April 1992 $5.00 £2.00

STUDIO SOUND

AND BROADCAST ENGINEERING

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COMPRESSORS & LIMITERS

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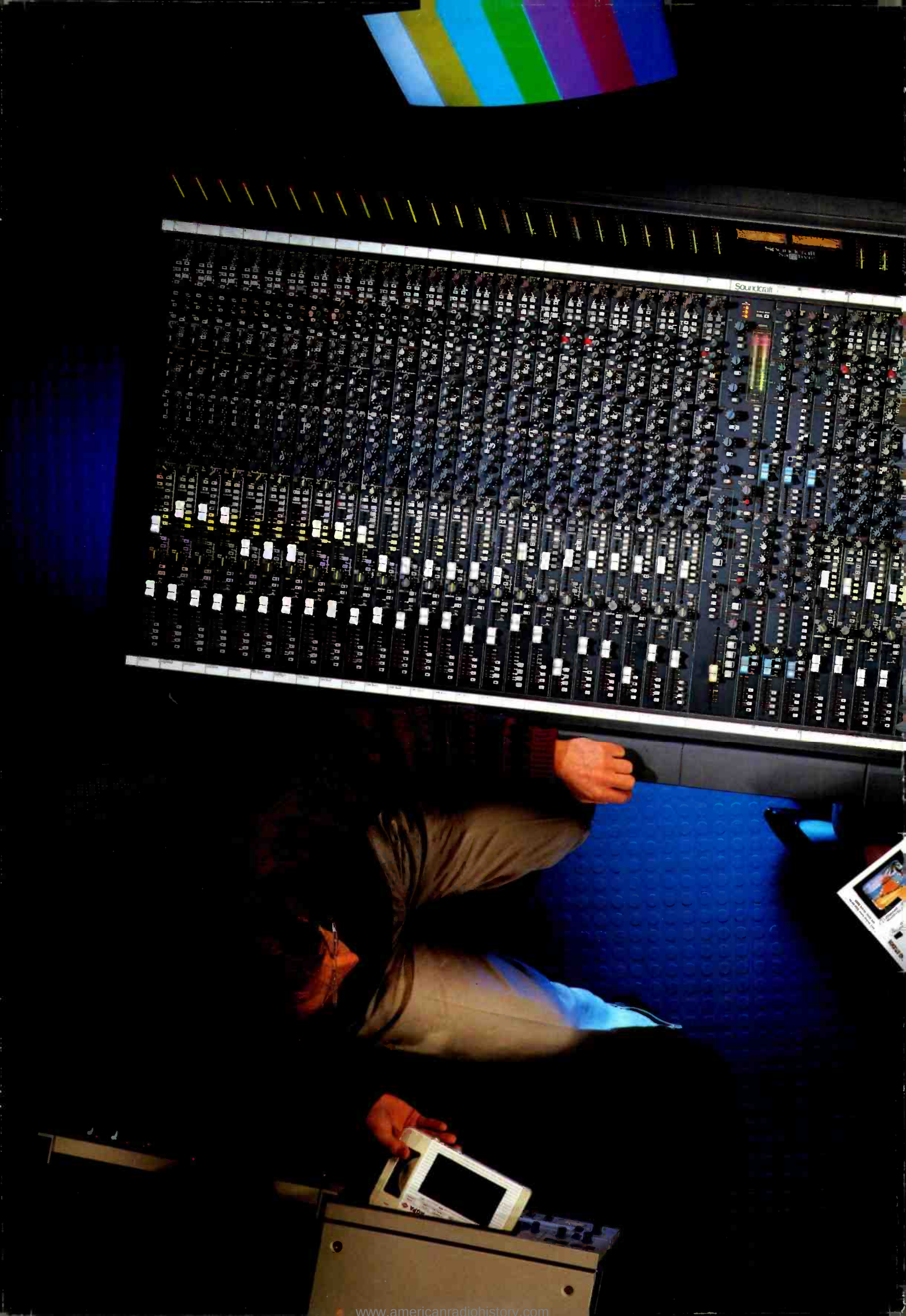

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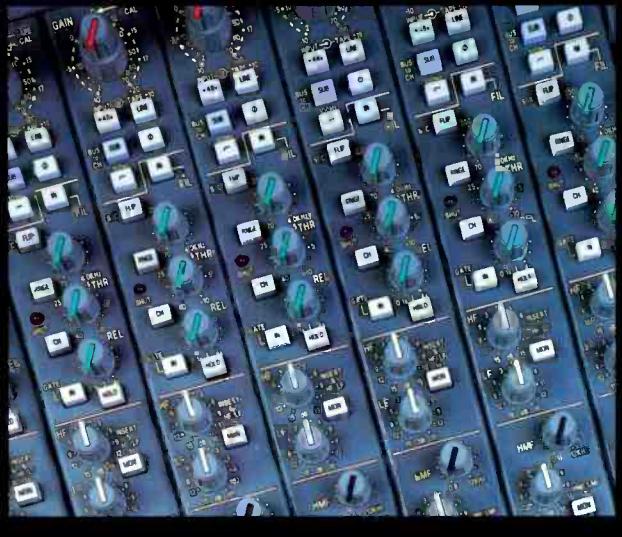

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STUDIO SOUND

Italy: the grand tour — see page 37

STUDIO SOUND
AND BROADCAST ENGINEERING

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The First factor

Do you remember the story of the eminent nuclear physicist who was convinced he had discovered how to create nuclear fission from a test tube of heavy water, only to have a class of sixth form schoolboys replicate and disprove the experiment in their classroom a couple of weeks later. His desire to be first with a historic discovery had possibly blinded him to simple truths that if he had stopped thinking about the glory for a moment, he might have seen for himself.

Neve's DSP series was first with a large format all-digital console back in 1981. They unveiled their prototype after finding the allure of a new technology, digital signal processing, too much to resist and bravely heralded a digital epoch. Of course their trial console had been used and evaluated by over 300 professional operators through development, so nobody could accuse Neve of glory-induced blindness with such a high level of outside industry contact.

The First factor is the need for manufacturers to get product into the marketplace before the competition and so reap the rewards commercially. This need for speed can develop into a race and we all have seen and heard many examples of new products that simply weren't ready.

But if manufacturing is the race, the starting gun has to be the customer. Back in the early eighties compact disc technology was the next big thing and studios were keen on the digital-chain from desk to disc. Now the need is for cheaper and more reliable digital-chains. The more important chain is perhaps from R&D to marketing department to studio owner, if all three are speaking the same language then the finished product should resemble the blueprint, but when the First factor starts quickening the heart beat, things begin getting a little blurred.

To the winner of the race supposedly the spoils and what spoils they can be. A certain recording studio owner in California has a well planned philosophy of investing in the latest thing as he knows that the promise of the best equipment first will bring in customers. He has been proved right and consistently attracts pedigree artists. That kind of decisiveness instills confidence.

The timing of product release as far as I can see relies on what type of company you are. A small company might get their product on to the market 80% ready and rely on the hype to get them through the remaining 20%. A larger company would look more to protecting their reputation and only releasing product 100% ready. But there's more to it than that. When Dolby released their digital cinema soundtrack product *SR-D*, they came clean and admitted it was still under development but they thought people ought to know more about it for the future. Of course their major competitor *CDS* had already been released hence Dolby's hand was forced to a degree. In the multimedia market you have Commodore, who released their CDTV format last year and Philips who are now in the process of marketing CD-I. Was Commodore right in presenting CDTV to an unsuspecting public? If rumours of a UK player base of less than 8,000 can be believed, perhaps not. But then you've got to start somewhere!

Back in 1983 Neve said that the DSP was competitively priced with large custom-designed analogue consoles demanded from studio at the time. In 1992 they say that *Capricorn*, their new and long-awaited digital desk, is also price-comparable with high-end analogue desks namely their own *V* Series. They also say that *Capricorn* is a 'Bomb-proof' design, meaning that its here to stay and isn't likely to be redesigned one year on. I hope and believe they're right and the fact that a certain Californian recording studio owner is coming to the UK for the launch might be a good pointer. ■

Julian Mitchell

Cover: Neve's new digital desk, *Capricorn*

AVALON SERIES

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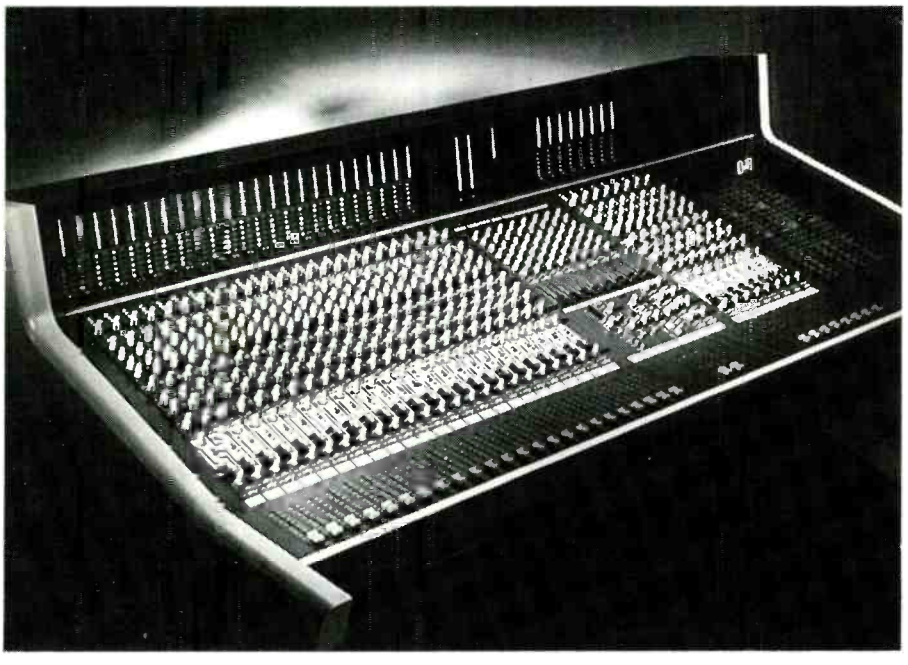

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EVERY SOUND UNDER CONTROL.

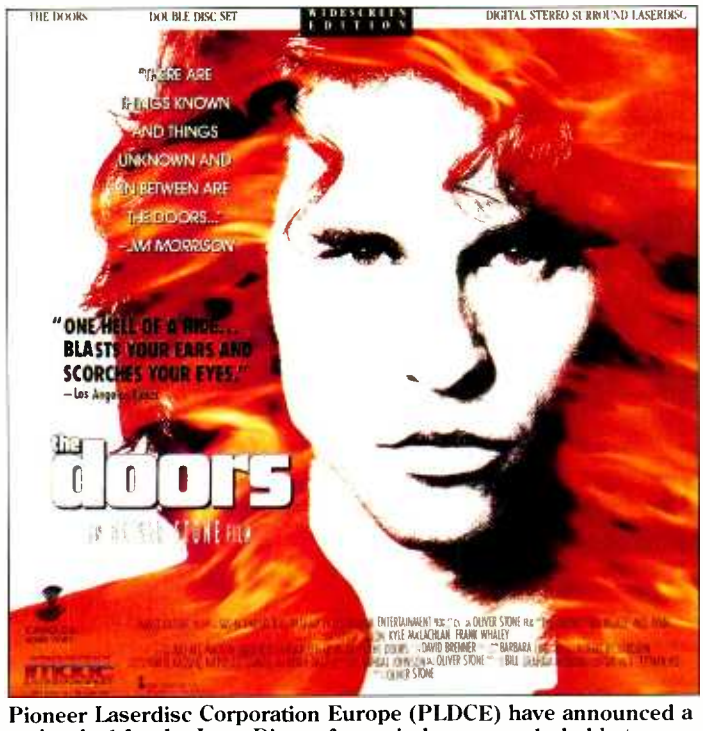
Debuts for Captain Ahab

Cadac have unveiled their new live console series for a new musical Moby Dick, which opened at the Piccadilly Theatre in March.

A 59-channel *J-Type* is being used by sound system designer Martin Levan. The desk was completed and installed just six weeks from the initial order, with Cadac quoting a typical turnaround of eight to ten weeks.

Moby Dick also features the second largest Sennheiser radio microphone system to be used in a West End production (the largest being used on Joseph and the Amazing Technicolor Dreamcoat) and the first ever system in the country to include units on the Channel 69 UHF frequencies.

A Yamaha *YPDR601* CD Recorder is also being used for its first stage role on Moby Dick for sound effects cued off the Events processor on the CADAC console.



Pioneer Laserdisc Corporation Europe (PLDCE) have announced a major deal for the LaserDisc software industry concluded between themselves and Guild Entertainment, a leading UK distributor. The package totals over 140 films with releases starting in May. First films out, for the reputed 8,000 UK player-base, include The Doors, Total Recall, and the full version of Dances With Wolves.

AMS dismiss networking for new BBC studio

AMS have developed a range of products based on existing *AudioFile PLUS* editor and *Logic* series mixers which they say will enable users to build an integrated post-production system tailored to their specific needs without the need for networking. Removable, reuseable magneto-optical discs will be at the heart of these systems.

AMS has been developing a system for the BBC's new 'tapeless' post-production studio due to open in July.

The BBC needed an autoconforming stage for which AMS is supplying a four output *AudioFile PLUS* which will record onto removable optical disks under the control of the video edit system during an autoconform on-line edit.

The disk will then be taken into a second area for fine editing and additional track laying using a 24-output *AudioFile* linked to a *Logic* mixer. The mixer will generate automation data for fine tuning during the final mix.

The resulting disks will go to a dubbing theatre where a 24-output *AudioFile* coupled to a *Logic 2* mixer will be used to complete the final mix. AMS is also supplying high speed Exabyte back up for long term archiving.

Sony's proprietary 20-bit techniques

All CD music releases on the Sony Classical label are now using a highly-modified Sony *PCM-3304* recorder with 20-bit A/D converters.

Sony Classical's VP of audio operations Christian Constantinov commented on the development 'We have developed a proprietary 20-bit recording process, that allows us to extract the fullest amount of sonic information from a classical session — up to 16 times more data than that generated by a conventional 16-bit recording system.

'After editing, these tapes pass through our proprietary SuperBit Mapping processor — a custom-built, high speed computer that accurately truncates and re-dithers the 20-bit signals to 16-bit for CD.'

This DASH-X format in fact allows 24-bit recording onto ¼in digital tape, comprising 20 data plus four auxiliary bits. There are several custom-designed DASH-X machines in the US and Germany but no other decks are available for use on non-Sony Classical sessions.

DTI get vocal

'At the moment if you're a band using radio mics you're more than likely to be illegal' say the DTI's Radio Investigation Service.

Under pressure from manufacturers who have followed regulatory standards, the DTI is about to clamp down on the widespread use of non-approved equipment, still being sold in music stores.

Penalties are the same as those for running a pirate radio station; up to two years imprisionment and/or an unlimited fine.

Agencies

● Meridien Communications Industries Ltd has been awarded the sole UK distribution for Barco-EMT studio products. Meridien Communications Industries Ltd, 33 Greenwich Market, London. SE10 9HZ. Tel: 081 293 0909 Fax: 081 293 5856

● Sennheiser UK have been appointed UK distributor for Soundlab GmbH microphones products, as featured in *Studio Sound* last month. Sennheiser UK, B2 Knaves Beech Business Centre. Loudwater, High Wycombe, Bucks. HP10 9QY. Tel: 0628 850811 Fax: 0628 850958.

Contracts

▲ Mingles Music, one of the UK's leading jingle houses have recently bought a Sony *MXD3000* mixing console and an *APR24* multitrack recorder for their studio

● Cinearte, one of Spain's leading audio post-production facilties have bought a Mitsubishi *X-880* 32-channel digital recorder. As have IRA Studio a new Italian studio in Florence.

● Multivision, Needham, MA, a video production company has bought two Yamaha *DMC1000* digital mixing consoles

● Madrid based broadcast communications group Retevision has bought two Sony *PCM-3324A* 24-channel recorders as part of their production studio at Spain's Expo '92 festival in Seville.

● Neve Electronics have installed the first *VR Legend* console at Touchdown Studios near Munich, Germany.

● UK distributor SSE marketing have delivered the first Schoeps *Sphere* microphone into a non-classical facility, Battery Studios in London.

FRANKFURT MUSIC SHOW

To say that the Frankfurt Messe is large is an understatement; imagine taking the equivalent of 24 aircraft hangars and stringing them together — that's the Messe! For the Music Show, only five of these are used (the Beer Keller probably uses more) of which one is for pianos and pipe organs. Having missed my flight across, courtesy of British Rail, the remaining four halls had to be covered in two days. Yours faithfully with sore feet . . .

Top to Bottom: Akai's Digital Signal Patchbay; Sampling Frequency Convertor and Digital Offset Editor for A-DAM

Consoles

Frankfurt is not the show where consoles usually appear, especially with the Vienna AES Show so close, but some new additions were shown. For studios, **D&R** of Holland introduced the *Orion* console, a 8 bus desk with a floating sub-group system and 4-band variable sweep EQ, and the *Portamix*, a high quality four input, two output portable unit for the film and video industry. Sound reinforcement had offerings from **Soundcraft** in the form of the *Venue II*, a 16/24/32/40 channel desk with eight groups and optional muting; cost range is from about £4,500/$7.650 to £11,000/$18,700 approx. with Mute and Group modules as optional extra. **Amek** showed the *SR6000* Foldback, a 40 input, 18 output desk with 18 auxiliary sends and 4-band EQ throughout.

Soundcraft also previewed the *Spirit Auto* which is the *Spirit Studio* with automation for fader positions and mute status with software designed by Steinberg. No price available at present.

Processors

LA Audio launched the *Classic* Compressor (£795/$1,352 approx.) with variable parameters for Attack and Release times and the ability to be run in stereo or 2 x mono while **Aphex** added a Parametric Equaliser module (*9901*) to their *9000* series. **Crystal** were showing the *Phasematic*, an interesting psycho-acoustic processor which upwardly expands the higher frequencies of a signal to enhance the stereo depth and spatial range. The front panel has a 'phase-meter' to show the phase differential of the two channels.

RSP Technologies added three units to their range; the *Intelliverb* (£1,030/$1,741 approx.), a 24-bit DSP, the four-channel *Studio Gate* (£354/$599 approx.), and the *Studio Q* (£293/$599 approx.) , a four-band parametric equaliser. **Digitech** added the *TS 22* True Stereo Processor to the other units introduced at the NAMM Show; users can write their own algorithms using various effects 'blocks' and up to 2.7 s of stereo sampling is available as an optional extra. No price at the moment. **tc Electronics** introduced the *M5000* Digital Audio Mainframe (£2,500/$4,225 approx.) with digital and optical interfaces as standard, 24-bit processing, SMPTE time code input and an optional 3.5 in HD disk drive, LAN port and SCSI interface. Finally, **Sabine** have a new feedback control device called the *FBX-900* Feedback Exterminator. This has nine narrow band, independent notch filters each of which can either come into use and stay locked to a particular frequency, or be dynamically allocated for use until feedback has subsided. Very impressive in demonstration, with the notched result bearing a very close resemblance to the original signal.

Microphones

The big news here was the launch of a new range from **AKG**, the *Tri-Power* series comprising of four vocal and three instrument mics. All provide a hypercardioid pattern, the patented Moving Magnet System which reduces handling noise by 20 dB more than conventional shock mounts, a two layer windscreen and a built-in hum compensation coil.

Digital Audio

The major launch here was of **Yamaha's** *CBX-D5* direct-to-disk recording system. The specification quotes 16-bit A/D and 18-bit D/A (8 x oversampled) conversion with AES/EBU, SPDIF and the Yamaha Y2 format digital inputs and outputs. The *CBX-D5* offers two-track record and four-track playback with digital, 3-band parametric EQ and a DSP to handle reverb and modulation-type effects. MIDI, 8-pin mini DIN and SCSI connectors are all included. The masterstroke is in not implementing a front end, but allowing specialist software companies to provide for in their particular field of expertise. Mark of the Unicorn, with *Digital Performer* on the Apple *Macintosh*, and Steinberg, with *Cubase Audio* on the Atari *ST*, are the two companies who are initially involved with Yamaha and it is fair to think that others will follow. (Cost — less than £2,000/$3,400 approx.) and availability is expected before the end of the year.

Plasmec Systems have had their *ADAS* two-track direct-to-disk system available on the Atari *ST* for some time. At the NAMM Show they introduced a version for the Apple *Macintosh* while at Frankfurt two more derivatives were added; one for the PC under the Windows environment and the other a 3U freestanding rackmount which includes a built-in LCD and a socket for an RGB monitor. The advantage of the latter is the removal of the restriction that the operating system for any computer may impose. Plasmec are also manufacturing their own drives now; 88 Mb Syquest removable, 128 Mb magneto opticals and fixed drives are all available.

Akai announced the *HD-R100*, four-track hard disk recorder. Up to four of these can be connected together to give 16 tracks and connections include SCSI, AES/EBU and SPDIF. Cost will be £1,400/$2,366 approx. Also released was a Digital Offset Editor for *A-DAM* (less than £1,000/$1,700 approx.), a Digital Level Meter around £1,200/$2,040, Sampling Frequency Converter (price unknown) and a Digital Signal Patchbay (£500/$850 approx.). The latter is an 8 x 8 AES/EBU patchbay with 128 memories. Also on show was the version 2.0 software for the *S1100* sampler; this adds the feature of direct-to-disk recording due to the existence of the internal *S1100* DSP at an additional cost of £349/$593 approx.

Scheduled for April 1992, *Opcode* showed their *Audioshop* audio management program for the Apple *Macintosh*. This integrates 8-bit digital audio and CD-ROM audio into a playlist which can be edited as can individual waveforms. A variety of formats are catered for including *Audio IFF* and *Macromind* and will include *Quicktime* in the near future. Cost — unavailable at present.

Software

Having led the market with their *Creator* and *Notator* sequencing and scoring packages for the Atari *ST*, **C-Lab** finally made the move into the Apple *Macintosh* market with *Notator Logic*. Part of the name may be inherited from the *ST* program, but nothing else has been; this is a brand new sequencing package intended for use with the *Mac*'s System 7 operating system. *Notator Logic* is an object-oriented music environment; the number of tracks are practically limitless with a resolution of 960 ppqn and a tempo range of between 0.05 and 9999.99 beats per minute. The entire MIDI set-up can be shown — and patched — on-screen including MIDI channelising and the setting of the MIDI note range per MIDI device in ▶

a similar manner to Opcode's OMS system. All events are shown on screen in a linear track fashion, but multiple tracks can be placed together in 'folders' to prevent the screen from becoming visually cluttered. Cycle points can be altered on-the-fly by dragging within a special area at the top of the Arrange window while editing takes place in a similar manner to that used on the ST Notator program — Event List and Score Editor.

At first glance, *Notator Logic* appears to be immensely powerful. Perhaps not as visually intuitive as Steinberg's *Cubase*, but then the power and user-friendliness of a sequencer cannot be readily commented on until it has been used for many weeks — perhaps months! Price is yet to be established; however, we can expect to see *Notator Logic* ported across to the Arari *ST* as well, probably by the end of 1992.

Steinberg were also busy with various additions to their software and hardware range including *MasterScore II* (£325/$550 approx.), a desktop music publishing program and *Tango* (£200/$340 approx.), a powerful improvisation program, both for the Atari *ST*. Hardware interfaces for the *PC* in the form of the *PC MIDI 1* (£90/$153 approx.) and the *SMP II* (£550/$953 approx.), and the *Mac* with the *Mac MIDI 1* (£70/$119 approx.) and the *Mac MIDI 2S* (£320/$544 approx.), with the latter including SMPTE and MTC sync were also on show.

Synths and MIDI

The most blazing synth at the show was **Waldorf's** *Wave*, a modular synth which can be purchased with the specific hardware that a player needs. As standard it has a 61 note keyboard with channel aftertouch, with 16 voices as standard but can be expanded to 32 or 48 by using expansion voice boards. The *Wave* is eight part multi-timbral; each voice has a most impressive list of controls including 2 oscillators, 2 wavetable generators, 2 LFOs, ADSR envelope, DADSR filter envelope, a wave envelope with 8 timé-level pairs, mixer, shaper, delay and so on.

To make editing simpler, the *Wave* has a 480 x 64 pixel LCD with 8 buttons and faders purely for the screen. 27 sound edit buttons, 53 sound edit knobs, 9 sound increment dials, 8 performance faders — the list is practically endless. All necessary controls for use as a master keyboard are included as is a 3.5 in High Density disk drive to which can be stored all data formats and external MIDI data from other synths. Price will start around £3,000/$5,100 approx.

Having been mentioned for some ▶

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Owing its heritage to the world-standard SM57 the Beta 57 offers improvements such as an extended low-bass response together with smoother and more gradual presence rise. Designed for acoustic and electric musical instruments, live and in the studio.

'The Broadcaster'
SM87 Vocal Condenser
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'The Stage Manager'
SM91 Surface Mount
The world's first unidirectional surface mount microphone has yet to be surpassed. Rugged enough for any application. Ideal for TV settings, news conferences, dramatic productions, stages etc. Wherever inconspicuous microphone placement is required.

time, **Cheetah** finally brought the all analogue *Zeus 24*, 61-note keyboard into the light of day. Although soundless on the stand, it boasts 24 oscillators with 12 envelopes and LFOs per voice with 8 polyphonic individual outputs and a full MIDI specification. Price will be £3,000/$5,100 approx.

Yamaha built on their *SY* range with the mid-priced, five octave SY-35 (£649/$1,103 approx.) and *SY-85* (£1,500/$2,550 approx.). The latter has an on-board sequencer and 3.5 in disk drive and so can function as a workstation. Also new was the *RM-50* £700/$1,190 approx.) drum sound module and 64-note polyphonic TG-500 sound module (£1,100/$1,870 approx.).

On the **Roland** stand, there were various new digital pianos and a five-octave General MIDI-compatible controller keyboard (A-30) along with the *DJ-70* Sampling Workstation which includes a 'scratch' wheel, a 12 cm horizontal plate for DJs to use!

Other bits and pieces included a powerful MIDI foot controller from **Dynamix** going by the name of *Ground Control* (£500/$850 approx.), and the *Studio 4*, a new *Macintosh* MIDI interface from **Opcode**.

And finally . . .

Controlling the EQ, pan, levels and mutes of a mixer over MIDI is an interesting idea; Mark of the Unicorn's '7S' set the idea in motion. **Fostex** released a budget eight stereo input to a single stereo output mixer in a 1U rackmount which comes along with a small plastic control box called the Mix Tab. It has 100 'scenes' where the settings can be stored and recalled; cost will be £700/$1,190 approx. **Soundtracs** have a similar unit without the remote control for £550/$935 approx.

Oddball of the show? Has to be the MIDI sequencer on an Atari Portfolio palmtop computer which includes a two input, two output MIDI interface — in fact the interface is practically larger than the computer. Will it sell? Of course not, but it's amazing what some people will work with simply because it's there.

Vic Lennard

In-brief

● ***CD-Secure* from Nimbus:** a way of encrypting information on CD-ROM so that it is only accessible to authorised recipients has been developed by Nimbus Information Systems, the CD-ROM division of Nimbus Records Limited.

● **Revox support:** Thear Technology has been officially contracted by Revox UK Limited to provide technical support for all Revox own stock and for warranty repairs. Thear Technology 0727 43667

● **Elstree Studio Projects:** a new company has been formed offering systems and professional engineering services for television and radio.

● **Elstree Studio Projects** is the result of a collaborative venture between Simon Shaw and the four key members from the Systems Division at FWO Bauch. More information 0923 894141

● **Hilton Sound move base:** Hilton Sound has moved into a new headquarters building near South London's Elephant & Castle, only a few hundred metres from its previous railway arch premises. Hilton Sound, Sutherland Hall, Liverpool Grove, London SE17 2HH, UK. Telephone and fax numbers haven't changed.

Exhibitions

29th-31st May, 11th International Conference, 'Audio Test and Measurement', Mariott Hotel, Portland Oregon, USA.
3rd-5th June, APRS Exhibition, Olympia 2, London.
3rd-7th July, IBC, Amsterdam, Netherlands.
8th-10th July, Pro Sound and Light Asia, Singapore.
26th-28th July, British Music Fair (trade only) Olympia 2, London.
6th-9th September, Plasa Light and Sound Show '92, Earls Court 2, London.
12th-16th September, In the City International Music Convention. The Holiday Inn Crowne Plaza, Manchester, UK.
1st-4th October, 93rd AES Convention, Moscone Centre, San Francisco, California, USA.
18th-21st Januay 1993, Middle East Broadcast '93, Bahrain International Exhibition Centre, Bahrain.
16th-19th March 1993, 94th AES Convention, Berlin, Germany.
31st October — 4th November 1993, 95th Convention, New York, USA.

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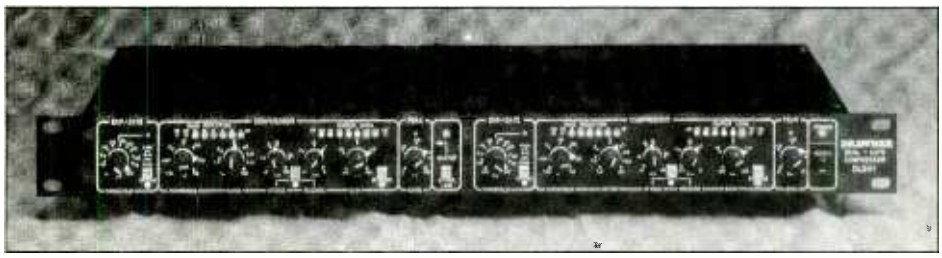
Dynamics and Noise Reduction

Drawmer's DL241 Compressor



The ubiquitous name of Drawmer, found on some of the most successful dynamics processors from home studios to top facilities, now graces a new compressor, the *DL241*. This is a two-channel/stereo unit, incorporating some interesting features belying its apparent simplicity.

Each channel comprises a compressor, an expander and a peak limiter, and the aim has been to combine versatility and effective processing with ease of use and speed of set-up. Easy to use it certainly is; the small number of controls are familiar enough, but what lies behind the front panel is doing rather more than might be guessed at first sight.

The compressor combines aspects of soft-knee and fixed-ratio compression, and although it is not clear from the manual what exactly has been done, the result is extremely unobtrusive, musical compression even when the unit is working quite hard. I find it puzzling that this idea of combining the two approaches to compression is not more commonly provided. Some manufacturers seem to see it as an either-or choice, and yet others provide a variable knee control in addition to the threshold and ratio knobs, giving remarkable flexibility. The *DL241* seems to be aiming to provide a general purpose happy medium between the two approaches, and despite the soft-knee aspects all the setting is done with conventional Threshold and Ratio controls.

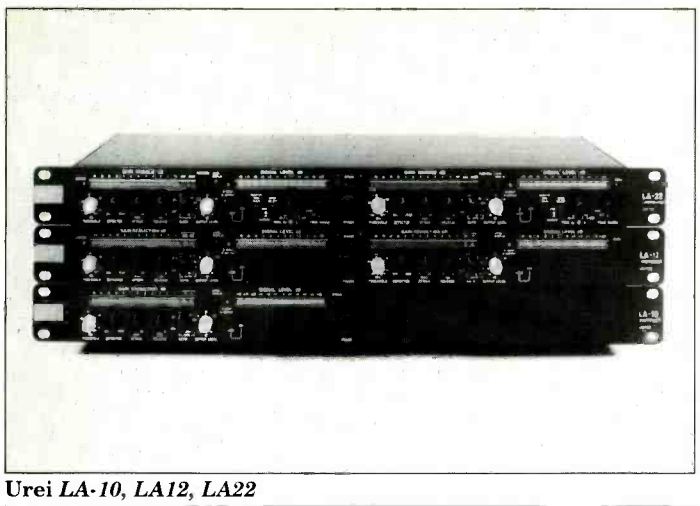
As far as time constants are concerned, wide-ranging Attack and Release controls are provided, but an AUTO button over-rides these; I found this to give excellent results on almost everything, only bass guitar perhaps needing a slower attack than the Auto setting produced. A ±20 dB output gain control is provided, and output level and gain reduction are shown on the usual LED meter strips — decent long ones with sensible colours for the level meter.

A peak limiter comes after the compressor output gain; Drawmer seem particularly proud of this, and with some justification as it is remarkably free from side effects even when pushed to ridiculous extremes. It seems slightly odd that the highest available threshold is +16; assuming this to be dBm (although no reference is specified) signals a good 4 dB above threshold could quite safely be encountered in most applications which one would not necessarily want to limit. In practice, however, this did not become a problem. A nice touch is that if the limiter is called upon to operate for more than 20 ms, additional gain reduction is applied elsewhere in the system to keep things safely under control.

Perhaps the most noteworthy section is the expander. This has only two controls — a THRESHOLD knob and a FAST/SLOW RELEASE switch — together with a single red LED to show when it is operating, and it would be easy to dismiss it as a token gesture, fitted because people expect compressors to have expanders to get rid of the noise they are so good at emphasising. In fact it is extremely effective and unusually easy to set up, thanks to what Drawmer mysteriously call Programme Adaptive Expansion. It seems that the expansion ratio varies according to the dynamics of the signal, a higher ratio being applied as the level gets lower. The result, according to the manual, 'is an expander that requires less stringent setting up and is more tolerant of wanted sounds that are only slightly above the residual noise floor'. Although this sounds a bit too good to be true, it turns out in practice to be pretty much the case. With the minimum of fiddling about, it can very quickly be set to get rid of, say, guitar amp noise, without getting confused by long sustained notes, clicking-in on transients or missing the beginning of anything. This is the simplest and most effective expander I have come across as part of a compressor package.

A STEREO LINK switch hands over complete control of the unit to the channel 1 controls, including LIMITER THRESHOLD and GAIN MAKE-UP, which on some units are left independent. Ins and outs are straightforward; the unit is available with XLRs or jacks (not both!), all balanced but fully tolerant of unbalanced operation, and the channels can be independently switched between +4 and -10 operating levels on the rear panel. Perhaps surprisingly, there is nothing in the way of side-chain access or key inputs, which could rule out using this for some more complex tasks which it would otherwise have been ideal for.

The *DL241* is an extremely pleasant box to have around. It did an excellent job on everything I asked of it, from gentle vocal compression to heavy rhythm guitar to overall stereo programme control. Even the most outrageous settings produced no unpleasant side effects — even deliberate pumping sounded nicer than expected. With its combination of intuitive use, novel features, powerful versatility and consistently musical sound, I should not be at all surprised to see the *241* join Drawmer's original *201* gate among the ranks of the classics. **Dave Foister**



Urei *LA-10, LA12, LA22*

Summit hybrid

Summit Audio have added a new vacuum tube/solid state hybrid processor to their range. The *DCL-200* is a 2-channel compressor/limiter using 12AX7A gain stages with discrete op-amp output stages. Compression ratio is continuously variable from 1:1 to 7:1 and the slope has a soft-knee charateristic. The channels may be run as dual mono or with stereo link controlled from channel 1. All inputs and outputs are transformerless and there is a side chain control for input.

Summit Audio, PO Box 1678, Los Gatos, CA 95031, USA.
Tel: (408) 395 2448.
UK: HHB Communications, 73-75 Scrubbs Lane, London NW10 6QU. Tel: 081 960 2144 Fax: 081 960 1160.

JBL/Urei news

The JBL division of Harman International debuted their *M* Series of rackmount signal processors at the recent NAMM show in California. Among them are the *M644* noise gate and the *M712* compressor/limiter.

The *M644* boasts four independent channels on a single chassis, with individual adjustment of threshold, attenuation, attack and release, as well as a key input, on each channel. The *M712* is a 2-channel (linkable in stereo) device featuring the company's well known soft-knee compression curve. Each channel has individual attack and release controls, as well as threshold and gain, and a gate with its own threshold control.

Both units feature balanced inputs, and servo-balanced outputs, which automatically adjust the gain for balanced or unbalanced loads. They also have an internally-defeatable infrasonic (they call it subsonic, but we know better) filter, and are designed for exceptionally low noise — a dynamic range of 115 dB is claimed. Price for each model is a mere $395 (around £232).

In private sessions at the show, the company was showing the first Urei-branded products to be introduced in some six years; three soft-knee limiters, the *LA-10, LA-12,* and *LA-22*. Featuring XLR and barrier-strip (for the sound contracting market) inputs and outputs, the *LA-10* is a single-channel unit, while the *LA-12* is a stereo-linkable dual-channel device.

The *LA-22*, also 2-channel, features two sidechain inputs with parametric filters on them, which allow frequency-dependent ducking or expansion. The filters are adjustable from 20 Hz to 20 kHz, with bandwidth from ⅙-octave to 2.5 octave, and can be used independently or they can be linked together to one or both channels. The company forsees the unit getting wide use in PA applications, and also among more creative studio engineers. Prices of all models are to be determined.

JBL Professional, 8500 Balboa Boulevard, Northridge, CA 91329.
Tel: (818) 893 8411
Fax: (818) 893 3639.
UK: Harman Audio UK, Mill Street, Slough, Berkshire SL2 5DD. Tel: 0753 576911 Fax: 0753 535306.

Symetrix 425

The *425* brings together a downward expander, a compressor, and a peak-limiter. The two channels can be operated in dual-mono mode or in stereo mode. Symetrix claim uniqueness as its processor sections are always in-line so there is no selector switch between expander, compressor and limiter. So for instance downward expansion can be used on the low level parts of a signal to improve SNR, compression can be applied to add punch and density, and you still have the security of a peak limiter for overload protection. Also the *425* comes with a superb manual with tutorial as well as practical sections.

Symetrix Inc, 4211 24th Avenue West, Seattle, Washington 98199, USA. Tel: (206) 282 2555
Fax: (206) 283 5504.
UK: Sound Technology, Letchworth Point, Hertfordshire SG6 1ND, UK. Tel: 0462 480 000 Fax: 0462 480800.

Dolby's budget SR

Dolby Labs introduced a new multitrack unit, the Dolby *SRP*, which, Dolby claim, provides 24 tracks of Dolby *SR* at a 25% saving on any stand-alone *SR* multitrack currently.

Targeted specifically at music studios, with simplified metering and alignment, the *SRP* maintains hard Relay by-pass, the Auto-compare feature, but loses the Uncal facility and the ability to operate in older *SP* series frames.

Dolby suppressor

A new single-ended noise reduction system, the *430* Series has been based on a modified version of Dolby SR, the *430* offers improved performance over its predeccessor, *Cat No 43*, which relied on Dolby A technology. The modular system provides remote control of up to six channels of noise suppression.

Dolby Laboratories Inc, 100 Potrero Avenue, San Francisco CA 94103-4813, USA.
Tel: (415) 558-0200
Fax: (415) 863-1373.
UK: Dolby Labs, 346 Clapham Road, London SW9 9AP. Tel: 071-720 1111. Fax: 071-720 4118.

Rane FPL 44 limiter

The Flex series *FPL 44* is a 4-channel all purpose limiter in a standard HR-compatible half-rack unit. Mounting two *FPL44*s horizontally offers eight channels of limiting in one rack-space. Each channel can be operated independently or by using the AUTOSLAVE feature, slave any channel to any other, or all channels together.

Rane Corporation, 10802 47th Ave. W, Everett, WA 98204, USA.
UK: Shuttlesound, 4 The Willows Centre, Willow Lane, Mitcham, Surrey. CR4 4NX. Tel: 081 640 9600 Fax: 081 640 0106.

SHEP Classic Compressor

Shep Associates have begun re-manufacturing the Neve *2254* compressor/limiter. Introduced in the late 60s, the module became very popular with both recording and broadcast studios. Shep have taken the original design with its discrete Class A transistor circuitry, and replaced the multi-circuit board construction with a pair of printed circuit boards. The new 1U rackmountable unit offers two identical linkable sections each providing separate limiting and compression. Dual concentric controls are fitted, and PPM bargraph metering displays I/O and gain reduction. A bypass relay switches I/P and O/P XLRs together, and all I/Os are transformer balanced and isolated. Multiple linking between units is possible via an 8 pin control voltage auxiliary socket, and access pins are also provided to alter the limit attack times and to drive external meters.

Shep Associates, Long Barn, North End, Meldreth, Royston, Herts SG8 6NT.
Tel: 0763-261686.
Fax: 0763-262154.

In-Brief

- The NTP De-esser/limiter *179-500* has been designed according to the German IRT spec for GPE limiters, and replaces the *179-400* limiter.
- The *Classic* Compressor from LA Audio is a dual-channel limiter/compressor for general purpose use. All inputs and outputs are balanced on XLR coonectors with transformers on the outputs and a sidechain facility.
- DOD have introduced the *R866* Stereo compressor/limiter/gate.
- Drawmer have launched the *DL251* Spectral Compressor which has a built-in enhancer for restoring the high frequency content and dynamics without increasing noise or output level.

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IN SCOTLAND, SOUND CONTROL. PHONE: 041 204 2774 FAX: 041 204 0614

Yamaha digital equaliser

Yamaha debuted at the January NAMM show an enormously flexible digital equaliser system, the *DEQ5* and *DEQ5E*, geared for both recording and live sound. Each unit can be configured as either a 2-channel, ⅓-octave graphic, or a 6-band parametric equaliser. In addition, it can introduce delays of up to 1300 ms, in increments as low as 20 ms.

The units work entirely in the digital domain, using 19-bit A/D and 20-bit D/A delta-sigma convertors, and have inputs and outputs for both AES-EBU and Yamaha's *Y2* formats, as well as analogue inputs and outputs. In addition, a word clock input is provided for synchronisation with other digital sources and processors.

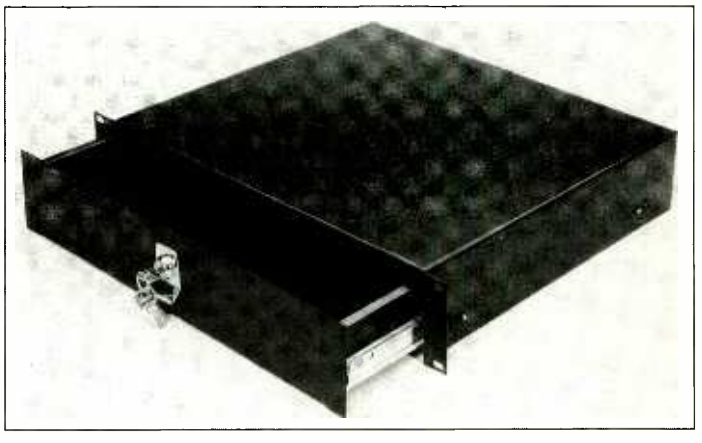
Up to 40 EQ curves can be stored in internal memory, and recalled either from the front panel, via MIDI, or directly from SMPTE timecode using the unit's built-in timecode reader. When a memory is recalled, the signal is not muted, but instead the EQ curve is smoothly changed one band at a time, with the entire process taking about one second.

A hum-cancellation circuit automatically attenuates the line-frequency fundamental and its harmonics when the input signal dips below a specified threshold. The circuit is user defeatable.

Programming is facilitated by a 240 x 64 pixel LCD screen that shows menus, text, and the EQ curves themselves.

The *DEQ5* is the main unit, and it has all of the control and display capabilities. The *DEQ5E* is a slave, with all of the features of the *DEQ5*, including its own memories, but without the front panel controls and LCD. One *DEQ5* can address and programme up to 23 *DEQ5E*s. US price for the *DEQ5* is expected to be around $2,900 (£1,706) and the *DEQ5E* around $2,400 (£1,411). Delivery of both is slated for the summer.

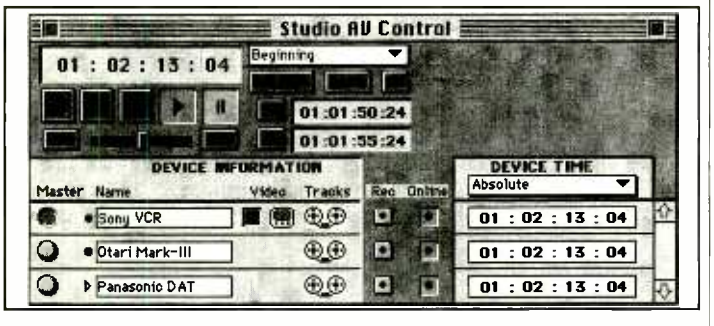
USA: Yamaha Corp of America, 6600 Orangethorpe Ave, PO Box 6600, Buena Park, CA 90622-6600
UK: Yamaha-Kemble Music, Sherbourne Drive, Tilbrook, Milton Keynes, MK7 8BL. Tel: 0908 366700



Rack Drawer

CP cases are now manufacturing a lower cost version of their Studio Drawer. The Road Drawer fits into a standard 19 in rack and is supplied in 2, 3 and 4-unit heights. The drawer features a black epoxy powder coat, matt finish, with stainless steel finger-pull key lock, and fully extending quick release drawer sides for easy removal. The Road Drawer offers useful storage for tools, manuals, CDs, etc., and is equally suited to fixed or mobile use.

CP cases, Worton Hall Industrial Estate, Worton Road, Isleworth, Middlesex TW7 6ER.
Tel: 081-568 1881.
Fax: 081-568 1141.



Opcode Transport controllers

The movement of MIDI into the world of high-end post production was also evident at the recent NAMM show thanks to several deveopments. One was the official adoption of the MIDI Machine Control (MMC) addendum to the MIDI Specification, by the Japanese MIDI Standards Committee.

Another side of this trend was on display at Opcode System's stand. The *Studio AV* system integrates control and synchronisation of video and audio decks with *Macintosh*-based MIDI and hard-disk audio recording and editing, at surprisingly low cost.

The *Studio AV* reads and writes Vertical Interval Time Code (VITC) and conventional Longitudinal Timecode (LTC), and will generate LTC locked to incoming video, house sync, or blackburst. It will generate window dubs, either when copying a video tape or live while playing back a timecode-striped tape, and will also display punches and streamers.

An included software program allows the punches and streamers to be created directly and tagged with timecode numbers, or imported from a standard MIDI file, using the file's markers as punch points. Marker names can also be displayed which among other advantages makes for a convenient way of indexing the tape. When used with the company's program *Vision* or *StudioVision*, streamers and punches can be generated automatically from a running sequence.

The software also provides transport control for audio and video decks, allowing start, stop, continue, pause, record, and shuttle. With *Vision* and *StudioVision*, transport control can be handled directly from the sequencer. Cables will be available for a wide variety of ½ in, ¾ in, 1 in, and digital video decks from Sony, JVC and Panasonic; multitrack audio decks from Otari and Fostex; and Video disc players from Pioneer and Sony, with the list continually growing.

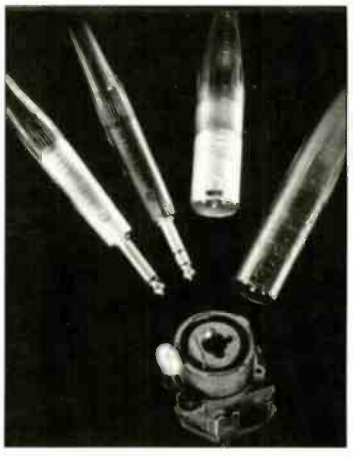
Opcode see the majority of their system's users to be project studios who need to control a single video deck, but they are also making the system expandable for larger applications. Multiple video and audio decks can be controlled from the same computer front-end, using *Studio AVx* expander modules. Each transport requires one module, and there is effectively no limit to the number of modules that can be connected together. The system will provide both timecode and capstan control, for frame-accurate synchronisation and editing of the various elements.

The system will be available in the second quarter of the year. US prices are *Studio AV*, $1,495 (£880 approx); *Studio AVx*, $995 (£585 approx); cables, $89 to $159 (£52 to $93).
Opcode Systems, 3641 Haven, Menlo Park, CA 94025-1010, USA.
Tel: (415) 369 8131
Fax: (415) 369 1747.
UK: MCMXCIX, 708A Abbey Road, Tudor Estate, London, NW10 7UW. Tel: 081 963 0663.

Adam-Smith PC Editor

A new editing software package has been announced by Adams-Smith which enables a suitable PC compatible computer to take on the full editing and control capabilities of the company's *2600E* A/V audio editor. This cost effective alternative, *2600E* A/V-S, is supplied on either 1.2 Mb or 1.44 Mb disks and includes a customised keyboard, dedicated processing and interface hardware.
UK: Marquee Audio Ltd, Shepperton Film Studios, Middx TW17 OQD. Tel: 0932-566777. Fax: 0932-565861.

Neutrik Combo Connector



Neutrik have developed a new PC board receptacle, the *Combo Connector*. The product consists of a new 3-pin XLR-PCB receptacle with a ¼ in jack built into its centre. The jack can be fitted with two or three gold-plated contacts and up to three normalling contacts.

Neutrik AG, FL-9494 Schann, Im Alten Riet 34, Liechtenstein. Tel: (075) 29666 Fax: (075) 25393.

The Producer's Friend

Trident Audio Developments have recently introduced a new option to its *Vector* range of consoles with a working title of *The Producer's Friend* the unit features an ¼ in display combining a number of functions into a single microprocessor-based unit.

Functions include a wide band timecode reader, switchable between two timecode sources, featuring display hold and a memory; Stop watch with a resolution in ⅟₁₀₀ths of a second, lap timing and memory register; digital metronome producing an audible output and visual indication of the tempo.

The unit can be fitted to a number of consoles, and can take its power from the console or from an external power supply. It is also available as a stand-alone desktop unit.

Trident Audio, Trident House, Rodd Estate, Govett Avenue, Shepperton, Middlx. UK. Tel: (0932) 224665 Fax: (0932) 226721.

Uptown film software

The Uptown *2000* moving fader automation system has been modified to accommodate film mixing. Up to three control panels may be installed, each offering programmable control of fader modes and grouping. A foot frame display changes all timecode fields to display feet and frames of film. Faders can be updated quickly via 'Touch Write' which switches the fader to write on touch, and another feature 'Cut Time' allows the mixer to work on a scene without having to worry about modifications made in the previous scene. In addition to reading Adam-Smith serial data, Uptown *2000* will now interface with *Lynx* and *Ketchem* machine controllers. A new directory structure allows mixes to be stored by Film, Reel and Type of Music without cluttering the Move to New Directory screen.

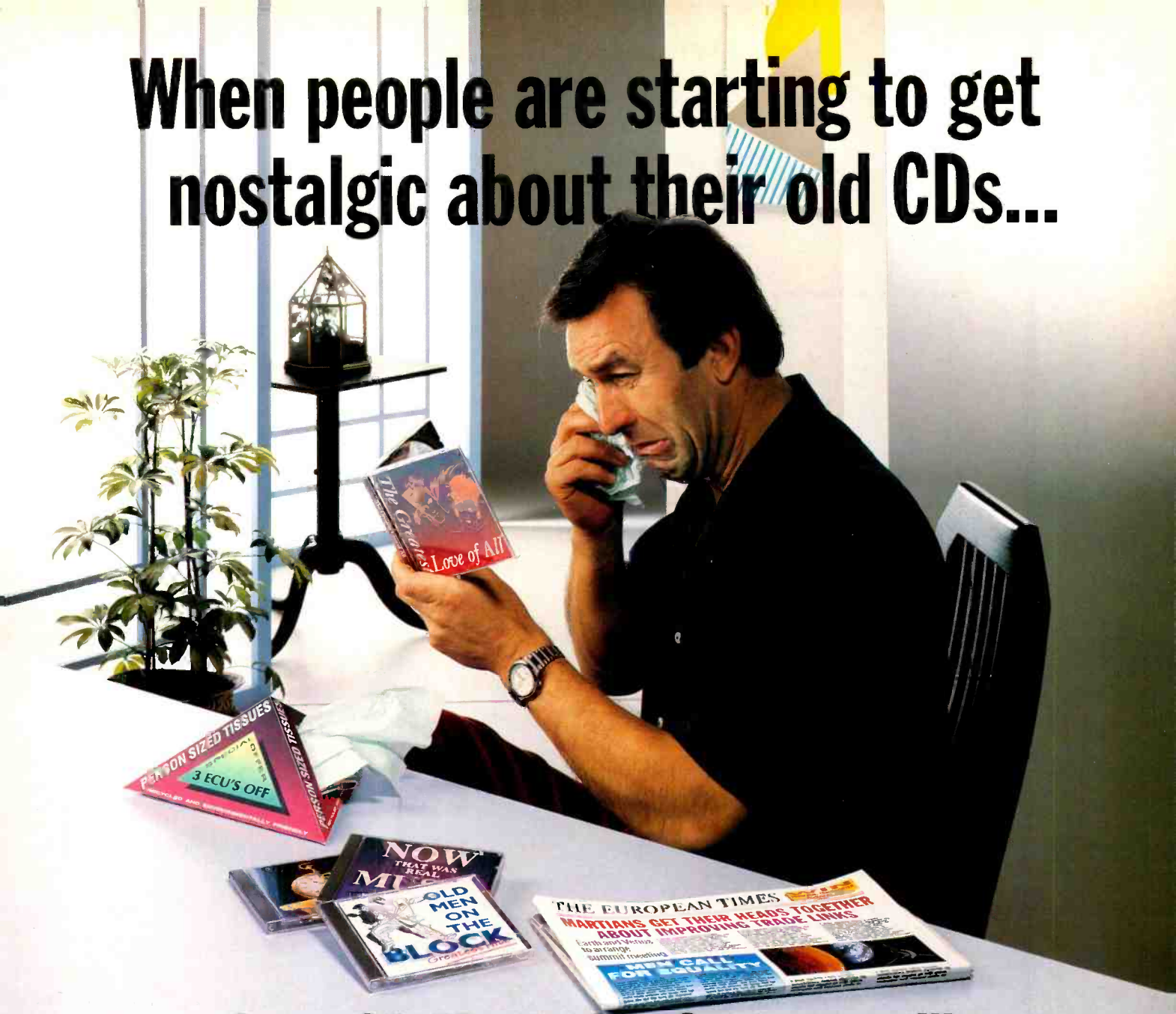
International: Audiomation Systems, Rockwood House, Barn Hill, Stanley, County Durham DH9 8AN. UK. Tel: 0207 282880. Fax: 0207 232023.
US: Audiomation Systems, Road, Sudbury, MA 01776, USA. Tel: (508) 443-8053. Fax: (508) 443-4844.

Audio Trax

Audio Trax is a program that combines a 2-track digital recorder along with a 64-track MIDI sequencer. Designed for *Mac II* and *SE 30*, the program records audio directly to the Macintosh hard disk elevating the need to sync sequencers to tape. The program is said to be ideally suited for adding music and audio to desktop video or presentation graphics. Audio Trax requires 2 Mb of memory and a 20 Mb. hard disc. It is fully System 7 compatible.

MCM, the MCM Building, 708A Abbey Road, Tudor Road, Tudor Estate, London NW10 7UW. Tel: 081-963 0663. Fax: 081-963 0624.

When people are starting to get nostalgic about their old CDs...



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Middle East, Geneva 022 7336350 Africa, UK 0256 55011

Sony Broadcast & Communications

Alesis D4

While drum machines offer a complete self-contained package, they can become a waste of resources when used solely as a sound module in instances where a studio its comfortable with its sequencer. The Alesis *D4* offers more than 500 drum and percussion sounds in 1U containing a distillation and enhancement of the samples gleaned from the company's successful range of beat boxes.

The device is stereo with four assignable outputs which can be grouped as pairs with MIDI in and soft switchable thru/out plus 12 external trigger sockets. The beauty of the device is that with 16-note polyphony, it can be configured to function as two stereo eight-note drum kits as well as allowing separate outputs to be used exclusively for single sounds.

The front panel is simplicity itself based around a 16 x 2 LCD and alphadial with a somewhat ineffectual velocity-sensitive PREVIEW punch button which requires a thump that would turn the rack over to illicit a 127 response from a sound. Two cursor keys select parameters which are then altered by the dial and the *D4* interestingly uses a Note Chase feature which make assignment of sounds to keyboard notes the doddle that it should be. A VOICE key allows the selection of individual sounds grouped as 99 kicks, 99 snares, 55 cymbals, 92 toms, 76 varied percussions and 80 special effects. The *DRUM SET* button permits the structuring and storage of 21 drum kits while the MIX key allows individual sounds to be stereo positioned in an arc of 7 segments with controllable level with the OUTPUT button dictating routing. Each sound can be tuned over 7 semitones and grouped in a real-world way to other sounds to facilitate, for example, the inability to strike an open hi hat when its been closed via the footswitch socket provided expressly for this purpose. The ability to bunch sounds in mutually inclusive groups and to give a sound multi or single trigger characteristics contributes significantly to the realism of the *D4* especially when coupled with Alesis's Dynamic Articulation which fires a different sample depending upon the velocity received.

MIDI-wise the *D4* responds to patch changes, — it can also patch map — Dumps and a number of controllers for volume, pitch bend and for remoting parameter and value selection.

External Triggering

One of the least well publicised aspects of the device is its external triggering abilities because not only can the *D4* be spurred into life through its back panel sockets but it also emits MIDI while it is doing it, operating as an trigger to MIDI interface. This makes any multitrack reconstructive surgery a good deal simpler when run alongside a SMPTE-locked sequencer. A total of 25 Trigger Types are provided — permutations of the recovery times (the trigger source's decay character), the noise floors and the amount of suppression likely to be required for a variety of sources. Alesis state that these Trigger Types have been optimised for different catergories of material from drum pads through piezo transducers to the essential badly recorded tape track. And very good they are as well. I was very surprised to get reliable and fast results from muddy bass drums and overwhelming snares with the minimum of EQ. If the *D4* additionally offered basic filtering to its trigger chain then I would hazard that it could be made to work as a stand-alone on absolutely anything, so quick is its response and so easy is the set-up. As it stands it is an extremely handy bonus to the unit and on that raises the device's value well beyond its £399 ($678 approx) price tag.

Sounds

Because the *D4* doesn't have any way of generating sounds on its own, the degree to which it impressses relies heavily on what you are capable of asking it to do. I happened to have a copy of Heavenly Music's *Dr Beat* MIDI File drum patterns to hand (see box story) and can recommend it as a means of demoing the *D4* into working up a sweat.

Given good source material the *D4* sounds remarkably good, particularly on the traditionally grey areas of single and multiple drum rolls and light touches where you can clearly hear the Dynamic Articulation adding authenticity.

It is not perhaps the quietest unit on earth but the sheer quality of the sounds completely obliterates this minor point. As a source of realisitic drums it is flawless with standard and contemporary basic sounds all being represented. The variety of kicks and snares is particularly noteworthy and I swear you can hear the difference between wood and chrome as clearly as if they were in front of you. There is little duplication of sounds with only a few sounding as if they are a curtailed version of something else but some do have incarnations available with reverb of flanging added. As a small criticism I found some of the reverb room sizes a little too large to be useful while some of the small room effects are maybe not as brilliant as the outstanding drum room algorithms housed in Alesis's outboard effects. However, to Alesis's credit they have captured the all important bass energy content of drums faithfully and consistently which is not something that can be said about all sampled drum machines.

There's a healthy selection of extremely varied cymbals including china's and excellent rides all with natural and sustained decays. Hi hats include foot pedal samples and some real power-hat dustbin lids. The toms can be positively enormous and benefit perhaps most from the individual tuning ability. Indeed it is difficult to not be overwhelmed by the sheer selection of sounds on offer and this almost works against the unit. Choice is somewhat confined when assembling a drum kit of sounds by the degree to which appropriateness is important — placing individually stonking open and closed hi hats together can end up sounding decidedly unreal.

There's also a selection of all popular percussion sounds, the ubiquitous congas, bongos and lots of shakes and rattles. The *D4* has been criticised for not including more ethnic percussion and while it is true that these could have inserted in place of the rather jokey special effects section (lip pops of all things?) the trouble with truly ethnic percussion is it doesn't transfer in the standard handful-of-shots manner to a sampler all that convincingly because of the subtlety or irregularity of the playing.

On balance the *D4* has got it about right. It is sonically outstanding and on a pounds per bang basis it cannot be touched.

Alesis, 3630 Holdrege Avenue, Los Angeles CA 90016.
Tel: (213) 836 7924.
UK: Sound Technology, Letchworth Point, Letchworth, Herts SG6 1ND Tel: 0462 480000.

Dr Beat

Heavenly Music is a small UK programming outfit that has put together the *Dr Beat* MIDI File format collection of Roland mapped drum patterns. Drum programming remains the single mysterious bastion of black art to most sequencer users who while they may be competent keyboardists and sequencer data manipulators are often unimpressed with their best attempts at getting a beat going.

Dr Beat Volume I, Volume II is imminent, addresses this very real need with a craftily assembled and infinitely usable selection of short drum pattern and fills in a variety of styles from rock through latin to Caribbean to expertly presented soul and funk grooves. And its the groove that *Dr Beat* has captured so convincingly. As a means of generating a rhythmic backdrop against which to write or even for important patterns into existing songs it is invaluable. The element of realism is staggering.

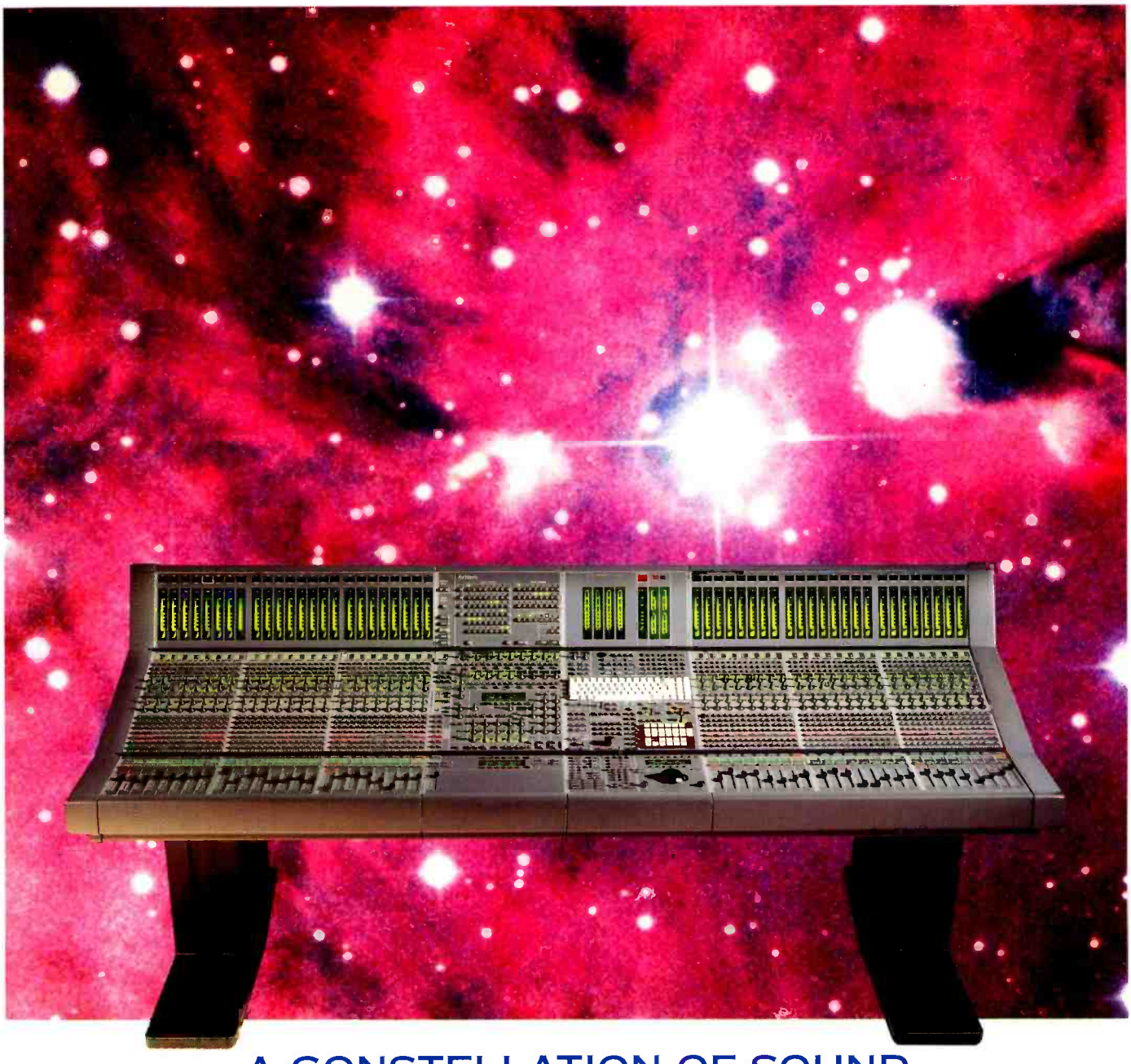
Patterns are presented in a manner that allows any moderately proficient sequencer manipulator to edit and strip away sections to expand the considerable variety being offered still further. In many ways this presents a far more original alternative means of rhythmic variety to drum loop sampling and it is also considerably more flexible.

Ridiculously under priced. Indispensable and a steal at £13.95.
UK: Heavenly Music Ltd, 39 Garden Road, Jaywick Village, Clacton, Essex CO15 2RT England. Tel: 0255 434217.

Studio Sound's Music News is compiled by Zenon Schoepe.

CAPRICORN

DIGITAL AUDIO REALISED



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HITOKUCHI-ZAKA

Zenon Schoepe discovers a studio complex in Tokyo.

One of the most peculiar aspects of recording studios in Japan is their physical location. The West is no longer surprised to discover studios in the basements of shops, in converted cinemas and churches, on farms, in a quiet mews behind a busy main road or among the warehouses of a city's industrial estate. In Japan, due to a severe shortage of space and the astronomical expense of what ever space there is, ingenuity and circumstance combines to situate studios in tall bland looking office blocks.

A step into the foyer of the building that houses Hitokuchi-Zaka Studios in Tokyo and you could be forgiven for thinking you were entering some multinational company's emporium as people in suits and tidy two-pieces pass you in the lifts and the lobby and park their umbrellas in the overcrowded parasol grids planted around the entrance now that the typhoon season has started.

Entering Hitokuchi-Zaka's floor in the building does little to lead you to suspect that you are any closer to a recording studio. The office atmosphere is one of hushed industry with carpeted corridors, tidy desks and the sound of people getting on with it. No MTV nor videos blaring out.

Finally a door opens into a pine panelled and comfortably cushioned relaxation area and from here the visitor steps into the blue and pale wood high ceilinged control room of Studio 1 — Hitokuchi-Zaka's flagship in its five studio complex. Recently refurbished with a Neve *VR72* with *Flying Faders* and acoustics by Kinoshita, the aesthetics of the room with its curved slatted ceiling are unusual, pleasing and memorable.

Opened 13 years ago, around time of the independent studio explosion in Japan, Hitokuchi-Zaka is part of the Fujisankei Communications Group whose interests include record and production companies. Fujisankei also owns the highly prestigious Kawaguchi-Ko residential studio which is blessed with an unrestricted view of Mount Fuji from the control room. The facility runs an SSL *4056E* with *G* Series computer and is complemented by six bedrooms and various facilities that make the most of the studio's location in one of Japan's most beautiful parks.

Tokyo's Hitokuchi-Zaka studio complex represents something of a showcase in Japanese studio terms most notably because of the size and ambition of the installation bearing in mind the cost of the ground it stands on — estimated to be in the region of Y1000,000,000 (around £400,000) per 3.3 m^2.

Studio 1 therefore goes out for Y45,000 (about £180) per hour excluding outboard and machines — Sony *3348* and *3324*, Mitsubishi *X850* and Studer *A800* are available in each room — and gets it according to Hitokuchi-Zaka President Hideo Tanaka. 'Rate cutting is negligible in Japan. We're selling on responsibility and reliability.'

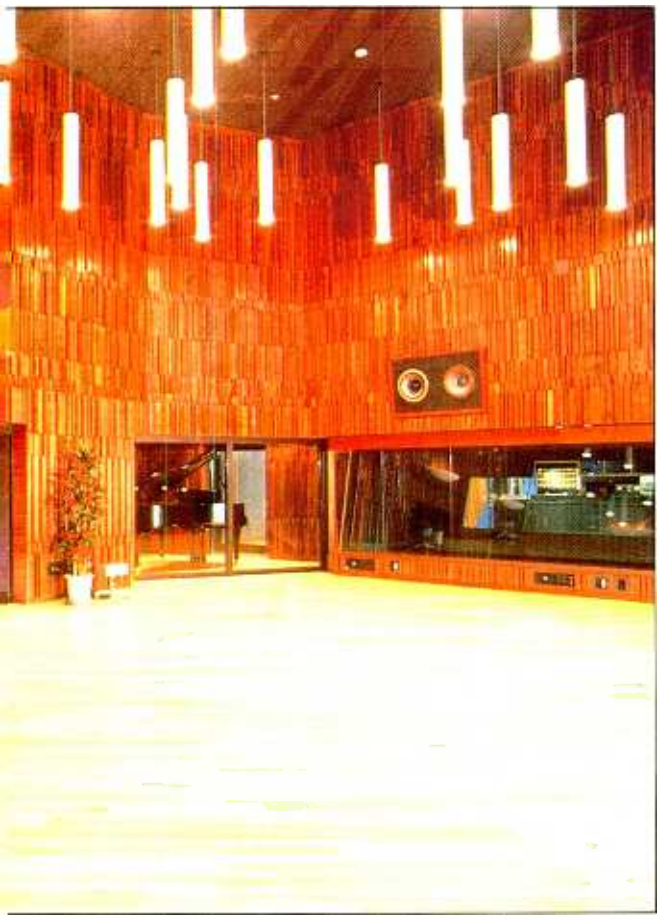
Originally the complex was all API equipped but the desks have since been sold or broken up for parts aside from the 'time capsule' of Studio 4 more about which later. Consequently all rooms boast racks of API EQs or built-in desk sections as in Studio 1 where a 48-channel cue mixer has been constructed from API bits with an additional solo panel with remote connection to supplement the rooms Neve desk.

The expanse of space behind the console in Studio 1 allows keyboard rigs to be wheeled in with ease and the control room plays host to an NED Synclavier *6400* system. The requirement for such a 'play area' had a strong bearing on the acoustic design of the room according to Katsuya.

Kuroda, General Manager of the complex's engineering department. 'We needed a design with very wide dispersion which could achieve a good sound well beyond the engineer position. And we have managed it.'

The control room's lack of daylight is skillfully overcome by very organic lighting which gives an airiness to the environment which is maintained in all the rooms throughout the complex even though some do benefit from natural light.

The outboard racks reflect the Japanese studio obsession with old style and particular processors: Urei *1176/8*s, Tube Techs, Neve *33609*s, Dbx compressors and EMT plates. Japanese engineers are used to working on digital formats and in line



Far right: Kinoshita-designed control room Studio 1 with Neve *VR72* and FLYING FADERS.

Centre: Live room Studio 1. The main area has a total of six booths adjoining it.

with popular thinking they reason that any processing that desterilisers the purity of digital has got to be a good thing. That being said the normal collection of digital effects units of Japanese origin are infiltrated only by the occasional AMS and Lexicon. The live area of Studio One is equally stunning with a 236 m² central area surrounded by seven sizeable isolatable booths. All are linked by windows so visibility throughout is excellent and flexibility is injected with each isolation booth inheriting individual acoustics from irregular brick-patterned walls and a domed and almost chapel-like stone and wood clad roof — a natural for drums and percussion. One booth also featured RPG Diffusors 'We like to try new ideas' says Tanaka. Kuroda meanwhile takes pride in explaining that all the wood used had been specially imported from Canada and that the reverb time of the central area had recently been reduced slightly to give a more controllable and general purpose ambience.

The live room's lighting again deserves special mention for its versatility and in the central area it consists of a ceiling full of illuminated tubes which can be raised and lowered as well as dimmed.

Studio 2 boasts an SSL *4064 G* Series in a control room designed by Karuda two years ago. The Kinoshita monitors unusually have triangular rock wool filled baffles placed between them to remedy 'a sound that was a little too central' according to Kuroda.

Tanaka on the other hand gives a brief lesson in business acumen. 'To be competitive, a rental studio simply must have popular consoles. SSL is the number 1 desk in quantity in Japan and its operation was certainly the easiest before Neve's *Flying Faders* came along. Necam is not exactly lightweight.

'The SSL is fast and easy. To some the sound is a small weak point but we have API EQ racks throughout the complex so no one can really complain. Add what you want to taste.'

Taste is certainly what the 'time capsule' of Studio 3 is all about. With an all original *4832* API with local and remote patchbays in a worn-in dark wood Kuroda designed control room with Kinoshita monitors, the feel is decidedly American. Even the obligatory Sony *PCM3348* at the back of the room looks comfortable and broken-in in what is Hitokuchi-Zaka's second cheapest room. Yet it jostles with the high tech heaven of Studio 1 as the most enduring memory. It's the sort of room that exudes chart success from the crumpled leather of the engineer's chair.

Its live room also enjoys a functional, homely and down to earth feel and is steeped in the character that is often stated to be lacking in Japanese recording studios. The 133 m² main area is covered in a repeating wood brick pattern which is just regular enough to look tidy yet random enough to grab the attention. Sizeable isolation booths lead off this and typify the ingenuity of the Japanese in making the most of the space they have. Referred to laughingly by Tanaka as 'Karuda magic', a door materialises from a previously solid looking wall to combine with another from a wall opposite to form an impromptu but efficient isolation booth.

Studio 4 — the remix room — on the other hand, returns to the art of setting the high tech standard with a suitably imposing 80-channel *G* SSL with a rare glimpse of daylight to the right of the desk. Daylight takes centre stage between the newly fitted Boxer monitors of Studio 5 — humbly referred to as a 'synth programming room used mostly for sound to picture work' by Kuroda. It houses an SSL*4056 E* with *G* Series computer, and an arsenal of D2 and standard VTRs and racks containing just about every current synth and sampling module.

To complete the sound production chain, Hitokuchi-Zaka has two CD mastering labs armed with Sony *DAE3000*, Digidesign *Sound Tools*, Sonic Solutions, Yamaha CD-R machines and a newly acquired Lexicon *Opus*.

Back out on the street and getting into the car, the building that houses Hitokuchi-Zaka looks even more ordinary after the visit and the temptation to crick the neck and try to work out how it all fits in is overwhelming. When you consider that the area roughly occupied by the patch bay on the Neve VR in Studio 1 is worth considerably more than the desk itself, you begin to understand why the Japanese build so tall. But then Hitokuchi-Zaka is aimed at the top end of the recording market and has a room to suit all tastes. ■

JAPRS

In addition to being President of Hitokuchi-Zaka Studios, Hideo Tanaka is also President of the three-year-old fledgling studio trade association — the Japan Association of Professional Recording Studios or JAPRS.

While stating that the versatility and high quality of Japanese engineers and studios is something that the Association intends to promote on a global level, Tanaka acknowledges that the youth of the rental recording studio in the country has created it own particular problems.

'One of the weak points of Japanese studios is management as many dilemmas are being faced by studio owners for the first time. Add to this the fact that there are extremely high land costs and construction fees and even simple things like a shortage of parking space and it is not surprise that our rental fees are so high.

'Japanese studios are beautifully equipped and have the same hardware as anywhere else but through music recording they are serving a very much smaller market than the other major recording centres because Japanese music is not exported nearly as much as English speaking music — it's almost entirely for the domestic market. That's a problem.'

Tanaka maintains that a strong trade association provides a unified front for recording studios that in insolation could otherwise be forced into negotiating rates. He also sees it as a forum for discussing new technologies and their adoption, a means of training new engineers and encouraging dialogue between studios and manufacturers. 'The start of digital technology has altered the speed of change in studios and with the different formats available some point for dialogue is needed to set standards and encourage excellence in Japanese studios.'

JAPRS membership currently stands at more than 80 studios, 40 manufacturers and service providers. Membership requires recommendations from two member studios and a Y10,000 (about £40) per month payment or one-off yearly membership fee of Y100,000 (about £400).

Tanaka is confident about the future. 'I see increasing communication between Japanese and foreign engineers as being one of the biggest benefits of JAPRS.'

The voice of authority

Dear sir, While reading the article by Barry Fox ('The Churchill Tapes' *Studio Sound*, October 1991) I did think that this story had run out of steam, but it seems that there are some people determined to keep it going.

For those readers who missed Mr Fox's piece, and earlier variations on the same theme in New Scientist and The Guardian, let me summarise the plot so far. A collection of Winston Churchill's most famous speeches has been issued on the Argo label, taken from a larger anthology originally released on 12 long-playing records by Decca. It is now alleged that some of these speeches are not in Churchill's own voice, but are an impersonation by an actor. The grounds for this allegation are twofold: firstly, it emerged that in 1940 the actor Norman Shelley impersonated Churchill in a recording of his famous Dunkirk speech; secondly, an organisation in the USA claims to have established, through a novel method of speech analysis, that some of the supposed Churchill recordings are not the genuine article. In his contribution, Barry Fox announced confidently that 'it looks as if speech experts at Sensimetrics in Cambridge, Massachusetts, have finally discovered the truth'. Is that so, Mr Fox? 'They have been using Churchill's speeches to test the power of new technology . . . ' Mr Fox explains. To *test the power of new technology*, eh? Well, one of the basic principles of scientific enquiry is that you do not test an unproven procedure against an unknown quantity. Have the 'experts' at Sensimetrics, I wonder, paid due regard to the fact that even a small variation in recording speed can give a significantly different harmonic configuration. Since we know so little about the modes of measurement and calibration adopted by Sensimetrics, it is impossible to do other than indicate honest doubt about the validity of their conclusions.

But there is further reason for scepticism: how many people, I wonder, have spotted the big hole in the account as it has unfolded so far? It really does give the game away. The claim is made that, out of 20 speeches analysed by Sensimetrics, three appear to be 'alien', in that they do not match the 'formant concentrations' supposedly established as the reference for Churchill's genuine voice. 'The analysis done by Sensimetrics,' Mr Fox claims, 'clearly suggests that when people listen to these three speeches they are unwittingly listening to an impersonation, almost certainly by Norman Shelley'. Now for the surprising bit: nowhere, in all the arguments thus far presented, is there any indication that these boffins at Sensimetrics have taken the next, and most obvious, step. If the three recordings, which someone has chosen to describe as 'alien', do not match the 'genuine' Churchill recordings, do they match recordings made by Norman Shelley? These are not hard to come by, as Norman made a number of A A Milne titles for Argo. It would seem to me that anyone trying to construct the sort of case that Sensimetrics have presented would first test the theory by attempting to match the 'format patterns' of the alleged impersonations with those of the supposed impersonator. I can find no mention of this phase of the experiment in any of the reports which have so far appeared.

Unfortunately, Barry Fox in his article is guilty of what Churchill would have described as terminological inexactitudes. 'Orr now works for EMI on the Argo label,' he writes. Wrong. I have never worked for EMI. 'When PolyGram bought Decca, EMI took an exclusive licence to sell the Argo recordings,' Mr Fox reports. Wrong again. PolyGram acquired The Decca Record Company in 1980, and I continued until 1987 to produce Argo spoken word recordings for distribution by PolyGram. The agreement with EMI did not come until eight years after PolyGram had bought Decca. 'Thames Distributors promised a digital CD version of the same recordings.' Wrong yet again: Thames Distributors have no agreement with Argo to produce a CD, and the EMI licence is exclusive.

Robert Berkovitz of Sensimetrics is very ready to preach to the record companies, telling them exactly what they ought to do. Barry Fox follows in his footsteps, echoing Berkovitz almost word for word when he advises the removal of 'the appalling artificial echo which Decca added to Churchill's original historic recordings'. After almost half a lifetime in the recording industry, I can tell Mr Fox that people have been adding artificial echo, appalling or otherwise, to records for longer than I can remember. Artifice is one of the vital elements of the whole business, and I know of very few recordings which have not been 'doctored' in one way or another. In the case of the Churchill recordings, Arthur Bannister, who worked for Decca on the compilation, tells me that many of the tapes, recorded at 30 inches per second on one of the earliest tape-recorders, required a great deal of attention to make them fit for public consumption. The original intention was to issue the material in stereo, and echo was added to some tracks simply to assist the listener in differentiating between various locations. Speeches originally delivered in the House of Commons would sound rather odd if heard in the boxy acoustic of a room at Chartwell where Churchill committed them to tape. It is merely a question of suggesting the right ambience, and I see nothing wrong with what I would call 'enhancement' for the listener's benefit. Indeed, after Churchill had heard a copy of the single LP, 'The Voice of Winston Churchill', LXT 6200, containing all the famous speeches now the subject of discussion, he sent a telegram to Decca on 3 December, 1964:

'I AM MOST GRATEFUL TO YOU AND YOUR COLLEAGUES FOR YOUR GOOD WISHES AND FOR ALL YOU HAVE DONE TO PRODUCE THE RECORD = WINSTON S CHURCHILL.'

There, if you like, is the seal of approval. For the American release, in order to frustrate attempts at pirating this historic material, a voice was added at a very low frequency, saying 'This is a London Record', and this was repeated throughout the recording. It can be heard only by running the tape on fast-wind, and holding it against the replay head. Strangely, the equipment used by Sensimetrics appears not to have detected the presence of this spurious voice.

Yet, out of all this speculation, one thing emerges quite clearly. Sensimetrics of Cambridge, Massachusetts, have won a great deal of publicity for themsleves. It would be interesting to see more detailed, and convincing, evidence that their method of speech analysis really does work. Churchill and Shelley are both dead: have those clever chaps in Massachusetts thought of trying out their techniques on living people?

Peter Orr, Argo Spoken Word Consultant, Guisborough, Cleveland, UK.

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PROJECT CAPRICORN

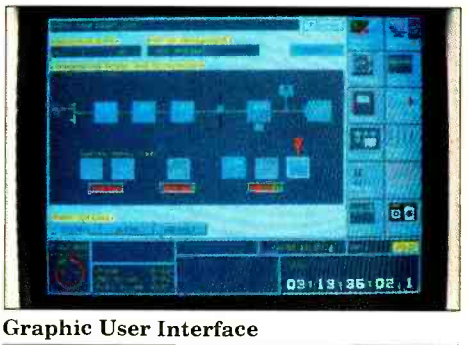
Neve unveil the Capricorn digital console. Patrick Stapley reports

If you had thought that Neve, after their experience with the *DSP* series, had washed their hands of a large scale digital music recording console, you would not have been alone. In fact this appears to be precisely what the company wanted people to think, keeping the *Capricorn* project a closely guarded secret during its four years of development. Even the 35 strong R&D team were moved out to a new site where their clandestine activities could be conducted away from prying eyes. This shroud of secrecy was still in evidence during our January visit, which was more akin to visiting a sensitive military establishment than a console manufacturer. But perhaps it's all justified when one finally comes face to face with this important product which could make the digital console as commonplace as the digital multitrack.

Capricorn is not simply a re-packaged, updated version of the *DSP*; of course much has been learnt from the past, and that knowledge has been put to good use, but it represents a new generation of mixing console from Neve. Paul Lidbetter, Manager of Digital System Development, outlines the goals that were set at the beginning of the project.

'We adopted an almost Japanese style of development and spent a lot of time defining and specifying what it was we wanted to achieve in terms of product functionality, performance and so on — we didn't get into the situation of finding things weren't quite right once the console was half built. So the areas we addressed were firstly Cost — if we were to successfully launch a new generation of digital console the price had to be far more comparable with analogue products — it actually works out being similar to an equivalent *V* Series. We also wanted to try and equate its functionality with the *V* Series so there would be a feeling of continuity and familiarity, although obviously there would be many more functions than on the analogue console. Size, power and weight were all areas we wanted to keep down, in fact the whole *Capricorn* system weighs less than a *V* Series console with all its modules removed. We wanted any control surface size to control any system size, so that as more inputs and outputs are added it's not necessary to add more faders — a minimum of 24 can control any size console. Also the inverse of this was important in terms of general flexibility, so someone requiring a fader for each input can equally be catered for. We wanted an assignable realtime control surface and by that we wanted to be able to access a path instantly without having to go through a menu system or different levels of operation. The system performance we wanted was 20-bit plus, and that is true performance right the way through. Total dynamic automation was an important requirement, which meant that the control bandwidth had to be such that every control could be updated within a frame or less, depending on the controls application — also it was essential to have silent parameter changes and this reflected greatly on the overall design concepts and filter structures and whether or not they were suitable — operationally we decided to continue the automation along the *Flying Faders* concept, so again the system would retain familiarity, although it's a lot more advanced. Finally, we were going for a 'Bomb Proof' design — with our experience of *DSP 1* and other products we didn't want to cut corners, launch the product and find that we were adapting it or redesigning it a year later.'

A great deal of R&D effort was centred around filter structures, and ramping techniques. After investigating many structures in minute detail, a new design developed by Neve proved most



Graphic User Interface

suitable, displaying consistent noise performance and frequency domain accuracy across the range.

Ramping is one of the biggest single applications of processing power in the console. To avoid modulation effects such as 'zipper' noise and to smoothly step any parameter changes (sometimes extreme due to automation), Neve developed ASICs (Application Specific Integrated Circuits) to perform processing functions including coefficient ramping calculations on a per sample basis. An ASIC can ramp 256 coefficients concurrently, and independently, and a total of seven types of ASIC were developed for the console.

Capricorn comes in three standard console sizes — System 64, System 112 and System 160. The largest of these provides 72 channel faders, 64 analogue mic/line A/B inputs, 32 stereo digital line inputs, 96 multitrack returns, 48 multitrack sends, 8 main outputs, 16 aux outputs, 16 cue outputs, 8 analogue mono insertions (another 24 are optionally available), 16 stereo digital insertions, 3 stereo analogue monitor outputs, 24 subgroup buses, 4 talkback I/Os, 79 dot matrix meters, 160 equalisers and filters, 160 sidechain filters, and 160 dynamics (Lim, Comp, Gate, Exp). Digital I/O is via AES/EBU ports and MADI ports for multitrack connections. All system ports will support up to 24-bit data, and the output ports can be individually selected between 16-24 bits being correctly, non-coherently, dithered.

System hardware consists of the Console Control Surface, high resolution VDU, DSP rack, analogue mic/line rack, AES/EBU I/O rack, monitor facilities I/O rack, analogue I/O rack, and machine control rack. patchbays both analogue and digital are options. The console itself is comprised of three component sections — the Strip Section which contains 24 strips, rather like conventional channel strips, organised in modules of eight, the AFU (Assignable Facilities Unit) which houses shared assignable control; and the Monitor Section that contains controls for monitoring, global automation, tape machines, as well as keyboard and trackball to interface with the Graphics User Interface.

Each console section is fully self-contained therefore 'bolting-on' additional sections, or changing positions, is easily implemented. Up to a maximum of five Strip Sections can be fitted to a console, which may be controlled independently from separate AFUs, making the console suitable for multi-operator applications.

Console set-up

The strip signal path can be configured with one of each of the following processing elements in any order — filters, EQ, insert, compressor, limiter, expander/gate, and fader. Cues can be configured with EQ or filters. As these elements are assigned, a graphics display will show how many of each type have been used and the number still available to the user. Each strip can be mono or stereo and assigned as an input, monitor return, sub-group, main output, aux master, or VCA group master. Depending on the number of strips fitted and/or the preferred way of working, different paths can share the same strips. This is made possible by the implementation of Strip Banks. Each of these 12 banks allows different configurations of I/Os to be assigned — for example a 48 fader console could have a mixture of mono and stereo mic/line inputs with VCA and sub-groups spread across 96 paths using Banks 1 and 2, a 32 track machine returning on Bank 3, effects sends and returns on Bank 4, and so on. This enables large numbers of I/O signal paths to be controlled from an extremely compact control surface — 24 strips are capable of controlling 288 paths. Also any path can be duplicated to a Bank, so, for instance, the main output fader can be assigned to the same strip on each bank for ease of access. Alternatively, if there is room to do so, the console can be laid-out more traditionally with a strip for each path.

Setting up the console is something that most users will do just once — set-ups being stored to floppy disc or DAT for subsequent recall. The console operating mode is set from the Graphics User Interface either by downloading one of the default states such as Record, Mix, Overdub, Broadcast, or by loading a user saved set-up.

Strips

The strip section allows local control and display of the more regularly used functions, it also provides access to the AFU where all parameter changes can be executed centrally. This gives the engineer the choice of operating locally on a per channel basis, or centrally by assigning all channel functions to central control. At the top of each strip are two columns of Function Indicators. These show at a glance which functions (EQ, filters, dynamics, etc) have been assigned to the strip and whether or not they're switched-in. Functions can be turned on locally with the aid of this display or centrally from the AFU. Other indicators confirm Phase Inversion, Stereo Mode, and 48 V Phantom Power. Also in this section is a twin arrow (East/West) nulling indicator shared between the strip's four rotary controls or FACs (Function Assignable Control). These shaft encoders are used for a variety of tasks including mic/line gain, aux contributions, pan, and EQ. Each FAC is surrounded by a segmented light display which behaves differently depending on the assigned function — gain functions are indicated by an increasing, decreasing block of light, frequency selection by a single illuminated segment, and cue by a crescent of light spreading from the centre. The controls are touch sensitive and an alphanumeric window placed above the top FAC displays either the status of the assignments or the value of the last touched control. Two arrow keys are used for switching auxs pre/post and on/off. FAC assignment is controlled from the AFU. FACs like other Strip controls can be linked together to form groups — so for example the gain on a group of mics could be reduced relatively — when a link such as this exists, a LED will light below the FAC as it is touched indicating that it belongs to a Link and will therefore affect other channels. The interrelationship of grouped controls can be changed by accessing the LINK ISOLATE key on each strip

SEND and RETURN buttons control Bus/Tape monitoring, and there is a LOCK key that isolates local selection from global switching. There are three types of solo available to the Strip — Destructive In Place, APL (After Pan Listen), and PFL — which are set globally. Muting is via a double-width key. At the base of the strip above the fader tray is the Strip Path Indicator which identifies the type of path currently assigned to the strip and whether it is under VCA control.

Above each motorised fader are two ACCESS buttons with associated display windows. These are responsible for assigning a Strip to the AFU, as well as being used in Routing, Grouping, Copying and Linking operations. Another function of these keys is to select between two Strip Banks specified by the user. The idea here is that the console can operate rather like a conventional in-line desk having a primary and secondary signal path. Normally, the upper ACCESS key would be assigned to the primary path, say mic/line inputs, and the lower to the secondary path, multitrack return. The windows associated with these access keys will display any prewritten channel ID, and the active bank will be displayed brighter than the passive bank.

The fader itself is marked with two scales — the usual gain/attenuation scale, and a Trim scale showing the -20 to +20 dB range of offset available in Trim mode. Apart from a null indicator, all other fader automation controls and displays are placed further up the strip. There are three separate sets of automation controls placed within the strip controlling — Fader, Mute, and FACs (including their associated switches).

Each strip has its own VHD (Vacuum Fluorescent Display) metering. This type of display uses fine dot matrix illumination making it possible to show other information such as EQ settings and routing. The default display shows input level, track send/return level, and dynamics metering, using large and mini bargraph sections. Ballistics are PPL but VU can be assigned to a separate display. There are also Peak Hold facilities, and tape machine Ready/Record indicators are placed at the top of each meter.

AFU

The Assignable Facilities Unit can broadly be divided into three areas. Firstly, it contains the various groups of controls necessary for controlling the assigned Strip, secondly, it globally assigns functions to the FACs on the Strips for local control, and thirdly, it controls selection of the 12 Strip Banks.

The EQ section consists of a 4-band parametric equaliser, along with a filter section. All functions have dedicated controls making the operation very straightforward; the rotary controls are the same type as used in the Strip. The equaliser controls are laid-out in four columns of three (FREQUENCY, GAIN, Q), and each band can be separately switched In/Out. The EQ is arranged into the following generously overlapping bands: LF (peak-shelf) — 16 Hz to 400 Hz, LMF (peak) — 125 to 3.15 kHz, HMF (peak) — 400 Hz to 10 kHz, HF (peak/shelf) — 800 Hz to 20 kHz. Each band has 57 steps at ½th-octave spacing, has variable Q of 0.5 to 9.00 and cut/boost of ±20 dB. Like the EQ bands, the two filters sections are separately switched; both High Pass (16 Hz to 400 Hz) and Low Pass (800 Hz to 20 kHz) can be individually selected to 12 dB or 24 dB per octave response, or to operate as notch filters with a -40 dB depth. At present there is no facility for automatically clearing settings, other than an AFU CLEAR key that zeroes all AFU controls assigned to the Strip apart from routing, or by copying an EQ section from an already zeroed Strip — a CLEAR button would make a useful addition to both the equaliser and dynamic sections.

The Dynamics controls are split into four vertical strips — Limiter, Compressor, Expander/Gate, and Sidechain Filter. Like the EQ, all controls are dedicated and arranged in a clear, easy to operate manner. The Sidechain Filter features a wide-band equaliser (25 Hz to 16 kHz, peak/shelf), Key assignment (with ID window), Inverse Key operation, Key Listen, and Delay Off which inhibits the delay set into the dynamics to compensate for attack time. Each of the three dynamics sections can be set up with unique sidechain filtering to create functions such as de-essing, de-popping, ducking, etc. Ten segment gain reduction metering is included on each dynamic ▶

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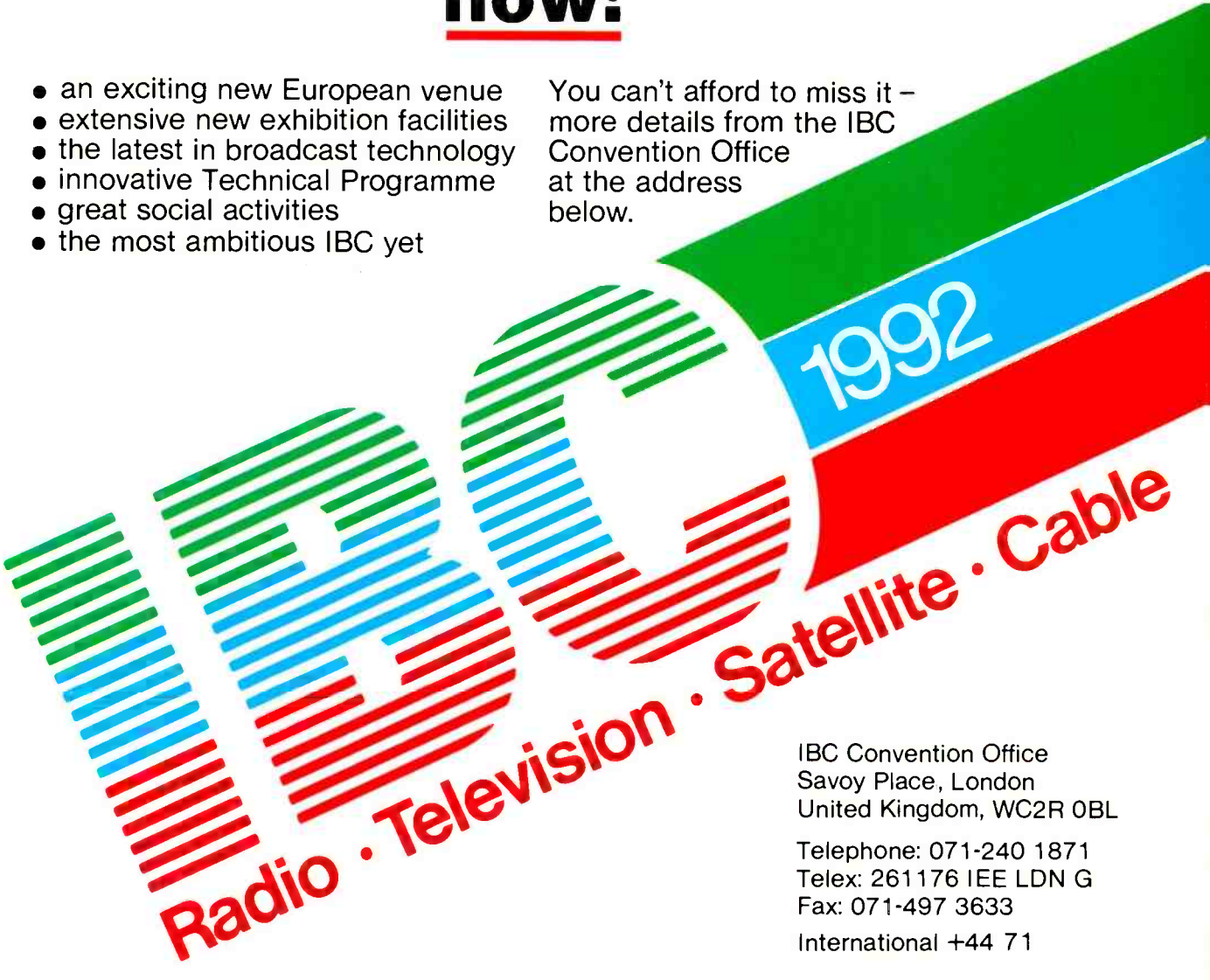

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section.

An Input Selection panel assigns A/B mic and line inputs to the accessed Strip, and adjusts level and balance. Stereo configuration and the selection of AES/EBU inputs are made from graphics menus. The A and B legs of the AES/EBU inputs may be swapped from the Input Selector.

All the AFU functions mentioned so far are mirrored in the AFU Vacuum Fluorescent Display. This display window either automatically follows the last parameter touched, or can be overridden by one of seven display keys (EQ, Comp, Input, etc) situated beneath the display. Apart from showing sectional detail of a Strip, the display will also display Strip configuration.

The 16 auxiliaries are arranged in two rows of eight. Each has a ROTARY control, PRE/POST button, CUT button and a destination window. If 16 are not enough, additional sends can be added per Strip using the multitrack buses and the AFU Track Contribution control. Master aux outputs and cues are controlled from the Monitor Section; both auxs and cues can be configured in mono or stereo.

The routing panel is positioned right at the top of the AFU section in the meter bridge. From here the routing to tracks (48 keys), subgroups (24 keys), Film Buses (4 keys) and main outputs (8 keys) is performed. The keys in each of these sections are double action allowing both for routing (full press) and interrogation (light press); there are two routing/interrogation modes — Forward and Reverse. In Forward, the ROUTING keys both select and display routing for the assigned Strip. Reverse mode allows the user to set up a routing configuration and then set it to the desired Strips by pressing their ACCESS keys; if a ROUTING key is pressed to its first level, the ACCESS keys will light on all the strips that have been routed to it. An Interlock facility allows keys to operate either in a latched or interlocking mode, and a CLEAR key will remove the currently assigned routing selection. The four Film Groups each comprise of eight buses; selecting a Film Group will change the pan law on the Strip to Left, Centre, Right and mono/stereo Surround can also be catered for.

The PAN/BALANCE control automatically matches the mono/stereo configuration of the Strip, and a separate WIDTH control is also available. Optional Delay can be added to the strip with a rotary control adjusting the amount up to 500 ms.

At the left side of the AFU is a duplicated section of Strip controls which allows other functions, such as fader and mute, to also be controlled from the AFU. In fact the entire Strip section can be controlled centrally without the engineer needing to move — even Strip assignment can be made from here using a step selector. If, on the other hand, the user prefers to work in a more traditional way, control can be allocated locally. This is done from the FAC Selection panel in the AFU where various functions, as previously described, are assigned to FACs on the Strip section. The faders may also be used to control other functions — for example auxiliaries can be assigned to faders to create a fast and intuitive cue balance, add automation to that and its possible to have discrete, automated foldbacks!

The assignment of Banks to Strips is also dealt with from the AFU, including Primary and Secondary Banks. The 12 Bank access keys are arranged top and bottom of a large VFD window showing current Bank selection. The assignment of actual signal paths to Banks is carried out using the computer.

Monitor section

The Monitor Section lies directly to the right of the AFU and is divided into a number of control sections.

Control Room monitoring provides access to four speaker circuits including a separate PFL speaker, and allows Phase Inversion (momentary), Mono switching, Cut Left, Cut Right, and Left/Right Swap (momentary). Five monitor source buttons are provided — OUTPUT, EXTERNAL, AUXILIARY, CUE, and FOLLOW ACCESS (monitors the accessed path rather like a solo). These selections are used in conjunction with a 16 key switching matrix to specify the source — O/P 1 and 2, Cue 1, Aux 5 and 6, Ext 3 for example. A display confirms the selected source, below which are LEVEL, CUT, and DIM controls. The same method of sourcing is used in the SLS/Phones section, and in the Cue section which also uses the switch matrix to select the 16 cue outputs. As with the Strip, Cues can be assigned to the AFU where their level may be controlled directly from a fader and EQ added. Cue outputs can be metered on the dedicated cue/aux meters at the top of the monitor section, which are switched to display cues 1-8 or 9-16. The Auxiliary Master section operates in the same kind of way as the cue also having access to the AFU. Displays are also provided for metering the main bus outputs, phase and so on.

Solo master controls allow Solo In Place, PFL, and AFL to be set up separately for Input, Monitor and Group paths; the SOLO keys may be switched between Interlock, Momentary or Latch. A Solo Memory facility allows groups of solos to be set by the press of a single key — if using this with Solo In Place, it can act as an inverse mute group. ▶

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Other facilities in this section include an Oscillator; level adjustment for Dim, APL, PFL, and Talkback; 10 Talkback Groups; Bus/Tape Master switching; Red and Green record lights; tape machine track control for simultaneous control of up to three 48-track machines and a further 12 ancillary tracks, providing Rehearse, Ready and Record Enable functions as well as Input, Sync, Replay switching; comprehensive transport control of up to six machines with Locate, Shuttle, Jog, Cycle, and Auto Record functions; VCA Group, Link, and Copy (allows selected control settings to be copied between selected Strips). The remaining areas of control are connected with the Graphics User Interface and automation system.

Graphic user interface

The Graphic User Interface is used for system set-up operations and adjustment of parameters and configurations that are difficult or unnecessary to provide for on a hard control surface. The high resolution, multi-colour screen is split into three main areas — the largest is the Applications Window where the majority of information for the current function is displayed. To the right of this is the System Icons region where a hierarchical arrangement of available functions is presented in icon form. Running along the bottom of the screen is the System Status area, that displays Timecode, Tape Machine Transport Status, Automation Modes, Glide Times, and Crossfade Time and Law. The Application Window may be further split to provide three active background partitions — these could for example concurrently show the Path Map (the configuration of the accessed path), Mix Tree structure (a family tree of mix passes), and a Label (cue) list. Each partition can be 'zoomed' to fill the whole window, and interaction is performed via dialogue boxes that overlay the screen.

The two main areas of control on the console are from the trackball situated at fader level on the monitor section, and a Soft Panel which provides 12 software labelled buttons. The keyboard and keypad are, of course, also used. A HELP button will flash-up function specific prompts, which in turn allows access to an on-line user manual giving more comprehensive information — text can be supplied in various languages.

Automation

The automation system is extremely comprehensive and to describe it fully would require another article — for now a basic overview will provide a flavour.

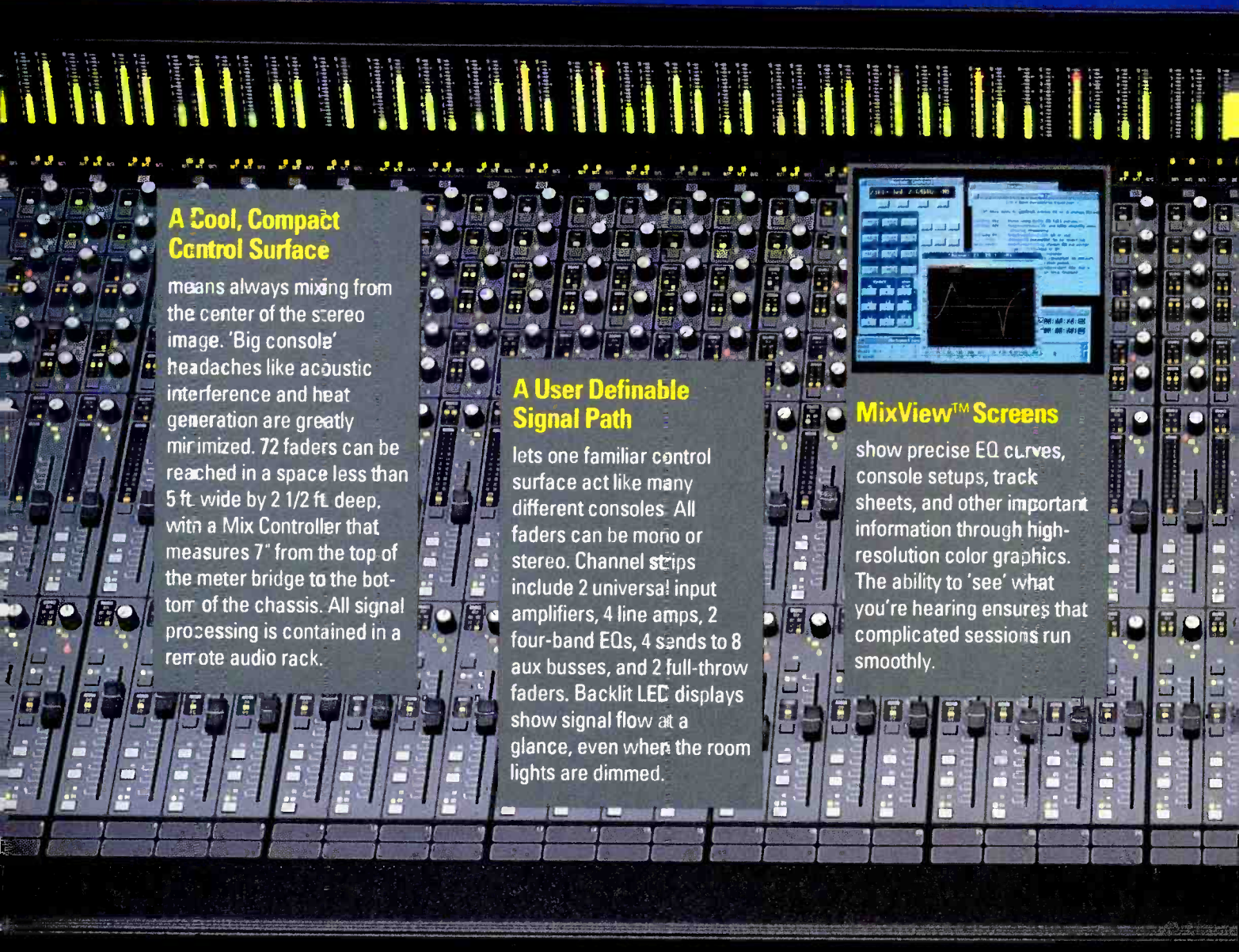
Automated controls fall into three types — Faders, Mutes, and Switches or Knobs. Each type can be set to an individual automation mode either locally or globally, or the entire console can be switched globally. The usual Record, Play, Update and Isolate modes are incorporated, with Trim (static or dynamic ±20 dB) for faders only, although other controls can be relatively offset by a different means. Touch Record and Lock Record modes perform in the same way as *Flying Faders* causing the control to drop-in to record on touch and to either drop-out on release or remain writing to the end of the pass. Switches and mutes have a Match facility that resets them to the previous pass position during an update. Glide returns faders or knobs to their previous pass positions at a defined rate, and Auto Match has the same effect once the control is released. Off-line editing of mutes, switches, events, trims, etc., are catered for, and there are comprehensive facilities for merging, moving, copying, and comparing mixes.

Like *Flying Faders*, there is a hierarchical filing arrangement of Client, Project, Title, Mix, and Pass. All passes of a mix are automatically saved to hard disc and displayed in the Mix Tree from where they can be retrieved at any time — master mixes can be removed on floppy or DAT.

Conclusion

Capricorn heralds the beginning of an exciting new era for the mixing console as well as the all digital studio. It offers an enormous number of facilities in a compact design while retaining operation familiarity — users of V Series and *Flying Faders* will find it especially intuitive. The console's flexibility allows it to be configured and operated in numerous ways to suit both personal and practical requirements, with the instantly resettable nature of the system adding to its versatility. Great care has been taken in ensuring that audio quality is not compromised in anyway, and throughout there is general evidence of attention to detail. The price tag at last makes the digital console a realistic proposition, and studios currently in the market for a top-end desk should think very seriously about this alternative. I have the feeling that *Capricorn* is going to be a great success, particularly as there appears to be little in the way of direct competition at the moment. ■

TOTAL AU



A Cool, Compact Control Surface

means always mixing from the center of the stereo image. 'Big console' headaches like acoustic interference and heat generation are greatly minimized. 72 faders can be reached in a space less than 5 ft. wide by 2 1/2 ft. deep, with a Mix Controller that measures 7" from the top of the meter bridge to the bottom of the chassis. All signal processing is contained in a remote audio rack.

A User Definable Signal Path

lets one familiar control surface act like many different consoles. All faders can be mono or stereo. Channel strips include 2 universal input amplifiers, 4 line amps, 2 four-band EQs, 4 sends to 8 aux busses, and 2 full-throw faders. Backlit LED displays show signal flow at a glance, even when the room lights are dimmed.

MixView™ Screens

show precise EQ curves, console setups, track sheets, and other important information through high-resolution color graphics. The ability to 'see' what you're hearing ensures that complicated sessions run smoothly.

The Crescendo System II

The Crescendo System II combines the wide dynamic range and smooth frequency response of analog signal processing with the power and flexibility of digital control. The result is a studio control center that helps to produce superior projects quickly and efficiently. If you're looking for a system that provides Total Automation™ and the highest sound quality available, consider the CSII from Euphonix.

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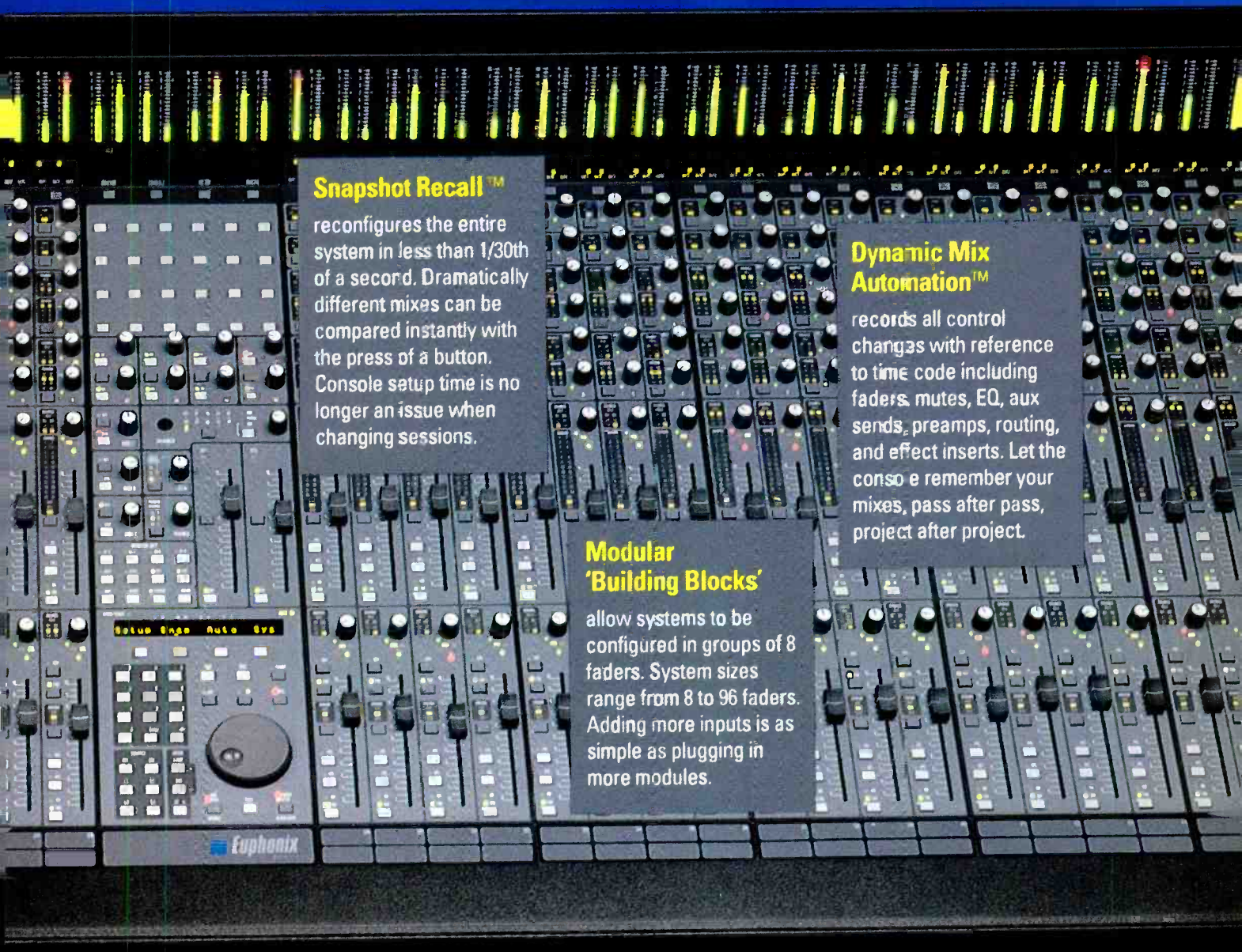

Snapshot Recall™

reconfigures the entire system in less than 1/30th of a second. Dramatically different mixes can be compared instantly with the press of a button. Console setup time is no longer an issue when changing sessions.

Dynamic Mix Automation™

records all control changes with reference to time code including faders, mutes, EQ, aux sends, preamps, routing, and effect inserts. Let the conso e remember your mixes, pass after pass, project after project.

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allow systems to be configured in groups of 8 faders. System sizes range from 8 to 96 faders. Adding more inputs is as simple as plugging in more modules.

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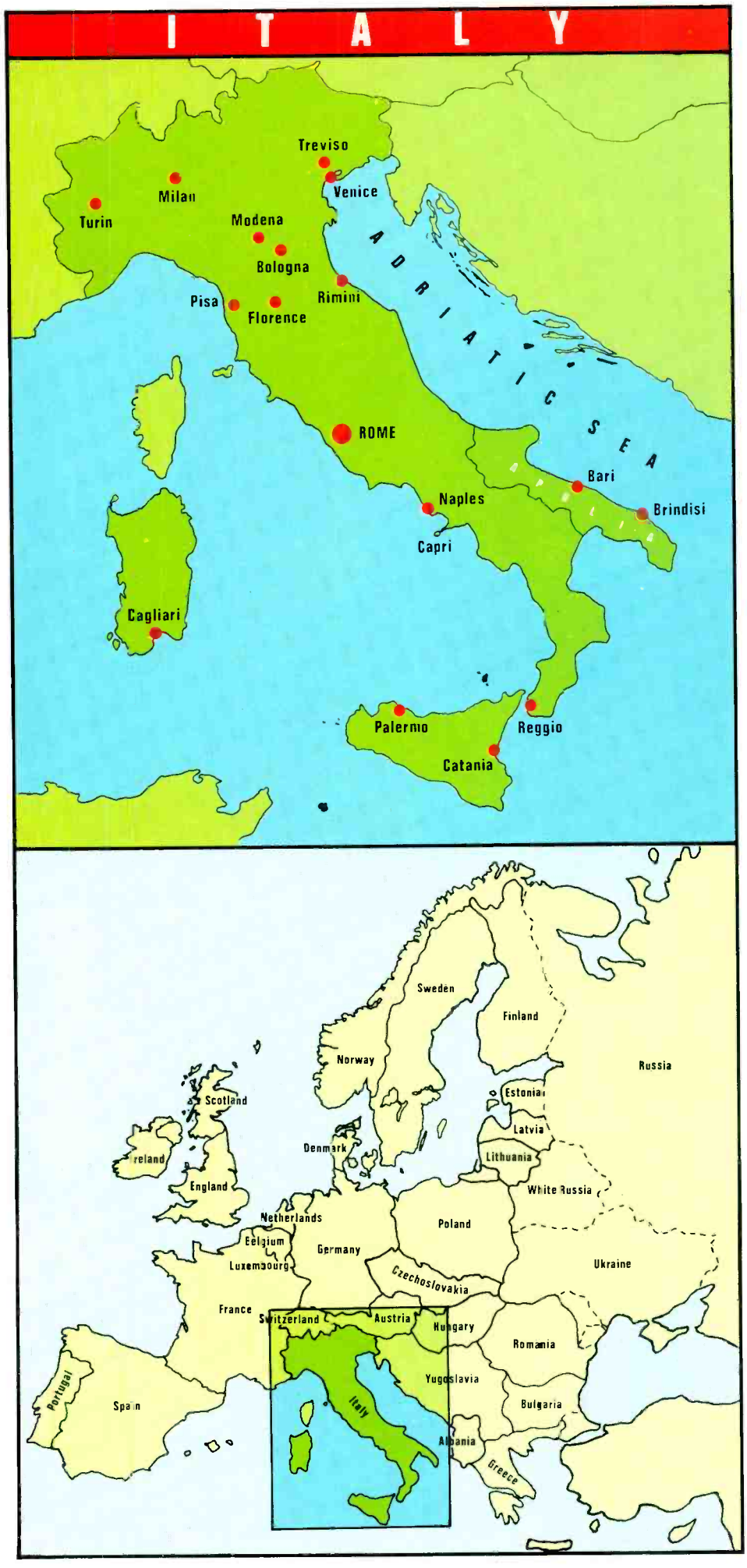

THE GRAND TOUR

Part Three of our European Survey discovers Italy. Caroline Moss & Mirco Bezzi get down to the heel.

Italy stretches roughly 700 miles from its Northern borders to the tip of the boot, a strip of land less than 150 miles wide travelling south-east, surrounded by five seas, bordered by four countries and populated by 57,500,000 inhabitants. As you head towards the toe rising temperatures are matched by a slowing pace of life, diminishing industry and increasing poverty.

Most of Italy's trade is based in the north and the recording industry is no exception, the highest concentration of studios and record companies being in and around Milan. However, two further recording centres — Rome and Naples — as well as a fair amount of choicely appointed residential studios, mean the country is quite well covered. Whatever your requirements of environment, temperature, temperament and cuisine you should find a recording location to suit you. Language shouldn't be a problem except in remote parts of the country and studios which intend doing international business should have at least one person who is fluent in English or other European language.

Italians are renowned for their warmth and hospitality rather than their organisational skills. If you are prepared to trade predictability with beautiful surroundings, sunshine and wonderful ▶

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cuisine then Italy could be the place for your next recording project.

Getting Around

Direct flights operate from London to Rome, Milan, Venice, Pisa, Naples, Bari, Turin, Bologna, Brindisi, Cagliari, Catania, Lamezia Terme, Palermo and Reggio Calabria, and from Manchester to Rome and Milan. Flights from the UK and Eire are operated by Alitalia, British Airways, Air Europe, Aer Lingus and BIA.

By car the distance from London to Rome is 1,124 miles via Calais, Bologne and Dunkirk and 1,084 miles via Oostend and Zeebrugge. Milan is 400 miles closer. The journey to Italy from the continental ports takes about 24 hours on good, mostly toll-free, roads. The Italian government offers a package of reduced-price petrol coupons (15-20% off) and highway toll vouchers bought in advance from the AA or RAC.

Once inside the country domestic flights are plentiful given the country's 25 airports. Reductions of up to 50% are available for family travel and 30% for night flights.

Customs and Visas

For a stay of up to three months a visa is not required by most nationalities, but it is wise to check with the Italian Consulate. Citizens of several countries, including former Eastern Bloc countries, will need an entry or transit visa. Italy and Israel are currently negotiating a no-visa agreement.

Goods can be brought into Italy duty free provided they can be proved essential to the owner's trade. However, large amounts of equipment should be listed on an EEC carnet (available from HM Customs and Excise) if travelling from an EEC country or an ATA carnet (available from the London Chamber of Commerce) if travelling from, or through, non-EEC countries.

The Recording Industry

Although Italian music has long been one of the country's strengths and trademarks, the same has not always been true of its recording industry. But over the last five years a spate of refurbishment, upgrades to new technology (often skipping over several generations of development) and construction of new facilities means that Italy now has studios that can compete on an international scale.

A wave of studios converted to digital technology in 1989 with Mitsubishi being the most quickly adopted format. As well as adding new technology, many studios were also renovated and residential facilities added or improved. Around the same time Italy's dance music started gaining international credibility after years of Euro-pop. Since then other Italian popular artists have found fame elsewhere, notably Zucchero, who has worked with Paul Young, Eric Clapton and Sting. Better quality recordings have led to more demand for Italian language records in Italy, resulting in more producers' and musicians' private studios being built and a general increase in studio activity.

The amount of Italian pro audio manufacturers is still small but growing steadily. For a country with over 9,000 transmitters it's not surprising that the main growth area is the manufacturer of small broadcasting equipment. Other manufacturers include Montarbo (Digital measuring equipment), Audiomatica (VCA and moving fader automation systems), RCF (loudspeakers), Brunetti (*PAR400* equalisers), Heri Elettronica (outboard equipment), Pastega Elettronica (radio microphones) and Tapematic (tape duplicating equipment). However, Italian dealers of foreign products are taking on more and more new products and offices are being opened by foreign manufacturers, most recently by d&b audiotechnik, the German loudspeaker manufacturer.

Hire companies don't really exist in Italy ▶

STUDIO SPOTLIGHT

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Production Room
Soundcraft *1600* 24-channel console.
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Enertec *F462* quarter inch tape machine.
Urei *811* main monitors, Yamaha and Genelec nearfield.
Selection of outboard equipment and microphones.
90m² wood and stone live room. with natural light.
Condulmer is situated on the 360 acre Condulmer Estate. Accomodation is at the sixteenth century Villa Condulmer. Recreation on the estate includes horse riding, swimming, golf and tennis.

although audio distributors can sometimes help out. However, Hilton Sound's Paris branch is quite often used by Italian studios, usually for long-term rentals of larger pieces of equipment, and Hilton are in the process of setting up an office in Milan.

Mobile studios are a fairly recent trend in Italy. The first commercial mobile was built by Cetra Art Recording in Milan, owned by the Fonit Cetra state-owned record company. Five new mobiles entered the market in the latter part of last year, the largest being the multi-media White mobile with a 30m² control room.

Italy's national TV and radio broadcaster is the RAI with centres in Rome and Milan. But the remainder of Italian broadcasters — thousands of radio stations and hundreds of TV channels — operate as pirates. New legislation is currently underway to grant official licences to radio and TV broadcasters.

Organisations

Although there is a musicians union in Italy its role in the recording process is practically non-existent.

The Italian AES division is based in Milan and meets once a year at the IBTS in October. There is also an Italian branch of SMPTE, founded in 1989 to deal with technical standardisation and work in the TV and film industries.

Although there is no official body for producers and engineers, the AFI (Italian IFPI or record company organisation) represents the rights of producers whose work is used for TV broadcasting. The AFI also continues to battle against Italy's huge piracy and bootlegging problem.

The Studios

As already mentioned, Milan is the main recording centre, although a number of its smaller studios have had to close their doors in the onslaught of home recording. One of the most established and well known is Morning Studios, co-owned by renowned mix engineer Renato Camtele and Red Canzian, a member of Italy's oldest and biggest rock band, Pooh. The studio, which went digital in 1989, is used for mixing by many top Italian stars, in preference to travelling to London or New York, and is generally booked out six months in advance.

Other top Milanese studios include Metropolis, which recently installed a new SSL *4056G* with *Total Recall*, Logic Studios, which became the first 48-track digital studio in 1989 with the purchase of a Sony *PCM3348* and which has a new A/V post production suite and Cetra Art Recording. Owned by the state record company Fonit Cetra, the studio was the first to install a Sony digital multitrack in 1986, later adding a Mitsubishi.

Condulmer Studios is 150 miles east of Milan in

Treviso, just north of Venice. Situated on the 360 acre Condulmer Estate, its tranquil location and high level of technology make it one of Italy's most popular studios for international clients, namely Simply Red, Miriam Makeba and Rain Tree Crow.

The Bologna region is a growth area for studios. In the town itself is the John Flynn/Sam Toyoshima-designed SSL studio Fonoprint, with Sony and Otari digital machines. Medicina was closed last year and its owners are building a new studio complex, to be called Esagono, in an old Parmesan cheese factory near Modena. Esagono will have residential facilities, rehearsal rooms and an open-air stage. The Medicina Group's other studio, Medicina Blanche near Modena, continues to be very busy. The Black Box dance team are from this region and now have three studios.

Nearby Rimini is also the choice of several small dance producers for building new, small studios. The area already boasts Heaven Studios, one of Italy's first SSL studios. Situated on a hillside with panoramic views over countryside and sea, Heaven offers residential facilities in the form of wooden bungalows around a swimming pool.

Further south in Florence, producer Alberto Pirelli has built a new digital studio called IRA Sound Lab based around a Soundcraft *3200* console and a Mitsubishi *X880* multitrack. Other studios in Florence include Studio Emme and Studio Uno Italia.

Rome is the centre of Italy's film industry so it's not surprising that it is home to the first digital film and video studio in the country, Digital Film Sound, which boasts a Synclavier *9600* suite. Another Roman studio is the aptly named Forum. One of its three recording rooms is able to accomodate a 90-piece orchestra, explaining the large amount of film soundtrack work undertaken. Equipment includes SSL and Harrison consoles and a Mitsubishi digital multitrack. Producer Claudio Mattone's studio was just refitted by Flynn & Toyoshima while a recent addition to the city's studios is the SSL digital studio Suona di Ripetta.

Down in Naples the main studios include SSL facility Splash, Saje studio Aita, Executive and Studio 52. But most recent excitement in Italy has originated from the Bay of Naples with the opening of Capri studios on the eponymous island. Linked by helicopter to the Italian mainland, the studio includes an SSL *G* Series desk with Real World cue matrix and Ultimation. Its international appeal was underscored by the opening session; Sting recording with Italian superstar Zucchero. ■

USEFUL CONTACTS AND INFORMATION

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British Embassy, Rome. Tel: +39 (6) 475 5441.

Italian Embassy, London. Tel: 071 629 8200.

Italian Consulate, London. Tel: 071 235 9371.

Italian Tourist Board, London. Tel: 071 408 1254.

Alitalia, London. Tel: 071 745 8200.

AES Italian Branch. Tel: +39 (2) 2514 7794 (Secretary Gualtiero Berlinghini).

AFI (IFPI Italy). Tel: +39 (2) 669 6263.

Morning Studios. Tel: +39 (2) 508 4326.

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DOWN ON THE RANCH

Yasmin Hashmi & Stella Plumbridge report on the headway that digital hard disk systems are making in American post-production studios

It's one thing to gauge how tapeless systems are developing by seeing them demonstrated at pro-audio exhibitions but quite another visiting some of the leading US post-production facilities to see how they operate, whether the technology is catching on and which systems are making headway.

Eastside Film and Video, based in Manhattan, New York, is a high-end audio post for video facility and is currently refurbishing its studios. They first bought an NED *PostPro* for non-linear editing, but when the time came for expanding these capabilities, they did not follow the usual pattern of purchasing successive systems of the same make, rather they opted for SSL's *ScreenSound*. At the time of writing they already had two *ScreenSounds* and were thinking of purchasing a third. Jim Williamson of Eastside said that *ScreenSound* was chosen because it had an intuitive user interface and that it only took the operator three days of familiarisation before they could start charging clients. With possibly three in-house *ScreenSounds,* the question arose as to whether networking using SSL's *SoundNet* was the next move. The reply was that each studio has one *ScreenSound* and the type of work undertaken can currently be satisfied within each studio. However, this may change in future.

Skywalker Ranch, owned by George Lucas, is one of the most prestigious audio post for film facilities in the world. It is located in quiet countryside on the outskirts of San Francisco and is so remote that it has its own fire engines on-site. Lucas not only wanted it to be well designed technically, but also to be aesthetically pleasing, blending with its surroundings. The Ranch therefore, does not announce the nature of its business and could easily be missed from the winding country road. It took two and a half years to build and has been operating for the past four years.

The studios resemble traditional American timber-framed buildings and are built around a small lake. Inside, there is a feeling of tranquility, with plenty of natural light, plants and tasteful furnishings. The environment is so peaceful that one would never guess that there may be up to 100 employees in the building at any time. The facility

Top left: Screen Sound digital audio system

Top right: A screen from the NED Sounddroid audio editing system

Bottom left: Skywalker ranch; the Technical House.

Bottom right: Skywalker ranch; the mixing stage.

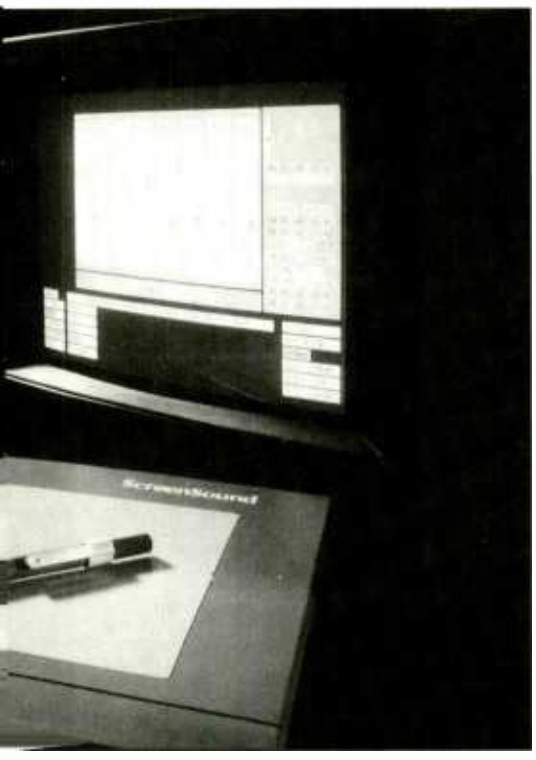
boasts two large three-man mix rooms, two smaller mix rooms (for premixing and sound design), a foley stage, ADR stage, a large scoring room and a screening theatre. The screening theatre has a large screen, seats around 300 people and is fitted with THX. The foley stage is specified to 5 dB below the threshold of hearing and has a multitude of walking surfaces such as genuine cobblestone and sound effects instrument including a Morris Minor convertible.

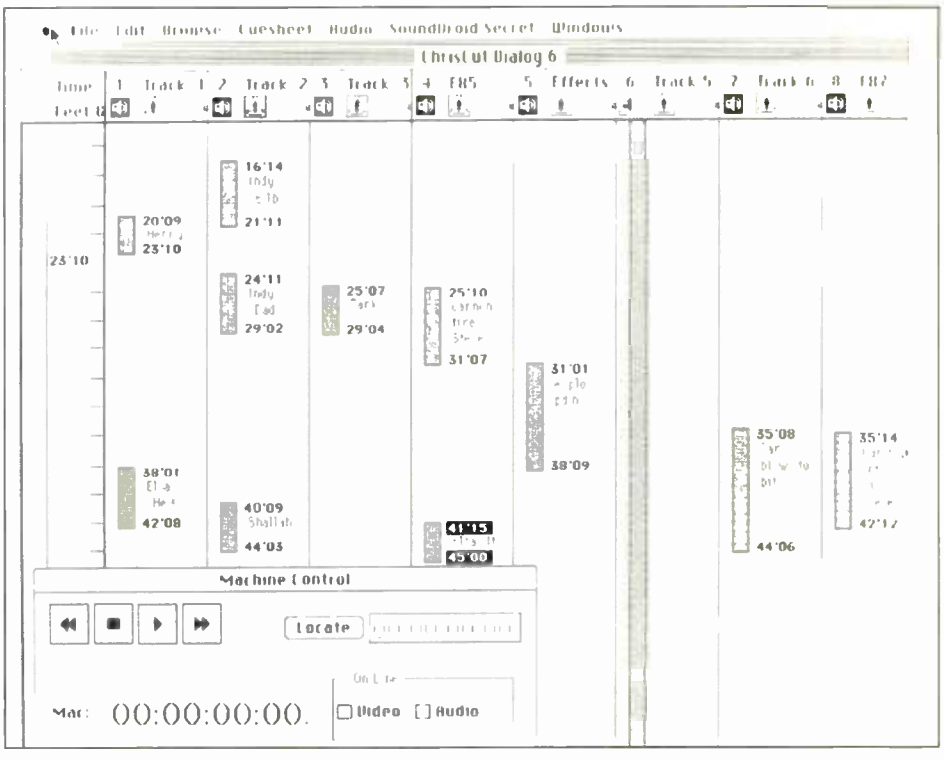
George Massenberg, while recording Linda Rondstadt, reputedly said that the scoring room was the best he'd ever recorded in. It contains a large screen and has wall panels that can be adjusted to give reverberation from 2.7 s to 8 s. It also has panels on the ceiling that can be electronically adjusted.

For post-production, Skywalker hold the record for the greatest number of NED systems which currently stands at nine. These comprise three of each of the *Synclavier, PostPro* and *PostPro SD*. Brian Kelly, the Project Manager for Editing Systems, explained that they chose NED because at the time only *PostPro* and WaveFrame's *CyberFrame* were capable of dealing with heavy duty feature film work. *CyberFrame* was designed as a mono dialogue editing machine and did not deal with stereo very well. In addition, the *PostPro* could be used either as a stand-alone, or transparently integrated with the *Synclavier* for sound design purposes.

Originally from Glasgow, Scotland, Kelly has been with LucasFilm for the past nine years. He used to work for Neve and in collaboration with SSL, designed the film mixing console for Lucas which is now marketed as the *5000F*. He also helped in the design of the studio and is currently working on the refinement and expansion of *SoundDroid* software. This should not be confused with the original *SoundDroid* system that was one of the first tapeless systems to be built. Although a feat of engineering at the time, it was not designed to be produced in numbers and now sadly languishes somewhere in the basement because it is not considered worth keeping operational.

Kelly's *SoundDroid* software operates with NED systems and provides both on- and off-line spotting features. Shipping of *SoundDroid* was due to commence at the time of writing. New enhancements include the ability to cut and paste parts of the edit list, which will automatically re-adjust timings, simple assignment of crossfades and the ability to split a cue across tracks easily. It will also indicate how much of a cue is not used (that is the areas outside the in and out points) and allows the in and out points to be kept locked against the events list timing whilst sliding the cue back or forth underneath the points. In





addition, the on-line versions can audition cues from the *PostPro* directory which can be dragged into the edit list. There are now many different ways of listing, printing and displaying lists and search features have been greatly expanded. The on-line software will cost around $4,000 (£2,367 approx) and the off-line version around $1,800 (£1,065 approx).

Since there is potentially much interaction between rooms at the Ranch, the idea is to network the NED systems as soon as this becomes possible. However, Skywalker are already using available networks in some interesting ways. Kelly works for Tom Scott who is the Director of Skywalker Sound (the post-production division of LucasArts Entertainment). Skywalker Sound North is based at the Ranch, with Skywalker Sound South based in Los Angeles. The entire company is networked using *Ethernet* and there is a T1 digital telephone link between the South and North studios. There are currently around seven beta tests sites for *SoundDroid*, including the LA studio, and, if any problems occur, they can be solved using *AppleShare* networking via the T1 line.

However, the T1 lines have other uses, including carrying phone lines, computing information, accounts *and* high quality audio (normally Dolby stereo). This had led to an extraordinary implementation of real-time networking between the South and North studios. An example of this was when Ron Howard was directing the mixing of the film Backdraft. Howard was in the LA Studio, but the mix was being done at the Ranch. Both studios had a copy of the picture and these were synchronised by sending time code/biphase through the T1 line. The audio, being mixed and synchronised to the picture at the Ranch, was also sent through the line which allowed Howard to listen live in LA and make decisions that could immediately be implemented back at the Ranch.

Another use of the system is providing the Ranch with a live audio source from LA. An example of this was when the Ranch needed some ADR from Arnold Schwarzenegger, who was in LA. Both studios again had synchronised pictures, but this time 'Arnie' provided the source, speaking his lines in the LA studio, but which were recorded, via T1, at the Ranch. Since many actors will be in LA rather than in or around San Francisco, this facility can prove extremely convenient and cost effective.

LucasFilm were also responsible for creating one of the first disc-based picture editing systems, namely *EditDroid*. There are 30 of these in existence, six are based at the Ranch and the remainder are on rental to other facilities. The system uses laser discs (with non-compressed data) and allows the generation of frame accurate negative edit decision lists in various formats, irrespective of which frame rate is being used by the video or film.

It seemed that wherever we went in the USA, someone had something to do with the sound for Terminator II. Skywalker was no exception and, amongst other things, provided all the custom effects which were generated on *Synclavier*. By all accounts, this picture has proved to be one of the most challenging and demanding with constant last minute changes, not only to the sound, but to the picture once the sound had been mixed. If ever there was a need for non-destructive editing, this would be a prime example — one feels almost obliged to see the film if only as a tribute to all those who toiled relentlessly over it.

Universal City Studios, near Los Angeles, provides another typically US superlative as being one of the most famous film studios in the world. The Sound Department is run by Bill Varney whose Chief Engineer is David 'Doc' Goldstein. Goldstein used to work at Warner Hollywood and has been at Universal for the past six years. They currently have a *SoundStation II* and a *Sonic System*. The *SoundStation II* is an eight-channel system with *WordFit* and *TimeWarp* and is used mainly for dialogue editing (sound effects prelaying is still being done using tape machines). It was chosen because of its user interface which was felt to be more familiar to editors and less computer-like. It only required one day's training for the operator to become sufficiently familiar with the system (although he was already used to the technology).

The *Sonic System* supports four channels with digital mixing and *NoNoise* and at the time of writing, Universal were beta testing Sonic's film editing software. The system has been used extensively to clean up old sound tracks for re-releases such as 'Dracula', which took two and a half days to de-crackle alone. An *Albrecht* is used for the playback of the old optical tracks and the sound is transferred digitally to the *Sonic System* via a DAT machine. Although the DAT machine does not have time code, Goldstein maintained that they do not encounter synchronisation problems because its speed is so stable. The audio is kept in the digital domain for as long as possible and the department is planning a digital archiving programme that will consist of storing the audio on Mitsubishi *X-880 PD* format.

The studio works as an independent company, with at least half of its business provided by companies outside Universal. In-house work includes reworking films for television and the airlines. It has five dubbing rooms and stages for ADR, foley and scoring. Dubbing rooms 1, 2 and 3 share the same machine room. Within the machine room, equipment is subdivided for each dubbing room, but the close proximity means that any equipment can be routed to any room. This means that any of the three dubbing rooms can act as a film stage or video stage simultaneously and all machines (including a number of multitrack playback machines) can be controlled from one ▶

to the multi-control is the *MC2 11* e by Jim Ketchum. This provides time code, biphase and RS422 outputs.

The dubbing rooms can handle any kind of film or tape and each have a three-man mixing console. The range of consoles within the studio include Harrisons, Quad 8s, an SSL *5000*, a Neve and a Neotek in the foley stage. Dubbing room 4, called the Hitchcock theatre, sports the SSL and has its own machine room containing 40 machines, each capable of providing from one to six tracks. The Hitchcock Theatre has been used for many of Spielberg's films (such as Back to the Future) and is reckoned by Goldstein to be the best dubbing theatre in the world due to its unique combination of people, equipment and film acoustics. Dubbing room 5 is a small room that is used for all types of work including film, video, foreign dubs and sound effects editing.

The ADR stage can use film or 24-track tape. Goldstein maintains that the difference between Universal and other post facilities is that in Universal, film and video are always locked together. This means that with around a third of the business being video-based, no time is lost in switching between one format and another. During our visit, the foley stage was being used for 'Murder She Wrote' — the artists' performances being recorded to film. The speed and accuracy of such professional foley artists cannot be matched using a digital audio workstation and sound effects library combination — particularly if the same dynamic expression and range of effects are to be achieved. This was confirmed by Goldstein who stated that Universal use tapeless systems where they make sense, but not for foley.

Todd AO provides yet another superlative, claiming to be the largest independent post-production facility in the world. Based in both Los Angeles and New York, Todd mainly specialises in feature films and episodic movies and has around 19 stages and a modest 37 Otari *MTR 90*s! John Haeny, who helps run the facility used to work in the music industry before moving to film 10 years ago. He maintains that there are a lot of applications where tapeless systems are used where they need not be and often their primary use is to attract a certain type of client. He is sceptical of the current usefulness of tapeless systems when it comes to sound editing for feature films, stating that typically, a film can use between 60 to 200 tracks of sound whereas tapeless systems generally provide only 16 or 24 channels at most. He added that another drawback is loading time, plus the time it takes to label cues and maintains that a soundtrack can be cut using a multitrack tape machine in the time it takes to load a tapeless system.

Haeny does, however, feel that the dialogue editing process may benefit from tapeless system technology since episodic shows can be compiled using only eight tracks. He also feels that they are perfect for ADR and foley because they can control backwards time code locked to tape. But samplers provide more manipulation of sound than conventional equipment, which is why Todd currently have three large *Synclaviers* and nine *Adap I* systems for sound effects/design as well as Digidesign's *Sound Tools*. These were used extensively for films such as 'RoboCop III' and for environmental and special effects for 'Robin Hood Prince of Thieves' (which used 84 tracks just for bows and arrows sound effects). As one can imagine, Todd's sound library is huge and employs a full time librarian. Apart from the *Synclavier*, which is backed up on MO, the library is backed up on DAT.

With respect to multichannel tapeless systems, Haeny stated that Todd are going to bite the bullet, but that they're going to take their time. He would be encouraged if multichannel MO drives were to become widely used, but believes that tape still has 5-10 years more as the principle mode of transportation. Before Todd were to move in this direction, they would have to be sure that there is a system that will suit their purposes. Haeny believes that form and function are even more important than how the system sounds and it would need to be capable of revolutionising or streamlining their current operations.

Haeny added that a strong point in favour of any tapeless system manufacturer is if they allow non-proprietary peripherals to be used with the system. Clear information on how much software upgrades were likely to cost and whether hardware upgrades would be needed would also be appreciated. However, perhaps most importantly, the manufacturer should be able to provide satisfactory backup and customer support — an issue that is bound to affect the eligibility on non-US-based manufacturers.

With so much potential input to offer, it is perhaps surprising that Todd AO have not yet been consulted by a single tapeless system manufacturer. Nonetheless, when they make their assessment of potential tapeless system candidates, they will have a predesigned test procedure consisting of both objective and subjective testing. Despite the reservations, Haeny admits that features such as time compression/expansion and non-destructive editing are making tapeless systems increasingly irresistible.

Unfortunately, our itinerary prevented us from visiting Columbia Westside Studios which holds yet another world record in having the greatest number of *CyberFrames* in the world — they currently have 21 systems. But in a country full of superlatives, it is no surprise that the USA leads the way in tapeless system application. ■

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Built to blast!

A technical report by Sam Wise on Australian Monitor's *AM-1600*

As a contrast to last month's amplifier review, we asked Steve Smith of the Sound Department to let us test this import from Australia. It is a no-compromise brute of an amplifier, making no concession to weight or the transient nature of audio signals, and is designed to be just as happy powering a shaker table as it is a loudspeaker. This contrasts with the *Chameleon* design, which is optimised for price and weight while still achieving high output power under music drive conditions. The Australian Monitor is rated into 2 Ω (single channel) or 4 Ω (bridged) which the *Chameleon* is not. Another difference between *Chameleon* and *AM-1600* is in output devices, the former using bi-polar transistors, the latter MOS-FETs.

Continuously driven, the Australian Monitor is rated to deliver 810 W into 4 Ω per channel (both driven), while the *Chameleon* achieves 650W. But on the Australian Monitor 'dynamic power' rating, 950 W per channel into 4 Ω (both driven) is specified. This dynamic power rating is according to the E1A standard mentioned last month. *Chameleon* achieves a measured 940 W/channel according to this standard, an almost identical rating. But what does 'continuous' as stated by Australian Monitor mean compared to the *Chameleon* two minutes on, eight minutes off 'sinewave power' rating? And, the final question is, what does this mean in audio application terms?

First impressions

This looks like an AMPLIFIER. As my son so aptly put it, 'if it was a person, I wouldn't want to get hit in the face by it'. The front panel is of 6 mm thick aluminium extrusion, with a grey satin anodised finish having dark blue and black screen printed lettering. The centre of the panel is made of a further black anodised plate having white lettering. The contrast and style of lettering makes things easy to read. At the left and right ends of the front panel, massive black handles are mounted, protecting the large fan grilles beneath them, and also preventing damage to the other front panel controls. The handles were not particularly easy on the hands, having fairly sharp edges.

The centre of the panel is occupied by the mains power rocker switch, with thermal cut-out indicator above. At the left and right of this are the level controls and meters, which are described in detail later. This central panel is held on by four allen head machine screws, and has the meter PCB attached to the rear. Servicing access is relatively easy, but the unit cannot be directly unplugged for exchange.

The rear panel is constructed of the same massive extrusion, which is not only 6 mm thick, but has a 35 mm deep return on the rear which stiffens it, and provides the slots for nuts mounting the equally massive heatsink extrusions running front to rear. These heatsinks, which are the left and right chassis members, are 110 mm x 125 mm in section. Each forms a tunnel in the centre and on all four sides through which air is forced by a fan mounted on each. Airflow is from front to rear.

Even though strongly built, the manufacturers recommend that both the front and rear are supported in rack mount applications. The *AM-1600* is more conventionally proportioned than the *Chameleon*, being 3 U in height and about 370 mm deep (omitting connectors).

Internals

The sheet steel top cover is held on by six screws each side and two in the centre of the top. The cover protruded a little on the top between the amplifier sides and central fixing screw. This could cause the amplifier to bind to equipment above

when rack mounted, so some additional top fixings are recommended. Following removal of the top, the bottom cover is retained only by two centre fixing screws.

Channel electronics can be unplugged and easily removed as a unit for quick servicing. To get at the power devices the whole heatsink assembly must be removed by loosening six bolts and sliding out, with some soldering required. The power supply components are all connected with ¼in faston connectors.

Apart from the meter PCB, which seems rather feebly attached by two screws at its centre, the build quality of the amplifier gives a feeling of confidence.

Power supply

The entire centre of the unit is filled with a very large toroidal power transformer. This is physically at least twice as large as that in the *Chameleon*. To the rear is a PCB containing the surge limitation circuitry, output muting and fan speed control. Below this are mounted two large power rectifiers, with a huge capacitor on each side. As will be seen from the measured results below, this is what a designer would call a 'stiff' power supply, designed to deliver the full load continuously. But the cost is in terms of size and weight.

Cooling system

The output and driver devices for each channel are bolted onto the left and right sides of each heatsink, with each of the two sets of audio electronics mounted on a single PCB fixed to the bottom of their respective heatsinks. Each of these areas benefits from direct airflow, as well as the heat distribution effect of the large volume of heatsink metal. There are no filters provided for the cooling system. Two thermal sensors are mounted on each heatsink assembly. The first, operating at 60°C, increases cooling fan speed, while the second, triggering at 90°C results in temporary thermal shut-down.

Front panel controls and indicators

The input level controls are rather ordinary looking pots with 21 detents calibrated from 0 dB to 20 dB attenuation, then off. Pot calibration relating the knob markings to actual attenuation is somewhat inaccurate, being in error by between 1.3 and 2.7 dB from the -1 to -8 settings, improving at higher attenuation levels. More importantly however, matching between left and right channels is superb, being within 0.1 at all attenuator settings.

The led ladder array meters initially indicate that the amplifier is on, illuminating a pair of green leds at the bottom of the array. The first indicates that the low voltage supplies are present, the second the high voltage rail. These functions are not labelled and would not be meaningful to the casual observer. As level rises, the meters make their way from green, through yellow to red in 10 x 3 dB steps from -27 dB to 0 (clipping). Meter ballistics and accuracy are not specified, but rise time is fairly slow with some overshoot, indicating a characteristic more like a VU than peak reading meter. Meters are accurate to within 0.1 dB except at -6 which is in error by 0.5 dB. We found when measuring with fast transients (20 ms), that levels more than 8 dB above output clipping would not illuminate the overload indicator, reading -3 dB on the meter. Increasing the burst time to 50 ms just illuminated OVERLOAD. The same under-reading occurred while measuring peak power with music signals.

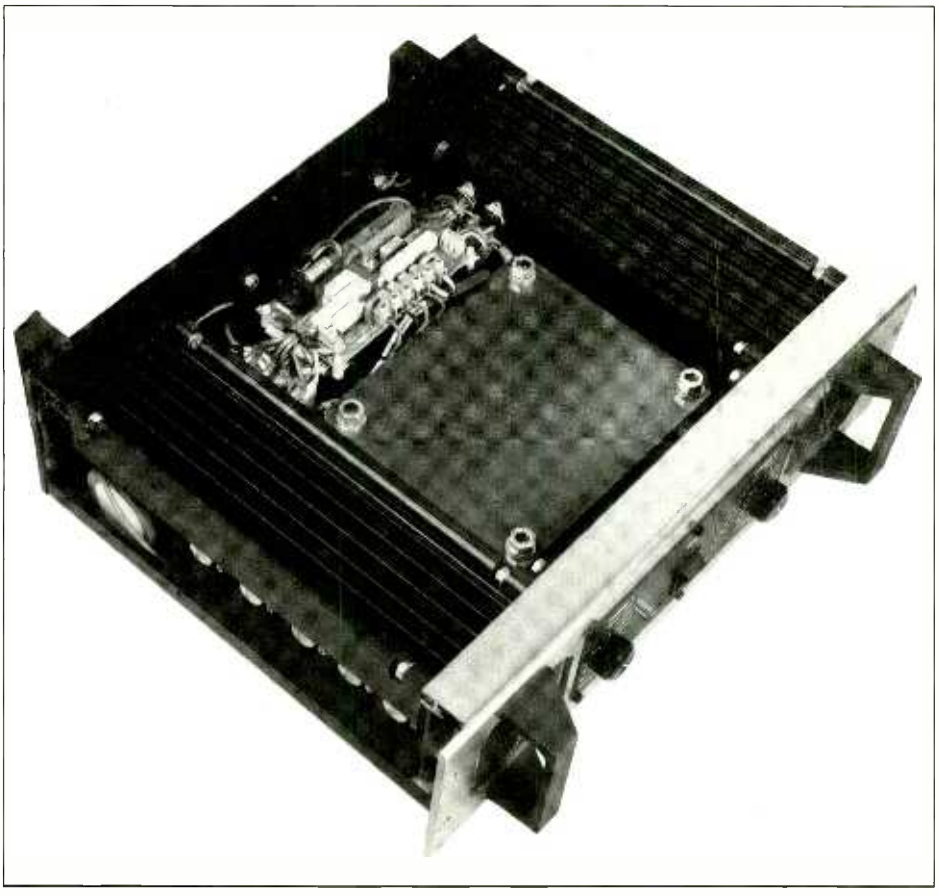
A FAULT led is located adjacent to the CLIP led. This illuminates orange in the event of an output short circuit, or due to a failure of the negative rail fuse. Indication only occurs in the presence of signal. Driving the amplifier into an excessively ▶

MANUFACTURER'S SPECIFICATION

Output power @ 1kHz	520 W/8 Ω single channel, 470 W/ch both
0.05% THD/RMS Continuous	900 W/4 Ω single channel, 810 W/ch both
	1200 W/2 Ω single channel, 1100 W/ch both
Bridged output power	1620 W/8 Ω
	2100 W/4 Ω
Dynamic Power — E1A RS-490	950 W/4 Ω both channels driven
Damping Factor	>650 at 1 kHz re: 8 Ω
Slew Rate	65 V/µs
Rise Time	2.2 µs @ 170 V pk-pk
Voltage Gain	38.5 dB
Signal to Noise	105 dB RE:rated power into 4 Ω, A weighted
THD+N	<0.005% at 1 kHz
SMPTE IMD	<0.015%
CCIF IMD	<0.01%
Input Common Mode Rejection Ratio	better than 90 dB
Channel Separation	better than 90 dB
Frequency Response	-0.5 dB (20 Hz), -0.15 dB (20 kHz)
Power Bandwidth (-3 dB)	5 Hz to 90 kHz
Input Overload	-20.6 dBu

DIMENSIONS

(HxWxD) excluding handles	133 mm x 482 mm x 375 mm
Depth including handles	460 mm
Weight	30 kgs



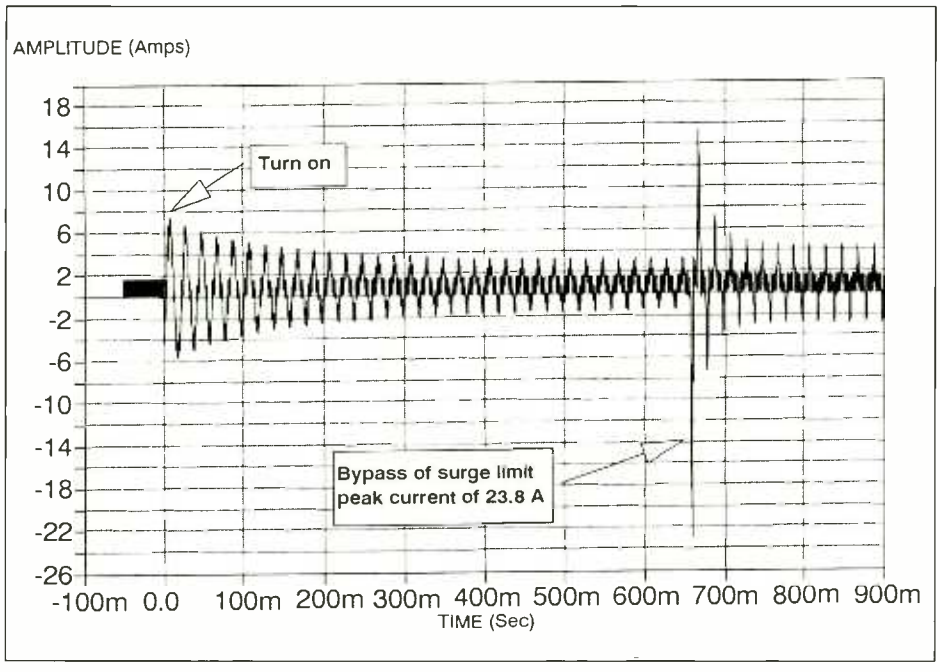


Fig. 1: Amplifier turn-on in-rush current. Note bypass of soft start resistor at 650 ms

low impedance, or into extreme clipping will also cause intermittent flashing of the FAULT led in the presence of signal.

Rear panel and connectors

Like the front, the rear panel has two handles protecting the fan grilles and other rear panel components. At the centre of the panel is the fixed mains cable, a large gauge obviously designed to tolerate the current which is present in 120V power systems. Directly above this is a mains thermal circuit breaker which will trip to protect the power supply against excessive heating. This should only activate with continuous sinewave drive into low impedance loads.

Each channel has a pair of XLR-3 input connectors, one male, the other female. This is to assist with looping a signal between amplifier channels. Thankfully, pin 2 is in-phase per AES standards. No BRIDGE MODE switch is provided, so ▶

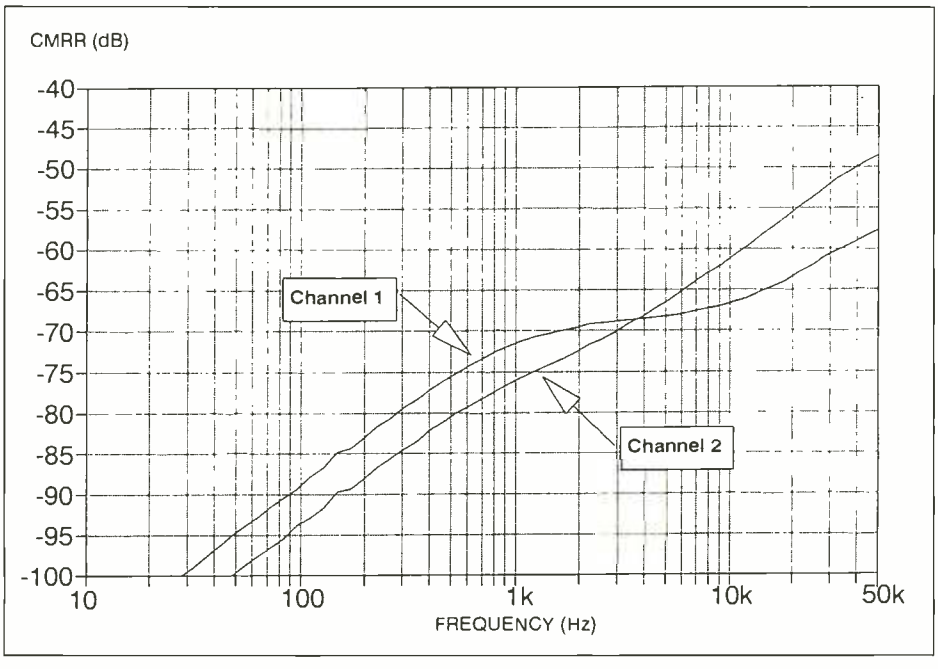


Fig. 2: Common mode rejection ratio of both channels driven simultaneously at 10 dB below 810 W/channel, into 4 Ω

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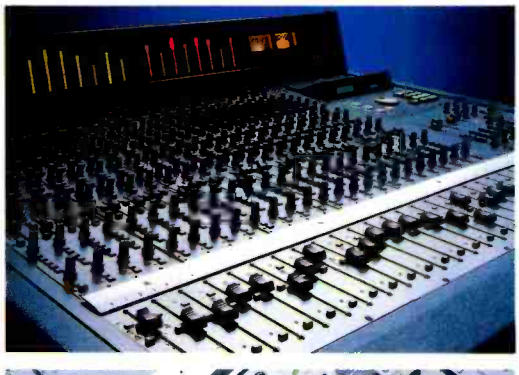

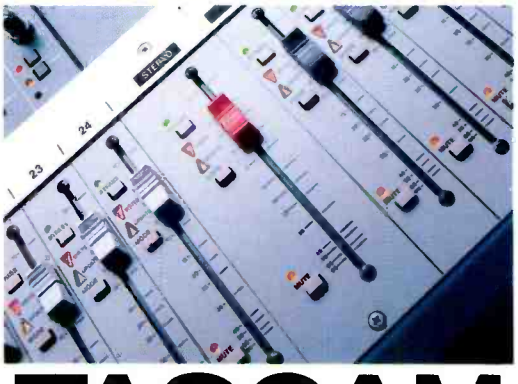

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operating in bridge mode requires a phase inverting jumper and equal front panel level settings.

Outputs are available on five-way binding posts in parallel with an XLR-3 male. While XLR's have been widely used for loudspeaker connection, this amplifier will operate at 25A into 2Ω, well beyond their 16A rating.

The rear panel also contains positive and negative high voltage rail fuses on each channel.

Turn-on surge limiting

As in many modern amplifiers, an in-rush or surge limiting resistor is switched temporarily into the mains input at turn-on. Unlike the *Chameleon*, the surge limiting resistor is not protected by a thermal fuse, though it does have a high thermal rating. Failure of the surge limiting system is indicated by continuous illumination of the **Thermal** led after switch-on. **Fig.** 1 shows the surge current, which reaches a peak of about 23A at 600ms after turn-on as the limiting resistor is switched out.

Inputs

Inputs are electronically balanced. Common mode rejection is shown in **Fig. 2**. At 70 to 75 dB at 1kHz this result is below the specified performance of 90 dB. Input impedance is as specified at about 9k Ω at 1 kHz, with little variation at other frequencies. As stated in previous reviews, a little higher impedance may be preferred.

The manufacturer warns about overdriving the inputs, and recommends running the amplifier with input level at maximum. With a maximum voltage gain of 35.8 dB, an input level of 11.6 dBu is required to give full output into a 4 Ω load. Reducing the gain by setting input level to 20 dB attenuation reveals an input clipping level of 25.3 dBu, which is more than sufficient.

Frequency response, phase and slew rate

Fig. 3 shows the frequency and phase response. There is very little out of band filtering, giving a very flat high frequency response, being down only 0.2 dB at 20 kHz, but possibly leaving the door open for muck to get in.

Slew rate is right on target, meeting the specified 65 V/μs, with a rise time as specified of 2.1 μs at 170 V peak-to-peak.

Channel separation

Power amplifiers can be prone to more serious crosstalk problems than line level electronics. This

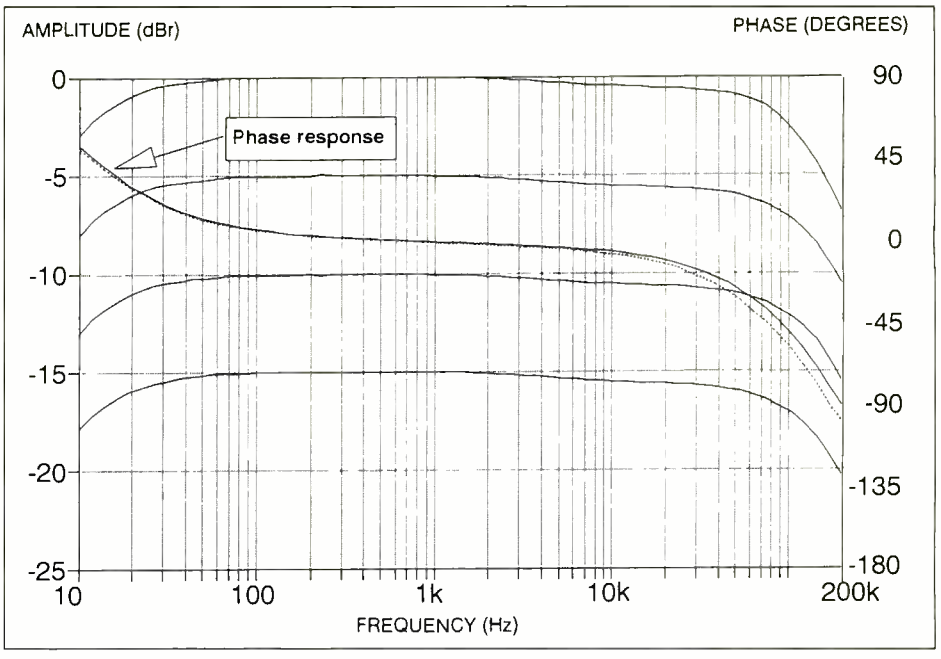

Fig. 3: Amplitude response of channel 1, driven at 0, 5, 10 and 15 dB below 810 W/channel into 4 Ω. Little HF roll off is evident

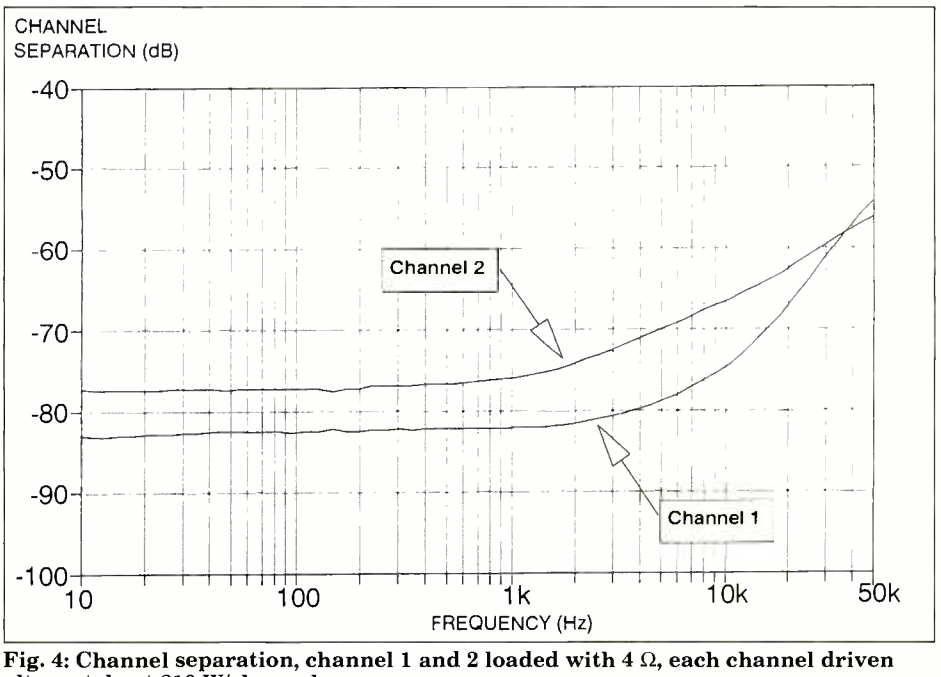

Fig. 4: Channel separation, channel 1 and 2 loaded with 4 Ω, each channel driven alternately at 810 W/channel

is due in part to the higher voltage and current occurring at the amplifier output, but also due to interaction between the shared portions of the power supply. In the Australian Monitor, the design approach is nearly the same as *Chameleon*. The power transformer has two independent and nominally identical secondary windings, with totally independent rectifiers and smoothing capacitors. The high output voltage and current can interact with input circuitry, making it imperative to measure crosstalk with one channel going full blast, and the other in a ready to run condition, but with a terminated input. For some reason the Australian Monitor specifies crosstalk with the undriven channel input level control turned completely down! In practice, we could not achieve their published results, but the state of the input level control made no difference.

Fig. 4 shows the crosstalk variation with frequency at rated output power into 4 Ω. The unused input is terminated in 50 Ω. At the more audible lower frequencies, the unit achieved 90 dB separation, compared to a specified 94 dB. At higher frequencies, the performance declined with respect to the specification, being about 10 dB worse between 3 kHz and 20 kHz. In most

TABLE 1: BROADBAND NOISE

Conditions	r.m.s. 22-22k	r.m.s. 400-22k	Q-peak A-wtd	Q-peak 22-22k flat	Q-peak CCIR
Channel 1 : 4Ω (ref. 800 W / 4Ω)	-70 dBu 107.8 dB	-73.7 dBu 111.4 dB	-75.1 dBu 113 dB	-63.7 dBu 101.5 dB	-60.5 dBu 98.2 dB
Channel 2 : 4Ω (ref. 800 W / 4Ω)	-69.5 dBu 107.2 dB	-73.0 dBu 110.7 dB	-74.4 dBu 112.2 dB	-62.2 dBu 100 dB	-58.6 dBu 96.5 dB

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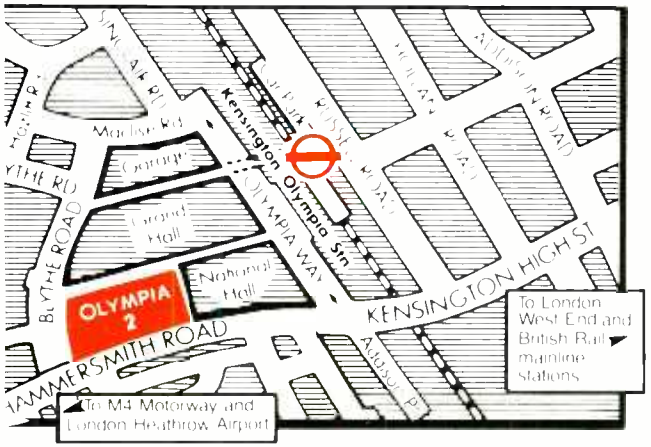

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TABLE 2: SUMMARY OF STANDARDISED POWER OUTPUT RATINGS

	1 ch driven 4 ohms	2 ch driven 4 ohms	1 ch driven 8 ohms	2 ch driven 8 ohms	Bridged 8/4 ohms
BS 6840:1988 Distortion Limited Output Power	995 W	900 W/ch	540 W	514 W/ch	not tested
AM — Continuous power rating	900 W spec	810 W spec	520 W spec	470 W spec	1620/2100 W spec
EIA RS-490 Continuous Avg Power	995 W	900 W/ch	540 W	514 W/ch	not tested
AM — Continuous power rating	900 W spec	810 W spec	520 W spec	470 W spec	1620/2100 W spec
EIA RS-490 Dynamic Power	1025 W	950 W/ch	540 W	514 W	
AM — dynamic power rating		950 W/ch spec			
(Dynamic Headroom)	(0.1 dB)	(0.2 dB)	(0.1 dB)	(0 dB)	
RMS 20 ms on/ 80 ms off	1000 W	910 W	550 W	520 W	
Eq to Hill Transient Power	No spec	No spec	No spec	No spec	
RMS 200 ms on/ 800 ms off	950 W	845 W/ch	540 W	483 W/ch	
Eq to Hill Dynamic Power	No Spec	No spec	No spec	No spec	

applications, this will not be audible. Dynamic response of both channels is well matched, indicating the probability of good stereo imaging.

Noise and distortion

Table 1 gives the wideband noise measurements. As with *Chameleon*, the top figure gives the actual output noise level, while the bottom figure indicates the dynamic range. The Australian Monitor dynamic range specification of 105 dB A-weighted, is well exceeded by the measured result of over 112 dB, an excellent performance ready for 18 to 20-bit digital audio. Noise levels do not vary with the load impedance.

Under high drive conditions, noise and hum increase only slightly. This is evident from **Fig. 5**

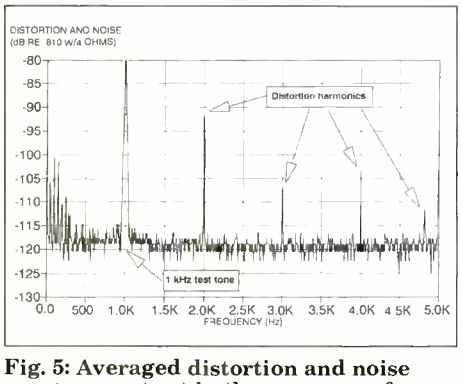

Fig. 5: Averaged distortion and noise spectrum output in the presence of a 1 kHz signal at 810 W into 4 Ω

which shows the signal, distortion and noise spectrum in the presence of a 1 kHz tone at rated power into 4 Ω.

Total harmonic distortion was measured under a variety of operating conditions. **Fig. 6** shows a swept measurement of THD+N at rated power into

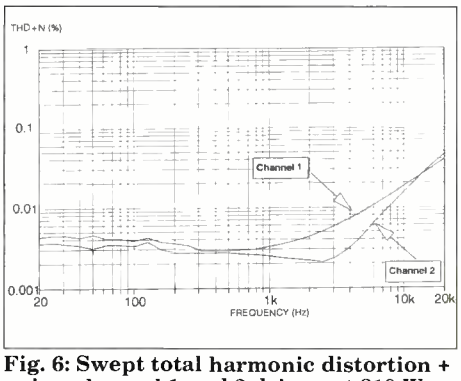

Fig. 6: Swept total harmonic distortion + noise, channel 1 and 2 driven at 810 W into 4 Ω

4 Ω across the audio band. This is inside specified limits, again a good performance. Likewise, SMPTE and CCIF twin-tone measurements are within specification at all operating levels and loads, being less than 0.005% in both cases. We did find that the audio connections for the best distortion or noise performance required an earthed screen connection between the test set output and the amplifier input. This is not optimum for cross-talk measurements, which are best with the screen connected amplifier end only.

Unfortunately, users cannot operate in both modes at the same time to get best performance. We recommend compromising the crosstalk by leaving the screens connected through, since that will have least aural effect.

Output power ratings

Last month we investigated various steady-state (continuous) and dynamic power ratings. Australian Monitor use the EIA RS-490 dynamic power method, which requires a 20 cycle burst at full power, followed by 480 cycles with the level reduced by 20 dB. We confirmed the Australian Monitor results by their method, then produced a matching set of measurements to those undertaken on the *Chameleon* for comparison. Results are given in **Table 2.**

In each case the *AM-1600* exceeded its specification, and appears able to deliver maximum output almost indefinitely. It was run at full output for 30 minutes until we were forced to stop by overheating load resistors. But, since long term performance virtually matches transient performance, peak or music power is the same as a continuous power.

Peak power using music signals

Except for a marginal improvement on the Indie Rock programme, there is little to choose between *Chameleon* and the *AM-1600* when driven from wideband music signals. The next investigation is to compare the two amplifiers on band-limited signals such as those produced when driving bi-, tri-, or quad-amplified loudspeaker systems. Separating frequency bands may result in lower peak-to-mean signal ratios, placing a further burden upon the amplifier. This we hope to ▶

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TABLE 3

MUSIC TYPE	Estimated Average Power	Peak Instantaneous Power	Apparent Peak to Mean Ratio
Classical	10-15 W	926 W	18 dB
Modern Jazz	90-120 W	1000 W	9 dB
Compressed Indie Rock	125-150 W	950 W	8 dB

include as a short follow-up result next month. The results are as shown in **Table 3.**

Damping factor

Damping factor for the *AM-1600* is specified as greater than 400 with a 4 Ω load. Our tests produced nearer 800, a good result.

Amplifier protection

Checking amplifier protection always comes last, since we do not want to destroy our only test sample. In this case, our first experience of protection taking place was of correct operation of the rear panel thermal breaker. The amplifier tested was fitted with a 220 V power supply, which when supplied with 240-250 V gave a substantial maximum power output increase (about 15%), but also popped the breaker under continuous sinewave drive. It works, and the power supply voltage was reduced to 220 V for the test measurements. Driving with a high level square wave also resulted in a thermal trip. No problems here.

Independent high voltage rail fuses protect the power supply in the event of output device failure. We removed these fuses to determine the effect. With the positive rail disabled, negative output disappears, no DC shift is apparent, but positive sine pulses of about 30% of the peak signal are output. This will sound nasty, but probably do no harm. Removing the negative rail results in a peaceful total lack of output. Warning indicators behave as specified. While testing in bridged mode into 4 Ω, we managed to blow both of the rail fuses in channel one, or alternatively tripped the power circuit breaker. This is an expected result when delivering massive amounts of current continuously. While specified for 2 Ω single channel, or 4 Ω bridged loads, under these conditions the amplifier will deliver transient current peaks, but not operate continuously at full output voltage swing. No harm occurred to the amplifier electronics as a result of this overdrive condition.

Input circuitry is protected against overvoltage, which might accidentally be caused by wrong plugging of rear panel XLR jumpers in the dark, connecting outputs back to inputs.

Short circuit protection

Repeated short circuits of the amplifier outputs caused no distress to the amplifier, which automatically recovered within about 5 seconds of removal of the short. The error indicator ▶

illuminated as specified. While performing bridge mode testing, channel one output was shorted to ground via a scope probe, which resulted in amplifier failure on that channel. This failure proved to be due to destruction of the input muting FET switch. A phone call to Steve Smith at the Sound Department resulted five minutes later in a return call from Stuart McLean in Australia, even though it was 10.00pm local time. Stuart was able to identify the likely faulty component, which was snipped out of circuit, restoring normal operation. The circuits within the *AM-1600* have been designed for the greatest flexibility of external earthing systems, leaving the possibility that the earth at the input can be pulled apart from other earth references under unlikely conditions. Under some circumstances this can cause failure of said FET.

Not being a power amplifier designer, it is difficult for me to comment on alternative circuit configurations. But, the present vagaries of external connection make the job of being compatible unnecessarily difficult — possibly making 100% safe design impossible. This raises an old issue of standards, and the glaring need for the audio industry to make final decisions about earthing, screens and related matters. Perhaps the problems raised by electromagnetic compatibility regulations will help, for certainly external earthing systems effect EMC performance. John Woodgate is at present trying to resolve a standard for screen termination within professional audio equipment — may he proceed vigourously.

Thermal protection

As mentioned earlier, two levels of heatsink thermal protection are included. During testing, even with long term sinewave drive, we could not reach thermal shut-down. The fan kicks into high speed only when the output is at full drive for several minutes. These tests took place in the comfort of our test lab, but we doubt that any difficulty will be experienced even with the relatively high ambient temperatures found in summer outdoor concerts.

Manuals

The unit comes with a user manual which is fairly basic, but which contains all of the essential information when combined with the information printed on the unit's rear panel. There is however no service information whatever in it, only advice that there are no user serviceable components inside. With no component references printed on the PCBs, telephone trouble-shooting at a distant location might prove difficult.

Summary

The *AM-1600* is the amplifier for the 'real man'. It is heavy, powerful and well-built. It might be that packing a punch like that is only needed on occasion, but from our evidence, it will be ready for that occasion. Being rated into 2-Ω per channel, or 4-Ω bridged will be an advantage to those requiring massive single output power levels or with loudspeakers having a very low nominal impedance. *Chameleon* is more like a lady, able to deliver a powerful wallop when required without the need to flaunt bulging muscles.

The failure of the amplifier, due to what is certainly our fault, is disappointing, for aren't power amplifiers supposed to tolerate anything a user might do to them? But, at least the fault wasn't costly, and operation was restored in minutes following a telephone call. The output devices were unscathed, and there was no risk of blown loudspeakers. Response from Australian Monitor was impressive, and I am told that someone can be reached at any time, 365 days per year. This is a good service if it can be maintained. Yes, they can design out the risk of this failure recurring, but at the cost of requiring more rigidly defined external earthing systems.

Like many choices in life, this one will be personal, based on a combination of perceived need and personal attraction. Both products are excellent examples of engineering design, providing the performance benefits perceived by their creators. ■

FROM OUTBOARD TO OPTICAL

Monitors - *The big noise in monitors must currently be Dynaudio and, in particular, the M1. Popular with producers and engineers for their portability and sound quality alike, these superb speakers are on demo at Stirling with a range of recommended amplifiers including Hill's Chameleon and Adcom's 5N5.*

Outboard - *The reputation of Lexicon's innovative 300 effects processor grows daily. Marrying legendary Lexicon sound quality with digital I/O and the facility to automate effects to timecode, the 300 is ideal for film and video post production applications. Along with the 480L it features in a carefully assembled list of outboard devices that includes the very best from Drawmer, Valley and Aphex. From the latter, the Compellor compressor/leveller, Dominator zero-overshoot peak limiter, Expressor single channel compressor/limiter and Expander/Gate are of particular interest. As is check out the amazing Sonic Maximisers from BBE.*

Recorders - *Analogue or digital, Stirling remains the place for multitrack. With an improved specification and a return to mid-eighties pricing, Otari's MTR 90 III represents a high quality yet cost effective choice in 2" 24 track machines. From the same stable, the MX80B now includes full remote control and Dolby HX-PRO. Akai's DD1000 optical disc recorder is now available with RS422 software providing serial control of video machines and a new "Timesqueeze" facility. With improved editing features, the DD1000 is now more than ever a logical choice of recorder for video post-production work.*

Microphones - *Following the success of the CU-41 studio microphone and the CMS-7 m-s stereo series, the latest mic from the Sanken stable to attain industry standard status is the tiny COS-11 lavalier mic. Already chosen by The BBC and ITN, the COS-11 has also found favour in theatre sound applications with leading contractors Autograph. See the COS-11 and the full range of Sanken microphones at Stirling.*

Consoles - *New from the USA and exclusive to Stirling is the fully automated Euphonix console. Assignable from 24 - 96 channels, this superb mixer is currently on demo in our studio alongside the very best from DDA, including the AMR-24, DMR-12 and the new Profile, and the latest from Soundcraft including the highly acclaimed Sapphyre and excellent value for money Spirit.*

DAT - *Our policy in DAT is simple – the best machines at the best prices. We currently recommend the Panasonic SV-3700, the PCM 2700 and TCD-D10 Pro from Sony and, for working with timecode, the Fostex D-20.*

Synchronizers - *Already an industry standard, Timeline's Lynx is further enhanced by the introduction of the SST System Supervisor and CCU Console Control Unit, facilitating integration with the host computer of consoles from SSL, Neve, etc. And new from Timeline is the Microlynx. Inclusive of remote control it can sync up to three devices – two multitracks plus video, for instance.*

Hard Disk Recording - *Having played a major role in pioneering the application of Hard Disk recording technology during the mid 1980s, we're naturally gratified to see its mass acceptance in the '90s. Alongside Digidesign's Sound Tools 2 track and Pro Tools multitrack systems, we are pleased to recommend systems from Cyberframe and DAWN. With on-board mixing, DSP and serial machine control, configuration of the former is particularly applicable to music and sound effects editing and dubbing in film. And the Macintosh based, 8 track DAWN system has already found homes in over a dozen video post-production facilities in the UK, providing a reliable, familiar and cost effective system for sound-to-picture work.*

Cable - *An after thought to many suppliers but at Stirling, we believe the cable that connects a system to be every bit as important as any single component within it. We are the UK's exclusive importers of the industry standard Mogami cable and are pleased to to provide a full custom service providing high quality wiring looms to your specific requirements. The full range of Mogami cable is also available "loose".*

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Barry Fox

By the time you read this, *Fantasia* will have been and gone. The first, last and only limited time period release on home video will have been withdrawn from sale. Having tried to write an article about Walt Disney's restoration of *Fantasia* for the release, I am not surprised that so little has been written about the excellent technical work done by Disney's engineers in Los Angeles.

Although Jeffrey Katzenberg, Chairman of the Walt Disney Studios, toured the world to announce the surprise release of *Fantasia* on home video, I know of no-one outside the showbiz mainstream press who was invited to the London briefing. I had to track down the London PR company employed by Disney and phone them several times even to get a press release.

When I asked about the soundtrack, the PR lady said that was nothing to do with her — another PR company was dealing with the record. When I asked to talk with Disney engineers about the restoration, she said I would have to provide copies of the magazines I wrote for, to prove bona fides, and then put all questions to her in writing. She would then get answers and relay them back.

I went out and spent £50 of my own money on the special edition version of *Fantasia* because it was supposed to include an extra video cassette with technical content. The cassette I bought turned out to be faulty with just snow on the tape after just a few minutes running time.

Finally, after refusing to give up, I got to talk in Los Angeles with Terry Porter, who restored the sound. He told a fascinating tale. But even then the curse of the PR company was still on us. The only pictures available to illustrate press articles were stills from the film. Although pictures of Walt Disney, Stokowski and the original *Fantasound* multitrack recording and playback equipment certainly exist, the PR company could not supply copies for press use.

The Disney studios restored *Fantasia* for limited cinema screens in 1990, to mark the film's 50th anniversary. Then Disney released it on home video, for a sales window of around 3 months. Disney now withdraws the film forever, in preparation for a new version to be released in around five years time. Some sequences of the 1940 original will be replaced by completely new sequences.

Walt Disney had originally planned to use Mickey Mouse in a series of animated shorts for which Leopold Stokowski, conductor of the Philadelphia Orchestra, would record the music. In the late 1930's the project grew into a full length feature film of classical music recordings made by Stokowski to match Disney's animated sequences.

Stokowski has been working since 1932 with the Bell Telephone Laboratories in New Jersey on hi-fi sound recording and transmission, first in mono and then in stereo. Bell Labs had found that disc recordings could not give a good dynamic range, so tried using optical film soundtracks instead. Bell Labs even used a film system to give playback recitals of recorded music in concert halls.

Walt Disney teamed up with RCA (not Bell/Western Electric) to build *Fantasound*, which gave not just stereo but a surround sound. *Fantasia* was the first feature film with stereo or surround.

The Disney and RCA engineers used eight separate optical 35mm film recorders to make an eight-track recording of Stokowski's orchestra. In Disney's Hollywood studios Disney and RCA engineers mixed down the eight optical music tracks into three optical tracks, carrying sound for the left, centre and right of the cinema screen. Cleverly, a fourth track was used to overcome a problem inherent in optical sound recording since it was first used in the 1920s.

If overloaded, optical tracks clip. If undermodulated, they suffer badly from ground noise hiss. In those days, the late thirties, there was no Dolby system or safe compansion.

Fantasound recorded everything at 100% modulation. Control tones on the fourth optical track (called the TOGAD, or tone operated gain adjusting device, track) electrically adjusted the gain of the amplifiers in the cinema.

At the same time notches cut in the side of the film switched relays which routed some of the sound to loudspeakers round the cinema and even behind the audience.

In 1940 no ordinary cinema could cope with these technical requirements. To show *Fantasia*, the cinema had to install two projectors, running together in synchronisation, one for the reels of 35mm film carrying the sound with TOGAD and notching, and the other for a 35mm film print with the pictures. There were sixty loudspeakers round the cinema to surround the audience with *Fantasound*. The Disney Studios organised *Fantasia* as a road show, with the equipment transported in 35 enormous packing cases across North America. That was in 1940.

America's involvement in World War II curtailed these plans and Disney released a single 35mm print, with mono sound, for projection in cinemas round the world.

In 1955 when Hollywood started releasing widescreen Cinemascope films with magnetic stereo soundtracks, the Disney Studios discovered that the original *Fantasound* sound tracks, which were on nitrate stock, were disintegrating. There was only one *Fantasound* playback system remaining, at RCA's sound studio in Hollywood, miles away from the Disney Studios in Burbank. The *Fantasound* equipment was old and awkward to move. So Disney's engineers took the decaying film to RCA, and played it on the *Fantasound* unit.

They then fed the sound down telephone lines to Disney's studios where it was recorded on three track magnetic film!

Even though Disney used Class A telephone lines, this cross-town transfer limited the frequency range of the recording to under 9 kHz, narrowed the previously wide dynamic range and introduced distortion. Also the engineers had to 'pan' the TOGAD volume control and notched surround sound effects into three channels. The decisions they took were effectively frozen into the re-recording made at the other end of the telephone lines. So much of the original subtlety and the effects planned by Disney and Stokowski were lost. This is the sound which cinema audiences have heard ever since.

To be strictly accurate, Disney tried in 1982 to get round the problem by re-releasing *Fantasia*, with a new soundtrack recorded by a new orchestra under Irwin Kostal using 3M digital equipment. The project was an artistic and commercial disaster, even though the Disney studios hyped it with the magic label "digital".

All the original *Fantasound* equipment has now disappeared. The nitrate film has long since disintegrated. Stuck with only the three track telephone line transfer to work with, Terry Porter searched the studio archives for blueprints of the original recording equipment. He also found Stokowski's original scores, complete with the conductor's notes. Together, the notes and annotated score explained how *Fantasound* panned the sound round the cinema, according to Stokowski's wishes.

In all Porter worked for two years on recreating the original track in modern Dolby stereo, with musical sounds coming from where Stokowski originally placed them. He spent three months filtering and equalising, to try and undo as much of the damage done by the telephone line transfer as possible. Porter found that the telephone transfer had skimmed off all frequencies above 8.6 kHz, at least 1 kHz narrower than a good optical track. As well as trimming the treble frequencies, the telephone lines had introduced hum at North America's mains frequency of 60 Hz, with harmonics at 120 Hz and 240 Hz an upwards. Additionally Porter erased over 3000 clicks and pops which blemished the sound.

Terry Porter has nothing but admiration for the original *Fantasound* technology. 'The method of 100% modulation was a wonderful noise reduction system if you haven't got Dolby,' he says.

'The big breakthrough,' says Porter, 'was finding Stokowski's notes. This let us re-mix the three-track sound into six-track Dolby for a 70mm release print which was screened at the Cinerama cinema theatre in Hollywood and at Paris and Nice as part of the 50th anniversary *Fantasia* celebrations.'

The six-track 70mm release used a modified Dolby surround system to spread three channels behind the screen and three more round the cinema. This comes as close as possible to the original 1940 roadshow effect.

All Porter's work was done in the analogue domain, with Dolby SR, but tranferring to Dolby stereo presented special problems. Porter found that there were substantial phase shifts between the three tracks of the telephone transfer. Back in 1955 the telephone company had very likely provided Disney with three separate lines which travelled by routes of quite different length across the city. Until corrected, these phase shifts played havoc with Dolby surround Matrix encoding. They caused even more problems with the mono track which was needed for linear video release. In the end Porter went back to the original mono film version of *Fantasia*, which for the post war years was the only one available for cinema release. He used this track for linear mono instead of a mix-down from the new stereo version.■

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Martin Polon

Our US columnist lays down some ground rules when purchasing studio equipment

Jason O'Dwyer felt uncomfortable with his newest purchase. Not so new anymore, he thought to himself. A 'Studio-User *One-Oh-One*,' he mumbled out loud. Actually, 101 good reasons that he should never have bought the darned thing. 'The console from hell,' he resumed his almost inaudible mumbling. 'I already have the mother-in-law from hell,' he pondered. 'Why should I be twice blessed?'

The process had started so differently 14 months ago. Jack Pardell, the lead sales engineer from Studio-User Corporation had wined and dined him. He had responded to every question that Jason had asked. He brought in engineering blueprints, supplied technical brochures, taken Jason to see other similar installations in the region, loaned them modules to examine!

The deal 'maker' had been Jack's relentless promise of support. 'I will always be there for you, bucko. If you have a problem, you call the big 'U' and I'll get right on top of your problem. Studio-User supports the customer. If I can't solve the problem or get right back to you, someone else will. We have an in-house customer support SWAT team (Special Warranty and Technology) — just like the police. If you have a technical problem, they will solve it. We stock an enormous number of parts in-house and our turnaround to you is the talk of the industry.'

That had sealed the deal. That plus the extraordinarily generous credit arrangements that Studio-User had offered to Jason. They had arranged with a third party lending firm to finance the purchase on very desirable terms. The new console was delivered within the promised 30 days and installed by Jason and his in-house maintenance engineer, Todd Ballinger. Todd was the first one to notice a problem. He had discovered that the modules supplied in the console they had were not the same as the units they had been given for inspection. The units in their console were soldered differently and had open frame audio transformers instead of the shielded coils on the other boards. The transformer maker was not a known quantity to them or to anyone else they queried. But, the console 'made' specs and was put into service.

Several projects and sessions were successfully produced with the new console. The first sign of trouble was when one of the monitor mix buses ceased to either monitor or mix. Todd could not easily find the fault. Jason had not heard from 'good old Jack' since the purchase agreement was signed but he had put it off to Jack's busy schedule. He knew in his heart of hearts that Jack would be right out to solve the problem as soon as Jason made the phone call. The phone call revealed that Jack had left the company the week after the sale had been finalized. The company had also indicated to Jason that customer contact was now in the hands of a newly appointed distributor for the region.

The console progressed from bad to worse. The transformers began to fail under high level input. The open frame replacements clearly did not meet the specifications for the appropriate units. The company could not provide other replacements since 'these units were the best we could find when our regular supplier cut us off because of a business dispute.' The new Studio-User distributor stated flatly that if they did not sell the console, they would not fix it under the warrantee agreement — 'for free or any other which way.' When asked about the SWAT Team, the distributor laughed and said, 'that should really stand for Sometimes Willing — Always Tardy.'

The last straw for Jason had been when the financial services company that had brokered the loan for Studio-User had sold the loan to an ordinary finance company. Knowing little or nothing about the studio business and only able to 'eyeball' Jason's receivables and cash flow, the new lender's nervousness about the loan translated into an attempt to seize control of the studio. Since the console purchase price was a large one, Jason could not pay off the loan at once. Finally, by borrowing from family and friends and taking a second mortgage on his house, he managed to pay off the financial 'hounds of hell'. The console was his to have and to hold — 'til time did them part'.

As is frequently the case in this column, the above tale of woe is not a retelling of a single problem experienced by one studio but rather an amalgam of problems experienced by a number of studios during their equipment purchases. The usual 'at the bar' audio trade show conversations involving studio equipment sales are almost always from the equipment seller's perspective. How tough it is to get a sale, how difficult customers really are, how hard it is to find financially qualified buyers, how studio operators shop price and then want service, etc. It frequently does not occur to those on the sales side of the line that the buyers have their own set of needs and concerns that must be met to make a 'deal' happen. Most studios owners are reluctant to discuss their 'problem children' in public. Nobody likes to air their own dirty linen and more to the point — look like a fool in the process.

There are two questions most frequently asked by audio equipment makers interested in selling equipment to recording studios. Firstly, 'What do studio operators really want from their equipment?' Secondly, 'What do studio operators really want from the equipment makers?' The completion of a recent study allows us to analyse some of the issues that constitute the answers to these questions. All of the studio operators surveyed demanded and received complete autonomy. Aside from a reluctance to 'bare one's chest', many of the individuals surveyed were nervous that their clientele might discover that a favoured console, digital tape recorder, or digital synthesizer/editor was a bit of a lemon.

Almost all of the questioned studio operators agreed that the following equipment issues are of significant importance!

Physical reliability

This was one of the issues that received virtual unanimous endorsement. The physical construction — and longevity — of studio equipment is frequently less robust than its electronic counterpart. Said one East Coast studio owner, 'What good is it to have a console that is reliable in an electronic sense if it begins to fall apart physically six months after you buy it? Also, the groups that rent the room for a project are not vandals contrary to popular opinion but they are very rough on a mixer. They might sit on it, lean on it, even jump on it. And our engineers are all over the thing mixing during a session. It has to be sturdy!'

Electronic reliability

The other issue of concern to everyone. The one thing studio operators do not want to hear about is downtime. A non-productive console means a non-productive room and both room and console are cost accounted on an hourly basis. There are loans to be repaid for the facility and the installed equipment and dead time is clearly an anathema. No manufacturer is ever going to lose a sale for using over-rated or military specification electronic components in their product.

Electrical responsibility

Safe products rate very high with studio consumers as well. That means careful simulation in the factory of all potential AC power hazards. One veteran studio engineer sums it up thusly: '11 Mills Kills. It only takes 11 milli-amperes in a heart path, that's hand to hand from leak to ground to take a life. Beware of transformerless inputs. Watch out for problems between equipment of different makers. Fortunately but not always, hum and other forms of audible ground loops reveal some kinds of problems. Needless to say, Underwriters Laboratories (UL) certification in the States is a real source of relief.' Another problem area involves units that are susceptible to static electricity discharges. Manufacturers must invest in the necessary test gear to find design flaws or hire consultants to do the same. Nothing is more frustrating than an expensive unit down due to a chip blown by static.

Modular construction

A virtual hue and cry is heard for units that have modular construction. Faulty modules can be removed and replaced on site with little or no disruption. Studios also have the option of stocking spares or swapping with the factory.

'Common' parts usage

Nothing seems to irritate more than the practice of using 'custom' semiconductors, or transformers, or other components that cannot be obtained from normal 'parts house' sources several years after the product has been discontinued. There are several excellent console designs that have faded ▶

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into oblivion because replacement parts are virtually unavailable.

Simplicity of usage

The rule of thumb in design for the computer industry is called 'KISS'. That acronym stands for 'keep it simple, stupid!' A complaint repeated over and over is the problem of studio staff members requiring six months 'to really learn how to use the bloody thing.'

Simplicity of interconnection

The use of complex and hard-to-wire connectors is another complaint frequently voiced. Everyone agrees that connectors are preferable to hard wiring but connector choice remains a topic of controversy. Of course, an industry that cannot decide upon a 'hot' pin two or pin three on a simple three connection audio connector should not be expected to innovate with larger connector standards.

Ergonomic interaction with studio life

Yes, Virginia, somebody is going to spill a cup of coffee into the faders during the first session the new console is booked for. Please, audio equipment makers, place a plastic membrane under obvious 'spill points' like console mixing positions. Also keep open interconnections off of the bottom of the console. And consider 'cola-proofing' faders and switches.

Manuals familiar to those not versed in technological Swahili

How wonderful the audio world would be if instruction manuals and repair manuals were written for those out in the studio world who did not attend a polytechnic or Institute of Technology.

From the audio equipment makers and their dealers — studio operators have identified the following business practices as being absolutely necessary.

Availability

Is the company that sold the equipment to the studio going to be there today, tomorrow and a year from tomorrow. That can be as simple a process as staying in business or as easy a practice as maintaining a toll-free product support line. Ditto the dealership. When a key salesperson leaves the firm or is replaced, it is imperative that a replacement is provided in a timely fashion and that contact with the customer base is rapidly re-established. Nothing makes studio customers feel more abandoned than the loss of all contact with the equipment maker.

Warranty policy

What the customer wants is a clear statement of support and a system to make the support available. Nobody wants to call up and find out that the salesperson who made all of the verbal warranty representations, good old Ed, has now taken a job with the electricity board and is currently wiring sewage aerators at a municipal facility near Swansea. Neither does anyone want to find a dealer/distributor who refuses to service anything for which the sale did not originate from within the shop.

Product support specialists

Not just for the first year of the product line's life, but for the life of the product in the user's hands. Nothing is more disconcerting than the process of buying an elaborate and expensive product at the point of product maturity only to find out that everybody who had anything to do with the project has moved on to other things or lives in a remote fishing village on a small island in Hokkaido Bay.

Credit availability

It is not just the availability of credit, but credit from a benign and helpful source. It is simply unacceptable for companies to provide credit via 'brokers' who will later turn around and sell a loan to a commercial credit firm who may then try to collect and/or foreclose on the loan and everything else in sight.

Real sales engineers who do not vapourise at the point of sale

That is a mouthful of words but it is heard again and again throughout the studio industry. A variation on the tired but true, 'will you love me when I'm old and grey.' What frequently happens is that commission-frenzied sales types receive no compensation for after-sale support of existing customers. Their only incentive financially is to 'churn' the new customer base.

Authorized dealers who really are and really stay that way

Another tongue-twister but more and the same from the previous category. Equipment makers must understand that their dealer network acts as the 'point man' for sales to their studio customers. It is simply unacceptable for a manufacturer not to support their grouping of dealers or to allow the dealer list to become a kind of 'revolving door'.

No bait and switch

A real 'down and dirty' marketing style where a vendor advertises one thing and tries to switch the customer to another. At the equipment maker level, it is usually a case of a new product shown at a professional gathering being 'unavailable' when customers come around to order after the trade show. At the dealer level, it frequently is a ploy to switch the customer from one brand of product to another. Sometimes this is done so that the dealer might enjoy a higher level of profit on the alternative equipment line or because the dealer is overstocked with the brand 'X' product that is being 'pushed'.

Stocking for availability of all needed parts

This is a financial issue for the manufacturer or dealer — plain and simple. Some managers shy away from tying up needed capital in a large and sophisticated parts store. Unfortunately, that is exactly what the customer needs. Despite EC and US legislation mandating support policies, the general state of audio industry practices on the stocking of parts still does not favour the customer. ■

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EXPLORING EQUALISERS

In Part Three Ben Duncan examines the 'real world' factors like the design, the components and the manufacturing quality of analogue equalisers

In Parts One and Two the family of equalisers was introduced. When sonic differences between equalisers are considered, it's usually the explicit differences in amplitude, phase response and Q that are discussed. These may be foremost in readers' minds, but there are other, arguably more important factors that are rarely mentioned and less well explored. Parts Three and Four are dedicated to probing these, and by filling in the gaps, consolidating our global understanding of audio equalisers.

Active device noise

A few vintage equalisers, mainly outboard *behemoths*, retained for their creative euphony, employ discrete transistors or valves (tubes). But nearly all modern, console equalisers rely on IC op-amps.

When op-amps are applied to EQ circuits, the rules for attaining good results are presumed to be no different to straight gain, buffering and mixing amplifier stages. However, the op-amp's envelope of operating conditions will be quite different in some areas, and in many cases, more stringent. An obvious difference is that the noise produced by the active devices both within and *before* the equaliser will often (but not always) be made more prominent when the EQ is set to boost. It can be audible when there is no signal and any gating is pre-EQ. Conversely, when the EQ is set to cut, the equaliser's own active device noise will be highlighted. However, the troublesome noise is then the *inverse* of the EQ'd band. So it's slightly worse when the cut band is narrow, and more so if the EQ's cut action demands make-up gain. The majority of consoles in the field still employ first generation *Bi-FET* op-amps (notably the quad *TL074* and its relatives, like National Semiconductors' *LF347* and Motorola's various *klones*) for reasons of tradition, low cost and reasonable sound in ideal conditions. For the most part, bi-polar op-amps (like the classic *NE5534*, SSM's upgraded *2134*, and their modern replacements *TLE 2037* and *HA 5221*) are considerably quieter, by 10 to 20 dB. In many cases, the EQ noise could be substantially reduced below audibility by an IC exchange, although few of the better bi-polar op-amps are available in physically compatible quad packages. But would lower noise necessarily be a good thing? Whether the tail ends of reverbs would sound any clearer depends on what nasties the original op-amps' noise floor had been masking.

The dominantly hissy noise of Bi-FET ICs is ideal stuff for masking the HF *fizz* of breakthrough from other stages and channels, and imperfect grounding layout. It's also worth remarking that for LF EQ below 200 Hz, the op-amp's 1/f noise corner increasingly establishes the pecking order, rather than the 1 kHz, midband noise figure that's usually quoted. On the other hand, psycho-acoustic weighting makes LF noise less of an issue. And measurements of equaliser SNR rarely consider the nature of circuit noise, which is neither purely pink nor white. In all kinds of active devices, impurities and metallurgical disparities add random noise signatures and affect the noise's peak to mean ratio. As a result, the noise of some ICs can be psycho-acoustically less obtrusive than others, even if a meter needle says the noise amplitude of the op-amp perceived as quieter is higher. For this and other reasons, one may end up preferring specific op-amps for the different EQ ranges. ▶

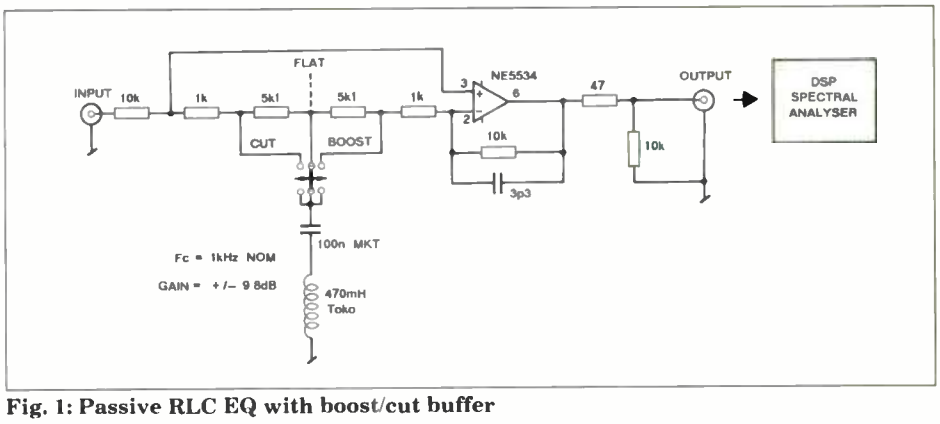


Fig. 1: Passive RLC EQ with boost/cut buffer

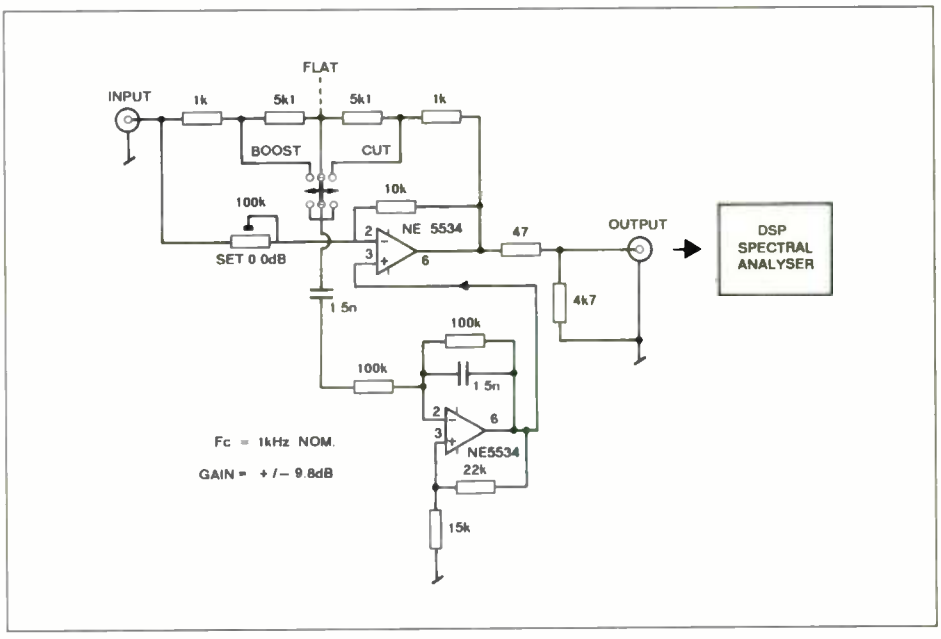


Fig. 2: Active Mid EQ with Wien sidechain

Distortion

In Part One, we saw that the gain-bandwidth product (GBP) of TL0 series op-amp (or any equivalent first generation Bi-FET) was barely adequate for +15 dB of HF boost in a Baxandall equaliser. In worst case specimens, there wouldn't be enough loop-gain to ensure low distortion above 3 kHz. If any ultrasonic signals are present, a nasty, fatiguing sound is a certain companion to HF boost. Many modern op-amps suited to audio have a far higher GBP's typically five, ten or even a hundred times greater. Until recently, these high GBP op-amps weren't very useable as they weren't officially stable at gains below x3 to x6 (+10 to +15 dB). At best they were costly and the necessary anti-oscillation measures seemed rather cumbersome. Also, stability could be questionable in cut mode, a state of active *negative* gain that's rarely encountered outside of equalisers!

Today, several high GBW devices are stable at and below unity gain. Linear Technology's *LT1220* and Harris' *HA5221* are notable examples, boasting GBPs of 35 and 45 MHz respectively. Even after performing +20 dB of HF boost, these devices retain some 55 to 65 dB of loop gain at 20 kHz, implying a distortion reducing capability of some 400 to 2000 fold. In Part One, we saw that some EQ topologies (notably those based on Sallen & Key filters and any employing sizeable positive feedback, for example Wein types, and A1 in the Good/State-Variable) 'eat up' disproportionate GBP with increasing Q settings. More than others, these locations will benefit from updated op-amp technology.

In the past year, powerful DSP testing using *Audio Precision*'s 'dual domain' system has unveiled new facts about the pattern of harmonic distortion in equalisers. In a nutshell, it's not always what simple theory predicts. To demonstrate this, two circuits were evaluated for this series. The first is an actively buffered R-L-C resonator (**Fig.** 1) The second is a boost-cut stage with a Wein bandpass section in the side-chain (**Fig. 2**). It's similar to that used by a large UK ▶

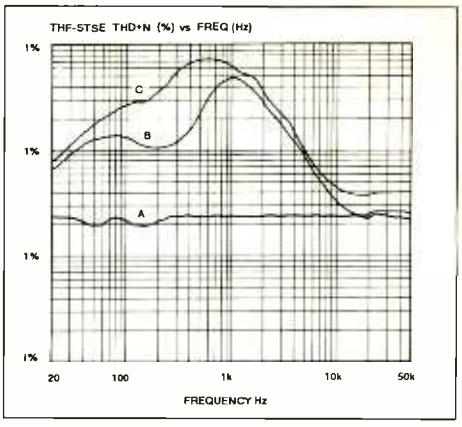


Fig. 3: THD+N vs. frequency for Fig. 1 circuit A,B,C = Flat, cut and boost

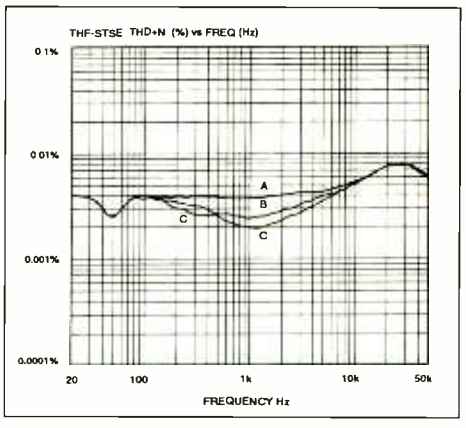


Fig. 4: THD+N vs. frequency, for Fig. 2 circuit A,B,C + Flat, cut and boost

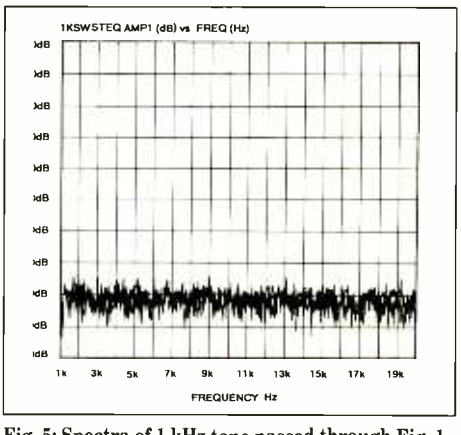


Fig. 5: Spectra of 1 kHz tone passed through Fig. 1 circuit, set flat. Only noise and small intermodulation products are visible

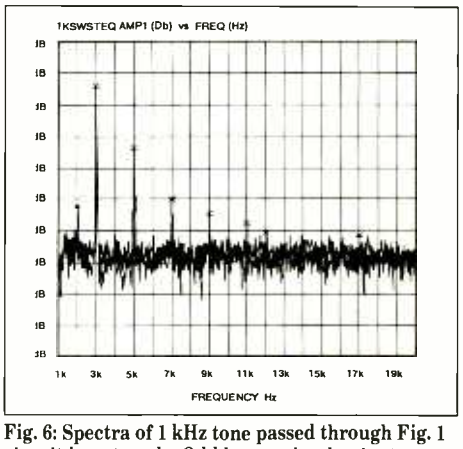
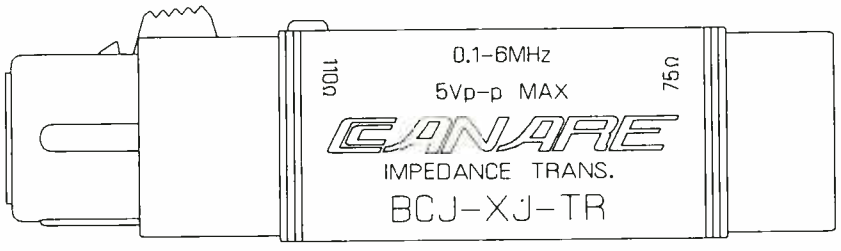


Fig. 6: Spectra of 1 kHz tone passed through Fig. 1 circuit in cut mode. Odd harmonics dominate



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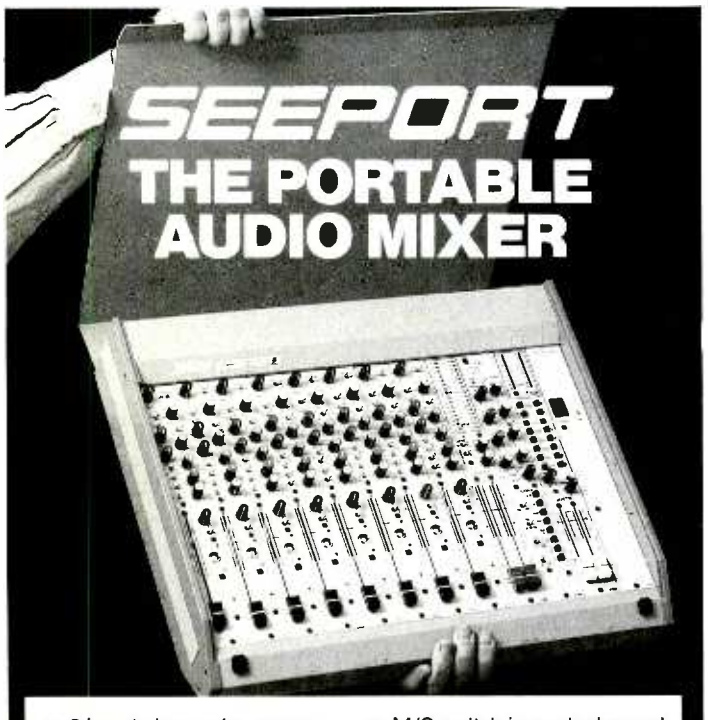

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console maker long regarded as building equalisation of high sonic repute. Both circuits are switchable between 0 dB (flat response), boost and cut, and both circuits are set to a nominal and arbitary 1 kHz centre frequency. The boost and cut ranges are ± 15 and ± 10 dB respectively; the difference is relatively unimportant.

Figs. 3 and **4** show THD+N vs Frequency for the two circuits when flat, cut and boosted. **Figs. 5, 6** and **7** use DSP to look at the spectra of **Fig. 1** circuit in these three conditions, with a 1 kHz tone. The tone is nulled to below 125 dB. In the flat position **(Fig. 5)**, the residue is mainly noise. In the cut position **(Fig. 6)**, spikes at 3, 5, 7 and 11 kHz, clearly indicate a prominence of odd harmonics, unpleasant to the ear, and only -65 to -100 dB below zero level. In the boost position **(Fig. 7)**, new spikes have appeared at 13, 15, and 17 kHz. These will add 'hardness', a metallic quality and 'noise' to the mix. Overall, this EQ emphasises odd harmonics and will sound particularly unpleasant when used at high boost settings.

Figs. 8 and **9** show the spectra for **Fig. 2** circuit, in flat and boost modes respectively. Other than the second and sixteenth (at 2 kHz, and 16 kHz), there are no obvious harmonics, but two notable intermod spikes at about 7.3 kHz and 18.9 kHz. Oddly, these products and the overall pattern are not affected by the op-amp used, whether it's a *5534*, *071* or *LF351*. Answers on a postcard please .... Even more interesting is that both flat and +10 dB boost have the same overall pattern. Boosting just shifts the entire residue (noise + intermodulation products) upwards. Aside from the prominent intermod spikes, **Fig. 2** circuit is clearly a well behaved equaliser topology. Boost, cut, or flat, it looks as if it will sound the same; only the noise floor shifts. Employing two op-amps (instead of one) and containing more parts with more critical tolerances, as well as relying on *positive* feedback, this is hardly the result you'd intuitively expect. Alas, it will take some time to untangle the mechanisms, not to mention evaluating all the known EQ topologies in this way.

Capacitors scrutinised

All analogue equalisers are built around reactive components, namely capacitors and (sometimes) inductors. In the late 1970's, a number of US audio engineers, and IC scientists, notably Richard Marsh, John Curl and Walt Jung, took seriously a growing perception and consensus amongst audiophiles that the qualities and construction (hence brand and model) of capacitors in and around an audio signal path can influence sound quality. Their work stimulated extensive debate in the UK press and several investigative articles [2, 3, 4, 5, 6]. Others, equally distinguished in audio ▶

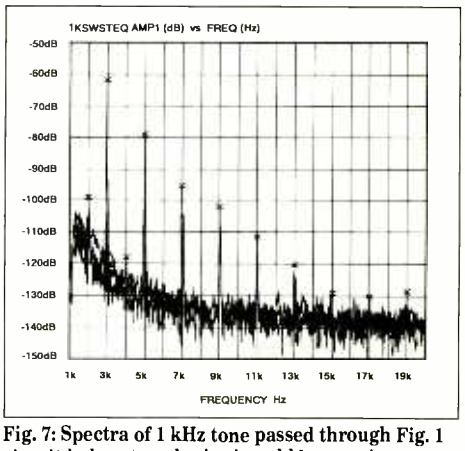


Fig. 7: Spectra of 1 kHz tone passed through Fig. 1 circuit in boost mode. Again, odd harmonics dominate

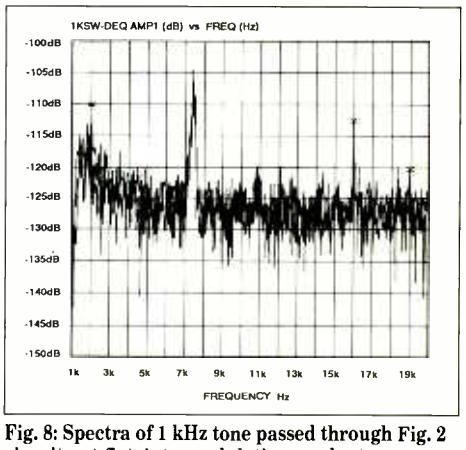


Fig. 8: Spectra of 1 kHz tone passed through Fig. 2 circuit, set flat, intermodulation products dominate. No harmonics are visible except the second

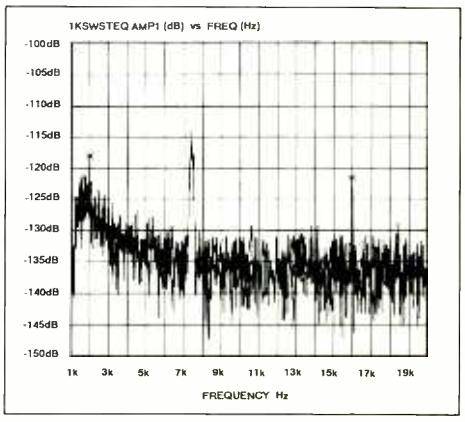
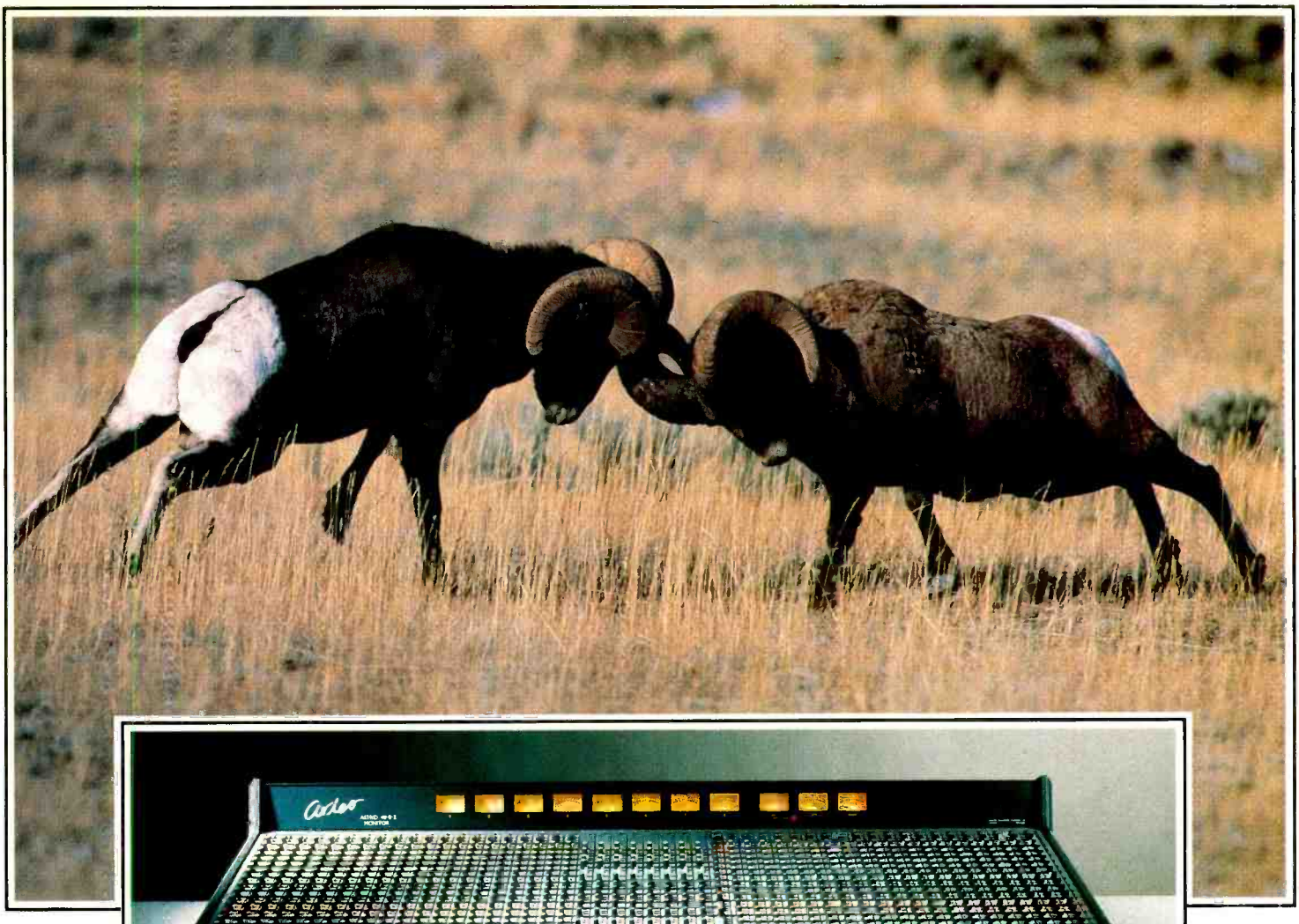


Fig. 9: Spectra of 1 kHz tone passed through Fig. 1 circuit, set flat. Again, intermodulation products dominate and no harmonics are prominent except the second



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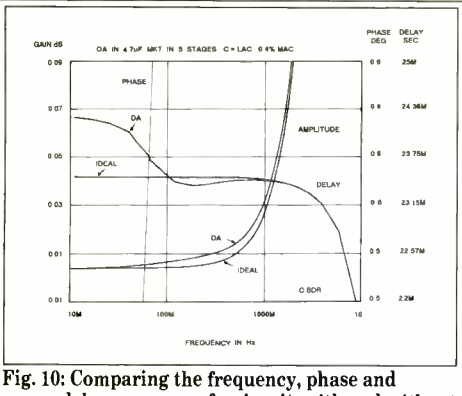

Fig. 10: Comparing the frequency, phase and group-delay response of a circuit, with and without the dielectric absorption of polyester capacitors

electronics (like Peter Baxandall) consider the idea 'utter rubbish'.

Even 'hard line' objectivists, though, will agree on three specific circumstances in which sound quality can be kissed better by a change of capacitor. First, no one disputes that when electrolytics are misused as filter capacitors, THD is apt to rise with decreasing frequency [7]. Second, owing to the way they're made, some types of capacitors, (particularly layer types in ceramic and polyester film) are prone to occasional dry, crystalline joints between the leadouts and the plates. The resulting crude diode causes distortion, which is not only audible, but even measurable with a plain sine wave drive and a THD meter. The problem is fixed by replacing the faulty part with one of the same make, without the defect. The whole batch may be suspect, so installing a different capacitor model as a replacement is fair enough, but to then claim it sounds better because it is a different model, may be missing the point. The statistical goodness of capacitors' (as well as resistors') leadout connections over time also needs to be borne in mind.

The third occasion when a capacitor creates a readily measurable problem, is when it resonates. Go high enough in frequency, and all capacitors eventually resonate, with the series inductance of their own plates and leadouts. For the most part, the self-resonant frequency of capacitors used in audio equalisers is at RF, well above 1 MHz. But many large and/ or older designs of electrolytics and some large (above 1µF), older design of plastic film capacitors have resonant frequencies just inside or just above the audio band. Ringing or bursts of oscillation may be set off by percussive transients, especially any ultrasonic garbage. Nearly all modern capacitors employ extended foils for low inductance which shifts the resonant frequency upwards, for example to at least 300 kHz for 2 µF and above 1 MHz for values below 220 nF. Then, usually, all will be well, assuming effective RF filtering at (or before) the equaliser's input.

No less than any other part, capacitors are subject to more subtle, second-order kinds of error. For example, the response of a simple RC network should change at -6 dB/octave. Period. But high accuracy measurements show that few capacitors can keep this up below -50 dB. As attenuation progresses beyond this point, the rate *slopes-off* gradually, eventually settling at -3 dB/octave. This behaviour, where the EQ slope derived with a real capacitor 'spreads' outside its passband in a way unpredicted by the simplistic, first-order theory textbooks may prove to have significant psycho-acoustic ramifications. Caused by partial transmission line effects [4, 8] it is least troublesome in low inductance capacitors, for example *layer* types.

The most imperfect kinds of capacitor are electrolytic (including tantalum), medium-k and high-k ceramic types, which all use brute-force means to yield high capacitance in small volumes. Considering their wide tolerances, usually ±20% or greater, and the amount by which their capacitance changes with frequency, temperature and ageing, these kinds should never be used for filtration in recording equipment, anywhere — ever!

The majority of EQ circuits employ plastic film capacitors which are, by and large, far more stable and come in tighter tolerances than the types just mentioned. There are four common types. Polyester (full name: *polyethyleneterephthalate*; also trade-marked 'Mylar' and closely related to *Terylene*) is the most common, closely followed by Polystyrene. Polycarbonate and Polypropylene are less common, more expensive, and the readily available range of values and voltages isn't so broad. All the names are a bit of a mouthful , so the industry abbreviations will be referred to from now on **(Table 1)**.

TABLE 1

Plastic Film Capacitor Abbreviations

MKC = Poly Carbonate
MKP = Poly Propylene
MKS = Poly Styrene
MKT = Polyethylene Terephthalate (Polyester)
Note: Originated in Germany, the 'MK' prefix roughly translates as 'Metallised Kapacitor'

Of the four, MKC and MKT are the least perfect. They exhibit *polarisability* mechanisms common to electroytic and ceramic capacitors, albeit on a smaller scale. The outcome is *dielectric absorption* (alias 'soakage'), a situation where residual charge lurks in the dielectric and emerges more gradually than predicted if a perfect capacitor is assumed. ▶

The absorption effect seems like it would potentially compound delayed resonances in EQ circuits. Still, objectivists have a point when they assert that there has not been much hard copy demonstrating psycho-acoustically significant effects on audio signals form capacitor error mechanisms, notably DA.

It is easy to show how dielectric absorption leaves a residue when a capacitor is hit by an assymetric pulse, but not with a sine wave or music programme. As DA is a *linear* error, the acid test (a challenge by Professor Lipshitz) is to show changes in amplitude response and group delay. Accepting the challenge, **Fig. 10** illustrates clear-cut differences between capacitors with and without DA. The plot shows the computer simulation of five, cascaded gain stages with 4.7 µF capacitors blocking the lower arm of each feedback loop'. The two graphs show switching between models of ideal (polystyrene) and a non-ideal (polyester) capacitor. In this example, the amplitude differences are small at around 0.04 dB and occur well below the audio band 0.6 Hz, yet a 1 ms deviation in group delay clearly visible below 0.1 Hz. The next challenge is to show effects of this kind in the audio band, something that requires more intensive modelling and new DSP tools.

As the equipment's temperature changes, MKC and particularly MKT, capacitors change value quite erratically. Their temperature coefficient curves (% of rated capacitance vs. degrees centigrade) are not linear, but like a roller-coaster. In valve (tube) equalisers especially, the drift from switching on, with the capacitor's temperature rising from 15°C (say) up to 80°C or higher, can cause an annoying shift in any high Q equalisation. Conversely, MKS and MKP capacitors exhibit a low and substantially linear change of capacitance with temperature — an effect that can be largely cancelled by combining them with suitable metal film resistors, whose temperature coefficient is almost exactly the opposite. With care, the result is an equaliser that behaves the same as it warms up. Moreover, the plastics in MKS and MKP capacitors are 'non-polar' (this is a feature of their molecules, nothing to do with 'non-polar' electrolytics), so dielectric absorption is nil, or extremely small, depending on the macro-molecular structure [5]. The main setback with MKS and MKP is their low capacitance per unit volume, which is about two-thirds of that of MKT and MKC. Their extra physical size is the penalty for relying on natural permittivity, whereas all the other polarisable dielectrics enjoy a kind of molecular 'capacitance amplification'. So as usual there are no free lunches in engineering.

There is little doubt that specific capacitor changes in equalisers (as elsewhere) are percieved by many experienced listeners as improving clarity, detail and space. And that better sound is broadly in accordance with increasingly refined construction and materials. But how does one connect the two? Gerzon [1] reminds us that 'Objectivists . . . are very narrow minded about what kind of measurements they will consider'. Artefacts may lie below -100 dB and be swamped by noise, yet that needn't mean they're inaudible. Perhaps plain mechanical considerations have been overlooked? Real situations are frequently bathed in high SPLs. Condenser microphones as well as electrostatic cans and monitors, are, after all, just specialised capacitors. Connect any large ceramic or plastic film capacitor across a power amplifier's output, and you have a tweeter, albeit crude and inefficient. The sound of classic valve (tube) instrument amplifiers owes much to the reverse effect, that of microphony. High and medium K ceramic capacitors are the worst offenders, being but one step removed from piezo or 'crystal' microphones and cartridges. The plastic film capacitors used in EQ circuits can be microphonic too, although the effect may remain hidden until the console is struck by high SPLs at the capacitors' acoustic resonant frequencies. Microphony needn't be a problem. It can be overcome by minimising network impedances, by considering the acoustic qualities of component mounting, and by specifying capacitors which the component maker can prove to be uniformly wound without voids and firmly embedded in epoxy. ■

TECHNICAL TERMS

GBP: Gain Bandwidth product, measure of op-amp goodness.

K: Shorthand for permittivity, or 'capacitivity gain'.

SNR: Signal to Noise Ratio.

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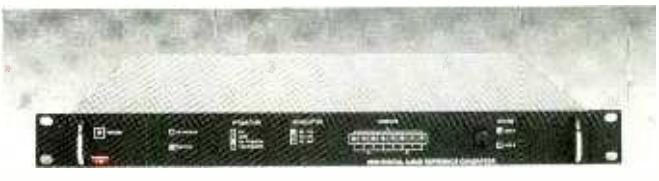

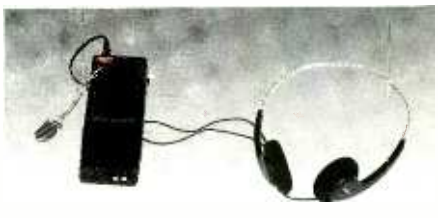

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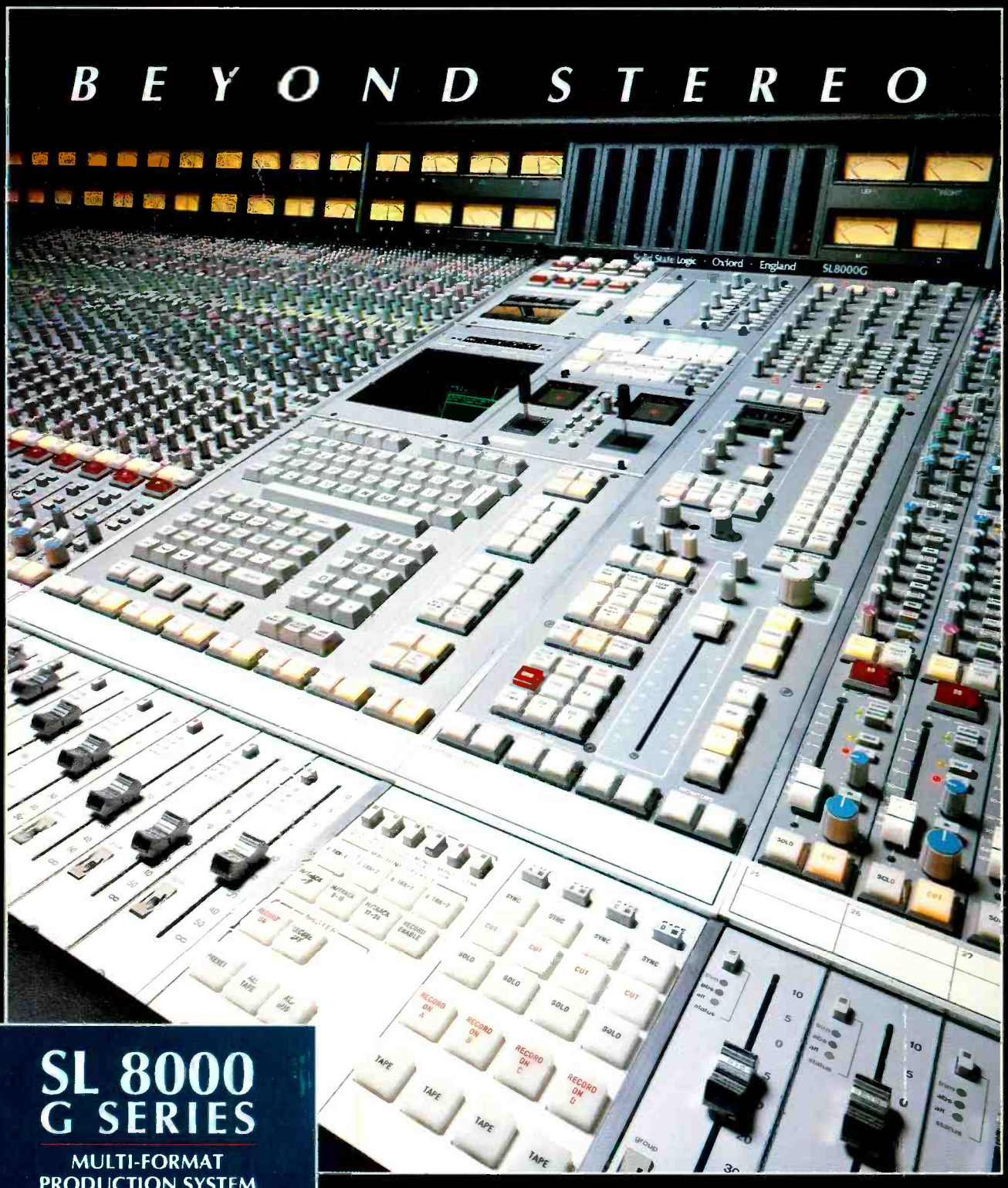

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