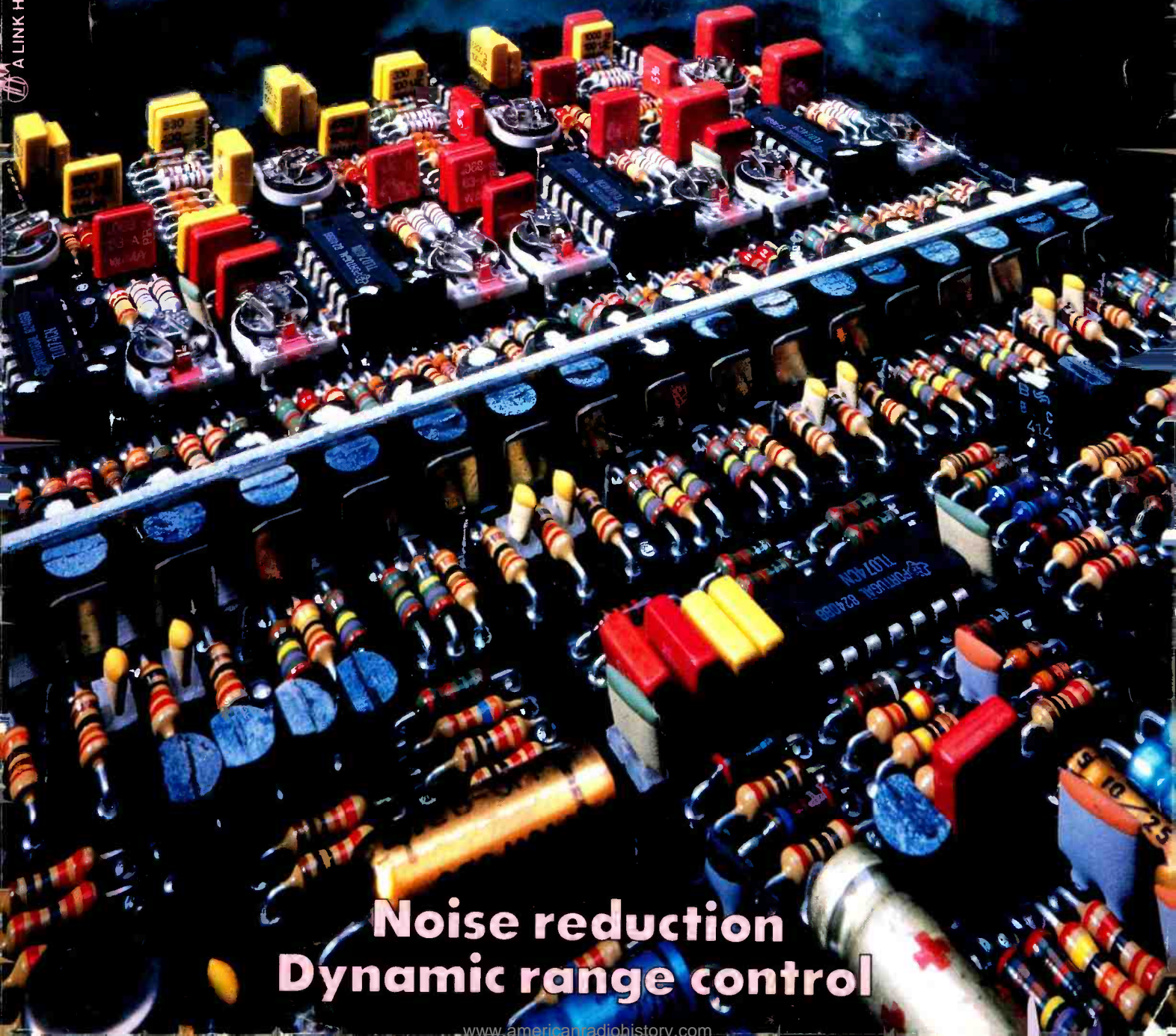


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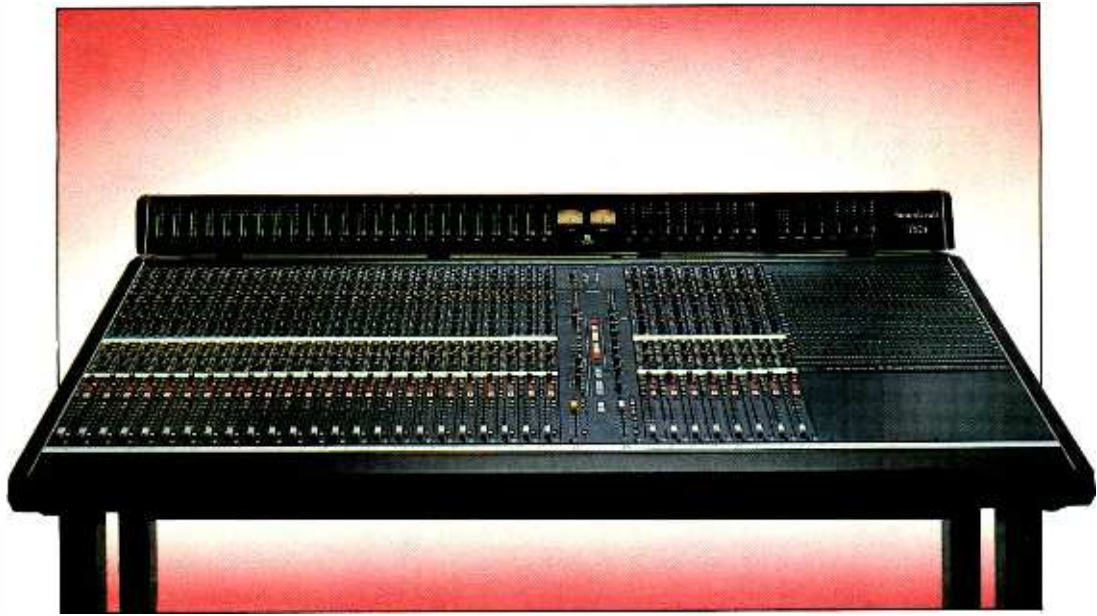
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the top off



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studio sound

AND BROADCAST ENGINEERING

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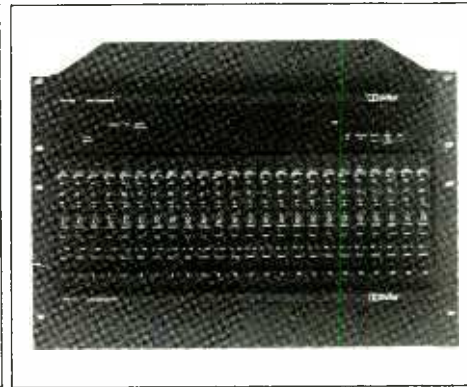
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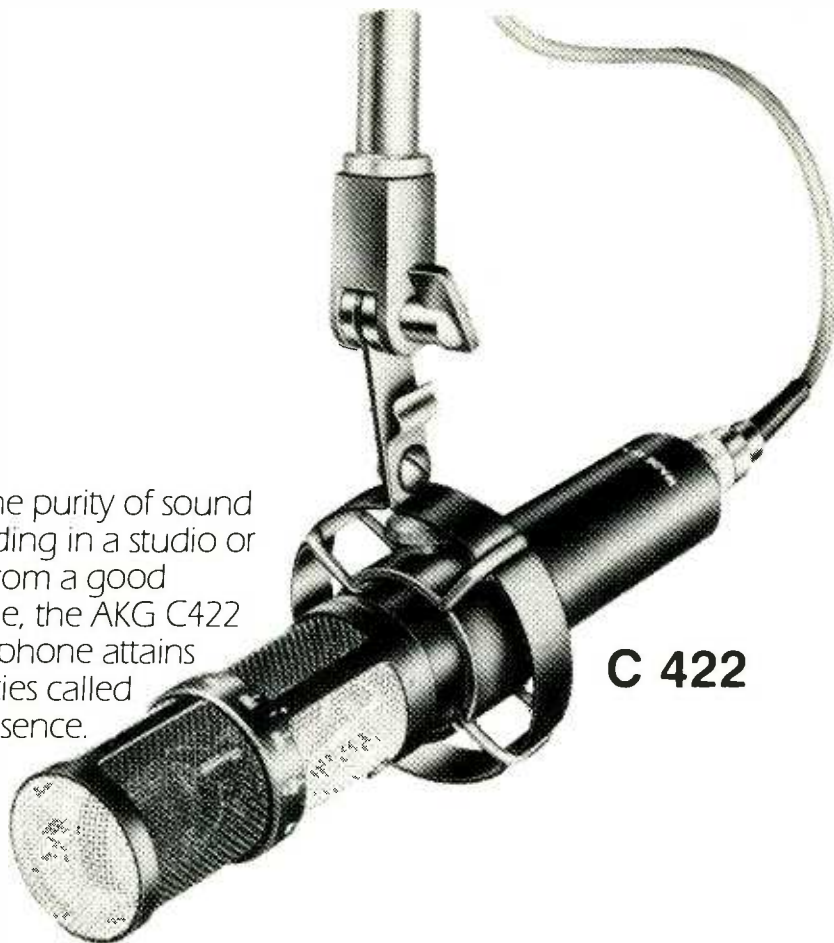


Vesta Fire RV-2—reviewed p.76



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Electronic instruments and the studio

One of the most interesting and rapid developments in the field of recording today is that of electronic musical instruments and their relationship to the recording studio environment. We have gone a long way since the introduction of the Moog synthesiser in the '60s: now we have a wide variety of electronic instruments which are in use on virtually every popular record and in several cases in more 'serious' music.

Many of these instruments are more modern versions of the 'traditional' synthesiser: perhaps with the addition of a number of memories to store preset or constructed sounds and a microprocessor to control the functions of the machine to make it easier to use. Other machines may use novel methods of synthesis, a long way from the old 'VCO, VCF, VCA' setup, perhaps using FM or algorithm-based methods of sound generation and control.

But there is a growing number of instruments available today—often at quite high prices—which are much more than a 'synthesiser'. They are 'computer-based musical instruments'. We have discussed the two best-known instruments of this type, the New England Digital *Synclavier* and Fairlight Instruments' *Computer Musical Instrument* (CMI) at length in these pages. They are without doubt the first two in a long line: I can see this type of instrument gaining a central place in tomorrow's recording studios. They offer capabilities like waveform generation and analysis; harmonic synthesis; a data-based equivalent of the multitrack recorder; external sound sampling and modification; composition languages and rhythm-based composition; and much more. Today's instruments do not yet include the ability to do away with the recording studio as it is presently defined altogether but such developments are no doubt on their way.

As time goes by, these instruments are bound to influence the operation and structure of the recording environment. Over the next few years we are bound to see smaller and much cheaper 'miniature' versions of today's computer-based machines, which will take their places with the humble *Portastudio* and 8-track $\frac{1}{2}$ inch machines in home and budget recording studios, offering many of the same facilities as the big machines but at a fraction of the cost, just as we have already seen the emergence of units like the Roland *MC-202* from the more up-market *MC-4* and *MC-8 Microcomposers*.

Meanwhile, what will happen to the big machines? I would expect them to increase their facilities, especially in the direction of being able to handle more aspects of the 'multitrack recording' application, in the sense of more voices being able to be stored, and more ergonomic balancing controls. These systems are already operating in the digital audio area, and the addition of, for example, digital EQ, comp/limiting and level control options would be a logical step, although it is currently rather expensive. What we will be looking at, quite simply, is the integration of the electronic musical instrument with the recording studio. The fact that these systems use data as the basis of their 'recording' systems means that only the control data for pitch, level and so on needs to be stored, thus eliminating the need for currently expensive full-scale digital audio systems and the attendant need for very high density, large-storage media like reel-to-reel

tape, at least at the instrumental recording and overdubbing level. Obviously, however, you would need to move into a more 'conventional' recording system to add vocals and 'traditional' (whatever *that* means) instruments; but here, too, there is no reason why the 'instrument/recorder' should not pop its output up in 16-bit PCM or whatever format we'll be using by then.

And once in the 'normal' recording environment, with such developments as the *MIDI* bus (despite some comments that it does not have enough flexibility), which enables a wide variety of instruments and other devices to be hooked up to each other with interactive control function possibilities, and SMPTE-based synchronisers which will lock all your instruments and many other things to SMPTE timecode, there is a real possibility of integrating not only the instrument with its own 'recording' capability, but also integrating that with the rest of the conventional (and unconventional) studio of the future—anything from consoles and multitrack machines to video, film and A/V equipment. The possibilities are virtually limitless, and as so many of them have already become a reality, it is hard to see how such a process could not continue.

In addition, there is activity on other fronts, like the interfacing of quite conventional synths, rhythm machines and the like, to external computer systems, be they as mighty as *Apples* and *IBM PCs*, or as lowly as the *Sinclair ZX Spectrum*. *MIDI* controller programs are now available for even the lowliest of machines, in addition to a wealth of rhythm and music sequencer programs. Many of these schemes are remarkably inexpensive, and make use of equipment which many people will have around already, notably the Personal Computer.

With this in mind, we are starting a regular department in *Studio Sound*, devoted to exploring and reporting on new developments in this field. We first looked at synthesisers some years ago and the subject has long since become a regular part of our annual schedule. Now, we feel, it is time to cover the field more regularly, and in more depth. Initially, we will be calling on two writers who have a great deal of knowledge on the subject on both sides of the Atlantic—Paul D Lehrman in the USA, and Mike Beecher in the UK—but we also welcome articles and other contributions from any source with something to share on the subject of technology in musical instruments. Additionally, we would like manufacturers of equipment in this field to keep us fully informed on developments for inclusion either in our New Products section or the new section, as appropriate. Although we will tend to be covering the upper end of this field, as we have in the past—the area in which the majority of our readers, be they studio owners and engineers, producers or professional musicians, will be interested—we will also be keeping an eye open for new developments in the more budget-conscious areas which will have repercussions throughout the creative side of the music industry. We also welcome readers' comments on the new coverage, and will, as always take note of what you suggest. The section will first appear in the April issue; we hope you like it and will help it to develop in the most useful directions.

Richard Elen

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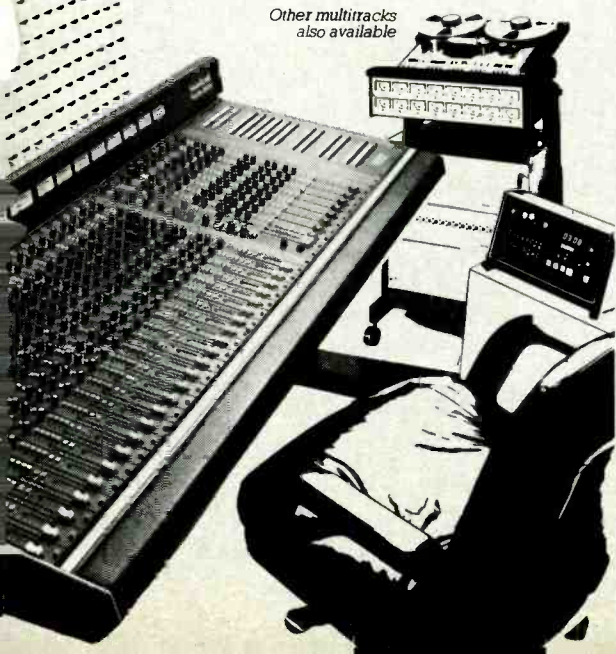
Price is not the only reason why eight track is such an attractive proposition for production recording. The track count is plenty enough in many cases, easy to work with, in particular as used in self-op installations. Packaging the Soundcraft Series 400B with the Otari 5050 eight track, shows three distinct advantages. There's the economy of half inch, the better free reliability of both brands, and the fastest and yet most comprehensive operating features in their class.

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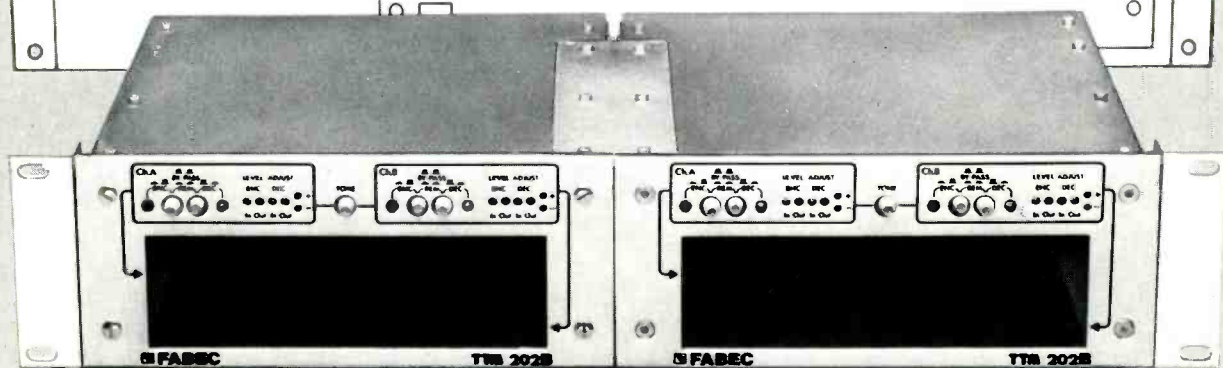
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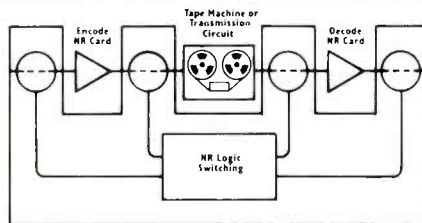
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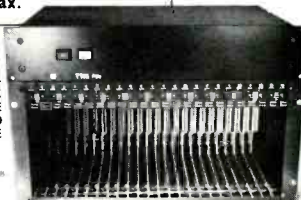
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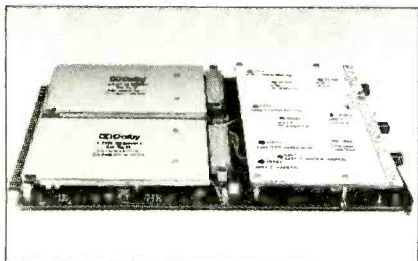


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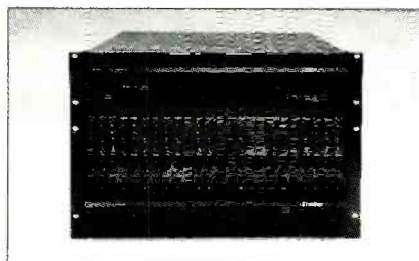
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Richard Elen. Studio Sound, August 1983.

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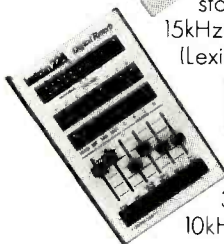
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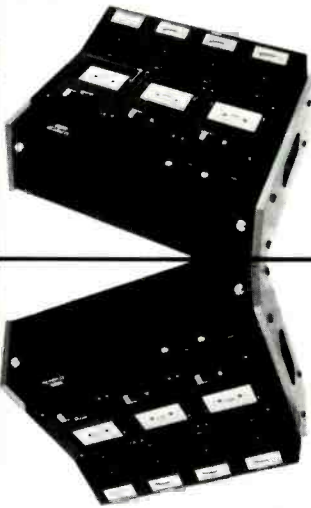
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DP 4050 C2

The C2 is a cassette-master copier running at 8x speed, providing simultaneous copying of both sets of stereo programme material. Two slave positions produce 2 C60 cassettes in under 4 minutes. Up to 3 DP4050-Z3 units can be added, giving a total of 11 slaves.

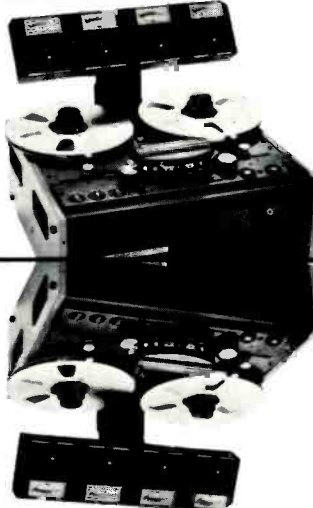


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DP 4050 C2

DP 4050 OM

A brand new product, the OM is a high-quality, dual-capstan reel-to-reel transport running at 8x speed (30 or 60 ips). It can drive up to 6 Z3 slave units and can bias chrome tape. A duplication system based on this master transport is capable of the finest in-cassette copying quality possible.

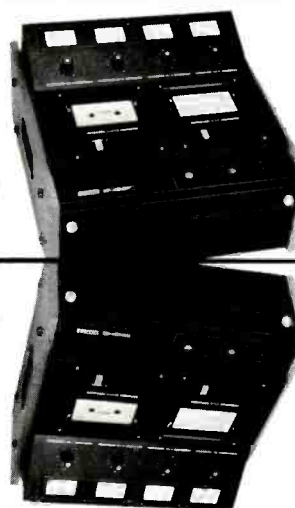


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DP 4050 OM

DP 4050 C1

Another brand-new product, this is a high quality low-cost 8x speed copier with one slave position only. However, it can be expanded with Z3 units up to a total of 3, or 6 if the OM reel-master transport is interfaced as a buffer. The slave position can also record from the OM master.



Another brand-new product, this is a high quality low-cost 8x speed copier with one slave position only. However, it can be expanded with Z3 units up to a total of 3, or 6 if the OM reel-master transport is interfaced as a buffer. The slave position can also record from the OM master.

DP 4050 C1

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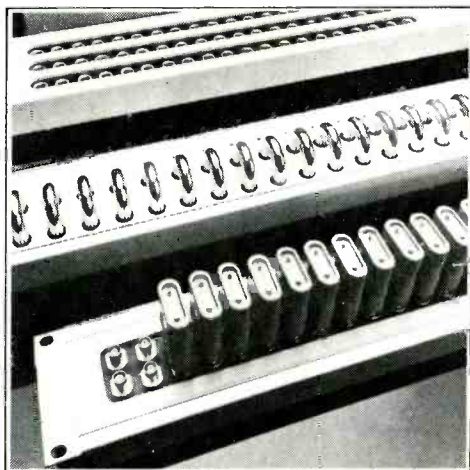
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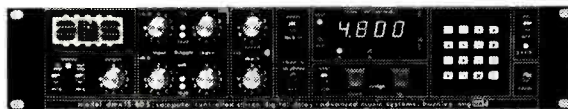
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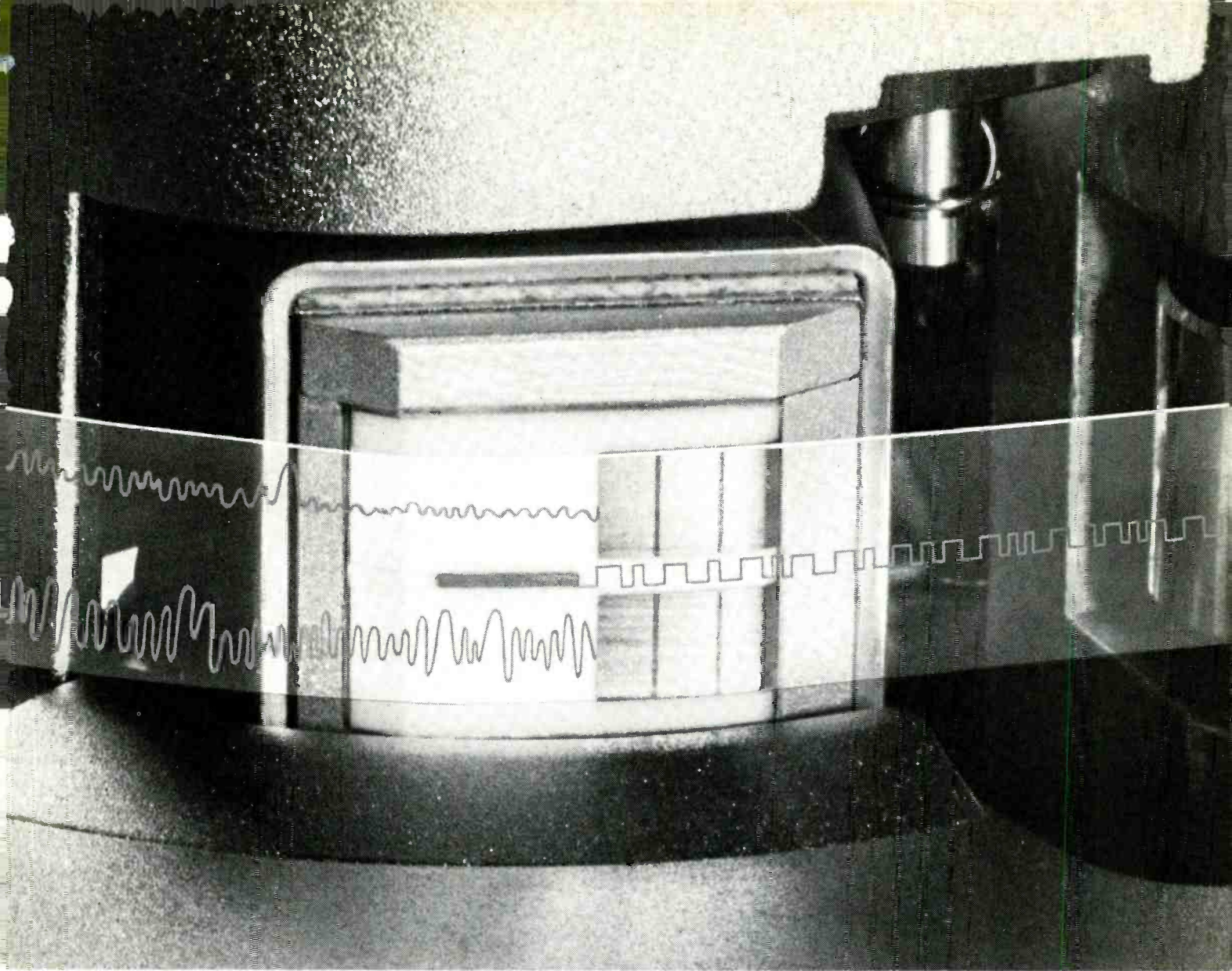
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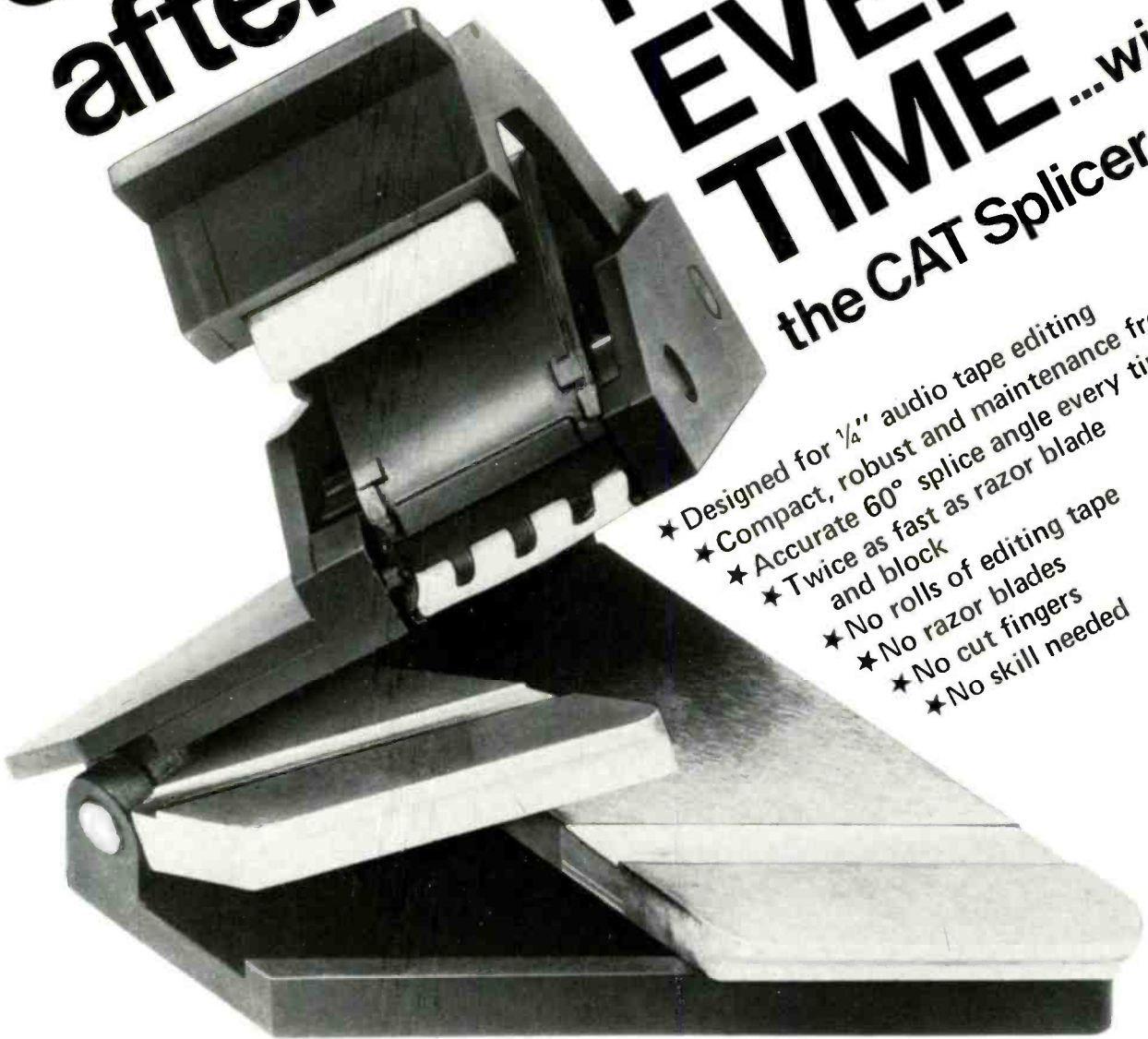


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The Sennheiser modular condenser microphone system provides an answer to every requirement of the modern recording engineer. The basic element is the K 3U powering module. This can be powered by a 9-52 volt phantom supply or an internal battery and has integral variable bass attenuation. The alternative K 30A V is available for use with video cameras.

The ME 40 cardioid capsule has a smooth extended frequency response and near ideal polar pattern making it suitable for any application. The ME 80 is a super-cardioid capsule. Its tight pattern and high output make it the right choice for "live" situations, interview work and p.a. systems.

The system has recently been extended by the addition of two new products. The MKE 212 acoustic boundary microphone gives a clean, balanced, natural sound that adds a new dimension to sound recording. The MKE 2 is a subminiature tie-clip microphone. Using the same capsule as the MKE 212 it provides a clear, crisp sound from a package only 5mm. (dia.) x 10mm. For full details of Sennheiser products and our guide "How to choose, use and abuse microphones" please contact us on 0753 888447

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Soundtracs 16.8.16 Mixer/Fostex B16 Tape Machine

Features on the Soundtracs include 16 monitors which can be used on re-mix, 8 of which have equalisation and fader reverse. Phase reverse is, of course, available on all inputs plus 16 track monitoring. Phantom power is standard. This exceptional mixer has a stunning range of features, and coupled with the Fostex B16 is exceptional value for money.

The new Fostex B16 is an innovation in recording techniques with a 16 track on $\frac{1}{2}$ " capability. The use of Dolby C noise reduction ensures

compensation for the radical use of $\frac{1}{2}$ " tape. Suitable for mounting into a 19" rack, this latest addition to the Fostex range will revolutionise home recording.

For the price, the B16 maintains the high quality you associate with the Fostex name, and the standard of features and construction is very high.

Included in the package is a full set of interconnecting leads.



Soundtracs 16.8.16 Mixer/Bel Noise Reduction/Soundcraft 1", 16 track machine

Features on the Soundtracs include 16 monitors which can be used on re-mix, 8 of which have equalisation and fader reverse. Phase reverse is, of course, available on all inputs plus 16 track monitoring. Phantom power is standard.

The Bel BC-3 noise reduction system was designed to be the ideal alternative to digital. A fully professional noise reduction unit for a fraction of the price.

The modular system is based around a slimline 16 channel, 19" rack mounting unit.

The Soundcraft SCM 761, 16 track, 1" machine completes this professional musician's package.

Engineered and designed to the highest professional standards, the Soundcraft comes with full remote control facilities and zero locator with cycle function. This machine runs on both 15 and 30 ips and has extra sync outputs fitted as standard. The SCM 761 comes complete with a cue light output, and is supplied with a foot punching switch.

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ough to a high performance 24 track combination.



Bel 24.16.24 Mixer/Soundcraft 24 track, 2" machine

Together these two high quality products make up an exceptional package with outstanding features.

The Bel 24.16.24 is a versatile and high value mixer incorporating 4 band eq, with 2 swept mids and a high and lo shelving, 16 busses, 3 band eq on 16 monitors which are routable to re-mix, 100mm long travel faders and the chassis is pre-wired for 24 track monitoring. Phantom power supply unit is available as an optional extra.

The Soundcraft SCM 762 24

track 2" tape machine brings 24 track recording within reach. With all the features included which are vital to any machine, the Soundcraft incorporates two remote control zero locators with cycle function. The autolocator option provides nine memory points and tape speed indication. It operates at 2 speeds on 15 and 30 ips.

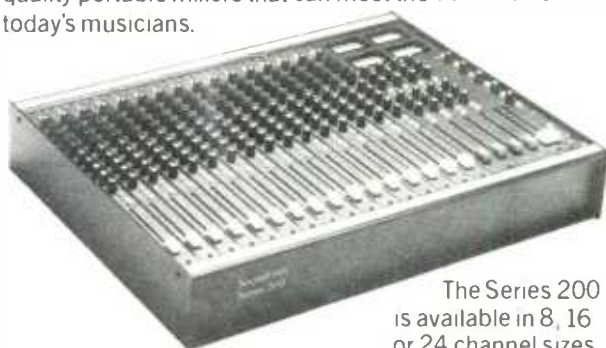
Together with the Bel mixer this is essentially a reliable and serviceable package and excellent value for money.

Comes complete with a set of interface cables.

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Soundcraft 200

The new Series 200 from Soundcraft is a range of high quality portable mixers that can meet the demands of today's musicians.



The Series 200 is available in 8, 16 or 24 channel sizes

and can be supplied in a custom designed, foam lined flight case. The 8 channel model is ideal for location recording as well as live sound work, and is also available in a rack mounting mode.

Features include a pad switch and LI switch for microphone and line inputs, 4 band eq and auxiliary sends, and the pan control takes the output of the fader to the pair of outputs to which the channel has been assigned. 100mm travel faders with an ultra smooth action are fitted as standard. The Soundcraft 200 has 4 output groups and 8 monitors.

Soundcraft 400B

The Soundcraft 400B is a versatile mixing console series suitable for PA and professional 8 track recording. The 400B frame comes in 3 sizes,



16, 24 or 32 input modules, but can

be supplied partly filled. Two VU meters display the monitor source signals while an additional 4 meters read the outputs of groups 1-4. 4 channel effects return module is optional and the sophisticated equalisation facilities make this ideal as a cost-effective answer to front-of-house mixing. As the channels route direct to the re-mix, the 400B is an ideal mixer for 16 or 24 track home recording.

CM50 Autolocator

The CM50 is a sophisticated autolocator which has nine memories with a cycle function between any two memories. Additional software soon to be announced will permit two CM50s to be used for machine synchronisation.

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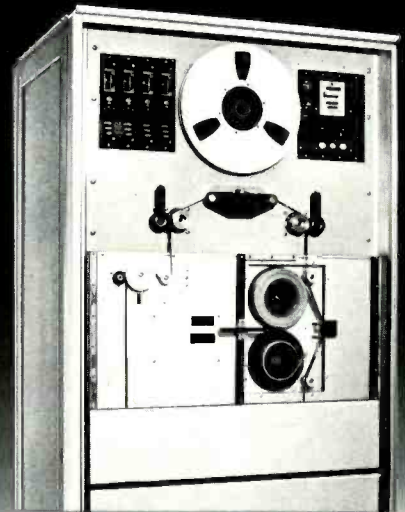
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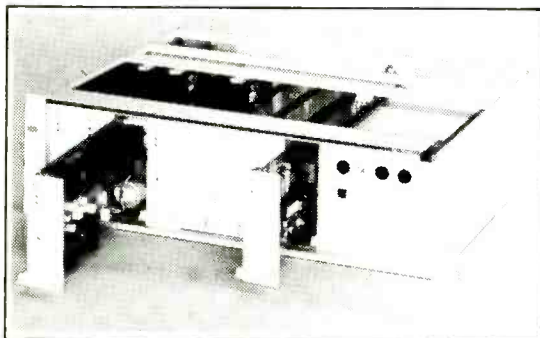
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- ★ Separate Limiter Threshold
- ★ Side chain access
- ★ Computer control mute input
- ★ Threshold down to -50dBm
- ★ Log/Lin release selectable

The S31 Compressor/Limiter is a dual function unity gain module which incorporates several new features.

A separate feed-back PEAK LIMITER can be moved by an indexed 20 position pot, over a range of 20dB from 0dBm to +20dBm. The Limiter has an auto attack and release function and operation is indicated by a single red led.

The feed forward compressor has linear RATIOS that can be continuously varied from 1:1 to 20:1. The THRESHOLD is an indexed 20 position pot and can be operated from +12dBm down to -50dBm (ideal for very soft slopes, 1:2:1 etc). RELEASE time can be switched to a LOG or LIN response. ATTACK time can be varied by a three position switch: 1.0ms(F), 2.5ms(M), 25ms(S).

MAKE-UP gain is a 20 position indexed pot which will compensate for gain reduction from unity to 30dB of gain. The SYSTEM can be switched IN or OUT as well as the side-chain (SC) being routed to an external equaliser. Gain reduction is indicated by a twenty segment orange led column with a range of indication from 0-60dB. Other features include a MASTER/SLAVE option which is switched on-board but with status indicated by front panel leds. This allows any one unit's MAKE-UP GAIN control to vary several units that are linked to it, thus simplifying stereo or four-channel operation. Control volt linkage for stereo operation is achieved by selecting STEREO link on the board.

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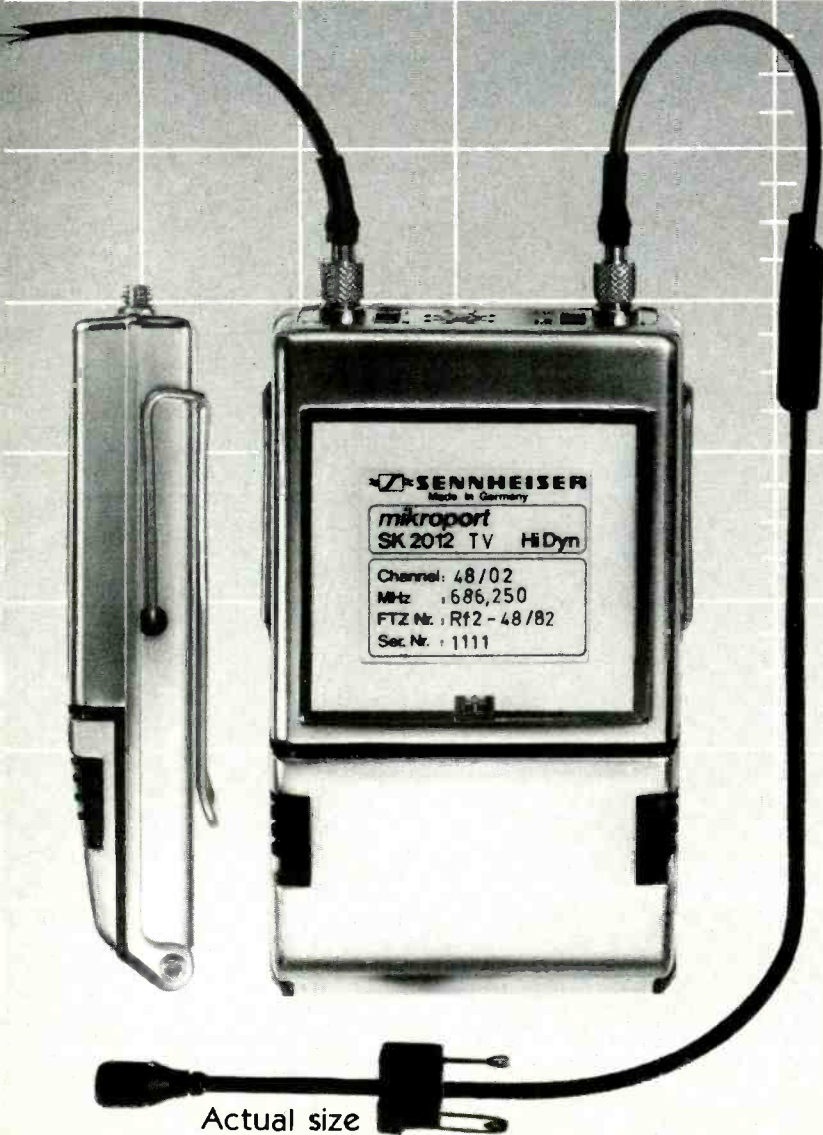
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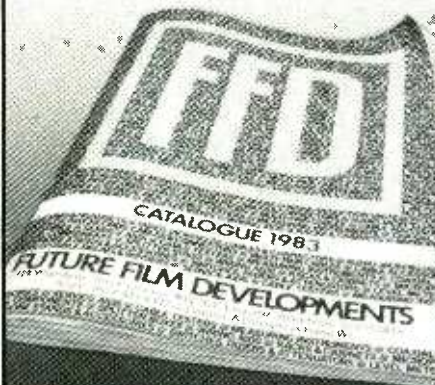
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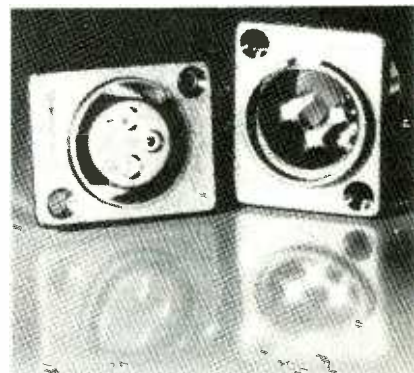
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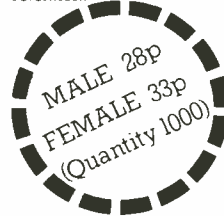
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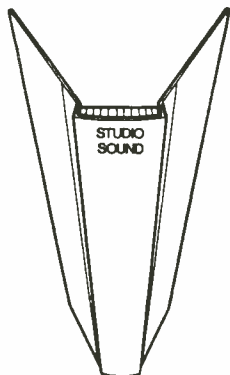
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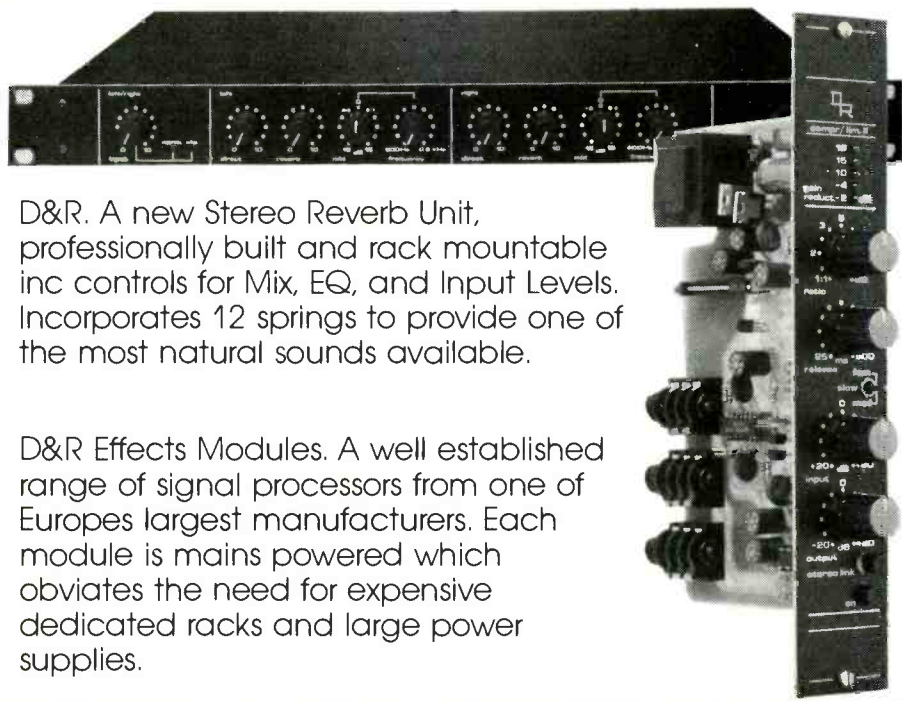
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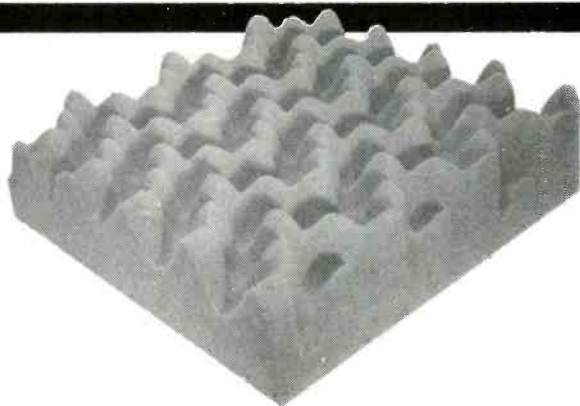


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new products

Symetrix Model 511 stereo noise reduction

Symetrix has recently released the *Model 511*, a stereo single-ended noise reduction system. They claim noise reduction figures of up to 30 dB from previously recorded tapes that are considered objectionably noisy. It can also be used to clean up other audio signals from a range of sources.

The *511* uses a downward expander in series with a programme-controlled dynamic low pass filter. The expander and the filter can be used together or separately to provide the greatest amount of noise reduction without altering the programme material.

The expander consists of a high performance VCA and detection circuitry to control it. The expander reduces broad band noise whenever it falls below the threshold point set by the front panel control. The detection circuitry is programme-controlled to adjust attack and release times to prevent low

frequency pumping problems.

The dynamic filter makes use of a number of psychoacoustical principles to achieve its effect. The first is the masking effect where programme material will mask noise in the same bandwidth. The second is the fact that reducing the bandwidth of an audio signal reduces the perceived noise. The filter examines the incoming signal for HF content and opens up sufficiently to allow it to pass and in the absence of any HF energy the filter closes to a 2 kHz bandwidth.

The *511* is a standard 19 in rack mount unit of 1 U high. The only adjustable controls are the thresholds for the expander section with switches to select filter and expander, and a stereo link. There are also simple LED indicators to show the operative noise reduction. **Symetrix Inc, 109 Bell Street, Seattle, WA 98121, USA. Tel: (206) 624-5012. Telex: 320281.**



Sequential Circuits Drumtraks

Sequential Circuits have announced a new drum machine system known as *Drumtraks*. This is a programmable unit with 13 digitally recorded instruments and is equipped with *MIDI*. Each of the 13 drum and cymbal sounds may be individually programmed for volume and tuning. This allows the user to 'expand' the 'drum kit' to create other percussion sounds such as gongs, etc.

Drumtraks features a programmable mixer with a mono output. For external processing, six audio channels (plus metronome) are available at the back panel through 1/4 in jack sockets. The unit has an overall memory capacity of over 3,300 notes which can be allocated to up to 100 different drum patterns, any of which can be up to 100 measures long in any time signature. Tempo range is 40 to 250 beats per minute. Each overdub of a pattern can be recorded with a different instrument volume or tuning in real time or auto-corrected to one of eight levels of resolution. Any part of an

instrumental track can be erased and patterns can be copied and added together.

Once drum patterns are recorded in the memory, up to 100 songs can be defined by chaining patterns together. Each song can consist of up to 100 steps and they can be edited, copied and appended as well. The unit has battery back-up and a cassette interface for program storage.

The *Drumtraks* also has two built-in interface systems—selectable 24, 48 or 96 pulse/quarter-note clock input, and a 24-pulse clock output for older sequencers or rhythm units and sync-to-tape. The *MIDI* interface will allow the *Drumtraks* to operate with other *MIDI* equipped instruments.

Sequential Circuits Inc, 3051 North 1st Street, San Jose, CA 95134, USA. Tel: (408) 946-5240. Telex: 364412.

Europe: Sequential Circuits Europe, Nijverheidsweg 11c, 3641 RP, Mijdrecht, The Netherlands.

Historic recording equipment

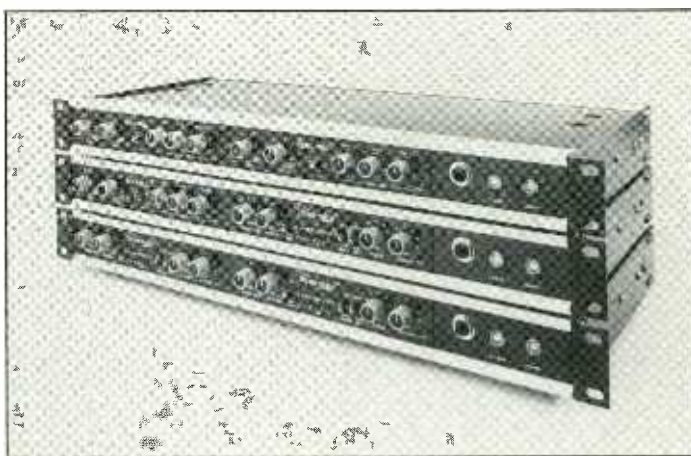
This may seem an unusual item under new products but it is appropriate as most of these items will be 'new' to a large number of our readers although they are, in fact, far from new themselves. How about the MSS disc cutter such as used by war correspondents? the CDC 'kick start' turntable with a 78 RPM 'synchronous motor system'? an *MX18* mixing console from the 1940s?

These items form part of an 'historic recording equipment' collection belonging to John Williams, an ex-sound broadcast recording engineer. John unfortunately had to retire through ill health and finds himself unable to care for, and finish, restoring his collection.

He is now forced to consider selling the collection although only to a caring home of a like-minded collector for restoration—hopefully to full working order.

Other items include two Presto 17 in 78 RPM turntables with amplifier bays and equaliser amplifiers; a Wearite tape deck of the type with the slide start knob; a *Type B* mixer with eight channels; two battleship-like response control units type *A1513* made by Associated Electronic Engineers, etc. There is also a fair number of spares for some of the units.

If you are interested and feel you can offer a good home, John Williams is contactable on (Bristol) 0272 45860.



Valley People 430 Series

Valley People have announced the successor to the *410/420* series *Dyna-Mite* and *Dyna-Mic* multi-function signal processors. The *430 Series* units are packaged in a robust rack mount chassis which provides RFI suppression and is suitable for 'on the road' use. The *430* consists of two channels of *Dyna-Mite* that operate independently although they may be stereo coupled. The *431* is a combination of one channel *DynaMite* and one channel *Dyna-*

Mic while the *432* is two channels of *Dyna-Mic*. All models may be ordered with an optional front panel jack that allows ready access to inputs, external inputs, outputs, patch points and control/meter functions by use of a patch cord at the rear panel.

Valley People Inc, PO Box 40306, 2821 Erica Place, Nashville, TN 37204, USA.

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



MXR 1500 digital delay

MXR Innovations have added the *1500* digital delay to their range of professional products. The *1500* has a maximum delay time of 1.5 s with a 20 kHz bandwidth; the minimum delay time is 0.10 ms. The unit is equipped with a modulation section offering speed and width control

and has a maximum sweep ratio of 10:1. The *1500* is a standard 19 in rack mount chassis of 1 U height.

MXR Innovations Inc, 740 Driving Park Avenue, Rochester, NY 14626. Tel: (716) 254-2910.

UK: Atlantex Music, 1 Wallace Way, Hitchin, Herts SG4 0SE. Tel: 0462 31511.

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new products

Tweek contact enhancer

One of the most commonly used items in a recording studio must be the can of contact cleaner spray. A quick spray of a plug, socket or switch following a crackle or intermittent signal will usually clear the problem or at the very least impress the client with your efficiency. Most contact cleaners evaporate within a few seconds of use hopefully leaving an electrically clean contact. Once evaporated, the effectiveness of the treatment really depends on how the contact is treated. The contact starts deteriorating as soon as the spray evaporates and the only long term protection is the fact that you can easily re-spray should it become troublesome.

Tweek is a non-conductive fluid whose primary function is not as a cleaner although its surfactant action will cause some cleaning of contacts that are made and broken. Its main application, however, is to reduce ("dramatically") contact resistance at connections and for all micro power applications—"The better the contact, the cleaner the signal". When applied as a thin coating it increases conductivity on a molecular level. The pamphlet says "A smooth, shiny metal surface when highly magnified looks like a photo of the Grand Canyon. When two of these surfaces are brought together, contact is actually made over a very small percentage of the total surface area and resistance increases. By filling in the microscopic gaps in a metal-to-metal contact, *Tweek* effectively multiplies the apparent contact area and radically decreases contact resistance." We admit to not following the physics of the last quoted sentence; however, a colleague on a sister publication assures us that it is effective.

Recommended areas of application include patch bays, banana plugs, computer connections, battery terminals, edge connectors, ground screws, switches, mic connectors, XLR connectors, output fuses, multi-stranded wire before twisting or crimping, crimp connectors, pots, IC sockets, vacuum tube sockets, etc. *Tweek* comes in a syringe-type applicator containing about 0.5 cc of fluid. It is apparently also available in bulk for industrial and OEM users.

We remain sceptical about the audible effect that *Tweek* might have with regard to improving connections that are functioning perfectly (we assume) already but are very keen to see if this is the case. Therefore, we hope to report our findings in the near future.

Sumiko, PO Box 5046, Berkeley, CA 94705, USA. Tel: (415) 843-4500.

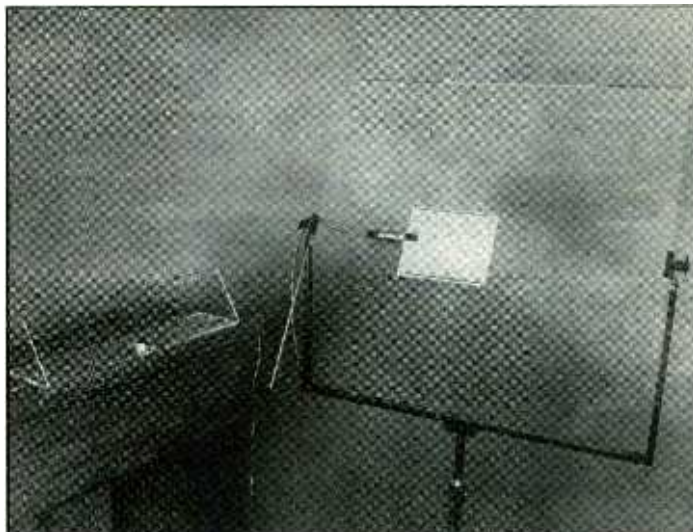
UK: Absolute Sounds, 42 Parkside, Wimbledon, London SW19.

New PZM boundary accessories

Crown have added some new accessories to the *PZM* range in the form of boundaries for mounting *PZM* mics. Placing a *PZM* on a boundary effectively increases the size of the back plate and so extends the low end frequency response, increases gain before feedback and also helps to make the *PZM* response slightly more directional.

The *A240* boundary is a transparent plexiglass panel, 2 ft square by $\frac{1}{4}$ in thick to which a stand mounted *PZM* can be attached. The panel is supplied with an adjustable stand adapter to mount the panel on any standard mic stand. There are also holes that allow the panel to be flown on nylon lines. Mic clips are attached to opposite sides of the panel for stereo use.

The other two boundaries are the *Isoflector 1560* and *1590*. These are L-shaped plexiglass boundaries to which a *6LP* or *6S PZM* can be attached. The *1560* has a 60° angle between the boundaries and the



1590, a 90° angle. The *1560* has a more directional response than the *1590*. The *Isoflectors* probably have most application in picking up spoken word on lecterns, etc, but other applications may suggest themselves.

Crown International, 1718 West Mishawaka Road, Elkhart, IN 46517, USA. Tel: (219) 294-5571.
UK: HHB Hire & Sales, Unit F, New Crescent Works, Nicoll Road, London NW10 9AX. Tel: 01-961 3295.

Monolith tape heads

Monolith Electronics has a range of record/replay and erase tape heads now available from stock. Designated the *R Series*, the heads are designed for use with $\frac{1}{4}$ in tape including full and $\frac{1}{2}$ -track mono, stereo, and 4, 6 and 8 channels. The 6- and 8- channel heads can be tailored to exact customer requirements with regard to inductance, resistance, recording current, playback level and bias and erase

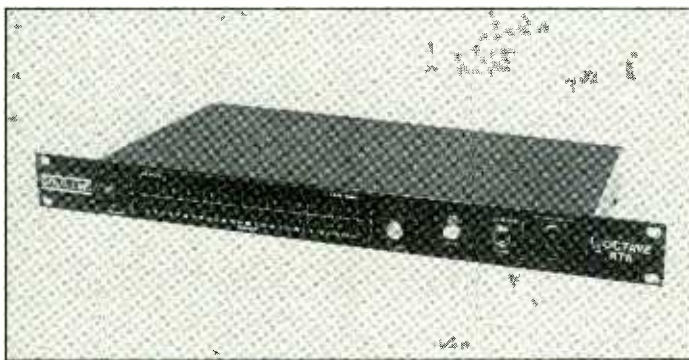
conditions.

Nominal head gaps are 2.5 μ m for the record/replay heads and 2 \times 127 μ m for the erase heads. Many special variations can be produced including the provision of chevron or protruding pole pieces, duplex or staggered gaps. Individual mounting assemblies with azimuth adjustment are available for all the heads in the range. Outline dimensions of the heads are 12.7 \times 12.7 \times

17.5 mm (HWD).

Monolith describe the *R Series* as being ideal for refurbishing tape transports economically where the original parts are no longer available. They also manufacture heads for other applications and for tape widths up to 2 in.

Monolith Electronics Co Ltd, 5/7 Church Street, Crewkerne, Somerset TA18 7HR, UK. Tel: 0460 74321. Telex: 46306.



Gold Line RTA

Gold Line have introduced the *LM-27*, a rack mounted $\frac{1}{3}$ -octave real time analyser with 27 bands from 40 Hz to 16 kHz at ISO centre frequencies. Each band has LEDs to indicate either ± 3 dB or ± 6 dB. If a pink noise source is patched through a PA system and the output monitored on *LM-27* via a microphone, the unit will give a clear indication of which bands need adjustment.

Should a particular band go into feedback/howlround, a spike corresponding to the band will appear

on the *LM-27* display. The unit is designed to be used with a $\frac{1}{3}$ -octave equaliser where it will be useful to indicate problem areas quickly.

Front panel controls include a pushbutton range switch, power switch and a reference level control. Inputs are low impedance, balanced mic level and high impedance line level.

Gold Line, PO Box 115, West Redding, CT 06896, USA. Tel: (203) 938-2588.

UK: Turnkey, Brent View Road, London NW9 7EL. Tel: 01-202 4366. Telex: 25769.

alphaton audio products

The West German company, alphaton Elektroakustik have recently made available worldwide a product line of audio accessories. These include the passive *SM-5* and active *SM-6* direct injection boxes; a line of audio transformers with nominal levels of -10 dBm, 6 dBm and 18 dBm; three audio distribution transformers splitting an audio signal of a nominal 6 dBm into two, three or four ways; and a line of audio distribution systems from 2-way to 12-way systems that may be stacked to any number of channels. There are also active 2-channel splitters with built-in phantom powering and three step line amp.

Most of these products were originally designed for German broadcast companies and have been available in Germany for the last two years. They comply with mechanical and electrical broadcast requirements such as 2500 V isolation test primary to secondary and 1500 V to ground on all splitters, distribution transformers and passive DI boxes. **alphaton Elektroakustik, Siemesstrasse 19, D-6233 Kelkheim, West Germany. Tel: 06195 74032. Telex: 417408.**



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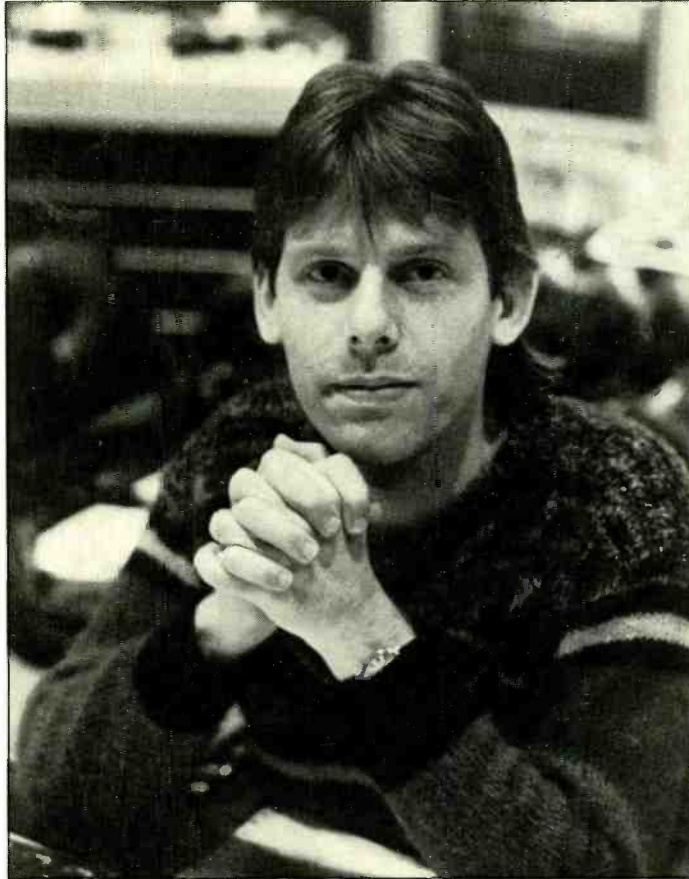
... the musician/engineers

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Hugh Padgham

Hugh first became actively involved in making music during the late '60s while still at school. Unable to afford a drum kit he borrowed a bass and joined a group playing covers of Led Zeppelin and similar bands.

"All recording engineers" he says with a smile, "seem to have played bass at some time or other."

After being in a couple of bands and even taking classical guitar lessons at one point, he was by no means convinced about going on to be a professional musician, and it wasn't long before he became more interested in using the school's mono Ferrograph tape recorder to record the group. At the time he found the machine's giant single spirit level type VU meter singularly most impressive.

"I just got more interested in the taping of rehearsals I suppose, than actually playing. I didn't want to be a struggling, busking musician on Charing Cross Station or something like that."

Had his education provided a good foundation for him as an engineer?

"I think I've probably learned

Hugh Padgham first began to attract considerable attention as a recording engineer at Virgin's Townhouse recording studios towards the end of the '70s. The project that really focused the attention of the recording industry on him was Peter Gabriel's third album, released during 1980.

Now he is one of the most sought after record producers. Most of his biggest successes so far have been with the acts with whom he co-produces: 'Face Value' and 'Hello I Must Be Going' with Phil Collins; 'Abacab' and 'Genesis' with Genesis; 'Ghost In The Machine' and 'Synchronicity' with Police; Frida's (of Abba) 'Something's Going On' which was co-produced with Collins despite incorrect sleeve credits; 'Time And Tide' with Split Enz, XTC's 'English Settlement'; and The Waitresses' 'Bruiseology' co-produced with Chris Butler.

Though he now regards it as something of a stone around his neck, he is particularly noted for the drum sound on Gabriel's 'The Intruder'. The sound was even more widely heard on Phil Collins' first solo album, 'Face Value'. His influence, particularly on recording drums, can be heard on many currently successful records. The Police's 'Every Breath You Take' was America's best selling single of 1983.

Ralph Denyer

more from what I've read since getting involved with the business. I did Science A Levels at school but failed my Physics A Level. I got so many O Levels for Physics, you wouldn't believe it. I kept trying to get Physics A Levels and kept getting O Levels. I was always quite interested in technology and things: Cars, anything. And I loved music. Recording seemed like a very interesting thing to do. I could get into music as well as playing with technology."

From Hugh's own remembrances of his early days in recording, his first faltering steps seem totally at odds with the impressive talents and professionalism he has displayed in recent years. His first offer of a place as a tape-op came from Decca in Hampstead. But when he went along there for an interview, he was immediately somewhat alarmed to see everyone there wearing white coats.

He recalls, "I thought: hang on, this isn't what I thought recording studios are about. I'm sure I've picked the wrong place here."

So Hugh was disappointed rather than devastated when a week later he

received a letter from Decca telling him that due to the general industrial situation—this was during 1973, the year of the infamous three day week—there was no job for him. Things were a little better at Advision though and Hugh perked up a little when they offered him a job.

“That was incredible. Yes, ELP and a lot of bands that were hip at the time I worked there. I was very keen but ignorant. It took me weeks to even understand what routing was. And I just couldn’t understand what the patch bay was.”

At public school Hugh had been used to having lessons rammed down his throat and felt that, in total contrast, he felt that no-one at Advision seemed to want to teach him anything and that the engineers were very secretive about their recording techniques.

“I was told that I must learn what the different mics were and I was a bit lazy about that. Anyway, after about six months their boss, Roger Cameron said: ‘I’m sorry, you’ve been made redundant.’”

“This came as a terrible shock to me and I think he just fired me because I was useless.”

He was still determined to work in recording and some six months later heard that Adrian Kerridge at Lansdowne Studios was on the lookout for a tape-op. Hugh got the job and, at this point, the tide turned.

I worked there for three or four years, learning a helluva’ lot. Because we used to do all sorts of sessions from jingles to string overdubs—it was well known as a string overdub studio—and Adrian and the staff were always very meticulous in their work. I think it was through them that I learned to be quite fastidious even though we had our ups-and-downs on a personal level.”

Fewer and fewer rock acts seemed to be recording at Lansdowne and as that was the music Hugh wanted to work on, it was time to move along.

Friends who played in Jim Capaldi’s road band put Hugh’s name up for a gig as the band’s sound mixer and he spent six months on a European tour with them, an experience which he greatly enjoyed and again found himself learning. Concurrently, he had heard that Virgin were going to build the Townhouse studios and halfway through the Capaldi tour, he went along for an interview.

“The Townhouse wasn’t even started then so we all mucked in and I’d had more or less a year out of the recording studio but it was incredible because myself, Chris Jenkins and Andy Wild—they were Townhouse maintenance engineers

at the time who later went to SSL—between us did all the wiring and stuff for Control Room Two. We didn’t do any of the actual construction because it was an Eastlake job but we did all the wiring. So I knew where every wire was. That was again, a very informative period.

“When we got that SSL desk—the

With any drummer, I would be worried if I didn’t have a drum sound in 15 minutes. People gaffer-taping up drums and all that; it’s a waste of time. I think it also insults the musician

4000B Series I think they called it—it was the first major desk they’d put into a London studio and it was fantastic because we did an awful lot of development on it. For instance if you were mixing, you couldn’t route out for extra sends, so you just had the stereo send and the four mono sends, we modified it so that it could do that, which is useful. We just did things that are standard on desks now. You can now choose certain channels on the desk that you can isolate from solo selection. In other words, if you solo something, it doesn’t mute all the other channels so you can hear the solo’d channel with all its echoes. I don’t think it originally had that.

“In record mode you could only use AFL so that you couldn’t possibly ruin a take. We said (to SSL): ‘Hang on, we’re professionals, we know what we’re doing.’ So we did a mod for that. We suggested they route the compressor section to other places in the channel which was a really innovative thing to have. EMI used to make desks like that years before but the SSL was the first of the modern generation to have that facility. We then suggested that we should be able to put that on to the monitor faders. Because the monitor faders were redundant when you were mixing, they could be used as a send or return as well. All those features were included on the later E Series desk. We did work quite closely with them and it was just good fun. I felt that they were the first manufacturer offering a console off the production line, with the engineer in mind.”

When asked if his general approach in the studio was to go in with set ideas or, was it a case of

going by his instincts and the sum of his experience. He said it was a bit of both adding: “Everyone has their favourite mics and everything.” But the way he works is dependent on who he is working with, and things are never the same twice: “Nothing ever turns out the way you think it’s going to.”

How does he get on with his big

acts, namely Police, Genesis and Phil Collins?

“I know Phil very well now. So we know by talking quite quickly, we can interpret each others ideas very quickly. I know Phil’s drum kit so well, and how he plays it, that if I can’t get a drum sound in 10 minutes, I start to get worried. Whereas I know that some people will spend a whole day getting a drum sound, and that’s wrong. It does help though if you know the person you’re working with.”

Hugh says he was: “A frustrated tape-op and engineer” prior to working with Peter Gabriel and others who gave him the opportunity to experiment in the studio. Before then, he’d been restricted to the confines that limit most mortals in recording when having to make ‘commercial’ records within a limited period of studio time. Hugh agreed that Gabriel’s method of working represents the absolute antithesis of that. Without the freedom to explore possibilities in the studio, Hugh may never have come up with his styles of recording drums that are now extensively copied by others.

“To me, drums had always sounded unreal on records. That sort of close-miked LA sort of sound that was really prevalent during the ’70s.”

Although he likes Tom Hidley control rooms, Hugh feels that to a certain extent through his studio design he ruined music in the ’70s. Hugh prefers the liver more reflective acoustics which are becoming more popular. In summary, he had always wanted to make drums sound as exciting and dynamic as they often do live at a gig.

Hugh also feels that many of today’s up and coming engineers are starting with a disadvantage because close-miking was so prevalent during the ’70s that many people regard it as the norm and ambient miking as something of a gimmick.

“From the word go, they’re working with groups. They’ve never worked with orchestras and other things, and they are taught to close-mic. I tend to go away from the instrument as much as possible and work towards it; if I need more presence or something I’ll move the mic in a bit. But on these Phil Collins’ records with the big drum sounds, most of that is from several yards away,” he says with a laugh, “depending on the room.”

He emphasises that the room acoustics are very important to him, along with microphone placement.

“With any drummer, I would be worried if I didn’t have a drum sound in 15 minutes. People gaffer-taping up drums and all that; it’s a waste of time. I think it also insults the musician.

“Getting into a broader studio thing, the musician doesn’t become a musician to play in the studio which is a very false place. They’re all divided off from each other, with threatening microphones all around. It can really put a musician off, especially if you spend two hours trying to get a drum sound, going through the same piece of music for two or three hours. They’re going to get bored with it so you’re not going to get the performance on the tape.

“Most people become musicians because they want to stand in front of huge crowds and play to them.

“My idea is not to even let people think they are in a studio. In other words ‘you play—I’ll record’. It’s not quite as simple as that but with experience, you can get to where you want to fairly quickly.”

If technicalities have to be broached, Hugh tries not to unsettle the musicians because they can easily begin to worry, and start thinking that the studio is falling down around them when it isn’t. Hugh hastens to point out though, his approach varies to suit the individual. He is more inclined to involve the band during mixing.

“I know that working with Genesis—their previous producer would never let them go near the desk. When I started working with them, they hardly knew what a fader did. Yet I was saying: ‘Come on, help me mix it; we’ll get in there together.’”

“Now they’re into it. They know what a fader, equaliser and echo sends do. Therefore, it depends on the group and their experience. I mean, I was so surprised with

The producer series

Genesis. I used to listen to them when I was at school and think: 'Christ, they know what it's all about.' But when I came to work with them, they didn't know much about the technical side at all.

"It's always been a hobby of mine to read *Studio Sound*, even the reviews. And I've got books and things lying around like John Borwick's *Sound Recording Practice*, I've had that for years. There's one in America that I'm quite interested in getting hold of, *The Sound Recording Handbook*.

"Basically I always feel completely inadequate you see, the self modesty thing, and that I've done a terrible job. I think: 'You've got to sit down boy, and do some homework. Read up a bit and then you might know what you're doing a bit more on the next album.'

It was suggested to Hugh that that is a great attitude to have providing he doesn't send himself into a state of manic depression, because he will be continually striving to do his best.

"I don't walk around depressed all the time by any means. I suppose it is a fairly healthy attitude, being unconvinced about yourself all the time."

Some people might however be surprised to hear Hugh talk about *Face Value* saying that he made mistakes on every track.

"You can probably say that about any album really. I listen to it and I cringe on this track or the other. I think it's the same with any job, if you're a professional you always see much further into your work than anybody else."

Face Value

Phil Collins had set up an 8-track recording package in a bedroom and already had demo tapes for his album when he came to work with Hugh. He expressed concern that some of the feel would be lost when the tracks were re-recorded. They decided to use quite a lot of the 8-track recording, dubbing them on to 24-track and building on the original tapes. Hugh cites this decision as a prime example of not allowing the quality of the recording to take precedence over the quality of the musical performance.

"This is the thing with a lot of '60s records, they're awful technically but they've got a great sound. Bags of reverb.

"So with things like *In The Air Tonight*, the basic *Prophet* and drum box sounds are from the 8-track tapes. At the beginning you can hear, it's all distorted! And the repeat echoes that happen (on the vocal) halfway through the song are not in time; if you listen carefully you can hear it. If I remember rightly, even the mix is a rough mix. The bass drum is off centre. But because it sounded better than any of the final mixes we tried to do, we had the courage of our convictions to say: 'Right, that'll be the one even though it's not technically perfect.' Whether it's a single, album or whatever; it's got to have atmos-



phere."

In The Air Tonight certainly has that.

"We were really worried about *In The Air* because it took a long time to cut. And also, to get the drums sounding really big at the end meant that the front bit had to be really soft. If it was too soft, people wouldn't hear the beginning of the radio. But if they turned it up loud at the beginning, they'd have been blowing up their speakers and stuff at the end. So we had to compromise."

The production on *Face Value* is extremely dynamic. Hugh and Phil feel that the music they left off the album during mixing was just as important as the music which was on the masters. Just because they had an overdub of a superstar guitar player or whatever, that didn't mean they had to use it if it interfered with the final concept.

"*I Missed Again*, was only piano, bass and drums on the backing track. It sounds quite full because we compressed the piano to death, it sounded so wide and it filled up everything; and we pulled it up in the mix. It sounds as if there's a lot going on, when in fact there isn't."

So broadly speaking, there was quite a bit of playing around with gadgetry to achieve dynamic effects?

"To a certain extent. I mean, that's what compressors are all about—I use them a lot."

Hugh has lots of different brands of compressors and after years of experimentation feels he can use them to very good effect. Phil Collins likes a cutting sound on his vocal and Hugh used a 'very cheap' compressor to achieve the desired effect on their tribute to the Beatles track, *Tomorrow Never Knows*. And he often uses relatively cheap guitar effects pedals. In general, he finds that studio effects are just not raunchy enough.

"If I'm using a phaser or a flanger, I'll invariably use a cheap guitar pedal because they've got such a bad noise to start with; that's what gives you half the sound. With

studio equipment, they're so careful and involved with things like keeping the signal-to-noise ratio down that you lose the effect. You need to go through two or three of them to get the effect that you want. You have to do things like phase the phase of the phase."

Just a final snippet on *Face Value*: the backwards sounding cymbals on *Tomorrow Never Knows* are not in fact backwards, they're (surprise surprise) heavily compressed.

Equipment

Hugh expresses strong feelings about equipment manufacturers—citing SSL as an exception rather than the rule—inasmuch as they virtually never seem to seek advice from top producers and engineers. He feels there is a lot of scope for improvement in the design of recording equipment, and is at a loss to understand the lack of communication.

"There are still producers about who maybe don't know too much about equipment, although I think you have to know more and more these days, but people like myself, Steve Levine and Steve Lillywhite and there are loads of others: I don't think any of us ever get rung up by people saying: 'Do you fancy trying out a new piece of equipment?'"

"AMS have phoned me once or twice; actually they're a good company like that. When they were developing their digital reverb, they mentioned the drum sound we got on Gabriel's album. They thought we'd done that electronically with some device but it was just acoustic really. They wanted to include something like it. They've got ambience programs and backwards things now, which can sound quite like squashed compressed rooms and stuff. Generally, though, I don't think there is much feedback; which is a shame. I'll probably get slagged off by the manufacturers and people for saying things like that.

"I mean, Sony was a bit of a joke. They build all this wonderful equipment and send it over here and

certainly when we were doing Genesis' record last year, I think we were working with (digital) equipment that was under par and the Sony people here didn't seem to know anything about it.

"Since then (August 1983) they've organised a couple of courses which were quite comprehensive. A couple of chaps from the Townhouse, Geoff from Genesis and some from HHB, and a lot of other people went on those courses and now they know all about it.

"I've actually bought a whole Sony 1610 digital system, complete with editor and two video machines."

HHB are looking after Hugh's system for him when he's not using it for his own production work. They have another digital system of their own and are geared up to store, maintain, deliver, etc. In a way, as a champion of new technology, by buying his own system and making it available for hire, he feels he is "putting his money where his mouth is". Hugh says Steve Levine has bought a Sony 24-track digital system which also receives his enthusiastic endorsement.

"I am very keen on the Compact Disc. I think it is very important that people are aware of it and try to use it. I think that it is so good that I want to sort of push it on to everybody. I think that one of the ways in which I can voice my opinion is by making facilities available to people."

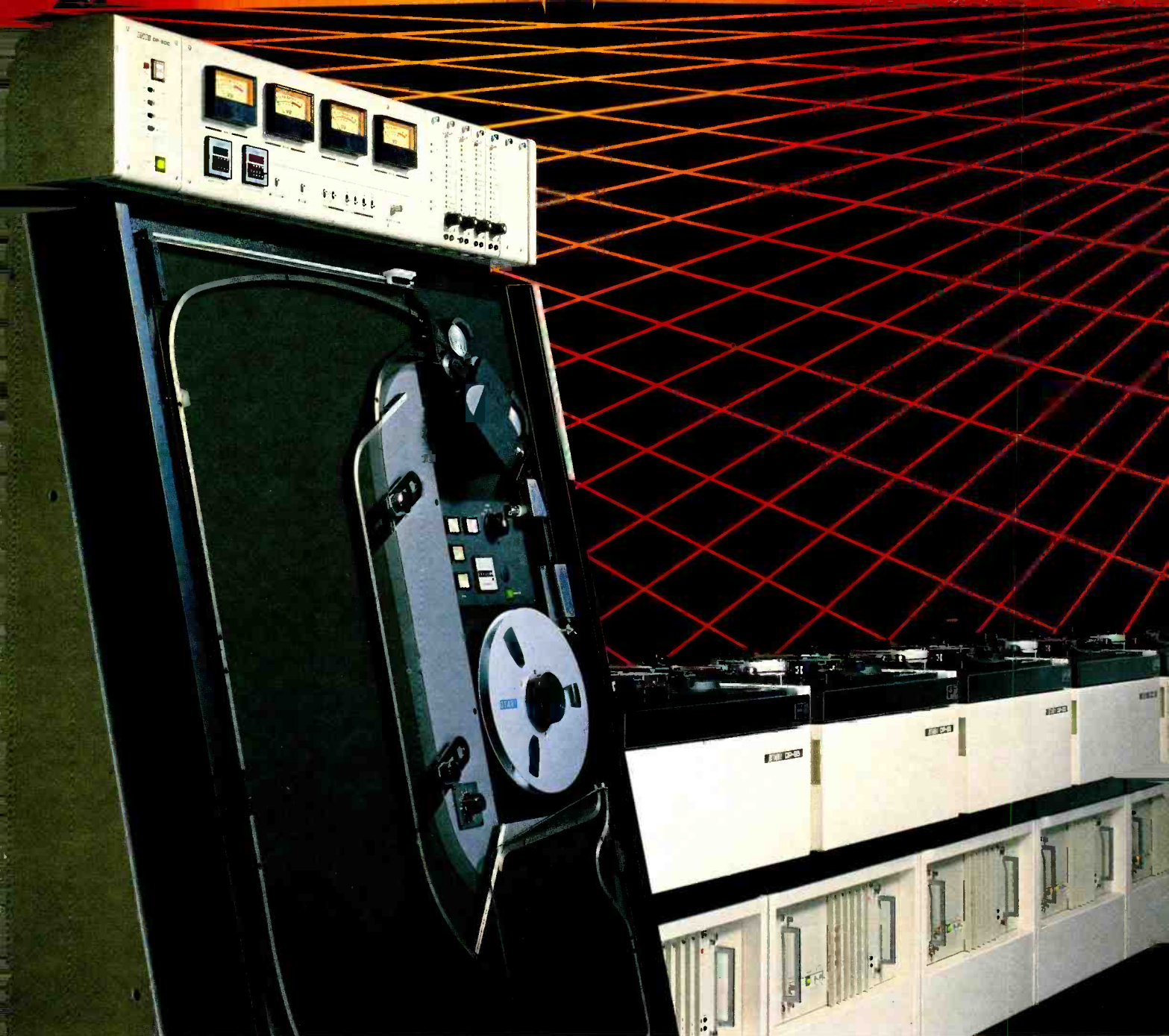
Following Hugh's considerable enthusiasm for the Compact Disc system, is much of his work available on CD?

"Oh yeah, loads of things though they weren't necessarily mastered on digital. *Synchronicity*, Genesis, Split Enz, well everything I've done this year (1983) has been mixed from analogue 24-track straight to Sony 1610. In fact the Police album was done on the JVC system which is a similar sort of thing though not compatible."

Hugh is still mastering as normal because everything has to be cut for vinyl for the bulk of sales. He continues talking about the Sony 1610 system.

"You end up with your *U-matic* cassette and that can then be directly transferred through the 1610 processor and the cutting console to another *U-matic*. In other words, you do a production master as you normally do which will then go to another *U-matic* and will then go off to the Compact Disc factory. Therefore, if you are going to make a CD now, you don't have to go through any generations from the first mix. And of course, the other advantage of using the 1610 system is that you can make as many copies as you like without any degradation at all. It just doesn't degrade one little bit."

Hugh also enjoys editing with his 1610 system because of the greater freedom and ease of operation. At the touch of a button, anything from the equivalent of a butt edit to a



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crossfade of up to 99 milliseconds can be achieved.

"A crossfade of 99 ms doesn't sound like very much but in terms of an edit, it is. It would be a very shallow angle on an editing block. It's fun doing that and you can edit to your heart's delight without actually ruining anything. Sometimes you're doing edits on ¼ or ½ in (analogue tape) you put it together and someone says they don't like it. You have to pull it apart and you'd be freaking out because of not wanting to crease the tape. Sometimes the editing tape can be so damn solid. And then when you've taken it apart someone will say 'Oh, maybe we'll have it back again.'

"By this time your hands are sweating and you start thinking you must be careful not to get any grease on the tape. When you're editing with digital, you just sit there and press buttons. And you can do outrageous things without having to worry about if it doesn't work."

Hugh considers the use of the Sony 1610 system less justifiable if the music is only going to be released on vinyl. Quite simply, the advantages—most noticeably, a big improvement in signal-to-noise ratio—are negated by the appallingly low quality achieved with most pressings. In brief, though he acknowledges that vinyl records can sound good, Hugh finds the general quality of records depressing and wishes he had greater control over the part of the process which finally dictates the sound quality enjoyed (or otherwise) by the record buyer.

"I'm probably in Australia or somewhere by the time the test pressing comes through and then it's too late and somebody else has to approve it. Maybe the test pressing was OK and then the second generation pressing comes out and it just sounds bloody awful. That depresses me. The thing with the Compact Disc is the margins of error like that are far much less. The thing is digitally encoded.

"You're dealing with very precious grooves and things with vinyl. You send your lacquer to the factory after spending weeks and thousands of pounds and probably the first thing they do is polish the metal work so the plastic falls off the stamper. You've just wasted all your time and money. So the quicker we can get rid of the record, the better.

"Some records can sound pretty good but if you listen to the 1610 in the studio, to me it's quite a lot better than ½ in (analogue) which everyone's been raving about for the past couple of years. That's still good but the 1610 is so much better. And when you get that on to Compact Disc as well, it sounds fantastic."

Police

"I'd done a couple of albums with XTC who did a long tour with the Police in America in 1979/80 when the Police were happening here and

I think one of the things about recording music is that you've got to be able to get on with people. Sometimes it gets a little bit difficult

were averagely happening in America but hadn't really made a killing there. They just did about two or three tours with XTC and I think it just came up in conversation one day between Sting and Andy Partridge—that they were looking for someone new. I don't know for what reason. Andy just said something like 'Oh well, the bloke who does our records is quite good; we like working with him.'

"In fact I was round at a girlfriend's house—it was round about Christmas time I think—and there was Miles Copeland (Police manager) on the phone. I still don't know today, how he got that number because I didn't make it very public. Anyway, he phoned me and I didn't actually meet the band until we were at the airport departure lounge on the way to Montserrat."

So Hugh just said hello and it was all very friendly?

"Yeah, well I think one of the things about recording music is that you've got to be able to get on with people. Sometimes it gets a little bit difficult. With the Police, one of their hobbies is arguing so it's a bit difficult to find yourself in the middle of that."

But surely totally objective argument or discussion can be very fruitful?

"Oh yeah, I think the band thrive on it really. It's not always heavy but sometimes it's heavy enough for you to get a bit worried and think: hang on."

"Sometimes it's very difficult to remain completely neutral as well because I have my own opinions on how things should go. But I always used to say 50% of the job is getting on with people and the other 50% is the technical side of things. If you don't get on with people, forget about record production. But I mean, we're all prone to being grumpy sometimes I suppose, working long days and long hours. You may not *always* love everyone you're working with. There's bound to be odd differing opinions."

Hugh recalls that problems with communication caused a chuckle or two.

"Even though they've got a lot of space in Montserrat, the drums in the studio sounded really boring and lifeless—it just wouldn't do. So we put the drums in the living room which created quite a lot of amusement."

Apparently they found that as the

living room is not acoustically isolated, they couldn't do much recording at night because a chorus of beasties, led by the tree frogs, provided continuous loud chorus.

"And the other thing that was amusing was it was quite close to the kitchen and they were always cleaning cutlery and humming away. So we had to keep shouting to them to keep quiet because we were going to do a take. Poor old Stewart, he couldn't see the rest of us in the control room or the other two playing in the studio. So he was just having to play along. He eventually started quite enjoying using the kitchen staff as a good vibe because they used to peer out of the kitchen and look at him thrashing madly away; apparently not playing with anybody. I'm not sure if they realised what was going on or not."

When Hugh and the band returned from Montserrat to record *Synchronicity*, their second album with Hugh, they rigged up a video camera for Stewart so that he could see what was going on in the control room.

Hugh went on to talk about the method of recording used on *King of Pain*, which was also used on a track called *No Self Control* on Gabriel's album which he also remembers as being a prime example of a mix ending up sounding totally different from what might be expected from the material recorded on the multitrack tape. Hugh explained that part of the effect was achieved by sub-grouping drums to one fader so that the whole kit could be switched in and out with one click of a switch with one finger as opposed to having to use five or six.

"*King of Pain* is a track that, if you listened to it on the multitrack tape, wouldn't bear any resemblance to the final track at all. In fact the first verse, which is just vocal and piano I think, was recorded on a completely different day and sounded different. So that was just an edit into the next bit. And we did all sorts of things that seemed weird at the time, knocking this in and knocking that out, just editing it all together as we went along."

Sting sax on Ghost

"That was quite funny because they had been on tour in Japan and Sting had just picked up a couple of saxophones there. He's brilliant. He'll learn to play anything adequately, very quickly. Anyway, he was in love with his sax at the

time and he used to walk around with it on all the time, even if he didn't have the sax on he'd have the strap thing around his neck. And everyone got sick of him in the end because he was walking round the studio going: HONK, HONK, HONK. Anyway, he was well into playing it at the time; he'd lost the urge by the time we did *Synchronicity* so there's hardly any sax on there. But his idea on *Ghost*—and I didn't know him very well at the time so I didn't know if he was taking the piss or not—was to do the sax parts and the singing at the same time. So I thought: Hang on, you get a sax sound and then do that?

"I thought it sounded like a pretty good idea. So we ended up with one mic. I couldn't be bothered to change between a vocal and a sax mic. If you had two mics there would be spill and they would be quite close together anyway. So we had one mic which was used in an average position. So he would stand up on his toes and put the bell of the sax to the mic and then stoop down to sing into it. The other thing that was amazing was that it was one of those songs—he did quite a lot of it on that album—that had banks of harmonies and he'd say: 'OK, I'm ready to do the first pass now.'

"He'd go through and sing it and say 'OK, fine.'

"Then he'd sing it the next time and I'd think: hang on, the harmony he just did on the first chorus was different from the one in the second chorus. I said to him that he was wandering around a bit and he said: 'Oh, don't worry about that, don't worry about that. Next pass.'

"And he'd do it again and it was just incredible. He'd build up a collage of harmony vocals, maybe six or seven tracks and maybe with a lot of the sax in unison. He's got a very good sense of harmony. He'd just build it up. Normally you say there's one harmony, we'll record it, double-track it and bounce it down. After that you do the next harmony or however you choose. With Sting it was just like BANG! it was done. Sort of, a massive half hour's work and I was lumbered with six or seven tracks with different harmonies all over the different tracks. I thought: well, sod it. Just play it all together.

"It sounded good and that's how it went. I just bounced it down from there. Saxophone, vocal, the lot."

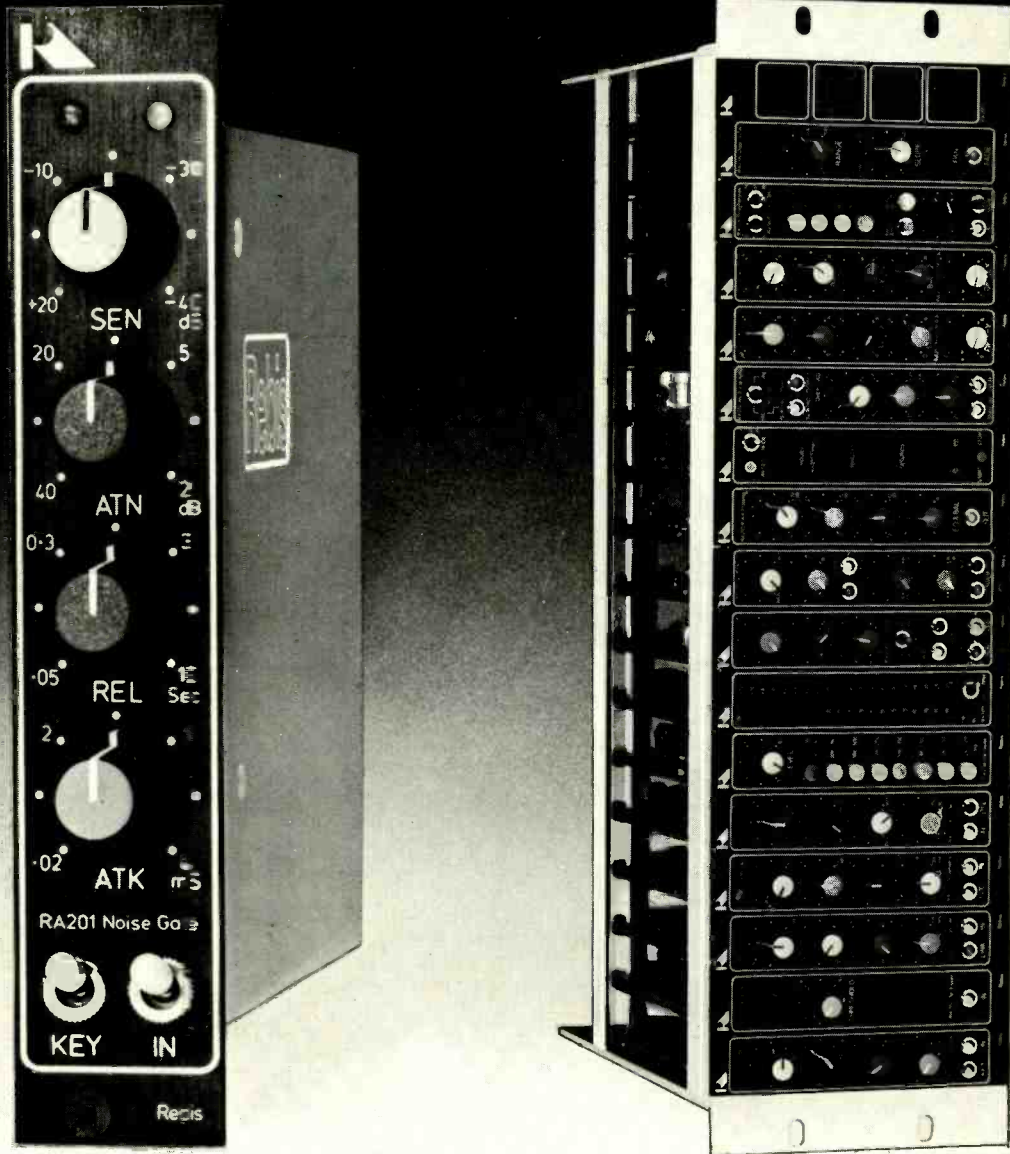
Sting was aware of the fact that he wasn't Ornette Coleman so all the sax parts were multi-tracked.

On the subject of Sting's vocals on *Synchronicity*, Hugh was quite pleased with the general results. Obviously he had felt more at ease with the band on the second album having got to know them during *Ghost In The Machine*.

"It was good because when we did *Ghost*, I thought there was too much of Sting tracking his voice up thousands of times. He's got a great voice on its own. He did a version of *Message In A Bottle* on one of those

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The producer series

charity shows (*The Secret Policeman's Other Ball*) with him just singing and playing guitar and it was brilliant. So I thought: OK, on *Synchronicity* he's got to do some single-track singing."

"*Mother* was a song that Andy had a demo of and the vocal was just manic, it was so good. It also sounded good. I think he'd used an old Hammond mic on it or something; which I've never come across before. But the chap who'd engineered it—it was his prize possession—had put this phaser and other stuff on it and we were trying for hours to match up the vocal sound. In the end I said 'This is a complete waste of time, we'll just use what is already there.' So we dubbed the vocal off the demo, because we luckily had the demo master. We got it in sync and stuck it in. When the vocal went out, we stopped the tape and got it in sync when it came in again. So we used the original manic vocal on that song. People either love that song or they hate it."

With unrelentless if gentle prompting, Hugh continued to rack his brains trying to remember details of how they recorded the album.

"*Walking In Your Footsteps* took about half a morning to do. Sting just wrote it one morning and came in."

Hugh says neither himself nor any of the Police can program synthesizers particularly well.

"We have the odd *OBX*, *Prophet* and Roland *JP8* and things around and it's great because Sting doesn't like to spend years getting synthesiser sounds. He'll just say he wants roughly such-and-such a sound and he punches through all the factory options (laughs) until he finds something. He says 'OK, that'll do, we'll record that.'

"I'd say 'How about... and it's 'No, no, no. We'll record that.'

"*Walking In Your Footsteps* was done like that. That's all it was really, a couple of sequencers going along, bits of percussion, a few guitar whines and it sounds great. The words are clever and funny. And that ended up finished quite quickly."

"We had to work quite hard on *Every Breath You Take*. We tried it different ways. Like their reggae way. I seem to remember it taking quite a long time. We didn't really know what to do instrumentally in the middle. Then one day Sting went into the studio and had these one note piano ideas, just two lines."

They were quite pleased to get the song wrapped up because it was evident to all concerned that it had something.

"Some songs you know are going to be hits and that one was obviously very strong. So we were keen to make it sound like a single. You see, when they go into the studio, they haven't rehearsed at all on the new songs. They've done their own demos. Sting gets quite happening demos together. And Andy had quite a few songs. Stewart had a



few. They didn't get together and talk about them before they went into the studio. So the first time that say Stewart heard *Every Breath* was in the studio. So we took every song from there. Andy would get his guitar part together or whatever. So it was interesting to work like that but you're often sitting around trying things out. Even though a song may sound really simple, you might have spent a week finding the sound that works.

"*Wrapped Around Your Finger* came pretty easily actually. I like that song a lot. I remember I had a terrible problem with *Synchronicity 1*. There were so many words coming out like verbal diarrhoea and sort of overlapping each other as well, almost like a round or something. That was really difficult to mix because I didn't feel that the diction was all that good when we did the vocals, but it had a good vibe.

"And *Synchronicity 2*, trying to make that sound really powerful."

Maintaining objectivity, particularly during long periods of concentrated work, can be a problem and as a result the question arises: is it the track or is it me?

"Sometimes I'm happily mixing away when I suddenly realise: Hang on, to my mind, it doesn't sound good at all.

"You can't understand why. So you just have to stop, put all the faders down, go outside and have a breath of fresh air and start again. Sometimes you start off thinking a track sounds great and then an hour or two later, it doesn't sound good at all. It's a very fine line sometimes, especially with these big drum sounds, between making it sound powerful and making it sound weedy. With snare drums and stuff; if they are too loud, they overpower things. If they are not loud enough or you EQ them too much, they can sound too thin.

"On *Synchronicity*, (laughs) I kept on trying to persuade Stewart to tune his snare drum down a bit. Everybody was. But we didn't succeed very much and I'm glad really. His snare drum is always so tight, it couldn't be any tighter. It

gives a very thin sound but it really makes your eyes blink when you turn it up on the monitors which I like but I wanted to try and get more variation really. But it is very much his trade mark."

The atmosphere and climatic conditions were somewhat different for the mixing of the *Synchronicity* album, which was done in the snow surrounded Le Studio in Quebec.

"When we mixed the album, I used to start off in the morning. I actually used a computer to help me. They had a Solid State Logic desk at Le Studio in Canada. So they would all go off ski-ing in the morning or the afternoon, (laughs) they'd leave me in the studio mixing away and I'd probably do quite a lot of work on the song. And they'd come back from ski-ing, change and come down to the studio. We'd spend a few hours discussing and changing things I'd done, that sort of thing, and finish it off like that."

They mixed about one track a day or so. As the album has sold in enormous quantities—millions in America alone—the mixing was quite cost-effective?

"Yeah, I think so. We spent longer on it than *Ghost*, more than any of their albums, but I don't think that matters. Actually, it wasn't very long compared to some bands. We had a week or so off at Christmas which we spent in the West Indies. I think the album took eight or nine weeks or something."

Slightly different from their first album, which was recorded in days rather than weeks, recording over old tapes previously used by Caravan. At that time they couldn't afford new tape.

Hall & Oates

As with Police, Hugh couldn't tell me exactly how Daryl Hall and John Oates came to want to work with him. They had asked him to work on their *H₂O* album from blank tape but the studio dates conflicted with his commitments to work with Phil Collins. Not to be deterred, they asked: 'Could he at least mix the album when he finished working with Phil? Yes was the answer and the resultant pressure gives a rough

idea of how badly they wanted Hugh to be involved in some way. He told me the tale.

"Well, I don't even know if I know the right story. But you never want to release an album too close to Christmas because it is likely to get all mixed up with *Perry Como's Greatest Hits* and that kind of thing. Therefore they wanted to get their album out well before Christmas but they started a bit later than they had wanted to. They had approached me originally to record the album but I couldn't because I was doing Phil's album. So anyway, they said to come and mix it. Then they phoned up and said could I come over a couple of weeks earlier because we really had to try and meet the deadline. It was ridiculous, the record was in the shops two-and-a-half weeks after we had finished it. They had the cover all done up front, the lyrics were all finished before they went into the studio. As soon as we finished it went from the cutting room straight to the factory."

The recording and mixing was all done at New York's Electric Lady Studios. Hall & Oates were recording away in one studio. They completed track by track instead of the more usual method of recording all the vocals after most of the overdubbing was completed. To begin with they handed one song at a time to Hugh.

"We just hired the two studios and they would send a tape up to me when they finished it and when I would mix it. They'd come up, listen to a mix and say: 'Jolly good' or whatever and then they'd go back downstairs and finish singing on another one. But eventually they finished before I did and we spent the last week or two mostly together. But that was all really because of the time pressure, that we overlapped in the studios for a week or two."

So the nett result was that the credits read: produced by Daryl and John, co-production by Neil Kernon, mixed by Hugh Padgham and mastered by Bob Ludwig. I told Hugh that I really liked the end result in terms of the quality of the recording. He didn't really seem to believe me but almost begrudgingly agreed.

"Yeah, it was interesting to mix someone else's recording actually. I didn't know if I was into it or not to begin with because being an engineer, I'm quite touchy about how I do things."

I suggested that surely that was a natural reaction and that he obviously has his own standards and wants to maintain them.

"Yes, Neil is a very good engineer himself. Otherwise I wouldn't have done it. But it was great to be able to hear the songs already recorded, and I could just come in and put my touches of echo and things on stuff that I hadn't already lived with for three or four months and got pre-determined ideas about. So in that respect it actually worked quite well.

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"There was the sax solo on *Maneater*. There's a helluva' long repeat on it. It didn't have that there to start with. We were playing it through and I was frustrated because I didn't like the sax solo that much. I thought it needed more, it was so laid back. I thought: sod it, I'll completely fill in the gaps.

"So I got the old AMS digital delay out, changed the sound a bit so that the repeat sounded as if it was coming from somewhere else and just stuck it in."

Daryl and John thought the effect was great and said it was something they hadn't even considered.

"If I had been there for the recording I would have said to the sax player to play more notes or something. So it was interesting to create something from my thoughts while mixing.

You can do lots of things like that. You can completely change the rhythm or feel of something by, for instance, auspicious use of digital delays, tape delays or whatever you've got around. You can actually change things you've already recorded quite a lot."

Hugh was pleased to work with Daryl and John as he'd always liked them though in his opinion, their records had often sounded under-produced in the past.

"That's a weird thing for me to say because I've always hated over-production. But their records sounded almost demo like. They didn't sound like records sometimes, they were just sort of straight. And therefore it was a real joy for me to be able to play around with the vocal echoes and things, the kind of thing that isn't on their previous or last couple of records, *Voices* and *Private Eyes*. So I was quite pleased to be able to stick my oar in like that."

Having listened to the *H₂O* album quite a lot, I told Hugh that I personally liked the freshness of the album. It has more of an urgent edge or contemporary feel than most current American music.

"Oh, they're very aware of that which is why they get English people to record their records. They have done that for the last three or four years. I think they've been less like American acts than most. I mean, it's awful isn't it, most American music?"

Accepting that once again I was talking in terms of personal preference, I told Hugh that although I can appreciate the craftsmanship of Steely Dan, hearing most of their records usually leaves me a "So what?" kind of feeling of being unmoved.

"It's so bloody clinical. They wouldn't let any mistakes or anything go through; that band. There's no way I could ever make a record with them. For a kick-off, I think it would drive me mad. They do make perfect recordings but as you say, 'So what?'. I call it *Hospital Rock*. It's really clinical, sort of sterilised. All the drums have been washed in TCP before they

When you are working, you are so honed in on things that being objective is quite difficult. I try not to spend too much time on mixing in order to keep an objective viewpoint

record them and stuff like that. And I'm into... on *In The Air Tonight* I could point out serious mistakes on every track as far as I am concerned, which makes me go on to the next recording thinking: I mustn't make that mistake again. But because the next record I work on isn't Phil Collins; a different situation arises. But OK, when we came round to the next Phil Collins record I thought: I've got to make sure I don't make any of the same mistakes on this LP.

"Most people who listen to the record don't hear any mistakes at all. That's the thing that keeps me going in a way. I always think I've done a dreadful job."

Mixing

"I'm always the first to admit that I'll do one mix and then another one—with slightly more echo on the guitar in the chorus or something—And I'll be biting my nails and think: well, I'll make a choice later.

"If I listened to the two mixes six months later, I guarantee I probably wouldn't be able to tell the difference. In other words, when you are working, you are so honed in on things that being objective is quite difficult. I try not to spend too much time on mixing in order to keep an objective viewpoint.

"I think it's really good—if you've got the bottle—to record your first impulses. So many times it is frustrating, you've done a rough mix with a tape echo that you've just rigged up at two in the morning, you come to mix it, refer to the rough mix and can you copy it? No. Something is not the same and you think: Jesus, why didn't I record it at the time?"

"But usually, you're freaking out because you think you are just about to run out of tracks. I guess some people like to record 46-track. I like the idea in theory but not much in practise."

The problem of 46 tracks of tape hiss doesn't seem to worry Hugh.

"I suppose it could be a problem but I think you can keep tape hiss down to a minimum if you are a good engineer."

He went on to explain that he likes the idea of being able to store the original backing track tape—perhaps 24-track or even 16-track—so as not to degrade the tape by spending weeks or months putting it through a multitrack machine but using a sub-mixed copy of the backing tracks for the overdubbing period of recording.

"I think that saving the backing tracks in that way is a good idea though I personally have never had the facilities to do it. Some people wouldn't agree with me. I have had some experience of 46-track mixing and quite honestly, I find it a bit of a pain. You've almost definitely got to use a computer. I'm talking about when you have something on virtually all 46-tracks."

Hugh cites the Glyn Johns' approach of recording everything on 16-track as with some admiration saying: "I haven't got the bottle he's got but I reckon 24 tracks are plenty."

"I've done some things on the 3M digital system. There was Frida's album which I produced with Phil Collins. We did that completely digital at their (Abba's) studio in Stockholm which is very nice. They've got a 3M 32-track and 3M mixdown as well. So we actually recorded and mixed digitally. I think that system looks a bit ropey compared with what Sony have got happening now. Though, 32-track wasn't such a bad idea. It would have been good if Sony had maybe done a 32-track option. That sounds a bit contradictory of me after saying that 24-track is enough, which it is really.

"But you see, I like to do things like record the ambience of drums on separate tracks, even if it sounds best a certain way. In other words you can record the ambience on to three or four tracks which I like doing because you can then do things like bringing them in on the chorus of a song or vice versa. We did that once or twice on Phil Collins' *Hello, I Must Be Going*. The drums are very dry at the beginning and then I very gradually fade in the ambience and get to full ambience halfway through the song. In fact I even added some digital stuff to it as well. At the end it went back to being very dry. I didn't know I wanted to do that at the time we recorded it: so I couldn't have done it if we'd mixed all the drums together with the ambience. So you do eat up a few more tracks, and I often think I am using too many for the drums. Then I realise that the guitar player and keyboards player are going to love me when I say we've run out of tracks."

I told Hugh that I found the way in which drums have come to the fore in recording of late to be quite amazing.

"I'm not saying that the onus is

on me as being responsible for that but I remember reading a review of mine in *Billboard* in America saying something like: typically Hugh Padgham percussively oriented mix.

"I thought: oh, no. He probably means that you can only hear the drums.

"I listen back to some records and think: oh, no. Maybe the drums are really loud.

"But people loved it at the time and when we built the Townhouse, New Wave had just started. It was the end of the era with the Eagles and that very dry drum sound: which never sounded like drums to me. It sounded like someone tapping on cardboard boxes. And the engineers used to gaffer the drums up until you couldn't see any drum skin in the end, and they never sounded like drums to me."

Hugh says the idea of the Townhouse studios (the main rooms, not the control rooms) was not to try and control the acoustics and literally see how it went.

"Trying to control the sound that the first few times we recorded was really strange because none of us had really heard sounds like that before, so it was quite good fun. Wondering if we were going over the top. And people ended up really liking it. I hope I've been able to come to a compromise so that I can get the drums sounding big and real but you can also hear other instruments as well now.

"I think there was a stage at which some people—me included—were mixing the drums a bit too far forward. It's rather an awful thing for me to say; but to me if the drums don't sound any good, the record doesn't sound any good. If you listen to some of the old Motown records and some of Spector's records, you can't even hear the drums. They're banging away somewhere but you've still got a fantastic sense of rhythm, probably because they are obscured by this huge tambourine and sleighbell in echo sound.

"Obviously, in today's rock music, drums are going to be there and there's Linn drums and all sorts of drums around now. I still prefer real drumming but then for some music, a lot of groups make drum machines work very well."

Hugh expresses the feeling that he didn't really want to do this interview in such a way as to sound as if he loves pontificating about the technical side of recording. He doesn't. Broadly speaking, he is still amazed by the amount of engineers and others who question him in such a way about recording techniques that as far as Hugh is concerned, they somehow miss the whole point of creative recording. "Some people come up to me—especially engineers—and say 'What microphone did you use on so-and-so's voice on that song?' And I'll think, I haven't got a clue. The one that sounded best at the time. They'll say they think it sounded fantastic. I'll remember thinking that sounded awful. ■

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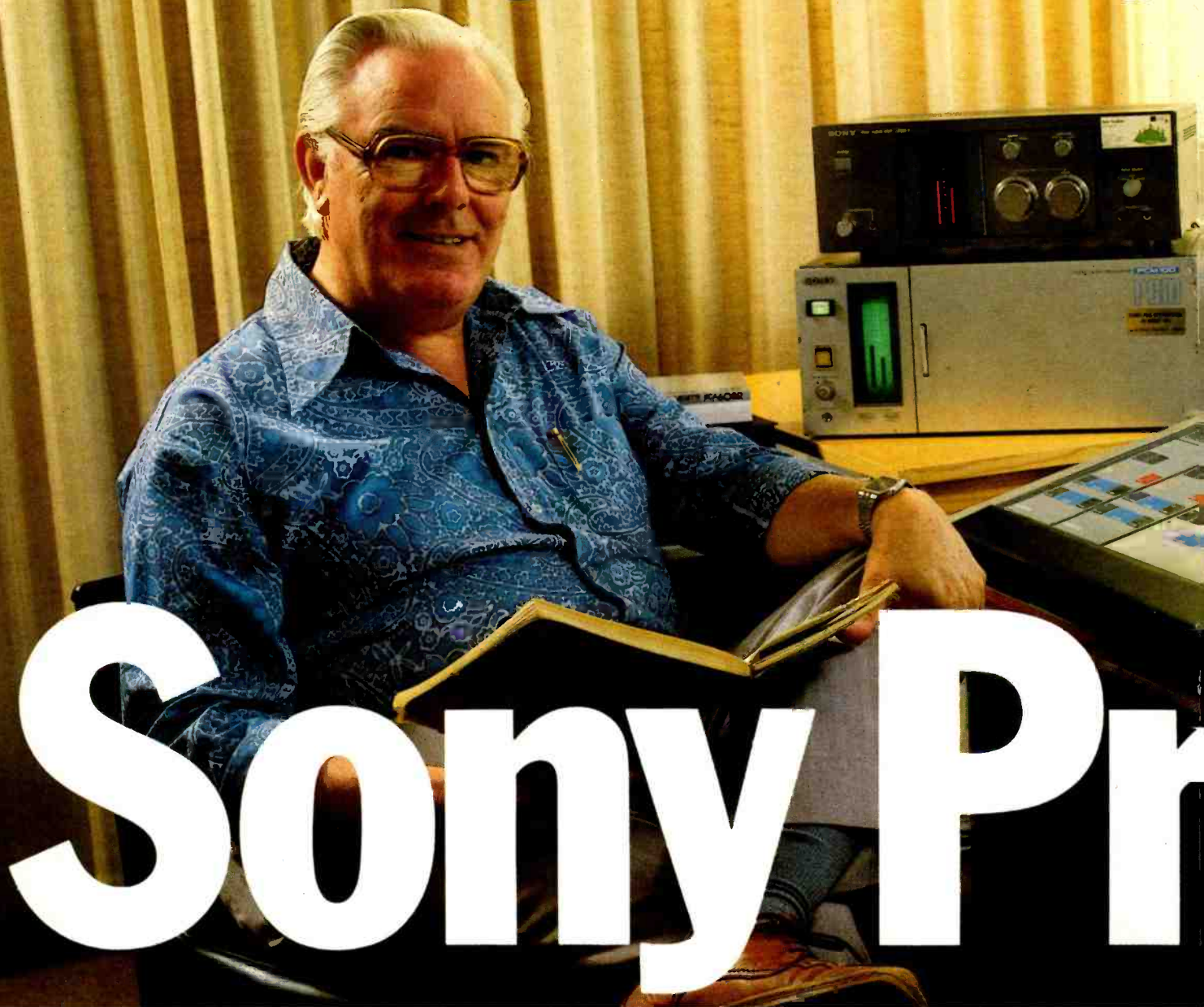


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A personal view of psychoacoustics—

Up to now this 'occasional' series (as our esteemed editor likes to call it, because of the sporadic nature of the output) has tried to deal with the quest for realism and exactitude in recording and sound reproduction, with occasional snipes at the less-than-purist elements of our profession. On many occasions this has been less than fair, as 'psychoacoustics' should be a general study of what we think we hear, rather than a label under which I can hang my numerous prejudices and pet phobias.

Down at the 'grass roots' level of sound recording—particularly in the pop business, there is an everlasting search going on. This search is given many names: 'Something new'; 'Gutsy sound'; 'Balls'; 'Depth'... the list is endless, as are the interpretations of what everyone thinks they are looking for. The common factor is that all are searching for a distinctive effect that is 'commercial', in that it is attractive to the great unwashed and it enhances the sales potential of the product material: in plain language, the kids will keep on buying it.

False premise 1: Caviar every day

The first few electric gramophone records sold like hot cakes: they were a tremendous improvement on the results of well-endowed sopranos screaming into recording horns. Phrases like 'superb realism' were used in the press, inferring the entry into Nirvana for the listening public. We have a very much more jaundiced ear nowadays... or have we?

All areas of commercial endeavour know of the 'Caviar every day' syndrome; the only way to retain solid customer interest is to change the product little and often. This is not too easy in recorded music but it explains the constant quest for the elusive 'something new'. The reality, though, is that it is being achieved all the time!... but even the most creative of us constantly fail to spot it.

False premise 2: The sound's the thing

Of course engineers know more about sound than they do about

music—otherwise they would be writing and arranging all the time. The uncomfortable fact is that the achievement of that subtle 'change' that makes a record a success is, by definition, a combination of creative artistry and creative engineering.

Without going into boring listings of the nexus points of record production, there were two examples in the not-too-distant past:

Telstar—Apart from the evocative title, which enabled the record-buying public to identify it, this record brought together the already existing technique of 'electronic-sounding' melody line with the swimmy, crushed rhythm sound that became the 'hit sound' of the early 1960s. The techniques used produced an exciting depth to the sound (as well as hideous distortion—but no-one cared at the time!). American producers and engineers emulated and improved the effect, producing great swirling 'orchestras' and vocal groups (*McArthur Park?*) yet retaining a recognisable and effective rhythm section. Later, a reaction to this sort of extremism set in.

The Beatles' White Album—This record successfully combined the Lennon/McCartney harmonic and rhythmic styles with what was then a sophisticated use of spatial dynamics... horrible phrasing, but exact—the use of expanders to give surrealistic separation, the treatment of drum sounds reminiscent of wet flannel slapping on to cardboard. The combination was by no means a sudden leap forward, more a final 'getting it exactly right'.

These two records clearly illustrate the point that success in 'creativity' (a synonym for 'making money') is a result of combining at least two right answers and getting a bigger right answer.

Another factor that existed in both records was that of 'hype'. This took the form of the name in *Telstar*, and the cover of the 'White Album'. Of course, one cannot apply 'hype' to the techniques of recording sound... or can we? Perhaps the simple fact of laying tracks one on the other, or adding effects is a form of 'hype'; taken to extremes it must be.

A great sound!

When visiting studios in the interests of the reputation of my Wonderland, I am constantly assailed by playbacks of engineers' most recent and stunning work; some pretty, some awful, but most just pretty awful. Engineers' conversations revolve around 'the sound'. They talk about gadgetry, microphones, new techniques, acoustics, digests and autolocators, but always it refers back to making 'the sound'.

One of the most common interminable subjects is 'what does a particular piece of equipment sound like'. To the non-technical or the newly-graduated this is equivalent to 'how long is a piece of string?' with the length neatly typed on a label in the form of a specification.

But life is not like that. Any experienced engineer with a reasonable pair of ears and a brain capable of using them (see 'The Human Ear', August 1983) knows that gear has specific sounds and no matter how hard manufacturers try to 'educate' users into believing specifications, this fact remains demonstrable to those who take the trouble to listen. For example, why is there a difference in sound between a multi-track machine running at 15 in/s and the same machine running at 30 in/s? For most purposes the actual 'sound' is identical; it is merely a difference in noise. The reality is that there is a difference: it is one of 'quality', an indefinable something that changes the human appreciation of the sound.

In this particular instance, it can be partially explained away by examination of the phase response of the heads at low frequencies at the different speeds but this is a classic 'tip of the iceberg'. There is one other piece of hardware outside of tape machines and dynamic peripherals that is common to all studios and is often overlooked as a contributor to the overall effect of a recording... the mixer itself.

Examples of this are legion in all areas of hardware. The most obvious is in the field of effects and dynamic skulduggery: the compressor, the limiter, the noise gate and their derivatives. The subject was discussed (or covered over) in 'The

Transparent Compressor' (November 1983).

Magnetic recorders is another area where the quality of the sound has very little to do with the technical specification of the machine. In the early days, the published spec of the EMI *TR51* was akin to a good quality AM radio receiver: any aficionado of the newly discovered 'Hi-fi' would have sneered at it as being totally unsuitable for quality recording and reproduction, and yet many wonderfully gutsy sounds were recorded on these machines. The demonstration of this was probably my own introduction to psychoacoustics, or the appreciation that you can't always measure what you hear.

The other shining example of this was the ubiquitous Revox *A77*. It was a wonderful machine, ahead of its time and with a very good written specification. Other machines were as good on paper but none approached it for clean, accurate and glassy sound—not necessarily the ideal for pop music but a significant contributor to the business as we now know it.

More modern machines also exhibit particular effects. The Ampex *ATR100* has a particular 'roundness' to the middle bass region and a 'frosted glass' sound to the extreme top. The effect is slight but quite noticeable when doing an A/B comparison with a Studer *A80* or a digital machine... but more of that later.

The gut solid mixer

Surely, a mixer is a mixer; what's the difference? A few years ago any engineer would expound the wonders of the latest 'Grieve' or 'Cladrack' machine; the superb punchy sound, or the range of EQ. Today, we (as manufacturers or users) are faced with entirely different questions and even more incomprehensible answers.

There are now about 20 manufacturers of audio mixers in the UK, all of them are staffed by sensible people who have had experience at various levels in different areas of sound recording. They are all experienced and knowledgeable, otherwise they would not be successful enough

The quest for the third ball

Ted Fletcher (Alice)

to remain in this highly competitive business. Their products are all adequate for the purposes for which they were designed; this is also a truism. And yet the true 'users' of the business still draw comparisons between the EQ of the 'Amex' product against the mic amp sound of the 'Snurdcruff'. (I should, in the interests of fairness, mention the 'Cullwreck', 'Milldross' and 'Assus-selle'.)

Is this just engineers' talk, or is there something behind it, that indefinable quality that turns a good sound into a great one?

My answer is, after years of approaching deafness, that there is a particular 'something' about the sound produced by equipment that designers have sweated blood over; it is the result of detailed examination and appreciation of the problems of the practical engineer put into practice, not some magic formula that was dreamed up in a moment of emotional fatigue.

This whole question was revitalised recently by a well-loved member of the fraternity (heavily engaged in recording soundtracks on absurdly popular puppet films for TV) who mentioned, over a sherbet in the studio canteen, that he had found it impossible to record dialogue with the requisite 'b--s' on his existing mixer; the sound was reasonable on the direct monitors, but lost it all during the transfer to and from the tape, whatever system (A or D) he used.

The old grey ears perked up! This was no hammerchewer talking; this was an experienced and bright engineer not happy with his 'lot'.

Some experimental work in the studio provided one of the answers. His mixer was suffering from VU-itis, the endemic disease that afflicts all who believe in Volume Units as a measure of sound level. Recording 10 dB lower in level revealed the sparkle and depth to the voices, allowing those all-important transients to appear on the final print (it is quite amazing how they persist after the first recording: it must be to do with the inability of the film processing equipment to remove them in any efficient way!).

Having rescued the Zeroids from

audio obscurity, the subject then turned to the 'Hit Record'. In spite of the above notes about creativity and engineering genius combining to create an advance in human experience, a late-night experiment proved beyond all doubt that some mixers produce a sound that is superior in its 'selling' effect than others. This problem occupied the old grey brain for some months in the early part of 1982, and during the project known affectionately as 'the Slik' (see *Studio Sound*, October 1983), we carried out some experimental work to establish the relationship between supposed technical perfection and 'sound' in its widest sense.

Drawing upon experience with lesser mixers in the 'Arris' range and comparing the results with prototype gear that very few could possibly afford, the results were quite predictable: the standard line equipment produced perfectly acceptable results, giving clean, undistorted sound as one would expect of good quality professional equipment. The prototype equipment produced sound that leaped out of the monitors and embraced the ears. It introduced another dimension to the effect of sound itself. This revelation was half expected in that there had been so much chat about this indefinable '3-ball sound' that it could not be all in the mind of wishful thinking engineers.

But why is this equipment/set-up so extraordinary? The real answer has to be that it isn't; there is no magic, no special anything. It is simply that the physical limits that we thought were important to reproduced sound are wrong by a large margin.

To get a little bit technical about it, distortion of 0.1% is definitely audible (Hi-fi people have been saying it for years!) and yet 0.1% has been an acceptable figure for distortion since Adam (sorry! An in-joke: Adam Francis, see *Terra-hawks*).

Even more important is the question of overload margin; this has been set at about 20 dB for most professional purposes for some years. In use, this is degraded by many dB because of the inefficient metering systems used (yes, PPMs as

well!) the reality is that *all* dialogue and a lot of music needs more than this, even allowing for the rotten metering systems in use. The experimental systems used in the tests had at least 35 dB of overload capability but didn't sound any louder! This may seem to be extreme—but when the opportunity arises to be truly scientific, it is reasonable to go the whole hog and remove the slightest technical doubts about procedure from the argument. The 'super' equipment had distortion in the region of 0.001% over the whole audio range (and then some), and a noise floor of 100 dB or more below the sane peak level. With careful design, this is not particularly difficult; it just needs an open mind and an acceptance that 'the establishment' may not be right after all!

In retrospect, what had we proved? Only that a piece of highly expensive machinery is transparent to the sound that is applied to it... Gong! It was a lot more than that. The mixer is the main processing equipment for the audio signal in every case. If it is capable of producing these stunning effects with the addition of the standard mixing and processing functions found on all mixers, then this is a significant advance to our general technology.

Three balls

I can hear the laughter, the guffaws of derision, echoing from Marble Arch to the Angel... 'We knew all this years ago!' The humourless answer has to be, 'Then why aren't all mixers made this way today, in the cold light of 1984?'

There have been examples of 3-ball equipment available to serious (and rich) recording studios in the past. Names like Neve, Swettenham and Green spring to mind, but in an historic context (absolutely no insult intended fellows!). The uncomfortable fact remains that, apart from some ageing relics of the '70s and one or two digitally-controlled prototypes that have not yet processed a hit single, there are no proper 3-ball desks in existence or in quantity manufacture.

Zuccarelli makes claims for the spatial veracity of his advanced

'dummy head' recording system and offers the effect for others to judge subjectively how much better the system is than conventional systems.

Besides being in basic disagreement with his physics (and biology) I suspect a misinterpretation of his psychoacoustic premises; all he has really discovered is 'the third ball'.

Conundrum

To reduce all the above to a simplistic statement would seem to be easy; that the sound from any good microphone is screwed up by the inadequate performance of your average mixing console.

From that, one could draw the conclusion that if the super sound was processed by a super desk, then transferred via more indifferent equipment, then it would suffer the same fate... another Gong! This is certainly not the case and the proof of this is hitting everyone's ears every day!

Medium wave broadcasting has to be one of the worst mediums for the transmission of quality music; and yet a carefully-produced record with good commercial content (both technical and musical) will leap out of the 3 in 'speaker' with all its essential 'gutsiness' intact... a little bent, but distinctly recognisable.

The experiment that is less easy to carry out is to listen to, say, a direct stereo recording made with PZMs on to a Sony F1, and to check it again after many generations of mixing. The basics of the effect are still there!

It would be delightful to be able to offer a simple explanation to this basic conundrum (any offers?) but I cannot. I suspect that the answer lies in both the technical area where the treatment of transients and complex wave shapes is not directly related to technical 'quality' as we know and measure it, and in the 'musicality acceptance' of the interpretation centres of the brain.

Work on realism carries on in Windsor (and doubtless in Cambridge and Oxford) but there seem to be no 'flash of brilliance' answers in this subject; the road to enlightenment is strewn with the potholes of charlatanism and greased with easy options. ■

Tannoy UK distribution

Tannoy have appointed FWO Bauch as sole UK distributor for the complete range of Tannoy studio monitors. Bauch have recently increased their involvement in system design and this means that they have a wider range of speaker systems that they can now specify. The appointment in no way affects the existing Tannoy dealer arrangement for studio products; all sales and deliveries now being channelled through Bauch who will also undertake reworking work. FWO Bauch Ltd, 49 Theobald Street, Boreham Wood, Herts WD6 4RZ, UK. Tel: 01-953 0091.

Literature received

● An 8-page brochure from Ernest Turner Instruments illustrating the wide range of panel meters and accessories as well as the new electronic ancillary equipment. Ernest Turner Instruments, Totteridge Avenue, High Wycombe, Bucks, KP13 6XG, UK.

● Two new catalogues from Carlsbro: Music Instrument Amplifiers and PA Systems for 1984. The first catalogue gives details of their *Studio* range of instrument amplifiers while the PA catalogue covers the full live sound range from power amplifiers to separate driver cabinets. Carlsbro (Sales) Ltd, Cross Drive, Kirby-in-Ashfield, Notts, NG17 7LD, UK.

Agencies

● C-Tape Developments Ltd have incorporated a wholly-owned subsidiary company in the USA. C-Tape Developments Inc will be run by executive vice-president

Glenn Mullis. A network of 22 representatives has been set up to service the US with a further network for Canada. The headquarters is in Schaumburg, near Chicago and has manufacturing capacity should it be decided to manufacture *C-ducers* in the US at a future date.

● The West German company, Audio & Video Consult GmbH, have been appointed distributor of ADT Gerd Jüngling products throughout Africa and Arabia. This includes the new *C24* automatable multitrack console. AuViCon is a company specialising in turnkey type studio installation including design, construction and equipment supply. They are located at Cuxhavener Strasse 36, D-2104 Hamburg 92, West Germany. Tel: (040) 7 96 67 01.

Name change

As from January 1, 1984 BAN Electromusic, UK distributors of Yamaha professional equipment and PA hire company, have undergone a slight change in their trading name. The initials BAN have been dropped and the company is now simply known as Electromusic. All other particulars remain as before although they have become a manufacturing member of the APRS.

Contracts

● Elliott Brothers have recently supplied DDA *M Series* and *D Series* mixing consoles to Metro Radio, Newcastle; Audio International Studios, London; Pullman Video, London and freelance recording engineer Tony Faulkner.

● Neve Electronics has just installed

four 5322 consoles and one 16-track 5104 console in the Dubai Centre as part of a turnkey project where they had total responsibility for the audio aspect. The new centre is part of the Dubai Radio and Television system.

● Philips Electro-Acoustics division have designed and installed a *Multiple-Channel Reverberation* (MCR) system in Studio One of the Limehouse Studios TV complex in East London. The studio in 6000 ft² and the installation uses 81 mics and 79 speakers. It is possible to control the reverberation time to suit the production being recorded.

Correction

In the January issue we inadvertently gave an incorrect telephone number for Marquee Electronics. It should have read 01-439 8421. Our apologies for any inconvenience this may have caused.

People

● Sony Broadcast Ltd have announced the appointment of Jeff Meadows as managing director designate. Previously he was vice president engineering and technical services for the NBC Network based in New York.

● David G Kennedy has been appointed president of dbx Inc. He was formerly vice president of finance for Instrumentation Laboratory Inc.

● Michael Stevens & Partners have appointed Steve Watkin as sales executive for their studio monitor and PA speaker range of products. He was previously with Bose UK Ltd.

Address changes

● Technical Projects Ltd, following a de-merger from the original mother company, have moved. Their new permanent home on the Isle of Wight has allowed them to set up new enlarged production and engineering facilities. A mainland office in London continues to provide back-up. Technical Projects Ltd, Unit 2 Samuel White's Industrial Estate, Medina Road, Cowes, Isle of Wight PO31 7LP, UK. Tel: 0983 291553. Telex: 869335 TECPRO G.

● Hardware House has moved and is now situated at West Works, Chalgrove Road, London E9 6PB, UK. Tel: 01-986 6111.

● The Infra Noise Laboratory Co Inc has moved and their new address is Azuma Building, 7-21 Hiroshibacho, Suita City, Osaka 564, Japan. Tel: (06) 338-1587.

In brief

Criteria Studios, Miami have acquired a second Mitsubishi *X-80* PCM 2-channel digital recorder and for mixdown and disc mastering use... Compass Point Studio B has been fitted with SSL console with *Total Recall*, a Studer *A800* 24-track and UREI *813B* monitors while Studio A has had an MCI *JH 536* 36-channel console installed... Britannia Row, London have recently added valve Fairchild compressor limiters, valve Pultec equalisers and valve Neumann mics to their hire stock. Also now available for hire is a Soundcraft *2400* console and a *762* 24-track tape machine package.

APRS tightens up membership requirements

The APRS has recently tightened up its requirements for membership. Comparing the 1982 application form with last year's, one notes a number of changes. The previous form simply asked for names and addresses, how long the studio has been around, and details of the sizes of the rooms, in addition to asking for specs on the major equipment, how many engineers employed, plus maintenance arrangements and available test gear.

The new form adds places for data on mobile facilities, including radius of business, and whether the gear can be taken out of the truck or not. Details of the console(s) are required for all types of studio, including how many channels and groups there are; what the monitoring systems are, with what amps; what the tape machines and their formats are; the make and number of mics and effects and EQ gear. Test equipment alignment tapes and frequency of machine alignment details are also requested, along with what arrangements exist to line up the

monitors. Indeed, maintenance is covered very thoroughly. You are asked to tell APRS whether or not the studio has continuous maintenance staff available during operating hours, and how many maintenance engineers are on the staff. The form does not say whether you pass or fail if you say 'no' and 'none' respectively, to these questions.

The form goes on to ask for details of important recordings made in the past year, and whether or not there are restrictions on operating hours, plus details of accommodation and catering facilities if available. Finally, there is a section in which studios can supply details of other services offered, including video and film facilities. At the bottom of the 4-page application is a section for the studio's Top Person to sign which includes an undertaking 'not to invoke the Association's name or support' without asking first. So you do not stand facing North in front of the console and intone the words 'I

invoke thee, O APRS' on difficult sessions or during the recording of the soundtrack to *Omen VI* unless allowed to in writing by an Initiate of the Association's Second Order. Clairvoyant appeals to the Secret Chiefs of the Association on the Higher Planes are presumably out of the question.

But seriously, folks, there is another interesting comment in the second section of the application, It says: 'Full Members are required to use the following minimum tape standard: 24-16 track 2 in; 8 track 1 in; 4 track ½ in; 2 track and mono ¼ in and equivalent tape standards for digital recording.' (We'd hate to hazard a guess at what 'equivalent tape standards for digital recording' are.) This ruling might concern some of the many studios with a goodly number of hits under their belts who use 16-track 1 in if they think of applying for membership. Any comments from you 8-track ½ in and 16-track 1 in users?

The Association of Professional Recording Studios is an organisation

that we would recommend to any respectable studio. Now 30 years old, the APRS has contributed a great deal to the British recording industry, not only via obvious activities like the annual Exhibition, but in more subtle ways too, establishing guidelines on contracts and the like. The introduction of stricter standards is probably a good thing; there are certainly a number of pretty nasty masters around from studios who should know better, and maintenance levels present a definite problem. *Studio Sound* would like to congratulate the APRS on its 30 years of success, and wish it even greater success in the coming years.

Britain has some of the best studios in the world, and the APRS' attitude to standards is definitely a contributory factor. If you think your studio would benefit from APRS membership, you can get the form from the Secretary, Mr E L Masek, 23 Chestnut Avenue, Chorleywood, Rickmansworth, Herts WD3 4HA. Telephone 0923 772907. **Richard Elen**

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Bee Jay Recording Studios, Florida

Visits to studios for Studiofile are arranged from such diverse sources as press releases, word-of-mouth reputation—or by simply opening up a phone book and ringing the first name that catches the eye.

Finding myself with a day to spare in Orlando, Florida, it seemed a good idea to check out the local recording scene, so, after a quick phone call, a visit to Bee Jay Recording Studios was arranged.

Though not a typical 'music industry' big city—or a getaway from etc.—Orlando has a lot to offer as a place to record. Easy to get to and small enough not to have the big-city syndrome, it is also in the heart of Florida's holiday attraction area, so when you want to relax or take a day off there is a wide choice of amusements to choose from. Whether your leanings are toward Disney World, Sea World, Cape Canaveral or others—you name it, they got it! However, if you just want to laze around there is always that Florida sunshine.

The beginnings of Bee Jay go back to the '60s when president and founder Eric Schabacker was running a booking agency for bands and groups. Faced with demands for demos of their acts, it soon seemed logical to build a small demo studio in order to economise on time and expense spent going elsewhere.

By 1967 the studio had a Crown (Amcron) ¼ in 4-track recorder, thus showing a willingness to be at the forefront of things even though officially a 'demo' studio. This attitude was carried through with the purchase of an early Ampex 8-track machine. During these early years the studio was located in various premises around Orlando and in 1975 Bee Jay had to make a decision—whether to expand into a full-blown professional studio or downgrade to the original idea of an artists' demo studio. Experience up to this point had shown that the studio had been successful with people coming back to make records on the strength of the sound produced on the demos and that also, there was at this time, no big studio in Orlando.

After the usual financial consultations, Bee Jay decided to become the 'first big studio in Orlando' and open their doors in December, 1977. And in no small way, either, as they are the country's first 32-track automated studio, with a Stephens 32-track machine and Sphere *Super Eclipse C 40/32* console with Allison automation. Acoustic design and installation was by Valley Audio Services in Nashville.

Since the opening of the new studio, Bee Jay have never looked back and recent up-dates have included the acquisition of a Studer



Bee Jay studio A
—pre Studer installation

A800 24-track recorder for Studio A and the subsequent upgrading of their smaller Studio B. The latter was a reminder of their earlier days and served for clients who, for various reasons, were not ready for Studio A. With the arrival of the Studer, the Stephens was moved to Studio B, with Valley Audio being called in again to do the acoustics. This meant that Bee Jay could now offer two multitrack facilities under the same roof to different budget levels whilst maintaining a first-class service.

Bee Jay Recording Studios are situated in a Tudor-style house in a little backwater just off a main road in the Winter Park Area of Orlando, with Interstate 4 a few minutes away. The foyer gives the lie to the atmosphere of Bee Jay; 'olde worlde' furnishings and a homely atmosphere make you feel you are visiting a secluded place in the country and in fact the whole tone of the building is that of a country house. As well as the foyer/drawing room, there is also a lounge area with hanging plantpots, large sofas and armchairs plus a separate room with TV and games. This way you can just put your feet up for a moment and relax without necessarily being zapped by Klingons!

My host for the visit was vice-president Jim Katt (pronounced 'Cot'). Jim was originally a musician in one of the bands booked by Mr Schabacker and just started coming into the studio 'to give a hand'. From there it was only a short step to engineering sessions up until the big decision. It was clear that if the studio expanded it would have to run along solid business lines and as Mr Katt's college studies were in business and management, it was logical that he take this side of the studio operation into his hands. However, he naturally retains a close interest in the latest developments on

the recording scene and has some definite views on the subject.

A session was in progress in Studio A so I was able to get a good idea of the basic sound. The Valley Audio acoustics are very much in the Westlake/Eastlake tradition but more 'rough hewn' in the finishes of some of the woodwork. The room itself is quite large and there is plenty of space to move around in, always an advantage for efficient working. The monitoring is Westlake *TM-1* cabinets but these have been fairly heavily modified, having the mid-range drivers replaced by TAD units and being changed from tri-amplified to bi-amplified. Another modification has been to invert the cabinets, ie: turn them upside down, and this has resulted in better stereo imaging. With the changes in taste and conceptions on monitoring, Bee Jay wanted to get away from the original idea of dispersing the sound from the compression ceiling—the sound swirling around—and this resulted in the monitors being inverted. As far as they are concerned, there has been a definite improvement in imaging and accuracy.

The Sphere console is a 40 input in-line with 24-track routing and quad/stereo buses, eight auxiliary sends with eight effects returns and nine VCA controlled subgroups. The equalisation is a little unusual being a nine-band graphic per channel and though different, I was told that it is very effective. In order to obtain a much more transparent sound, both the automation and the VCAs in the console have been upgraded and Bee Jay feel that the Sphere now holds its own with the best of them.

As well as the Studer A800, there are Studer B67 and Ampex ATR100 master recorders plus additional ElectroSound and Ampex 2- and 4-track recorders for copies, tape

echo, etc. Secondary monitoring is via Auratones (surprise, surprise!) and JBL 4311/UREI 811 speakers that can be set up as required. Power for the monitors is provided by BGW and Crown amplifiers with the main speakers being equalised with UREI 539 graphics. Thirty-two channels of dbx noise reduction are available as well as a respectable amount of signal processing.

Bee Jay have made attractive mobile wooden racks in order that effects equipment can be moved between Studios A and B as required and thus add to flexibility of working. Effects available include Audio & Design *Vocal Sstressors* and well stocked *Scamp* rack, dbx and UREI compressors. Eventide *Harmonizers*, DDL and *Instant Flanger*, Marshall *Time Modulator*, Orban parametric EQ, de-esser and stereo synth, Pultec *EQP-1A3*, EMT and MicMix reverb and Lexicon 224 and *Prime Time* digital units.

The session in progress was a local band, very much into the Southern rock idiom, who were laying down some ideas for a forthcoming album. The sound was certainly very clear and open with lots of punch, as well as having a very 'live' feel to it. In fact the overall impression was very much that of being in the studio with the band and not the other side of the glass in the control room.

The studio itself is 30 x 50 ft with quite a high apparent ceiling, the actual ceiling height taking up a further 4 ft of trapping. The finishes are similar to those of the control room with rough and smooth wood panelling, carpets and drape fronted traps. Various booths are available for drums and vocals plus a larger booth that is used for strings, this latter booth featuring a slate floor and glass ceiling thus making for a very bright sound.

For rock sessions it is often

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Bee Jay cont'd

desirable to obtain a 'liver' feel to the sound and this has been achieved after some experimentation by making removable hardwood panels that can cover up to 75% of the ceiling. This in effect increases the resonance of the middle and high frequencies while turning the ceiling into a half-trap and lowering its tuning, meaning that the 'mud' gets eaten up. For most rock sessions the drums are out in the studio with the bass amplifier in the drum booth and everyone just cranking it out!

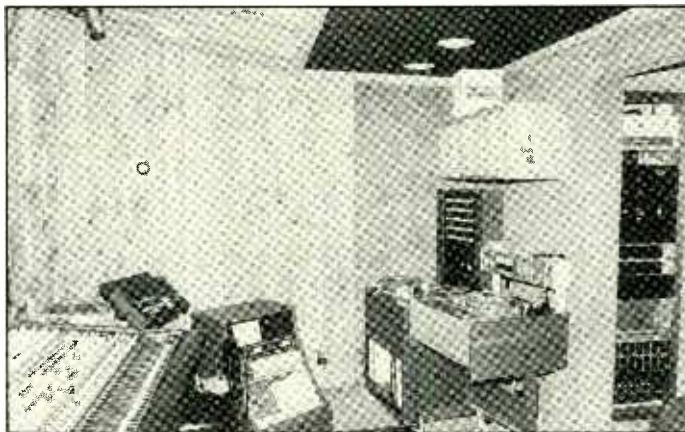
The studio has a good roster of instruments including a Kawai grand piano, Hammond C3 with Leslie, Clavinet, Rhodes, upright tack piano, *Mini-Moog*, EML synthesiser system, Pearl and Rogers drum kits, Music Man amplifiers and bass plus various effects that musicians like to play around with.

Microphones available are a broad selection from Neumann, AKG, Sony, E-V, RCA Sennheiser, Shure, Beyer, Studer (Schoeps) and some Wahrenbrock PZMs.

Foldback is provided via various varieties of Koss and Fostex headphones or Electro-Voice *Sentry III* monitors.

Things were starting to get a bit hectic in the control room so it was time to move on and have a look at Studio B. Formerly a demo studio, this is now a small mastering studio in its own right with recording centring around the Stephens multi-track and a Studer *B67* master recorder. Though 16- and 32-track headblocks are available, the Stephens is used most of the time as a 24-track machine and to this end there are 24 channels of dbx noise reduction available. The console is an Audiotronics *501* with 26 I/O channels and 16-track routing. Acting upon the advice of the manufacturers, Bee Jay have 'opened up' the bandwidth of the desk from around 20 kHz to 40 kHz, with very noticeable results. The circuit changes have often been a matter of different R-C values or new components and thus the actual modifications have been very simple. However, the end result has been a far greater transparency in the sound and the equalisers sound 'far more musical'. It all goes to show, or at least suggest, that there are components in the audio spectrum that, while we may not be consciously hearing them, must make a difference to the overall sound.

The control room is quite small without being cramped or oppressive and is built into the middle corner of the L-shaped studio, thus having good visual contact between the two rooms. Monitoring is UREI *811s* and Auratones with BGW amplifiers and White graphics, and JBL *4310s* are also available as secondary monitors. The acoustics for the



Bee Jay studio B control room



Studio area B showing foldback system

studio and control room are again by Valley Audio and feature smooth wood panelling for the front of the control room with rear ceiling trapping and carpeting, while the studio retains more of a 'frontier style' rough hewn finish.

The studio itself has two corner booths—rather like log cabins!—with the rest of the room a mixture of carpet, large trap with drape and wooden panels that have been arranged in a vertical 'sawtooth' pattern for additional dispersion. The ceiling is also open trapped. The only instrument kept here in permanence is a Steinway baby grand.

The foldback is mainly stereo and this is distributed through either E-V *Sentry IA* monitors or headphones. The latter are plugged into Tennessee Instrumentation cue boxes where each musician can balance the output between the two channels. The boxes can be clipped onto solid hexagonal wood bases that also serve as ashtrays and thus keep a bit of order about the place!

Lighting in the studio is controlled by variacs—as it is in Studio A—and can be adjusted to taste in both control room and studio.

Though small, the studio can easily accommodate five or six musicians comfortably and it is often also used as an overdub studio thus freeing up Studio A for full sessions and giving further flexibility to the complex as a whole.

After the visit I was able to have a talk with Jim Katt (thanks for your time, Jim) and get some of his views on the recording scene and how they applied to Bee Jay.

The studio's first gold record was with a Canadian release for Long John Baldry and this set the ball rolling for a series of golds with groups and artists such as Krokus, Blackfoot, Judas Priest, Molly Hatchet, Cameo Productions and so the list goes on. Considering the number of rock bands one is tempted to think that the studio wanted to specialise in this field. However, this was not the case and Jim told me that the rock sound just came by a bit of an accident! I remember that I had been struck by the open, driving sound of the Blackfoot records and it wasn't until I saw the records on the wall that I made the connection. Jim commented, "Yes, there is a definite transparency in the sound, it breathes." Of course, a successful sound is a combination of many things such as musicians, engineers, equipment, atmosphere, etc, but it is probably the results obtained at Bee Jay that brought Molly Hatchet in for three albums in a row.

Though Bee Jay have two house engineers, there are often 'visitors' and I asked Jim how this worked out usually. Apart from the fact that one can never have enough reverbs, today, it would appear that the

engineer/producers are the easiest to get along with. If a certain piece of equipment is not available they can generally get the same effect they are after with something similar. However, a lot of producers just come in with a 'grocer's list' of equipment and they must have exactly that if they are going to get that sound they got on their last record and nothing else will do. There is often an unwillingness to accept that other makes of equipment can produce as good an effect as the make that they are used to. The tried and tested path is always the right one and why bother to experiment. (One might add at this point that successful producers are often successful *because* they experiment!) Up to a point this is understandable, especially if the last record was a success, though it does seem to indicate a greater reliance on black boxes than in the music.

Jim also finds that the way trends tend to change every six months keeps things interesting. People take something as gospel for a while and then it's on to something new. Er, what was really it, is, er, no longer it! This led on to a discussion on the modifications to the monitoring system in Studio A and how they felt that it was more important to have accurate information rather than just have a sound 'swirling around everywhere'. More accuracy has helped them create a better sound on tape and that's what it's all about.

Speaking about current developments in control design, Jim Katt personally felt that there would be no real advance until "you get that big, flat 3x8 ft board out of there that is messing everything up!" Certainly a valid point! He tends to think that consoles will end up as a keypad or typewriter keyboard with faders controlling a computer, but also thinks this type of mixer will encounter a lot of resistance. To illustrate this point of view he cited the case of an engineer who did not want to use automation as he felt it would interfere with his being able to act on the spur of the moment or go with his reaction to the music at a certain point. "There is a tradition of live mixing that is hard to overcome. Today, things are often more clinical."

Clinical or not, Bee Jay do tend to go for a good, together rhythm sound in order to have a solid musical base to build upon, rather than the disco-style build-it-up-from-a-click-track approach.

The motto of Bee Jay Recording Studios reads, 'The difference is how you're handled'. The gold records on the walls indicate that their customers like the way they are handled. **Terry Nelson** 56 ►
Bee Jay Recording Studios, 5000 Eggleston Avenue, Orlando, FL 32810, USA. Phone: (305) 293-1781.

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The Fallout Shelter, London

Island records established the St Peters Square studio back in the mid '70s; it was a Sandy Brown design equipped with Helios, Lockwoods and Studer. In those days it was simply known as Island Studio, but since then there have been a number of fairly major changes, the first of which was the replacement of the original Helios with a new, custom designed console from the same manufacturer.

Soon after that, John Wood, who had worked as both an engineer and producer at Island, completely re-designed the acoustics, replaced the Studer 24-track with a 3M M79, and installed UREI 815 monitors.

Up to this point, the control room designs had placed the communications window side-on to the console but when Doug Hopkins took over responsibility for the studio in 1980, he, together with newly appointed technical engineer Peter Jones, restructured the room so that the desk faced the window. At the same time the Helios was replaced with a 36-channel, MCI 500 series desk, and UREI 813s were installed in place of the 815s.

But the story doesn't end there, for there is one more metamorphosis to bring us up to date. At the end of Spring 1982, Paul Jarvis, then the technical manager of Island's Compass Point studios in Nassau, put into practice a set of designs which he had drawn up, based loosely on what he'd learnt at a couple of Syn-Aud-Con courses in the USA run by Don Davis. The courses included a detailed introduction to the techniques involved in the construction of 'Live End, Dead End' (LEDE) control rooms, and whilst Paul's design couldn't accurately be described as an LEDE construction, he did apply some of the techniques he had learnt to St Peters Square.

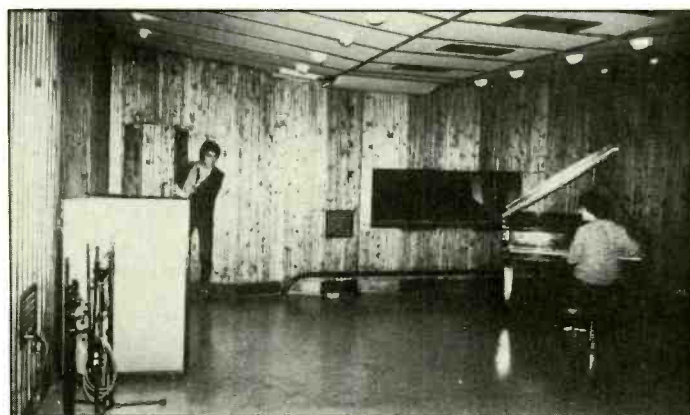
The first thing he did was create a symmetrical control room using plasterboard and blockboard stud work, filling in all the gaps and holes with high mass ballast. There was no room to create a room-within-a-room construction, and so it was not possible to form a second set of low frequency boundaries as would have been ideal.

Before coming over to England, Paul had been supplied with all the necessary data on the studio to enable him to prepare a list of room modes for both the control room and the studio floor area. He found them to be closely and evenly spaced, and decided it was unnecessary to provide any specially tuned absorbers. Therefore the treatment in both rooms is very simple, and doesn't include any form of purpose-built bass trapping.

Every inch of the front half of the control room, with the exception of



Control room



Studio



Fallout Shelter cutting room (not covered in article)

the carpeted floor, has been covered with a straightforward treatment of 2 in, tissue-faced Rockwool slabs, applied directly to the walls with a cosmetic covering of cloth. The other exception to this is, of course, the 8 x 2½ ft control room window, although directly below it is a padded seat which faces a couch of similar design, positioned up against the back of the mixing console. This very functional furniture has been designed to prevent reflections from the rear face of the desk and to absorb those from the control room window.

The rear half of the room, which starts at the front edge of the console, has been treated with a 2 in layer of Rockwool followed by two layers of ½ in plasterboard, with a tongue and groove 4 in boarding finish. To aid diffusion, each board

has a channel cut down its length, and the contours of the walls follow a series of splays. Either side of the window, concrete shelves have been cast to support the 813s which are enclosed by brick walls to ensure that a high proportion of the bass energy is sent forward. The speakers themselves rest on wedge shaped wooded frameworks giving the slight downward tilt necessary for correct HF focus at the monitoring position. The cabinets are isolated from the wedges by Neoprene strips.

Paul used TDS techniques in conjunction with an FFT analyser using the Time, Energy, Frequency measurement system, under licence from the Californian Institute Research Foundation, and although a pair of ⅓-octave White graphics are in circuit, the correction is minimal.

He was aiming for a very flat curve which, in my experience, never provided a subjectively very pleasing sound. In this case, however, it sounded exceptionally good. At the time of my visit there was no tape available which had been recorded and mixed there. I listened to a copy of a Grace Jones master produced at Compass Point. The bass end was very full and punchy and, despite the lack of bass traps, very tight. The imaging and clarity in the middle and upper frequency bands was also notably excellent.

In the mixing position, then, just in front of the console, there was an extraordinary clarity, and as I moved back towards the rear of the room, the recorded sounds and their stereo positions became less distinct. Paul's view is that it is more important to design a room which will sound excellent at the monitoring position than one that will sound OK over a wider area.

The studio area itself had previously been dominated by a large and rather oppressive air conditioning duct running across the centre of the ceiling, and so this had to be disguised within the acoustic treatment. The duct included various traps and a Rockwool lining so it wasn't too much of a problem acoustically. The ceiling is simply a 4 x 2 in framework covered with cloth.

The room measures approximately 20 x 30 ft and down its length the treatment goes from live, splayed board, similar to that at the rear of the control room, through open or spaced boarding to a broadly absorbent covering of cloth over Rockwool. The live end has a lino floor with optional carpet, whilst the deader end has a permanent covering of carpet.

The 24-track is Studer A80, whilst mastering facilities include three Ampex ATR 100s with a couple of optional ½ in stereo headblocks, and Dolby A noise reduction is available throughout. A good selection of processors includes two EMT 140 valve plates, an AMS 15-80S stereo DDL with a pitch change card, an AMS RMX 16 digital reverb system, a Lexicon 224, Ursa Major 8X32 and a large range of compressors/limiters, expander/gates, equalisers and effects.

Since the console update, Island, or to use its new name, The Fallout Shelter, has been at some pains to dispense with the old Helios model. Any offers?

Hot food is available at a very reasonable price together with various drink and snack dispensing machines. There is also a domestic video system to look at, but happily no video games.

James Francis
The Fallout Shelter, 6 St Peters Square, London W6. Phone: 01-741 1511.

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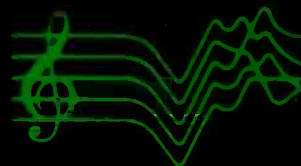
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Noise Reduction



Keith Spencer-Allen

With digital electronics and digital recording taking greater chunks of the editorial space of this and other audio-orientated magazines, it is easy to forget that the bulk of all professional recordings are still made in the analogue domain with all its attendant problems. I would not be surprised to find that at the present time, less than a couple of per cent of current professional recordings involve some form of digital recording in their completion. If my supposition is correct it means that the majority of engineers are not yet able to avail themselves of one of the major advantages of digital recording—the low noise floor and potentially wide available dynamic range—and that recording levels, tape noise and noise reduction are still very much real life problems.

Noise reduction as a topic seems a whole lot less contentious these days than it was, say, 10 years ago. Working patterns have evolved and there are now accepted norms with regard to when noise reduction is used, not used, not needed and which type used for what application. In my experience it is less likely to be considered a hot topic for discussion. If Dr Ray Dolby had not produced the Dolby system when he did, the next generation of higher level studio audio tapes would have negated a lot of its advantages for many applications. On a cost versus practical improvement basis, the system might not have been deemed necessary for professional 2-tracks/¼ in standard and its track multiples. Current practice appears to have led us to a situation where some studios use noise reduction, some don't, some use it occasionally dependent on the type of recording and some don't use it occasionally depending on the client. There are a fair number of studios running with no noise reduction systems at all and some who run multitracks without but encode mixes (usually for financial reasons) and rather more who encode multitracks but not mixes.

Although it's difficult to be totally sure, it is generally accepted that Dolby has the most noise reduction channels in professional operation throughout the world with dbx rather fewer. Dolby has become accepted as the noise reduction system for use with master mixes and most studios and cutting rooms need to own a pair at least for compatibility reasons.

With both Dolby and dbx becoming, in various ways, heavily involved in digital R & D and products; with new tape formulations increasing maximum recording levels; and with the day approaching (if still rather distant) that analogue recording becomes the exception rather than the rule, there have not been any startling events in the area of professional noise reduction. What has happened though, and this could be described as a trend, is to modification,

presentation in more suitable packages and development of existing systems for new applications.

Dolby's new products in the last year have been typical of this. The *Model 372* portable 2-channel is the first portable system from Dolby although other manufacturers had produced portable Dolby systems based around the standard *cat 22* card. The *372* is very compact being 8½ × 7¼ × 1¼ in and weighs only 3 lb. It can be powered from internal batteries or from an external source. The other main features of the unit include electronically balanced inputs, switchable preset/variable input levels, LED level metering and remote switching capability. Although Dolby *C* is a domestic standard system, the use of the system by Fostex has brought a lot of studios into contact with it and I have found that studios who refrained from using Dolby *B* for clients' cassette copies are often now buying Dolby *C* equipped cassette machines and using them. For those who wish to use Dolby *C* with a non-equipped deck, the most convenient unit to buy is the Nakamichi *NR-200* which is a simultaneous record/play unit with both the *B* and *C* systems, level oscillator and LED metering in a standard 19 in rack mount chassis.

The Dolby *HX* system, though not of course a noise reduction system, is often used in conjunction with domestic Dolby systems. Two recent applications are to be found in its incorporation in the Otari and Electro Sound latest generation of high speed duplication systems and as a retrofit module, the Dolby *CN248*, for the Otari *MTR10-4* mastering machine used for the preparation of duplication masters. With the *HX* system providing up to 6 dB improvement in HF output at 10 kHz and more in typical application, this is bound to have implications in associated noise reduction fields but I'm not sure where and how.

Dolby are also continuing with the development of noise reduction cards for video recorders demanded as the video industry becomes aware of the need for better quality sound. The latest are the *cat 226* for the Ampex *VPR2B* and Marconi *MR2B*, and the *cat 234* for the Sony *BVH 2000*. These join cards such as the *cat 221* and *255* already available for specific machines.

There has been little new from dbx in the professional line although they now have a system available for satellite links. There has also been a resurgence of interest in dbx encoding of discs largely prompted by the marketing of the CBS *CX* system but this market is controlled by the 'software' and has therefore not reached a level of much commercial significance despite the fact that in some cases, the dbx encoded results were quite stunning.

Telefunken, or as that part of the company is now known following the restructuring ANT Nachrichtentechnik, has replaced the *C4D telcom* noise reduction board with the *C4DM*. This has the advantages of smaller size and also a reduced power consumption when used in noise reduction frames designed to take the Dolby *cat 22* card. According to recent advertisements, it appears that ANT are looking to find applications for *telcom* in video tape recorders and line satellite transmission as well although we have not had direct information on that.

Originating from the same parent company as *telcom*, is *Hi-Com*, a simpler system aimed at the more budget conscious studio which has also found a certain amount of application in very top end cassette systems. Nakamichi, who had a hand in the development of *Hi-Com II*, have a 19 in rack mount simultaneous encode system. In the studio field, manufacturers such as Rebis and D&R Electronica have used *Hi-Com* as part of their noise reduction systems. Both manufacturers produce modules that fit their rack frames and in the case of the Rebis model, 17 modules of *RA220* simultaneous encode/decode can be fitted in the 19 in *RA17R* frame. If the simultaneous encode/decode facility is not required, the track capacity can be doubled by the addition of plug-in relays.

Other manufacturers producing noise reduction systems include Bel and ACES. The Bel *BC3* system has been available for a couple of years but has recently been redesigned in a slimline version to fit 16 channels of simultaneous encode/decode in a 19 in frame. To achieve this size reduction, the output level pot has been changed to a preset accessible through the front panel with a screwdriver although it remains fully modular. The 8-channel and stereo versions are still available.

ACES have recently launched a 12-channel and a 16-channel noise reduction rack. Developed largely for use with their own tape machines, it is modular in both formats, simultaneous encode/decode and when the system was first available figures of 50 dB noise reduction were being claimed although it doesn't form part of the written specification.

Both Bel and ACES are aiming at a very specific market as their systems are not totally compatible with the more established noise reduction systems and are generally used in applications where this is not a problem. Bel *BC3* will actually make quite a good job of decoding dbx encoded material.

A development of recent years that is gaining popularity as the systems improve, is the single-ended noise reduction system. These are units that operate on an already recorded signal or any

60 ▶

"We do use a lot of Shure mics... I think to great advantage. There are a lot of their mics I tend to use for fairly specific things. I've got good tom mics, good overhead mics. And there are certain Shure models—like the SM7—if we had only SM7 mics it wouldn't be the end of the world because you can actually use them on anything.... Actually, the SM7 is a great bass mic, that's the particular function I use it for."

From an interview with Mick McKenna—engineer with The Rolling Stones Mobile Studio. Reproduced by kind permission of 'Studio Sound'.



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Noise Reduction

other source, and do not require previous encoding of the signal. The best known is the MicMix *Dynafex* system that was reviewed in August 1982. This system is now available in modules to mount in a card frame and therefore make multichannel applications easier. Recently MicMix have developed a *Dynafex* IC in conjunction with Solid State Micro Technology For Music Inc and this should have some interesting implications as this becomes available to other manufacturers.

A more recent single-ended system has been announced by Symetrix, the *Model 511*. This is a stereo rack mount unit using a 'soft-knee' VCF in series with a 'soft-knee' downward expander and these may be used at once or separately. The degree of noise reduction is controlled by a variable threshold control and visual indication of filter and expander circuits operation is provided.

Lastly, it is interesting to note that the Fabec *TTM* noise reduction frames are still available. The major reason for their purchase used to be that the *M Series* multitrack Dolby

racks would only hold 16 channels and for use with a 24-track machine you needed the 8-channel rack which was just a half full 16-channel rack. This took up a lot of space. The *TTM* frame was designed to take 24 channels in the standard 19 in rack width. Two years ago Dolby launched the *SP Series* of multichannel racks that accept 24 channels in 19 in and I had assumed that the multichannel version of the *TTM* frame would disappear. As Dolby will not sell you an *SP* frame without the *cat 22* cards and the *TTM* frame is still available I can only assume that you still enjoy playing cards. ■

Dynamic Range Control



Keith Spencer-Allen

Trends in the area of dynamic range control are very difficult to pinpoint. The quality of low cost compressors has increased; there has been an increase in the number of units using programme-dependent parameters rather than manual controls; an increase in the number of complex multifunction units; the increasing sophistication of noise gates; the entry of multiband compression into the recording studio and the continuing popularity of some of the old favourites.

Symetrix *CL-150* is a good example of the increasing sophistication of lower priced designs. It is a single channel compressor/limiter with manual control of threshold, attack, release and ratio but with a switchable manual mode, allowing attack and release to be programme-controlled. The unit also incorporates what Symetrix refer to as *Fast RMS*, a circuit that they claim combines the advantages of peak and RMS limiters. This means that you have standard RMS limiting and the 'soft-knee' entry into compression or limiting is gradual but the transients are still 'grabbed' by the peak limiter.

Fostex introduced a new channel compressor/limiter, the *3070* as part of their increasing range of ancillary equipment to bridge the gap between top end semi-pro and studio equipment. It incorporates, as well as standard compressor features, a noise gate with independent threshold settings and mono/stereo linked modes.

The Aphex *Compellor* is an interesting piece of equipment combining three functions in the one box—limiting, compression and levelling. The compressor section works over a 30 dB range of input levels with a self-adjusting range of ratios and programme-controlled attack and release. Apparently this allows the use of heavy compression while maintaining a natural sound. The levelling section will maintain gain within 1 dB for a 20 dB change with a slow enough action to have little effect on transients and other short term dynamics. There is also a peak limiter feature that will hold an absolute level of 12 dB above average level. In addition to all this there is a Silence Gate that will prevent the gain reduction release from returning to normal should the input level fall below an adjustable

point—useful when this would otherwise increase noise levels. Finally, there is provision for certain stereo image widening enhancement when the side-chain is triggered by certain programme information.

dbx modified the very successful *160* compressor to make the *160X*. The areas of improvement included the addition of stereo linking, selectable compression ratios and improved metering.

Drawmer introduced their long awaited compressor, the *DL221*. This is a stereo unit compressor/limiter with manual control of threshold, ratio, attack, release and gain. The interesting points about the unit are the addition of a separate peak limiter that can be switched in to remove any transients that gentle compression might not touch, and a switchable output select that allows normal processed output, bypass and a side-chain listen facility that allows the user to monitor any EQ applied to the side-chain. Usefully the gain functions are operative in the bypass mode and the *DL221* can make a good line amp should the need arise. There is also another version of this unit, the *231*, that also has a noise gate included.

A more complex unit recently made available was the Valley People *610*. This is a dual channel compressor that operates in three sections—a compressor, expander and VCA. The compressor can be used as a standard variable slope compressor with fully adjustable threshold and ratio and switchable attack or as a voiceover gate. The expander section has a switchable expander slope and adjustable threshold. The VCA section may be controlled by the compressor or expander sections or from an external source with provision for the insertion of FM pre-emphasis for use with FM transmitters. The VCA release time may be switched to manual or auto. Valley People also introduced the *430 Series* of the *Dyna-Mite* multi-function signal processors to replace the *410/420 Series*. The *430* consists of two channels of *Dyna-Mite*; the *431* is a combination of a *Dyna-Mite* channel and a *Dyna-Mic* channel and the *432* is just two *Dyna-Mic* channels. These units are standard 19 in rack mounting.

Recent changes in musical styles have increased the demand for noise gates and expanders. This demand has been met by manufacturers increasing the flexibility of their units. The Drawmer *DS201* stereo noise gate has an internal frequency-conscious keying facility that can be easily monitored by a single switch. It is possible to adjust high and low filters individually and the manual control section allows adjustment of threshold, hold, decay and a range control with up to 80 dB at max position. The unit can also be operated in an inverse mode as a ducker. In *DS100* single-channel form it is available to fit a standard *Scamp* rack.

The French company SCV have a similar type of unit known as the *NGS 2* dual channel frequency noise gate.

Audio & Design added an expander/gate, the *S30*, to their *Scamp* rack and this was accompanied by the *S31* compressor/limiter. These units are improved versions of units that were previously available.

An interesting new type of unit that two manufacturers have made available is the multichannel noise gate. Both units are mainly intended for live sound applications although there is no reason why they should be exclusively so. The Psionics *NG4* quad noise gate has four channels each with gain, threshold, attack, release and depth (range) adjustable controls, provision for mic inputs with 30 dB gain boost, provision for external keying, LED indication of gating and a bypass switch. All four channels are in standard 19 in 1 U rack and it represents one of the best examples of compressing large numbers of controls into a small area, while still retaining clarity, that I have seen.

The other 4-channel unit comes from Loft in the form of the *Model 400*. This is a feed-forward limiter/noise gate. Each channel has controls for noise gate threshold, limiter threshold and limiter attack/release time. To aid adjustment of the thresholds, both have LED indication. Each channel also has a phase reverse switch. This is also a 1 U 19 in unit and there are a number of options available such as recessed controls and different connectors. ■

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Zuccarelli in print

Hugo Zuccarelli has finally published his hypothesis on hearing. I'll admit that when I heard publication was nigh I was surprised. It's far easier to talk about wanting to publish and be taken seriously, than actually to publish and risk not being taken seriously. Zuccarelli finally came out in *New Scientist* (November 10, 1983) with an article written by himself, but alongside a blunt editorial reminder that his theory of hearing is only an unproven idea. There is also a reminder that the article is not an explanation of his dummy head. This was prompted because in his article Zuccarelli writes "I have built a recording device that makes a reference sound that creates an acoustic hologram. I do not wish to reveal the basics of the device for commercial reasons, but it provides monaural, stereo sound".

Fortunately for Mr Zuccarelli your average record company executive will never read the article or the editorial disclaimer. He will just be impressed by the fact that a welter of words were published in *New Scientist* under Zuccarelli's name. To set the record straight, although I write for *New Scientist*, it was agreed all round that I should not see the Zuccarelli opus until it appeared in print.

In his own words, Zuccarelli's hypothesis is that "the human ear is an active organ, not a passive one; it does not simply receive sound, like a microphone, it emits sound as well and so behaves as an interferometer".

There is nothing wrong with having an armchair hypothesis. Tonight, if you wish, you can sit down and postulate that the human eye sees by emitting an invisible laser beam and so behaves as an interferometer. If you make enough noise about your theory, you can then put the burden of disproof on everyone else. Prove me wrong, you say. That's far easier than getting out of your armchair and doing some hard work to prove the theory right. And working towards proof doesn't generate half as many headlines, half as quickly.

In a published letter to *New Scientist* (November 24, 1983) Dr David Kemp says it with academic clout: "Not since April 1 (April Fool's Day) have I read a 'scientific' article so devoid of scientific understanding, logic and rational thought as that by Hugo Zuccarelli. . . many of his ideas are contrary to the laws of physics and make mockery of his attempts to stick together fragments of auditory physiology just to add credence to a sound-recording technique."

Dr Kemp is entitled to talk bluntly. He and his colleagues at the Institute of Laryngology and Otology at the University of London, have for many years worked on recording and reporting sounds emitted by the human ear. (*Journal of the Acoustical Society of America*, November 1978 and *Hearing Research*, 2 (1980), pages 213-232.) These emitted sounds, says Kemp ". . . are a seepage of biological energy from the very active sensory cells in the ear which react physically to the vibrations they detect". But again, fortunately for Mr Zuccarelli, record company executives are unlikely to read the *New Scientist* letters page. Significantly, perhaps, Dr Martin Rosenberg of St Bartholomew's Hospital in London, whom Zuccarelli originally cited as an academic who took his ideas seriously, will now say for publication only that he is glad that Zuccarelli's ideas have been published.

*In the meantime, the music magazine *E and*

MM (December 1983) contains a muddled article on the pop group Psychic TV, which have always loved something odd and took to Zuccarelli's recording mumbo jumbo like a duck to water. According to the Psychics: "Like radar, or a bat, Ringo (Zuccarelli's dummy head) sends out a frequency, at seven cycles per second, and that fills up the space that it is in. It bounces off the room itself, the furniture, the people and the instruments. . . that goes through a box, the interference with the sound, and it transfers the sound that it is presented with to the tape." Although muddled, this ties in with Zuccarelli's own November *New Scientist* statement that his dummy head "makes a reference tone".

Let's nail this once and for all. Although Zuccarelli won't let Ringo out of his sight, perhaps for fear of someone finding out that there's nothing worth finding out, there's a dead simple way of analysing how the head works. All a recording engineer need do is record a sound effect, that just happens to be a controlled pulse of the type used to test loudspeakers by digital analysis. Once that pulse has gone through Ringo's ears and onto tape it becomes a telltale of all the processing circuitry encountered *en route*.

While someone is rigging this test, I'll leave you with a passing thought. Optical holograms can be captured on a small photographic plate because the wavelength of light is microscopically short. But the wavelength of sound in the air is often larger than a normal human head. Although Zuccarelli either doesn't know or care, that's the basis of how we hear the direction of sound. The head acts as a baffle so a soundwave arriving at one ear arrives later at the other ear and with a phase difference that the brain computes. When the wavelength gets smaller than the size of a human head, so that a soundwave can go through several full cycles as it travels from ear to ear, phase difference becomes useless. So the brain starts using pressure or intensity differences instead of phase to locate direction. That's why small animals listen by turning their heads. Their head baffle is smaller. It is possible to use sound for holography. An ultrasonic wave is used, to make the wavelengths as small as possible. The interference pattern is created either on a matrix of pressure probes, like very small microphones, or on the surface of water in a tank. The vibrations on the water surface are then photographed, and the picture reduced by the opposite process of photographic enlarging, ie like looking through the wrong end of a telescope. For Zuccarelli's hypothesis of a real time hologram in the ear to hold water, the listener would need an enormous ear, and therefore a big head. Is there a moral there?

PS. Dr. Hero Wit of the Institute of Audiology, in Holland, continues the demolition job in a letter published in *New Scientist*, Jan 12, pp 46, 47.

True or false?

A recent issue of the Institute of Broadcast Sound newsletter pursues the old scare story that tube trains can wipe tapes or floppy discs. A bunch of BBC engineers put it to the test. They reckoned that the hot spot for danger was over the drive motor. It develops 1500 horse power under load and when the train crosses points, the power is suddenly shut off and switched back on again. If anything erases

tapes it should be a seat over the motor when passing points. But despite all the folklore about lost programmes and data, none of the engineers could prove any damage after tests running over several weeks of tube travel.

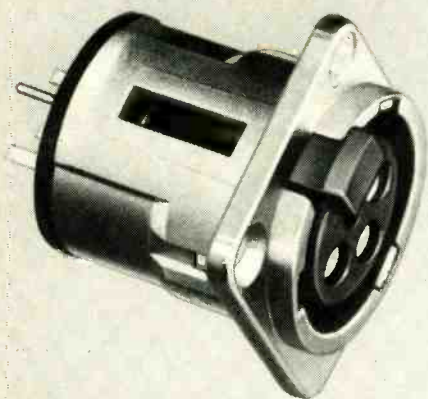
As a check they recorded a set of test tones on one batch of cassettes that was left in a BBC locker. The same tones were on the tapes that travelled on the tubes. There was no detectable deterioration, even at 12 kHz. So how to explain the folklore? In reply the IBS editor puts another question. How can you separate tube travel from all other activities? Can you be sure that the tape you think has been blitzed by the tube, hasn't actually been blitzed by heat, a loudspeaker magnet or physical shock?

IBS also quotes another piece of folklore. The new Victoria Line in London can run automatically. Drivers and guards are there only to keep the unions happy. The recording bias on an old Uher matches the high frequency signal used by the trains to check the signal status. So if you sit at the front of the first carriage and switch your Uher to record, you'll fool the train into making an emergency stop at each signal.

Limehouse Sound

After one year and £8.5 million, an old banana warehouse in London's decaying dockland is now the new Limehouse Studios complex. The main studio has a controllable acoustic commissioned by Sandy Brown Associates, using equipment made by Philips in Eindhoven. But it isn't an assisted resonance system like the one used in London's Royal Festival Hall. Assisted resonance uses a large number of discrete mic-amp-EQ loudspeaker channels which work in parallel, each operating over a narrow frequency band at high gain. For the Limehouse system which cost £160,000, there are 79 discrete channels, each operating over a broad band at very low gain. So the system is very stable, no one channel ever approaching howlround level. Limehouse uses 79 AKG omnidirectional mics high in the roof and 79 12 in Philips speakers. Gain control for all the amplifiers is ganged and although there is a filter in each channel which allows a little equalisation, each channel is essentially full range. By altering the amplifier gains all together, reverberation time can be swung between 0.8 s for speech and drama to 1.5 s for music. So it should be possible to record large bands and orchestras live inside Limehouse, under something approaching concert hall conditions.

At the opening ceremony the sound of speech was far better when they turned off the horrid house PA and used assisted resonance instead. But clips from the first TV programme, *Celebration*, made at Limehouse were pretty disappointing for sound, although visually impressive. A comedy sequence was ruined by canned laughter so bad that it may even have intended as satirical; in which case it's a dangerous in-joke. The music sequence looked distinctly uncomfortable. Flute and two guitars standing lonely on a large stage do not look right if heavy electric bass and drums are featured on the soundtrack but missing from the picture. Significantly, when *Celebration* was broadcast on Channel Four a week later, someone had the good sense to edit out the appalling canned laughter. ■



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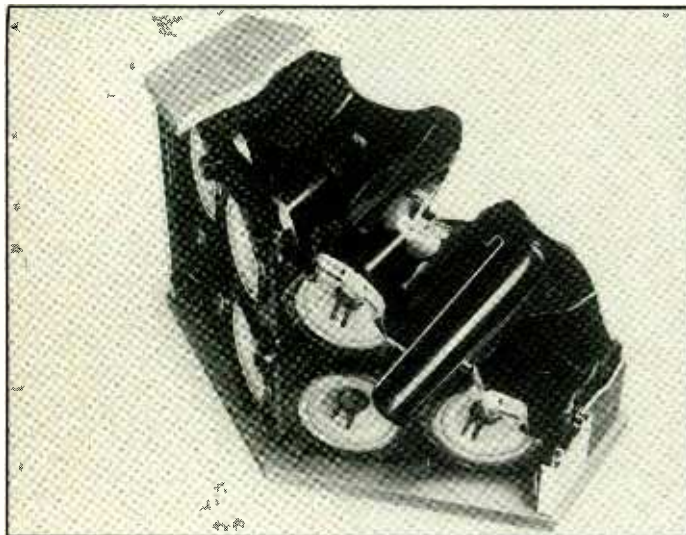
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The Bose direct/reflecting loudspeaker system



Barry Fox

There are a few subjects in the audio business guaranteed to raise the temperatures of anyone discussing them. Surround sound, Pressure Zone microphones, digital-versus-analogue and transistors-versus-valves; take a room full of engineers, tip in one of these topics and you are bound to start an argument. If all else fails, you only have to stir in one word and dispute is guaranteed. The magic word is Bose.

Everything beginning with Bose seems different. The man who runs the company, Dr Amar Bose, is also a Professor of Engineering at the Massachusetts Institute of Technology. His firm makes loudspeakers based on his individual approach to sound reproduction. Every product stems from the same train of thought. Bose loudspeakers have been praised, derided, hailed, heralded and hated. But they sell extremely well and the company is hugely successful. Anyone who works for Bose subscribes to the boss's theory. If they don't subscribe they don't work for the company. Commitment is total. Since the first Bose 901 loudspeaker was introduced in 1968, there have been several product updates. But the original design criteria, based on Dr Bose's direct/reflecting approach to sound reproduction, are still unchanged. The loudspeaker has nine small drivers, eight firing one way, and one firing in the opposite direction. Each driver is the same and handles a full range audio input to the 901 must be heavily equalized. This compensates for the inherently bumpy frequency response of such a small driver, in a small cabinet, working across the whole audio frequency spectrum.

The nine drivers in the 901 are each of 0.9Ω impedance but strung in series, so the overall impedance is 8Ω . This incidentally is why drivers used singly, ie in a car system, need an amplifier which delivers high current into the low impedance.

Bose claim that the use of nine drivers, each with its own hefty magnet, gives a very large total flux which creates a low back EMF and makes the 901 easy to drive. But this article isn't about the argument which rages over whether the sound you get from a 901 system is or is not an accurate transduction of the input signal. As a matter of long-standing policy *Studio Sound* has not yet reviewed loudspeakers, either by subjective listening tests or objective measurement. This article is about Dr Bose's decidedly unorthodox theory of sound reproduction, which leads to the use of more speaker units firing away from the listeners than towards them. As I threw in as a passing comment in a previous article, the theory is not widely understood, largely because the Bose company treats it tritely in advertising literature and Dr Bose the designer has never put it down on paper in simple terms.

I met recently with Dr Bose, and he let me ride a hobby-horse. This is that any theory can be explained without recourse to mathematical formulae. When an article sinks into formulae, I switch off. Often it is because the writer doesn't understand what he or she is writing about, and is passing the buck to the reader. The classic example of an author *not* passing the buck, is Lewis Epstein's recent book on relativity (*Relativity Visualised*, Insight Press, 614 Vermont Street, San Francisco). In this book Epstein

achieves the impossible; he explains Einstein's theory of relativity without recourse to any mathematical formulae. If he can do that with something as inscrutably complex as relativity, surely we can do the same with Bose's theory of loudspeaker reproduction...

When Dr Bose first bought a loudspeaker, in 1956, he didn't like what he heard. For the next 10 years he spent time at MIT, often working with Professor Tom Stockham (now best known for his Soundstream connection) on a way of improving the image produced by a loudspeaker. By 1965, Bose still didn't have any answers. In 1966 he got what he saw as a first clue. Two years later the first 901 was born.

Consider first what happens when we listen to live music from an orchestra, playing in the open air. The sound from every instrument in the orchestra is radiated in every direction. So this direct energy falls off sharply as the sound moves away from the instrument. In fact it falls off by the square of the distance travelled, the so-called inverse square law. Without any surfaces to reflect the sound, a listener hears only the sound that comes direct from the instrument. This is why an orchestra in a field sounds surprisingly quiet and quickly gets progressively quieter as you move further away.

We pinpoint direction of the arriving sound partly by sight and partly by a clever trick played by the ears and brain. All the sound coming from the orchestra reaches both ears. But unless the sound is coming from front dead centre, it will reach one ear slightly earlier than the other ear. Because the human head is a solid lump of bone and flesh, it acts as a baffle. By and large, the spacing between a pair of human ears is always the same. So the extra distance travelled by the sound from ear to ear around the head puts a fixed delay or phase shift in the signal. The brain uses this as a clue to direction. At higher frequencies, when the wavelength is shorter than the distance travelled, the phase clues become meaningless. A wave delayed by a whole cycle will appear to arrive at each ear simultaneously. So at higher frequencies the ears and brain start to sense any difference in intensity. A sound arriving from the left will be stronger at the left ear than at the right because the right ear is shielded by the head baffle. By balancing phase and intensity clues picked up from our two ears, the brain comes up with a consensus decision on where the sound is coming from. If the listener can see the sound source, this very powerful clue is added to the mix.

The Ambisonics sound system is able to create a better illusion of the original surround sound field than the old 'quadro-phantic' systems, because it takes both phase and intensity clues into account. The most disillusioning aspect of the whole Hugo Zuccarelli farrago is that this young Argentinian-Italian

is rejecting the ear-brain direction decoding process in the most patronising manner, without offering anything more than a colourful armchair hypothesis of inner ear holograms to replace it. Incidentally, and contrary to what Hugo Zuccarelli maintains, people with hearing in only one ear *do* find it difficult to locate the source of sound. There are two record producers who are deaf in one ear, (one of them an original Beach Boy) and they most certainly find it difficult to hear and mix in stereo. Listen with one headphone to any dummy-head recording, Zuccarelli's or otherwise, and the stereo effect is lost. This directly contradicts Zuccarelli's recently published claim to have provided 'monaural stereo sound'.

When an orchestra plays inside a hall sound arrives at the listener's ears both direct from the instruments and as reflections from the walls, floor and ceiling. As you move away from the orchestra it remains fairly constantly loud, once the direct sound field has become swamped by reflected sound. Unless the hall is gigantic, and the reflection time very long, the ear does not register the reflections as discrete echoes. Instead there is an effect of ambient warmth. There is good reason to believe that this ambient warmth provides more clues for the ear and brain to use in locating the direction of a sound source. A genuine mono recording, made with an omnidirectional microphone in a live acoustic, does contain some clues to directionality even though there is only a single channel of sound information available for reproduction (whether through one loudspeaker or several). In halls where there is a marked absence of reflection, for instance the Barbican in London, it is far more difficult to pinpoint the direction of sound. We shall return to the fascinating story of the Barbican at a later stage. As things currently stand, the consultant responsible for trying to improve the acoustics there refuses to talk to the press unless he can vet anything written before it is published. Obviously this is unacceptable. We will either write the story without his co-operation, or without his vetting. Watch this space.

On the face of things it might seem impossible for the ear to detect direction from phase and intensity clues, when they are confused by the reflected sound. But by another clever trick, the brain gathers its clues from the first arriving wave only. The replica waves that follow later as reflections, are largely ignored as phase and intensity clues. This is the so-called 'precedence effect'. The visual clues are of course still important. Try closing your eyes at a concert and you may be surprised at how difficult it is to pinpoint a sound source. Try also, if you can cope with the embarrassment, of slumping down in your seat so that the direct sound is largely blocked by people sitting in front of

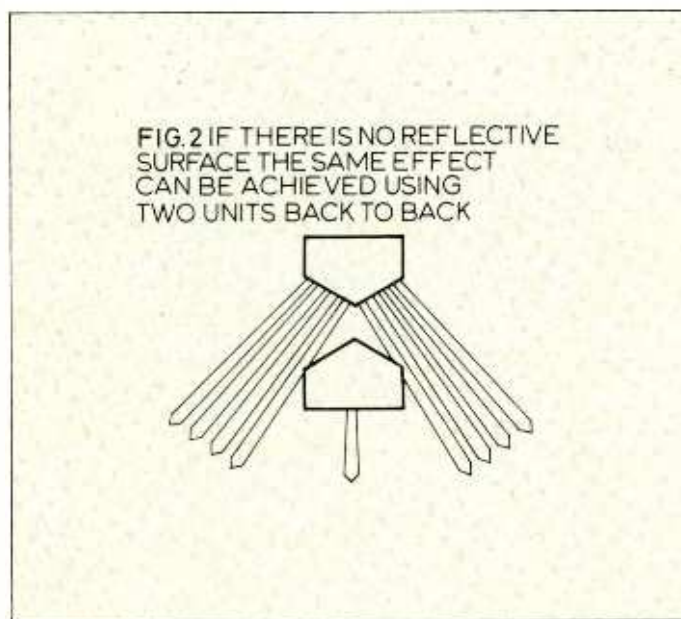
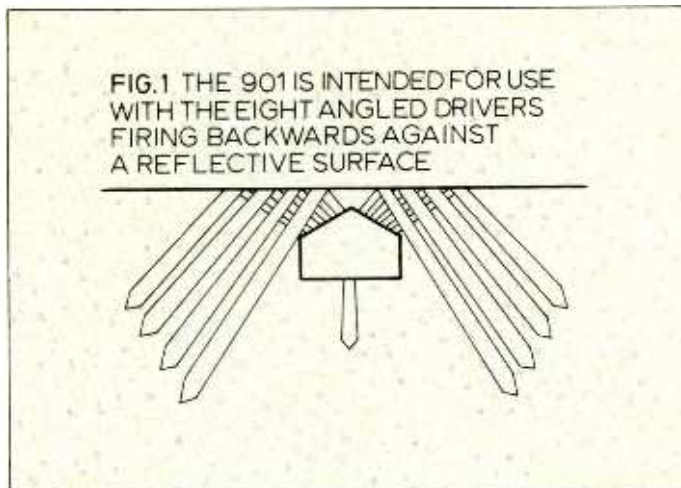
you. You are now hearing mainly reflected sound, which is the difference between the soundfield in a field and the soundfield in a hall. In both cases the direct sound is identical. Try turning your back on the orchestra so that again you are hearing mainly reflected sound. In both cases, 'slump low' and 'back to orchestra', the indirect soundfield is surprisingly strong. That is why the sound level from an orchestra in a hall falls off only a little once you move out of the predominantly direct field at the front and into the indirect field further back.

Now let's think about what happens when sound is recorded, either with a stereo pair of microphones or a mix of mono mics panned into stereo. Essentially the two channels contain information on sound waves picked up from two directions. When these signals are played back through a pair of loudspeakers spaced apart and pointing in towards the listener, a remarkable thing happens. There is a phantom spread of sound between the two loudspeakers. We now take this for granted and overlook just how remarkable it is.

In the early 30's, when Bell Labs were making their first experiments with stereo, audio engineers already knew full well that the easy way to reproduce a spread of sound from two channels of information is to record with a dummy head and listen on headphones. The dummy head has a microphone in each ear and 'hears' what a human head would hear. When signals transmitted or recorded from the two microphones are reproduced through headphones, the listener's left ear hears what the left ear microphone heard and the right ear hears what the right ear microphone heard. So there is a reasonable recreation of the soundfield at each ear which the brain decodes as a reasonable, but by no means perfect, recreation of the total soundfield around the dummy head. But of course as everyone who re-invents the 100-year-old dummy head recording technique finds out sooner or later, headphones are antisocial and it is very difficult to create the same effect with loudspeakers. Unless the loudspeakers are arranged one on each side of the ear, like giant headphones (as Zuccarelli uses for his demonstrations to the gullible) the left ear hears sound from both the left and right loudspeakers and the right ear hears sound from both the right and left loudspeakers. This completely destroys the dummy head effect.

Bell Labs tried to solve the problem with the 'curtain of sound' approach. A string of microphones in front of the orchestra was used to record or transmit sound for a string of loudspeakers.

The system works tolerably well, despite confusion from the sound emitted from the backs of the loudspeakers, but is impractical for domestic use. At least three transmission or recording channels,



and three loudspeakers are needed.

The conceptual breakthrough on two channel, two speaker stereo was made over 50 years ago, by Alan Blumlein, working in the EMI Laboratories, Hayes, Middlesex. He stopped fighting the problem that sound from each loudspeaker reaches both ears, and instead capitalised on it. He abandoned all hope of recreating the original phase clues at the ears, knowing that this was only possible with headphones or loudspeakers arranged like headphones alongside the head of a listener forbidden to move. Any change of position means a change of relative phase. Instead he built 'shuffling circuits' which took the low frequency phase differences in the signals picked up by two microphones, and converted them into amplitude or intensity differences. Exactly the same trick is played by a cardioid microphone, without any additional circuitry, by virtue of its directional pickup pattern.

When the resultant signals are replayed through a stereo pair of loudspeakers, positioned as we now expect them to be positioned, the brain is fooled into thinking that what the ears hear is a spread of sound, not two separate sound sources reproducing two perspective sound views of the original acoustic

field. Sound from the left loudspeaker hits the left ear first and then reaches the right ear a fraction of a second later; sound from the right speaker hits the right ear first and then after an equally short delay reaches the left ear. So an artificial phase clue is introduced at low and mid frequencies and we register source direction. When the same sound is reproduced from each loudspeaker, each ear hears it at the same time which replicates the situation of live sound arriving from centre front. At high frequencies, over around 1 kHz, the loudspeakers reproduce the original intensity clues.

The precedence effect, also known as the Haas effect (after the Dutch researcher who evaluated it) can be over-ridden by changes in sound level. When sound of the same level arrives at one ear earlier than the other, the brain takes the first arrival as the direction of the source. But if the level or intensity of the later arrival is increased, the brain is fooled into downgrading the importance of the first arrival and taking the louder, late arrival as the main clue to source direction. This, of course, is how the balance control on a stereo amplifier works. If you sit too close to one loudspeaker, then the sound from that speaker will arrive first and the image will

swing lopsidedly towards the nearest speaker. But if the gain of the signal fed to the more distant loudspeaker is increased, the louder signal will pull the image back again towards the more distant loudspeaker.

Back in the fifties when Dr Bose decided that he did not like the sound of conventional loudspeakers he concluded that it was because they were producing too much direct sound. What he wanted was a loudspeaker that radiated sound in all directions to take advantage of the reflective characteristic of the room, and so throw a mix of both direct and reflected sound at the listener's ears. With most conventional loudspeakers, of course, the sound heard is beaming direct from the loudspeaker cone, in a fairly tightly defined cone of mid and high frequencies. In his own words, he and his colleagues at MIT believed 'that many of the harsh and shrill sounds encountered in loudspeaker music reproduction may be due to the fact that loudspeakers have been designed to beam the sound directly at the listener, as opposed to delivering it from a wide distribution of incident angles'. This led him to try to 'design a speaker that radiates only a small portion of its energy directly towards the listener and grazes the larger portion of its radiation off the walls of the listening room to create spatial patterns in that room comparable to the spatial patterns one receives in the audience of a live performance'. His first experiments were aimed at recreating a pulsating sphere. He built an array of 22 radiators arranged in an eighth-part sphere and positioned it in the corner of a room so that the walls and floor produced reflections that simulated a full sphere. But the sound was poor. He went back to using a small cabinet, but with an unusual driver pattern. "We found that excellent results were obtained by employing about 10% direct radiation toward the listener and about 90% of the radiation at 30° angles towards the wall behind the listener" says Bose. This was how the Bose 901 was born.

The 901 has one driver in the front face and eight in the rear face, split four and four between two angled sides. Although some theatres deliberately use these speakers the wrong way round, with the eight drivers firing forwards, they are intended to be used with the eight angled drivers firing backwards onto a hard reflecting surface like a home wall (Fig 1). Where there is no reflecting surface, for instance in a futuristic home or outdoors, the same effect can be achieved using a pair of 901 units mounted back to back. The drivers then behave as a mirror image to each other, exactly as if there were a single driver in front of a reflecting surface (Fig 2). With either arrangement the listener hears sound direct from the front of the loudspeaker, and reflected sound from the rear coming off all the walls.

The Bose direct/reflecting loudspeaker system

Surely, you may well argue, this cannot improve on the image produced by two directional loudspeakers. After all, whether there are extra reflections or not, there are still only two source loudspeakers fed from two source channels of information. All that is happening is that the sound information generated from each loudspeaker is being spread wider and made more diffuse, by reflection. Will this not make the stereo image worse?

Here the important point to remember is that the brain still gives precedence to the first arriving sound. Although only around 10% of the sound from the speaker is direct, and 90% reflected, the 10% direct sound arrives ahead of the reflections. So it is this sound that the ear uses to decode the sound image picture.

Bose claims that a pair of 901s will not only produce a good stereo image, but produce it over a much wider listening area than is acceptable for conventional loudspeakers that fire only direct sound. The logic here is persuasive. When you listen to a live orchestra, and move from one side of the hall to the other, the sound remains as a stereo picture,

albeit with changing perspective (Fig 3). But if you move across the listening area in front of a pair of stereo loudspeakers (Fig 4) you first hear mono in front of one loudspeaker, then hear stereo as you pass into the ideal listening area halfway between the two speakers and then hear mono again as you pass the other loudspeaker. According to Bose's theory, if the loudspeakers are producing a high level of

reflective sound (see Fig 5) there is a compensatory effect that preserves a stereo image over a relatively wide area. The key point here is the angling of the rear-facing loudspeaker units.

As you stand at one side of the listening area, you hear direct sound from the closest loudspeaker and indirect sound bounced from one set of four rear facing units on the far loudspeaker. In the middle there is a

symmetrical mix and at the far side a dose of compensation from the angled drivers again.

With obvious qualifications (tonal quality of voice or musical instrument) the ear and brain tend to interpret amplitude or intensity as equating to nearness. Since reflected sound contributes to amplitude, the quantity or dose of reflected sound will affect the perceived proximity or intimacy of a performance. A small musical group performing in a large dead hall will not sound intimate. This, argues Bose, makes the 8:1 speaker layout of the 901, with its high dose of reflected sound, better able to produce a realistic balance in the room.

Let me repeat, this article is *not* intended as a paean of praise for the 901 loudspeaker, or editorial blessing for Dr Bose's theories. It is simply a sincere attempt at putting those theories into plain words so that a few more people may be able to understand them and then listen for themselves to see if they hold good in practice. The exercise seems worthwhile if only because, whether you like it or not, Dr Bose, his theories and his loudspeakers, are not going to go away. ■



FIG. 3 LISTENER HEARS STEREO IN ANY POSITION IN FRONT OF THE LIVE ORCHESTRA

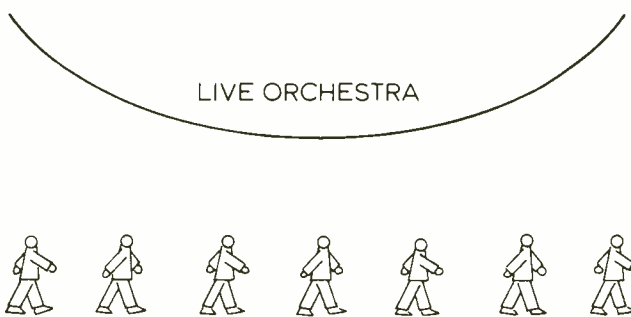


FIG. 4 MOVING ACROSS THE PATH OF A PAIR OF STEREO LOUDSPEAKERS THE LISTENER HEARS STEREO BETWEEN THE TWO BUT MONO IN OTHER POSITIONS

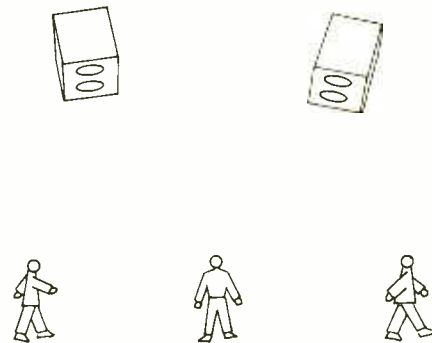
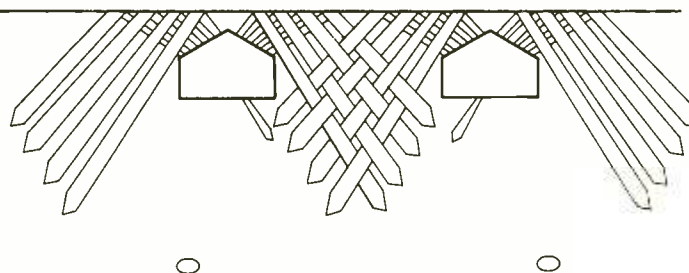


FIG. 5 LISTENERS IN THESE POSITIONS RECEIVE SOME SOUND FROM DISTANT SPEAKERS SO HEAR STEREO



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letters

Digital misconceptions

Dear Sir, I was greatly heartened to read the splendid article 'Digital Misconceptions' by Keith Armstrong (Studio Sound January) where, in spite of his obvious mathematical ability, he treated the subject in a most lucid and informative way. His explanation of the necessity for 'dither', and the examples of the horrors of ultra-high order filters produced real enlightenment in a dark and alien world.

However, I will take issue with him on two minor points (and why not?)—a snakey little reference to the misconception of '96 dB dynamic range in a 16-bit system', and references to 'expected' overload margin in an analogue system.

Keith states that the achievable dynamic range of a 16-bit linear is about 90 dB. To argue for the opposition, my own tests have shown it to be a good bit (!) better than that; a recent system giving 93 dB measured carefully using IBA Code of Practice methods. One must admit that the subjective difference between 90 and 93 dB is hardly going to set the world on fire, but was I doing it all wrong?

He further states 'An analogue mixing system of any merit will have a dynamic range of 110 dB at least'. Here again, I am perhaps arguing myself out of a job, but 110 dB dynamic range is by no means easy to achieve in any reliable production mixer; indeed, this figure is VERY close to physical limits even with the balanced throughout philosophy of our own 'Silk' series mixers. Statements about 32-bit arithmetic (and 100 A power supplies!) call into question the real world requirements of future sound processors.

Yours faithfully, Ted Fletcher, Joint Managing Director, Alice (Stancoil Ltd), Alexandra Road, Windsor, Berks, UK.

Keith Armstrong replies: I am pleased that Ted Fletcher was heartened by my article 'Digital Misconceptions'.
● His 16-bit system measured 93 dB dynamic range, but was it dithered correctly? I am not aware of any standard measurement technique to quantify dither performance and rely on listening tests. There is clearly a lot of room for the 'spec-man' here, and although I will allow that 93 dB may be achievable in a properly dithered converter 90 dB is closer to the current state of the art.
● I actually said that an analogue mixing CIRCUIT of any merit would have a dynamic range of over 110 dB, and was not referring to mixing systems (ie, desks). Interestingly, the misconception that digital mixing would have only 96 dB range is one that Ted himself has perpetrated in the past (Studio Sound May 1983—Page 64).

In addition to the above, Ted raises some other points I would like to comment on: his 'horrors of ultra-high order filters' are all avoidable as described in my article; and although I did not mention 100 A power supplies it is worth noting that a 100 A logic supply is only 500 W.

Compact Disc

Dear Sir, I am indebted to Van Webster (December 1983) firstly for his compliments and secondly for providing me with an excuse to reply and to qualify one or two important points.

Mr Webster is quite correct in his statement about PCM-1600 being compatible for Compact Disc masters, provided the 44.1 kHz crystal is fitted. However, it must be realised that the sampling rate flag bit is not encoded by the PCM-1600 and therefore, when played on a PCM-1610 the wrong sampling rate indicator il-

luminates. There is a way to modify the PCM-1600 to encode the extra data but this is not necessary provided the cassette box is marked with a clear explanation of the sampling rate used and that it is of PCM-1600 format, and that the wrong sampling rate indicator will show. Failure to do so, will result in the rejection of the tape by the Compact Disc plant.

Mr Webster's second point about analogue and digital masters proves that my powers of expression on paper are not as good as they should be. When I spoke of an analogue production master, I meant the production master for analogue disc cutting. Of course, the recording of the production master should be digital. The point I was trying to make, was that some extreme dynamics might have to be removed to obtain a sensible cut on 'black disc' but it has already been proved that it is considerably easier to cut from digital masters. The main reason appears to have the improvement phase linearity at lower frequencies which take up less 'land' on the lacquer which in turn, may allow for a higher level cut.

Yours faithfully, Chris Hollebone, Sony Broadcast Ltd, City Wall House, Basing View, Basingstoke, Hants RG21 2LA, UK.

Us and Them

Dear Sir, I was shocked to read your editorial (Us and Them) in the November issue. You are doing just what you are accusing 'them' of.

I agree that digital is in its early stages and shouldn't be judged so sharply right now. But it is the manufacturers who are telling us that it is perfect 'Now'! They're the ones who are spreading myths. And you add to the fire by stating outright that in a generation or two there 'won't be a contest'. Do you have an open mind or have you decided that digital is it... now and then? As for Ivor... yes, he speaks rather sharply... as do Sony and Philips and the rest. His sing-along technique is the best technique I have encountered for judging the merits of music reproduction equipment and source. (The key word is music.) Unfortunately, the name makes it a joke, but when properly demonstrated, even you could recognise how rational it is, and that in fact digital has severe musical problems. A looney? Maybe an outspoken genius. Everyone laughed at Ivor when he said that the turntable can be heard and really makes a difference. They're not laughing now, and every turntable made compares itself to the Linn.

And by the way, the direction of wire can and does make a difference, if it is not masked by other faults in the system. I grant you that not very many people will recognise or care about the difference, but leave those of us who want the most of the musical listening experience alone.

Yours sincerely, Michael Tapes, Sound Workshop, Professional Audio Products Inc, 1324 Motor Parkway, Hauppauge, NY 11767, USA.

Who reads the small print?

Dear Sir, Yes I'm sure that in future we will have to state somewhere on the packaging exactly how a master is derived—be it analogue or digital; and this will have to include everything from mics through to actual monitoring speakers and onboard gear: there will always be enthusiasts who will find this info a gas. But let's make it small print!

Can you imagine the sort of comments people will be making in 20 years time about this sen-

sitive era of digital birth: 'Do you remember when we had to read the sleeve to tell us what to believe about the quality of recordings?'

We all know as technicians and as artists that the order of merit of a particular recording is not in direct proportion to the pureness of its digital breeding. So although we do not wish the consumer to be tricked by such label flashes as 'Digital Mastered' when actually it was recorded analogue but slapped on to a Sony F1 just to satisfy the law—we should not however encourage a preoccupation in this area: we would be educating the consumer to focus at the wrong area when attempting to assess the quality of a tape or disc.

I think that the importance of creating a standard identification code for analogue and digital packaging is for the industry only: so that record companies are not ripped off; so that there is a validity check possible at street level; so that the artists themselves are not conned—in fact at every level, more information can only be helpful to those who seek and understand it... But for us to headline the differentials as being an important factor in record buying for the consumer—I think it becomes counterproductive in attempting to assess the actual quality of goods: namely the quality of production/musicians/engineering/recording environment, etc.!

Yours faithfully, Steve Hall, Hallmark Studios Ltd, 32B Fouberts Place, London W1V 1HF, UK.

Richard Elen replies: I think you've got it the wrong way round: the problem is that the hi-fi magazines by and large have managed to confuse the man in the street into thinking that 'digital' means 'quality' by definition, and that if something says 'digital' on it, it must be in some obvious technical way superior. Such 'digital festivism' has to answer for the consternation that someone will feel when he buys a record he already owns because the new version says 'digitally mastered' on it—and finds it identical to the old. Or the disappointment in finding that the new CD has no pops and crackles, but has a load of hiss on it! Certainly a labelling scheme would provide information for those inside the industry, but much more important, it would tell the consumer what he was getting: if the CD was labelled 'AAD', for example, he would know that although the recording was analogue all the way down the line to the final transfer for CD mastering, it would be the closest possible approach to what people heard in the studio. A CD labelled 'DDD' would indicate to the consumer that here was a recording made to the highest possible technical standards available today. That coding would help the consumer—in the sense that even if he just feels that 'more Ds are better', he will know exactly what he is getting—but of course such a coding would not indicate anything about the performance, mic technique, production quality... such things are often subjective and not amenable to coding; nor would it be desirable to try. The SPARS coding scheme gives the consumer the same kind of reference as in the old days he would have got from a record labelled 'electronically reprocessed mono' as opposed to 'stereo'.

Despite all this, though, I would not expect the coding to be writ large on the cover... but it would be there if the consumer wanted to know, and it would stop record companies being taken to court under the Trades Descriptions Act by an irate consumer who didn't feel he got what he paid for. That on its own would be a good reason for adopting a 'Digital Audio Reference Code'.

dbx

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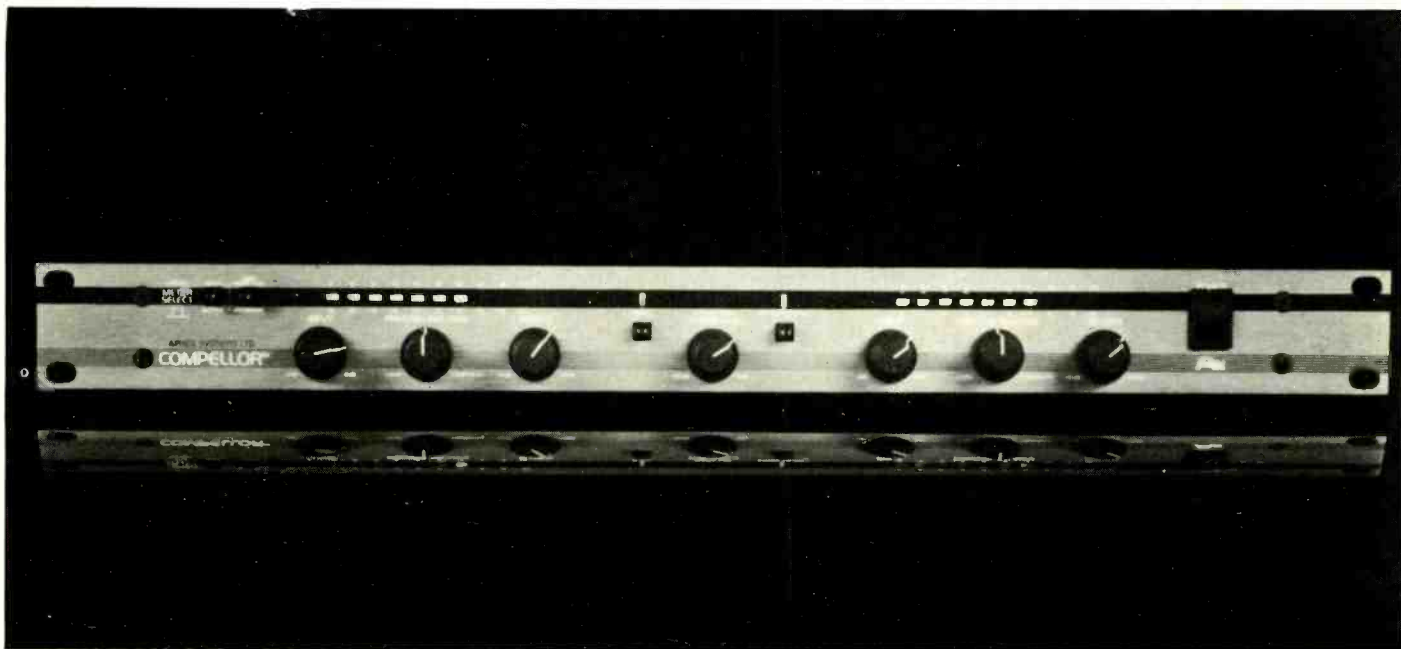
Also in this format the new dbx 140 provides two channels of type II encoding and decoding, usable separately or simultaneously for use with cart machines and transmission lines to give a full 40 dB increase in dynamic range.



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This article (or set of articles) is a somewhat unusual departure for us, as it represents neither an objective or subjective review, prepared by our own reviewers, nor is it the normal type of article we ask a manufacturer to write, providing an insight into a product: it is somewhere in between. Aphex worked closely with a number of top industry names during the period before the *Compellor* was released, and

ensured that it received a good deal of field testing. Aphex asked some of their users (some who had seen the *Compellor* at the prototype stage, and others who had not) to write down their comments and experiences with the unit for us to publish. At the very least they represent a useful insight into the applications and operation of what appears to be a unique and highly useful dynamic control system.



Aphex Compellor

Barry Victor, radio station KROQ-FM, director of technical operations. Previously chief engineer, radio station KMET. Technician, technical services CBS Television, KNXT & CBS TV CITY. Asst production director, Drake Chenault Ent Inc.

Areas that can benefit by using gain reduction are:

- (1) Main programme channel(s) before studio transmitter links;
- (2) Microphone pre-processing (levelling);
- (3) Production studio levelling (tape headroom).

Main programme channels that are before the STL (studio transmitter) link need to have the levels kept within certain parameters to protect the STL from being

overdriven so as not to cause distortion and also not to be too low in average level so as to maximise signal to noise ratio of the STL. Most radio stations are run in a "combo" operation where the disc jockey controls the audio levels as well as produces and announces the show. As most DJs are not technically inclined, levels from an on air console can range from -20 dB to +20 dB. An automatic gain control device or AGC is employed to correct for the wide discrepancies in level.

Microphone pre-processing is very desirable at many times due to the wide dynamic range of human voice. Again, as DJs are more concerned with the programming aspect of their shows, a compressor on the mic channel can be very helpful for keeping levels constant and the programming intelligible. When

interviewing guests mic levels can be kept from causing undesirable feedback on open mics from headphones by a noise gate.

Production studio levelling can prevent audio tape from over saturation causing distortion. Again air talent producing commercial spots are more concerned with the end produce than with technical concerns. Audio tape headroom can be extended by employing a peak limiter to prevent unwanted transients from saturating the tape. An AGC unit can be used to provide a consistent level to maximise signal to noise during recording.

Up until the early 70's the most prevalent AGC unit was the *Audimax* and its companion limiter, the *Volumax*. These units and the many others of their type were quite good for their day. In fact you can still find many of them around in

use. The main problem with this type of limiter and compressor is that they can cause pumping or bring up a lot of background hiss during quiet passages when used to excess. Peak limiters like the UREI *LA-2* and the later model *1176* have been used to protect sources from transients but they can cause pumping when used to control more than peaks.

There is then the problem of FM broadcasting in which you have a 75 μ s pre-emphasis curve to overcome signal to noise problems in the transmission. This brought out products like the *FM Volumax* which inserted a 75 μ s pre-emphasis curve in front of the limiter to cause the high frequency information to create more limiting so as not to overmodulate the transmitter with high frequency peaks. This works

74 ►

Many options are available with the MXT-1200 – they include pre or post fade balanced insertion points; a full cue/remote start switching system with two independent external drive circuits for all microphone channels to operate on air lamps and loudspeaker mute circuits; balanced independent channel outputs; PFL/AFL options on faders and push buttons. Auxillary modules are options on the MXT-1200 too – they include compressor/limiter, oscillator/talkback and a selection of monitor modules, some with monitor mixdown for 4 and 8 group systems.

For OB and mobile applications smaller versions of the MXT-1200 contain an integral mains power supply and an external 24 volt d.c. input facility. For permanent installations the MXT-1200 is designed for 'drop through' mounting into a working surface – the lower sections of the timber side cheeks and front buffer being detachable.

To speed installation all programme inputs and outputs, which are balanced and floating, are via XLR and multiway connectors.



As a professional you are more than anyone aware of the need for total comprehensive production facilities, a greater efficiency in studio usage with improved 'audio quality'. You also need to specify equipment very accurately in order to meet your requirements.

To achieve that 'edge', we at Audix have designed the MXT-1200 to contain most of the options and flexibility you will need – the result is a remarkable mixing system which can be quickly assembled to your design, from stock – at sensible manufacturing costs.

In broadcasting it is virtually impossible to produce one typical mixing desk – that's why we designed the MXT-1200 in either 2, 4 or 8 group versions as well as radio studio 'self-op' operator announce configurations.

You can choose from a range of 7 frame sizes and 14 different modules so that mixers from 4 inputs/2 outputs to 36 inputs/8 outputs can be built up – to suit your applications and budgets.

The MXT-1200 can be easily built up for announcer-operated studios combining stereo high level input modules and optional wrap round free standing consoles.

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**AUDIX
MXT-1200
FOR
PROFESSIONALS**

Aphex Compellor

fine when you don't have to have a "loud", competitive sound.

This was partly solved in the introduction of two types of peak limiters/levellers. The three-band *DAP-310* and similar units which allowed individual compression/limiting of three separate audio bands helped in being able to limit the high frequencies without causing unnatural-sounding loss of low frequencies. The other was *Optimod 8000* which took a 2-band limiter compressor and matched it with a stereo generator. This allowed closer attention to prevention of overshoots and peaks which cause unwanted over-modulation products.

A large problem with audio gain reduction products is that some can cause rather large amounts of harmonic distortion when they are operating. Some have built in overshoot problems due to faulty transformer designs or large amounts of IM distortion products caused by phase shifts or similar problems. Some multi-band processors will cause phase shift, ringing and distortion due to the splitting of the frequencies by very sharp filter networks and then the resumming network which can cause cancellations in the audio source.

The problem with overshoot and distortion products in the broadcast facility is that these products tend to overmodulate the broadcast transmitter causing the station to have to lower its average level of modulation to compensate for them. Of course distortion is not pleasant to listen to and will cause the listener to fatigue and possibly tune out.

Lately with the introduction of superior audio performance stereo generators, FM exciters and new high performance STL microwave radio, the gain reduction units show up as the weak link in the broadcast chain.

Long a problem in many US radio markets is the need to be as "loud" as or "louder" than the competition. This involves a large trade off, one of apparent loudness and that of audio quality. The reason behind this is that you only can modulate so much before you exceed set standards and risk being fined by the FCC. Several means have been developed to allow maximum modu-

TABLE 1

All measurements made with 0 dB reference at +4 dBV. Output control full clockwise. Input adjusted to achieve output level. Stereo enhance circuit out. All tests performed with Sound Technology 1710A.

Frequency response

Process control at full compress 10 dB gain reduction
10 Hz to 20 kHz -0.0 +1.0 dB
50 kHz +13.0 dB

Process control at full levelling 10 dB gain reduction
10 Hz to 20 kHz -0.0 +1.0 dB
50 kHz +13.0 dB

Total Harmonic Distortion

Process control at full compress 10 dB gain reduction
700 Hz 0.065% with 30 kHz bandpass
700 Hz 0.087% with 80 kHz bandpass
700 Hz 0.097% with no filters
10 kHz 0.070% with 80 kHz bandpass
10 kHz 0.090% with no filters

Process control at full levelling 10 dB gain reduction
700 Hz 0.055% with 30 kHz bandpass
700 Hz 0.070% with 80 kHz bandpass
700 Hz 0.090% with no filters
10 kHz 0.060% with 80 kHz bandpass
10 kHz 0.080% with no filters

Clip level at 700 Hz +20.0 dB +24.0 dBV

Noise floor 700 Hz tone at reference silence gate engaged
-65.5 dB -61.5 dBV

Absolute noise floor. Output control full clockwise input shorted
-74.0 dB -70.0 dBV

Smpte—IM distortion
4:1 Ratio

Process control full compress 5 dB gain reduction
0.056%

Process control full levelling 5 dB gain reduction
0.25%

lation of audio programming—eg large amounts of compression to keep the average level at its highest possible level and then to use clipping to keep the peaks from overmodulating. There are several clippers in various final limiters and several clipper products made to be inserted after the stereo generator to prevent overmodulation and to maximize the average loudness. The problems with these, of course, are if you use them to excess you make a very hard sound, one that can tire the listener out. Face it, square waves are not pleasant to listen to. So the engineer has a fine line to tread to have a signal that is loud enough to cover the intended area and please the programme director (who wants to keep a competitive edge of loudness) while still trying to

maintain a quality signal that won't tire the listener, or worse yet drive him or her away completely.

I was made aware of a possible new product from Aphex Systems called the *Compellor* some time ago. I was invited to see and hear a prototype and asked for my ideas. The product sounded very good and I offered the suggestion that it be made with minimum of user controls and the cleanest audio path. Transformerless balanced floating input stages were designed so that it could be used in any environment with any type of equipment and not have side effects of transformers.

The *Compellor* can be used single ended. Either leg of the input or the 3 pin *XLR* connector can be grounded and no change of level occurs as compared to normal

balanced output. Input and output can be 0 dB referenced at +8, +4, 0, or -10 dB. The heart of the *Compellor* is the DVG and the DRC which control the attack, release and length of compression or levelling depending on where the process mix pot is set. Either full compression or full levelling or any mix in between is possible. The actual attenuator is the Aphex VCA which offers excellent performance. Refer to table 1 for actual measured performance.

The *Compellor* also has a built in fast peak limiter riding 12 dB above the 0 reference, it prevents transients above 12 dB from passing.

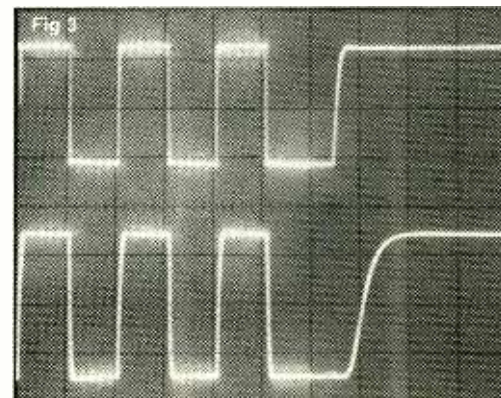
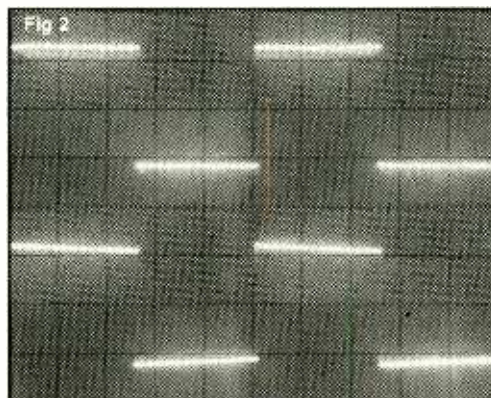
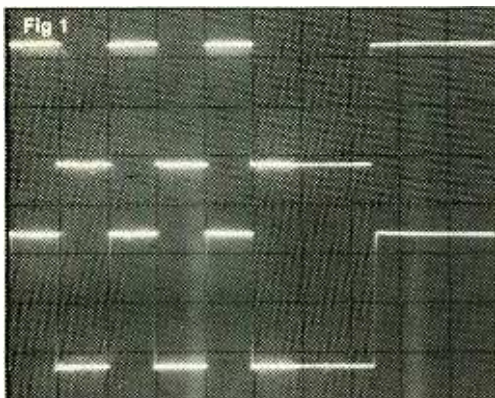
Referring to Fig 1 we have a 1 kHz square wave at 22 V amplitude. Top trace is input to *Compellor*, bottom trace is output. Both traces are vertical 10 V/div, the horizontal is 500 μs/div and the expanded horizontal is 20 μs/div. The *Compellor* is set for 10 dB gain reduction. As you can see the input and output traces are almost identical showing no ringing or overshoot.

Fig 2 is a 100 Hz square wave at 22 V amplitude. The top trace is the input to the *Compellor*, the bottom is the output of the *Compellor*. Both traces are vertical 10 V/div the horizontal is 2 ms/div. The *Compellor* is again doing 10 dB gain reduction. The picture shows very little tilt of the low frequency components and no ringing or overshoot whatsoever.

Fig 3 is a 10 kHz square wave with input of 22 V amplitude and output of 13 V amplitude. The *Compellor* seems to think of a square wave of this frequency a little harder as the gain reduction settled in at 20 dB. The top trace is the input at 10 V/div and the bottom trace is the output of the *Compellor* at 2 V/div. Horizontal was 50 μs/div and the expanded was 5 μs/div. This shows a very slight rounding of the edge of the output but once again no ringing and no overshoot.

As evident by these square wave response pictures the *Compellor* is a very transparent device exhibiting no real degradation to the audio source.

Due to the *Compellor's* unique control circuit a stereo enhancement circuit can be derived from control voltage only to cause the compressor to increase the apparent separation of the two channels enabling an increase of the stereo effect. This comes in real handy as in conven-



tional compression, the more compression that is done the less apparent the stereo effect is. The silence gate will freeze the level of the *Compellor* when audio drops to a predetermined point to avoid increasing background noise. Also you can see the silence gate detector does not control the audio directly. It controls the sidechain which instructs the VCA thereby giving a very clean yet stable command.

I was finally able to get one of the first *Compellors* off the assembly line and actually try it out. The unit was bench tested with the results in Table 1, and was put into service a short time later. The *Compellor* was put into the broadcast chain at the studio just before the STL. Depending on the programme material and who was running the air console the gain reduction was anywhere from 5 dB to around 18 dB. The *Compellor* was able to handle this with no problem and the silence gate made times of low or no modulation very quiet with no hint of pumping or apparent squashing effect as evidenced by other compressors. I was able to let my final limiter at the transmitter do barely any work at all except for high frequency protection due to the 75 μ s pre-emphasis.

One of the next two units went into the production room to be inserted between the production console and the input of the tape recorders. The *Compellor* has aided our production team in the production of taped spots and especially in the carting of music. We put a few songs on cart that are hard to find or only one copy is available due to limited release and the difference between playing from cart or from disc can be quite a problem from a quality standpoint. The *Compellor* was able to help cut a hotter tape without tape saturation.

The third unit was put in the mic channels for two of our on air microphones in the air studio. They interfaced very easily and have made a major difference in the sound quality of our announcers.

As a final note the *Compellor* will work very well as a pre-limiter for any final broadcast limiter on the market and able to provide a punchier sound with excellent clarity and new dimensions of openness. The *Compellor* operates with an intelligence depending on the music content. ie If the source doesn't need processing the *Compellor* doesn't process. The best thing I can say about the *Compellor* is that you can't hear it work.

David J. Holman—Independent producer/engineer. Engineering credits include platinum albums by Olivia Newton-John, *Grease* and *Xanadu* (albums and movies). Producing credits include Cindy Landis (Allegiance), Coyotes (Lorimar), King Bees, Mary MacGregor (RSO/Polygram).

using limiting on vocals; 1) The 'squashed' dull sound, 2) The pumping effect, and 3) The accentuated sibilance. Using the *Compellor*, however, none of these undesirable effects were noticed even with extreme settings, ie greater than 20 dB of gain reduction. I found it hard to believe that I was using that much gain reduction and had to flip it in and out of by-pass to make sure that it was indeed in circuit.

Prior to receiving the *Compellor*, I was mixing cuts on the new Coyotes album. On one cut I was confronted by a female's breathy, soft vocal which was at the same time, very peaky. The music tracks were heavier Rock & Roll. Using another device the peaks were squashed, words dropped out, the sibilance came up necessitating the use of a de-esser, and then EQ had to be used to correct for the de-esser. I worked like hell to make the vocal sit in the track and was really frustrated when the record company wanted a re-mix.

By that time I had installed the *Compellor*. I sat down at the console and by the end of the first verse I knew my job would be much, much easier.

On another cut off the same album I had a problem with the bass not 'sitting' in the track. I tried every compressor/limiter in the room (12 different types from old to new) but I could not get what I wanted. When I used the *Compellor* with approximately 14 dB of gain reduction the bass was even, sitting where I wanted to put it, and free from any colouration.

During a recent recording session for Cindy Landis, the signal chain consisted of microphone, pre-amp, fader, *Compellor*, to tape. Before I had the *Compellor*, I always had to EQ her voice. Even with the *Compellor* I am sure that I will have to use the EQ to record many tracks, but it does give me greater opportunity to eliminate a stage in the recording process.

I should say that I use compressors and limiters as creative devices in that each has its own "sound". For example, acoustic guitars gain sustain and vitality with compression. The *Compellor* does not do this. Simply put, if you are looking for level correction without any other sonic effect, the *Compellor* is the only device I know that does the job.

Joe Klein — producer/engineer L.A. Trax 1982 Winner of Clio award, three International Broadcast awards, sixteen Clio award finalist. Produced over 500 commercials since 1976 for the top acts for major labels including Donna Summer, Kenny Rogers, Fleetwood Mac, The Doobie Brothers, David Bowie, Sheena Easton and Lionel Ritchie.

A record commercial is the only commercial except for a movie or a

TV trailer in which the listener or viewer gets a sample of what is being sold. My job is to make a record sound bigger than life plus get a sales message across all within a span of 10 to 60 seconds. Some might think that my mixes are simple in that I typically have only three tracks—stereo programme and an announcer—and sometimes two or three more for sound effects. Given that I have as little as 10 seconds to achieve maximum impact; every millisecond, each nuance is important to me. The success I have had is due to the attention I pay to detail. One very important detail is dynamic range control.

I make commercials which play on radio (AM and FM) and TV. Every broadcaster uses some form of compression/limiting. If I were to send out tapes with levels all over the place, there would be no way to predict what effects the stations' processing would have. In order to avoid, or at least minimize, changes at the broadcast stage my spots all have tightly controlled dynamics. Aside from level and peak control I use compressor/limiters for another, perhaps not so obvious, reason.

I was always a radio freak. More often than not records sounded better to me played on the radio than on a stereo. These records apparently made the broadcast processors "pump" in such a way that the sound was actually enhanced. I set the attack and release of the compressors so that the pumping gives a more rhythmic feel to the music as well as the announcer. This technique is especially effective for R&B spots.

I use the UREI 1178, and when I want a less noticeable effect, I use either the dbx 165 or the Orban 424. I get the effects that I want with these devices, but they all have shortcomings.

I should qualify what I am going to say next because I have had the *Compellor* for a relatively short time, but I am impressed enough to be writing this report.

The *Compellor* does not have the shortcomings of the other devices in that it has no 'effect'. It makes a spot sound as though I had recorded and mixed very well, instead of recorded and mixed and then ran everything through a compressor. That is an amazing thing for me.

The combination of levelling and compression is a new experience for me. Although there have been other types of levelling devices, I felt that they degraded the signal too much to be of any use. The *Compellor*, without colouration, smoothes out my mixes making them easier and, at the same time, better.

I recently completed the winter campaign for ON-TV (subscription TV). Since this was all dialogue, I definitely did not want any of the compression 'effects' I mentioned before. I needed clear, clean, punchy tracks. I found that using the *Compellor*, even with over 14 dB of gain reduction, clarity was not lost.

After the *Compellor*, I used the

Aphex II *Studio Exciter*. This gave the tracks even greater intelligibility and punch. The *Aural Exciter* is a very important part of my sound, there is nothing that I have produced in almost 3 years which did not run through the unit. The combination of the *Compellor* and the *Aural Exciter* is powerful—a consistent, tight mix with a very dynamic feel.

Another spot I 'Compelled' was for Kenny Rogers "Greatest Hits" LP. The problem in that one was I had to connect 10 songs, each with a different texture, together with an announcer. The *Compellor* smoothed the transitions beautifully.

A client typically does not know what equipment was used, nor should he care. When I delivered the new spots to ON-TV, the response was "God, that sounds fantastic". That is, for me, the bottom line.

Frank Kejmar—manager/Recording Services/MCA/Whitney Studio Engineering for over 20 years. Credits include platinum albums for Barry White and Aretha Franklin, audio for Hanna-Barbera animation and Disneyland exhibit "America Sings".

I used the *Compellor* on the mixdown of the opera *Bells of Bethlehem*. The orchestra had been already mixed in London, the six soloists were recorded with AKG C12, and the twenty-five voice chorus was recorded with overhead AKG C24 mics in stereo-M/S.

With pop music you can get away with using a variety of limiters. Classical dynamics, however, are much more varied and critical. I had at least 20 dB of dynamic changes in this project and only the *Compellor* kept the levels inaudibly controlled.

The vocalists thus appeared to have excellent mic technique without any conscious effort on their part. Chances are I could have achieved the same results by riding the gain manually for five or six takes, but the *Compellor* did it perfectly the first time. Another way of achieving the effect would be to program level changes via automation, but that would be time wasted if you have a *Compellor* available.

One does have to recognise that high level and low level balances will change depending on the amount of processing. The already mixed orchestral track was fine for the album master. I had to make a special mix for cassette duplication which was going to be played back during live performances. I wanted to avoid any need for gain riding during a performance so I ran the orchestra mix through the *Compellor*. Again, it did the job without any colouration.

The *Compellor* is very simple to use, after five minutes of playing with it, I had complete confidence in its function. The metering was useful in that I had a good indication of what the unit was doing dynamically at any particular time. ■

I find three main problems when

Vesta Fire RV-1 & RV-2 Cutec CD-425 - user reports

Keith Spencer-Allen



These two user reviews form the start of an occasional series in which we will be looking at items that would not generally be reviewed in depth within these pages. This may be because of cost or application and the reasons for covering them will generally be that they fulfil some application that is relatively unique or that they are of general interest.

Shiino Musical Instrument Corporation, 37-1, 2-Chome, Kamiyama, Setagaya-Ku, Tokyo 154, Japan.

UK: MTR Ltd, Ford House, 58 Cross Road, Bushey, Herts.

THE *RV-1* and *RV-2* are low cost spring line reverb units. The *RV-2* is a stereo unit with two input channels and two output channels. It is basically a 2-channel version of the *RV-1* although they have several different features.

The *RV-2* has its input and output sockets on the rear panel with all the controls being on the front panel except a slide switch that selects between the mixed signal or reverb only for the output. The two channels can be operated independently of each other and both channels have a ½ in square yellow illuminated push-button switch in the top left side of the front panel whose size leaves no doubt as to which channels are on or not. There is then provision for separate foot switches to remotely switch both channels. To the right of this is the input mode switch allowing the two channels to operate independently or from a common mono input. Each of the two channels then has a low cut filter that removes most of the input signal below 100 Hz to prevent the low end upsetting the springs. This is followed by input and output controls for both channels with a tri-colour LED indicating overload/limiting. The correct operating level is apparently when this LED flashes green only on the peaks but it will go through yellow to red when limiting occurs although distortion is not obvious when running higher levels than this. The limiter is situated before the springs and the design intention appears to be only to remove the very troublesome peaks and let the rest pass.

Aside from the illuminated power button, the final control is the output mode select which will

either leave the unit to operate as a straight two channel unit or will reverse channels on the output so that the dry output of channel 1 is mixed with the reverb of channel 2, and vice versa.

Each channel has four springs with excitation times of 43, 37, 27 and 19 ms and an overall decay time of 2.5 s. The unit is slightly better than the average for its resistance to external knocks and vibration although only average on its 'ping' resistance to transients in the input signal. It is however quiet in operation and the reverb is very good for a spring unit in this price range with the decay quality being very respectable.

The *RV-1* model is a mono unit with only a single channel of reverb. The unit is standard 19 in rack mount but only 1 U high. The rear panel has a single jack input and two outputs with provision for a foot switch control. There is also a -20 dB input jack socket on the front panel. The front panel controls consist of an effect bypass switch with LED followed by a reverb send level control. There then follows an EQ section acting upon the reverb signal. This has parametric controls and offers a frequency sweep of 100 Hz to 5 kHz, a gain of ±18 dB and an adjustable bandwidth of ⅓ to ⅙ octave. This offers plenty of scope for colouration of the signal or correction of any minor nasties. There then follows a reverse phase switch that reverses the polarity of one of the mono paralleled outputs and gives an excellent stereo effect—but don't be fooled—sum the outputs in mono on the console and suddenly all the glorious stereo effect disappears and the signal is as dry as the input—truly just a polarity change.

There then follows the heart of the *RV-1* and really the reason for this whole review. Unlike the *RV-2* where the limiter was before the spring line, the *RV-1* has its limiter after the spring and

so this then acts as a decay control. The 'Rev Limiter' control sets the limiter level and the decay time is 2½ s in the minimum position and 5 s in the maximum position (with max reverb send level). Now of course the limiter responds to changes in signal level and what we have here in effect is dynamic decay control. The effect of the limiter set high is to exaggerate the dynamic of the input signal and make the reverb sound larger than life. A little care has to be taken to not let the signal become too noisy with badly set input levels and too long a decay time but the results can be very effective. The actual reverb sound is very different from the *RV-2*. Although the *RV-1* has four springs, two are straight and two are tapered. It is about averagely susceptible to external knocks. Reverb is probably not quite of the clean quality coming from the *RV-2* but the *RV-1* is far more suited to adding reverb on single instruments than the *RV-2* and less prone to 'pinging'. When mixing I always like to have access to a spring reverb as it often seems the type of echo most suited to guitar solos and any non-percussive instrument that needs a lot of depth, needing to go back into the stereo picture beyond what can be normally achieved with other mechanical devices and who can afford to tie up a digital reverb on just one extreme effect during a mix. I am a firm believer in having as many reverb sources as possible at one's fingertips when mixing so that you can separate out instruments and place them all in the right depth position in the stereo image particularly if it was not possible to achieve the required sound when recording. The *RV-1* would make a useful addition to such a collection of reverb devices. If however you are looking at a unit such as this your sole source of reverb, you would be far better off with *RV-2* with its less extreme effects and more even performance.

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reviews

THE CD-425 is a very low cost digital delay line with no modulation facilities—purely delay. It is fairly unique though in having two delays, both independently adjustable in delay time.

The unit is standard 19 in rack mounting and 1 3/4 in high. All input and output sockets are situated at the rear of the unit and the majority of the controls are on the front panel. The top of the case has an excellent block schematic diagram of the circuitry and signal paths that I found very helpful as the supplied literature does not really amount to very much. The overall construction is lightweight although strong enough while mounted in a rack. On the subject of construction, the internal layout has the electronics on two separate boards with a strengthening strut running front to back. Although the boards are beautifully laid out, there are no component identification details on the boards and the inter-board wiring could be tidier.

The front panel controls contain very little mystery and are all very clearly labelled in cream lettering on a semi-matt black finish. The controls begin logically at the left hand side with the input level pot. This controls the level of everything that will appear at the mixed or delayed outputs although not the straight through direct output. Next along are two controls labelled high and low EQ. These controls are graduated + and -5 although what units if any these figures correspond to is not quite clear. They are only operative on the original delayed signal (not on the feedback

chain) and are quite useful for tweaking the delay at some of the more extreme settings that we will come to later. To the right of these EQ controls lies a five LED level indicator. Calibrated from -15 to +2 (dB presumably) this displays the level at the lowpass filter just prior to the A/D converter so this includes the to-be-delayed signal and any feedback signal but not the dry signal component of the mixed output.

Heading right again there is the delay level output that sets the delay level in the mixed output and the delay only output. To the right of this there are the delay select pushbuttons. The CD-425 has two delays known as the main and sub delays. There is really no difference between these two delays except that there is a separate sub delay level control on the rear panel. This is a little bit inconvenient when the unit has been rack mounted although there must have been a real difficulty in finding a space for it on the front panel. The delays are selected by pushbuttons with indicator LEDs and this means that for some effects the delay can be immediately switched in rather than having to turn up a level control. A third button with LED selects the feedback control. This control recycles the signal from both delays at the relative levels at which they appear after the delay section. The range on the control is such that at the top end of the control range it is possible to go into an ever-increasing level spiral. I find this beneficial as there are occasions where it can make very interesting effects.

Just to the right of the feedback control is

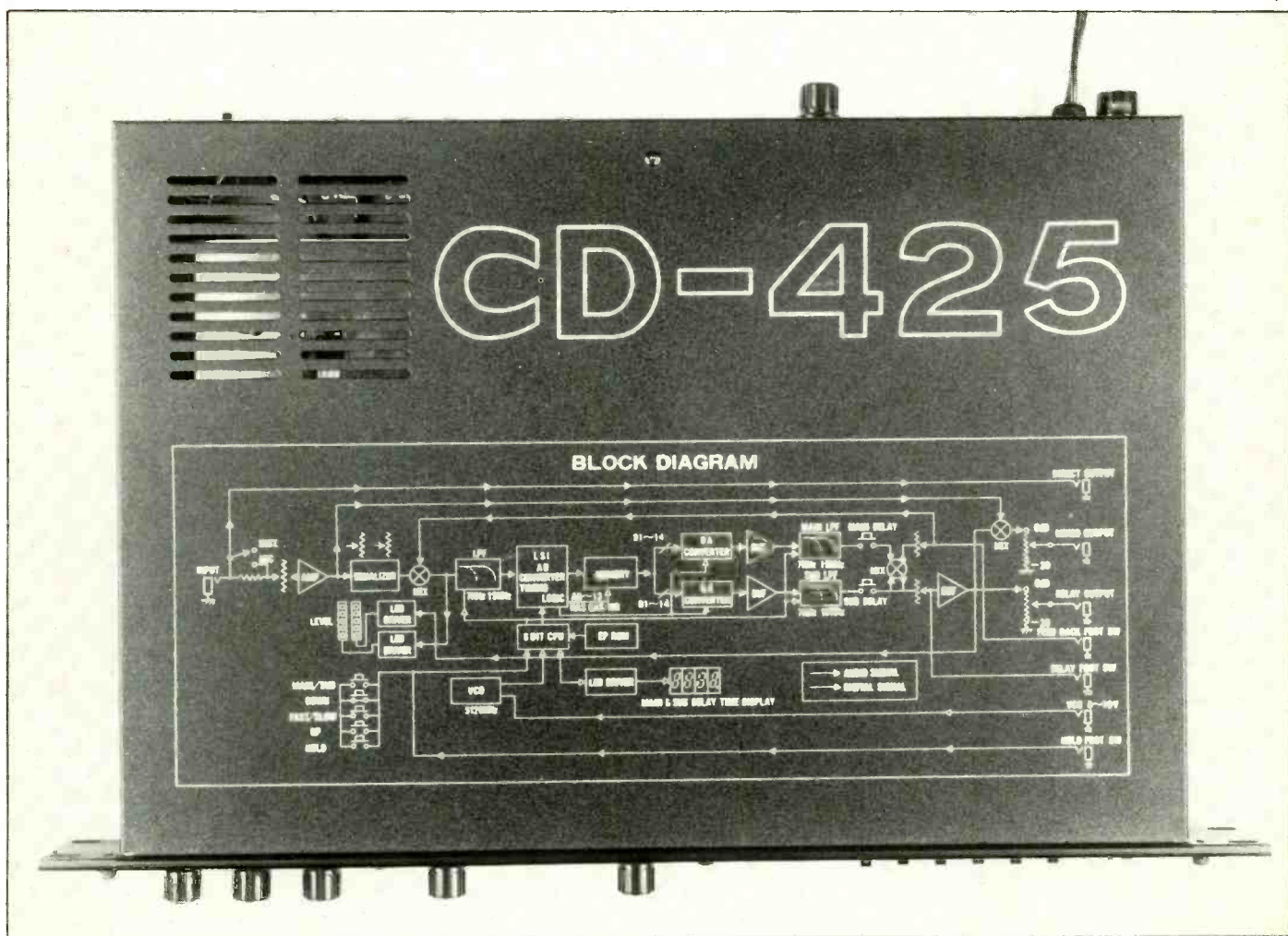
another level LED meter, the same as the previous meter. This displays the level at the output of the delay section just before it passes to the delay only out or is mixed with the dry signal for the mixed output.

Both delays can be individually adjusted in 1 ms steps from 1 ms to 1024 ms and as I mentioned earlier, there are no differences between the quality of the delays and nothing to stop the sub-delay being longer than the main delay. A 4-figure display registers the delay time in milliseconds of the sub or main delay, whichever is selected by the switch to the right of the display. When the unit is first turned on both delays read 400 ms. There are three switches to the right of the display which alter the delay time of displayed delay. Holding down the 'up' or 'down' buttons shifts the delay in ms steps in the required direction. The centre button is labelled 'fast' and if this is held down as well as one of the other two, time travel is much quicker.

There are three buttons remaining to the right of the already mentioned controls. The hold button is a latching pushbutton with LED that continuously repeats the contents of the memory until released. The output button and LED indicator select either 0 dB or -20 dB output levels. The final button is the power on/off switch.

Rear panel sockets are from right to left, standard jack socket input with switch for selection of 0 dB or -20 dB operation; jack socket outputs for delay only or mixed outputs; three jack sockets for foot switch control of

80 ▶



BOX CLEVER

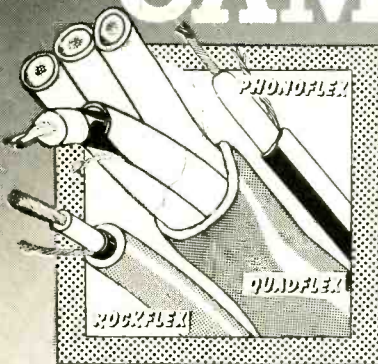
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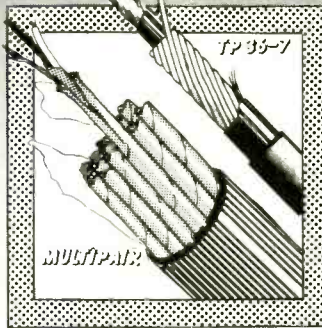
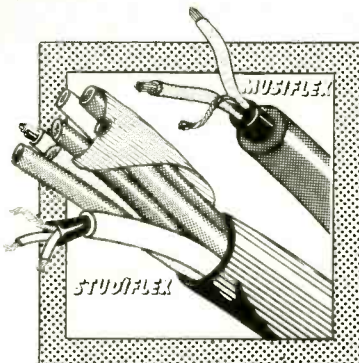
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reviews

hold, feedback and delay switching; direct output; and VCO input for remote delay time control. Apart from the previously mentioned sub delay level control there is a two core attached mains lead, an earthing post and a fuse holder. This power cable arrangement should be modified to a standard IEC socket or a correctly colour coded three core mains lead (for the UK).

The CD-425 digital section is 14-bit with a 16 kB memory. Up until a delay time of 400 ms there is a delay bandwidth of 15 kHz \pm 3 dB; and from 401 ms to 1024 ms it reduces to 7 kHz \pm 3 dB. Both ranges are available at the same time, there being an automatic switch over when the 400 ms 'barrier' is crossed with a slight mechanical relay click being audible from within the unit. In practice this means that the sound quality on delays on single instruments under 400 ms is pretty good but of course it becomes rather band limited over 400 ms. Aside from a fairly severe top loss the sound quality is usable for effects and can be helped by appropriate adjustment of the EQ section. It is obvious that at price levels such as those of this unit, you cannot expect performance of units costing far more.

The interesting side of the CD-425 though is its effects capability. With sub delay level turned up to maximum so that it was the same level and the main delay, I set up a delay of about 35 ms on

echo of a Binson *Echorec* or WEM *Copycat* but without the noise that those systems usually generated to accompany the signal. There are some settings where it is possible to have a thick multiple repeat carpet going underneath and then using a fairly short delay as well, have the same musical figure heard quite clearly over the top of it producing a beautiful thick sound. Sometimes, if the relationship between the times becomes an 'uncomfortable' setting it can sound unpleasant. I pinned this down to the relationship between the two delays. If the longest delay was set at 1024 ms, the shorter delay should be kept away from any multiple related delay eg 256 ms. Any time closer than 10 ms to this figure sounded unpleasant with multiple delay, with the odd delay times sounding far worse—they got out of time and became very discordant on sustaining type sounds such as guitars.

On the tested unit there was a slight repeat echo (one time) on all settings even without the feedback control turned up or selected but this didn't prove a problem at all as it was easily masked by any other sound present.

As you may be able to tell, I had a lot of fun with this unit and I'm a little reluctant to let it go because of that echo capability. As with all units that you delve into quite deeply, you end up thinking 'Why didn't they do that as well?' In the



the main delay and then raised the sub delay in ms steps up from 10 ms. At about 20 ms the delays are almost indistinguishable from each other on non-percussive material and they act together to produce a very natural sounding short ambient echo. This effect gets even stronger for the next few ms and then when they are about 10 ms apart cancellations start occurring. These cancellations can be used to produce some interesting tone colours with each ms distance between the delays sounding different. If feedback is now added, this effect is further enhanced as the delayed signals also become progressively more filtered.

When using longer delays it is possible to create the density of repeat echoes that are normally associated with musical instrument echo units.

This takes a little practice as the relationships between the delays effect the type of achieved echo as much as the overall delay time selected. If one of the delays is beyond the 400 ms point the multiple repeats on the shorter delay will mask the frequency response deficiencies and you can end up with an echo repeat that doesn't sound so far distant (no pun intended) from the

case of the CD-425 it is the obvious point—why didn't they bring the two delays out separately instead of recombining them internally. Cost may be the answer but the schematic diagram on top of the case shows both main and sub delays are separate paths after the memory each shown as having their own D/A converter, low pass filter and buffer before they are recombined at the mixing point. Somewhere there must be an answer. The possibilities with separate outputs would be enormous particularly for mixdown where it would be possible to locate items in the stereo picture using Haas effect techniques rather than level panning and with the low cost of these units, more than one might not be outside the reach of bigger studios—but I must stop supposing. But give it some thought Cutch.

So this is a very low cost delay line with no modulation section and a good value for money performance and within those requirements can be recommended for those looking for such a unit. It can also be recommended to those users who don't want a low cost delay line but are keen to try a piece of equipment that is capable of some quite unique effects at a price that is quite acceptable.

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Down at Dolby Labs

Richard Elen

Dolby Laboratories was founded, in May 1965, with a staff of four, in London SW6, and immediately began to produce prototype noise reduction systems, moving to larger premises in September. The following month they demonstrated a prototype noise reduction system to Decca for professional music recording applications. Decca evaluated the system very thoroughly, and finally responded by ordering nine *A301* units which were delivered in April 1966. At that time, these well-known and well-loved units sold at £700 each. By the end of the year, Dolby recordings had been released—by Decca—the first album being Mahler's 2nd Symphony, catalogue number SET 3256. Dolby NR systems were also introduced to the USA and sold to major record companies—CBS, RCA, MCA, Vanguard, and a number of independent studios. The system began to take off and a number of articles appeared in the audio and music press.

It was a natural step to liaise with the hi-fi industry on possible applications of the Dolby system for domestic uses, and work with KLH in Cambridge, Massachusetts, resulted in a simplified Dolby system—to become known as Dolby B—and a distinction was made between A and B-type systems.

By October 1967, further A-type production facilities had been introduced in London SW8, and the following month a New York import and distribution operation had been set up. During the following months, work was done on the consumer system, culminating in the introduction of the first B-type-equipped machine by KLH. It was the *Model 40* reel-to-reel machine, which ran at 3¼ and 7½ in/s. This was the first tape deck licence agreement, exclusive until 1970.

By the end of 1968 it was necessary to move to newer, bigger London premises, and this move prompted a flood of new orders into the premises at 346 Clapham Road, London SW9—where they still are today. Better facilities led to more efficient production techniques, enabling a reduction in the price of noise reduction, and the price of the *A301* dropped to £560.

Dolby Laboratories is certainly the best-known name in noise reduction, but that is only one of the aspects of audio quality which has been tackled by the company. Presently the organisation is involved in video and film sound as well as professional and consumer applications of noise reduction, and their latest development on the audio front, Dolby HX, has nothing much to do with noise reduction at all! Dolby's main concern has always been with improving quality in general. But before we look at these new areas, let's remember how it all started, with the history of the company.



Mixing soundtrack for *Apocalypse Now*

Dolby was rapidly accepted in studios as they progressed to multitrack techniques, and by the end of 1969 the majority of London studios had multitrack recorders equipped with Dolby-A on every track.

Dolby also continued work during this period on the Dolby cassette recorder, resulting in the demonstration of a B-type-equipped cassette machine at the AES Convention in New York, October 1969. Advent produced an add-on B-type unit in February 1970, and several companies had released cassette recorders with Dolby-B by the middle of that year.

Dolby began to take an interest in other fields, examining noise

problems on 35 mm optical film soundtrack formats, but a major development at the time was the introduction of the *360 Series* as a replacement for the *301*, which made multitrack installations more practical in terms of physical size. These units are, of course, still in production, although they are today used primarily for stereo applications, two subsequent series of units for multitrack having been introduced. Also, in June 1970, the first professional B-type system was introduced for tape-duplication applications, and a great deal of work was carried out with Ampex and Decca on the application of NR systems to this purpose. Later in the

year, Revox joined the 'Dolby-B club', becoming a licensee. By the end of the year Dolby was in a position to experiment with film-sound NR techniques, using excerpts of the film *Jane Eyre*.

A major advance on the consumer front was a deal with Signetics in mid-1971 to produce B-type ICs, but Dolby was already looking at a new field—FM radio noise reduction. Experiments took place with a B-type encoder, the *Model 320*. It was rapidly discovered that Dolby NR gave excellent results; in some cases the effective service area of a station was increased by up to 50%.

Back on the film front, the first commercial release of a movie which used Dolby NR in the sound production stages came at the end of 1971, with the release of Kubrick's *A Clockwork Orange*, now sadly withdrawn. Noise reduction was used on all the pre-mixes and masters, although it was released with a conventional optical soundtrack. But by February 1972, the *Model 364* A-type unit was introduced to handle optical soundtracks. It was distributed through Rank Film Equipment. Kodak later in the year began experiments with a 16 mm film format with stereo sound and Dolby, but by that time New York radio station WQXR had already begun full-time Dolby-B transmissions: Dolby's activities were expanding on many fronts, in all the areas to which they thought their noise reduction system would offer quality advantages.

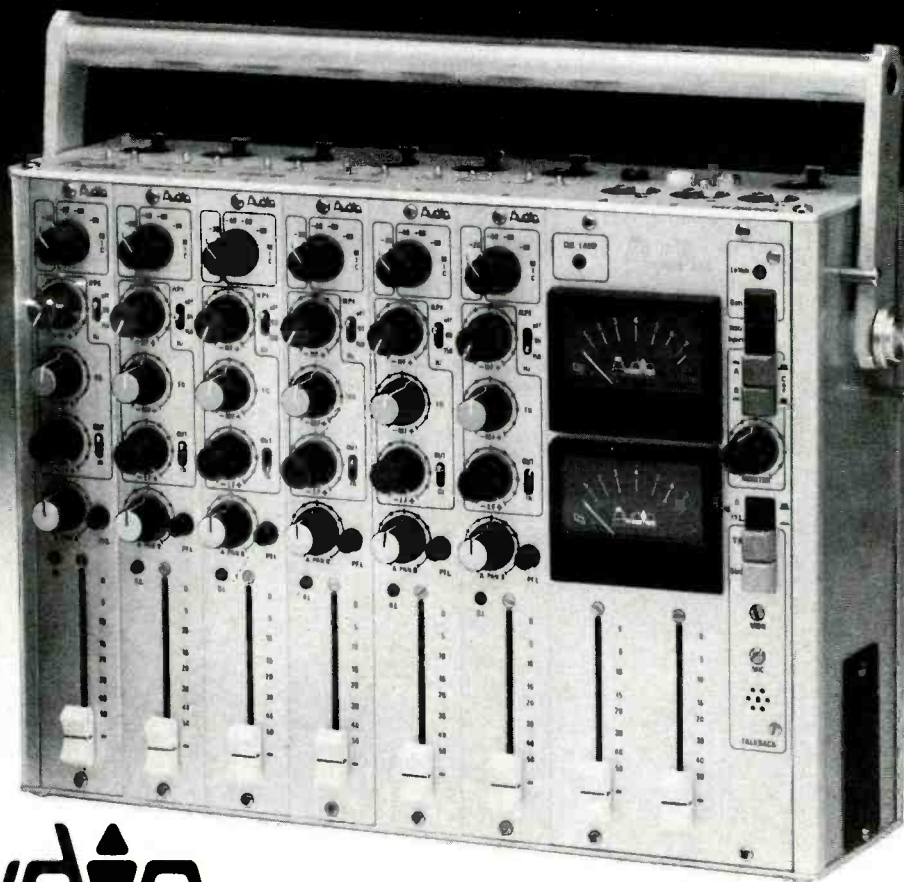
Back in the professional recording world, a major development was announced at the September 1972 New York AES, in the shape of the *M Series* multitrack noise reduction system. Using the A-type system, of course, this unit featured a rack-mounting frame about the same size as the old *A301* units had been, but holding up to 16 *cat 22* noise reduction cards and switching modules in the same space.

The year 1973 began with the shipping of Signetics *NE545* Dolby chips to licensees, and was followed by an agreement with Philips later in the year to use the system in their audio gear. Dolby FM broadcasting

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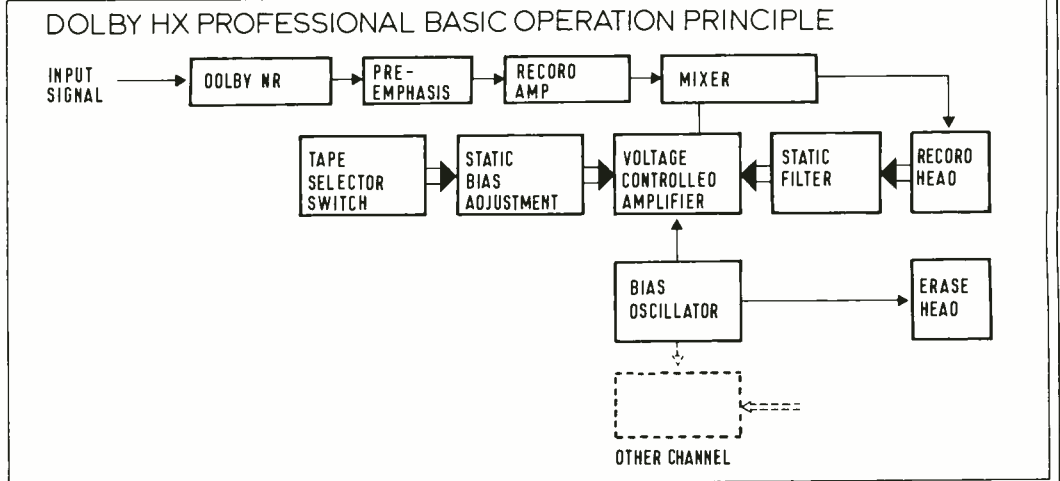
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Down at Dolby Labs

proposals were published in the AES Journal in June of that year, and this system, utilising 25 μ s pre-emphasis, was demonstrated to the FCC the following February. In September 1973, the E2 equaliser was introduced for cinema applications to complement the introduction of noise reduction in theatres.

The first Dolby-encoded movie (in mono) was *Callan*, which was shown at the Cannes Festival in May 1974, and in July that year EMI was commissioned to build a 35 mm stereo optical recorder by Dolby Laboratories. June 1974 saw the acceptance of Dolby FM proposals by the FCC, and the 334 FM broadcast unit was introduced in October, along with the 330 B-type encoder for pre-recorded tapes. November saw the demonstration of the Dolby 35 mm variable-area optical system at the SMPTE Convention in Toronto; this was followed in February 1975 by the release of the CP100 Cinema Processor for Dolby Stereo optical and magnetic soundtracks. The first unit was sold the following month for the London premiere of *Tommy*; Ken Russell's *Lisztomania* was the first feature film—released that September—to have a Dolby Stereo optical soundtrack for general release. By August there were 100 US radio stations using Dolby FM, and this was followed in October by the approval of Dolby FM by the Canadian Department of Communications.

A major development came in January 1976 with the closing of the New York office and a move to new headquarters in San Francisco, only a few months in advance of the 10th anniversary of the sale of those first units to Decca records. San Francisco took over head office administration, R&D, new market development, licensing and US sales, while the UK factory and offices continued to handle manufacturing and international sales. Permanent applications engineers were established in New York and Hollywood. A second 35 mm optical recorder was commissioned by RCA and Dolby Labs, this time in Hollywood. At the end of 1976 the CP50, a low-cost Optical Sound Processor for



Dolby Stereo was introduced.

An important year for Dolby was 1977, with the opening of *Star Wars* in 46 Dolby Stereo-equipped theatres in the USA. Eleven other Dolby Stereo movies were released that year, bringing the total to 30. Also in 1977, the Dolby Laboratories Licensing Corporation was set up to be responsible for all Dolby licensing activities.

The following year saw the release of *Superman*, the 50th Dolby movie. It opened in over 200 theatres simultaneously. The film was also used for the first experiments with 70 mm stereo/surround, a subject we have covered elsewhere in *Studio Sound*.

Apart from the introduction of Dolby-B-equipped VHS recorders and car cassette machines, 1979 saw the first 70 mm Dolby movie—*Apocalypse Now*—released. This was to become the third Dolby Stereo release in a row to win an Academy Award for 'best sound'. But Dolby was once again looking to other areas, and 1979 also saw the introduction of the HX 'Headroom Extension' system, which was not a noise reduction system as such at all...but more of that later. Also introduced was the first NR unit for video, the cat 155, which was designed for inclusion in 1 in *Type C* VTRs, in April 1980. Also in that year the CP200 cinema system was introduced, including Optical Bass Extension and format programming for larger theatres. Autumn saw the introduction of the domestic C-type system. The following year the first

chips offering B- and C-type were released. It was the most complex linear IC ever developed, with over 750 equivalent components. 1981 also saw the *SP Series* on the market for multitrack applications.

Dolby HX—a new departure

One of the most recent developments from Dolby is *HX Professional*, a development of the original *HX* system which was introduced in June 1979. Although the original circuitry came out of the inbuilt frequency-sensing capability of the Dolby-B system, *HX* itself has nothing, strictly, to do with noise reduction. Instead, it concerns itself with the bias level present during a recording. It is a fact that the presence of a signal affects the effective bias for the recording, although low frequencies have little effect compared with what occurs at the top end. Thus, if there is a large HF content in the signal being recorded, that high frequency information will contribute to the bias level—a phenomenon known as 'self-biasing'. Dolby *HX* took the fact that the Dolby-B processor acts at HF to extract a signal related to the top-end content to drive the noise reduction system. With this frequency-related voltage being present, it was moderately straightforward to use it to control the bias itself in an effort to keep the true bias level constant at the optimum throughout a recording, and also, in the original Dolby implementation

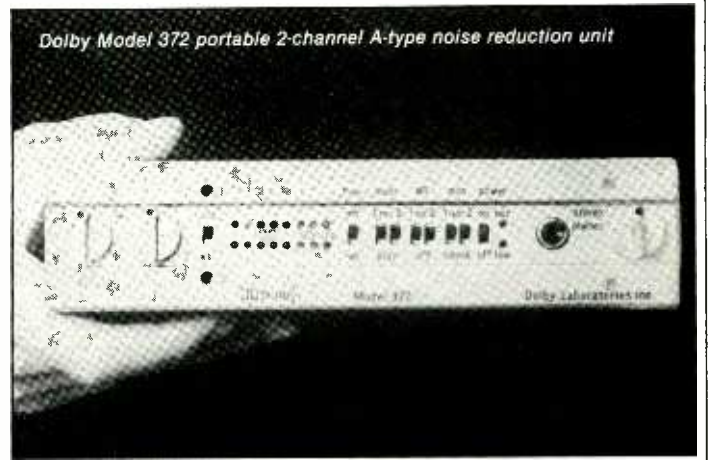
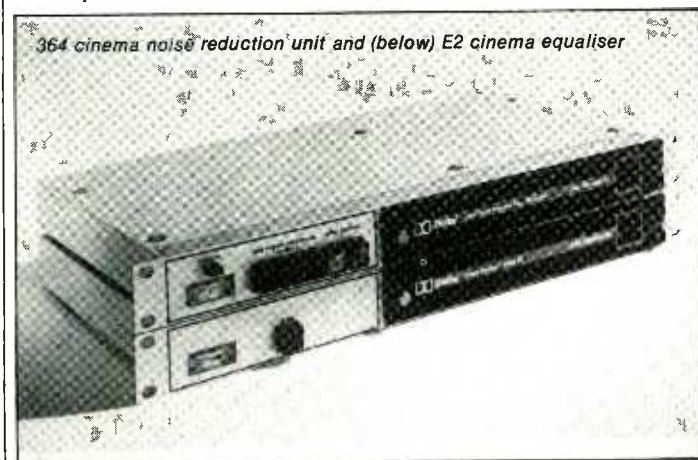
of the technique, it could be used to help to get the maximum possible amount of HF accuracy on tape.

But while Dolby were working on *HX*, Bang & Olufsen were experimenting with a similar technique, but one whose primary application was in maintaining a constant and correct level of bias. Dolby became involved in the finalisation of the system, which became known as *HX Pro*. The original idea sprang from the mind of J Selmer Jensen of B&O, and his work is explained in detail in his AES paper presented at the November 1981 New York Convention.

Dolby *HX* and *HX Pro* are similar in that both modify the amplitude of the bias oscillator signal, but the method as well as the application is different. Fig 1 shows the basic principles of *HX Pro*. Unlike standard *HX*, which measures the audio signal and calculates the required bias, *HX Pro* measures the sum of the audio signal, pre-emphasis, and the bias, at the tape head. The signal to the record head is simultaneously sent to a processor which is simply an accurate passive filter. The filter-modified signal is rectified, the resulting control voltage being an accurate representation of the total biasing effect of the signal and the static bias level. The filter's characteristics are dependent only on the record head and its related record circuitry.

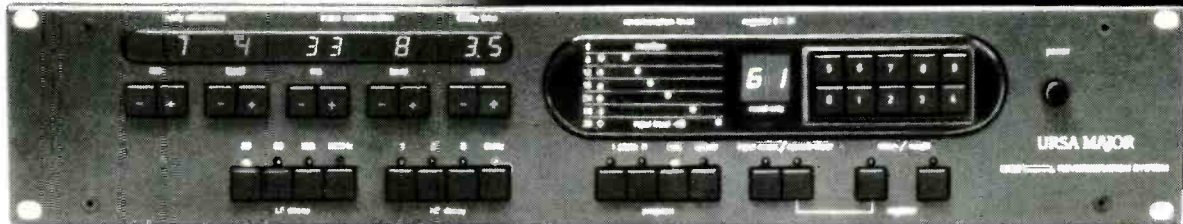
Measuring the signal at the record head has the advantage that it always represents the actual flux

86 ▶



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Down at Dolby Labs

level across the head-gap, including any processing that may have occurred (eg Dolby-B and pre-emphasis) along the way, and it takes into account the static bias level from the oscillator set for the tape being used.

The control voltage is compared to a reference voltage which can be adjusted for the static bias required by the tape in use, and a 'correction' voltage is generated. This is fed to a VCA which is thus adjusted to alter the bias signal from the oscillator to the tape to maintain a constant active bias for the signal being recorded. Obviously, the effective result is that the bias oscillator level is adjusted so that a lower level of static bias is produced in the presence of a higher level of HF content in the signal. As the optimum bias is maintained as closely as possible at all times, the result is that better HF headroom is achieved before tape saturation or other forms of overload take place.

As there may well be differences in HF level (and thus self-biasing and 'mutual biasing') between the two channels of a stereo signal, the two channels of *HX Pro* operate separately so as to achieve optimum bias on both channels independently.

Other new developments

Another field that has been occupying Dolby engineers in San Francisco for the last few years (so much so that they have not yet had the time to write an article on the subject for us!) is that of digital audio. As with much of Dolby's work, they have chosen a different approach to the 'conventional' linear PCM system used for recording purposes. They have experimented with the idea of Delta Modulation—the same concept as that on which the dbx 700 Series digital audio processor is based, a subject which was covered in depth in the February 1983 issue of *Studio Sound*. They have however taken this different approach to the application of the DM technique—quite simply because they are looking at the satellite communication market (amongst others) rather than the professional recording field. Satellite audio transmission and reception has a number of widely differing criteria and limitations to the studio environment, and this has necessitated a different way of utilising Delta Modulation for optimum results. Consequently it seems that the two systems will not be in competition with each other—at least, not immediately or directly. K J Gundry, D P Robinson and C C Todd of Dolby Labs presented a paper containing the principles of the system in their AES paper (preprint number 1956) at the 73rd Convention held in March 1983 at Eindhoven. We also hope to be publishing an article specifically

about this system in a future issue.

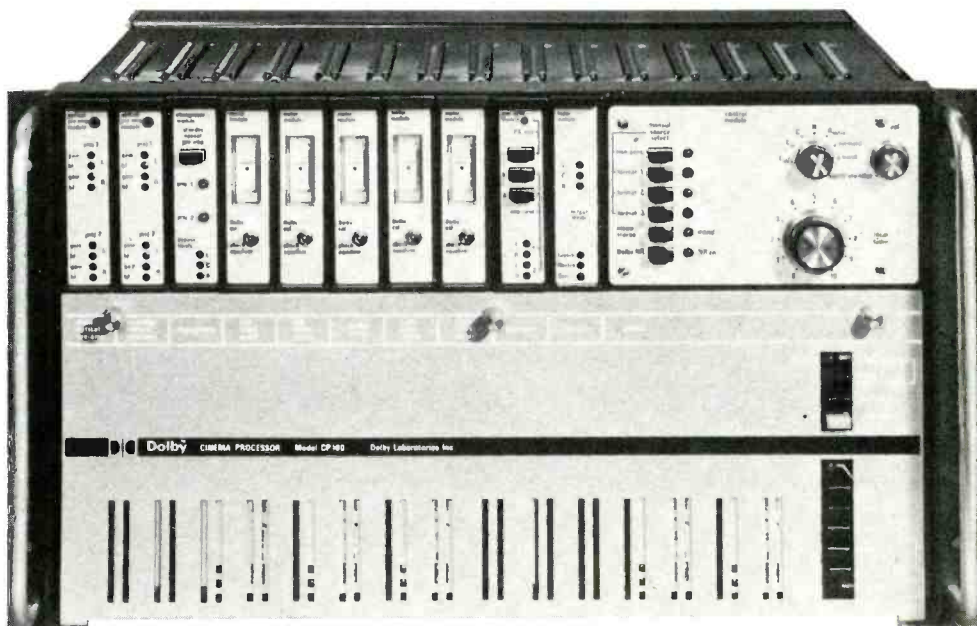
Another important front for Dolby's noise reduction activities is the video field, which has assumed a greater importance as time has gone by. It has been suggested that one of Ray Dolby's original intentions was to produce a system for reducing video noise levels, but this idea has not yet seen the light of day, no doubt because of the increasing use of digital techniques in the video field—it may no longer be so necessary. On the video sound front, however, Dolby have put a good deal of work into NR systems for video cameras and recording systems. Based around the *cat 55* A-type NR module, there are now several cards for common VTRs, including the 226 for the Ampex

VPR-2 and the 221B for the Sony *BVH 1000/1100*, plus the 234 for the Sony *BVH 2000*. All three of these modules directly replace audio cards in the recorders, handling both the original functions of the card and the noise reduction. These are only a few of the VTRs which can currently be fitted with Dolby cards for better audio quality.

On the film front once again, there has been a great deal of interest generated by the consumer-oriented decoders available in the USA to decode surround information on home videotapes where the original utilised the Dolby surround system. This topic, and sources for the decoders, were discussed in our overview of surround-sound published in the February issue.

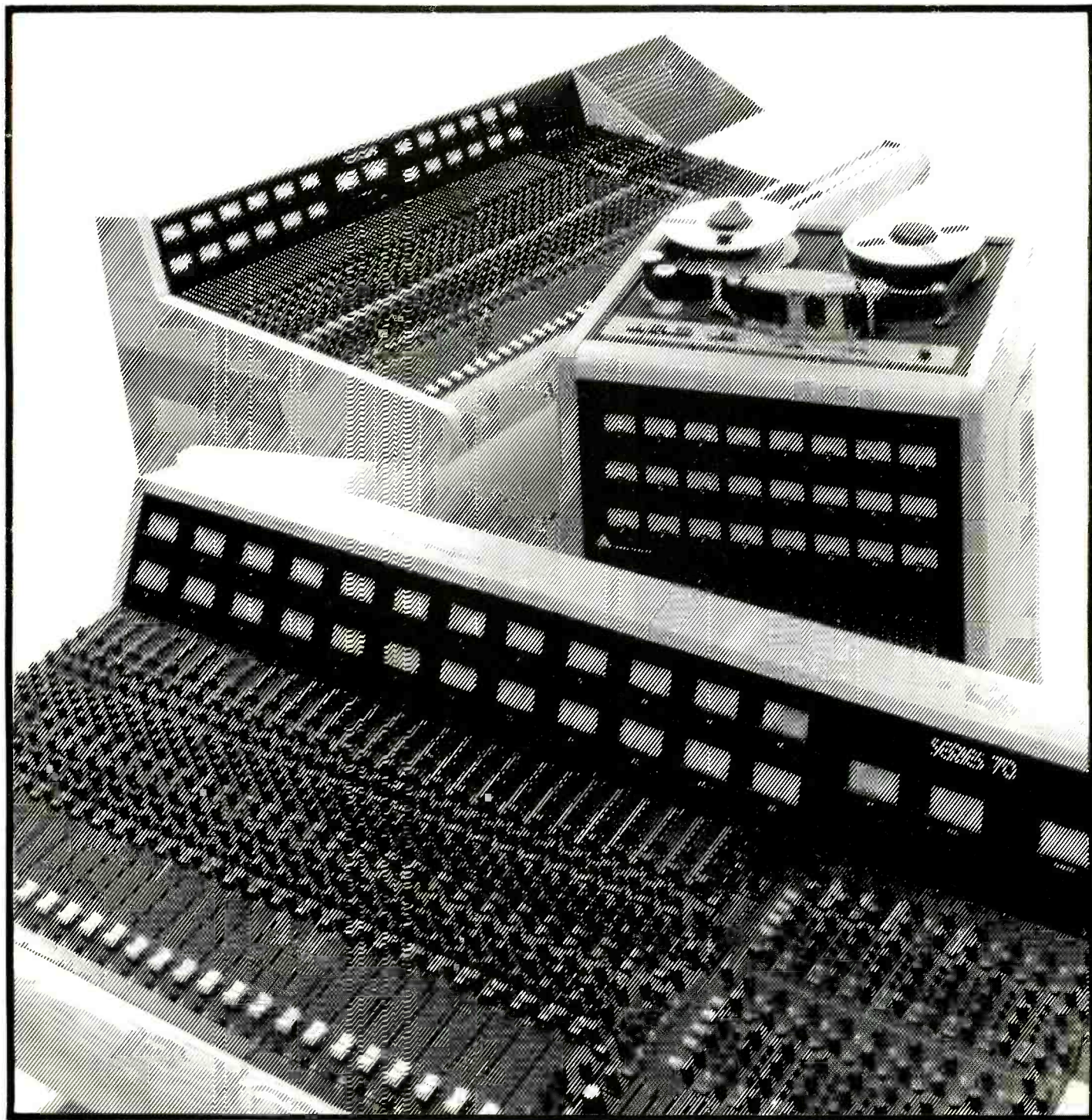
Dolby Laboratories will be 20 years old next year, 20 years which have seen dramatic improvements in the quality of recorded sound. Dolby have had a great deal to do with those improvements, despite a few confusions which have arisen from time to time, for example the original suggestions on Dolby level versus recorded level, which were soon sorted out. In today's entertainment fields, where high quality audio is more than ever necessary, video people have discovered that good sound really is important, and digital techniques have greater application almost every day, Dolby quite obviously have an important part to play both today and in the future of top quality audio. ■

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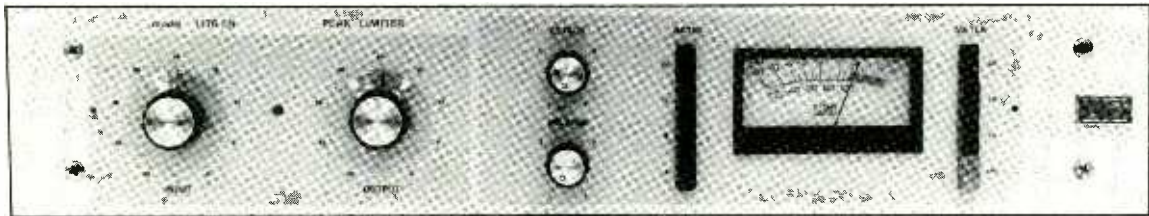
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UREI 1176LN peak limiter

Hugh Ford



Hugh Ford reviewed the UREI 1178 limiter, a stereo version of the 1176, in *Studio Sound* March 1981. Although the review was fairly complimentary, a number of points were made with regard to improving performance and the manufacturer stated that modifications would be made to future models. As the 1176 is still a popular unit, we decided to look at a current model of this limiter.

MANUFACTURER'S SPECIFICATION

Input: balanced bridging, differential amplifier.
Input impedance: 20 k Ω , used as balanced input; 10 k Ω , used as unbalanced (single-ended) input.
Maximum input level: +20 dB maximum (ref 0.775 V RMS).
Maximum gain: 45 dB, ± 1 dB.
Frequency response: ± 1 dB, 20 Hz to 20 kHz.
Output: floating, transformer isolated.
Output load: 150 Ω or greater.
Maximum output level: +24 dBm into 600 Ω load (12.28V).
Distortion: less than 0.5% total harmonic distortion, 50 Hz to 15 kHz with limiting, at 1.1 s release setting (as with all limiting devices, distortion of low frequency peaks increases with faster release time).
Signal to noise ratio: greater than 81 dB at threshold of limiting, 30 Hz to 15 kHz.
Attack time: less than 20 μ s for 100% recovery, adjustable to 800 μ s with front panel control.
Release time: 50 ms minimum, 1.1 s maximum (for 63% recovery). Adjustable with front panel control.

Threshold vs output level:

Compression ratio setting	Input level at minimum limiting threshold ± 2 dB	Relative output at threshold*
20:1	-24 dB	+10 dBm
12:1	-25 dB	+9 dBm
8:1	-26 dB	+8 dBm
4:1	-30 dB	+7 dBm

* with output gain control set to provide a reserve of approximately 10 dB.

Power requirements: 100 to 125 V AC, or 200 to 250 V AC, 50/60 Hz, switch selectable, less than 10 W.

Environment: operating, 0°C to +50°C; storage, -20°C to +60°C.

Input and output level: continuously adjustable.

Attack time: continuously adjustable, 20 μ s to 800 μ s (fastest attack is in the maximum clockwise (CW) position).

Limiting ON/OFF: this switch is coupled with the attack time control. In the full counterclockwise position (CCW) the limiting function is disabled.

Release: continuously adjustable from 50 ms to 1.1 s (fastest release is obtained in the maximum CW position).

Compression ratio: switch selectable with four interlocking pushbuttons.

Meter function: three interlocked pushbuttons switch the limiter on and switch the meter to read either the amount of gain reduction or the output signal level referenced to +4 dBm or +8 dBm. The fourth pushbutton switches the AC power off.

Gain reduction '0' adjust: screwdriver adjustment accessible through a hole in the front panel (between the input and output level controls).

Power switch: any of the meter function buttons switch the 1176LN on. The device is switched off by depressing the red power switch button.

Connections: rear chassis barrier strip for input and output; power through 3 wire IEC-style connector.

Stereo interconnection: phono jack at rear of chassis; requires 1176SA stereo adapter to couple two limiters.

Dimensions: 483 x 89 mm rack panel, depth behind panel 203 mm (19 x 3 1/2 x 8 in).
Finish: panel is 3.18 mm (1/8 in) brushed clear anodised aluminium in two shades, chassis is cadmium plated steel.
Weight: 5 kg (11 lb).
Shipping weight: 6.6 kg (14.5 lb).
Accessories: model 1176SA stereo adapter, model 301XLR/QG adapter for signal input and output, model SC-2 security cover.
Manufacturer: United Recording Electronics Industries, 8460 San Fernando Road, Sun Valley, CA 91352, USA.
UK: FWO Bauch Limited, 49 Theobald Street, Boreham Wood, Herts. WD6 4RZ.

THE UREI model 1176LN is a single-channel peak limiter particularly intended for disc cutting and broadcast applications but equally at home in the studio. Accessories allow the limiters to be ganged for stereo operation. Designed for 19 in rack mounting the brushed aluminium front panel is equipped with suitable holes, the limiter being two rack units in height. Only straightforward functions are provided, resulting in an uncluttered front panel to the left of which large knobs with somewhat arbitrarily calibrated dials function as input and output gain controls.

There follow two further potentiometers which control the attack and release times over a wide range, the former potentiometer having a switch which turns the limiter off in the fully anticlockwise position.

To the right of the panel either side of an illuminated VU meter are vertical rows of four

interlocking pushbutton switches. One set allows the compression ratio to be selected from 4:1, 8:1, 12:1 or 20:1 with the second set of switches allowing 0 VU to be set to +4 dBm or +8 dBm, indicating gain reduction on the VU meter and switching the power off.

At the rear the audio input and output are on a barrier strip with a single ground connection. A special optional adaptor is available to convert the unit for XLR connectors. A phono socket provides a gain control output for linking units in stereo via an adaptor with the mains input being an IEC connector with the 115/230 V selector and imperial size fuse nearby.

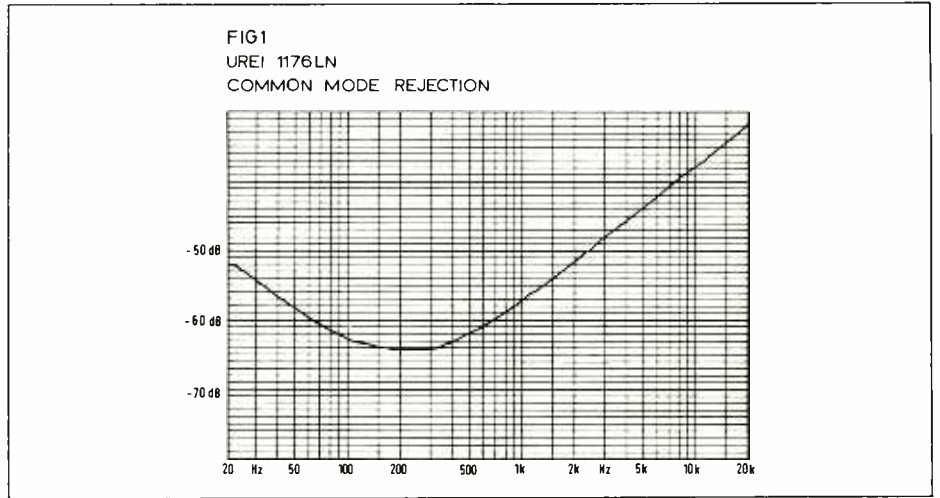
Within the unit all parts except the power transformer and the front and rear panel features are on a single good quality printed circuit board with clear component identifications. The integrated circuits are socketed as are some transistors, the instruction manual including good servicing information in addition to circuits and operational information.

Inputs and outputs

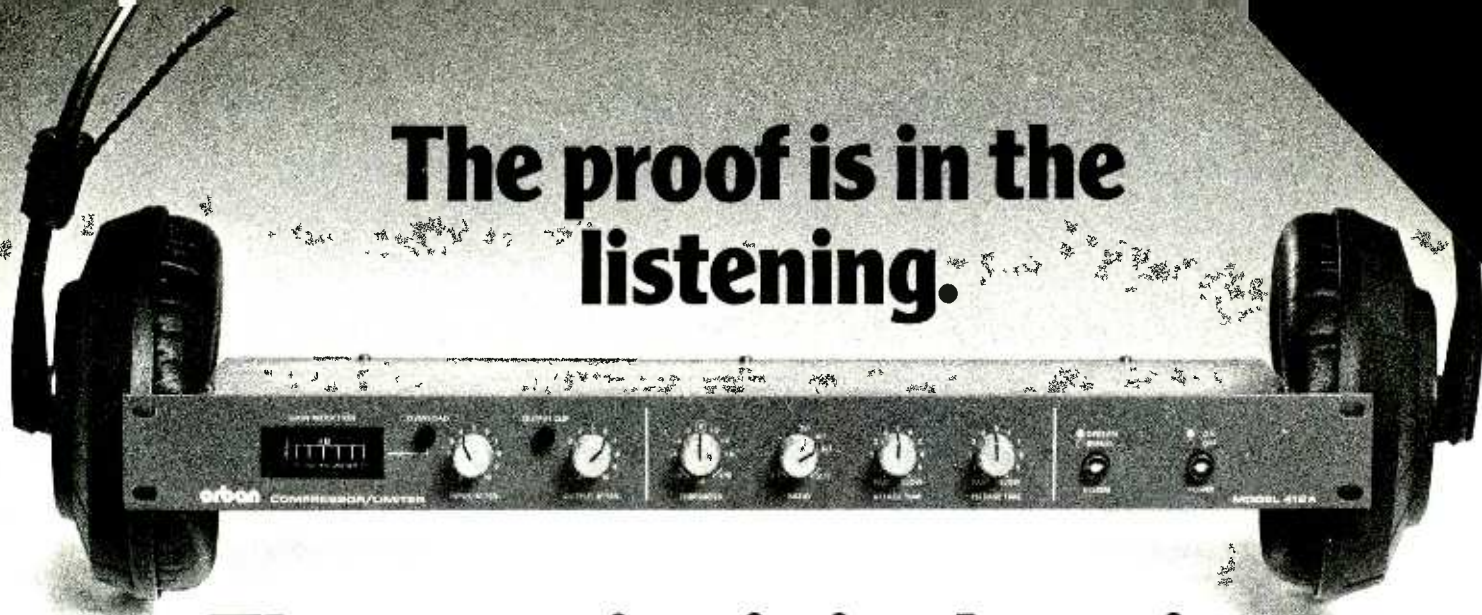
The electronically balanced audio input had an impedance of 20 k Ω when operating balanced or 10 k Ω single ended, both constant with control settings. Input clipping occurred at +22 dBm input irrespective of the input gain setting with the common mode rejection as shown in Fig 1.

Maximum gain to the floating transformer coupled output was 46.5 dB with the output

90 ▶



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Performance Highlights

- Streamlined, straightforward front panel offers the most-demanded user controls, including ATTACK TIME, RELEASE TIME, RATIO, and THRESHOLD. These wide range controls permit extremely natural sound or special effects.
- Exclusive Orban feedback control circuitry (adapted from our popular 424A Gated Compressor/Limiter/De-Esser) achieves remarkably transparent sound.
- User controls interact intelligently to simplify and speed setup, and to prevent errors.
- Peak limiting and compressor functions are crosscoupled to eliminate potential pumping and modulation effects.
- THRESHOLD control with 20dB range allows user to determine the level at which gain reduction first occurs, without changing below-threshold gain. Ideal for sound reinforcement applications.
- Proprietary circuitry achieves optimum headroom and signal-to-noise regardless of THRESHOLD control setting.
- Front-panel OUTPUT ATTENUATOR control with OUTPUT CLIP LED to indicate line amplifier clipping.
- Illuminated, true peak-reading GAIN REDUCTION meter is more accurate and readable than LED displays.
- GAIN REDUCTION OVERLOAD lamp warns of control circuit overload due to a demand for G/R which exceeds the range of the VCA.
- Hard-wired system bypass switch for fail-safe protection.
- Side-chain externally accessible for special effects such as frequency-selective limiting.
- Active-balanced, floating input and output interfaces easily to any system, balanced or unbalanced.
- Proprietary Class-A Orban VCA features very low distortion and noise.
- Stereo 414A has STEREO COUPLING switch to permit either stereo or dual-mono operation; an unlimited number of units can be wire-coupled to track $\pm 0.5\text{dB}$.
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—a bit old fashioned!

At the onset of clipping the output voltage was +24 dBm loaded into 600 Ω or +24.5 dB.7V into a high impedance with the maximum output when limiting being +20 dBm—these being fully variable by means of the output level control.

Frequency response

Fig 2 shows the overall frequency response with the gain reduction switched out and with 10 dB gain reduction in action. In both cases the response is adequately flat within the audio frequency band. The increase in high frequency response when limiting is not thought significant, no RFI problems being noted.

Noise

With the onset of limiting set to 0 dBm output the noise in the output was measured with 0 dB and 10 dB gain reduction and the results are shown in Table 1. These results imply that little noise breathing is possible under any conditions and no other unwanted noise was found in the output.

Distortion

Both individual harmonic distortion and intermodulation distortion to the CCIF twin tone method were measured at unity gain at +10 dBm output with no compression in action. The harmonic distortion shown in Fig 3 was quite good and fell at lower levels as did the intermodulation distortion shown in Fig 4. The third order component (F2 + (F2 - F1)) and its lower frequency counterpart were however on the high side.

Under gain reduction conditions with the unit set for +10 dBm output and 10 dB gain reduction at maximum release and attack times the harmonic distortion shown in Fig 5 varied very little if the gain reduction, compression ratio or input/output levels were altered.

The CCIF twin tone intermodulation distortion shown in Fig 6 exhibited similar characteristics. It should however be noted that the higher frequencies in Fig 6 are *not* realistic conditions because above 20 kHz the amount of compression reduced with a consequent significant increase in output level.

Compression conditions

The static input/output characteristics under compression conditions for the four different ratios are shown in Fig 7 to follow the specified ratios with a fairly slow entrance into compression conditions.

The attack and release times appeared to be independent of the compression ratio or the amount of compression with the shortest attack time for completing full compression being less than 2 μs which is fine for protecting broadcast transmitters. The mid point control setting was 1 ms with the maximum attack time being 2 ms which is perhaps on the short side for some applications. Release times ranged from 175 ms to 4 s with a mid control time of 2.5 s—a sensible range here. Both the attack and the release were exponential with no unpleasant results provided sensible control settings were used.

Other matters

Whilst the VU meter had the correct rectifier characteristic the rise time was too slow with the indicator showing -0.5 dB on a 300 ms tone-burst which could overshoot the 0 VU mark. Also the fall time was a little slow needing 500 ms to fall from 0 VU to rest. 92 ►

FIG 2
UREI 1176 LN
FREQUENCY RESPONSE

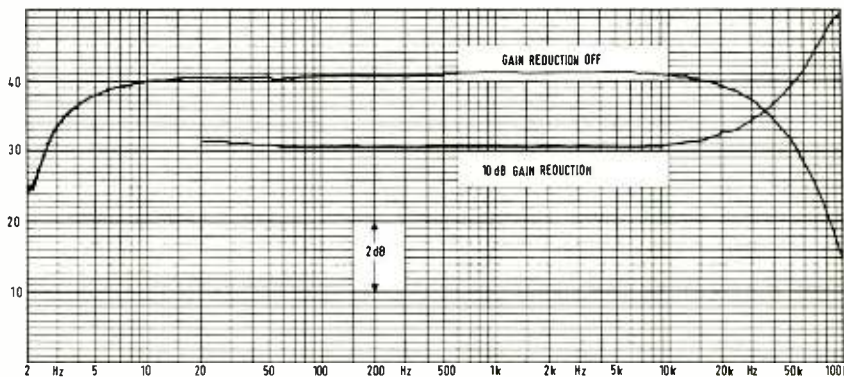


FIG 3
UREI 1176 LN
HARMONIC DISTORTION

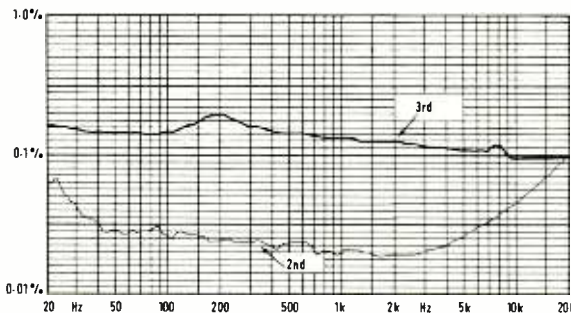
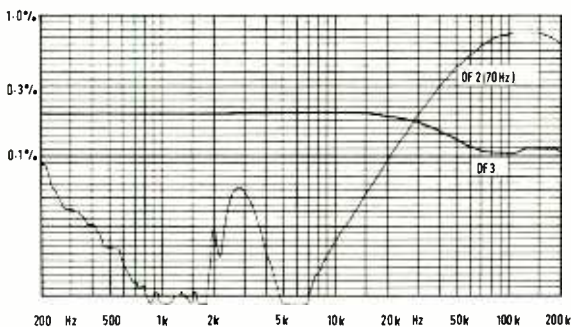


FIG 4
UREI 1176 LN
IM DISTORTION



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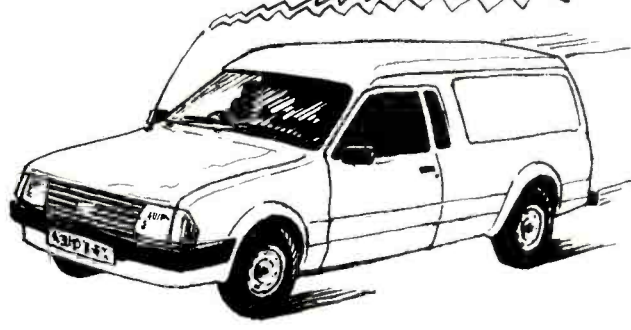
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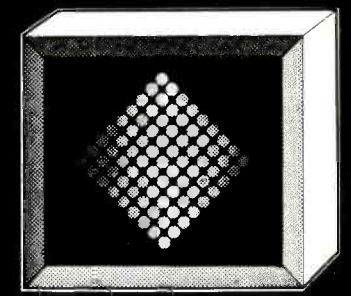
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reviews

Summary

This is a very well made unit with comprehensive operating and service information. Providing basic compression/limiting functions only the

unit is easy to operate with the minimum of clearly identified controls. Intended mainly for broadcast and disc cutting this UREI unit fits the bill. ■

TABLE 1	Measurement method	0 dB GR	10 dB GR
	22 Hz to 22 kHz RMS	-78.7 dBm	-83.0 dBm
	A-weighted RMS	-81.6 dBm	-88.3 dBm
	CCIR-weighted RMS	-73.0 dBm	-78.0 dBm
	CCIR-weighted quasi peak	-69.5 dBm	-74.0 dBm
	CCIR-weighted ARM ref 2 kHz	-80.0 dBm	-86.0 dBm

FIG 5
UREI 1176 LN
HARMONIC DISTORTION WITH
GAIN REDUCTION SET

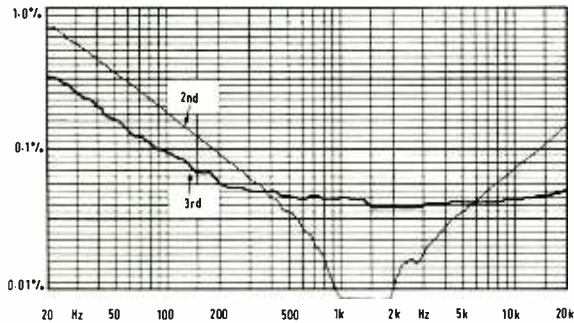


FIG 6
UREI 1176 LN
CCIF TWIN TONE IM DISTORTION

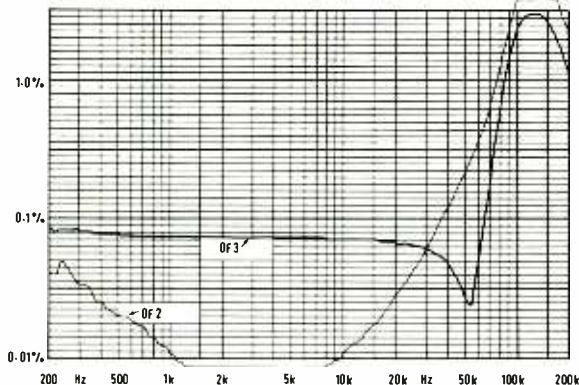
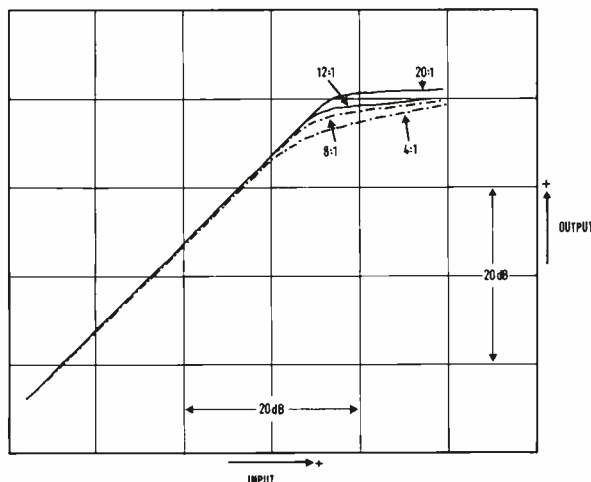


FIG 7
UREI 1176 LN
INPUT/OUTPUT CHARACTERISTICS



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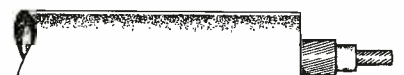
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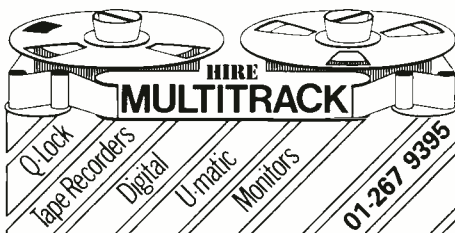
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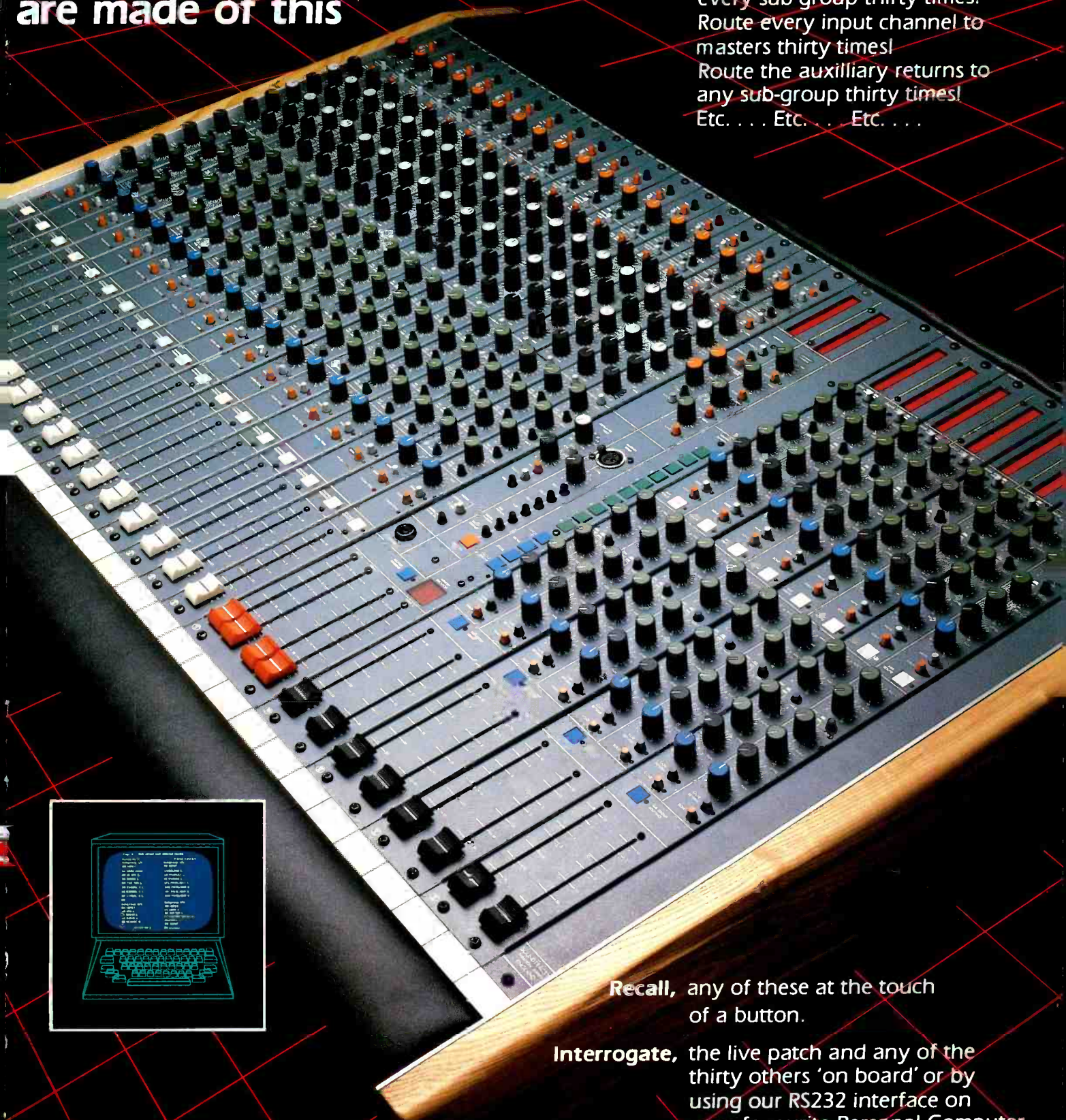
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