consoles were equally large or larger than their movie counterparts as though size and weight dictated the quality of audio produced.

That was the reality of audio quality in our past but it was also a myth. The formats for the release of the recorded electronic entertainment (today we would say software) were marginal in quality at best (as with film or television) or else allowed to lapse into a kind of technological senility via neglect (in the case of the LP record). Granted that it was 'as good as good gets' by the standards in the use at the time but the point remains that the decline of LP

On quality

record quality did not have to happen exactly as it did. Quality issues involving the LP record began initially because of the oil price crunch of the early '70s coupled with the rise of environmental concerns about the carcinogenic impact of virgin record vinyl production. Bottom line: the cost of the raw material for record production became much more expensive while the issue of producing new raw material appeared to involve potentials of liability and responsibility for disorders like liver cancer amongst vinyl plant workers.

The solution taken by many record producers especially in the United States was to cut back on the quality of record vinyl by reprocessing old records. The result was much lower cost coupled with greatly lessened liability. The problem even affected the availability of cutting masters according to some experts, who tell stories of secret record company memos. The presence of finger grease, dust, old paper labels, mice, cats and rats in the vinyl broth at the reprocessing plant is the stuff that tens of stories have been written about in the consumer audio press. The reality is not the issue, as much as the perception.

Similarly, by the end of the '70s the forthcoming digital disc appeared on the horizon as a great panacea and virtually everyone in the industry jumped on the CD bandwagon. The public was told about the problems of reprocessed vinyl; again perception was stacked against the LP record and as a result the LP record was condemned by the industry.

Similarly, the massive integrity of the hardware in motion pictures and television along with the penalties of personnel holding a union card but not always an affection for audio, did not have to carry through to the beginning of the '80s. Neither did we have to perpetuate the endless cackling between TV set manufacturers and TV networks or companies to explain why neither side could improve TV sound quality. For more than two decades worldwide, the quality of television sound was defined by a 3 in speaker with a magnet the size of a walnut and either one half of one vacuum tube or several transistors recently escaped from a small radio. Just think; in today's world where nostalgia is dying along with old buildings, fish and chip shops, diners serving meat loaf, etc, one can still find the application of a 1938 curve for the recording and reproduction of sound in film production.

Nonetheless, we are in the 1980s and we have the best sound quality we have ever had in the home and in the theatre. Names like 'Compact Disc', 'Dolby', 'TV Stereo', 'THX Sound System', etc, have all come to mean a level of quality for the '80s that is truly remarkable. Now the task is to protect our industry from yet another wave of implications, perceptions, confusions and just plain cost cutting that can threaten the high level of confidence the consumer has today in the audio industry.

Consider these areas for their potential to disrupt the current image of quality that the audio industry has finally achieved with much hard work.

CD labelling and source material standards have not so much been relaxed but rather have never really been enforced. In the rush to provide a catalogue of CD titles, many producers have gone back to the 'vaults' to resurrect master tapes. In some cases, as with English Decca, that option was even anticipated a number of years previously and pristine masters were set aside especially for the day of the dawning of digital. That is the exception and not the rule as a number of record companies have rushed to create depth of CD catalogue by re-releasing obviously old master tapes from LP sessions.

This CD programme material origin issue, has raised a number of hackles in and out of the industry but no uniformity of response amongst the various record companies. A standard for labelling has been provided through the good offices of the American group, SPARS (Society of Professional Audio Recording Studios). The SPARS Digital Audio Code—Recorded (D) Digital or (A) Analogue, Mixed (D) Digital or (A) Analogue; and Mastered (Releases) (D) Digital or (A) Analogue; has been adopted by some record makers, with an all digital performance being labelled 'D/D/D'. If the release is direct, without mixing then the rating should be Mixed/Mastered so digital direct would be 'D/D'. No topic is encountered more frequently when talking to consumers and record shop owners than this issue of CD quality, or the lack thereof.

CD box changes in the rumour mill are said to include the substitution of cardboard for plastic. A 'straw has been placed in the wind' in several parts of the Western World to gauge consumer and trade response to such a move. There are record industry executives who honestly feel that the move could be made without detriment to the CD. To some extent, these good gentlemen still believe the CD's early launching parties where cigarette ashes, peanut butter (smooth not chunk style one hopes) and strawberry jam were mashed into a CD to prove the system's ruggedness. The CD's plastic 'jewel box' is an expensive proposition in the world of record economics as compared to a fibreboard sleeve. Unfortunately, the 'box' is still needed to protect the CD from foreign matter that can affect performance. There has been a degree of backlash to the idea of eliminating the plastic box and this may temporarily inhibit the record industry cost cutters.

CD pressing short-cuts are feared by some in the rush to get enough product

IN PERSPECTIVE

into the market place. Although there is no question in the minds of most observers that the multi-million dollar Philips-Du Pont (US) marriage will achieve accelerated CD production without any sacrifice in quality; the same cannot be said of all smaller-scale ventures pending on the horizon. If these new production schemes cut enough corners or just relax quality control, they will affect the quality of their finished product. The question of defective CD returns has not yet become a major problem to record retailers but several studies of LP defects show that some record stores do not always view quality as their most important product. One record retailer of note in the US frequently enjoys holding a little quiz with new employees. "What is the most important device in a record store, in terms of producing profit," he asks. After soliciting answers that include a cash register, an inventory computer, a shop-lifting (theft) detection system, and others, he turns and beams, "A shrink wrap machine to 'process' my returns."

A more frightening threat to quality comes from the world's pirates. This disregard for quality affects audio on LP, on cassette, on VHS and on Beta cartridges at this point in time. There have been reports of pirate CDs *(and a bootleg CD—Ed)* being produced but aside from being difficult to verify, these alarms seem to be a case of misuse of existing facilities if anything is really being pirated. The $1m plus price tag for even a small CD plant is offputting to the pirates of the world, who usually frown on capital investment. However, as less expensive production processes evolve to meet the ever growing demand it seems inevitable that pirates will have CD production capacity. The pirates do keep up with the latest technology. The new 8 mm video format with its PCM stereo digital audio is already being utilised by pirates according to some reports, trying to meet the largely untapped demand for motion picture software on the new system.

Movie sound quality in exhibition is still capable of producing nostalgia for the days of crisp popcorn surrounded by a golden splash of sweet creamery butter but precious little else. The presence of Dolby SVA (stereo variable area) soundtracks since the end of the '70s and its impact on perhaps 50% of all features produced has been the single most successful innovation in motion picture sound in this era. American motion picture industry spokesman Jack Valenti lectured his audience of theatre owners at a recent meeting on the need for better sound in the theatres. One theatre owner commented, "We all care about the buck. We use butter flavoured popcorn oil and cheese flavoured Nacho spread. We do the same thing with our pictures. We equip a few of our screens for Dolby and these are the spaces with most seats. We put the most profitable pictures into these theatres; not the picture that will provide the best stereo sound experience for the audience."

TV sound quality is still delimited by its weakest link. A chief engineer for a large TV station in one of the top five US markets commented, "The only thing that I have ever seen that damages audio quality in terms of phase, time and frequency as badly or worse than today's 1 in professional video tape recorders is the earlier 2 in video tape recorders." The level of video tape transfer away from the master tape can frequently amount to 10 generations or more depending upon several variables of production and distribution. Experts at a recent SMPTE Conference in Chicago said 10 to 15 generations were not unusual with some programming.

None of these problem areas has to follow a predetermined course although several could be on their way to becoming self-fulfilling prophesies. None of these is especially connected to any of the others and they all can be eliminated if the audio industry decides that is what is right. An old commercial campaign for the American General Electric company stressed, 'progress is our most important product'. The audio industry needs to remember that quality is our most important product. □

STUDIOFILE

Master Sound, New York

Traditionally, Manhattan has been the recording centre in New York, however, things are stirring out in Queens where the term 'multi-media complex' is taking on a whole new meaning.

In fact, things have been stirring since 1977 when the Kaufman Astoria Studios came into being. The studios themselves have a history stretching back to the silent days of cinema before becoming the Famous Players/Lasky Studios. With the growth of Hollywood as the film capital, Paramount took over the complex but in 1942 the studios were bought by the US Army Signals Corps when they were used for the production of films whilst doubling as an emergency communications centre in time of crisis. The army moved out in 1970 leaving the future of the complex uncertain, however, businessman George Kaufman recognised the potential of the site to the film industry and, with a group of investors, took the Astoria studios over in order to expand and renovate them under the new label of Kaufman Astoria Studios. The complex in fact now houses over 70 media-related companies which cover production, advertising and casting agencies, radio stations, banks, secretarial services, etc. It also houses a new and very interesting recording studio by the name of Master Sound Astoria.

Master Sound is the project of husband and wife team Ben Rizzi and Maxine Chrein. Ben is a musician and freelance engineer and Maxine a singer with experience in marketing and administration. They have also had a studio in operation on Long Island for over 12 years.

After a year of intensive planning (and over $3 million investment) Master Sound Astoria started operating in September 1985.

Unlike many studios, Master Sound had more than enough room at their disposal which meant that the rooms could be built to an ideal size and not be restricted within the confines of a basic shell.

The studio is interesting in that it combines influences from the past and modern acoustic science. "I wanted to get away from the dead room approach and back to making music. For this reason the studio has been built as a small concert hall and not as a typical recording room. That the 'studio' works is attested by the fact that musicians of all types have to be regularly thrown, if not dragged, out of the place because of the sound."

The Master Sound Studios are situated in part of the massive basement area at Astoria and access is by equally massive freight lifts that can take whole trucks if necessary. There are also very wide corridors leading directly up to the studio.

The basic construction of the building is very solid and nothing has been left to chance. Every detail of the studio from audio connectors to bolts has been carefully looked into in order that no weak links can arise.

The floor consists of an 18 in thick slab of concrete supported on 25 ft pilings run directly into bedrock and faced on the top with tongue and groove oak flooring. The control room floor is further isolated with a floating platform filled with 15 tons of sand.

Control room and studio walls feature a double skin with a 4 in air-gap between the two wall sections. The inner wall consists of 2×6 in steel studs faced and seated with Neoprene and layered with ⅝ in sheetrock (plasterboard), 1 in coreboard (similar to sheetrock), a sealing layer of lead and a final layer of ⅝ in sheetrock. The outer wall is constructed with 2×6 in fire-rated wooden studs glued and screwed together and seated and faced in Neoprene, ¾ in industrial grade particle board (again screwed to the studs—no nails) ½ in cellotex, lead seal and ⅝ in sheetrock. The ceilings feature the same double construction and are fully isolated and floating using Mason-Berger isolators. To give an idea of the massive construction the walls weigh in at over 10 lb a square foot!

The solidity of the construction keeps all the sound in, especially the low frequencies. "If the walls start flapping when there's a bit of bass then there's your low frequency response gone out of the window right away. The control room has been designed to reproduce accurately whatever may be being produced in the studio and though the speakers won't go down that far, the room is virtually flat down to 7 Hz. This may seem a little excessive to some people but it does mean that the bass response is very accurate and that there are no nasty surprises when tapes leave here."

The design of the rooms is the work of Ben Rizzi, Charles Bilello (acoustician) and the Crown *Tecron* computer.

Billed as the world's largest certified *LEDE* control room, the Master Sound design features "a totally symmetrical room placed within a second asymmetrical room" with the inside dimensions averaging 32×27 ft. The ceiling starts at 14 ft high at the monitor bridge and rises to 19 ft at the rear.

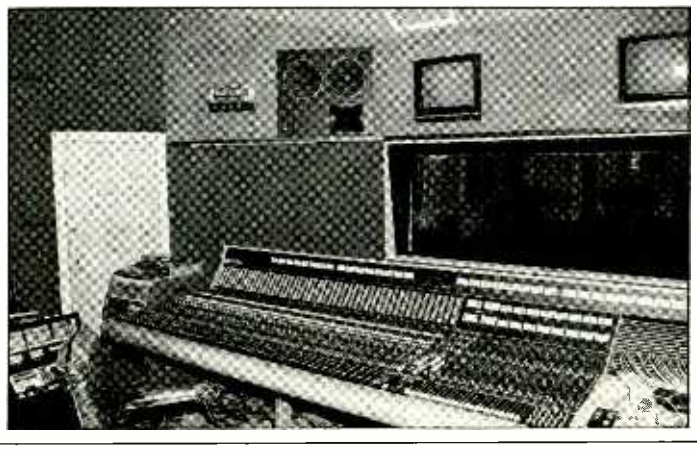
A slightly unusual feature of Master Sound is that before any design work started the choice of monitor loudspeakers had to be finalised. "This was really important. I think people are starting to realise more and more that the room and the speakers form part of one and the same thing. If they don't work together then you may as well forget it. I didn't want to build a room and then think 'now what speakers do I use?' The JBL *4435* monitors were chosen because after a lot of listening and testing, they came out the best: which is kind of funny, really, when you consider that up until now I never did like JBL speakers."

The choice made, the control room was designed and built for them. Power is supplied by MacIntosh *2500* amplifiers in bridge—one per speaker—giving 1000 W continuous and 2000 W peak handling. The amplifiers are mounted 2 ft away from the speakers in the monitor bridge with Monster cable for the connection, thus virtually eliminating any losses due to cabling between amplifier and speaker. In accordance with *LEDE* principles the speaker enclosures are fully isolated from the structure in order to avoid early-early reflections.

Ben has taken the *LEDE* concept a bit further and achieved what he calls a non-reflective front end control room. A prime consideration in the design was to have a stable stereo image along the whole length of the console as there is room for 10 to 12 people behind the desk. Peter D'Antonio RPG (Reflection Phase Grating) diffusers provide uniform dispersion over a wide bandwidth and thus aid a stable image across the room. The front end design ensures that the direct wave-front from the monitors is well in front of any reflections.

Walking slowly behind the console is a strange experience as the sound is changed at every step by a variable bandpass filter (each slot of the grating diffuses a specific frequency band). In short, they work! 12 gratings are fixed to the rear wall where they are surmounted by a large non-reflective surface, with three ▷

Control room A1 with modified TSM console



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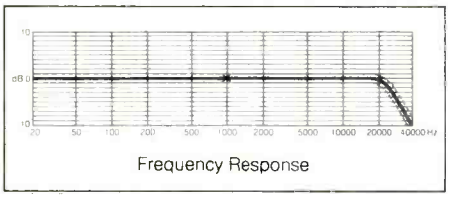

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STUDIOFILE

gratings on each rear side wall that are dedicated to the lower frequency bands.

The non-reflective (or dead) surfaces of the room are a mixture of moquette on the flat surfaces and a velvet-like material on rounded absorbent sections. The hard surfaces are painted sheetrock. The main floor section is covered with computer vinyl (used for flooring computer rooms as it is non-static and non-slip). The small 'studs' provide further diffusion; the lower section in front of the console is carpeted.

The colour scheme of the room is very restful: pastel greens and blues contrasting well with the warm brown of the woodwork of the console and diffusors to give the impression of an airy drawing room rather than a place of work.

A batch of first class airline seats are on order to provide seating for visitors in the control room. The space available also means that the control room can be used as a synthesiser studio. Overdubs would also be easy if musicians preferred to play in the control room.

The monitor speakers are not angled down in order to bore holes in the listener's head but are mounted vertically. (It must be remembered that the ceiling rises at quite a sharp rate so interference from reflections is not a problem.) Ben: "In everyday life it is very rare that we hear sounds on-axis; rather they flow around us and this is what happens here."

Increasing the volume slowly until the pressure of the bass frequencies becomes quite uncomfortable the audio spectrum remains unchanged to the ear, even when the level is dropped to low again. At no time is there a hint of distortion or breaking up. The spatial information is excellent with pronounced depth, giving a very 'live' impression of the programme material.

Each rear side wall features a glass-fronted clean room for housing two Ampex *ATR 124* 24-track analogue recorders and two Sony *3324* digital machines. "I wanted to have 48-track analogue and digital for compatibility reasons among others. We can simultaneously record 46-track

Master Sound, continued

analogue and digital and then decide which we prefer later. Or we can do 24-track analogue for rhythm tracks, for example, with dubs on the digital and so on. We can even lock up the four machines together if anybody wanted it though I think that would be going just a little over the top. The two-to-two basis seemed more flexible to me than say having two analogue 24-tracks and a digital 32-track."

Whereas Ben feels digital has a long way to go yet he is a real enthusiast when it comes to the *ATR 124*s. "These have to be the best machines ever made and it's a real tragedy that Ampex stopped making them. Especially as they were just taking off when production was stopped. That's what happens when you have accountants running things instead of people. The original *MM1000* was a good machine because the video people were in on it, however, the *MM1100* and *MM1200* suffered because the audio folks thought they could do it better. Fortunately they saw the light and got the video side back in for the *ATR 124*, which is really a video transport with audio electronics. They have a phenomenal frequency response from around 25 Hz flat up to 30 kHz and over. In real world terms that's better than digital and means that you are getting all those harmonics on tape that we may not be consciously hearing but that we are certainly aware of. It's also why they sound so transparent compared to other recorders."

Mastering is on a roster of Ampex *ATR 102* and *104* 2-track machines, Sony *APR 5003* stereo recorders with SMPTE/EBU centre timecode. Digital mastering is with Sony *1610* and *F1* machines. Two Sony *PCM 3302* DASH recorders running at 15 in/s are also on order. For other requirements a range of Ampex machines is also available.

Secondary or nearfield monitoring can be provided in the shape of "any kind of speaker you want". For the studio there are over 60 pairs of Fostex headphones and two dozen MacIntosh and Crown *Microtech* amplifiers to drive them all!

The outboard equipment is housed in three slanting wooden double racks that can be wheeled out into the room from under the back wall diffusors. There is no set list of effects gear as new equipment is coming through all the time and anything not in stock can be rented at extremely short notice. Reverberation effects are provided by an *EMT 251* and stereo plate with other equipment from Lexicon and AKG.

Master Sound has its own power supply in the form of a sub-station within the complex. The supply to the control room and studio is via a two transformer isolated system using hospital AC outlets and true star grounding. All audio lines are star grounded to the console with low-capacitance Belden cable for line level runs and Star Quad ultralow-capacitance cable for microphone lines. On top of this, the control room is shielded by a Faraday cage. "It's not cheap to wire in like this but the difference in noise performance alone makes it more than worthwhile. There is absolutely no point at all in building an expensive studio if you are going to put in 'just alright' wiring. By paying attention to every detail we have a system that is incredibly quiet and free of the usual pops, bangs, clicks and RF interference that can be the bane of many studios. Good installation is more important than having the latest toys; you can get them anytime but the wiring defines how good your system can be."

The Trident *TSM* automated console is over 12 ft long and "the world's largest *TSM*"—it is also probably the most modified.

"An important aspect of the studio is that the audio paths are all totally phase-coherent. This means that a positive wavefront at any input to the desk will come out at any output as a positive wavefront, regardless of whether outboard equipment is patched in or not. Again, this means that what you hear is what you are getting and not a phase-shifted approximation.

"The Trident was chosen principally for its signal handling capacity, having a slew rate of 13 mV/s. I also like split consoles (inputs and groups), however, a lot of changes had to be made; in fact it is probably truer to say that it has been completely rebuilt. Expensive to do but the console now does exactly what we want it to do and has a performance second to none."

Among the modifications were completely redesigned microphone preamplifiers and line amplifiers, all insert points were converted to 600 Ω balanced, replacement of all pots and capacitors plus most of the switches, etc. The patchbay was also treated to a set of new high quality patchcords.

"The problem with most consoles—and other audio equipment—is that the power supplies are very rarely up to standard and have an unacceptable failure rate. It's as if the equipment is designed first and then with the 5% of the budget that's left someone says, 'Oops, we forgot the power supply!' "

Master Sound have bypassed this difficulty by installing two massive Hewlett-Packard computer power supplies that ▷

Control room A1: effects racks are stored below the diffusors

If every musician in an orchestra were to play a different tune, you can imagine just what a disaster an opening night could be . . . The same goes for multi-track recording systems. If you don't make the right choice you could end up being a one man band.

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STUDIOFILE

have been specially modified to run the Trident.

Configuration of the console is 48 mic input channels, 24 output groups and 32-track monitor section with full 4-band EQ on channels and monitors thus giving 80 line inputs for mixdown.

The studio is deceptively simple looking being 42 ft wide by 60 ft long, the ceiling height varying from 18 to 23 ft. Though in appearance a rectangular box, the walls are in fact cunningly offset in order to eliminate standing waves. The décor is very elegant with the highly polished oak floor and various scattered Persian carpets contrasting well with the white walls and ceiling.

Didn't they feel the white was a bit clinical? Maxine: "As you can see there is a lighting grid attached to the ceiling. The studio is large enough to do video shoots in and the white surfaces form a projection backdrop for the

Master Sound, continued

lighting. We have 600 amps on a separate supply just for the lights and with dimmers we can create whatever mood the client may want for a session, video clip or live broadcast. For sessions many of them like it as it is with the standard lighting but colours are there if they want them."

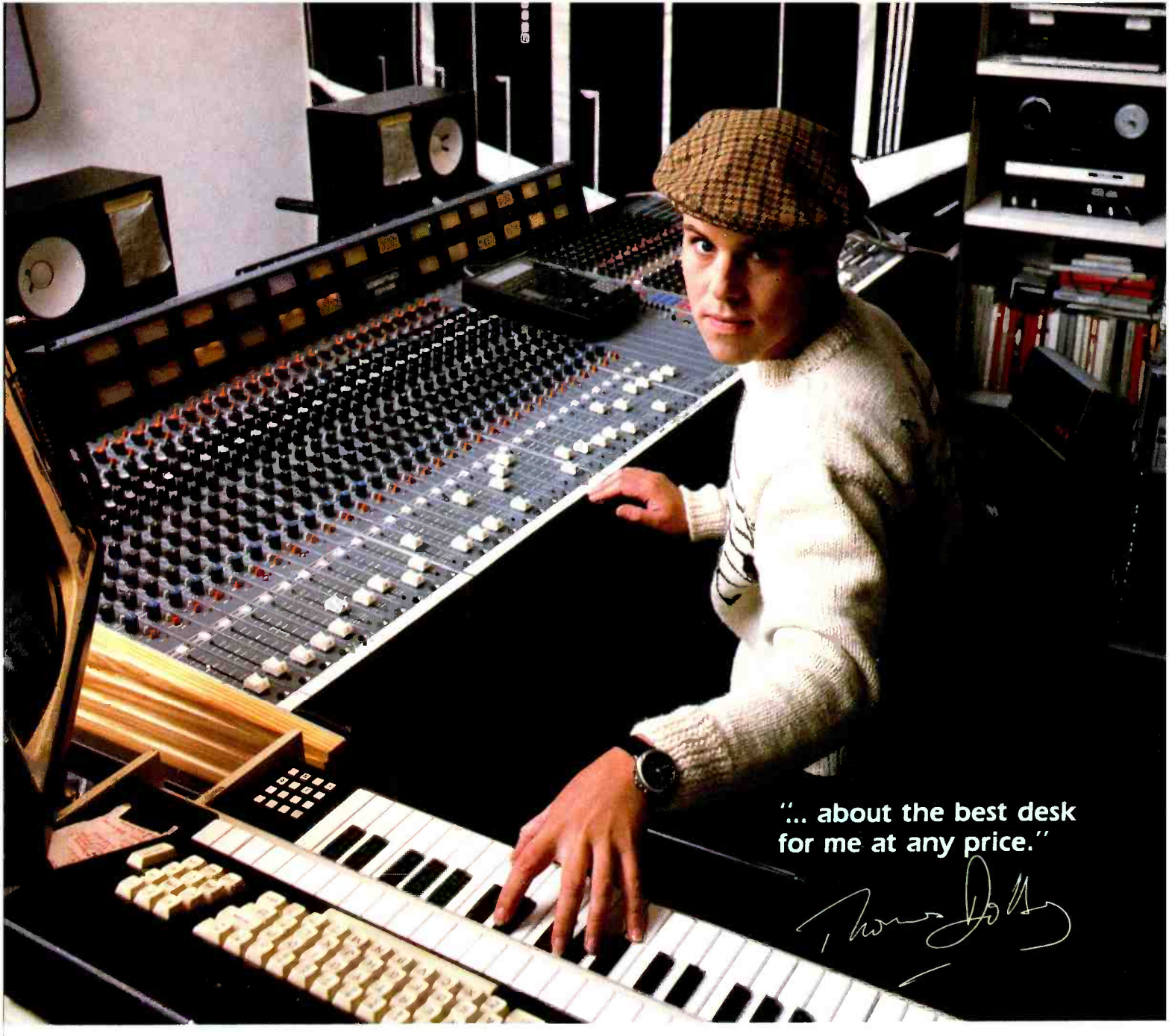
Like the control room the studio sports RPG diffusers along the side walls—four groups per side—together with reversible rotating panels that are either non-reflective or reflective. Ben: "Most studios start with a basic reverberation time and pull it down with drapes, traps, what-have-you. In other words, they are already taking out sound by absorption and then trying to put it back with reflective panels or artificial reverb. I feel the better way is to define a minimum reverberation time *without* attenuation—here it is about 1.5 s—and then augment it with diffusion which is what we are doing with the RPGs and reversible panels. We can very quickly change from 1.5 s through to 3 s and tweak by fine adjusting the panels or putting the carpets down, these latter being the only absorbent materials in the studio."

What about the panels? "They don't actually absorb. One side is very reflective so it throws the side around whereas the other is non-reflective rather than just sucking frequencies out of the air. The sound is there, it just doesn't go any further and that is the difference. What we usually find is that people are startled by the full reverb time and ask us to pull it down. Then, of course, they want it 'just a little bit more live' until we end up where we started!"

That the aim of the concert hall acoustic has been achieved is almost an understatement with a smooth response right up into the high frequencies. The acoustic properties have far more in common with stone churches than a recording studio.

With film stages in the same building it would have been strange to find Master Sound not equipped for film recording. The control room end of the studio has provision for a wide screen above the window with a large projection room situated over the isolation booths at the other end. Facilities include three high speed 35 mm projectors with three 35 mm dubbers and a 6-track 35 mm magnetic recorder. 16 mm magnetic recording can also be handled.

The two isolation booths are the original army control rooms/transmission centre and in contrast to the studio have quite a dead acoustic due to large amounts of absorbent material on the walls. This ▷



"I put my studio together to suit my particular needs for songwriting, sequencing, and film scoring. I took a look at all the mixing desks around, but most of the facilities I needed were only available on ridiculously expensive desks. So when I heard about the Soundtracs CM4400, I never imagined it would turn out to be about the best desk for me at any price. So I bought one and I'm delighted.

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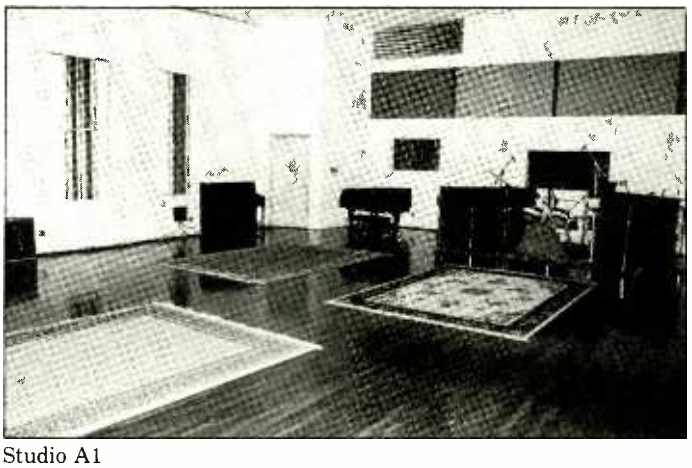
STUDIOFILE

makes them very suitable for vocals and overdubs where more flexibility is required in creating an acoustic with reverb units, etc. Each room measures 18×20 ft and as might be expected, is of bomb-proof construction with 18 in reinforced concrete walls, complete Faraday cage shielding and the original army 1400 lb double doors! Visual communication with the studio is very good and there is also a window between the two booths.

Despite the size of the studio, set ups can be made very quickly and Master Sound were quite relieved recently when they found that a session involved only 30 musicians which meant just a leisurely half-hour set up before rolling tape. Bigger sessions are typified by the recent cast recording of the Broadway success *Edwin Drood*, where the cast and 56-piece orchestra were recorded straight down to 48-track digital. Sessions of this size require a very large and varied mic selection, which Master Sound have.

In order to help the smooth preparation for a session, each microphone in the studio has its own Tecron sweep chart, showing the actual response of the microphone as compared to what the manufacturer says it should be. Ben explained, "Whereas I am the first to agree that technology should not take over what we are doing, I also think we should use it to help us as much as possible. The Tecron sweep on a microphone just indicates how that piece of equipment is working, it doesn't say where to put it or how to use it. The engineer can use his own technique and creativity but instead of working blind and hoping that using a particular microphone in a certain way will produce the desired result, he can use it with confidence. He will also know, for instance, that any microphone receiving a positive wavefront will present that to the console so he does not have to worry about the phasing of microphones which means that phase reversing for effect becomes a lot easier. When you come down to it, a studio is a place where something is created and I think the last thing the engineer should be worried about is his tools."

Master Sound, continued



Studio A1

Rock and roll sessions have also been coming in thick and fast and the studio is now virtually turning around the clock. The negative aspect of continual working though is that it makes it hard to be up to date with maintenance—and Ben is a stickler for that.

"The lifeblood of a good studio is the maintenance engineer. At present I'm having to do a lot of it myself as it is difficult to find really competent personnel. Any studio manager who feels that a maintenance engineer is an unnecessary expense isn't in the right job."

What about the air conditioning? The construction of the studio is such that the rooms are completely airtight so the air supply is vitally important.

There are separate systems for the studio, the control room and two machine booths. In practical terms these provide 10 complete air changes in an hour. The design of the air conditioning was computer-aided and the possibilities of structure or duct borne noise have been eliminated.

Master Sound are not an isolated entity in the Kaufman Astoria complex and are hardwired into three of the film stages, E, G and H. Stage E is the East Coast's "newest and largest" with an area of 27,000 ft² and has already been used by Steven Spielberg for *The Money Pit* and Francis Ford Coppola for *Cotton Club*. Stages G and H are both 12,000 ft² and also feature large tanks or swimming pools under the floor.

Each stage is connected to the studio by 100 microphone lines and audio and video monitoring tielines. As the cable run is quite considerable, Master Sound have installed high quality microphone preamplifiers in the stages with repeater amplifiers along the lines to ensure an even +4 dBm reference level down into the studio.

As well as being the scene of many films since 1977, both for cinema and television, the Kaufman Astoria Studios are also in busy use for video shoots and rehearsal facilities. The 31 ft high grid in Stage H is ideal for flying lighting and PA rigs for pre-tour rehearsals and has been used by the Power Station, Roger Waters, The Beach Boys, Rolling Stones.

The radio stations in question are the Doubleday Broadcasting-owned WHN-AM (top country station) and WAPP-FM, who should now be on the air. They are literally just down the corridor from the studio and thus within easy reach. The studio is also 40 ft away from a satellite uplink station which uses K band, a higher frequency that does not create the disturbances found in lower frequencies. As well as being used for beaming the daily rushes from the film stages back to California, it also comes in handy for live broadcasts.

Maxine: "The studio was planned to be multi-media from the start which is why the main studio is fitted out for television lighting. This way we can record a live show and send it out via satellite for nationwide coverage."

Due to the involvement with video, Master Sound also have an off-line ¾ in video editing room with monitoring in the control room consisting of two 25 in video monitors mounted over the control room window between the loudspeakers.

There is also a high speed cassette duplication facility to round off the services offered.

The main studio is designated A1—but there is also an A2. Construction of A2, together with the acoustic treatment, is as A1 and by the time you read this the studio should be up and running.

Other plans for Master Sound include a re-recording theatre for film mixing, a Foley stage and expanded post-production facilities. The re-recording theatre will be built in the old projection theatre the other side of the isolation booth end of the studio. This way the projection booth upstairs can serve both theatre and studio. The film mixing room itself will be the size of a medium cinema so there will be plenty of room for installation of the latest surround sound formats.

"When the opportunity to build a studio here came up we thought that the possibilities would be enormous but it would have to be done properly from the start. We couldn't build just another studio—it had to be acoustically and mechanically as near perfect as possible. You can always change the equipment but not the rooms! Nothing can beat careful planning and not leaving anything to chance. The reward has been results that are very gratifying. The response to the studio has been phenomenal with musicians saying it's a wonderful room to play in, and drummers love the sound. The bottom line is that they all want to come back with future projects. We even had *Vogue* magazine wanting to use the studio for a photo layout!"

Terry Nelson

Master Sound Astoria Recording Studios, Kaufman Astoria Studios, 34-12 36th Street, Astoria, NY 11106, USA. Tel: (718) 786-3400.

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STUDIOFILE

STUDIOFILE

Studio 150 Amsterdam

Not the most original idea to name a studio after the number of the house, especially when your studio is situated along one of the old canals in the city of Amsterdam but then, what's in a name?

The City of Amsterdam is known for its narrow but deep houses and Studio 150 is no exception. Behind the two stable doors that form the entrance is a 37 m deep and 5 m wide building of which the first 30 m are for recreation only. The first 10 m have no function at all, the next 10 m house the bar, whilst the third 10 m are meant to be a relaxation room. Here we find the obligatory pinball machine and colour TV. The last 7×5 m form the control room. It was not designed from scratch, but has grown with the studio and needs some professional rebuilding. The studio is next to the control room and measures 5½×12 m.

The studio was founded in 1979 by three people: sound engineer Peter Riebeek, maintenance engineer Sander Janssen and his cousin Bart Janssen, who did the paperwork. They started with a Tascam *80-8* multitrack recorder, a Tascam *M-15* console and very simple ancillary equipment, like the Dynacord *DRS 78* digital reverb. Business went well and the *80-8* was soon replaced by a Tascam *85-16* and more effects were bought. Artists, like Al Jarreau and Randy Crawford started making demos there. In the meantime Sander Janssen left. The better Dutch acts, like The Nits, Vitesse and Mathilde Santing started recording at 150. Spargo recorded their third album, *Go*, on the 16-track Tascam, which turned out to be a bestseller throughout the Continent.

In the following two years almost all the equipment was upgraded, including the console and the multitrack machine. The Tascam console was replaced by the Amek *M 2500* 32/24/2 which seemed an odd choice since it is not known in The Netherlands. Peter chose the Amek for its extremely versatile routing system and things like the quadruple parametric equaliser per channel. It appears, however, that Studio 150 cleared the way for Amek in Holland and that two other studios will soon switch to Amek. Peter is very happy with the sound quality too. "The desk never gets in the way, it does its work unnoticed. And that's very important to us, for we are into creating albums and not interested in transistor-freakery. If we freak, we like to freak with sounds."

The new 24-track is an Otari *MTR-90* II, equipped with autolocator and 12 dbx *180* units. In Holland, there is a tendency to use dbx *150* units, which are meant for low level signals, like the −10 dBV (316 mV) Tascam standard or the 0 dBu (775 mV). Used with +4 dBm (1.22 V) equipment, it reduces headroom by about 9½ dB. The Dutch distributor argues that when dbx is used, you already have the noise floor at −90 dB, so who cares about the extra 9½ dB? Peter does not agree: "What's the use of buying a system with 26½ dB of headroom, if it's limited by the noise reduction?"

What is the philosophy of Studio 150? Peter: "Concerning recording techniques, it's very simple: the philosophy we have is to have none. We record all kinds of music, so we adapt our way of working to the way the musicians work. We have had salsa bands, where a good deal of the sound is made in the studio. And we have had disco acts, where most of the sound is made in the control room. Luckily we can handle both, we have a fairly large studio and a comprehensive set of effects. The idea behind this studio is to offer good, professional quality at a budget price. Of course, we will never beat Wisseloord (Phonogram, Hilversum) but then again we do not charge their prices. Recording at 150 costs about £250 (*f*1050) a day, excluding materials, VAT and the use of the AMS *DMX*. We try to keep up with the new gadgets, like the AMS, and with new techniques. If a producer wants to record with purple microphones, we are very interested in what it will sound like."

Concerning the price, the facilities indeed are impressive: Four reverb units are available: AKG *BX 10*, Lexicon *224X/LARC*, Lexicon *PCM-70* and Yamaha *REV-7*. Of course, the *224X* is most used but the three other systems have their special sounds. Peter: "Nothing in nature is perfect, so why should a reverb system be perfect? For instance, the sound of both Lexicons is mellow and round where the Yamaha is thinner, more brittle. The AKG can be handy with gated drum sounds. Besides, during remixes it's very convenient to have several different reverb sounds at the same time."

The other ancillary equipment is equally taken care of: AMS *DMX 15.80S*, Lexicon *Prime Time 2*, Klark-Teknik *DN360* graphic EQ, Eventide *H949 Harmonizer*, A+D *Compex* limiter, dbx *165* compressor/limiters, Valley People *DynaMites*, *Kepex IIs*, dbx *900* series de-essers, gates and compressors, Roland delay. A/DA stereo tapped delay, Dynacord *TAM 19* flanger, AMS *DM 2.20* tape phase simulator, Aphex *B* and dbx *20/20* computerised equaliser/analyser. The usual collection of solid state and tube mics are available.

Instruments are: Yamaha grand piano (*C3D*), Yamaha *DX-7* and *RX-11*, Akai polyphonic sampler with micro floppy and Charlie, Vox *AC-30* and *Boogie* amps.

Since the start, monitoring was done on JBLs, at first the *4333a* with Dynaco amps. Currently a set of *4435* is used, amped by bridged Crown *PS-400*s for LF and a *DC300A* for HF. There is a choice of two nearfield monitors: Auratone *5C* and Yamaha *NS-10M*, both amped by a Quad. Mastering is done on Studer *B67* Mk 2 for analogue and on *PCM501/SL-HF150* for digital.

The studio, like the control room, has changed with requirements. Nowadays it is fairly live, to cope with the more acoustic approach that has become popular. Although the room sounds good, complete rebuilding is planned sometime in 1986. The main reason is to improve the control room but enlarging the studio was another. Next to the current studio is an unused room of about the same size. Re-situating the control room will make it possible to have two studios, both in visual contact with the control room. Bureau Peutz & Associes BV are being consulted.

There is a remarkable atmosphere: "If it doesn't work one way, we'll try another," explained Peter who controls the studio with ease. Nothing is impossible and there are no stress situations. Even language is no obstruction: Dutch, French, German and English are spoken perfectly. Recreation is no problem either. The Lauriergracht (avenue of laurel) is on the outer side of the famous quarter De Jordaan and the Leidseplein, where the cultural scene meet, is only a five minute walk away. So there is no need to bring your car, which is a good thing because, like London and New York, Amsterdam has a parking problem to match the bad traffic circulation. But then again, who wants to visit Amsterdam by car?

Studio 150, Lauriergracht 150, 1016 RV Amsterdam, The Netherlands. Tel: 020 259585. Hans Beekhuyzen ▷

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STUDIOFILE

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Westland Studio, Dublin

In spite of 'The Troubles' the cultural aspect of Irish life has never been stronger. Music, for centuries has formed the basis of the national folk culture, and in more recent times, aided and abetted by the international success of rock musicians of the ilk of Thin Lizzy, Van Morrison, and of course U2 and Feargal Sharkey, Ireland is now well and truly established on the music world map.

Testament to this fact is the newly rebuilt and refurbished Westland Studio (formerly Lombard Sound) in the heart of Dublin. As studio manager Deirdre Costello explained: "There was a studio here before but we are very anxious to give it a new identity because it was a bit of a tip!"

The original facility was opened in 1976 with a Helios console and Studer tape machines to cater for a demanding local music scene. "The old Studers took a hell of a lot of abuse; we used to ring up for parts and they used to laugh at us because the machines were so old!" said engineer Philip Begly.

Today's studio is virtually a brand new Eastlake design. Brian Molloy, who with his partner Tom Costello owns Westland, explained the thinking which led them to invest in a new high quality recording facility built to international professional standards when, till then, the work attracted by the studios had been almost entirely locally based.

"We are delighted with our Eastlake/SSL facility; it is a dream come true for us. It was a decision we had to make to go for the top of the market. We had to decide whether bands here would sustain such an investment and if we could attract work from abroad. It was certainly very tempting to go for a safer medium level facility but it does seem as though we made the right decision. We are choc-a-bloc with bookings and I doubt if we would be had we not gone for SSL."

As Lombard, the studio was fitted with Eastlake monitors and thus it was David Hawkins who was asked to bring the facility in-line with the equipment chosen. David: "It was originally built on a very modest budget around 10 years ago and the finishes were fairly spartan; the isolation between the studio and control room as well as between the adjoining properties was inadequate. Our brief was to bring the place further into today's requirements in terms of internal acoustical performance, and upgrade the isolation system.

Control room complete with engineer and musicians

"We started by installing separate floating floors for the control room and studio. The building had to be tested to see if it could support the weight and they did this in an interesting way: they actually went down with strain gauges and loaded in bags of sand; there is a certain amount of sagging before it actually snaps so they could tell if it was getting too much! We then built the isolation walls on those floors and then inside walls inside the newly isolated walls.

"They had a pretty ghastly old studio and they just wanted something more up to date. It was not very live—very heavily damped, which may have been appropriate 10 years ago but not now. The control room also was heavily damped."

Working within parameters dictated by the structure of the building, it was not possible to vary from the original basic shape. A stud wall isolation system was introduced and the ceiling capped across with timber cross beams with isolation materials built up on top. Control room acoustics were designed on the following principles: "Reverb time in the control room has to relate to the reverb time in a typical domestic listening environment. It is all very well making it particularly long or short but it makes the mix's reverb time wrong. The domestic listening environment is very relevant to control room design. The danger with inappropriate reverb time is that the electronic reverb introduced on a mix will be disproportionate. A brighter acoustic is very much the trend; reverberation time in studios now is much longer than before."

The control room shell size is 6.5 m wide by 5.5 m deep with a recess along the back wall for seating of non-participating visitors. The colour scheme is based on blue fabrics and light woods, a theme which is carried throughout the facility. The timbers chosen are French Chestnut hardwood for the walls which is very durable and will stand the inevitable knocks and bangs from equipment; the floor is covered in Danish Ash which is even harder.

The monitor wall houses the new *JM3T* Eastlake monitors with the new shaped horn (it is otherwise very much the standard box with two 15 in TAD low frequency drivers and TAD berrylium diaphragmed high frequency driver). Finished in the Ash, there is a low frequency absorber beneath the window and glass panels underneath the monitors themselves.

Eastlake's main objective was to remove as much non-essential equipment from the room as possible to compensate for the relative lack of space. "It is by any standards a compact control room, and although it is easier to make a smaller room sound more impressive, a lot of people are asking for bigger rooms to accommodate keyboards these days."

Centrepiece is, of course, the SSL *4000* console. Outboard equipment is housed in a matching Chestnut trolley rack on castors. ("We took care that it was not too high to give reflections on one side of the room.") Provision for later additions has been made with an additional rack which will slide out of a recess in the wall but which, until then, is just a panel in the wall. At the time of writing there was a Drawmer *DS201* dual gate, Yamaha *Rev 7*, Lexicon *200* digital reverb, AMS *RMX16* and DMX *15-80S*, dbx *903* compressors, two Aphex *Aural Exciters*, Orban dynamic sibilance controller and Lexicon *224XL*. Additional monitoring is on Auratones and AR *18*s as well as Yamaha *NS10*s.

The front half of the floor is covered in made to order grey carpeting. "The carpeting on the wall is of a slightly different density because it does not get the same sort of wear and tear as the floor. (*! Ed*). The overall atmosphere is completed with incandescent downlighting on dimmers which are rotary transformer."

All tape machines and anything else possible is housed in a separate machine room which is accessed either via the control room or from the hallway. Once again the colour theme is blue and light timber. In here are a Studer *A800* MkIII 24-track, *A820* and *A810* mastering machines as well as a Sony *PCM 701* system, two Studer *A710* cassette machines, and Dolby *XP24* noise reduction.

The machine room floor as well as the corridors is covered in Pirelli raised rubber tiles which are becoming popular ▷

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The main recording area (36.5×14.5 m) is pretty large as current studio sizes go, with defined areas of varying acoustic. At the back of the room there is a dedicated drum area with Chestnut walls and Ash floor creating a reflective bright environment. Bass absorbers to left and right prevent the sound going out into the studio. Moving down the room there is a carpeted area which gives way to, once again, timber floor with reflective wall surfaces of pale blue laminate matching the ceiling fabric colour. Here is the home of the Baldwin grand piano.

"We worked to a noise criteria of NC20 and we changed everything, even the size of the window making it extra large to give a good view into the studio. You wouldn't recognise the place now if you had known it before. By introducing loads of small light fittings on tracks you achieve good diffusion and it is possible to move it to suit."

An isolation room required more work than the other rooms since they had existed before. Formerly a storeroom and stair well, the 4×3.3 m room has double glazed sliding doors into the main room. It is finished in accordance with the other rooms, ie Chestnut (one wall) and low frequency absorbers covered in the blue fabric (one side and rear walls). The function of an isolation room was still under discussion and it may be that in the future the floor may be refinished in wood.

As in the machine room, studio and control room, there is a totally separate air conditioning system which is a Japanese heat pump type of plant incorporating a rotary

Westland, continued

compressor in order to keep the noise output low.

Local engineer and ex-full time Lombard engineer Philip Begly played a major part in equipment choice (all equipment being installed by Jim Dunne and John Byrne of Control Techniques, Ireland). As a busy freelance engineer in Ireland, Philip is very well placed to comment on the Irish recording industry and its facilities. "Other 24-track facilities here are the two studios at Windmill Lane and also at Lansdowne. Originally we wanted something different to the SSL which Windmill also has but it is very difficult to find something. Besides, it is in fact a very good console and any business man wants clients."

As for work: "We don't get just one type of recording here, we get *everything*: traditional Irish, acoustic music, orchestral, rock, just synthesisers and drum machines. . .you really don't know what is going to come next." This, he went on to explain, is one of the main reasons why he is content to stay in Ireland since studios in England, for instance, tend to specialise more.

Westland are hoping that the new studio will attract international acts and feel that there is plenty of room for all the facilities in Dublin to thrive because the music industry is growing not only on a worldwide basis but also on an Irish basis. "Since we opened not only have we been choc-a-bloc with local bands, but we had a Finnish band here just from being in the SSL directory. Prior to this, there really wasn't much competition for Windmill Lane. It is good to have a professional multitrack facility available in the area at all times which we have now, even if one of us is block booked. We look at it in a positive way."

In addition to those already mentioned, studio personnel includes house engineer Daire Winston and tape-ops David Brown and Terry Urwin. On the maintenance side there is an arrangement with the aforementioned Jim Dunne and John Byrne who are on 24-hour call.

The building in which this facility is housed is also home to several other music related companies, some of which are part of the organisation. Since they have their own Lunar Records label and Squirrel Music (publishing) there is scope for a certain amount of in-house work.

Lunar Records gained its name as the result of its first signing which happened to be a group of very young boys. The father of one had been elected to represent all the boys' rights and eventually negotiated royalties for sales in cities (should they ever be founded) on future American space stations. So Lunar was formed. Current projects include work in conjunction with the local RTE television on a series of live concerts (resulting in 10 live albums). In a contra deal Lunar is provided with television advertising and an override on the sales; there are no real recording costs apart from cleaning up a bit and no advertising costs; can't be bad. It is also a good opportunity for local artists to get local promotion.

If you need more incentive to work in Ireland than the rolling countryside and the active cultural life, how does tax advantage strike you? If you are forced to work outside your own country Ireland has the same attractions as others whilst, for English speaking clients and especially British people, there is a special appeal. First off your money is worth 20% more. Current studio rates are 75 Irish pounds (£62 sterling).

Or as Brian says, "You can still watch *Coronation Street* (UK TV). If you want to go away from home without too much culture shock, well—here might as well be home. We can also offer Dublin with its environment conducive to creativity, its very young population and the fact that there is a lot happening musically; it is on a par with the Liverpool of the '60s. It is cost effective to record here."

As for supplementing the studio gear, there is not much facility for hire of studio effects although keyboards are fairly easy to get hold of. "For studio gear we would have to get if from across the water but it's not a hellish problem," explained Daire.

The studio lies a 30 minute drive from the airport (Dublin is only an hour and an half away from London) and the harbour is virtually within walking distance if you prefer to cross by ferry. At the same time it is almost in the city centre—300 to 400 yards away from Dublin's shopping centre, Grafton Street.

In spite of what they say, it's not really little England, it is definitely a place with a charm and character all its own. The only way to understand is to go there.

Janet Angus

Westland Studio, 5/6 Lombard Street, Dublin 2, Ireland. Tel: 01-774229. Telex: 32618.

Sawmills, Fowey, Cornwall

Bodmin Pill sounds an unlikely name for the location of a professional recording studio. A studio on the Pill? Hardly the place to conceive musical ideas! On the contrary, the long list of name artists who have recorded there bears testimony to Sawmills' popularity as a recording venue away from the disturbances of the city. For Bodmin Pill is in fact a quiet dreamy backwater off the River Fowey a mile or so from where it slips by the town of Fowey and out into the English Channel, after flowing from craggy heights down through an area that has been an inspiration to writers, artists and musicians for centuries.

Viewed from the far side of the Pill, Sawmills Studio, surrounded by oak woods, is picturesque enough, but the view, through the control room window might only be described as an 'animated' Constable between the monitor speakers. If music is poetry, it would be hard to imagine a better place to write it, as the original owner of the studio must have been aware when he first installed it in 1972. Now the studio has been completely re-equipped so that the music may be written and recorded with all the dexterity that modern computerised technology has to offer.

There has been a settlement on the site since the 11th century for it was mentioned in the Doomsday Book. But the architects of the present day building, several hundred years ago, unknowingly provided structural features well suited to a sound recording environment. The main outer shell is constructed of solid granite blocks hence sound leakage in or out is minimal and the granite, being unrendered on the interior in ▷

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MZ101 for vocal

MZ102Be for vocal

MZ103Be for vocal

MZ104 for instrument

MZ105Be for instrument

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both the control room and studio, lends a natural, untiring brightness to the sound. Especially useful in the latter area when recording acoustic instruments such as guitar, flute, 'live' drums and electric guitar sounds—not to mention 'airy' vocals. Also, the interior partition walls are not parallel, thus troublesome room resonances and standing waves, associated with colouration of monitor speaker output, are avoided.

Simon Fraser, the new owner, has worked the studio since it was first installed and his practical experience combined with the expertise and ideas of two other engineers, John Cornfald and Dennis Rigley, has resulted in the new configuration and re-equipping completed at the end of last year. Long term inmates of the professional recording business and readers of *Studio Sound* may recall an earlier review of Sawmills in October 1976.

Simon Fraser: "The digital computer synth business just expanded so rapidly that we decided, as so many of the musicians working here are synth bands or lone composers to revamp the studio so that it could be operated by one person if necessary. Also, we do a lot of film music for travelogues, radio jingles and commercials and TV ads and it became practically obvious to orientate everything around the computer and mixing desk rather than to a control room window looking out into a studio which is only used for drum, vox and guitar overdubs. Even guitars go through synths and more often than not a whole band, with synths keyboards and drum machine will be working around the board looking at the engineer rather than at each other as it was, or rather is, during conventional band recording when visual contact between musicians helps to keep the track tight. Now the computer or drum machine click track takes care of that. And separation isn't needed because every instrument is direct injected straight into the system. We use the studio most often for 'live' drum tracks and guitar, percussion and vox overdubbing. That is not to say we no longer cater for conventional set-up. The past

Sawmills, continued

John Cornfald and owner Simon Fraser

14 years have proven the versatility of the studio area. It has a variety of 'acoustics' which may be exploited quickly. A great aid to creativity. And the granite wall down the whole of one side means that acoustic musicians such as folk or classical guitarists, lutanists, etc, have a very 'natural' setting for their instruments from the outset. But the studio is easily damped down or separated off and there are 'dry' drum, and vocal booths."

In fact, Sawmills is a very fuss-free and practical studio all round. All round being the most descriptive words for several reasons. Firstly, on taking up the engineering position at the newly installed customised Trident series *80B* console (30/24/24 with 50 channels of remix) one is likely to get the impression of sitting in the flight deck of a jumbo jet as all the signal processing and effects equipment falls within easy reach not only to the right and left of the console but also above the engineer's head in a sort of 'effects' bridge. Equipment parameters may be altered without the need to leave the head position simply by reaching upwards or to each side. Manufacturers represented here include AMS, MXR, Drawmer, Lexicon, Yamaha, Eventide, Audio Design, Aphex—in fact, there is just about everything anyone might ever need.

Secondly, for digitally triggered synths, keyboards and drum machines a MIDI ring is wired throughout the control room and studio, along with a DI ring and the usual mic circuits. The MIDI ring is connected to a BBC computer, also ergonomically located to the immediate right of the engineer's seat, and up to eight digital instruments may be inserted into the ring at any one time. Digital sequences written into the computer memory are related back to each instrument 'individually' and not on a 'thru' loop system from instrument to instrument which can cause disparity between trigger pulses. All the information written into the computer may be displayed on the VDU.

To the immediate left-hand side of the seat is the Fostex *4080* autolocator for the Ampex *M1100* 24-track tape machine and, as remotes for every other tape machine are on the mixing desk, an engineer or engineer/composer may work the studio single handed. The only reason he would need to leave his seat would be to load tape or play musical instruments—if the computer hasn't already been programmed to do so. A Sony *PCM-F1* is also in residence.

A most interesting and unique feature of Sawmills is that it has what can only be described as the largest 'reverb' device in the world (unless someone has built a studio in the Grand Canyon).For not far from the existing *EMT 140* stereo plate is a door in the wall. Behind the door is the Pill (the wooded valley with a tidal creek in it). "We stack about 1000 watts-worth of speakers in the door and place mics at either end of the building and then shoot sound across the valley. As the tide comes in the reverberation time increases because the sound is continually reflected between the surface of the water and the trees and valley sides. The only problem is that when a shorter reverb time is needed it takes three hours for the tide to go down and we don't have a button on the board to control the moon!"

Better not zoom any sawtooth wave forms out there with all those trees around!

"The effect sounds absolutely amazing at the desk where one hears a combination of recorded and 'live' sound."

Most echo chambers sit in the studio, this studio sits in the echo chamber.

Quested *212* system monitoring has recently been installed powered by Yamaha amps.

"We are fortunate here in that much of the cladding that you might see in, for instance an Eastlake-type studio, such as natural stone and wood, is already inherent in the room. Visiting producers may install their preferred speakers if they wish."

With a spacious sun patio overlooking the Pill and river just outside the control room doors, and the large lounge with inglenook type fireplace stacked up with logs in the upper part of the building, the atmosphere is very relaxed and ideal for block bookings with the provision of chalet accommodation. Nearby are the hotels and restaurants of Fowey and the beaches of the Cornish Riviera.

"For what it would cost to hire an AMS for one day in London will book this studio for two days and that includes everything. Our rates are discountable the longer the period booked so after a week or so we're very cost effective. A band on a low recording budget can get all the facilities of a top studio and as there is no pressure on time, musicians can work when and for as long as they like day or night."

David Hastilow

Sawmills Recording Studio, Golant, Fowey, Cornwall, UK. Tel: 0726 833338.□

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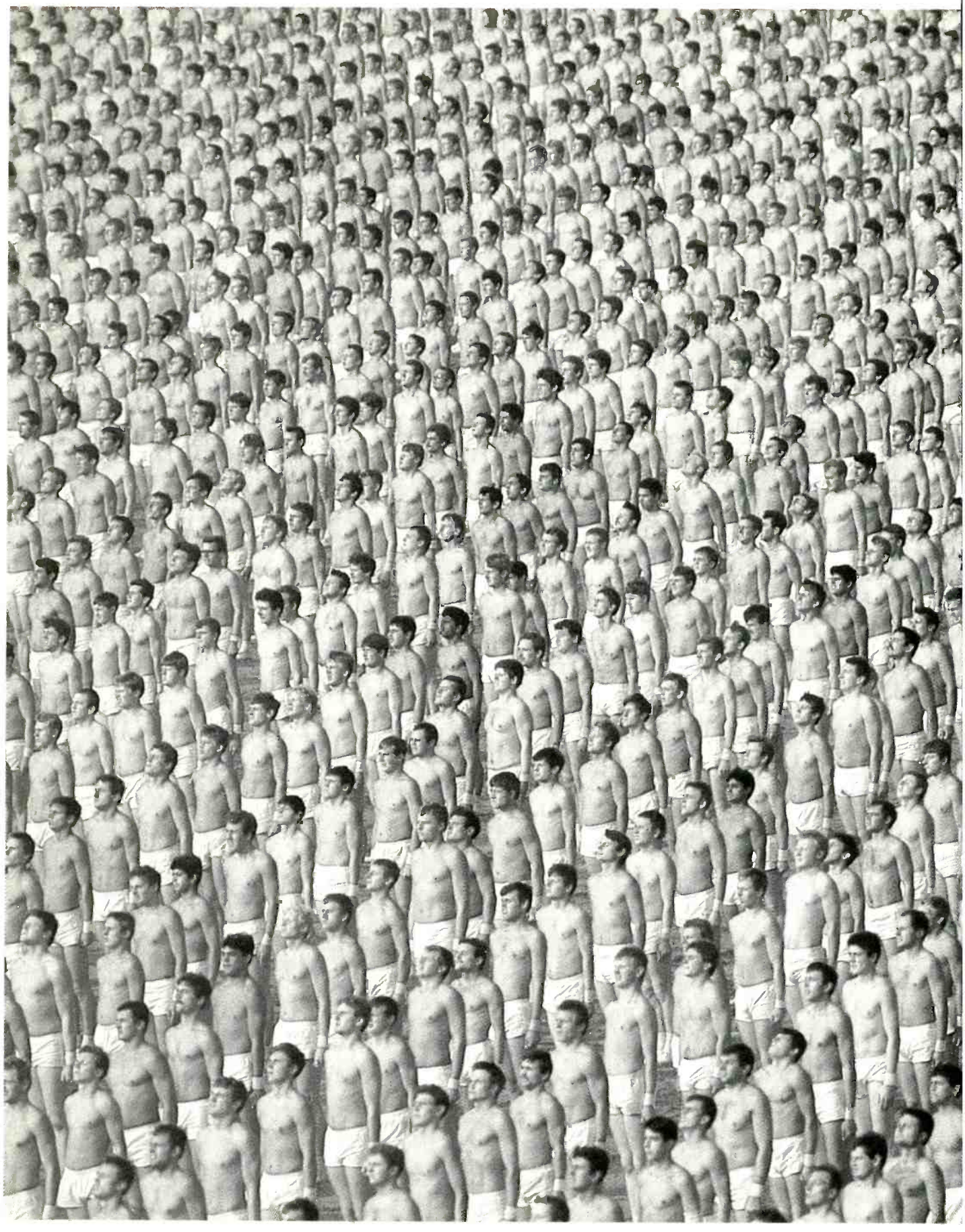

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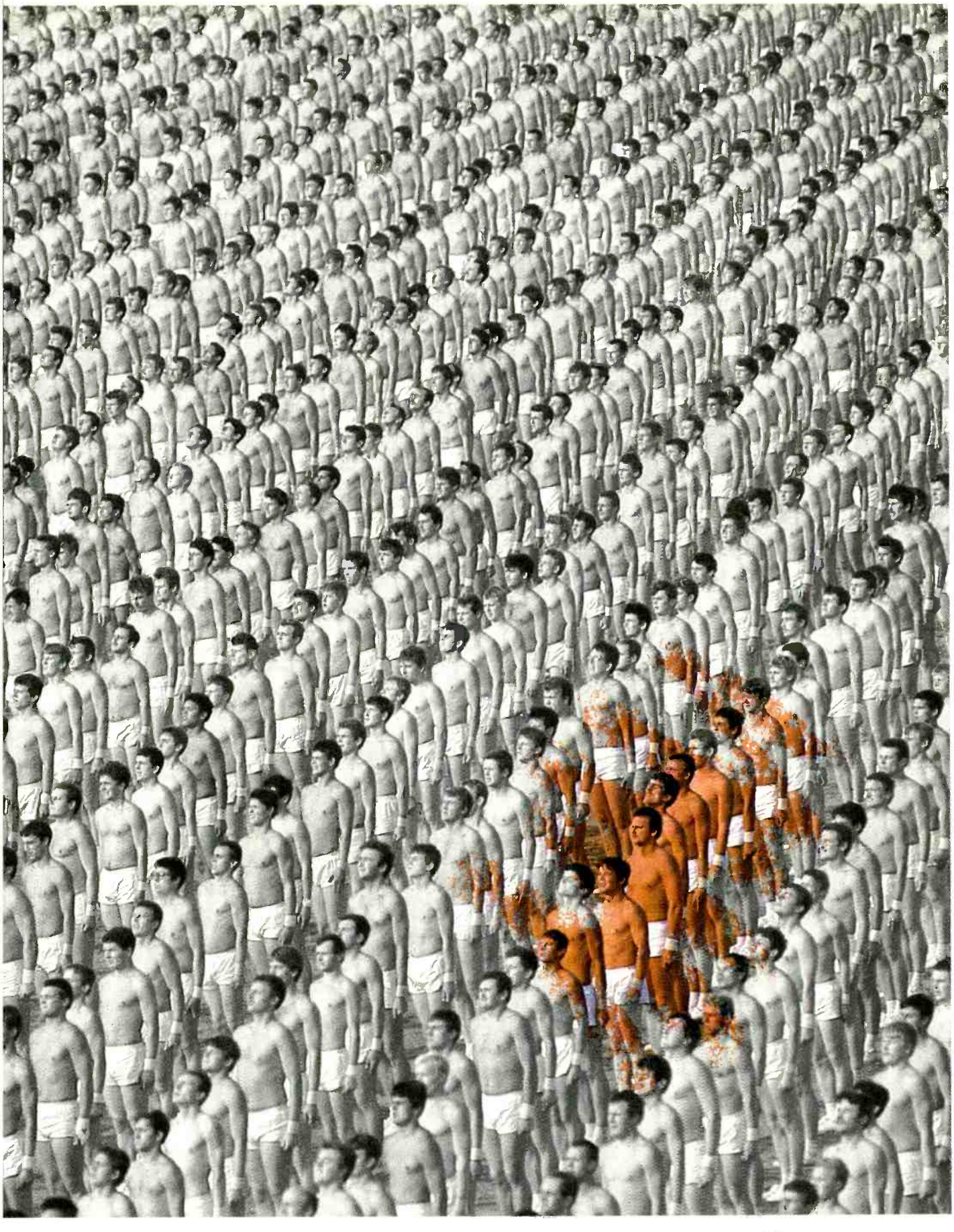

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MIXING CONSOLE TECHNOLOGY
THE TRIDENT VIEW

A number of mixing console manufacturers are looking towards digital technology. Malcolm Toft of Trident outlines why he believes the human element is important

As the use of digital recorders becomes increasingly commonplace in 24- and 32-track recording studios, there is mounting pressure upon manufacturers to provide recording consoles which embody this technology. It is obvious to all concerned why digital technology has in the main been applied to storage (tape recorder) rather than real-time (console) since the magnetic tape recorder has for many years been the weak link in the signal to noise/headroom chain. Apart from improving the signal quality digital technology has provided scope for the manipulation of audio signals that would have only been dreamt of even a few years ago. In a recording console, it is this manipulation that is possibly more important than whether the signal remains in the analogue or digital domain.

The problem with implementing digital technology in a recording console is as much one of technical design as of the human engineering aspect. With a tape recorder it does not really matter (within reason) where the controls are situated, as its primary function is to capture and reproduce sounds as faithfully as possible. The layout of the console's controls, however, are far more critical; a misplaced control can be just an irritation at the start of a session and a major cause of annoyance 12 hours on. Engineers and producers often work under extreme pressure so it is obviously of great importance that the equipment they use is logical and easy to operate.

Without entering into a lengthy definition of the term 'human engineering' it has at its roots two fundamentals:

- ergonomics—the physical layout whereby all controls must fall to hand in a logical pattern or sequence;
- system design—the arrangement of the circuit 'blocks' such that whilst the overall system may be extremely complex, the signal path follows a logical pattern or sequence that is easy to understand and modify if necessary.

It is not easy to achieve good human engineering in an analogue console but providing common sense prevails it is possible. With the design of a digitally controlled console (whether entirely digital or digitally controlled analogue) that task becomes infinitely more complex and a complete re-think becomes necessary in terms of the presentation of the operational controls. The problem is caused mainly by the fact that the role of such a console becomes more as a computer and less like a recording console once you think in terms of total reset and storage of every function in the system. It is very easy, therefore, to let technology take over with the resulting console resembling a data entry terminal.

Three key issues formed the basis of Trident's ergonomic and system design strategy for a console incorporating digital technology.

- All-digital or digitally controlled analogue?
- System design: virtual or dedicated?
- Dynamic or static automation?

In addressing the first item we had to consider two major factors. Firstly the selling price of an all-digital console would probably be two or three times its digitally controlled analogue counterpart. Secondly, research time would be

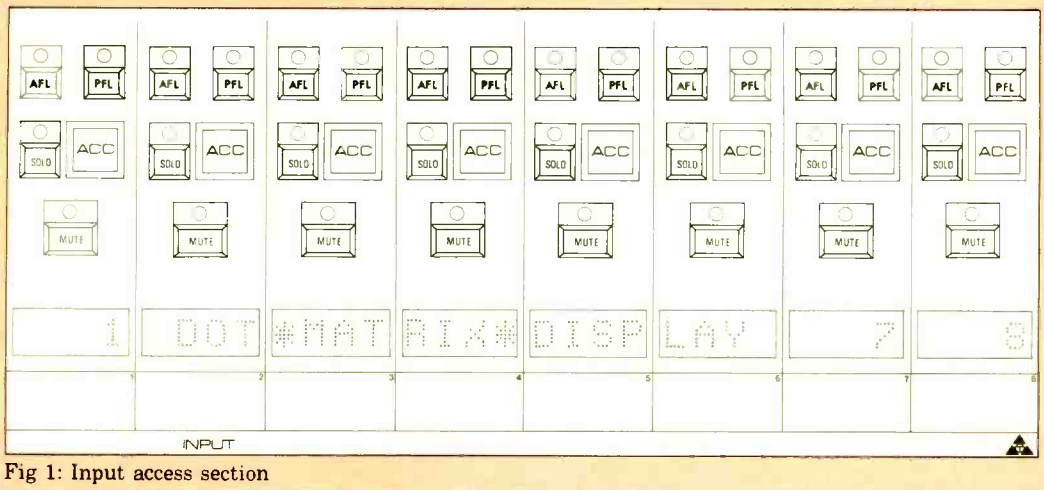


Fig 1: Input access section

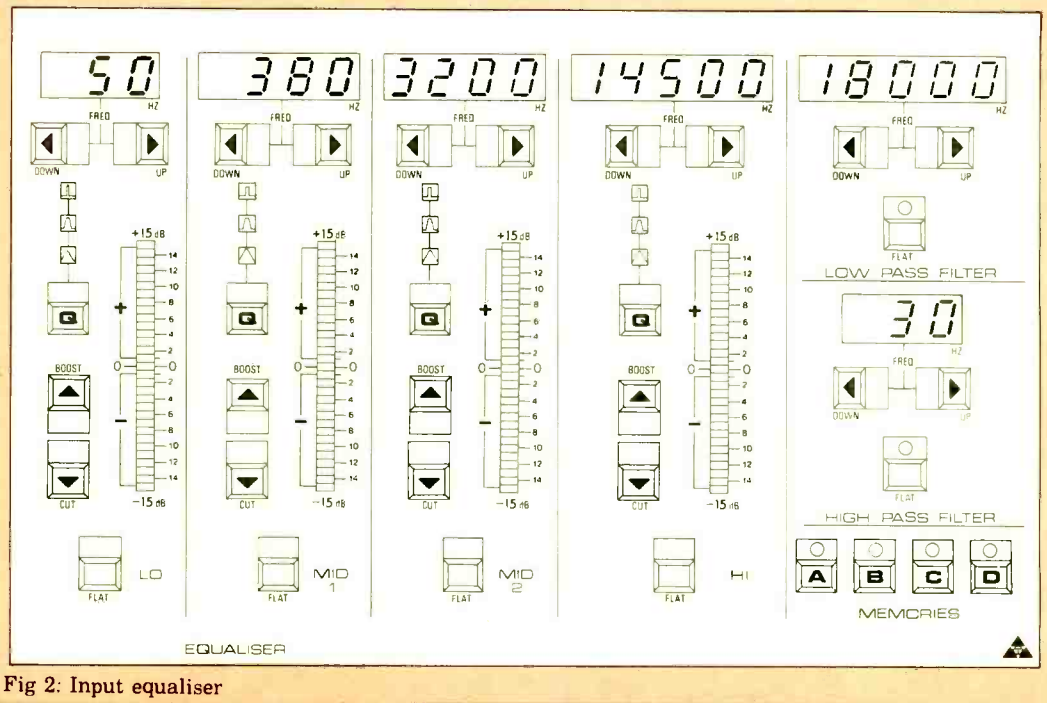


Fig 2: Input equaliser

extended to such a degree that by the time the project was completed, advances in technology would probably have superseded the original design work making the product obsolescent. Discussions with many engineers and producers also convinced us that there is a tremendously strong preference for keeping the audio signal in the analogue domain with the manipulation of the signal being carried out in the digital domain. Whilst the *Di-An* console is fundamentally a digitally controlled analogue console, it is digital-ready in as much as it is anticipated that the analogue audio cards will be replaceable at a later date with all-digital electronics making the console fully digital.

Regarding the choice of 'virtual' or 'dedicated' system design, it might be prudent at this juncture to explain to those unfamiliar with the meanings of these terms. A virtual console is one in which all blocks of signal circuitry are under software control so that effectively any signal path can be constructed within the system architecture and stored for further use. A dedicated system design is similar to that of conventional analogue consoles except that digital control allows much greater switching capability from one function to another. Virtual design is a very alluring feature for manufacturer and customer as theoretically it means that one console can be very quickly (instantly?) reconfigured from, say, multitrack recording to music dialogue and effects recording for film. In practice, however, our evaluation has shown that two major problems arise. Firstly, the customer buys many facilities he will never use—how many multitrack studios, for example, require 3-track surround sound panning? Secondly, the system becomes far more unwieldly to operate; the software becomes more menu-driven just like a normal computer. The more elaborate the software, the more layers of operational instructions the user has to wade through to get to the one he wants.

In order to provide a clear and logical operational path, the *Di-An* console employs conventional analogue dedicated circuit paths so is configured primarily as a multitrack recording and remixing console. Because large amounts of digital control and software are used, designing a version dedicated to the tasks of video, broadcast, film or theatre use is much simpler than with a conventional console: it becomes mainly a replacement of standard sized digitally controlled analogue (DCA) cards and software.

Since it was a criterion from the outset to provide a console where every front panel control could be memorised and instantly reset, the way in which this was to be achieved was the subject of much discussion between Trident and potential end users. It soon became apparent that the word 'automation' in this context was misleading as this had generally been applied to the control of faders which are dynamic in nature and it is often a requirement that their actual movement is recorded.

When we look at the rest of the controls in a console, however, the story is quite different. The equaliser is the most complex and often used part and yet once the required modification has been achieved it is nearly always left in that position. This holds true for just about every other control in the console apart from the faders. In order to provide dynamic automation, the computer has to scan every control many times a second to see if there has been a positional change and if so record it. As the number of controls increases, so does the speed and therefore the computing power requirement. It follows, therefore, that a console providing dynamic automation of every function would require an extremely sophisticated computer to provide a facility that is seldom used.

Apart from the faders, the *Di-An* console provides static memory of all levels, routing, equalisation, auxiliary sends, panning, mutes and solos within the console. By this method, computing power is reduced considerably, all software being held in RAM so that use of the console is instantaneous, floppy disks only being used for the storage and retrieval of desk settings.

Since the static memory system is linked to SMPTE timecode, console settings can be changed every frame (typically 40 ms). A change can comprise just one setting or every control in the console. Trident has termed these changes an 'event'. Within the *Di-An* system it is possible to ▷

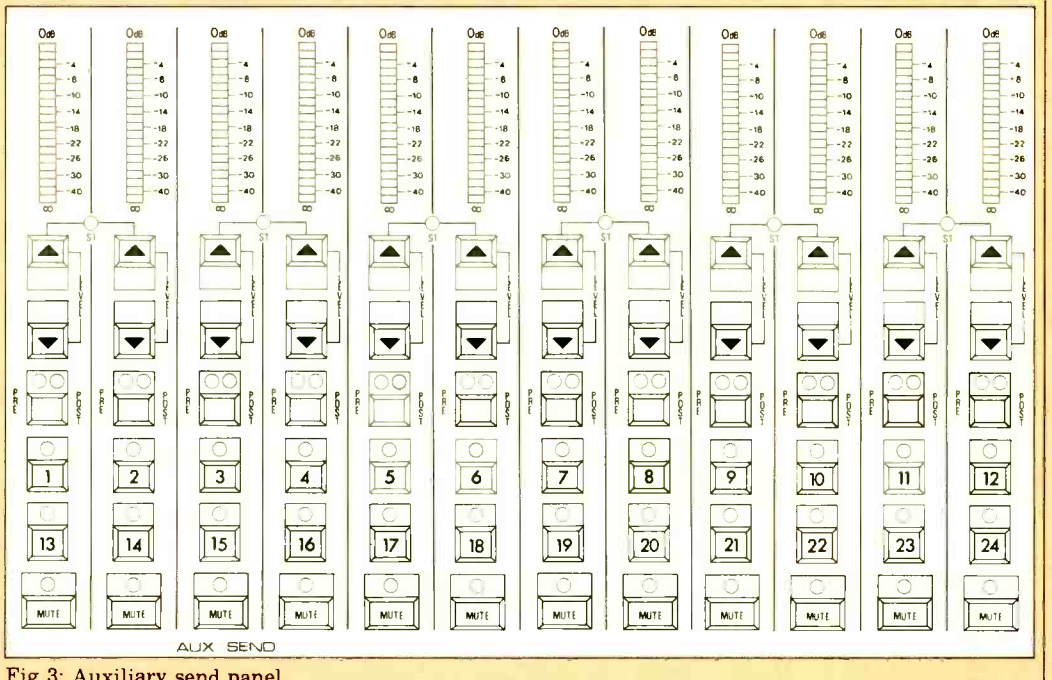


Fig 3: Auxiliary send panel

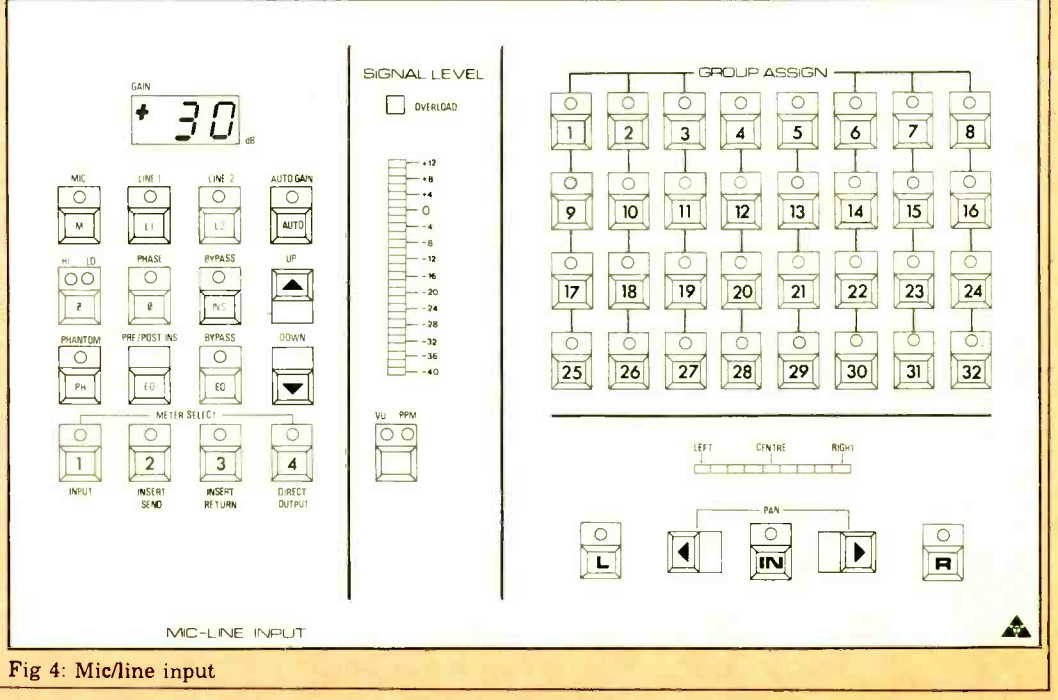


Fig 4: Mic/line input

have up to 255 such events. It is therefore theoretically possible to change every control approximately each second of a 5 min remix.

If it should ever become necessary to simulate dynamic automation, this can quite easily be achieved by stringing together a number of events. Since an event can take place every frame (to sub-frame accuracy) a sequence of events can create an extremely good facsimile of movement in exactly the same way that a moving picture is created by a number of still pictures being sequenced in rapid succession.

The *Di-An* does not contain any input or output modules in the accepted sense. Instead the console allows the user to access a number of central control panels via an illuminated access button situated above each fader. These access buttons together with mute, AFL, PFL, stereo solo and channel status indicator LEDs are the only controls duplicated for every input.

The input section of the console comprises three central control panels (each about the size of an A4 sheet of paper) and separately consists of: equalisation, auxiliary sends (24) and input selection, level, routing and panning. Directly above the faders are the access panels shown in **Fig 1.** Each panel caters for eight inputs and provides individual channel access, mono after-fade listen, pre-fade listen, stereo solo, mute and automute. A 4-character alpha-numeric display per input makes it possible to memorise and load from disk, information pertaining to that input. A conventional writing strip is also provided below the display for additional information that does not need to be memorised.

Above the central control panels and furthest from the operator are the routing indicator panels. Again, these are in sections of eight and consist entirely of LEDs that indicate to which group the input is routed, which input is selected (mic or one of two line inputs), phase reverse, equalisation and dynamics (an optional noise gate/limiter per channel is provided for).

Fig 2 shows the input equaliser section. As can be seen, this consists of six individual sections. The first four are almost identical and each comprises a 16-frequency sweep equaliser with digital display of frequency, boost and cut buttons with bargraph display, 3-position Q control and individual bypass (flat) keys. The last two sections are swept high and low pass filters which again have 16 frequencies with digital display in each range with a slope rate of 12 dB/octave and individual bypass keys.

Completing the equaliser section are four memory keys. These make it possible for each input of the console to store up to four different EQ settings which can be recalled simply by depressing the appropriate key.

Fig 3 shows the auxiliary send panel divided into 12 identical sections providing level control, pre/post fader selection, mute and the ability to re-route the auxiliary sends so that up to 24 sends are available from each input. If two re-routing keys are depressed in pairs, ie 1 and 2 or 3 and 4, they automatically become stereo pairs. By this method, the stereo balance can be set by adjusting the adjacent level buttons for the correct perspective, then touching both routing buttons together will cause the level controls to track together thereby maintaining the stereo image. Similarly either mute button will affect both sections. An LED between each pair indicates when the stereo mode is selected.

The final panel in the input section is the mic/line and channel routing section (**Fig 4**). The left hand section of this panel provides for selection of any of three input sources: mic, line 1 or line 2. Line 1 would normally be the appropriate multitrack return, whilst line 2 could be used as a synthesiser or any other line level input. Below the Mic Input key is a high or low impedance select button which, when set to the high mode, allows for the direct injection of a high impedance musical instrument such as a guitar, etc. A digital display indicates the input level set for the appropriate input and this can be set or adjusted via the Up/Down keys. In ▷

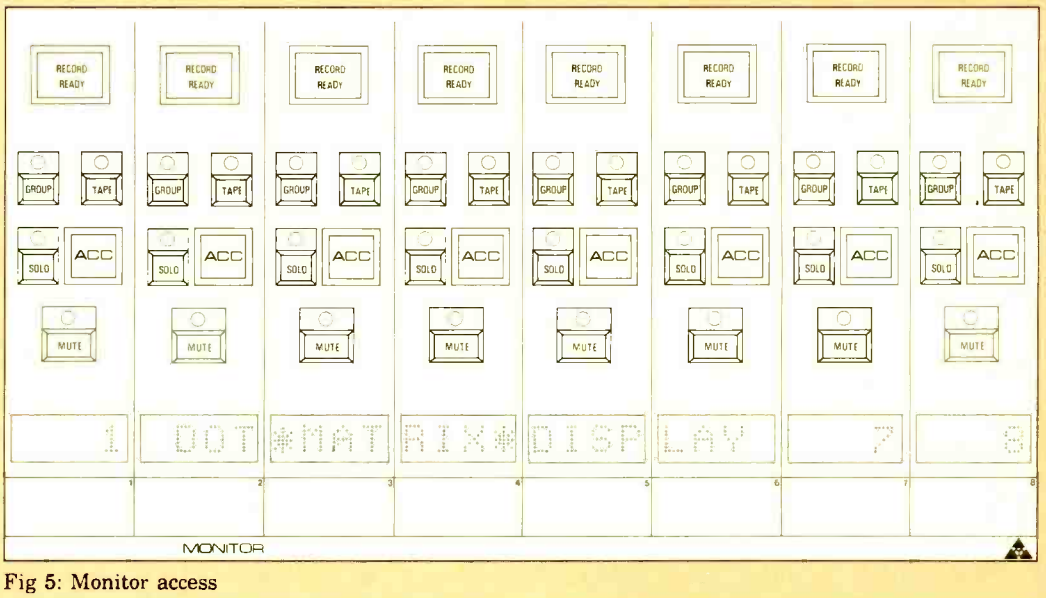


Fig 5: Monitor access

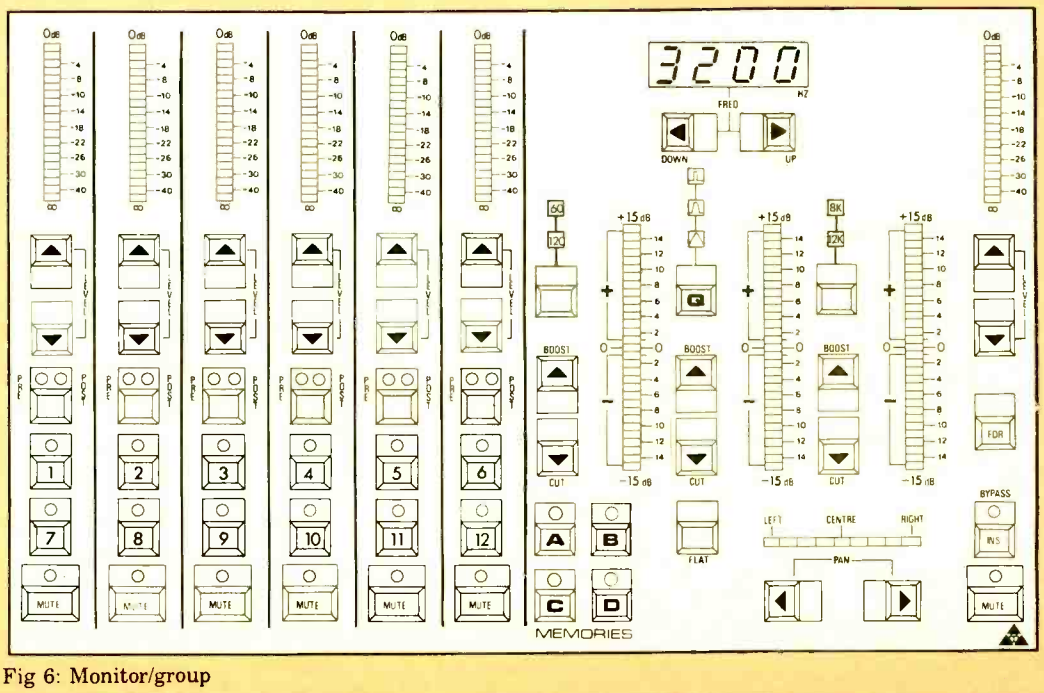
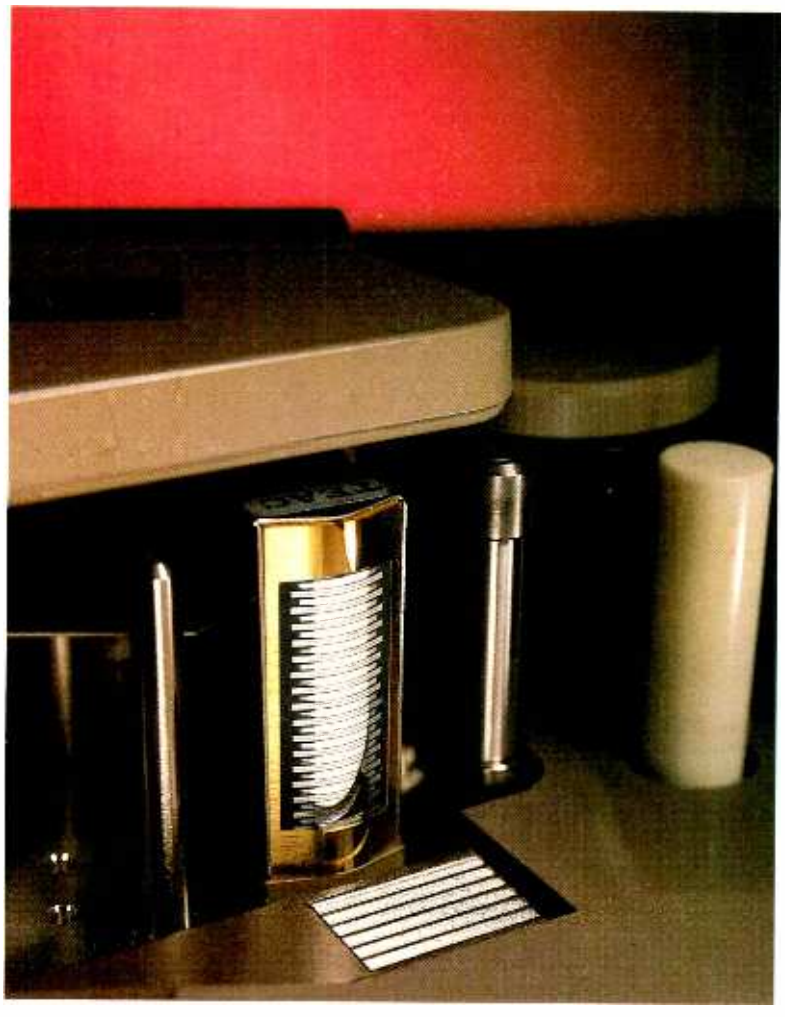


Fig 6: Monitor/group



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TEAC Professional Division

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association with this is an Auto-Gain key. By depressing this key, the input level will be set for the input selected by sampling the incoming signal for a pre-determined period and automatically adjusting the input amplifier so that the level is set 5 dB down from peak amplitude. A master Auto-Gain control located elsewhere in the console makes it possible to adjust all input levels simultaneously. Other facilities in this section are: phase reverse (on all inputs), bypass of the insert point, selection of the equaliser pre or post the insert point, phantom power on/off and finally the ability to meter the input at any one of four different places in conjunction with a 100-segment bargraph display situated on the meter overbridge in line with each fader.

To the right of the input section is a level indicator which reads in tandem with the appropriate 100-segment bargraph meter. This saves the operator from having to glance away from the panel in order to check the input level. This meter can also be switched between VU or PPM and above the meter is an input overload indicator which is a summation of all the input level monitoring points. To the extreme right of this panel is a 32-way keypad making it possible to select an input to any combination of output groups (panning being between odd and even pairs). Separate keys select the input to the master monitor/remix outputs. A 9-position pan control with LED indication of stereo position completes this panel.

The console has a separate 32-way monitor section which is in many ways similar to the input section. Thirty-two automated faders are provided for (these normally controlling the monitor levels) together with an access panel (**Fig 5**) which provides monitor access, stereo solo, mute, group/tape monitor switching, plus a large illuminated Record Ready button which will select any individual track to the record mode in conjunction with the recorder's master record button. A programmable dot matrix display of four alpha-numeric characters per track completes the monitor access panel.

One master panel (**Fig 6**) provides all the necessary monitor facilities. Six auxiliary sends are provided (which can be re-routed to become 12) with pre/post selection and mute. A 3-band equaliser having high and low shelving with selectable turnover points in each range plus a mid-range section with digital frequency display from 700 Hz to 7200 Hz and three bandwidth settings with overall bypass and four memories is also included. Monitor panning is provided by means of a 9-position pan control with LED indication of stereo image. Group output levels can be adjusted by means of up/down keys combined with a bargraph display of level and mute. Since the monitor levels are normally adjusted by the long throw faders, an automated monitor mix becomes possible. Similarly, when the monitor section is used as additional line inputs during mixdown, these too can be automated. A fader reverse button per monitor section is, however, provided should it become necessary to adjust the group output level by means of the long throw faders.

The final central control panel in the system is the aux master/echo return panel (**Fig 7**). Simultaneous access to the appropriate aux master and echo return is provided via a 24-way keypad. A digital display indicates which of these has been accessed. Above the display are up/down keys to set the aux master level with LED bargraphs to indicate level adjustment and actual output level. A high and low shelving equaliser can be selected to either the aux master send or echo return and like all other equalisers in the system, is provided with four memory capability. The echo return section is also provided with a level and pan control, solo and the ability to route the return signal to aux sends 9-12 for echo to foldback (cue) purposes.

In order to provide an integrated system, the *Di-An* console will offer the option of an in-built tape synchroniser. Additional software will also provide track sheet information, etc, which can be displayed on an external monitor.

Fig 8 shows the overall layout of the console and as can be seen, it is of similar proportions to a conventional console. The operational hand span is, however, considerably reduced which is significant considering the amount of additional facilities offered. □

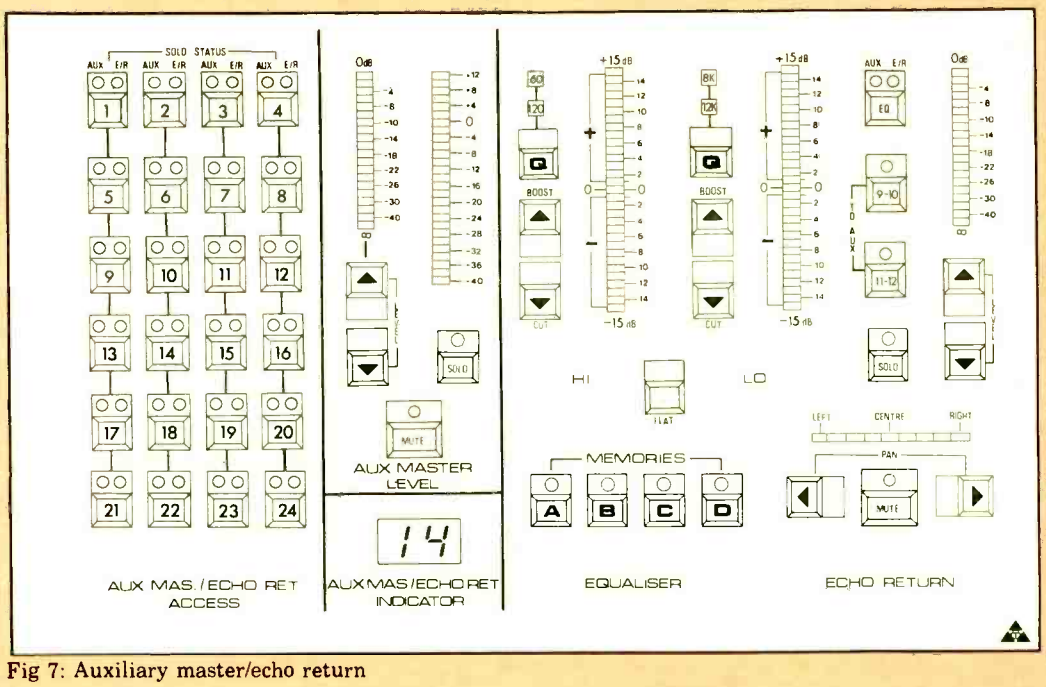

Fig 7: Auxiliary master/echo return

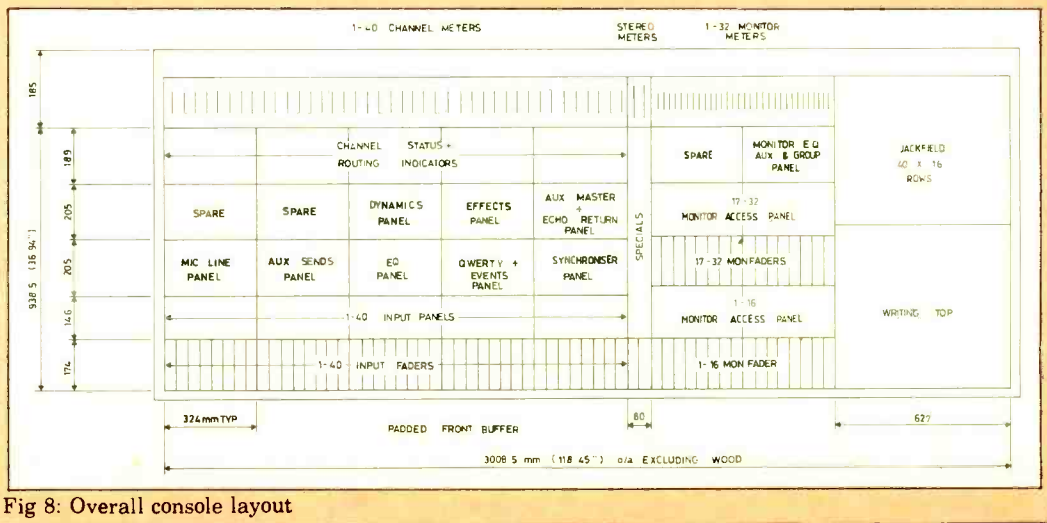

Fig 8: Overall console layout

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STUDER REVOX CANADA LTD Toronto Telephone (416) 423-2831

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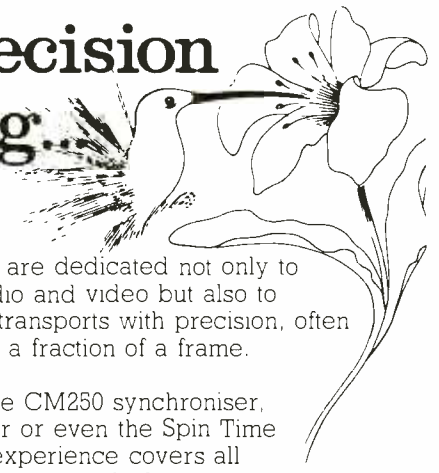
Interconnection

A guide to suppliers of connectors, plugs, patchbays, etc.

	Jack plugs	Jack sockets	Jack panels	Jackfields	Phono plugs	XLR-type sockets	XLR-type connectors	Patch cords	Patch panels
ADC (USA) **ADC Products, 4900 W 78th Street, Minneapolis, MN 55435. Tel: (612) 835-6800. Telex: 290321.** **UK:** Communication Accessories & Equipment Ltd, 70-80 Akeman Street, Tring, Herts HP23 6AH. Tel: 0442 824011. Telex: 82362.	•	•	•	•	•	•	•	•	
AMPHENOL (USA) **Amphenol, 33 East Franklin Street, Danbury, CT 06804. Tel: (273) 743-9272.** **UK:** Amphenol Ltd, Thanet Way, Whitstable, Kent CT5 3JF. Tel: 0227 264411. Telex: 96157.						•	•		
BRYANT (UK) **Bryant Broadcast & Data Communications, Top Floor, 33 London Road, Bromley, Kent BR1 1JG. Tel: 01-464 4967.**			•	•	•			•	•
CANFORD (UK) **Canford Audio, Stargate Works, Ryton, Tyne & Wear NE40 3EX. Tel: 091-4137171. Telex: 537792.**	•	•	•	•	•	•	•	•	
CANNON (USA) **ITT Cannon Electric, 666 East Dyer Road, Santa Ana, CA 92702 Tel: (714) 557-4700.** **UK:** Cannon Electric (GB) Ltd, Jays Close, Viables Industrial Estate, Basingstoke, Hants RG22 4BW. Tel: 0256 473171. Telex: 858105.						•	•		
CONNECTRONICS (UK) **Connectronics Ltd, 20 Victoria Road, New Barnet, Herts EN4 9PF. Tel: 01-449 3663/4044. Telex: 8955127.** **USA:** Connectronics Corp, 652 Glenbrook Road, Stamford, CT 06906. Tel: (203) 324-2889. Telex: 643678.	•	•			•	•	•	•	•
DRAKE (UK) **Philip Drake Electronics Ltd, 37 Broadwater Road, Welwyn Garden City, Herts AL7 3LX. Tel: 07073 33866. Telex: 25415.**			•	•				•	
FUTURE FILM (UK) **Future Film Developments, PO Box 3DG, 114 Wardour Street, London W1A 3DG. Tel: 01-434 3344/01-437 1892. Telex: 21624.**	•	•	•	•	•	•	•	•	•
MONSTER (USA) **Monster Cable Products Inc, 101 Townsend Street, San Francisco, CA 94107. Tel: (415) 777-1355. Telex: 470584.** **UK:** Custom Cable Services, 35 High Street, New Malden, Surrey KT3. Tel: 01-942 9567.	•				•	•	•	•	
MOSSES & MITCHELL (UK) **Mosses & Mitchell Ltd, Weydon Lane, Farnham, Surrey GU9 8QL. Tel: 0252 721236. Telex: 858820.**	•	•		•				•	
NEUTRIK (Liechtenstein) **Neutrik AG, Im Alten Riet 34, FL-9494, Schaan, Furstentum. Tel: 075 26383. Telex: CH-77771.** **UK:** Eardley Electronics Ltd, Eardley House, 182/4 Campden Hill Road, London W8 7AS. Tel: 01-221 0606. Telex: 23894. **USA:** Neutrik Prods, 77 Selleck Street, Stamford, CT 06902. Tel: (203) 348-2121.	•					•	•		
RENDAR (UK) **Wilmot Breeden Electronics Ltd, Durban Road, Bognor Regis, West Sussex PO22 9RL. Tel: 0243 825811. Telex: 86120.**	•	•							
RS COMPONENTS (UK) **RS Components Ltd, PO Box 99, Corby, Northants NN17 9RS. Tel: 0536 201201 or 01-360 8600. Telex: 342512.**	•	•			•	•	•		
SWITCHCRAFT (USA) **Switchcraft Inc, 5555 North Elston Avenue, Chicago, IL 60630. Tel: (312) 792-2700. Telex: 792-2700.** **UK:** FWO Bauch Ltd, 49 Theobald Street, Boreham Wood, Herts WD6 4RZ. Tel: 01-953 0091. Telex: 27502.	•	•	•	•	•	•	•		
TRIMM (USA) **Trimm Inc, 400 Westlake Street, Libertyville, IL 60048. Tel: (312) 362-3700.** **UK:** Future Film Developments, PO Box 3DG, 114 Wardour Street, London W1A 3DG. Tel: 01-434 3344/01-437 1892. Telex: 21624.	•	•	•	•					
TURNKEY (UK) **Bandive, Brent View Road, London NW9 7EL. Tel: 01-202 4366.**			•		•			•	•

precision timing...



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ADV 349/2/E

Cables

A short guide to specialist cables and cable manufacturers

ALPHA (USA)
Alpha Wire Corp, 711 Lidgerwood Avenue, Elizabeth, NJ 07207. Tel: (201) 925-8000.
UK: Alpha Wire Ltd, Central Way, North Feltham Trading Estate, Feltham, Middlesex. Tel: 01-751 0261. Telex: 8813660.

Extensive range of wire and cables suitable for audio and transmission use.

ANIXTER (USA)
Anixter Bros Inc, 4711 Golf Road, Skokie, IL 60076. Tel: (312) 677-2600.
UK: Anixter (UK) Ltd, 632-652 London Road, Isleworth, Middlesex TW7 4EY. Tel: 01-561 8118.

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BELDEN (USA)
Belden Corp, PO Box 1331, Richmond, IN 47374. Tel: (317) 966-6661.
UK: Leonard Wadsworth & Co (Electronics) Ltd, Warehouse Block F, Imber Court Trading Estate, Orchard Lane, East Molesey, Surrey KT8 0DA. Tel: 01-398 4288. Telex: 264028.

Extremely wide range suitable for most electrical and electronic applications.

BICC (UK)
BICC General Cables Ltd, Helsby Works, Helsby, Warrington, Cheshire WA6 0DJ. Tel: 09282 2700. Telex: 629348/9.
USA: BICC Ltd, 126 Northpoint Drive, Suite 108, TX 7706. Tel: (713) 447-7915. Telex: 774200.

Multipair, mic and loudspeaker cables including both PVC and polythene types.

BIW (USA)
Boston Insulated Wire & Cable Co, 65 Bay Street, Boston, MA 021125. Tel: (617) 265-2102. Telex: 940604.
UK: Boston Insulated Wire (UK) Ltd, 1 Canbury Park Road, Kingston-upon-Thames KT2 6JY. Tel: 01-546 3384. Telex: 21885.

Specialist cable manufacturer for OB and studio use.

BLAKE (USA)
Blake Wire & Cable Corp, 19505 Pacific Gateway Drive, Torrance, CA 90502. Tel: (213) 515-0561.

Wide variety of audio and video cables including multicore with control and communications lines.

CANARE (Japan)
Canare Electric Co, 16-13 Shobuike Otsu, Nagakute, Nagakute-cho, Aichi 480-11, Japan. Tel: 05616-2-5446. Telex: 4496030.
UK: Future Film Developments, PO Box 3DG, 114 Wardour Street, London W1A 3DG. Tel: 01-434 3344/01-437 1892. Telex 21624
USA: Canare Cable Inc, 6733 Vineland Avenue, North Hollywood, CA 91606. Tel: (213) 506-7602/(213) 980-8092.

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CLIFF (UK)
Cliff Electronic Components Ltd, 76 Holmethorpe Avenue, Holmethorpe Industrial Estate, Redhill, Surrey RH1 2PF. Tel: 0737-71375.

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CONNECTRONICS (UK)
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DAVU (UK)
Davu Wire & Cables Ltd, Harrow Manorway, Abbey Wood, London SE2 9AA. Tel: 01-310 7036. Telex: 896767.

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EMT (Switzerland)
EMT Franz GmbH, Postfach 1520, D-7630 Lahr, West Germany. Tel: 07825 512. Telex: 754319.
UK: FWO Bauch Ltd, 49 Theobald Street, Boreham Wood, Herts WD6 4RZ. Tel: 01-953 0091. Telex: 27502.
USA: Gotham Audio Corp, 741 Washington Street, New York, NY10014. Tel: (212) 741-7411. Telex: 12969.

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GOTHAM (Switzerland)
Gotham AG, CH-8105 Regensdorf, Althardstrasse 238. Tel: 01/840 0144. Telex: 59222.

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ILLINOIS (USA)
Illinois Cable Company, 8225 N Christiana, Skokie, IL 60076. Tel: (312) 679-0160.

Multicore cables up to 27 pairs and 2- and 3-conductor cables for audio and broadcast use.

KELSEY ACOUSTICS (UK)
Kelsey Acoustics Ltd, 28 Powis Terrace, London W11 1JH. Tel: 01-727 1046. Telex: 298951.

Range of custom cables and multicores.

KLOTZ (UK)
Cable Technology, 72-74 Eversholt Street, London NW1 1BY. Tel: 01-387 5783.

Wide variety of cables including multicore up to 32 pairs, and mic and speaker cables for studio and broadcast.

LECTRIFLEX (UK)
Lectriflex Cables & Accessories Ltd, The Paddocks, Frith Lane, Mill Hill, London NW7 1PS. Tel: 01-349 2011. Telex: 28915.

Instrumentation cable in one to 100 pairs.

MONSTER (USA)
Monster Cable Products Inc, 101 Townsend Street, San Francisco, CA 94107. Tel: (415) 777-1355. Telex: 470584.
UK: Custom Cable Services, 35 High Street, New Malden, Surrey KT3. Tel: 01-942 9567.

Specially constructed speaker cables and *Prolink* and *Interlink* cables for audio and video applications.

NEK (Norway)
Norsk Elwktrisk Kabelfabrik, Etterstadkroken 9, PO Box 23, Bryn, Oslo 6. Tel: (02) 67.41.80. Telex: 18001.
UK: NEK (UK) Ltd, 88 Easton Street, High Wycombe, Bucks. Tel: 0494 447024.

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PIRELLI (UK)
Pirelli General plc, PO Box 4, Southampton, Hampshire SO9 7AE. Tel: 0703 34366. Telex: 47522.

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STANDARD (USA)
Standard Wire & Cable Co, 2345 Alaska Avenue, El Segundo, CA 90245. Tel: (213) 973-2345. Telex: 653423.

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WIREWORKS (USA)
Wireworks Corporation, 380 Hillside Avenue, Hillside, NJ 07205. Tel: (201) 686-7400. Telex: 710-985-4675.

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BUSINESS BUSINESS

Barry Fox investigates the facts behind the industry news

Floppy launch

When I wrote a piece last year about how smart marketing was making Los Angeles a Mitsubishi X-system area, there was a howl of protest from the DASH camp over there. Interesting to note that the howlers have never followed through with any updating info.

In the UK Mitsubishi now seems to be coming on stream, albeit a couple of years late. I can only hope that Mitsubishi's digital salesmen do a better job than their colleagues in the computer disk division. The two technologies are, after all, pretty closely related.

I received an invitation to attend the launch of "the most advanced floppy disk on the market today. . . amidst one of the tightest security operations ever mounted for an exhibition in the UK". Because the invite came from Mitsubishi, not the kind of firm, normally associated with daft PR hype, I read on rather than dumping it in the bin. "It is not an understatement to declare categorically that it will be spectacular."

No train ticket. No bus pickup. Just, be there. I took the train to Birmingham for the launch. Two actors dressed as Samurai posed for photographs. A Marilyn Monroe look-a-bit-alike twirled her skirt and showed her legs. There was no technical presentation. I was given a pack of trade literature describing what looked suspiciously like a bog standard computer floppy disk.

"It's new technology," a PR man assured me but admitted that he didn't know what the new technology was. Finally I found a Japanese gentleman who said he knew. Mitsubishi's factory in Japan, he explained, has been making floppy disks for seven years but has now improved its magnetic coating technology and quality control checks. The improvements, he added, were "secret".

You mean that for the past seven years Mitsubishi's coating technology and quality control hasn't been up to the usual high standard of Japanese factories?

"No, no, no," protested Mitsubishi in horror. "It's been very good and now it's even better."

Don't Japanese children learn the traditional story about crying wolf?

Was DAT it?

1987 looks like being the year of the DAT. Don't be fooled into thinking that DAT (Digital Audio Tape) is for the domestic, hi-fi market only. It's not. It's an across-the-board invasion, due any time now and it could well put European tape firms out of business.

DAT offers several hours of 16-bit, 44.1 kHz, digital stereo from a cassette which is smaller than an ordinary audio cassette. For the first time domestic tape will match CD in quality and beat it on unbroken playing time. Sony has secretly shown DAT prototypes to broadcasters. They like it because of the split second cueing available from sub-code tracks buried in the data stream, just like CD. As a CD-mastering format it makes U-Matic, with an hour the normal maximum playing time, look very old-fashioned.

The Japanese electronics industry likes the idea of DAT because it means that a new, almost exclusively Japanese technology will replace the traditional Philips cassette. Noise reduction also goes out of the window.

The Japanese tape firms like the idea of DAT because, like 8 mm video, it relies on very high coercivity tape (around 1500 oersteds). Chrome, from Du Pont and BASF, won't work. Matsushita has a patent monopoly on the technique used to make metal-evaporated tape. Sony, TDK and Fuji have been perfecting metal powder video tape for 8 mm video.

The only people in Japan who don't want DAT are the retailers. Last year advance publicity for the annual hi-fi show promised what everyone had been expecting—the official launch of DAT. The Japanese daily newspapers said DAT would be on show. So did the Tokyo weekly tourist guide. Most significant, so did the official list of exhibitors and schedule of events, with the additional promise of equipment "on the market sometime in 1986".

But there was no DAT at the show.

The trade body for Japanese retailers, NEBA (Nippon Electric Bigstores Association, no kidding, I checked) objected. "We are struggling to sell compact disc and 8 mm video as well as conventional audio cassette," said NEBA, "if DAT is announced it will kill existing sales stone dead." The show organisers bowed and extracted an agreement from all exhibitors that they would not unveil DAT.

As a compromise the DAT standards committee was permitted to organise a seminar in the nearby Hotel Den. The committee said the public would be allowed to attend. One by one all the participants dropped out—except Sony.

The seminar went ahead and Sony quite literally unveiled a small DAT machine, looking rather like a CD portable. A blanket was pulled off the top of a table and the magic gadget switched on. At the same time Sony showed a small unit looking rather like an ancient reel-to-reel tape recorder. This sandwiches blank and master tape to make copies by magnetic transfer. The effective copy rate is 200 hundred times normal recording speed.

The Sony DAT machine had breadboard electronics under the table, just like early CD prototypes. No-one makes LSIs until the bugs are out of the system. And the Sony player obviously still had some bugs. It played for a while but the sound then broke up into what sounded like uncorrectable errors and muted. Sony engineers rushed round in a panic and it started working again. Then more break up and the demonstration came to an abrupt halt.

Syncing patent

An interesting patent application was filed recently by Warwick Kemp of Westcliff-on-Sea in Essex. The idea is to synchronise two tape decks by ear rather than expensive electronic lock. For obvious reasons it's aimed at small studios. Here's how it works. A track on the 8-track multitrack recording is selected by its audio content for use as a sync track; anything which plays more or less continuously without long gaps will do. This track, plus a rough guide mix of the multitrack, is copied to stereo. The two tracks, guide mix and sync, are then copied back on to a new reel of multitrack tape.

Fresh tracks are now laid in the usual way. These tracks are then mixed down on to one track of the 2-channel machine again; the sync track goes on to the other. If the stereo machine is a video recorder with 2-track digital processor, the sync track can be dumped on to the linear analogue track to leave both digital channels free for music recording. So the sub-mix can be in stereo.

The time is now right to copy this mix back from the 2-channel tape on to the original multitrack tape. And of course this is where syncing is necessary.

The sync track for the sub mix is routed to the left hand channel of a stereo monitor system. The sync track on the original multitrack is routed to the right monitor channel. Both tracks have identical musical content. When they are accurately in sync the sound heard comes from centre front. If one channel leads the other, then the image swings to that side.

Warwick Kemp claims in his patent application that if one of the tape machines has variable speed control it is possible to sync up the two tapes by ear and accurately dump the sub-mix back on to the master tape. He suggests that a drum track, spoken count or white noise all make good sound for syncing. He also suggests that it should be possible to use the same technique for syncing video and audio tapes or patching together quite separate backing and vocal tracks from different studios.

All that is necessary in each case is to have an identical recording on each of the two halves and then rely on precedence effect and varispeed to create a centre front image. Realistically Kemp may find it hard to win a patent on the idea; so far it is only an application. Also, even if a patent is granted, it is hard to prove infringement of a method or technique.

(Who remembers phasing in the pre-electronic days—re-invention time? Ed) □

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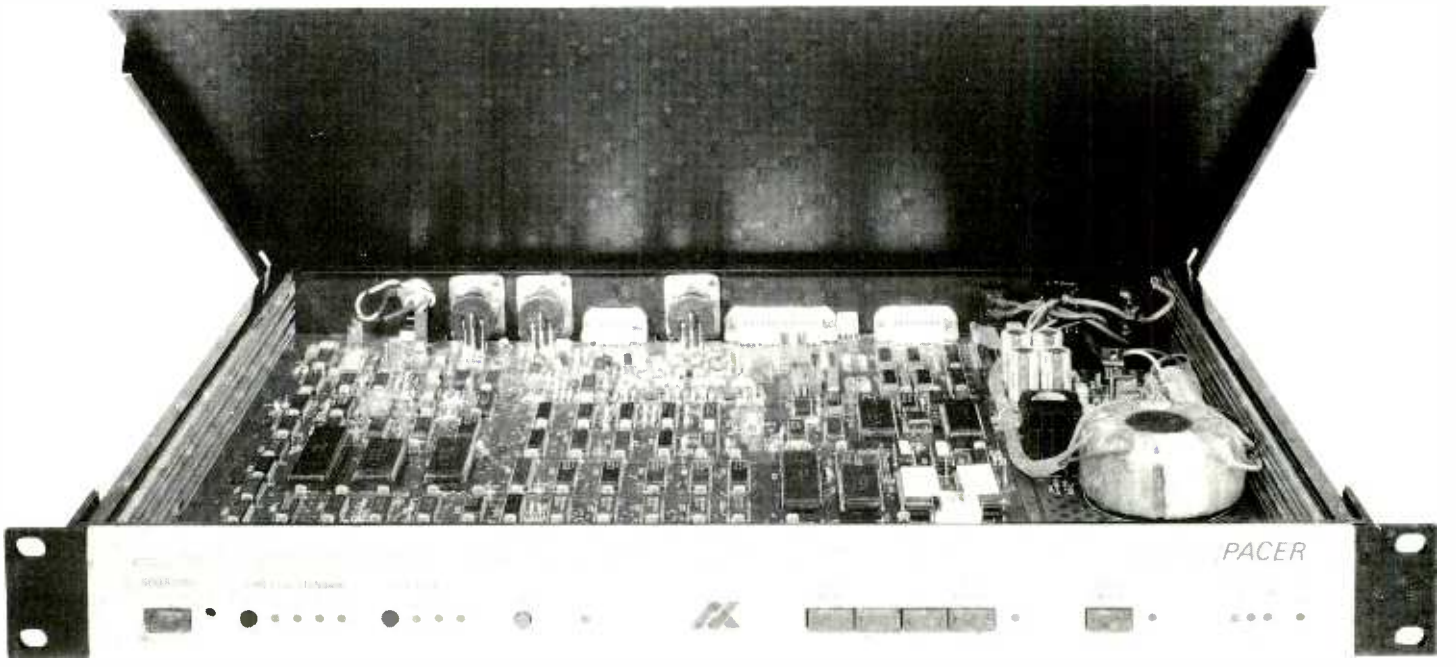

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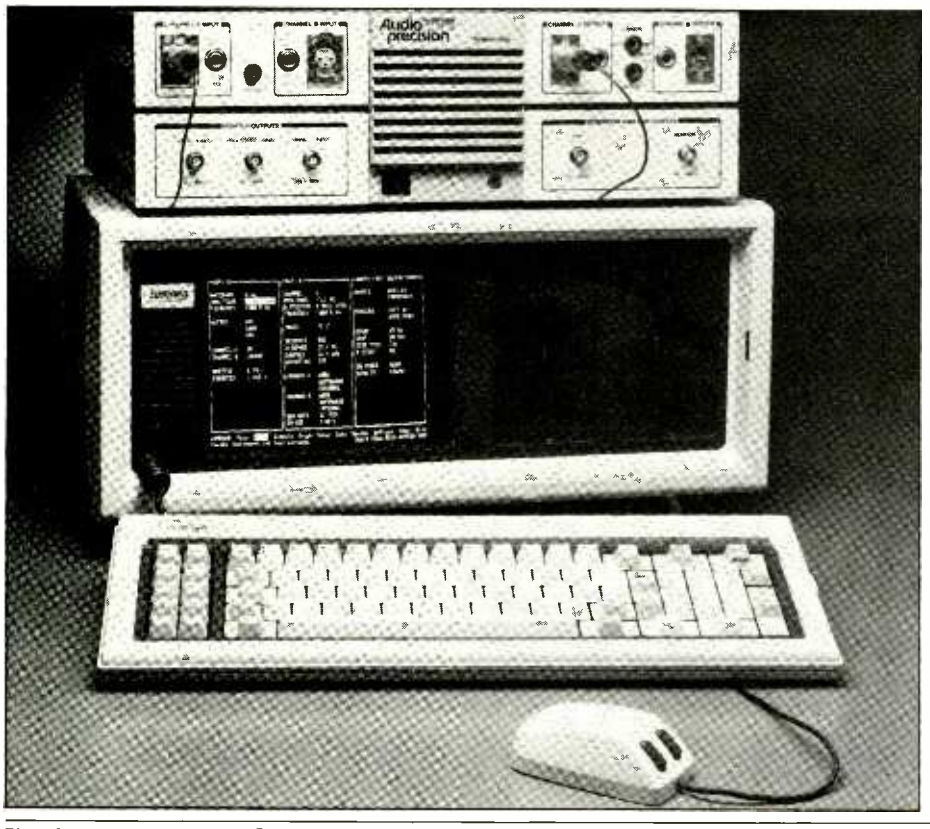
REVIEW REVIEW

Hugh Ford reviews an automated test system

AUDIO PRECISION SYSTEM ONE



Audio Precision's *System One* is a complex piece of test equipment designed on a modular basis so the user need only purchase the facilities required. A pre-requisite is the availability of an IBM compatible personal computer with a minimum of 256K of memory together with a suitable monochrome or colour monitor and at least one disk drive. All functions of the *System One* are driven from the computer and the only user control is the power on/off switch on the front panel.

The interface uses one of the expansion slots in the computer which connects to *System One* via a multiway cable fitted with a locking 25-way 'D' connector. For full possible speed of the system the computer should be fitted with the *8087* maths co-processor but this is not necessary for most applications.

The basis of the system is the module frame and power supply which is a 440×133 mm (wh) case. The mains power feeds into an IEC socket/voltage selector/tap changer at the rear where the 25-way interface connector is located.

At the centre front is the power on/off switch and power indicator above which is a cooling fan. This feeds air over the power supplies located in a tunnel between the front and rear and holes in the sides of the tunnel pass cooling air over the circuit boards either side.

The audio generator option fits to the left of the cooling tunnel with the option of single or dual outputs. In either case the outputs are at *XLR* plugs in parallel with 3-pole ¼ in jack sockets, alternatively banana sockets on the standard ¾ in spacing. In addition BNC ▷

MANUFACTURER'S SPECIFICATION

Signal generator module (GEN-1)
Frequency Related
Range: 10 Hz to 204.775 kHz.
Accuracy: high-accuracy mode—0.03%; fast mode—0.5%.
Resolution: high-accuracy—0.005%; fast mode—0.025 Hz from 10 Hz to 200 Hz; 0.25 Hz from 200 Hz to 2 kHz; 2.5 Hz from 2 kHz to 20 kHz; 25 Hz from 20 kHz to 204 kHz.
Amplitude Related
Range (1): 20 Hz to 50 kHz <25 μV to 26.6 V, open circuit (−90 to +30.7 dBu); 10 Hz to 204 kHz <25 μV to 13.3 V, open circuit (−90 to +24.7 dBu).
Maximum loaded output (2): into 600 Ω +30.0 dBm, R_s=50 Ω, +24.7 dBm, R_s=600 →. Into 150 Ω +30.0 dBm, R_s=50 or 150 Ω.
Resolution: V_{OUT} >2.6 mV 0.01 dB or 0.05% V, worst case V out <2.6 mV 1.27 μV.
Accuracy: 0.1 dB (1%) at 1 kHz.
Flatness: 0.05 dB, 20 Hz to 20 kHz. (1 kHz reference) 0.20 dB to 10 Hz and 100 kHz.
Distortion (R_{LOAD} ≥150 Ω):

50 Hz to 5 kHz	0.0005% (−106 dB)
20 Hz to 20 kHz	0.0008% (−102 dB)
15 Hz to 50 kHz	0.0025% (−92 dB)
10 Hz to 100 kHz	0.01% (−80 dB)

Derate 20 to 25 Hz THD to 0.0025% for output levels exceeding 20 V (+28 dBu) balanced, or 10 V (+22 dBu) unbalanced. THD measured using passive notch filter-spectrum analyser.
(1) Divide maximum output ratings by 2 (−6 dB) for unbalanced or common-mode configurations.
(2) Maximum peak output current rating is 120 mA balanced/240 mA unbalanced. Current limited at approximately 200 mA/400 mA.
Output configuration
Physical: front-rear mountable panel with male *XLR* (pin 2 high) wired in parallel with ¼ in stereo phone jack or dual banana jacks. Ground and output common (CT when balanced) banana jacks.
Impedance: 50/150/600 Ω balanced, 25/600 Ω unbalanced (all ±1 Ω), floating or grounded. Source impedance does not change in OFF condition. Common-mode test configuration connects generator output between output common and centre tap of selected balanced source impedance.
Maximum rated floating voltage: 42 V peak AC, 60 V DC. True transformer isolation.
Auxiliary outputs
Sync output: ground-referenced LSTTL-compatible square wave signal which allows stable oscilloscope displays, including operation with future options.
Monitor output: ground-referenced constant amplitude sine wave (nominally 1 VRMS) at generator frequency.
Trigger/gate input: ground-reference LSTTL-compatible input for use with tone burst option (available Summer 1986).
Dual output option (Dua-Gen)
Output modes: selectable A only, B only, A+B (both on), A−B (both on, B output phase inverted) or OFF.
Output separation: 110 dB to 20 kHz, any source resistance.
Maximum loaded output (3): both channels into 600 Ω +29.4 dBm, R_S=600. Both channels into 150 Ω +24.0 dBm, R_S=50 or 150.
(3) Maximum combined peak output current rating is 120 mA balanced/240 mA unbalanced. Current limited at approximately 200 mA/400 mA.
Level/frequency measurement module (LVF-1)
Input related
Configuration: fully differential (balanced). Female *XLR* (pin 2 high) wired in parallel with ¼ in stereo phone jack or dual banana jacks. Chassis ground banana jack.
Impedance: 100 kΩ (1%) and <270 pF each side to ground, AC coupled. Selectable 600 Ω (1%) or 150 Ω (1%) DC coupled terminations.
Maximum rated input: 140 V RMS, 200 V peak with high impedance, 24.5 VRMS (+30 dBu) with 600 or 150 Ω termination. Termination will automatically open above approximately +32 dBu.
Common-mode rejection: 70 dB, 50 Hz to 20 kHz.
Ratio: (V_{IN} <2 V, +8 dBu).
Amplitude measurement related ("Amplitude" voltmeter)
Range: 0 to 140 VRMS (+45 dBu). Range selection automatically determined from peak value of signal, to prevent overloading with high crest factors.
Detectors: selectable true RMS, average, quasi-peak (CCIR Rec 468-3), or peak indication. Linear response with signal crest factors to at least 7. Average and quasi-peak detectors RMS calibrated with sine waves.
Accuracy (1): 0.1 dB (1%) 20 Hz to 20 kHz. 0.3 dB (3%) to 10 Hz and 100 kHz.
Resolution: V_{IN} >100 μV−0.01 dB or 0.1% V (4 digits). V_{IN} <100 μV−0.10 μV at 30 readings/s, 0.012 μV at 3.8 readings/s.
Response flatness: 0.05 dB, 20 Hz to 20 kHz, 0.20 dB to 10 Hz and 100 kHz, less than −3 dB at 500 kHz. ▷

STUDIOMASTER

SERIES II

SPECIFICATIONS

FREQUENCY RESPONSE: 14Hz to 19kHz ± 1dB **T.H.D.:** < 0.02% @1kHz **C.M.R.R.:** –79dB @1kHz **EQUIVALENT INPUT NOISE:** –128dB **CROSSTALK:** –62dB channel to channel @ 10kHz **MAXIMUM VOLTAGE GAIN:** 82dB **DIMENSIONS** (L x H x D): 1016 x 245 x 718 mm (16.8.2 & 16.16.2) 888 x 245 x 718 mm (16.4.2). Input expander 268 x 140 x 718 mm Tape monitor expander 76 x 140 x 718 mm. **ACCESSORIES:** ALL SERIES II mixers are supplied with an external power supply as standard. Flight cases are available for any SERIES II at extra cost.

THE STUDIOMASTER SERIES II MIXING CONSOLES

For many years now, Studiomaster have been producing high quality mixing consoles which with each phase of development have brought improved standards of mixing within the reach of more people.

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Six auxiliary busses with push-button return routing and a wide range of insert points cater to the growing demand for effects. 4-band input equalisation offers supreme sound control. Other useful features new to this mixer range include· push-button output level selection (+4dBm/–10dBv), tape remix function, separate control room and studio cue mixes.

Perhaps the most outstanding feature of the SERIES II is the MIDI controlled muting of auxiliary returns and input channels. "Patches" are set up on a computer screen, then during mixdown or remix, sets of channels and auxiliaries are sequentially muted or switched on leaving you free to adjust fader levels and effects etc. while the computer actually performs the mixdown.

At Studiomaster we perfected the audio aspect of the mixer to give superb sound control and flexibility, THEN addec the computer-assistance in a clever way which adds very little cost to the desk, and leaves the desk fully operational when the MIDI is not required. All too often, mixers are built with "gimmick" computer features which are in practical terms useless as they create extra work, or their inclusion means sacrificing audio facilities.

The specif cation of these mixing consoles is superb, which means you can be sure that the mixer quality matches your multi-track machine for first class recordings that can go on to be mastered perfectly.

As always with Studiomaster, your mixer will grow with your demands: after purchasing your mixer and acquainting yourself with it, you can explore the MIDI capability, you can expand your input channels up to 32 (with 8-channel expanders that require NO solder ng) and even expand your multi-track tape monitoring up to 16- or 24-track (on the 16.8.2 and 16.16.2 respectively) with an all new retro-fit add-on.

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sockets provide an LSTTL-compatible sync output and a monitor output in the form of a 1 VRMS sine wave. A further BNC connector is a trigger input for the tone burst option which will become available later.

A currently available option is the intermodulation distortion measurement generator. This provides SMPTE-type test signals with a 1:1 or 4:1 amplitude ratio, with a selection of eight low frequencies; the high frequency is swept from the main generator over the range 10 Hz to 204 kHz.

In the CCIF mode the generator provides two equal amplitude sine waves with the frequency separation being selected from eight values between 80 Hz and 2 kHz and the lower frequency being sweepable between 4 kHz and 200 kHz.

The third type of intermodulation distortion signal is for the measurement of dynamic intermodulation distortion (DIM) which I believe is unique to *System One*. These signals comprise a square wave mixed in a 4:1 amplitude ratio with a sine wave which may be swept from 4 kHz to 20 kHz. The DIM-A test uses a 3.15 kHz square wave with the DIM-B method using a 2.96 kHz square wave. In the DIM-A test the square wave bandwidth may be limited to 30 kHz (DIM30) or 100 kHz (DIM100).

The computer selects amplitude, frequency, type of test, output(s) on/off, balanced/unbalanced, floating/grounded, etc. In addition the size of the frequency steps or amplitude steps may be selected when plotting functions.

Turning to the receiver section the basic unit is the level and frequency measurement module which like the generator modules is available with single or twin inputs at *XLR* sockets again in parallel with ¼ in jack sockets or banana sockets. Three BNC sockets allow monitoring of the two input signals after autoranging and the processed signal after any filtering, this includes THD+N and wow and flutter residuals.

The inputs may be balanced or unbalanced with the load impedance being 100 kΩ, 600 Ω or 150 Ω, the latter two terminations opening automatically at input levels above +32 dBu. The maximum input is 140 VRMS, suitable for connecting directly to power amps.

Normally the voltmeter section is autoranging with the reading rate being selectable between 4 and 32 readings/s with a choice of rectifier characteristics. These including RMS, average, peak and CCIR recommendation 468-3 quasi-peak. The standard filters include a choice of high and low pass filters which include the CCIR recommendation 468-3 22 Hz to 22 kHz unweighted measurement in addition to 100 Hz or 400 Hz high pass filters and 30 kHz and 80 kHz low pass filters. Internal sockets allow four further filters to be added; IEC-179 A-weighted and CCIR 468-3 weighted noise filters are currently available.

The display always shows the input voltage at the selected input, the frequency of the input signal and the result of the current measurement, the measurement conditions being displayed.

An option within the level/frequency module *LVF-1* is the measurement of the phase relation between the two inputs over 360° with a resolution of 0.1°. Thus phase may be plotted against amplitude or frequency.

Total harmonic distortion plus noise may be measured with the distortion measurement module *DIM-1* which uses the inputs of the *LVF-1* input module and its measurement and filtering capabilities. The distortion measurement module is a fast auto-nulling unit covering the fundamental frequency range 10 Hz to 100 kHz with the typical residual system distortion being less than 0.001% below 20 kHz.

Whilst the auto-nulling mode is the most common mode of operation, the notch frequency may be locked to the generator or set manually for such measurements as low level distortion in digital systems to determine quantisation noise.

Also available in the *DIS-1* module is a bandpass mode approximating a ⅓-octave filter characteristic over the range 20 Hz to 200 kHz and a band-reject mode. The tuning of these filters may also be automatic or manual.

The intermodulation distortion measurement option (*IMD-DIS*) may be added to the *DIS-1* option to allow the measurement of IM distortion to the SMPTE, CCIF or DIM methods. In comparison with narrow band analysers the measurements are limited but this reflects in the cost of the option. When measuring SMPTE-type IM distortion the instrument measures amplitude modulation of the HF tone with the specified residual distortion of 0.0018% comparing well with other analysers.

In the case of CCIF twin tone intermodulation distortion the unit measures the even order products in the range 50 Hz to 2.3 kHz with a very low residual distortion of 0.001%.

The DIM/TIM measurements evaluate the distortion products over a similar bandwidth, again with a good residual ▷

Residual noise (input shorted, RMS detector): 1.5 μV (−114 dBu), 22 Hz to 22 kHz BW. 3 μV (−108 dBu), 22 Hz to 80 kHz BW. 15 μV (−94 dBu) full bandwidth. 10 μV (−118 dBu), A-weighting. 5.0 μV (−104 dBu), CCIR weighting, QPEAK detector.
Reading rate: automatic or selectable 3.8/7.5/15/30 readings/s. Typically 3 to 8 readings/s above 20 Hz when sweeping using default values for settling algorithm and delay parameters with *8087* co-processor installed in computer.
(1) RMS and average detectors only. Typically less than 1% additional error with 7 to 1 crest factor signals. QPEAK detector accuracy within limits of CCIR Rec 468-3. Peak detector accuracy typically 0.3 dB for repetitive signals 50 Hz to 100 kHz.
Standard filters
High pass: 22 Hz, 3 pole within LF unweighted response limits of CCIR Rec 468-3. 100 Hz ±5%, 3 pole Butterworth. 400 Hz ±5%, 3 pole Butterworth.
Low pass: 22 kHz, 6 pole within HF unweighted response limits of CCIR Rec 468-3. 30 kHz ±5%, 3 pole Butterworth. 80 kHz ±5%. 3 pole Butterworth. One low pass and one high pass filter may be selected simultaneously.
Optional filters: four sockets provided for user's selection of additional filters available from Audio Precision, including A-weighting per IEC 179 and CCIR weighting per CCIR 468-3.
Monitor outputs: separate front and rear mountable connector panel with three BNC connectors, Input A, Input B (functional only when *PHA-LVF* option present), and Processed Signal. These signals are intended for oscilloscope monitoring or similar applications. Input A and

MANUFACTURER'S SPECIFICATION

Input B provide approximately 0.6 to 3 Vp-p buffered replicas of input signals following any attenuation or preamplification. Processed Signal provides a buffered replica of the signal presented to the detector inputs following filtering and additional gain stages. Signals are ground-referenced with nominal 560 Ω source resistances.
Frequency measurement related
Range: 10 Hz to at least 500 kHz.
Timebase accuracy: 0.003%.
Resolution: 0.001% (6 digits) or 0.0002 Hz.
Reading rate: at most 3.8/7.5/15/30 readings/s, limited by signal period.
Minimum input: 10 mV (−38 dBu) for specified accuracy, usable below 1 mV.
Phase measurement-dual input option PHA-LVF
Configuration: option board which mounts to *LVF-1* module. Replaces standard input connector panel with panel carrying two sets of connectors. Measures phase of signal at Channel B input relative to Channel A input. Duplicates input attenuators, preamplifier, termination and independent autoranging circuitry of *LVF-1* module input, to facilitate rapid 2-channel system measurements. Other *LVF-1* measurement functions and performance identical but connected to only one channel at any instant.
Channel separation: 140 dB to 20 kHz, R_s ≤600 Ω.
Phase measurement related
Range: 0 to 360° or +/−180°, automatically selected.
Accuracy: 2°, 20 Hz to 20 kHz, typically 0.5° for signals of same amplitude.
Resolution: 0.1°.
Reading rate: ganged to amplitude reading rate.
Minimum input: 40 mV (−26 dBu), both channels for specified accuracy.
Distortion measurement module (DIS-1)
Level measurement related ("Level" voltmeter)
Resolution: V_{IN} >25 mV—0.01 dB or 0.1% (4 digits). V_{IN} <25mV—25 μV at 30 readings/s, 3.1 μV at 3.8 readings/s.
Distortion (THD+N) measurement related
Fundamental range: 10 Hz to at least 100 kHz, usable to 200 kHz.
THD+N range: 0 to 100%.
Minimum input: 10 mV (−38 dBu) for specified accuracy in %, PPM or dB units.
Accuracy: 0.5 dB for harmonics to 100 kHz, +0.5/−3.0 dB for harmonics to 500 kHz. Distortion may be displayed as percentage of input signals, dB below input signal, parts per million, or in absolute amplitude terms such as volts, dBV, dBu, etc.
Residual THD+N: 50 Hz to 5 kHz—greater of 0.001% (−100 dB or 1.5 μV, 22 Hz to 22 kHz bandwidth. 20 Hz to 20 kHz—greater of 0.0018% (−95 dB) or 3 μV, 22 Hz to 80 kHz bandwidth. 10 Hz to 100 kHz—greater of 0.01% (−80 dB) or 15 μV, full bandwidth. Worst case system specification including *GEN-1* module. Residual THD only contribution from *DIS-1* and *LVF-1* modules is typically 10 to 15 dB lower. Derate 20 to 25 Hz system THD+N to 0.0025% if *GEN-1* output exceeds 20 V (10 V unbalanced).
Notch steering: automatic or manual. During stimulus-response testing with signal providing by *GEN-1* module, notch is automatically tuned to generator frequency. When testing with ▷

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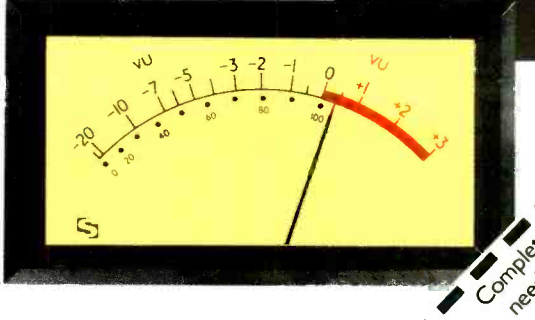

*vu to ANS C16.5-1954. PPM indicators to BS 5428 : Part 9 : 1981. to IEC268-10A, and to BBC specifications ED1476, ED1477 and ED1542 (dual indicators).

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The final internal option, which as yet is not specified by the manufacturer, is the wow and flutter measurement board. This allows the measurement of wow and flutter to the IEC quasi-peak, NAB or JIS standards either weighted or unweighted using the appropriate rectifier characteristics.

The normal measurement bandwidth is 0.5 Hz to 200 Hz but flutter alone may be measured over the bandwidth 10 Hz to 200 Hz to any of the three rectifier characteristics with an additional, novel measurement being scrape flutter.

The latter measures over a 300 Hz to 5 kHz bandwidth with a peak or RMS rectifier characteristic in the presence of a 12.5 kHz recorded tone, thus giving an indication of scrape flutter and modulation noise effects.

Manual control and the panel display

The system is initiated by booting up the computer with an MSDOS disk after which the two software disks provided with *System One* are used to operate the system. These disks will be updated free of charge as new software or hardware becomes available. The latter currently includes 12-way switch boxes for interfacing with multichannel audio equipment such as desks or multitrack recorders to provide automated testing of all channels without having to alter connections.

Tests are set up using what is called the Panel mode of the instrument which is found by pressing the ESCape and P keys on the computer keyboard which then produces a display similar to **Fig 1** depending upon the options fitted. In this display the left part shows the status of the generator, the central part the status of the measuring section and the right hand part conditions for producing a swept display on the monitor screen.

Any particular section of the display may be addressed with the highlighted cursor which is moved about the screen by means of the arrow up/down and left/right keys at which time the operator's options are displayed below the panel display. An available option is a 'mouse' to move the panel display. For instance, if the cursor is moved into the oscillator section over the current waveform SINE the resulting panel display is shown in **Table 1**.

Pressing the space bar alternatively highlights each test waveform, pressing the Enter key selects the desired waveform and changes the panel display.

Whilst I have described most of the test waveforms I have not mentioned the EQSINE facility which is particularly useful. This facility allows such characteristics as RIAA equalisation or pre-emphasis characteristics to be stored such that the generator can correct its frequency response to these characteristics. Furthermore, the generator can be arranged to use a previous measurement for correcting its frequency/amplitude characteristic.

This is a very valuable feature, for instance when measuring microphone frequency response. The response of the anechoic chamber may first be measured using a measuring mic, the generator is then corrected for the response of the chamber and the other mics measured using the corrected stimulus.

When using the EQSINE function the generator amplitude and the post equalisation amplitude are simultaneously displayed in similar units—a useful feature. Placing the cursor over the unit's RMS shown in the generator display in **Fig 1** gives a new display below the PANEL display allowing the type of units to be selected (see **Table 2**).

Whilst RMS volts and peak-to-peak volts are obvious units the dBm and watts units refer to 1 mW into the load shown at the bottom of the display, dBu refers to 0.7746 VRMS, dBV refers to 1 VRMS and dBr refers to the dBr at the bottom of the generator display which may be reset to the current conditions by a single keystroke. This itself may be in VRMS, Vp-p, dBu or dBV.

Amplitude and frequency are entered directly from the numeric keys, however, the abbreviatons 'k' for ×1000, 'm' for ×0.001, 'n' for ×0.000,001 in addition to scientific notation in the form xEy are accepted.

Reference to **Fig** 1 shows that below the frequency display in the generator section is the word FAST. Selecting this with the cursor allows a fast mode or high accuracy mode to be selected. In the Fast mode the frequency resolution is 0.25% with an accuracy of 0.5%, suitable for most measurements. However, when needed the slower High-accuracy mode may be selected when the resolution becomes 0.005% and the accuracy 0.03%.

Within the Output section of the display the outputs A, B, A & B, A & −B, OFF are options with both outputs being balanced, unbalanced, floating or

TABLE 1

SINE	EQSINE	SMPTE4:1	SMPTE 1:1	CCIF	DIM30	DIM100	DIMB
Generator waveform					To return to menu press Esc key		

TABLE 2

Vrms	Vpp	dBm	dBu	dBV	dBr	W	To change setting, use SPACE bar.
generator amplitude units							To return to menu, use Esc key.

uncontrolled source such as a distant-origination signal or pre-recorded signal, notch is automatically tuned to frequency measured by *LVF-1* module. Notch may also be set to any arbitrary frequency within its range for quantisation distortion, SINAD and IHF-FM receiver sensitivity testing, or can function as a band-reject filter, frequency accuracy ±3%.
Notch characteristic: 4th order, dual state variable (patented). 10 to 20 dB greater rejection of flutter/noise products within 10% of fundamental than conventional designs. Less than 0.2 dB attenuation at 2nd harmonic.
Fundamental rejection
THD+N mode: −110 dB, 10 Hz to 20 kHz, −100 dB, 20 kHz to 100 kHz or 30 dB below signal THD+N.
Bandreject mode: −40 dB including tuning error.
Measurement speed: typically 10 s or less for a 20 Hz to 20 kHz 16 point (15 step) sweep using default values for setting algorithm parameters, and *8087* co-processor installed in computer. Typically 2-3 settled readings/s for fundamental frequencies above 100 Hz.
Bandpass mode related
Selectivity: approximately ⅓ octave (Q=4.3, 12 dB/octave rolloff slopes.
Frequency range: 20 Hz to 200 kHz.
Frequency accuracy: 3%.

MANUFACTURER'S SPECIFICATION

Gain accuracy: 0.5 dB, 20 Hz to 100 kHz.
Residual noise (input shorted): 0.5 μV (−124 dBu), 20 Hz to 5 kHz, increasing to 1.0 μV (−118 dBu) at 20 kHz and 3.5 μV (−107 dBu) at 200 kHz. Equivalent noise BW of bandpass filter is approximately 0.36 times the frequency setting.
Intermodulation distortion options (preliminary)
Generator related
Test signal modes: SMPTE1:1, SMPTE4:1, CCIF, DIM30, DIM100 and DIM-B.
SMPTE LF tone: selectable 40, 50, 60, 100, 125, 250 or 500 Hz, all ±2%.
CCIF difference frequency: selectable 80, 100, 120, 200, 250, 500 or 1 kHz, all ±2%.
DIM square wave: 3.15 kHz (DIM30 and DIM100) or 2.96 kHz (DIM-B), ±1% square wave is bandwidth limited to 100 kHz in DIM100 mode and 30 kHz in DIM30 and DIM-B modes.
Analyser related
IMD range: 0 to 20%.
Accuracy: 0.5 dB for indicated IM products.
Minimum output: 10 mV (−38 dBu) for specified accuracy, usable at lower levels. 200 mV (−12 dBu) for specified residual IMD.
SMPTE mode
Test signal compatibility: 40 Hz to 500 Hz (LF) and 3 kHz to 200 kHz (HF) tones, mixed in any amplitude ratio from 0:1 to 10:1 (LF:HF).
IMD measurement: 40 Hz to 500 Hz amplitude modulation products of HF tone, expressed relative to HF tone.
Residual IMD: <=0.0018% (−95 dB) for HF tones to at least 20 kHz.
CCIF Mode
Test signal compatibility: two equal amplitude 4 kHz to 200 kHz tones with 80 Hz to 1 kHz separation.
IMD measurement: difference frequency product, expressed relative to the amplitude of either tone.
Residual IMD: <=0.0005% (−106 dB) for centre frequencies to at least 20 kHz.
DIM mode
Test signal compatibility: 2.90 kHz to 3.25 kHz square wave and 4 kHz to 100 kHz sine wave (probe tone), mixed 4:1 (square:sine). 15 kHz probe tone provides both even and odd order products which fold into analyser bandwidth in DIM30 and DIM100 tests, 14 kHz probe tone recommended for DIM-B test.
IMD measurement: IM products from 800 Hz to 2.3 kHz, expressed relative to the amplitude of the sine wave probe tone.
Residual IMD: <=0.0032% (−90 dB).
Manufacturer: Audio Precision, PO Box 2209, Beaverton OR 97075, USA.
UK: Scenic Sounds Equipment Marketing Limited, Unit 2, 10 William Road, London NW1 3EN. □

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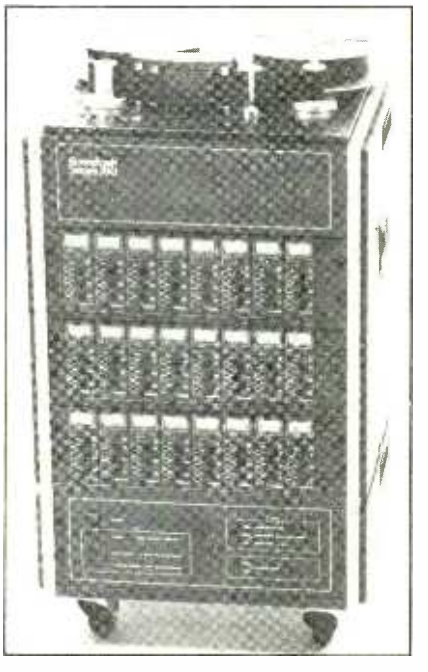

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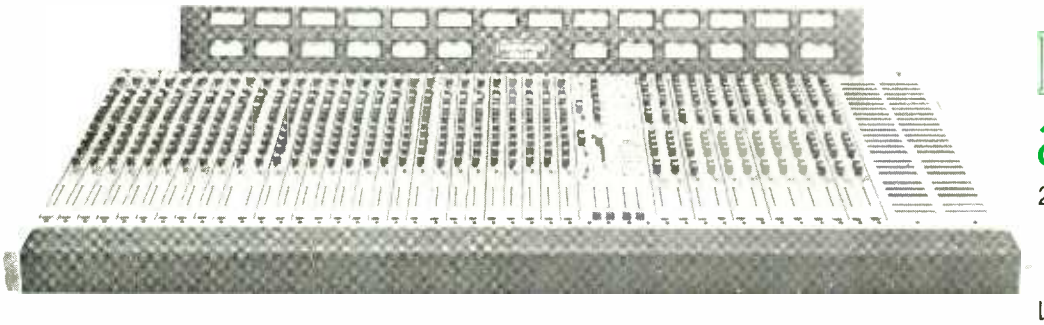

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REVIEW

FIG 1
PANEL DISPLAY

```
|=GEN1==================|=LVF1==================|=SWEEP TEST DEFINITION==|
|                       |                       |  (press F9 to sweep)   |
|WAVEFORM   SINE        |MEASURE    A THD+N     |DATA-1     LVF1   RDNG  |
|AMPLITUDE  1.000   Vrms|READING    0.00158  %  |GRAPH TOP  1.00000  %   |
|                       |LEVEL      .9939    V  |   BOTTOM  0.00050  %   |
|FREQUENCY  1.00000 kHz |FREQUENCY  1.00106 kHz|£ TICS     0            |
|           FAST        |PHASE              OFF|TYPE       LOG          |
|IM-FREQ    60.0000  Hz |                       |                        |
|                       |BP/BR FREQ         AUTO|DATA-2     LVF1   NONE  |
|OUTPUT     A&B         |DETECTOR   4/sec   RMS |GRAPH TOP           OFF |
|           BAL         |BANDWIDTH  <10Hz >500kHz|   BOTTOM           OFF |
|           50 Ohms     |FILTER     OFF         |£ TICS                  |
|           FLOAT       |                       |TYPE       LIN          |
|                       |CHANNEL-A  GEN-MONITOR |                        |
|AMPSTEP    0.010   +   |  TERM     100k Ohms   |SOURCE-1   GEN1   FREQ  |
|FREQSTEP   1.260   *   |  RANGE            AUTO|START      20.0000 kHz |
|                       |CHANNEL-B  GEN-MONITOR |STOP       20.0000  Hz  |
|dBr   REF  387.3  mVrms|  TERM     100k Ohms   |£ STEPS    30           |
|dBm/W REF  600.0   Ohms|  RANGE            AUTO|STEP TYPE  LOG          |
|                       |Freq  REF  1.00000 kHz |STEP TABLE ON           |
|                       |dBr   REF  387.3   mV  |                        |
|                       |dBm/W REF  600.0   Ohms|DISPLAY    COLOR-GRAPH  |
|=======================|=======================|========================|
```

TABLE 3
AMPLITUDE BANDPASS BANDREJECT THD+N SMPTE CCIF DIM W+F
Measurement mode
To return to menu, press Esc key

FIG 2
SCREEN DUMP

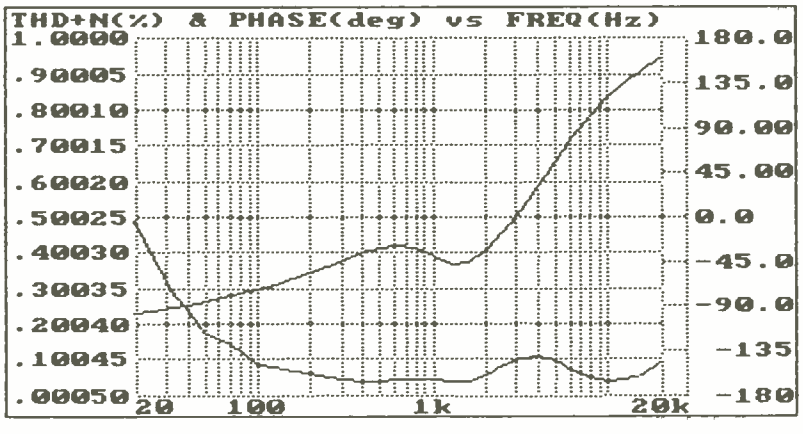
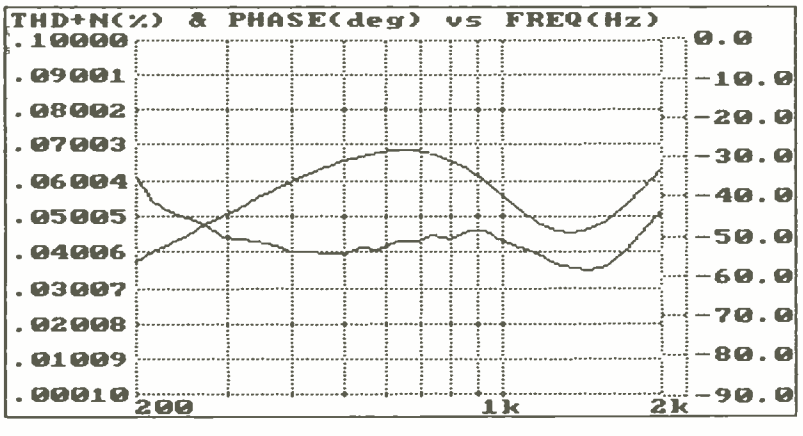


FIG 3
DETAIL OF FIG 2



grounded with an internal common mode test available. Choice of the output impedance is between 600 Ω, 150 Ω or 50 Ω in the balanced mode or between 600 Ω or 25 Ω in the unbalanced mode.

The remaining part of the generator display deals with the AMPlitudeSTEP or FREQuencySTEP during swept displays and when stepping manually up/down using the INS and DEL keys. These steps may be additive or multiplicative with the default frequency step being ×1.260 which corresponds to ⅓-octave steps.

Proceeding to the centre of the PANEL display the =LVF1 part deals with the measuring section using the cursor in a similar way to the generator section. Placing the cursor in the MEASURE section first allow the channel A or B inputs to be selected and then selects the test by displaying the PANEL display shown in **Table 3**.

Once the desired measurement has been selected the READING section gives the result, the LEVEL section the input level, the FREQUENCY section the input frequency and the PHASE section the phase between the two inputs. All these sections may be individually switched on/off, as is the PHASE section in **Fig 1**.

A great variety of units may be selected for display in these sections depending upon the measurement in use and the contents of the bottom three lines of the display used for relative measurements. For instance, distortion may be in %, dB, PPM, V, dBm, dBV, dBu or OFF. Frequency may be in Hz, % drift, Hz drift, %Hz, OCTaveS, DECadeS or CENTS.

Within the centre part of the measurement display noise or other filtering is selected as is the frequency control of the bandpass or band-reject filters which can either track the input frequency as would be used for measuring pre-recorded or remote sources or may be locked to any frequency as when measuring quantising distortion.

There remain in the measuring section the CHANNEL-A and CHANNEL-B input control sections which are independent of each other. Either may monitor the generator section or the inputs with terminations of 100 kΩ, 600 Ω or 150 Ω. Normally the instrument will be used in the autorange mode but manual ranging may be used in a variety of units with the desired range being input from the numeric keys.

The right hand section of the PANEL display deals with plotting sweeps on the monitor screen in monochrome or colour with, amongst other possibilities, dumping the screen to a dot matrix printer such as an Epson *MX-80* or *FX-80*. One or two sets of data may be plotted on the Y axis with the X axis being frequency, amplitude or time from the internal generator or external sources.

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REVIEW

Such a plot of THD+Noise and phase against frequency from 20 kHz to 20 Hz is shown in **Fig 2** with **Fig 3** showing how the detailed performance of the same device under test may be examined with this screen plot taking about 20 s.

The Y axis parameters are determined by the DATA-1 and DATA-2 sections of the sweep PANEL display. These may select the level or reading from the measurement in the current measurement mode plus phase. Vertical scaling may be linear or logarithmic over any desired range with tick marking as desired or set automatically.

Plotting of the X axis is determined from the SOURCE-1 section of the PANEL display with the X source being internal or external and the X-plot being with increasing or decreasing amplitude or frequency depending upon the setting of the start and stop parameters and on a linear or logarithmic scale.

Other display features

A further feature of the plotting system is that a table of results can be automatically made and printed or stored for further use. The latter feature being transferable to the EQSINE function of the generator section.

So far I have only mentioned the numerous measurements that may be made with *System One* and have made no mention of the more advanced and valuable features. Not only can complete PANEL displays and measurement results be stored on disk and recalled at will but measurement set ups may be automatically chained so that a sequence of measurements may proceed automatically. Furthermore, test limits may be inserted and a warning given if a device is out of limits, including the *System One* itself.

During such processes the unit can display operator instructions or other messages in addition to providing an analogue display which is useful for such operations as setting tape recorder bias.

The analogue display can show up to three parameters as shown in **Fig 4** where the three horizontal bars represent input level, THD+noise and generator frequency. The latter may be controlled by the arrow left/right keys (or the optional mouse) with the current frequency being 1.99075 kHz with the upper displays showing minimum/maximum and current readings of level and THD+noise.

This type of display could be used to bias a tape recorder where the maximum output is recorded as +23.40 dBV and the current output about 3 dB lower at +20.43 dB. Pressing one of the function keys restores the minimum and maximum values to the current readings.

Files, test limits and procedures

System One can file on to disk and retrieve various forms of information which include TEST, LIMIT, SWEEP, COMMENT, PROCEDURE, DATA, EQ and IMAGE all of which are identified by a user name up to eight characters in length—longer names would be nice.

The SAVE TEST function stores the complete current panel set up together with the comments file if this has been loaded with comments whilst the SAVE SWEEP function saves the last sweep that has been plotted together with any identifying names or dates that may have been attached to the sweep.

Logically the SAVE COMMENTS function does just save the comments information whilst the SAVE DATA function just stores the test results and not the PANEL set up. This may be used to transfer data to other programs such as for statistical analysis purposes.

The EQSINE waveform may be derived either by manual entry or by running a frequency sweep. The frequency response curve is then stored on disk and may be readily recalled and, if desired, inverted and again stored on disk.

A similar operation applies to inserting test limits. Out of limit conditions may be stored on a disk or may be displayed if the screen is not used to plot a graph. In the latter case any measurements that are not within the limits are reported together with a statement that they are above or below the limit which itself is also shown on the screen.

Procedures in their simple form join together a series of tests that have already been filed on disk with or without limits in use. Entry can either be from keyboard strokes or the *System One* can record a procedure from the operator performing a number of tests.

It follows that setting up a series of different tests to run automatically is a very simple operation but there are many other possibilities. For instance a procedure may include prompts to the operator, can switch to the analogue display, can enter a subroutine written by the user to drive other instrumentation or interface with tape recorders and other devices and can print graphic or text results.

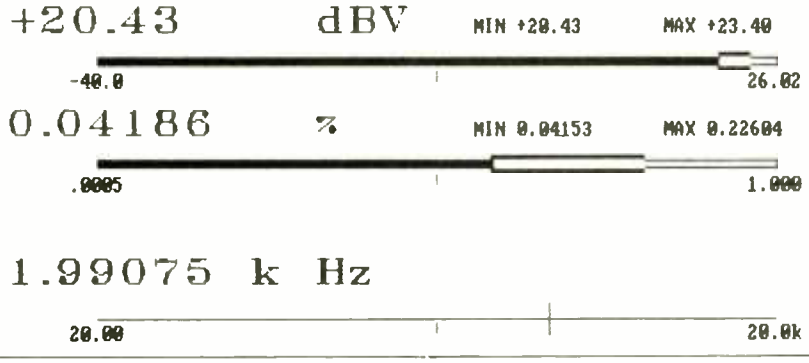
It is thus possible for an unskilled operator to run a comprehensive evaluation of audio equipment by pressing a single button. The idea of evaluating a 24-track recorder for frequency response, distortion, noise, wow and flutter, etc, with printed results and warning of out of tolerance conditions is a very attractive proposition when it only needs the pressing of the start button.

So much for a lengthy but incomplete description of the facilities offered. Just how good is the performance?

TABLE 4

Nominal	Channel A	Channel B
50 Ω	50.046 Ω	50.171 Ω
150 Ω	149.980 Ω	150.139 Ω
600 Ω	599.93 Ω	600.14 Ω

FIG 4 ANALOGUE DISPLAY



Generator section

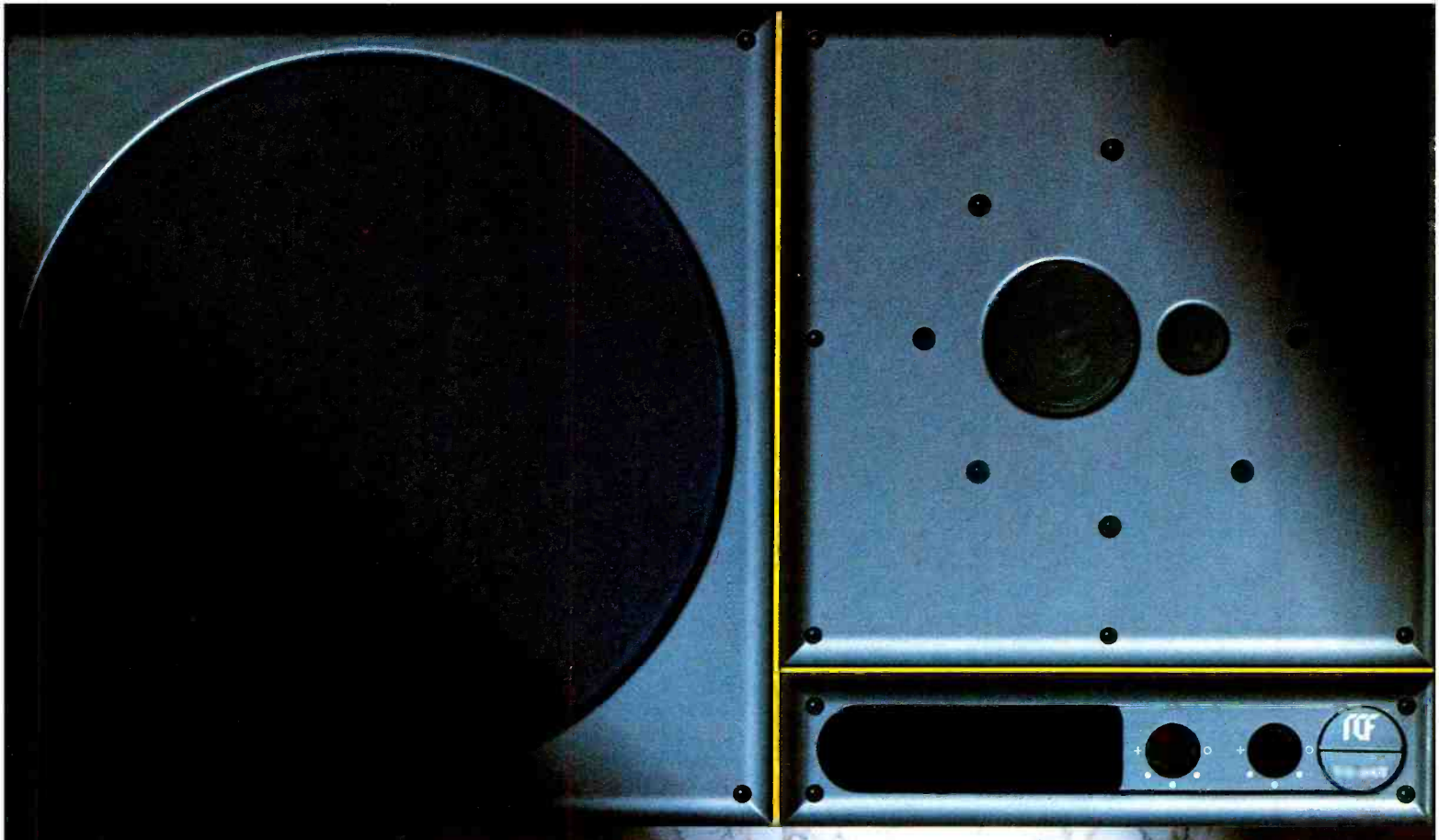
The sync output takes the form of a rectangular waveform with a duty factor of 51:49 and a amplitude from +0.17 to +4.00 V irrespective of the amplitude of waveform of the audio outputs. The source impedance was about 1 kΩ with a rise time of 1.09 μs and fall time of 644 ns making this waveform useful for other purposes than synchronisation as no square wave output is included.

The period of the sync output corresponds to that of the audio outputs in the sinewave mode, the low frequency in the SMPTE mode, the square wave in the DIM mode and for some reason half the difference frequency in the CCIF mode.

Like the sync output, the monitor output is always energised irrespective of the audio outputs, giving a replica of the current waveform at constant amplitude of 2.80 Vp-p from a source impedance of 563 Ω.

At the audio outputs the impedance was extremely closely matched in the balanced mode as was the amplitude of the outputs. **Table 4** shows the impedance of the two output channels in the balanced mode.

The maximum output level followed the manufacturer's specification with the unusually high output of 26.599 VRMS being a valuable feature found in very few oscillators. Furthermore the ▷



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REVIEW

TABLE 5

Output level (1 kHz)	20 Hz	100 Hz	20 kHz	100 kHz	200 kHz
9.9728 VRMS	−0.006 dB	−0.009 dB	−0.017 dB	N A	N/A
0.9943 VRMS	+0.014 dB	+0.013 dB	+0.002 dB	+0.012 dB	−0.050 dB
0.0998 VRMS	+0.015 dB	+0.012 dB	−0.004 dB	−0.064 dB	−0.074 dB

TABLE 6

Frequency	Second harmonic	Third harmonic
60 Hz	−108 dB 0.00039%	<−108 dB 0.00039%
150 Hz	−110 dB 0.00032%	−110 dB 0.00032%
1 kHz	−115 dB 0.00018%	−115 dB 0.00018%
10 kHz	−108 dB 0.00039%	<−120 dB 0.0001%
20 kHz	−111 dB 0.00028%	−122 dB 0.000079%
50 kHz	−108 dB 0.00039%	−102 dB 0.00079%

TABLE 7

Frequency	Residual
<10 kHz	>−110 dB 0.00032%
20 kHz	−100 dB 0.001%
50 kHz	−90 dB 0.0032%
100 kHz	−76 dB 0.016%

TABLE 8

Condition	Noise in dBu RMS	Average	Quasi-peak
Wideband 10 Hz to 500 kHz	−119 dB	−120 dB	−120 dB
Band limited 22 Hz to 22 kHz	−116 dB	−117 dB	−115 dB
A-weighted	−119 dB	−120 dB	−120 dB
CCIR-weighted	−110 dB	−112 dB	−114 dB
Bandpass at 1 kHz	−134 dB	−135 dB	—
Bandpass at 10 kHz	−126 dB	−127 dB	—

minimum output level was less than 10 μV making the unit suitable for feeding very high sensitivity inputs.

When changing waveforms or output levels there was negligible delay or amplitude bounce with the peak-to-peak amplitude being the same for all waveforms—the level reading, however, always showed the RMS value of the peak equivalent sinewave, a possible source of confusion.

Another matter which requires some caution is that with both outputs in the dual output oscillator in use the indications of power levels assume both outputs to be correctly loaded.

The output level accuracy was well within 0.05 dB at any level with the amplitude response being measured as shown in **Table 5** for 10 VRMS, 1 VRMS and 0.1 VRMS nominal output reference 1 kHz.

The accuracy of the frequency indication was within 0.1% in the fast mode or within 0.005% in the high resolution mode with the frequency of the SMPTE and CCIF signal being within +0.32/−2.5% which is quite satisfactory but slightly out of specification. The frequency of the DIM 3150 and 2960 Hz tones was within 0.11%.

Crosstalk between on and off outputs was at a very low level, being <−135 dB at 1 kHz, −117 dB at 10 kHz or −87.5 dB at 100 kHz with noise in the outputs when switched off being <6 μV over a 22 Hz to 22 kHz bandwidth.

Harmonic distortion was measured using a notch filter followed by a narrow band spectrum analyser, there inevitably being some uncertainty about the extremely low figures resulting (see **Table 6**).

From the above figures it is clear that this is one of the lowest distortion oscillators commercially available and an interesting feature is that in view of the lack of amplitude bounce it may be used for sweeping loudspeakers for the subjective detection of defects, subject to the use of an adequate number of frequency steps.

In the CCIF intermodulation distortion waveforms the even order difference frequency components predominated, the residual varying with the high frequencies as shown in **Table 7**.

In the SMPTE waveform mode the residual distortion in either the 4:1 or 1:1 amplitude ratio measured less than 0.001% when using an independent IM analyser.

The DIM waveforms were examined for distortion products in the 800 Hz to 2.3 kHz measuring range relative to the amplitude of the sine wave probe tone and found to have no products greater than −90 dB in the spectrum.

Level and frequency module

As with the generator the selectable load impedances of 150 Ω or 600 Ω were extremely accurate with the high input impedance of 100 kΩ in each leg being sufficiently high for most applications. Common mode rejection at 1 kHz was in excess of 100 dB for both channels, being >−70 dB from 20 Hz to 80 kHz falling to 62 dB worst case at 200 kHz.

The two BNC monitoring outputs provided an autoranged replica of the input signal varying between 1.3 VRMS and 0.6 VRMS from a source impedance of 560 Ω. Autoranging held down to input levels of 70 mV.

At the residual monitoring BNC output a similar maximum level is available with autoranging extending in 10 dB steps down to an input level of 70 μV with the source impedance being again 560 Ω.

The absolute accuracy of level measurement in the wide band mode or filtered mode was excellent, being within 0.5% (0.04 dB) down to 10 mV. Wide band measurements were useful down to 1 mV where the accuracy was degraded to 2.5% (0.2 dB), however, in the bandpass mode measurements within 2% accuracy could be made down to 10 μV input.

Amplitude accuracy of the metering was within +0/−0.05 dB from 20 Hz to 20 kHz down to 10 μV input with the performance up to 100 kHz being within +0/−0.15 dB at that at 200 kHz within +0/−0.5 dB down to 1 mV input. As the unit was completely stable it is of course easy to subtract any inherent measurement errors from the final results to obtain extremely good accuracies with a usable resolution of about 0.05 dB.

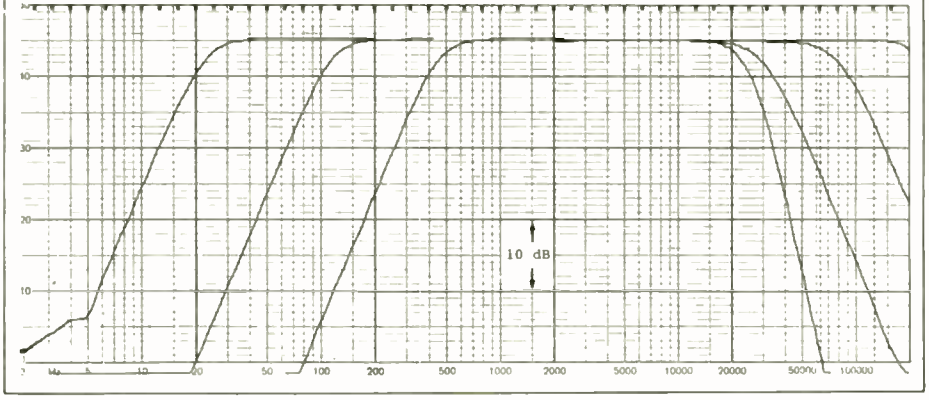
Inherent system noise was also excellent: **Table 8** shows residual noise with inputs shorted in dB relative to 0.7746 VRMS.

The characteristics of the noise weighting curves were checked with the A-weighting being within 0.1 dB of nominal and the CCIR—weighting having a maximum error of 0.5 dB—both very well within the standard requirements. The alignment of all filters at 1 kHz were precise and the performance of the high and low pass filters are shown in **Fig 5**.

In the case of the high pass filters the turnover frequencies of the 100 Hz and 400 Hz filters was precise but that of the 22 Hz filter was at 19.7 Hz putting it just out of tolerance for CCIR-unweighted noise. The low pass filters were satisfactory.

The shape of the band pass filters is shown in **Fig 6** to have the specified 12 dB/octave roll-off for three frequencies ▷

FIG 5
HIGH AND LOW PASS FILTER ALIGNMENT



REVIEW

FIG 6 BAND PASS (ZERO LEVEL −50 dB)

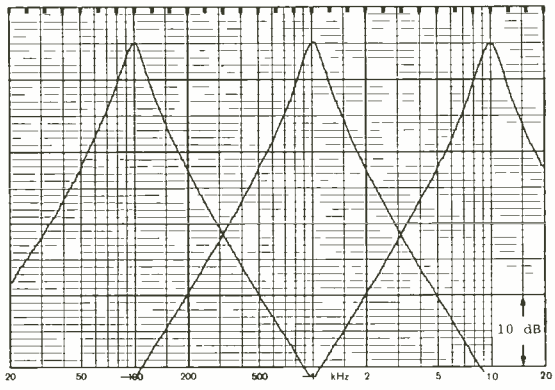
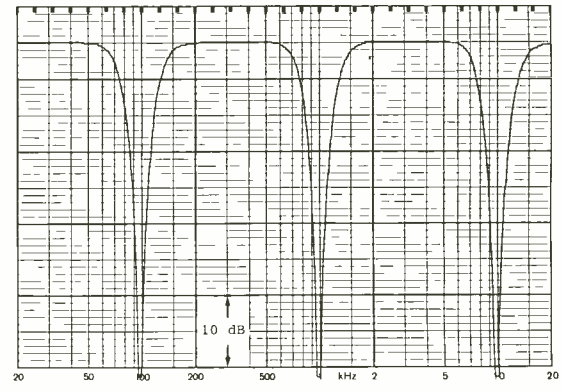


FIG 7 BAND REJECT



where the shape is consistent. The gain accuracy was found to be very good.

In the band reject mode the notches were as in **Fig 7** where there is negligible attenuation of the second harmonics with the amount of rejection in fact varying with frequency.

Total harmonic distortion plus noise for the overall system was remarkably low as shown in **Table 9** with my best oscillator reading 0.0006% for 1 V (1 kHz).

Plotting THD+N using the internal oscillator was fast. External spot frequencies were easy to use but a fair amount of care is required if trying to plot frequency sweeps.

RMS, average, peak or quasi-peak rectifier characteristics are available for all measurements. These were found to be correct as were, so far as possible for a digital readout, was the effective ballistics of the CCIR 468-3 metering.

Intermodulation distortion residuals in the DIM modes were at low levels depending upon the frequency of the probe tone, with **Table 10** giving a guide to the measurement potential. Over the frequency range 20 Hz to 20 kHz at these input levels the specified 40 mV phase readings were generally within 1° provided that noisy signals were not presented. At lower input levels down to about 3 mV phase readings continued but with significantly reduced accuracy, whilst at even lower input levels on either channel the phase display showed blanks.

I would personally have preferred the phase display to blank out at a higher input level and also to blank out when the frequency is out of range. However, in practice, quite accurate phase readings were possible up to 200 kHz.

Finally, considering the wow and flutter section, which is not in its final version, the weighting curves were found to be very close to the nominal curves and very well within the standard limits. Also the 'unweighted' curve had the accepted characteristics and the rectifier for the IEC, NAB and JIS standards were correct.

The accuracy of the indication was beyond reproach with the residual wow and flutter being far below any other known instrument at <.00046% unweighted or 0.00000% to any weighted standard. So sensitive is this instrument that a very good audio generator is needed to measure its performance.

TABLE 9

Frequency	THD+N at 10 VRMS in	Filters
10 Hz	0.0017%	<10 Hz to 22 kHz
100 Hz	0.00037%	<10 Hz to 22 kHz
1 kHz	0.00054%	<10 Hz to 22 kHz
10 kHz	0.001%	400 Hz to 80 kHz
20 kHz	0.0011%	400 Hz to 80 kHz
50 kHz	0.0049%	400 Hz to >500 kHz
100 kHz	0.0066%	400 Hz to >500 kHz

TABLE 10

Measurement	Residual DIM distortion	
	3 kHz to 20 kHz	3 kHz to 100 kHz
DIM30	0.0023%	0.0023%
DIM100	0.0023%	0.004%
DIM-B	0.0023%	0.0024%

A limitation in the prototype wow and flutter section is that the digital metering has difficulty following the ballistics of the IEC peak standard. In this respect the instrument failed to meet the requirements for unidirectional bursts of frequency modulation.

The scrape flutter function accepted a carrier frequency of 12.5 kHz ±1 kHz and is based on the method described at the 66th AES Convention in a paper by Dale Manquen, *'A Wideband Tape and Transport Diagnostic Method'*—AES preprint 1637.

In *System One* the residual is in the order of 0.0003% providing an extremely critical test for magnetic tape and tape transports.

Summary

This is a remarkable piece of test equipment permitting a wide variety of fully automated audio measurements to a very high accuracy. Whilst there are other instruments for automated testing, many do not approach the accuracy and versatility of measurements offered by *System One*. Furthermore, it is all too often left to the user to write the computer programs—a time consuming task which I personally do not relish.

Even sophisticated features of this system do not require any knowledge of computers or programming and it only takes a very short time to learn to make measurements of the type normally made with manually controlled instruments. Entering procedures takes rather longer to learn and the instruction manual could be improved in this area.

Within the instrument all parts are manufactured to a good professional standard with about 25% of the available space left free for future measurement modules which are under development.

Finally, for its capabilities, *System One* is not an expensive instrument and I strongly recommend anyone concerned with regular audio measurements to give this instrument serious consideration.□

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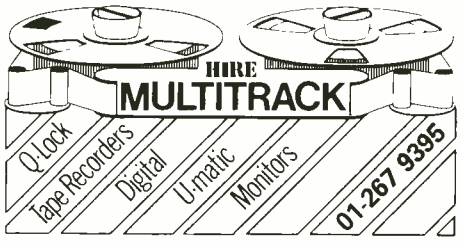

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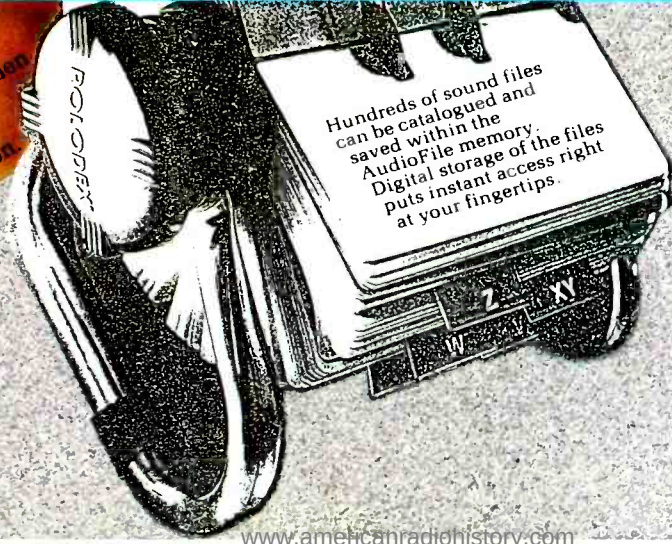

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