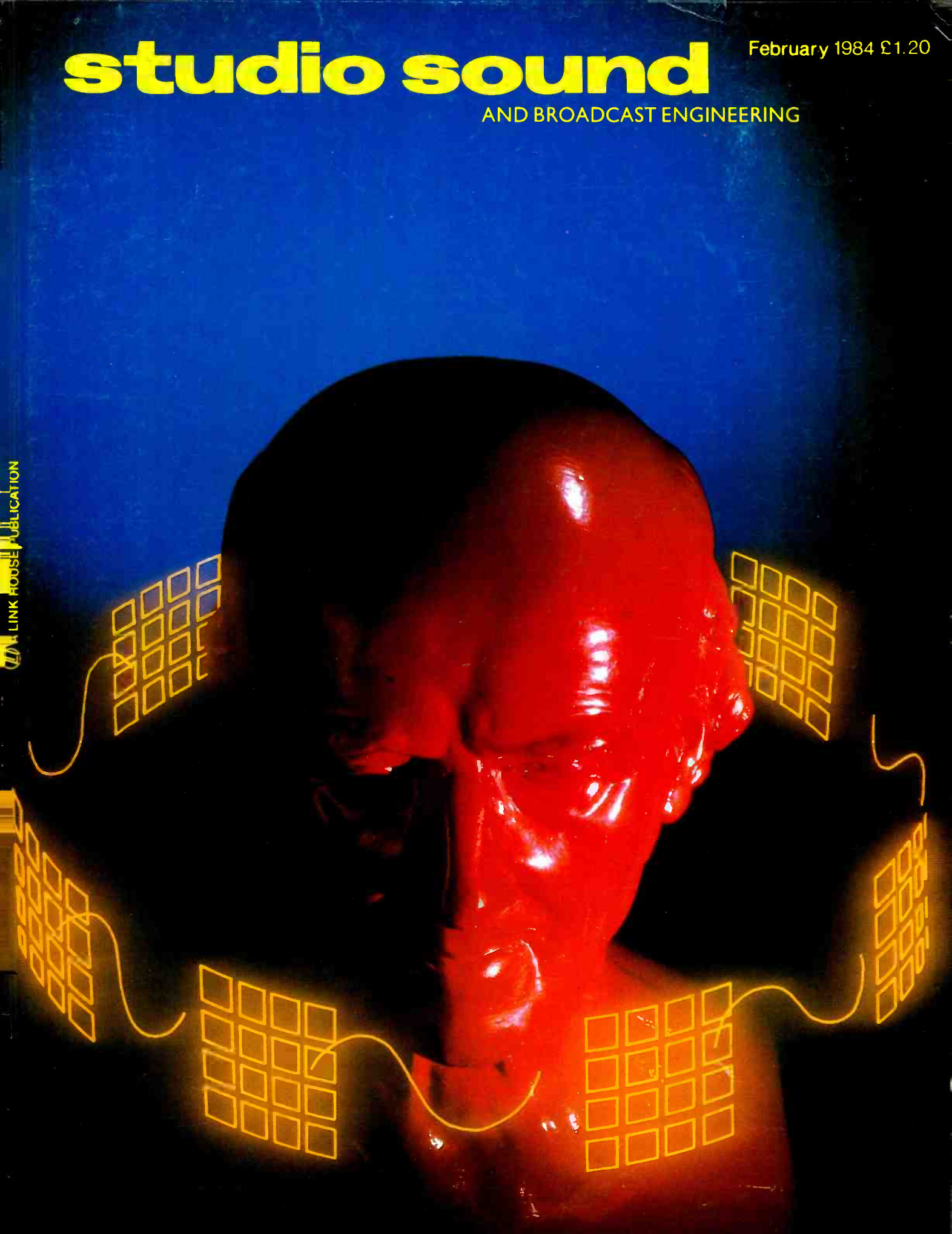
studio sound

AND BROADCAST ENGINEERING

February 1984 £1.20

A LINK HOUSE PUBLICATION



Surround sound
Music synthesis

Pretty Impressive

Over the past couple of years our Series 2400 studio mixing consoles have been impressing more and more people. So many, in fact, that over 200 consoles have been installed already in studios throughout the world.

Studio owners have found that the 28/24 version of the Series 2400 is the most cost-effective way to get 52 equalised inputs during mix down.

While their clients love the flexibility of the split console design, with its logical format and easy to follow signal paths.

All sound professionals are impressed by our attention to functional detail. Like the three solo modes, two programmable mute buses, six cue sends and of course semi-parametric equalisation on input and monitor channels. And the new optional Soundcraft Automation system makes Series 2400 even more versatile.

Richard Elen of Studio Sound recently described the Series 2400 as "a very impressive console that is a pleasure to use".* Which is praise indeed.

So it's no surprise that the Series 2400 is the most popular 24 track studio console in Europe. And that's a pretty impressive achievement – even for a Soundcraft.

* Studio Sound – September 1983. Reprints available.

Soundcraft
The Professional's choice

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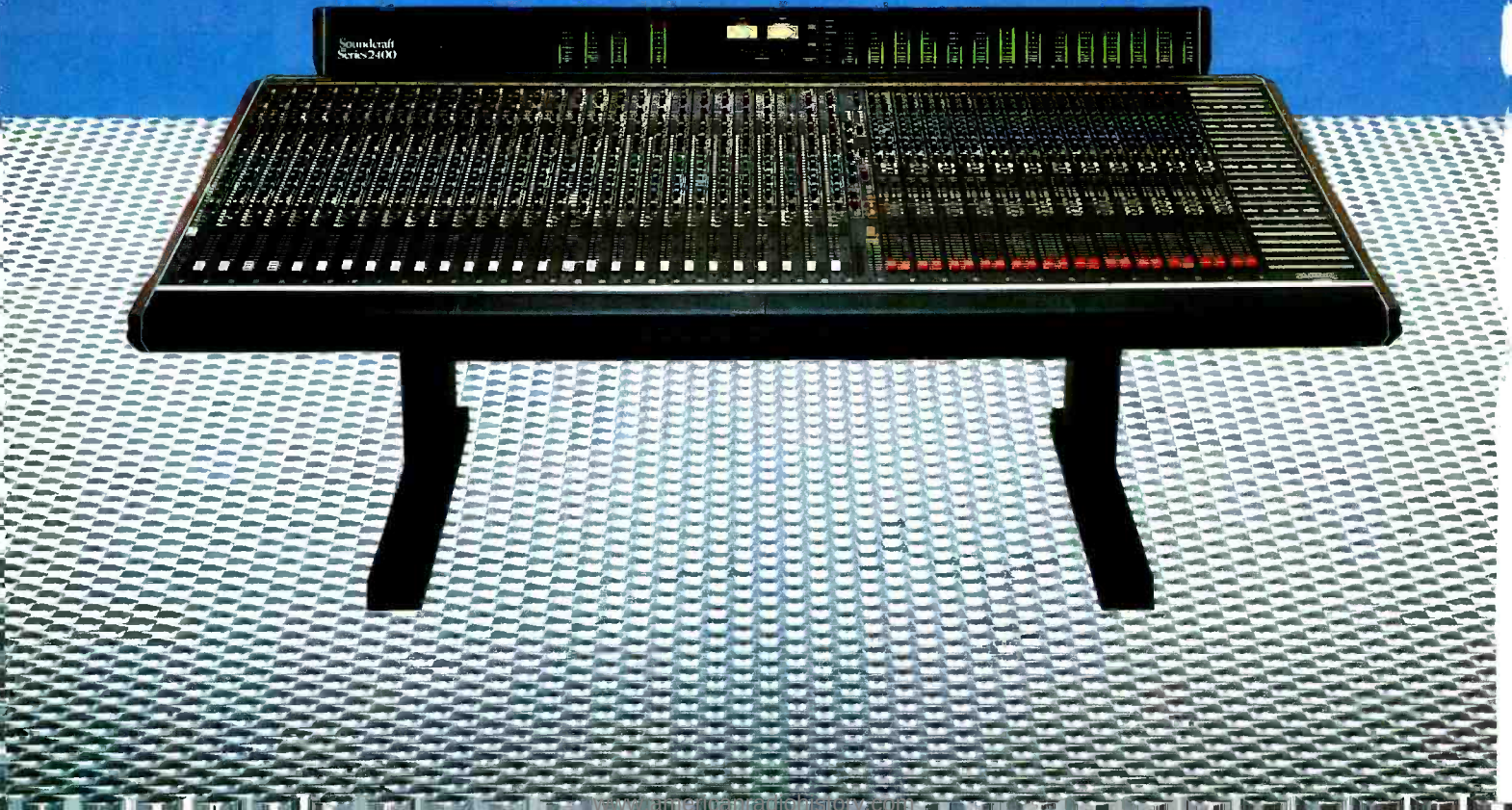

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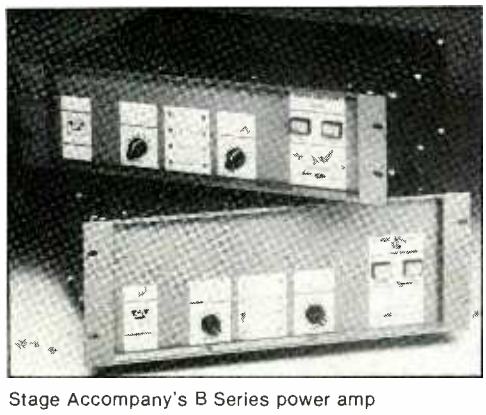

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Advice, instruction, back-up support. These are the key words in HHB's digital service philosophy.

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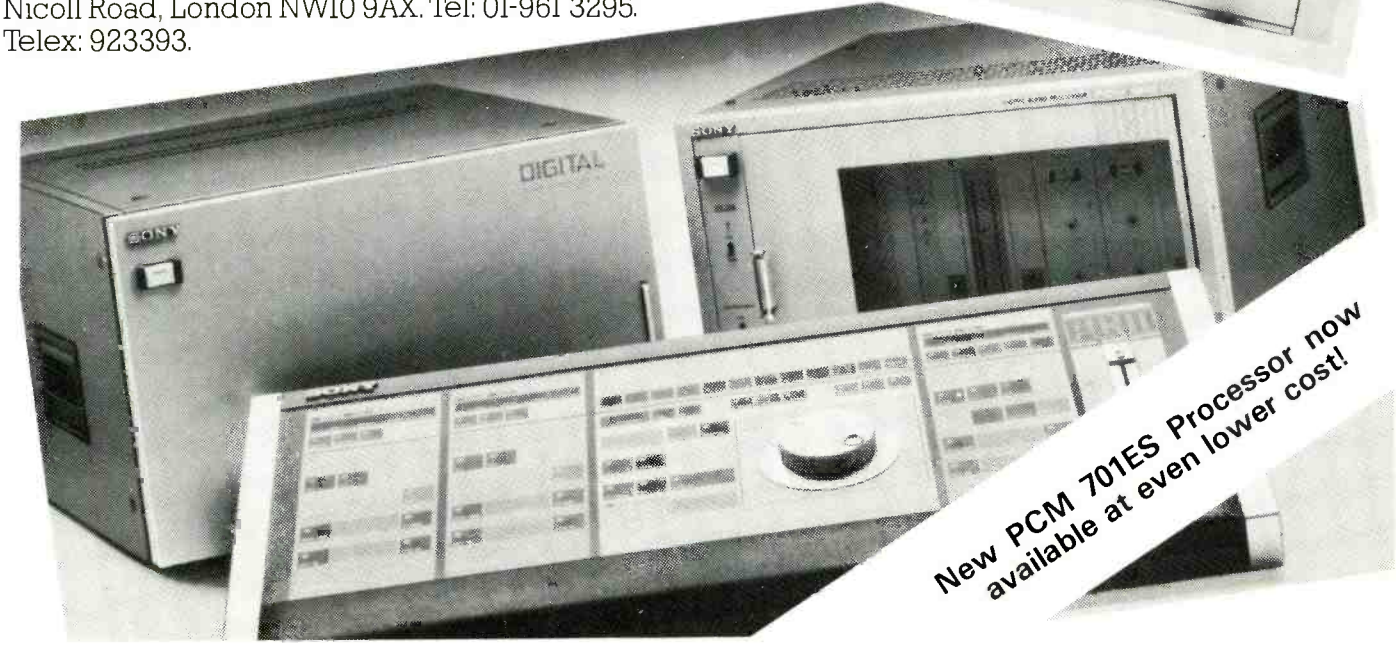

studio sound

AND BROADCAST ENGINEERING

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EDITORIAL

Diversify and die?

A major problem is hitting the recording studio business. It's already taking out studios in the United States, and in the UK it's surprising that something hasn't happened already. The problem relates to new technology, work, pricing...the lot. The result may mean the disappearance of the recording studio as we know it.

Modern recording can be an expensive business. There are usually a number of recording studios serving the same geographical areas, and if one particular highly-priced bit of hardware is purchased by the place down the road, or across town, there will be plenty of pressure on other studios to follow suit. It's happening right now with consoles; next year it will probably be digital multitrack or something.

It isn't that such pieces of equipment aren't a good idea...far from it. The question is where the money is going to come from. Chris Stone, president of Record Plant Los Angeles and chairman of SPARS, thinks that the solution is to rent rather than buy, and he put this point forcefully at the recent APRS/*Music Week* digital audio seminar. We are publishing his comments in this issue. But while renting may be fine for a digital multitrack, it is a bit impractical to handle a console that way (or a new acoustic design).

The point is that studio charges do not reflect a sensible rate for the job. They haven't kept pace with inflation in the US, let alone the UK, where there is a massive amount of price-cutting that is simply going to put studios out of business. And the studios that go out of business will be those that are not backed by large corporations, the independents, simply because they will not have the backing to throw money at the studio until the competition dies out.

So why aren't studio rates more sensible? On the face of it, the main reason is that record companies will not pay what the rates ought to be. They think that everything can be done in £35-50/hr studios, and why should it cost more? They will put their premier artists into more expensive facilities, but such acts account for only a small percentage of studio usage.

Now, there is nothing wrong with 'second division' studios in this price range—I do a lot of work in them and they are fine for what I do there—but you can't do everything in them. There are times when a cosy little basic 24-track establishment is just not enough. But the 'first division' studios aren't charging that much more...perhaps only £50-75/hr. They must be perilously close to break even limits; some must be working beyond them, if they are selling 24-track time in central London at £48/hr or multitrack digital at a mere £80. Surely, it simply isn't practical.

But why are the record companies unprepared to pay higher rates? Simply, because they know they can go down the road and get it done cheaper. There is no agreement, even a local one, between studios about the going rate for the job, and it's hardly surprising: there isn't enough work to go round. So if they are relying on record work, they can die in one of two ways: set a respectable rate and keep to it, and die through lack of work; or price-cut each other into the ground. The decision is merely whether or not you die now or next week, and whether you go out crammed full of work that costs you more than you get, or empty. And it won't get any better.

So you cut costs. You throw out your maintenance staff and rely on freelancers and the poor old manufacturer. But where are they at 4.30 in the morning when the machine goes down? You can do without tape-ops and assistant engineers, and thus ensure that there will be no new engineers coming into the industry...so there's a whole new set of ways to go out of business to add to the others. It's like playing Russian Roulette with several of the chambers loaded. What are your chances?

Aha, you say. But we can diversify. Into video. We can offer video post-production facilities. We can do sound-to-picture. There's lots of work, there, and the rates are high...

Yes, and so are the overheads. Video gear makes the average audio studio look like peanuts. And it will only take one enterprising video facility to think 'look, we could put two state-of-the-art sound studios in there for a quarter of the price of another video suite...' and that market will start to go away. Offering odd little post-production facilities may help the sound studio for a while, but ultimately... Certainly there is a market there, like there always has been for film music and the like (many of today's big independent studios started that way), but it isn't that big. And the extra business being generated by music video may be more like marsh gas than a genuine light at the end of the tunnel. Someone, somewhere will soon realise that spending £50,000 on a video to promote a recording which cost a tenth of that is just damn stupid. And that cable systems like MTV in the US only make their slim profits (or large losses) because the promo clips are free...and will they always be so? The money has to come from somewhere, and there are those in the US who are suggesting that music video is just another fad, like skateboards, CB, video games and home computers...that it will die out. In the UK it might not even start, as the population density is all wrong and it will be fiendishly expensive to cable more than a small proportion of homes, because most people don't live in towns like Maidenhead or Swindon, which are easier to cable; they live in old cities which are very expensive, or in low-density housing. Plus, broadcast TV *works* in UK—we don't need 40 channels of programming which can't afford to be produced. Like the US, but worse...you'll need to be in the feature films business to make money on cable. Music video isn't the future, much as I would dearly love it to be, and I wouldn't put my money into it. It might get a studio out of hock for a year or two, but then?

Ultimately, though, there will always be a market for music. Compact Disc, vinyl, digital cassette, crystal, who cares. Maybe it'll have pictures on it, moving or nearly so. Someone will have to record it, and someone (not a million miles away from what we today call a 'record company') will have to pay for the facilities or run them themselves like the old days. If we want the recordings of the future to be made in facilities which are fun to work in, and bring out creativity in the artists, you independent studios will have to be there, or it'll be fluorescent lights and grey walls all over again. To be there then, you will have to charge realistic rates now. All of you. It's as simple as that.

Richard Elen

Turnkey's 1984 Wind-Up

The Fostex B16. We introduce an element of choice.
There's a scramble to mate this remarkable sixteen track with the ideal budget mixer. You'll see ads for individual packages appearing in the press about now. In fact, the choice of console lies between three major brands. Each with features to suit different applications.
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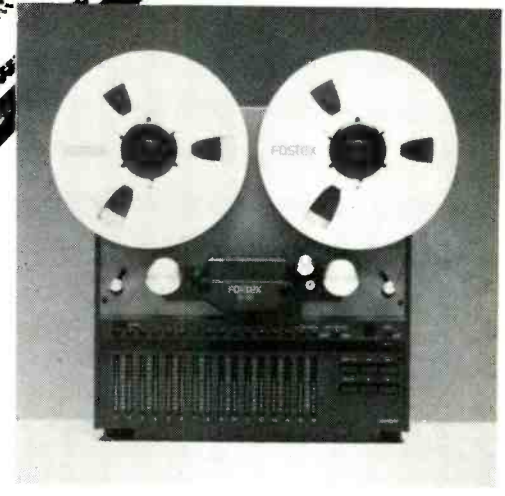
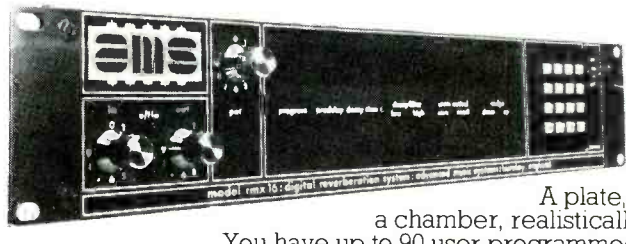
The Soundtracs 16.8.16 features a degree of sophistication not usually found in consoles in this price bracket. Call for details.

We are back on line for the full supply of the Allen & Heath System 8, in every configuration, and custom modification.



The new SECK 16.8.16 mixer, is the lowest priced yet includes many of the features in consoles at twice the price. Also suitable for many live applications. Full specifications on request.



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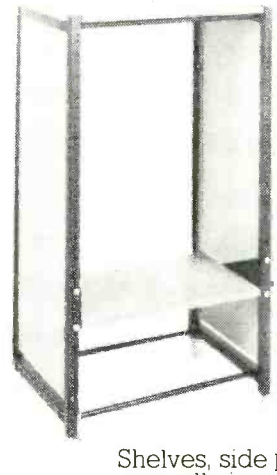
N.B. Our Free Trial offer of whole week's evaluation in your studio, applies ONLY to the digital processor.



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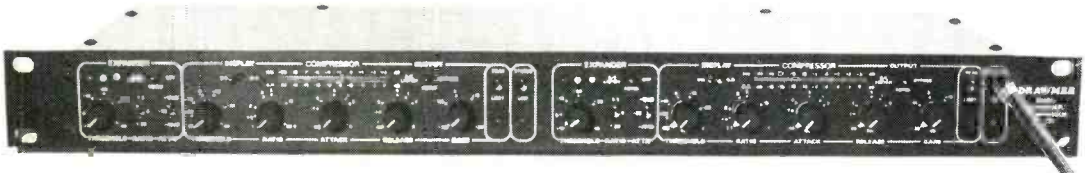

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PZM Price Crash
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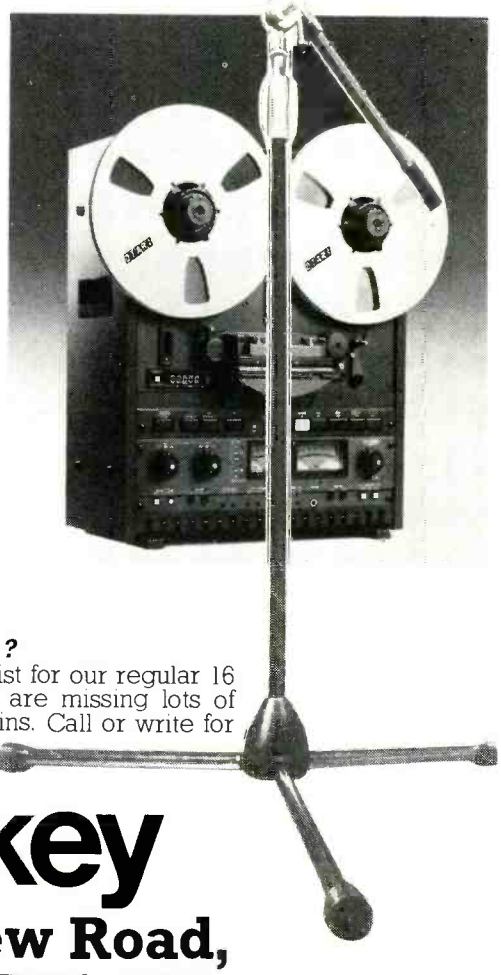

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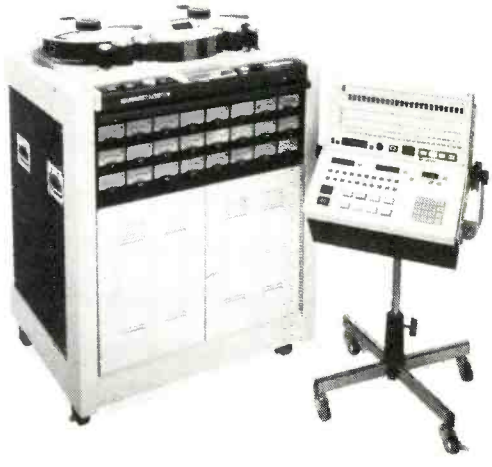

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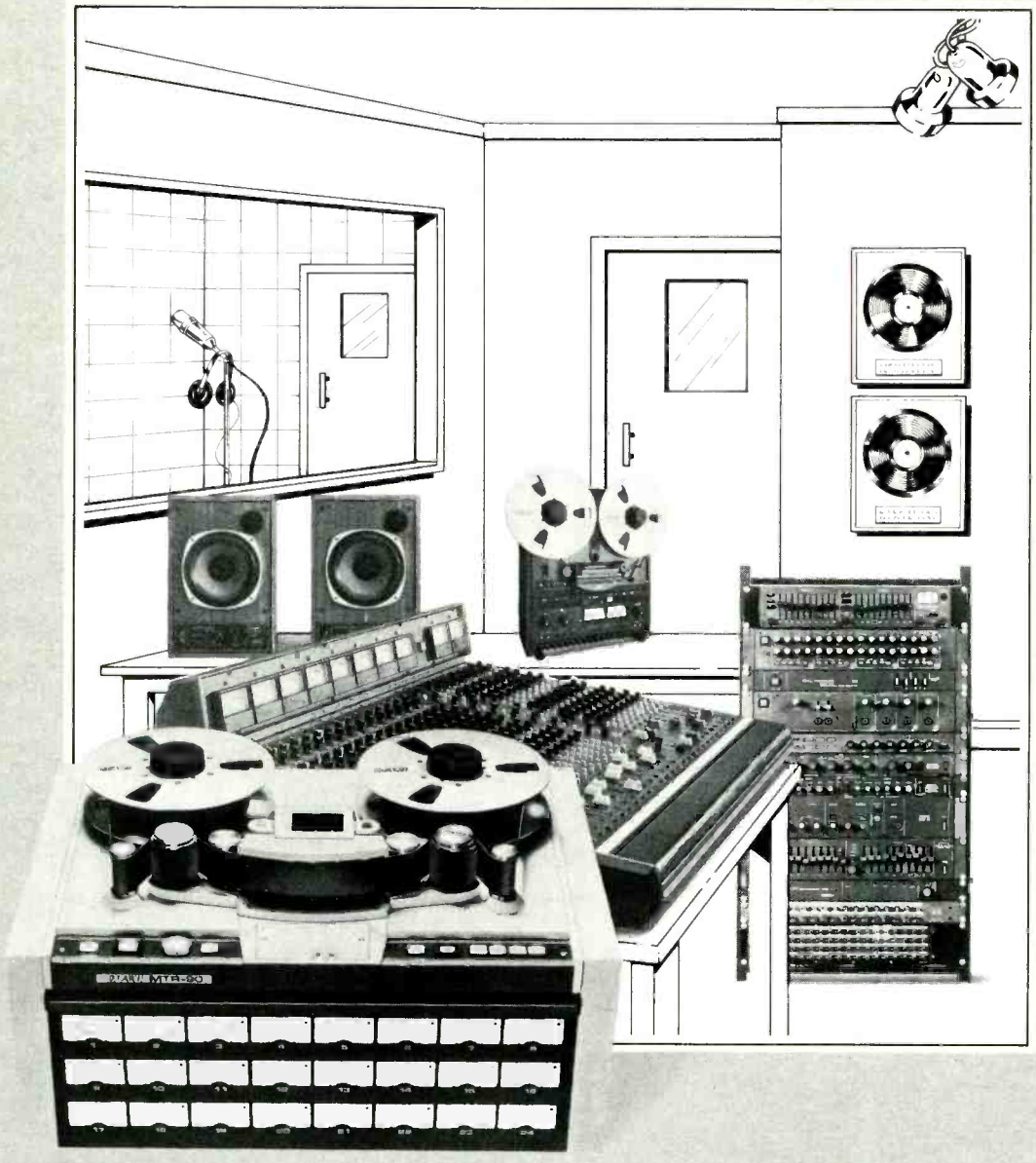

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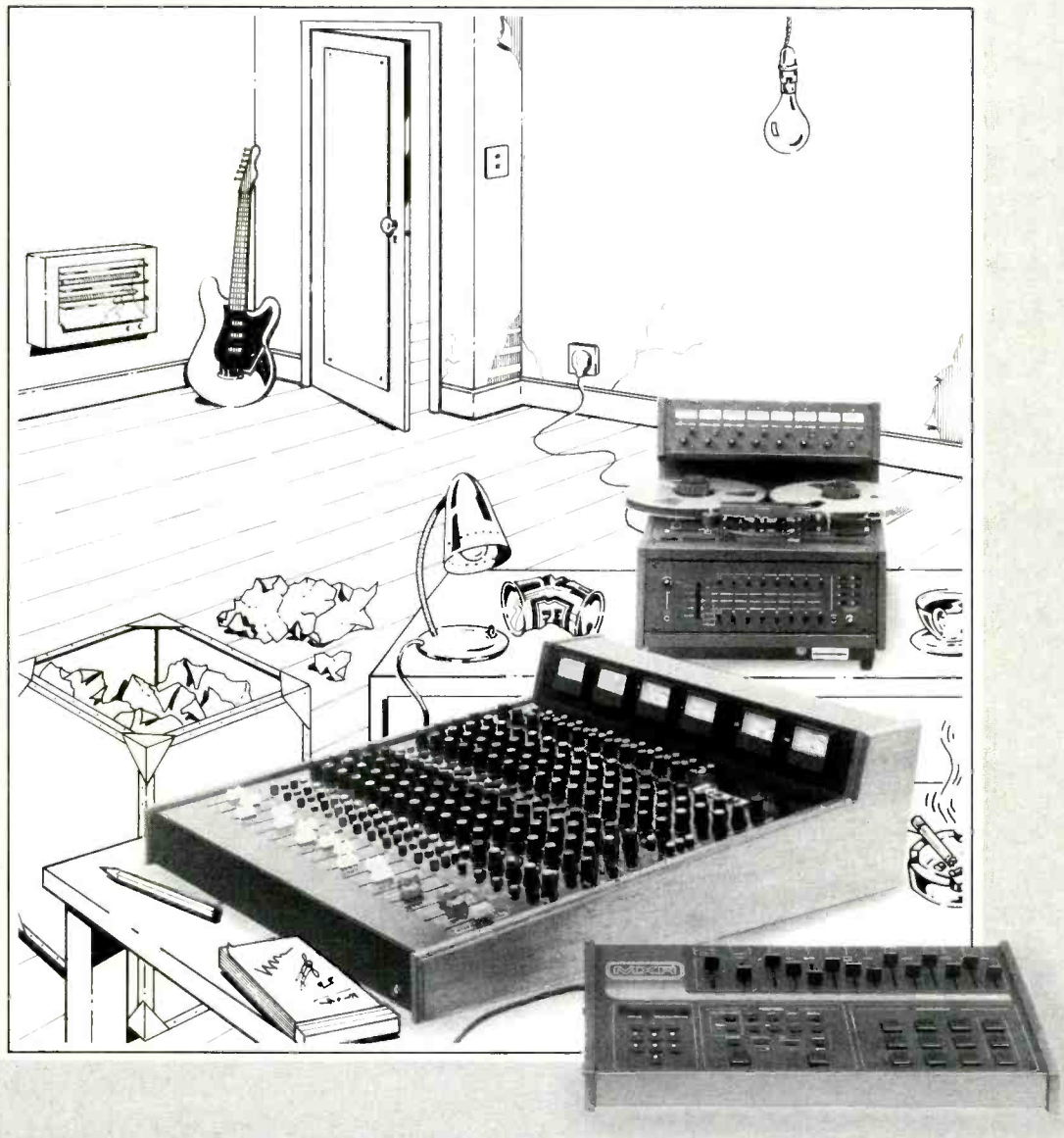

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He'll be happy to answer your questions and discuss your requirements.

INDUSTRIAL TAPE APPLICATIONS
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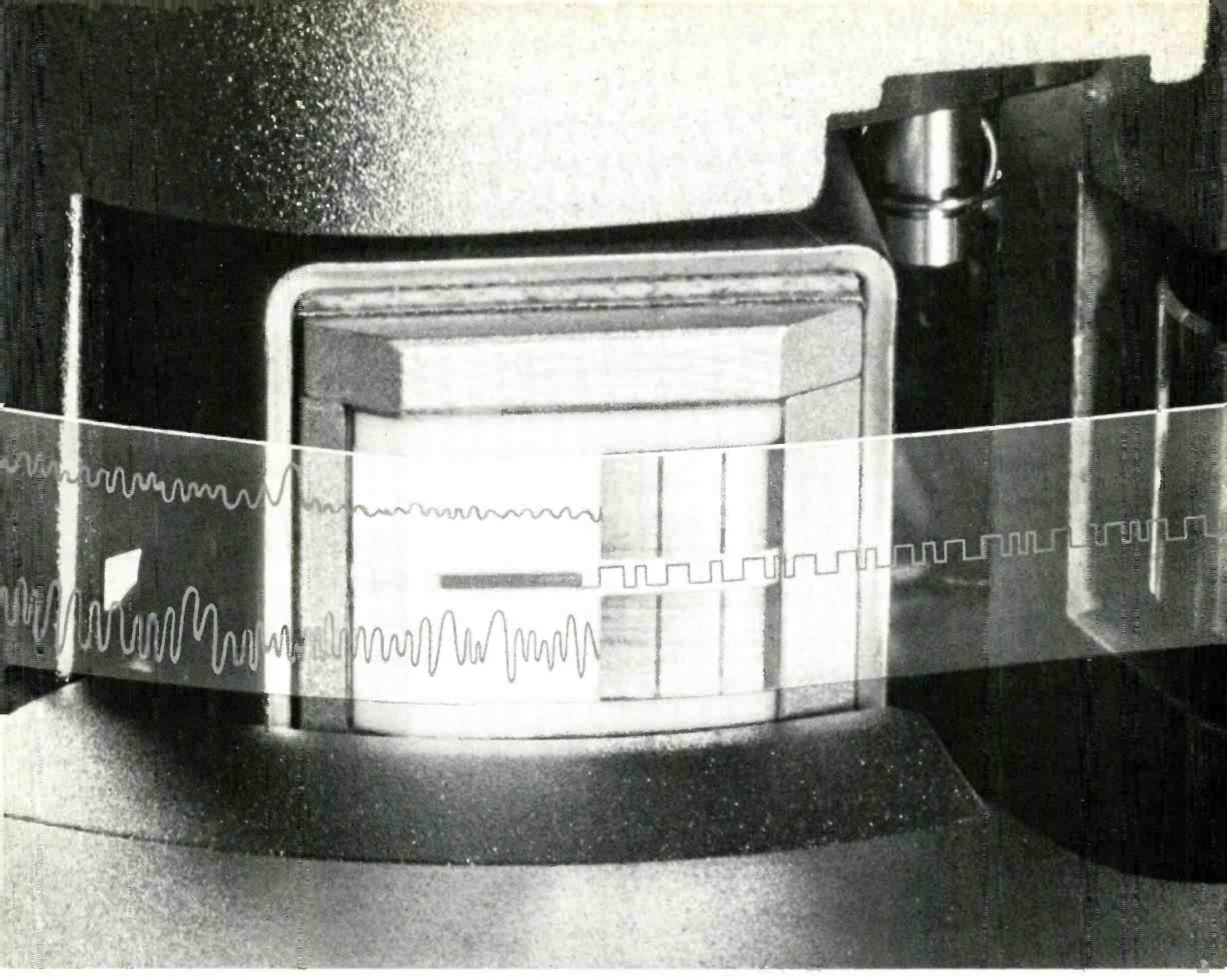
WE'VE JUST PLAYED A LEADING ROLE IN BRITAIN'S BIGGEST TV PRODUCTION.



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MTR

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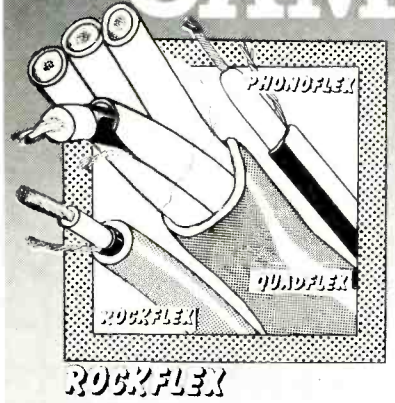

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- For: Guitars, keyboards, effects, patching etc.

QUADFLEX

- Extra-low capacitance audio cable, (4 x Phonoflex)
- Conductive Thermo-plastic Shield
- High-speed preparation
- For: Audio sends and returns, Hi-Fi, effects rack feeds, etc.

PHONOFLEX

- Extra-low capacitance audio cable
- Conductive Thermo-plastic Shield
- High-speed preparation
- For: Audio, Hi-Fi, HiZ Mics, effects racks patching etc.

MUSIFLEX

- Faster wiring — no braiding to prepare
- 11 High-visibility Colours
- Tough, flexible P.V.C. jacket
- Conductive thermo-plastic shielded
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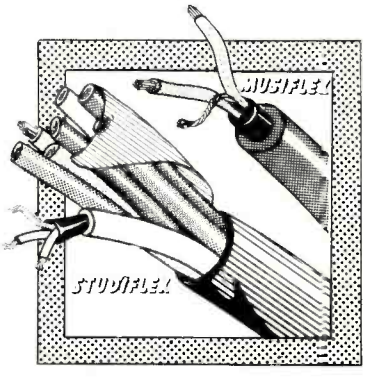
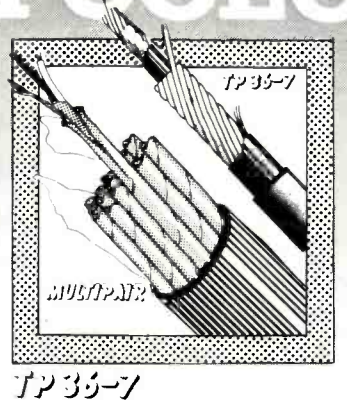
- Available in 1 and 8 pairs, other configurations to order
- Conductive Thermo-plastic Shield
- Fast Preparation Time
- Fully colour coded — high visibility colours
- For: Studios, Audio, TV, Control etc.





TP 36-7

- Conductive Thermo-plastic shielded multicore
- Sends and returns separately shielded (36 sends and 7 returns)
- For: P.A. Cable Systems ('Snakes')

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- Aluminium foil-shielded mylar wrapped, melinex taped
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The Professional Revox.

The PR99 has been developed from the highly successful B77 in order to meet the stringent demands of the recording and broadcasting industries. The PR99 offers the professional these important features:

1 Raised deck plate for easier editing
2 Improved tape start
3 Tape dump
4 Two-way self-sync with automatic sync/input switching
5 Balanced line inputs and outputs
6 Calibrated or uncalibrated level adjustments
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The Revox PR99 is available in several versions: mono or stereo 3¾/7½ ips NAB or 7½/15 ips NAB or IEC. And being built to Studer precision, the PR99 achieves exceptional performance and reliability but now at an easily affordable price.

For more information on the PR99 phone or write for a catalogue.

STUDER REVOX

F.W.O. Bauch Limited

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

You thought Trident spelt mixers?

Well, you were half right, but only half.

Up until now the Trident TSR Multitrack Recorder has somehow managed to keep a low profile. We've decided it's time to put a stop to that and let it blow its own trumpet.

The Trident TSR Professional Multitrack Machine speaks for itself.

Supplied with full Remote control and autolocator, this fully professional machine is available in 16 and 24 track versions,

both of which are considerably less expensive than the overseas competition.

Now available as an extremely attractive package with the new Trident Series 80B or Series 70 mixing consoles. These complete Trident packages are available only from Don Larking Audio Sales and they are just waiting for you to come and try them out in our studio at Luton.

Call us today on Luton (0582) 450066.
29 Guildford Street, Luton, Beds.

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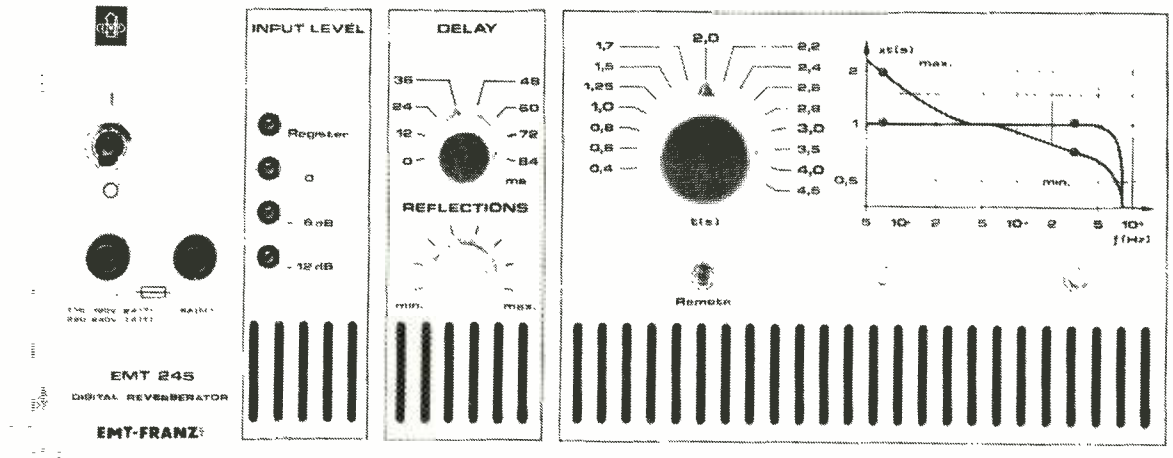
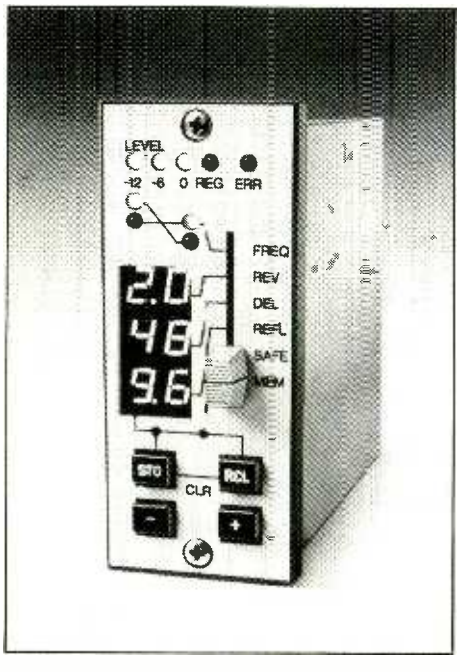
The more memorable EMT 245.





The EMT 244 gave you the warmth of sound you'd expect from a plate but in a digital reverberation unit. Now the EMT 245 gives you even greater flexibility.

The 245 features natural, large-room reverberation through adjustable predelay. You have amplitude control over the first reflections, selectable pre-echo delay in 8 steps from 0-84ms and reverberation time in steps from 0.4-4.5 secs and frequency response of reverberation time switchable for bass and treble equalisation.

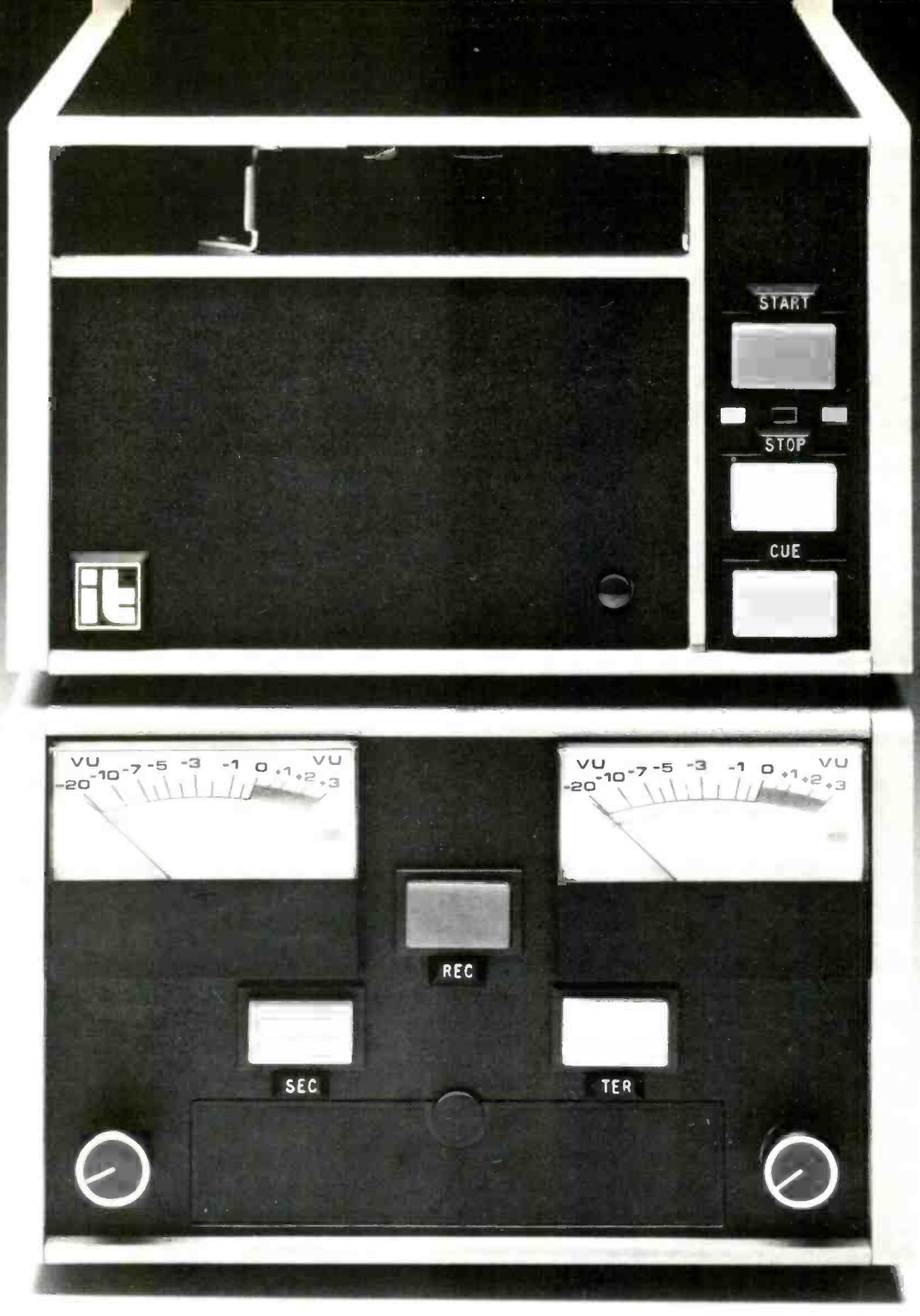
The reverberation parameters may be logged in an optional 10 programme store and immediately recalled by the remote control unit.

With improved algorithm, greater programme memory and, of course, a superbly clean decay, the EMT 245 has an extremely low noise floor, making it ideal for studios, broadcast units and mobiles. And you'll warm to its economical price as well.

To find out how much more you can now get from the space-saving EMT 245, contact Bauch today.

EMT FRANZ GmbH
Postfach 1520, D-7630 Lahr.

F.W.O. Bauch Limited
49 Theobald Street, Boreham Wood, Hertfordshire WD6 4RZ
Telephone 01-953 0091. Telex 27502



THE NEW ITC 99B IS MORE THAN JUST ONE GREAT IDEA ON TOP OF ANOTHER.

When the microprocessor-controlled ITC 99 was introduced three years ago, it represented a new generation of cartridge machines capable of producing reel-to-reel performance. Numerous mechanical and electronic innovations ensured the highest sound quality, improved operator convenience and much simplified maintenance.

Now, the ITC 99B has taken the original breakthrough several stages further.

The result is cleaner, crisper sound... consistently.

Write or telephone for full details:

International Tapetronics Corporation
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F.W.O. Bauch Limited

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STUDIO SPARES

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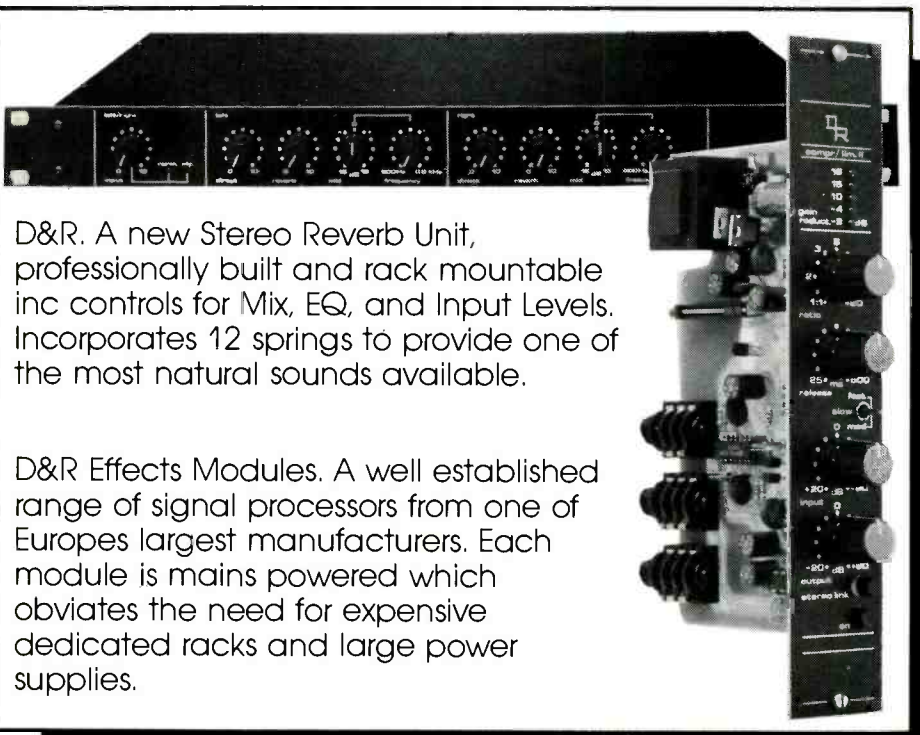
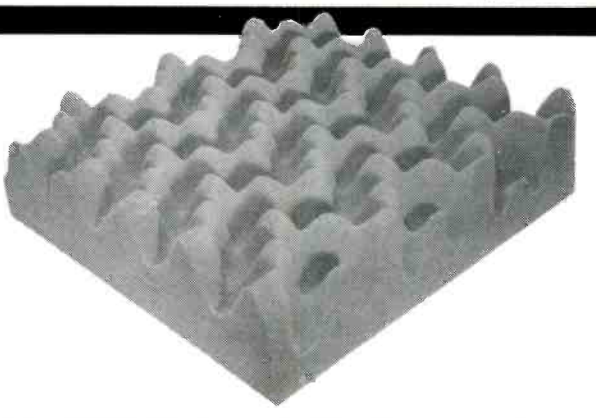
PRODUCT PROFILE



D&R. A new Stereo Reverb Unit, professionally built and rack mountable inc controls for Mix, EQ, and Input Levels. Incorporates 12 springs to provide one of the most natural sounds available.

D&R Effects Modules. A well established range of signal processors from one of Europes largest manufacturers. Each module is mains powered which obviates the need for expensive dedicated racks and large power supplies.

Cassette Duplication. Digital and Audio. The Pentagon C20 is probably the most popular duplicator currently available. 16 times speed, copies both sides simultaneously. Digital and Audio versions.



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The capsules are mounted in a spring suspension which gives protection against shock and eliminates handling noise.

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Hayden Laboratories Ltd, Hayden House, Chiltern Hill, Chalfont St. Peter, Bucks. SL9 9UG

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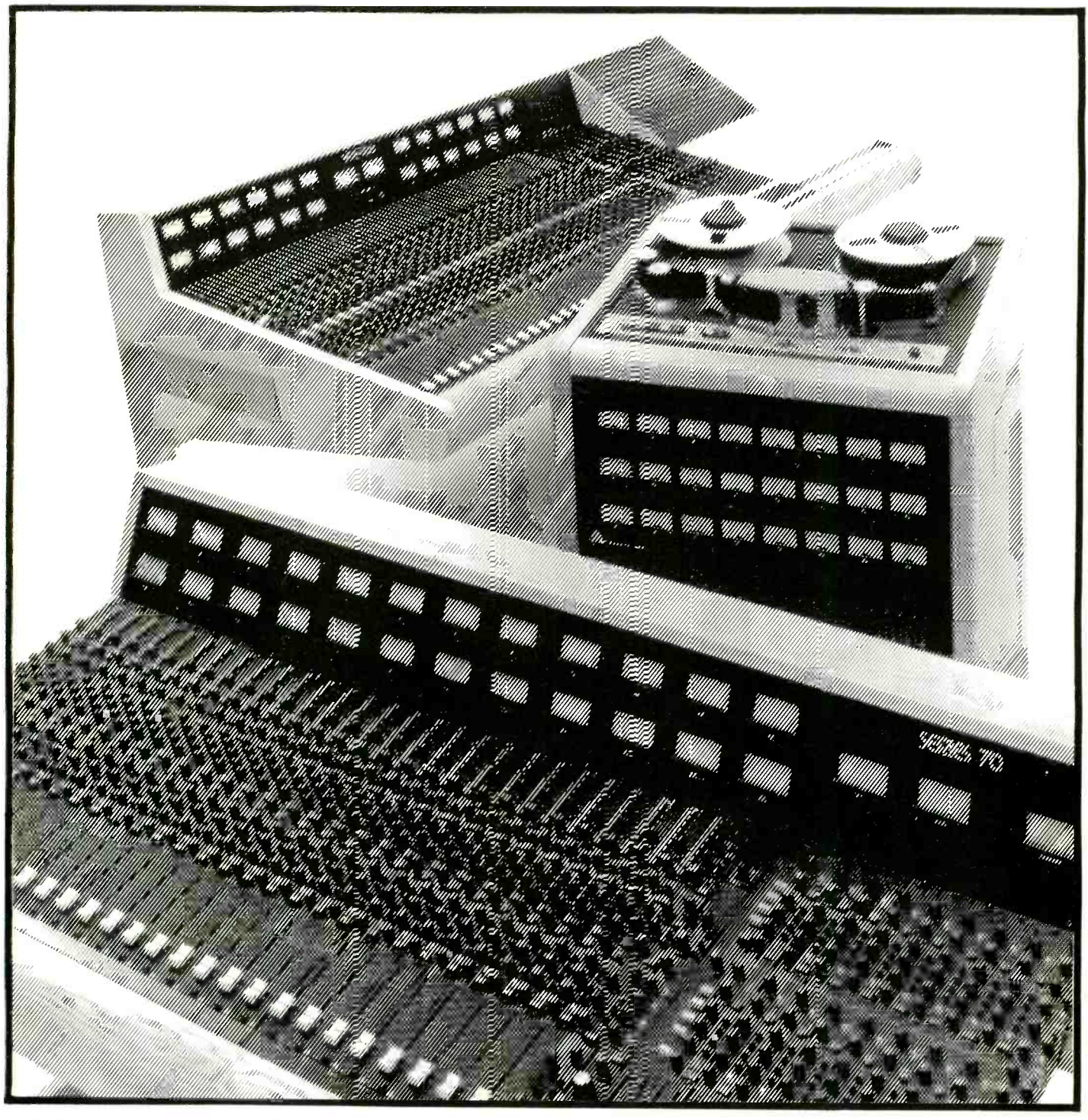

For the committed professional there is one word that represents the highest standards in studio hardware – Trident.

The Series 70/Series 80B consoles and TSR machine are production engineered to the quality you associate with Trident. Off the shelf or customized you've never been able to buy a Trident for less.

Using the TSR multitrack machine as the foundation of the system, Trident packages cover advanced recording for the producer's studio up to full industry standard.

The range consists of TSR 16 and 24 track machines, supplied with remote controls and full auto locator at a price that foreign imports can't match.

The Series 80B is a 32 input, 24 group/monitor console, and the Series 70 is a 28 input, 16 group 24 monitor console. Both desks are fitted with a fully professional patchbay, 4 echo returns with EQ, and have the facility to use the monitor section as further inputs on remix.

Your limit isn't 32 inputs, Trident's engineers will design you an individual 56 input console at a price which will impress your bank manager.

So don't mince words – say Trident.

TRIDENT

Trident Audio Developments Ltd.

Shepperton Studio Centre Shepperton Middx. TW17 0QD, U.K.
Tel: Chertsey (09328) 60241. Telex: 88139282 (TRIMIX G)
Trident (U.S.A.) Inc. 652 Glenbrook Road, Stamford
Connecticut U.S.A. Tel: 203-357 8337

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The lightweight portable with heavyweight features.*

* 4.9 kg Total operational weight
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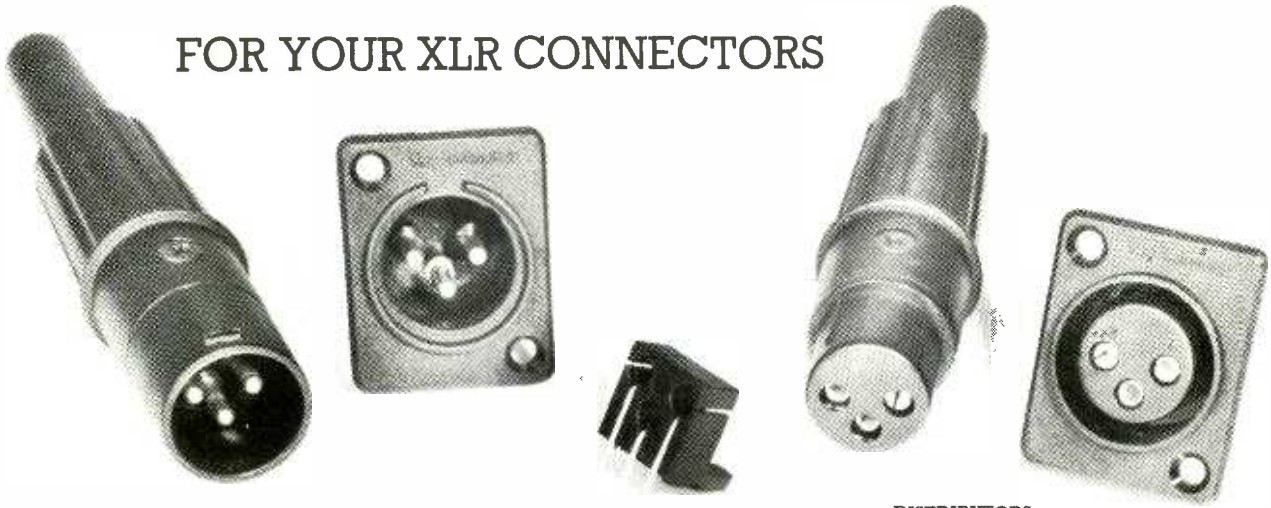

This new range of XLR connectors, manufactured in the U.K. by Key Technology Ltd., fill a demand in the audio industry for a high quality, inexpensive range of British made XLRs.
The chasis sockets are rear and front mounting, with a PCB mounting socket also available. Made from glass filled nylon for a durable and attractive finish. Silver plated pins give low contact resistance and excellent solderability.

The line connectors have been carefully designed with ease of assembly in mind, and good cable retention.

KEY TECHNOLOGY LTD.
Unit 9, Rosshill Industrial Park,
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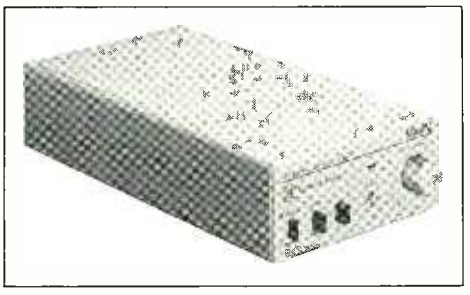
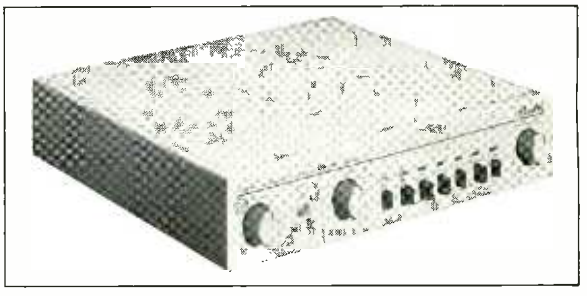
new products

Minim expand Ambisonic range





Minim Electronics, one of the first licensees of Ambisonic technology in the hi-fi field, have been making Ambisonic decoders for several years. A new leaflet details the current range of products which includes several additions at both the budget and pro/audiophile ends of the range.

The *AD7* is a compact, inexpensive (£50 inc VAT, P&P and NRDC licence fee) decoder offering both UHJ 2-channel and B-Format inputs. It also has a stereo enhance capability enabling the processing of ordinary stereo signals with adjustable width. A stereo bypass switch removes the decoder from circuit and powers only the front pair of loudspeakers. A switched layout control compensates for different speaker configurations. The *AD8* offers the same facilities but additionally includes two 30 W amplifiers for the rear information. The decoder card (*AD2*) used in both these units is available for incorporating into homebuilt equipment (retail around £30) or for OEM applications.

At the top of the range, the *AD10, AD10P* and *AD12* offer more features for the audiophile or the recording studio environment. Based around the same circuitry, the *AD10P* is an upgraded professional version of the *AD10* with better than 0.1% accuracy selected components, while the *AD12* is a 1U 19 in rack-mounting version with *XLR* connectors. Special versions can be made to order; in addition, a conversion kit can be added for 6-speaker applications in larger replay environments. The units accept 2-channel UHJ or 3-channel B-Format and offer horizontal surround decoding for 4-speaker layouts. The layout control is variable between 1:2 and 2:1 ratio of sides for the speaker configuration. A Focus control enables the listener to enhance front-stage directional information, while a Position control enables the listener to vary their effective position in the soundfield (eg moving closer to, or further away from, the orchestra in a concert hall). A hard-wired bypass switch disconnects the unit for ordinary listening. An omnidirectional output is available for driving sub-woofers.

All the units in the range are easily interfaced in the studio environment between console and monitoring amp, or between pre and power amp in domestic setups. For integrated pre/power amps and *AD5* interface unit is available which attaches to the tape sockets (and duplicates them).

Minim also produce a wide range of multi-event timers for broadcast and consumer applications.

Minim Electronics Ltd, Lent Rise Road, Burnham, Slough SL1 7NY. Tel: 06286 63724.

Useful boxes from ADR

Audio and Design Recording are marketing a set of very useful and reasonably-priced units which are selling like hot cakes.

Most interesting is the *Propak 2;* an interface box which has *XLRs* at one end and phonos at the other. It drops line level to −10 and ups −10 to line level for interfacing consumer gear with pro levels and providing electronic or transformer balancing. The *Propak 1*, also available, does no more than this but the *Propak 2* also includes a switchable 11.34 μs time coincidence delay, which will put all your *F1* recordings done with the box into time-coincidence, so that you can lift the digits off the *F1* and into a *1610,* etc, without getting your bits out of step. It has a corresponding delay on the replay side so that time-corrected *F1* recordings will play back time-corrected! The unit will also, therefore, time-correct certain Japanese CD players which use the same technique (switching converters from one channel to the other to save money). This technique is probably the main reason for the difference in sound quality between CD players.

ADR also produce a neat little timecode reader. Hand-held and battery-powered, it has a phono socket input and will read EBU or SMPTE, reading user bits and showing drop-frame and colour frame where applicable. Four AA cells drive it for about 2,000 hours.

Then there is the *AmPak 8* audio amplifier. With *XLR* input and push-terminal output, it delivers 8 W into 8 Ω for instant foldback, talkback or other noise-making applications—with optional transformer input balancing.

ADR also make the DI boxes shown in the photo, plus they have just released the new Ambisonic Mastering System mixdown, encode and decode modules, which are discussed in the surround-sound overview in this issue.

Audio & Design Recording, North Street, Reading, Berks RG1 4DA. Tel: 0734 53411.

New Q.Lock interfaces

Audio Kinetics have released a new software package for the *Q.Lock 3.10C* synchroniser and a new range of video machine interfaces. The new software, *Q.Soft-Conform*, is specifically designed to streamline the process of editing an original master audio track to an edited video tape. With this process the quality of the final audio track on the video tape is improved by two generations. Very simple key sequences automatically cue all the machines to the required points, drop into record when desired and relocate for a review of the edit, calculating offsets automatically.

Q.Soft-Conform is normally configured for three machine operation with the facility for locking together the video machine and the multitrack recorder for ease of use. The original audio is transferred from the third machine on to the multitrack and relay closures within the *Q.Lock* permit alternate track laying to be performed with an overlap between the segments for full mix/edit facilities.

When used in a 2-machine configuration, the software will enable two video machines to be used as a simple assembly video-editor complete with colour framing calculations modifying the machine offsets.

Previously, the *Q.Lock* interfaces for the Sony *5630/5850 U-matic* video cassette machines did not permit use as a slave to an audio or video master. The latest generation of interfaces for these machines is now capable of being used as a master or slave. Existing *Q.Lock* systems can be retrofitted with the new interface.

Audio Kinetics (UK) Ltd, Kinetic Centre, Theobald Street, Boreham Wood, Herts WD6 4PJ, UK. Tel: 01-953 8118. Telex: 299951.

USA: Audio Kinetics Inc, 4721 Laurel Canyon Boulevard, Suite 209, North Hollywood, CA 91607. Tel: (213) 980-5717. Telex: 19481.

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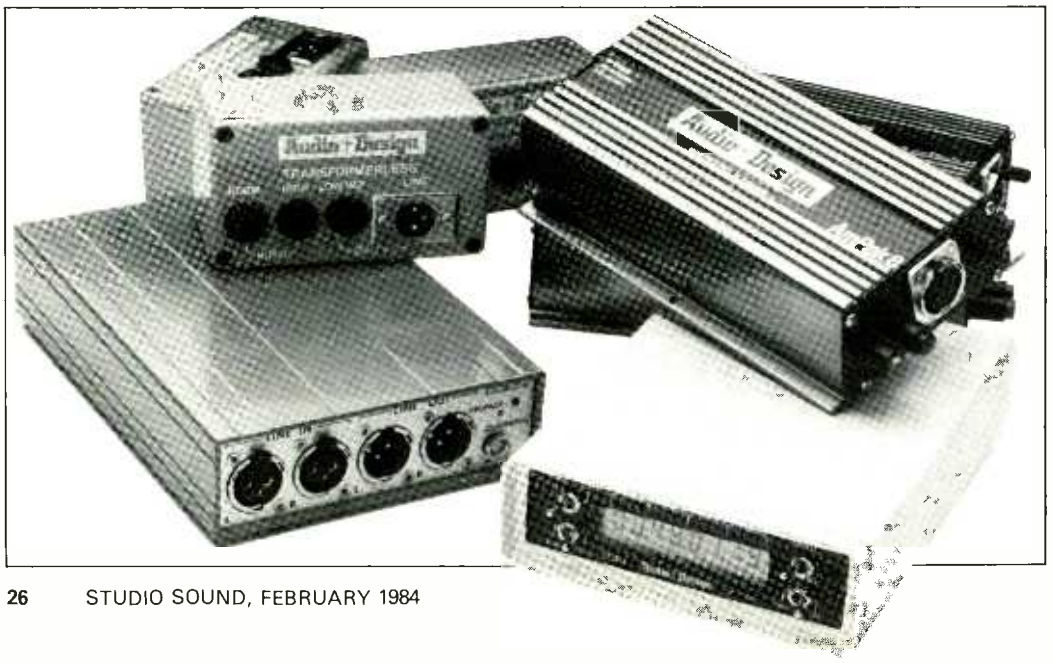

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☐ **Please send me information on the MXR Drum Computer.**

SS 2/84

new products

Stage Accompany B Series

Stage Accompany have made available new versions of their *SA 900A* and *SA 500A* power amplifiers known as the *B Series*. These models feature a number of improvements such as individual power supplies for each channel and better performance and protection. The inputs are switchable balanced/unbalanced with the balancing being electronic. There is also provision for switching of the earth. The protection system uses an opto-coupler to protect against switching peaks heavy overload, short circuit and DC at the output while temperature sensors prevent overheating. The amplifiers are equipped with 2-speed fans and all power/driver transistors are mounted on heatsinks with 'Sil-Pads' for long-life heat transmission. Construction uses specially designed aluminium profiles that enable the amplifier to withstand heavy road conditions.

Stage Accompany, Industrieweg 30, 1775 PV Middenmeer, The Nederlands. Tel: (31) 2270-2157. Telex: 57680.

UK: Stage Accompany are currently looking for a 'serious' UK distributor for the power amplifiers and their other products which include active crossovers, DI boxes, passive speaker filters, flight cases and cabinets for studio and PA applications.

Ferrograph head defluxer

The Ferrograph *D/2* defluxer has been a well established tool for use with reel-to-reel tape machines and cassette recorders. There have, however, been some tape machines that has made its use difficult, in particular NAB cart machines, without partial dismantling of the machine. To help ease this problem, Ferrograph have manufactured the *D/3* with an extended probe which allows easier access to 'difficult' heads.

Audio Video Marketing Ltd, Units 20/21, Royal Industrial Estate, Jarrow, Tyne & Wear NE32 3HR, UK. Tel: 0632 893092.

Dynafex ICs

MicMix Audio Products in conjunction with Solid State Micro Technology For Music Inc, have recently announced the development of a new IC using the *Dynafex* single-ended noise reduction system.

SSMT specialises in the manufacture and marketing of ICs for audio and electronic music applications and they will handle these aspects of the *Dynafex* chip under licence from MicMix. According to SSMT, production quantities should be available in the first three months of 1984 and SSMT will be selling them to qualified OEM users who will also be required to complete a sub-licensing agreement. They expect that interested parties will include console manufacturers, tape machine manufacturers and professional video equipment manufacturers, users of cart machines and film reproduction systems.

Solid State Micro Technology For Music Inc, 2076B Welsh Avenue, Santa Clara, CA 95050, USA. Tel: (408) 727-0917.

AKG low cost gooseneck

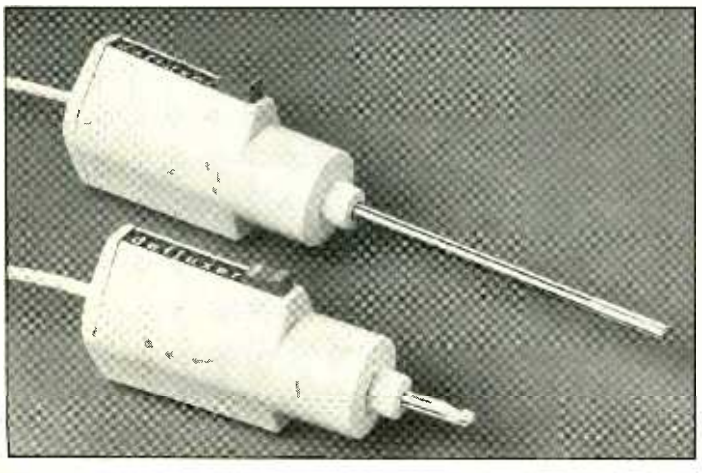
AKG have introduced a new low cost gooseneck mic, the *D541*. It is a dynamic cardioid with a speech tailored frequency response. The unit is finished in non-reflective satin black and has a single hole fixing with cable entry above or below the mounting surface. Sensitivity is 2 mV/Pa with an impedance of 720 Ω. Overall length is 13½ in and weight 12 ozs.

Also under development are omnidirectional and hypercardioid versions plus a longer gooseneck model. Fitted XLR connectors are an optional extra.

AKG GmbH, Brunhildengasse 1, A-1150 Wien, Austria. Tel: 0222 921647.

UK: AKG Acoustics Ltd, 191 The Vale, London W3 7QS. Tel: 01-749 2042.

USA: AKG Acoustics Inc, 77 Selleck Street, Stamford, CT 06902. Tel: (203) 348-2121.



3m handy dispenser

3M have introduced a dispenser for cable marking tapes. The unit will hold 10 rolls of Scotchcode 5 mm wide self adhesive tape, each carrying a different number or letter. This epoxy film tape will not smear and is resistant to flagging, dirt, oil solvents and heat. The dispenser measures 3 cm across and 11 cm long, easily fitting into a pocket. There is also a loop at one end to clip on a belt, etc. There is a precise tearing edge to cut the length of tape required. Tape refills are available through the normal 3M suppliers.

3M Electro-Products Division, 3M Center, MN 55144, USA.

UK: 3M Electro-Products Group, 3M United Kingdom PLC, 3M House, PO Box 1, Bracknell, Berks RG12 1JU. Tel: 0344 58755.

New portable Sony mixer

Sony have a new portable 12-channel multi-purpose mixer available that is compact enough to fit into a 19 in rack. The *MX-P61* has balanced transformerless inputs and outputs and all input channels have *XLR*-type connectors. There are four line outputs and three aux sends together with monitoring and talkback facilities. Each channel has a 3-band EQ, and the other unit features include VU or LED peak programme metering, high and low pass filters, two stereo output limiters and a choice of AC or 12 V DC power. There is further provision for selectable 48 V or 12 V AB phantom powering and selectable line/aux output reference levels of +4, +6, +8 dBm. The *MX-P61* weighs just over 40 lb and has dimensions of 17 in wide, 22⅛ in deep and 5⅛ in high.

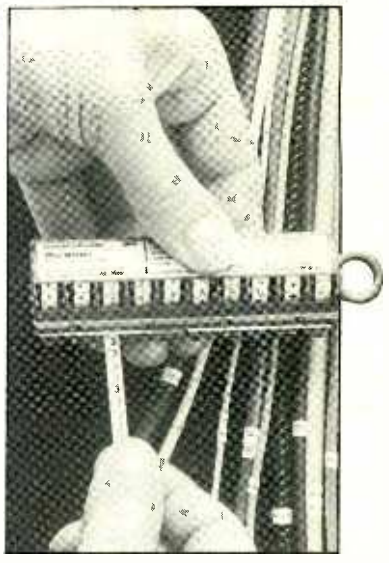
UK: Sony Broadcast Ltd, City Wall House, Basing View, Basingstoke, Hants RG12 2LA. Tel: 0256 55011. Telex: 858424.

USA: Sony Corporation of America, 9W 57th Street, New York, NY10019. Tel: (212) 371-5800. Telex: 424595.

Spectrum Emphasizer

A Japanese company by the name of Ortho Spectrum has sent us brief details on a sound processor known as the *Spectrum Emphasizer SE-1000*. A dual channel unit operating on 'psychoacoustic principles' it acts to emphasize and retain the clarity of mid-frequencies that are often masked by greater energy levels in higher and lower octaves. It appears that there are 14 settings adjustable for specific requirements. The manufacturers envisage applications in both live sound and studio recording. Hopefully more information will be available soon.

Ortho Spectrum, Infra Noise Laboratory Co Inc, Azuma Building, 7-21 Hiroshiba-cho, Suita City, Osaka 564, Japan.



Nady HeadMic

Nady Systems *HeadMic* is a very lightweight microphone headset intended for stage performance although it should have a number of other uses. The headband can be concealed in the performer's hair leaving only the boom section in view. The mic used in the assembly is the Countryman Associates *ISOMAX* directional unit and this is in very close proximity to the performer's mouth and is capable of a natural full-frequency voice performance. The unit may also be used with wireless transmitters or the standard hard wire connection.

Nady Systems Inc, 1145 65th Street, Oakland, CA 94608, USA. Tel: (415) 652-2411. Telex: 470747.

UK: Hardware House (Sound) Ltd, West Works, Chalgrave Road, London E9 6PB. Tel: 01-986 6111.

Syco SMPTE synchroniser

Syco Systems are now bringing in the Friend Chip *SMPTE Reading Clock* unit, the first to allow drum machines and synthesisers to be synchronised with SMPTE code. With the *SRC*, only one code is necessary for all sync applications. The unit includes a 24-hour SMPTE reader/generator which will function in varispeed. Cue points may be set allowing sequencers and drum machines to be started at any point in the track. Start/stop cues may also be generated.

The *SRC* is a modular system in 19 in rack-mount form and can apparently sync with 'all known instruments' including Fairlight, Roland, *Synclavier*, Linn and PPG devices. A clock delay allows offsets from milliseconds to 24 hrs. The unit can communicate with other computers via *RS232* serial protocol.

Friend Chip: Bergmannstrasse 4, 1000 Berlin 61. Tel: 030/692 76 46.

UK: Syco Systems, 20 Conduit Place, London W2. Tel: 01-724 2451. Telex: 22278.

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news feature

Digital Audio Seminar

Terri Anderson

It would have been a dull and dogged music business person who left the APRS/*Music Week* digital seminar with no interest in, or understanding of, digital recording. And it would have been a steely hearted reactionary who left without at least a glimmer of enthusiasm about the new recording technology in general and Compact Disc in particular.

The cumulative effect of excellent 'layman's-terms' lectures—by Dr Geoffrey Barton on what digitised sound is and how the recording process works; by Dr Martin Jones of Neve on what a DSP mixing console can offer; by Richard Elen on the medium and marketing of CD and Barry Fox on the consumer's view of this new music carrier; by Bjorn Blüthgen (head of special technical assignments at PolyGram in Hanover) on what wonders digital sub-codes will soon offer on CD—was enough to enthuse and entice most people in the music business.

Although anxiety was expressed about quality, accessibility (for smaller labels and studios), cost, the debatable value of recording digitally for vinyl and analogue cassette, and the repertoire now accumulating on CD, there seemed to be a fairly cheerful acceptance among music business delegates that they had probably seen the future and it certainly appeared to work.

The APRS had adopted and firmly maintained a policy of 'first come, first served' on applications for invitations to the seminar (the seating capacity of Advision's Studio One being strictly limited). The record industry, which is used to unapplied-for invitations on which the letters 'RSVP' are no more than a quaint decorative motif, apparently did not appreciate that (a) the number of places was genuinely limited; and (b) first come first served meant exactly that—with no concessions to corporate clout of latecomers.

As a result it is difficult to judge record industry interest in the details of digital recording from the names on the list of invited delegates. The absence of any representatives from two of the five major record companies cannot be taken as evidence of uninterest in digital recording, since all the majors and well-established large independent labels now have CD product out (except EMI UK, which delayed its decision on CD and has now had to put back its debut several times because of pressing problems).

It would also be unfair to assume that all the missing record companies believe they have nothing to learn and no need to discuss the subject; they might simply have been too slow to realise that the event was on and they actually had to ask to be invited, and once all the seats were allocated no-one else could get in.

It is interesting to note that while the first day of the seminar—which was for studio owners, engineers and other technically fluent people—was rapidly oversubscribed after only one announcement, the second day, aimed at non-technically trained music business personnel, filled with a rush only after an expensive APRS mail out exercise—despite a series of advertisements and editorial plugs in *Music Week* for a month before the event. It is also worth noting that while the room was actually filled to overcapacity throughout the first day, a number of seats remained empty for the record business day. This meant applied-for but then unused invitations, which had kept other would-be delegates in the queue from being able to attend.

The PolyGram contingent, however, was large and senior—attesting their position as leaders in launching CD in the world, and their commitment to perfecting and popularising it. The contributions of marketing executives Clive Swan (UK) and Wolfgang Munczinski (Hamburg-based) to the general discussions were of interest and value. Equally welcome was the presence of a large number of voluble and concerned representatives of small labels and studios.

Overall, the event should be accounted a success. It was the first of its kind, bringing together the providers and users of recording facilities in a genuinely informative (and fairly informal) joint venture. The reaction from delegates, and the feeling of speakers, after each day's sessions was highly appreciative, optimistic and—best of all—discursive.

While it was, in fact, delivered on day one to the technical delegates, the statement which summed up the message from the technical side of the audio industry to the music-making and marketing side, came from BBC research engineer Guy McNally. Expressed as a solemnly gleeful promise rather than as a sympathetic warning it was: "The pace is hotting up in digital recording technology, making even the computer industry look a bit tardy."

One speaker who reinforced this message most effectively and frequently was Bjorn Blüthgen. Spelling out a few details on the second day he told record labels that recording technology is moving ahead much faster than they, the customers, can use it.

There was much interest (and some muffled groans of despair) when he promised that within two years there would be CDs which, via digital sub-codes, will offer colour graphics, colour still pictures which change every 12 seconds and a visual display of a lengthy text about each track available while it plays. He promised a fairly inexpensive black box to link CD players to TV in the next generation of home entertainment hardware.

Later, in conversation, he was to confide that the applications of sub-codes could be made available sooner, but the end users (led by his own company) do not want technical developments to come on to the market too fast. He also privately advised studios to start collecting sets of colour transparencies documenting recording sessions, because these can be encoded on future CD versions of the LPs being recorded.

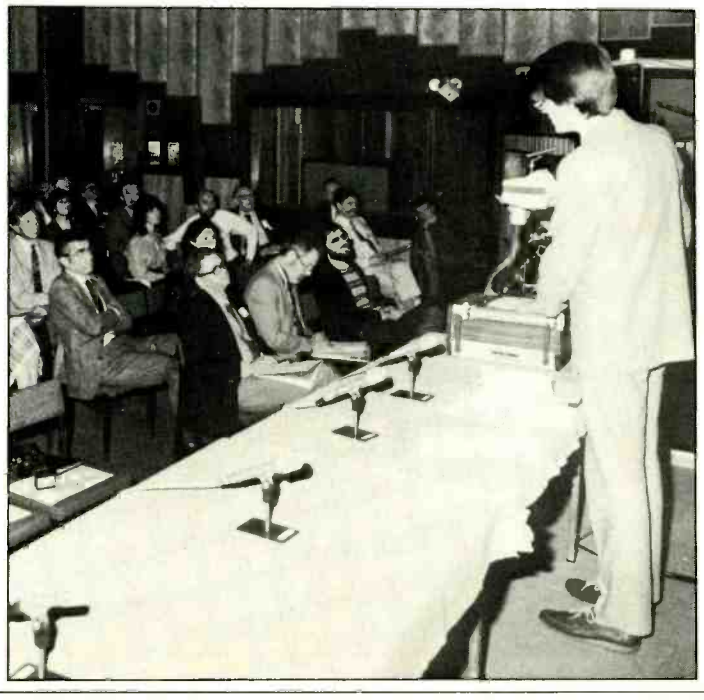
Dr Barton, in answering a question from Denis Knowles of Tellydisc Records, offered the music industry wider prospects still. He confirmed that interactive home entertainment systems could be expected to be available in the near future—depending on the speed with which cable TV establishes itself. The necessary technology for using TV and home computers in an interactive entertainment system already exists.

This was a topic appropriately raised by an executive of a direct response TV merchandising label but other delegates were obviously aware of the implications for all home entertainment software manufacturers.

The record labels (having been

32 ▶

Geoff Barton addresses the Seminar



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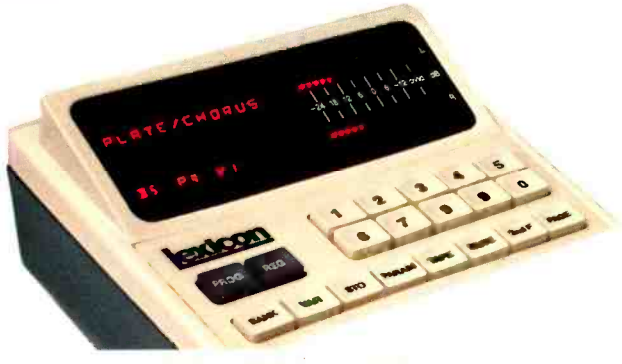

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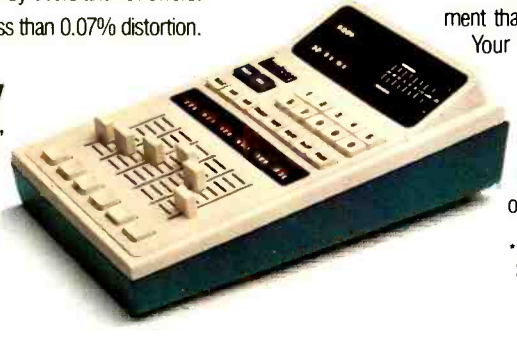

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SSE

given a very clear description of what digital sampling of sound is, how it is stored and why it does not suffer degeneration of sound quality in the way that analogue recordings do) were reminded repeatedly that digital recording for CD 'removes the mask' which on analogue vinyl and cassette recordings obscures recording imperfections. Several speakers stressed that the artists, producers, record companies and eventually consumers must accept that they will hear virtually exactly what went on to the master tape in the studio. *(Whether the engineers can hear it all or not—Ed.)*

Blüthgen underlined this with a report of having meticulously traced a hum on one CD pressed at Hanover (and rejected as faulty by the customer) back to a striplight in the recording room of the studio where the orchestra had worked.

Dr Jones' description of the all-digital studio of the future answered the implications of this anecdote; he said it would be essential to have soundproofed equipment rooms—away from either recording room or control room—to minimise unwanted studio sounds getting onto the recordings.

Richard Elen, speaking as a producer, engineer and CD enthusiast, stressed that much greater care and attention to detail will be needed in all-digital recording for CD. Equally, he argued, the music makers and the music buyers may well have to revise their approach and appreciation along 'warts and all' lines.

The record industry was also told that it must be prepared to pay more for digital studio time; the cost must be appreciably higher than for full-price state-of-the-art analogue.

Peter Harris, speaking as MD of what will, next spring, be the world's first all-digital music studio, told the assembled potential customers (and other studios) that the recording facilities cannot afford to go on investing in new technology unless they can earn a fair rate from it.

He added that he expects to charge £130-£150 per hour for the all-digital CTS studio; and he already has bookings at that price.

The main point had already been put in characteristically forceful fashion by SPARS chairman Chris Stone—who had travelled from his Record Plant studio in Los Angeles especially to take part in the seminar. He said he was shocked by the low rates being charged in UK studios. Coming from a country where much higher rates were being charged, yet the studio industry was still rapidly contracting, he warned: "Your UK studio industry will not be able to survive unless your prices go up...that means the digital equipment will end up in subsidised studios. You will have things go full circle, and there will be no choice of independent studios, only very functional, subsidised, in-house record company facilities." He spoke as one whose admiration for the UK studio industry was of long standing.

"The UK has always been ahead of the US in terms of developing studios," he remarked, adding, "we based Record Plant on Olympic—and stole one of their engineers."

In the lively open forum which closed the seminar a question about digital studio rates was answered by an uncharacteristically rather grim Peter Harris. "We have taken the plunge and set up a fully digital studio," he said. "We believe this will give us lead time on the competition; we will be in a unique situation for quite a while and we think we can hope to make a major recoupment of our investment.

"We are going to have to charge more—although we have evidence that record companies in general want the digital facilities but do not want to pay more for them...On the music side we will obviously service the superstars initially but there is also interest from people making movies (particularly Disney).

"We already charge £85-plus per hour for analogue and £110 for movie work. Prices are creeping upward, although studios still cannot get the rate they need to support the necessary phenomenal investment in new equipment.

"We hope and believe that one way to get away from price cutting and throat cutting is to take a quantum leap to move into an area which is completely new. We can then raise the general approach to pricing, and bring other studios up with us.

"Time alone will show but we have done some sums and have high hopes. We have in the UK one of the finest collections of studios in the world; record companies should think twice before they knock them down. They should think about the future, whether they want the same damn good studio industry in 10 years time, or not."

Smaller studios, totally unable to contemplate the kind of investment that the big league are having to make in the new technology, asked how they could get to use digital techniques. Advice from several speakers was to hire, or 'dip a toe in' by buying the Sony *PCM F1*. Blüthgen and Dr Barton promised a professional reel-to-reel 2-track from MCI/Sony soon, and progress on the harmonisation of standards for multitracks.

Barry Fox, Elen and Stone led the rest of the panel in advising the record industry *not* to produce pre-recorded digital cassettes using systems currently under development in Japan. This, it was urged, would be an obvious way to avoid piracy of CDs (since they will be an in-home/in-car/personal hi-fi music source anyway). Digital cassette versions of CD product will be instantly recognisable as illegal if offered for sale.

Fox predicted a digital audio cassette version of the VCR—progammable, remote controlled and with three hours recording/playing time—within five years, using digital micro cassettes of metal-evaporated tape in helical scan machines (and he predicted that both hardware and software will be relatively inexpensive from the outset).

Yet again, Blüthgen was able to volunteer the information that the technology already exists; only the need to standardise is holding up manfacture—but he expected the coming of satellite TV broadcasts with digital audio to engender consumer demand for the domestic digital tape equipment, at which point "...we'd have to provide it".

One point, raised by Nick Austin, director of the highly successful Beggar's Banquet indie label (and something of a technophile) was left very much in the air. He complained of the seemingly unrealistic minimum order quota for labels wanting CDs pressed by PolyGram and of the inordinately long waiting time (he is having to wait over three months to get his label's first CD pressed, although the digital master is ready, and it will be released on vinyl much earlier). Clive Swan insisted that CD sales were high enough to justify reasonably high pressing orders, and Blüthgen said that the waiting period for CD custom pressing should only be six weeks. He did promise, however, a great leap in pressing capacity at Hanover, which is quadrupling its number of presses to 48.

The analogue 'mask' was mentioned again when jazz musician and owner of Wave Studios, Pete Ind, asked whether it would soon be possible to completely reprocess (not merely transfer) old, bad, jazz recordings for CD. While Fox argued that such recordings were likely to suffer from removing the mask, Ind said he felt that all the necessary audio information was in fact present and could be 'reclaimed by technology'.

Stone won heartfelt agreement from studio delegates when he talked about the record companies' (and artists') attitude to studio charges—an attitude which has led to a radical change in his business methods.

He announced that he will not be buying any digital machines and ancillary equipment for Record Plant.

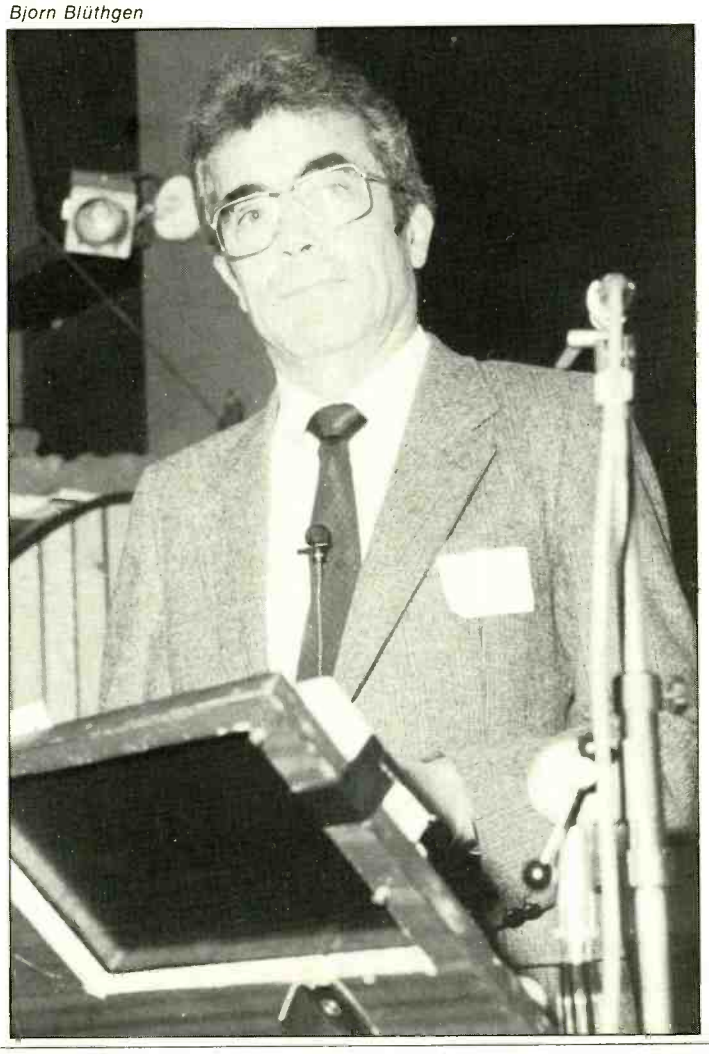
"I cannot afford to buy it because the customer will not pay for using it. If something is installed in a studio they expect to use it for nothing.

"However, if a piece of equipment has to be hired in for use in a session, the clients will happily pay hundreds of dollars a day to use it.

"So I will not buy—I will rent."

Appreciation of his hard hitting comments was heightened by the knowledge that Stone owns his own equipment hire company. ■

Bjorn Blüthgen



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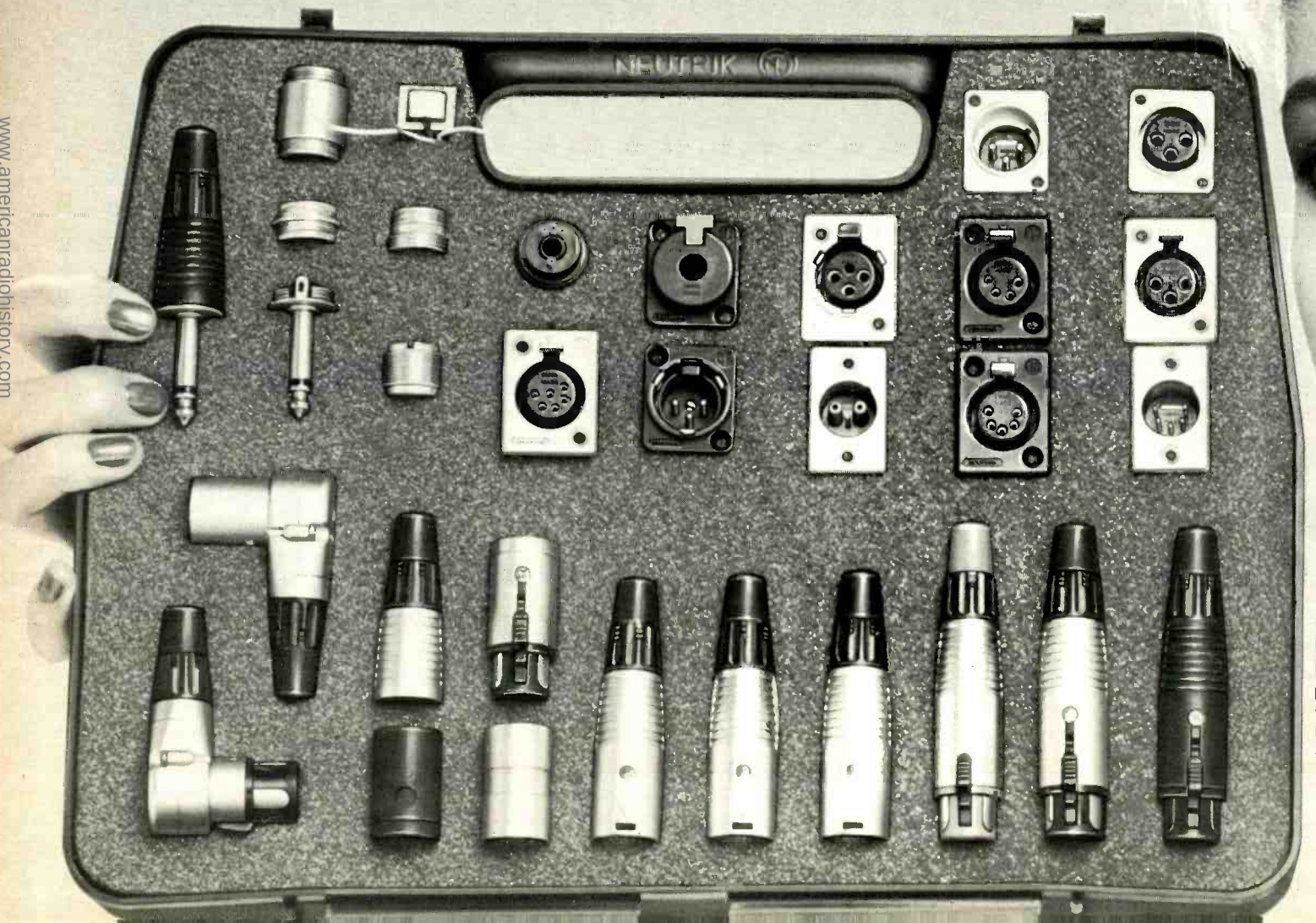

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diary

Disc cutting showrooms

Tam/England have recently opened new premises devoted entirely to disc cutting equipment; something that is probably unique in the world. The aim is to provide a permanent showcase for their own products (manufactured under licence from Ortofon) together with a large range of secondhand equipment, either from their own stock or systems they are selling on behalf of clients. Additionally they will be supplying all the necessary consumable items for Ortofon cutting heads.

All equipment on show will be demonstratable in working order and other facilities will include a fully equipped workshop and a room where it will be possible to set up customers purchases for training purposes. Tam ask that customers phone for an appointment as 'the purchase of disc cutting equipment is a pleasure not to be hurried'.

The opening reception is on January 26 and anyone wishing to attend is asked to phone or write to Tam. Tam/England, 13a Hamilton Way, London N3 1AN, UK. Tel: 01-346 0033.

Kulka urges truth in labelling

'What you see may not always be what you get', claims audiophile record producer Leo de Gar Kulka. Kulka, president and chief engineer at San Francisco's Sonic Arts Corporation, is alarmed about "...the proliferation of recordings released under the label 'digital' which are in reality analogue tape recordings, super equalised and transferred to a digital medium in order to call them digital or as Compact Discs.

"These doctored up analogue recordings which often do not sound very good, give the digital storage medium a bad name," Kulka continues. "I am reminded of the time when stereo first came out, and a whole lot of 'fast buck artists' doctored up old mono recordings and sold them as stereo. It got so bad that the Record Industry Association of America was finally able to enforce the proper labelling of these misrepresented recordings as 'pseudo-stereo' or 'electronically enhanced monaural recording'."

Leo Kulka has produced 17 gold records and is the force behind Sonic Arts' Lab Series, which includes releases by the Midsummer Mozart Festival Orchestra, cellist Stephen Kates, the Turk Murphy Jazz Band, pianist Tibor Szasz. Kulka contributes regularly to audio journals and is closely tied to the San Francisco Chapter of the National Academy of Recording Arts and Sciences. What he is saying is let the buyer beware. All that glitters is not gold, and all that says 'digital' was not necessarily born that way.

"A third generation multitrack analogue recording mixed down to analogue 2-track and then dubbed to a digital medium bears no resemblance to a dimensionally mixed stereo recording made directly to the digital stereo medium.

"Digital records, if properly made and properly recorded directly to the digital medium are breathtakingly delightful, clean and realistic. I make digital records, and I can compare the sound between the studio and the performer and what I hear on playback. The engineering and the medium must be transparent to the listener. If he can hear either, then the sound has been coloured; it is no longer true. And any deviation from the original is a distortion."

Sonic Arts Corporation also operates the international College for Recording Arts, which draws students from all over the world to learn the principles of recording and the music industry.

Address changes

- EAR Professional Audio has moved to larger premises and is now located at 2641 E McDowell, Phoenix, AZ 85008, USA. Tel: (602) 267-0600.
- The Assocation of Sound & Communications Engineers has moved and is now located at 4B High Street, Burnham, Slough, SL1 7JH, UK. Tel: 06286 67633.

People

- Gene Perry has been appointed general manager of Audiotechniques, New York. He will be directing an expansion programme that will include enlarging the sales department, the establishment of a major MCI/Sony parts department and the construction of a digital audio editing and transfer suite. Before joining Audiotechniques, he was general manager of the professional audio/video department of Harvey Radio.

Forthcoming events

January 23 to 28
MIDEM, Cannes, France
February 21 to 23
Sound 84, London, UK. Tel: 06286 67633.
March 27 to 30
AES 75th Convention, Paris, France. Telex: 635 66 AESEUR B (Brussels office).
April 29 to May 2
NAB 62nd Convention, Las Vegas, USA
May 12 to 15
AES Conference, Anaheim, USA. Tel: (212) 661-8528. Telex: 620298 AES UW.
June 13 to 15
APRS Exhibition, London, UK. Tel: 0923 772907. Telex: 24224 258.
September 21 to 25
International Broadcasting Convention, Brighton, UK. ■

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Surround Sound

In this article, Richard Elen gives a personal overview of developments in multichannel and surround-sound technology, concentrating on three main areas: the Tate developments of SQ technology; Ambisonic mixing and microphone developments; and Hugo Zuccarelli's Holophony.

The past few months have seen a fair amount of activity on the surround-sound front, in three major areas. First, there has been growing interest in the United States in enhancements to the CBS SQ system by Tate Audio; second, there are now Ambisonic mixdown systems available; and finally, there is the rather more contentious subject of Holophony.

The CBS SQ/Tate Systems surround-sound approach is based on the old SQ system marketed by CBS in the early 70s. Failing in the consumer audio market, the system was licensed to Dolby Laboratories for motion picture applications, and formed the basis of the 'Dolby Stereo' system. It turns out today that with several home video releases on the market which incorporate Dolby Stereo soundtracks, the home listener can extract surround information with the user of a decoder such as that marketed by Fosgate Research in Prescott, Arizona. Their *101A* decoder offers SQ and 'cinema' surround decode options, and has full level control on input and output, with LEDs indicating optimum signal levels. A remote unit is also available for the device. Fosgate also produce an in-car model of the decoder (the *201*).

The Tate system is discussed in detail in the Autumn 1982 edition of *MCS Review*. It appears that the system adds 'directional enhancement' circuitry to the basic SQ decode matrix (the impression given being that the Tate DES may be used to enhance *any* multichannel matrix system). The system was designed by Martin Willcocks, and although the system is getting increasing coverage in the US, most of the work on the theoretical aspects of the Tate system appears to have been done by Britons! Willcocks has published a good deal of material on the Tate DES, including two papers at the New York AES Convention in October 1983 (preprints 2017 and 2029). The former covers decoder technology and compares Tate and Ambisonic systems. With the Tate system's derivation from CBS SQ technology, it looks rather as if the old battle of words, equations and theories between Michael Gerzon (Ambisonics) and the late Ben Bauer (SQ) has now become a dialogue between Gerzon and Willcocks.

Unfortunately I have not had the chance to examine the theory of the Tate enhancements in detail, as we were only informed of it relatively recently (in a concerted approach by Greg Badger and Wesley Ruggles) and the recent AES provided the first opportunity to look at Willcocks' work in detail. Not being a theoretician of either Gerzon's or Willcocks' stature, a cursory glance tells me little, but it does look very much as if the Tate enhancements optimise SQ surround-sound most effectively. It certainly looks good on paper, and I hope to be able to listen to the system in the near future.

Optimised or not, though, there are those who will point out that the idea of trying to get separate signals out of four speakers in a square to represent a soundfield is basically a false premise—that at least is what Ambisonic theory suggests. When I first heard Ambisonics in the mid-seventies, I had already had experience of mixing some quadrifontal material which was encoded into the Sansui QS system. I remember being rather unhappy about rear signals, which seemed to pull in dramatically. I never mixed in SQ, but the early examples I heard seemed to lack front/back distinction and were rather muddy in their localisation. By comparison, on hearing Ambisonics I did not suffer either of the same problems. I simply found myself listening to the music and not to the system, and that converted me. Since those days both Ambisonics and SQ have come a long way, and I would not judge the present state of SQ technology on my memories of the odd demonstration of ten years ago. Neither would I regard cinema reproduction of Star Wars effects as particularly indicative of the performance of a surround sound-system. I am looking forward to the experience. Indeed, we would have experienced it by now, were it not for problems including a bomb scare at the concert to which we were invited to hear the system in use on a recording!

Greg Badger, in his letter to us introducing the Tate DES, rightly accused us of not discussing their system, or even mentioning it in passing. This was true, mainly because we had never seen any information on it. Had I not made a point of keeping in touch with the Ambisonic fraternity, no doubt we would have ignored surround-sound altogether simply through lack of information from both camps. This was not the case, however, as having seen the potential of Ambisonics, some colleagues and myself did a great deal of experimentation and liaison with workers in the field, getting to know the subject inside out and doing our best to investigate the applications of the system to mixing rock music (it having been designed originally, by all accounts, as a means for recording and reproducing live performances more accurately). None of us ever got anything out of it, financially or otherwise (in fact quite the opposite—it *cost* us money to experiment) and I still don't. I give the system editorial support because I think it works and I enjoy using it; plus I think it is an important development. For exactly the same reasons we push CD and digital audio, various aspects of console automation...and so on. Thus in Ambisonics, as in most other things, I am biased (as Greg Badger suggests)—biased in favour of things I know about which work! Now we are only too pleased to hear about the Tate DES, as we are certainly in favour of surround-sound.

Thus on to developments in Ambisonics, which have been several. Despite some people's suggestions that there are no popular panpotted multitrack-derived Ambisonic records because UHJ 2-channel suffers problems in rear channel 'separation' and stability (it doesn't), the real reason is that until very recently there hasn't been the gear to do it. The technology has been known for over a decade (some of Gerzon's earliest papers tell you how to make Ambisonic panpots) but nobody made any (commercially, anyway). Now the equipment which I discussed in prototype form in the September 1983 issue is available. And any interested manufacturer can get a licence to make their own. The first production gear is from Audio & Design Recording and goes under the generic title of the 'Ambisonic Mastering System'. It is in the form of rack-mounting modules which interface with a normal mixing console. They currently handle horizontal surround only and utilise the 'studio format' for Ambisonic signals, more correctly known as 'B-format'. The Transcoder and Decoder also handle 2- or 3-channel UHJ formats, 2-channel UHJ being a convenient release format for 2-channel media. The first batch of 10 systems has been made for the NRDC, and will end up in studios for people to experiment with rent, but ADR are also selling the units.

The Decoder accepts 2- or 3-channel UHJ or B-format and includes forward preference control, layout preset (2:1 to 1:2), distance compensation switch, mode selection and fail-safe relay bypass. The basic unit provides feeds for four amps and speakers but the internal decode circuitry is brought out on a 9-pin D connector on the rear panel, facilitating external converters driving six or more loudspeakers. Also on the rear panel are four male *XLR* outputs and three female inputs, a D-type remote control connector and a 5-pin *XLR* B-format input. The unit powers up in bypass, a 'decoder in' button on the front panel selecting 2-channel UHJ as the default input.

The Encoder/Transcoder takes a B-format input, and provides 2- or 3-channel UHJ output (two models are available). The 3-channel UHJ model is an encoder only but the 2-channel device also has Transcode facilities, enabling two stereo pairs to be input, with individual control of the stage widths of front and rear pairs. The output is in 2-channel UHJ and the unit can accept 4-channel and B-format signals simultaneously. The Transcoder can thus be used for basic ▶

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mixdown applications (although without the flexibility of the converter and pan-rotate units) or for converting 4-channel 'quad' recordings to UHJ.

The Converter simply enables mixing console panpots and routing to be used Ambisonically. It contains two identical sections which each accept four groups and an aux send from the console, panning between odd and even groups giving localisation across a 90° quadrant.

The Pan/Rotate unit takes up to eight individual signals (eg from direct console channel outputs) and enables them to be localised anywhere in the horizontal plane. Each input has direction and diameter controls, the former being a 360° pot, setting the basic direction of the sound, and the latter varying the apparent distance of the source from the centre (varying from positive through zero to negative, it pans across a diameter of the field). The combination of localisations set up on the eight inputs can be rotated with a further 360° control, which can be switched in or out of circuit, and can operate either on the field generated by the eight inputs, an external B-format input, or both. Inputs are on bantams or *XLR*s.

All the units have IEC mains inputs with fuse and voltage selector and all *XLR*s have internal jumpers to select whether pin 2 or 3 is hot. Prices are quoted by ADR as £380 for the Converter, £755 for the Encoder/Transcoder, £850 for the Decoder, and £1,650 for the Pan/Rotate unit. All the units are 1U high except for the 2U Pan/Rotate unit.

The availability of this equipment means that it is now possible to produce multitrack-derived Ambisonic recordings; I have now done two albums this way and the results have been very exciting. In addition, the tracks sound exceptional in stereo, without decoding, having excellent clarity and image stability. I would say that it was worth mixing to 2-channel UHJ even if no-one in the world was ever going to decode it. We've already had some very good feedback on the material. Now other engineers can try Ambisonics for themselves and see if they like the results. I would certainly like to hear how people get on. To encourage people to have a go, there are apparently plans for a day-long seminar in a London studio in the near future for engineers and producers to hear about and play with the system.

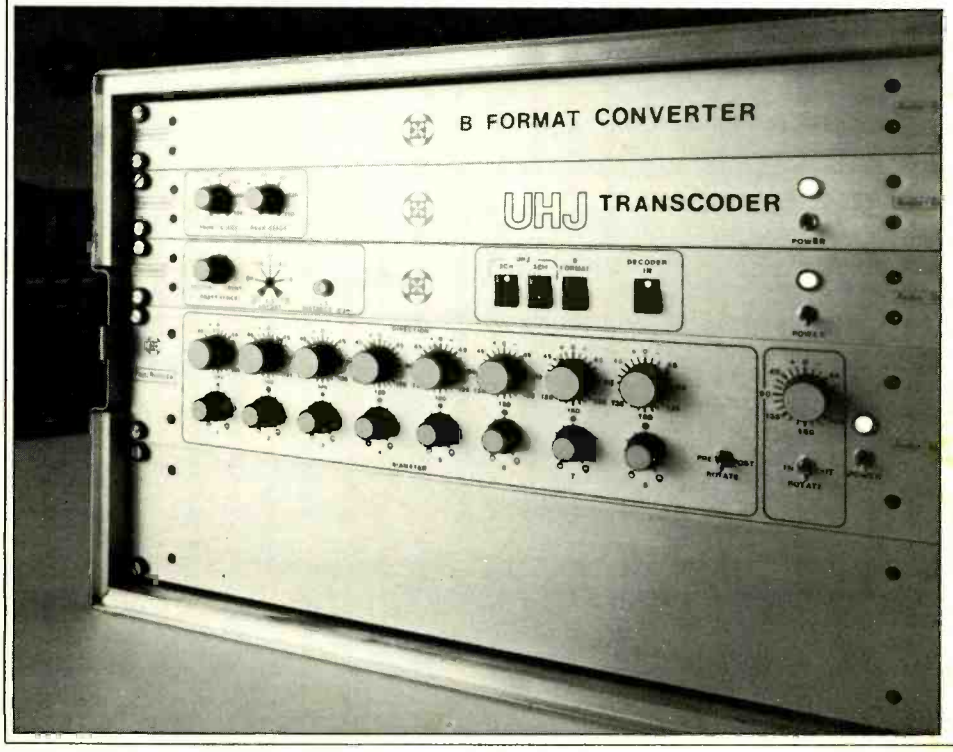
Calrec are still the only company making a *Soundfield* microphone, and they have recently introduced the *Mark IV* model which offers even lower noise levels. It also concentrates on the benefits of the microphone in the stereo environment, and the resulting control unit is thus less complex and therefore more inexpensive. B-format outputs are still provided, though, so Ambisonic use is not compromised. But just as the production gear can be used to great effect even if the result is never decoded from 2-channel UHJ, so the *Soundfield* mic, although basically an Ambisonic device, has wide stereo applications. Overall, if Ambisonics is going to take off in the consumer environment (it is already gaining wide application in the audio-visual field), there now exists all the hardware to do the job and produce the software. I would expect significant moves this year if everyone pulls their fingers out.

Finally, we come on to the somewhat vexed question of Hugo Zuccarelli's 'Holophonics'. At the time of writing, the man is in California, where he appears to be causing quite a stir. We have already had numerous phone calls from a Scottish gentleman, James A McShane, currently working on the West Coast, who is rather annoyed that Zuccarelli is taking the name of his invention, the 'Holophone', in vain. Unfortunately we don't yet know what the Holophone is, but we *do* know that it has been around for a good many years. There are also murmurs of the name 'Holophonics' being trademarked in Australia by yet another inventor, who is also claiming prior use. Zuccarelli's efforts in the UK to date have resulted in a set of record releases by CBS, compromising a Holophonics demo 12 in single, effects on the Floyd's *Final Cut* album, and, most recently, an album by Psychic TV which uses Hugo's binaural system extensively. While offering some unusual and original material which is interesting artistically, Psychic TV's album contains a number of effects not unlike conventional binaural material. Indeed, a section in which the head is buried in a coffin sounds almost identical to a binaural recording on Godley and Creme's *Consequences* album of a few years ago. The album was recorded digitally with the Sony *3324* and claims to use no microphones (only 'Ringo', Zuccarelli's dummy head), thus indicating a rather limiting definition of the term 'microphone'.

Meanwhile, the system itself has been covered quite extensively in a number of publications including our own, culminating in an article by Zuccarelli on the theory of Holophony in the popular science weekly *New Scientist* (November 10, 1983, p438) which resulted in a number of letters in that publication including one from David T Kemp of the Institute of Laryngology and Otology, University of London. Kemp's Institute was the first to document sounds emitted by the ear, and has done a great deal of work on hearing mechanisms. He leads off his letter by saying that "Not since 1 April last have I read a 'scientific' article so devoid of scientific understanding, logic and rational thought... These sounds [emitted by the ear] are very weak. They do not create holograms in the inner ear...All of Zuccarelli's ideas (except holography and quantum particles) have been voiced years ago and have since been disproved by direct measurement. Many of his ideas are contrary to the laws of physics and make a mockery of his attempts to stick together fragments of auditory physiology just to add credence to a sound-recording technique. The ability of the ear to extract directional information is well understood by many..."

But despite apparent theoretical inadequacies, there is no doubt (as Barry Fox has pointed out) that the system works. *Why* it works is another matter. It appears to behave in all respects like a highly-optimised binaural dummy-head system, in which sense it definitely represents the best commercial exploitation of binaural recording to date. This apparent fact would be worthy of some praise, but it increasingly appears that Zuccarelli is damaging any respect for his results by claiming theoretical originality. Already, as Barry Fox predicted, the system is disappearing back into the woodwork as binaural techniques have tended to do every few years. Despite the widespread use of personal hi-fi units with headphones, it would appear that the system is not taking off this time either. It is incidentally worth noting here that work is going on to produce a small decoder which will take UHJ 2-channel Ambisonic signals and 'decode' them binaurally for headphone listening. I see no reason why the same approach could not be used with the Tate DES, in which case both systems would offer distinct advantages which would outweigh the disadvantage of requiring a decoder, however basic, namely that both SQ and Ambisonics can be generated by mixing from multitrack sources—the way most modern recordings are done, obviously—whereas binaural systems make this very difficult if not impossible, and the results often leave a lot to be desired.

Richard Elen



Information on systems described in this article may be obtained from:

Fosgate Research Inc, 714 Clubhouse Drive, Prescott, AZ 86301, USA. (Tate decoders)

Ruggles Reber & Associates, 4324 Promenade Way, Suite 311, Marina Del Rey, CA 90291, USA. (using the Tate system for video applications—live recording soundtracks)

Dolby Laboratories Inc, 346 Clapham Road, London SW9 9AP, UK. (Dolby stereo and surround)

Audio & Design Recording, North Street, Reading RG1 4DA, UK. (Ambisonic mixdown and decoding equipment)

Calrec Audio Ltd, Hangingroyd Lane, Hebden Bridge, West Yorkshire, UK (Soundfield mic)

Zuccarelli Laboratories, 60 Hungerford Road, London N7 9LP, UK. (Holophonics) ■

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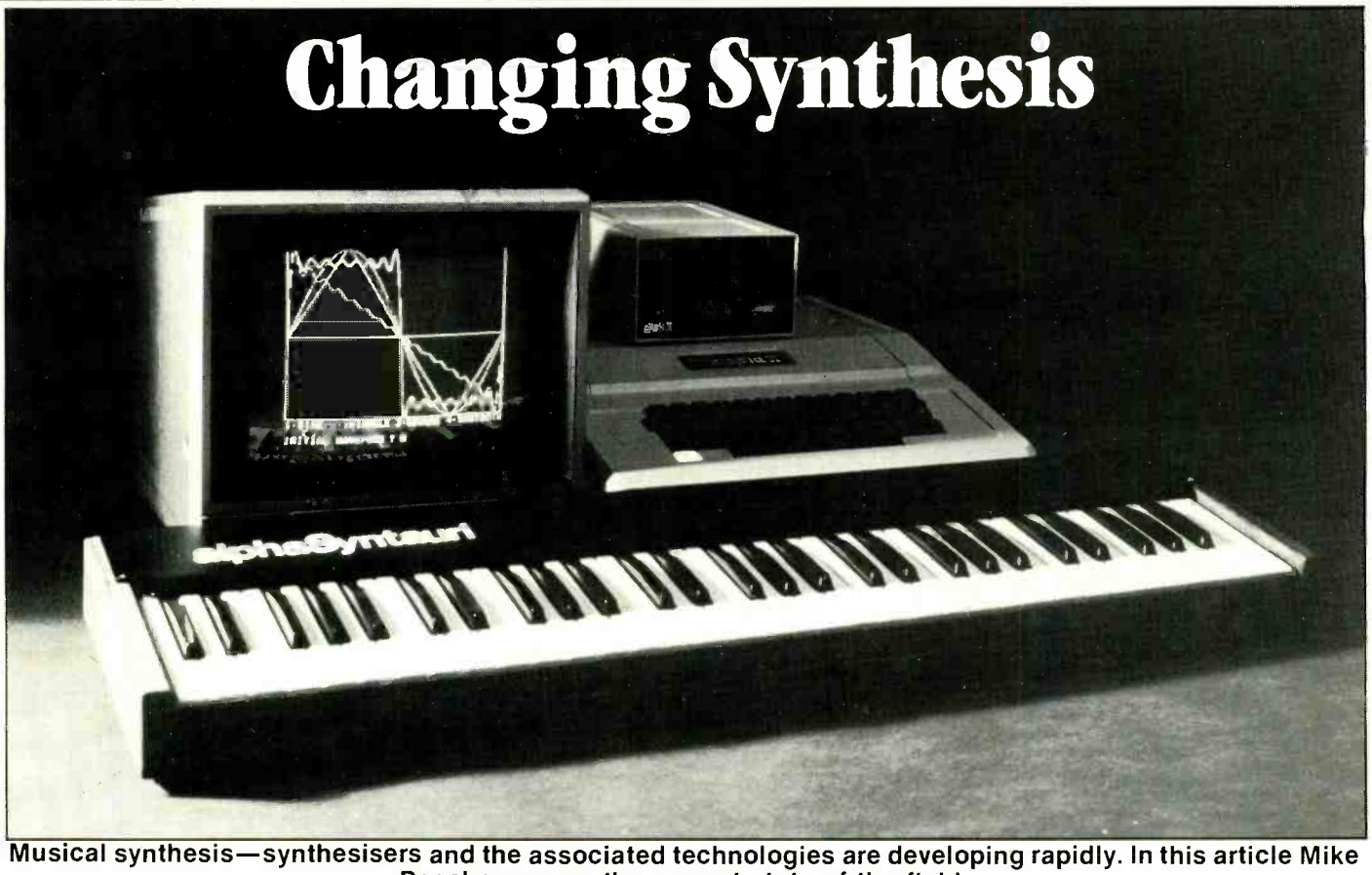

Musical synthesis—synthesisers and the associated technologies are developing rapidly. In this article Mike Beecher covers the current state of the field.

Only a few years ago, the idea of using a micro to control musical sound production was reserved for the few musicians who could either afford dedicated systems like the Fairlight *CMI*, had access to university mainframe computers, or who had sufficient knowledge of electronics and micro interfacing to be able to build their own customised machines.

One of the biggest problems facing the synthesiser user was the incompatibility of the instruments he was using. Although the use of voltage control in the '70s allowed note playing from one monophonic keyboard to another, many difficulties were encountered. For a start, different manufacturers used their own control voltage and trigger-gate output levels or polarities.

More recently, we have seen polyphonic programmable synthesisers which, despite the inclusion of micro-based circuitry, were even more incompatible with each other, most having minimal external access.

While studios and musicians alike were becoming increasingly aware of the control potential of digital computers, it was the home computer boom that made manufacturers come together to discuss ways of making instruments compatible with one another.

In Autumn 1981, Dave Smith of Sequential Circuits, following discussions with Tom Oberheim (Oberheim Electronics) and Ikutaroo Kakehashi (Roland) presented a specification for a Universal Synthesizer Interface (USI) at the AES convention. A conference followed in January 1982 with representatives from CBS-Rhodes, Yamaha, E-mu, Korg, Music Technology, Kawai, Octave Plateau, Passport Designs, and Syntauri. As a result, the first MIDI (Musical Instrument Digital Interface) specification was proposed in October 1982 and soon after incorporated in the *Prophet 600*.

MIDI offers a truly significant advance in the way musicians and studios can control the playing and synthesis of music. Putting MIDI in perspective with other developments, there are many questions for the synthesist to ask at the present time: 'Which is the best dedicated micro system for making music in my price bracket?', 'Can I connect my micro to a Yamaha *DX-7*?', 'Can I use an external trigger with MIDI?', 'Is my analogue synth usable with MIDI?', 'Which is better—analogue or digital?', 'Is FM synthesis worth the trouble of understanding?', 'Will there ever be a cheap sound sampling machine?', 'If I use computers to make music, will I lose the emotion and dynamics?', 'Which is the best micro to buy to get into micromusic?', 'Do I have to be able to write music to have a printed score?', 'Is there any hope for my *Strat* or *Les Paul* to link to a computer? Do I have to expertly play everything in real time or can I do it some other way?', 'Can I have some interactive graphics on the TV screen when I play on stage?', 'Can I store my instrument's sounds through MIDI or is it just that it remembers notes?', 'Is it really possible to link mono and poly instruments, and drum machines, as well as make 16-track recordings?', 'Can I use MIDI in music education to advantage?', 'And is the Kurzweil keyboard instrument really an artificial intelligence machine?'

Let's begin to answer some of the questions by highlighting the MIDI concept. MIDI requires both software and hardware, the latter usually consisting of a built-in serial port with 5-pin DIN or *XLR* In/Out (and sometimes Thru) sockets on the intrument. Most manufacturers have gone for the DIN connector—only the Octave Plateau *Voyetra 8* and the Yamaha *DX-1* appear to use the *XLR*. The data transfer is extremely fast at 31.25 kBaud at TTL levels. Special control codes in the data stream announce or request a particular event. In other words, you can send or receive with your computer all available MIDI control information from a MIDI-equipped instrument and the provision of 16 'channels' allows you to specifiy which instrument you control.

The most important consideration at this point is to understand what MIDI really offers on a particular instrument. For example, the first synthesisers with MIDI should have been able to 'talk' to each other freely in any combination, but if you connected a Roland *JX-3P* to a *Prophet 600* and then a Yamaha *DX-7* (in that order of Out to In connectors) you got a peculiar 'boing' at key release from the Yamaha. Since then, the Yamahas after touch has been modified to stop this.

Not all MIDI instruments have the same control: the Yamaha *DX-7* has note playing, velocity and pressure control, as well as every single parameter (145 in all) controllable: the *Prophet 600* plays notes, does program changes and dumps or loads all prepared program patch parameters in one go; Roland's *JX-3P* however, only does note playing, program changes and a few control operations. Incidentally, while other manufacturers' MIDI's 'wait' between data transfers, the Yamaha throws out continuous codes, making it the most challenging instrument to connect to a micro!

The MIDI system operates in three modes: Omni, to cater for a 'play all instruments connected' situation; Mono and Poly—these both play only through an assigned channel so that a complete 'orchestral score' can be built up. Mono also allows legato and gives assigned channel notes to a particular voice.

More to the point perhaps, is what instruments are available with MIDI, although this list may have expanded rapidly by the time you read this: synthesisers include the Yamaha *DX-7; DX-9* and *DX-1*, SCI *Prophet 600, T8* and *5* (latter as a retrofit), Fairlight *CMI* (coming soon), CBS/Rhodes *Polaris*, Seil *Opera 6*, Octave Plateau *Voyetra 8*, and Korg *PolySix* (as a retrofit). In addition, Roland appear to have made the biggest contribution so far, with the *JX-3P, JP-6, Juno 60* and *JP-8* synthesisers (the latter two through a special DCB to MIDI interface), *HP-300* and *HP-400* contemporary pianos, *PB-300 Rhythm Plus*, as well as the first MIDI drum machine, the *TR-909*, and the first MIDI guitar system, the *GR-707* with its accompanying

GR-700 synth unit.

Another important feature of the *GR-700* is that Roland have realised that guitarists want to keep their *Les Pauls, Strats* and *Schectors*, so they're setting up guitar centres to insert the electronics into your own guitar to give it full polyphonic synthesis (plus the original guitar sound and external MIDI control). Chandler guitars are the first appointed UK centre.

Although, in principle, any solid guitar can be retrofitted, some guitars have as many as five or six dead spots where the fundamental is missing and its presence is required for correct operation. The *GR-707* is fitted with a stabiliser arm to eliminate unwanted resonances and maintain strong fundamental tone on all notes. The new *GR700* synth unit will also operate from the existing *GR-300* and *GR-500* guitars.

Completing the MIDI line-up, several companies have produced a MIDI/CU interface will put your analogue 1V/octave mono synths into your MIDI system. There are also expansion boxes (one MIDI In to four Thru) and master clocks with tempo readout compatible with SMPTE and EBU time codes for correct studio sync to tape and autolocate capability.

As for possibilities, it is almost incredible to see and hear a guitarist playing Hammond organ or a pianist playing a dynamic drum solo!

Moving more to the micro end of MIDI, a whole series of software/hardware packages should be around for the Frankfurt Music Fair for sophisticated sequencing, programming, graphics and training. In this country there is a specialist company called Electromusic Research Ltd set up in liaison with the main manufacturers to answer musicians' problems on interfacing, as well as provide suitable hardware/software.

Choosing the right micro for full exploitation of MIDI will be essential and the current implementation of either *Z-80* or *6502*-based 8-bit micros in the home will make software programming go possibly one way or the other. So the term 'home' applied to computer is not strictly true for the musician as some of these will be ideal for stage and studio use.

The *Apple II* (and *IIe*) is already well established as a 'musician's micro' with several dedicated systems (more on this later). It's *6502*-based and is likely to be joined by two other *6502* machines: the BBC *B* and the *Commodore 64*. The latter is already widely used in Europe and the United States. The Sinclair *Spectrum* would seem to be a firm favourite too, but the latest issue 3 of the micro has internal configuration changes that are already causing many problems for games software manufacturers.

Other less likely contenders to pick up much music software are the IBM *PC*, *TRS-80* 3 & 4, Oric (very popular in France), Lynx, Dragon, Atari, with *ZX-81*, Sharp *MZ-80A*, Sord *M5*, Aquarius and Texas *TI 99-4* at the end of the line. What may sway you into your final choice could be that the *Apple* has Roland (previously Amdek) CompuMusic, AlphaSyntauri, Jen Musipack, Passport Designs Soundchaser, and Rhodes Chroma; the *Commodore 64* also runs the Chroma and will soon have an add-on keyboard to control its special SID music chip; *ZX-81* runs the *MPC1 Drum Computer* and the *MUZIX81*; and of course, there's the music synthesis offered on the actual micro.

Interfacing and control

In a well-equipped studio, a lot of time can be spent setting up correct triggers and syncs to instruments and tape machines. Simple trigger interfaces can be made, to invert or divide master clock outputs and so on, but the one instrument that covers most possibilities is Garfield's *Doctor Click* controller from Syco Systems. It also gives two independent rhythm-activated envelopes as well as outputs synchronised to a live drummer. However, the use of MIDI could reduce interfacing to single cables that never need changing once set up as all switching functions are handled digitally.

As an alternative to the serial MIDI, the Chroma keyboards division of Fender Musical Intruments introduced the *TRIAD* system that connects synthesisers to micros via a 25-pin D connector cable. Multi-instrument set-ups can use one Triad interface as a star-network controller. It operates via two uni-directional 8-bit parallel ports, offering similar features to MIDI and connecting to the Rhodes *Chroma* and *Polaris*. An unusual function on the latter is a tempo adjusting control that sets an external drum machine or sequencer sync pulse to give the right playback/record rate.

Another kind of interfacing is the link between humans and the synthesiser controller. Whilst not forgetting *Synclavier II*s link to a Roland *GR-500* guitar, it's Roland's new guitar controller that could put the guitarist's skills back in perspective, and instruments like the Lyricon wind synthesiser have led to Yamaha incorporating a unique breath controller on their *CS01* and *DX* instruments.

The new GR-707 guitar controller

On the keyboard side, although several instruments have velocity sensitive keys and even less have weighted keys or pressure (after touch) control, it could be that Dr Robert Moog's company called Big Briar has developed what appears to be the ultimate controller (the *100 series*). Wood action keys and digital scanning detect four independent, continuously variable modes of touch sensitivity: left-to-right position of the finger on the front half of the key surface, front-to-back position on the same area, up-down position of the key itself, and key pressure when fully depressed. In addition, the key's downward velocity is measured. Big Briar also produce touch-sensitive plates (*300 series*) and a Theremin-type controller (*500 series*) with numerous control options.

The possibilities of the MIDI system have already paved the way for a new modular synthesis system, such as the Roland *MK-1000*, where a 'mother' keyboard is all that's needed to communicate with a host of appropriate 19in rack-mounted modules. The *MK-1000* has weighted wooden keys, touch sensitivity, programmable split point, and mono or poly modes. After touch control is such a good thing to have too—particularly as an assignable function as on the *Voyetra 8*, *Chroma* and *DX-7/1*—but it does swallow up the micro's memory when used through MIDI. On note played on the *DX* with pressure changes can take 5 kBytes of memory in a few seconds.

External control of echo to synchronise with your drum machine or tape tracks can now be cheaply done using the Boss *DE-200* digital delay's 'rhythm sync' function. Natural sounds can be captured and replayed in time in the same way as a sampling machine.

Drum machines

It is worth pausing here to consider the influx of drum machines we've had over the last year or so. We've seen the change from analogue to sampled sounds and the use of micro control to create sophisticated playback of complete 'songs'. In retrospect, many would say they know a Linn (for example) when they hear one, and that might suggest that the ultimate is still the Fairlight, in conjunction with its *Page R* real time sequencer, because of its complete ability to change all the sounds at any time.

From the studio angle, a lot of mixer channels can be saved by using a single sync track to control a multi-output machine with its own stereo panned mixdown and treatment send/returns. While variations on the analogue/digital PCM/sampled sound continue to appear, the MIDI link could clinch the control possibilities.

Multitrack

With the inclusion of sophisticated multitrack recording on board the Fairlight *CMI*, PPG *Waveterm* and the *Synclavier II*, it is not surprising that the trend in polyphonic synthesisers has been to include similar facilities, albeit at a much less intelligent level in many cases. Instruments like the *Synergy*, *Emulator*, *Voyetra 8*, *Prophet 600* and *T8*, Roland *JX-3P*, Yamaha *CS-70M*, Elka *Synthex*, OSC *Oscar* and the new Moog *SL-8* all have sequencers built in. Most are concerned with remembering notes played and although some are also polytimbral (playing more than one voice per track), you have to go to a dedicated computer-linked system to get completely different voices per track.

Another point to consider is the method of input: Manual (step-by-step) or Real Time. Most of these polyphonics have real time recorders, that is, you input notes exactly as they should play back. Often, this can be done at a slower speed than actually required and various levels of editing would be available.

The method of Manual input has definite advantages for certain types of music sequence and is certainly not just for the less able playing-wise or the less experienced in musicianship. Casio, Yamaha, Technics, and other manufacturers—particularly Seiko, with their new *DS-320* digital 4-track recorder—have manual and/or real time recording systems that puts this facility right across the price range.

Storage of sequences can be from internal memory with battery back-up, cassette tape, floppy disk, or a special memory cartridge. Tape storage is significantly slower than the others to be unsuited to stage use and, while the cartridge format gives instant access in a handy portable pack, the new Sony 3.5 in floppy disk may prove a less costly storage medium as it becomes more available, as well as being more rugged down than the current 5.25 in or 8 in disks.

The implementation of manual input does open the door to sound engineers and non-musicians having a hand in programming. Fairlight's Kim Ryrie says there are already plenty of people who can type in the required data straight from a music score into the machine without having to play a note of music. Nevertheless, serious use of manual input systems in studios is only possible when all time signatures can be freely used and clear graphics define the composed score for quick editing over several tracks. Adequate sync ins is also essential.

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Changing Synthesis

MIDI sequencers, and Roland's latest add-on sequencers include the *JSQ-60* digital recorder that links with DCB and MIDI, with real time and manual input and up to three polyphonic overdubs. Top of the line in MIDI/DCB comes the *MSQ-700*, having 6,500 notes on up to eight tracks, with merging and chaining also possible.

Micro-linked systems

The most expensive of these, the Fairlight *CMI*, the PPG *Wave 2.2* (with *Waveterm*), and the *Synclavier II*, still offer the widest possibilities for digital synthesis, sound sampling and multi-channel sequencing. But there is definitely a place for studios, particularly in educational establishments, to consider the under £2,000 systems like the *alphaSyntauri* and *Soundchaser*. Both have 16-track recording software, music printing, additive synthesis, and waveform drawing, as well as sync-to-drum output, and are growing in popularity as performing tools for the micromusician. The latest entry in this area is the Jen Musipack 1.0 system from Italy. Like the others, it requires an *Apple II* (or *IIe*) micro with disk drive, joysticks, and the supplied 16 oscillator and keyboard interface cards complete the package. The Jen is considerably cheaper, and employs their *Apple* look-alike '*Lemon II*' micro and disk drives. It is currently limited to 4-track with no sync out, but software/hardware for full 16-track recording (with sync) and music printing is expected soon.

The Roland CompuMusic system is IBM *PC*, *Apple II* or Sharp *MZ-80K/A* based and is a plug-in unit with controlling disk or cassette software for manual input only for built-in drums, bass, lead and harmony lines. If it has any value in the studio, it is through its additional analogue CV/trigger outputs and clock sync.

Add an *Apple* to your Rhodes *Chroma* and it also becomes a dedicated system with sophisticated real time 16-track recording and manual editing. At the other end of the scale comes the *ZX81* for the MPC1 *Drum Computer* and also the Hungarian *MUZIX81*. The latter is a low cost unit with real time/manual input from an analogue 1 V/octave mono synth that can be multitracked on tape. A second software pack sequences external trigger inputs on drum machines. It was used on Gabor Presser's Electromantic LP (*EMC 3428*).

Roland's *Microcomposers* continue to put advanced micro control within the reach of many musicians — since the original *MC-8* in the '70s, the *MC-4* has been used on many recording tracks and the *MC-202*, despite its very low cost and miniaturization, is found in plenty of studios.

Music notation

The most advanced music printing system is undoubtedly for the *Synclavier II*. Fairlight *CMI* are still developing a suitably precise system, while the new Kurzweil *250* could match the *Synclavier*'s quality when it becomes available over here.

At the present time, the most economical and efficient printing software comes on the Alpha-Syntauri—called the 'Composers Assistant'. It's also used with the *Chroma/Polaris* micro link-up to an Apple or Commodore *64*. The ability to combine 16 tracks of Syntauri's 'Metatrak' onto one piano score (bass and treble lines) plus immediate transposition of any line makes it ideal for churning out studio session parts, although its memory (without expansion) limits its use to short pop-length pieces.

But the trend will be to real time screen input and playback, as in the Soundchaser 'Note-writer' and a recent prototype for the BBC *B* by Dr David Ellis. A good printer such as the Epson *RX-80* is required, linked by an Apple parallel interface card (eg. the 'Wizard' with memory buffer so you can continue composing during printout).

Other methods of displaying music writing include x-y directional roll printout on the Yamaha MP-1 (single line, with chords), the LCD on the Seiko *DS320* 4-track recorder and the Boss *DR-110* rhythm box. For the percussion synth, the screen display on the *ZX81/MPC1* is an impressive real time 'moving cursor per beat' visual and the Simmons Sequencer's LED matrix is similarly innovative.

It won't be long before X-Y plotters lend a hand in music printing—Roland already have music scores examples on their own product. As for reading music, this only appears to be happening at the general user's end, with Casio's bar-code reader and Yamaha's magnetic tape strip on music for the *MP-100*.

With micros all around, much can be done to improve the visual aspect of music. Small portable micros use large LCD 'windows' that were first seen on the PPG *Wave 2* and will continue to be a useful visual readout (providing backlighting is included).

FM

The original development of the Fairlight CMI was actually based on FM synthesis, but later dropped in favour of the present system. Synclavier II has remained the only instrument incorporating FM and its high price suggested that FM synthesis was a luxury item for the well-off studio. Then out the blue came Yamaha's *DX-7*, putting FM into the £1000 bracket.

The most relevant aspect of these remarkable instruments is that they represent a return to traditional instrument resonances. The metallic nature of a trumpet or French horn, the percussive timbre of a xylophone, piano, timpani or tubular bell, the close acoustics of a cello or flute—all these become precisely defined components of the FM system. Yamaha's *DX-1* also allows two sounds to be mixed and a host of performance parameters to be memorised in every preset.

The understanding of algorithms, operators and FM ratios will be made clearer by interactive MIDI-linked micro software becoming available, and the opportunity to set and store the 145 parameters of a DX program preset (with or without MIDI) should offer new directions in creative synthesis.

Sampling

1984 should see the arrival of low cost sampling machines, although it could easily have happened last year considering the amount of R&D in this area here and abroad. While Fairlight, PPG and Emulator still hold their own in polyphonic sampling, the *Synclavier II* makes monophonic, limited range samples of wide bandwidth, and Movement Audio's *Mimic* with EDP Wasp-style keyboard, shown briefly in the summer, was destined to be the first self-contained mono sampling machine under £500.

However, there are many problems associated with the making of a sample at low cost that can discourage commercial enterprise: the degradation of the sample as it is transposed on the keyboard away from its root; the sample length v bandwidth; the glitching at start and end points; and the making of suitable sustain loops.

The 360 Systems Keyboard (with user playback only) has a high density of memory storage IC's to retain the optimum bandwidth for studio use and the highest number of samples over the keyboard—it's not just a question of spreading samples equally across the range; the saxophone, for example, requires most samples for its middle C range and generally, unless there's a sample for just a few semitones, it's quite likely that your ear will detect a distinct timbral/dynamic change on solo notes.

Since sampling has a lot to do with the digital processing of echo, the French Publison company also plan to bring out their 'Nature Boy' sampling instrument.

Artificial intelligence

In the search for an electronic keyboard that is capable of producing sound quality indistinguishable from that of acoustic instruments, notably a truly realistic grand piano, Raymond Kurzweil of Kurzweil Music Systems has made use of artificial intelligence techniques for recognising, analysing, and manipulating complex shapes and patterns.

Their new instrument, the Kurzweil *250*, will play its preset sounds together, generate new sounds electronically, change tempo, key or voice, and print out music played.

Phillips Dodds, KMS director of R&D (who previously developed the Rhodes *Chroma* and *ARP4* systems) stresses that artificial intelligence techniques are essential to compress the vast amount of information about each note's harmonics, pitch, loudness, attack and decay rates etc. The process stores maximum level samples so that 100 dB dynamic range is achieved in conjunction with attenuating circuitry. The system uses the equivalent of 10 home computers and has weighted, touch sensitive keys. The *250* will link to Apple II, Commodore *64* and IBM PC initially and will contain up to 100 preset sounds.

Incidentally, Stanford University in California use computer music as part of their research into artificial intelligence.

Looking ahead

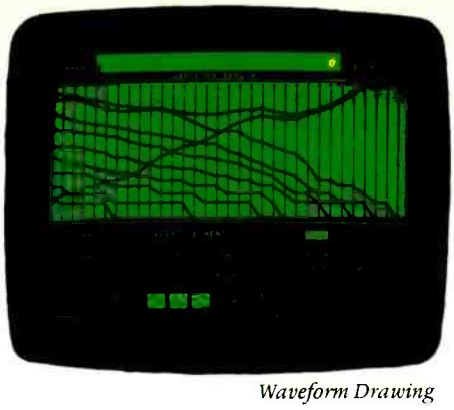
'Non-obsolescence through complete expandibility' must be the catch-phrase for 1984. The Rhodes *Polaris* even has a button marked 'Magic' to accept new software updates! The use of a mother keyboard that controls 19" rack-mounted MIDI sound modules will help to streamline the synthesiser studio, connecting analogue/digital/FM instruments and computer software add-ons for complex sound and envelope generation. Since the MIDI is a low cost peripheral, its use is likely to spread quickly to the portable keyboard market and no longer will the 'new technology' enthusiast have to be deterred by high prices before using micro control in his music. The intelligent 'composers assistant' is already part of Marvin Minsky's project on artificial intelligence at MIT, where 'music is important in revealing the workings of man's creative thought'.

Meanwhile, organs have become portable keyboards and almost back again, judging by Casio's recent contribution, while complete music compositions can be stored in a PROM for ever or transmitted down your telephone line by a modem.

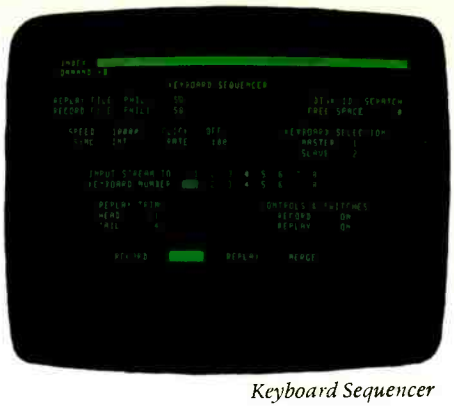
The meeting of manufacturers to implement MIDI is a landmark that will create new and powerful equipment for making music. The emotional content is still only restricted by the performer's experience and we shall see more customising than ever before—a new personalised music will be available to a much broader spectrum of people through user-friendly micro software.

As Chris Franke of Tangerine Dream said over a year ago, "We are now reaching a point where a new sound for every note can be played." And finally, a comment from Vangelis should bring us thoughtfully down to earth when he comments: "To play a synth the right way you still need the same amount of technique you would need to play a violin, trumpet, flute or any conventional instrument." ■

Screen Print



Waveform Drawing

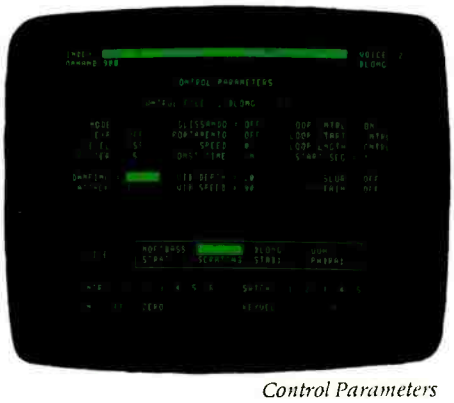


Keyboard Sequencer

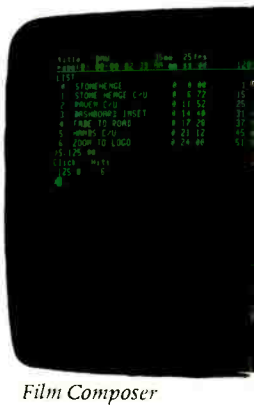
Harmonic Faders

Help Page

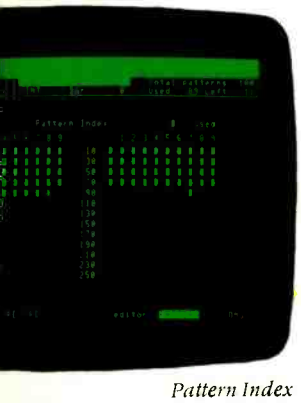
Disk Control



Control Parameters

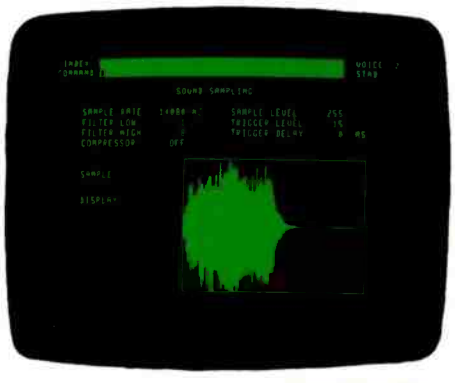


Film Composer



Pattern Index

Analog Interface



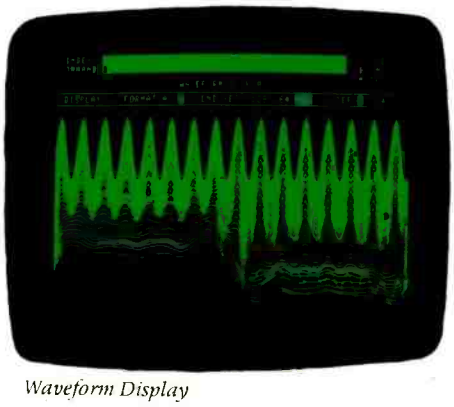
Sound Sampling

Cyword

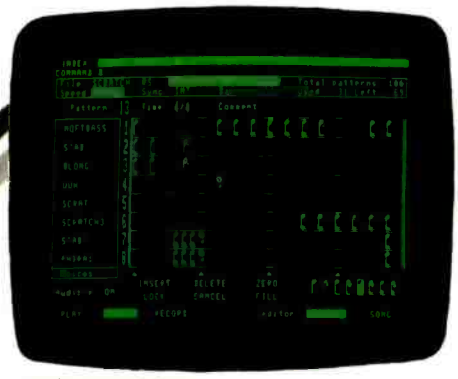
Keyboard Control

Harmonic Profiles

Composition Language



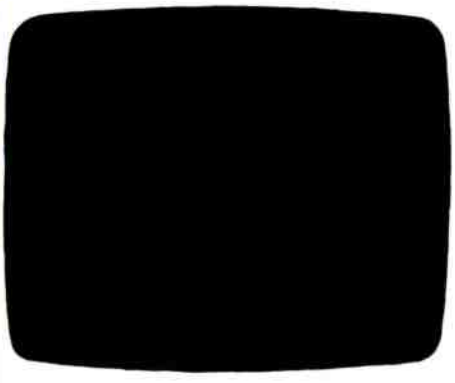
Waveform Display



Real Time Composer

Help Page

Index



Film Composer

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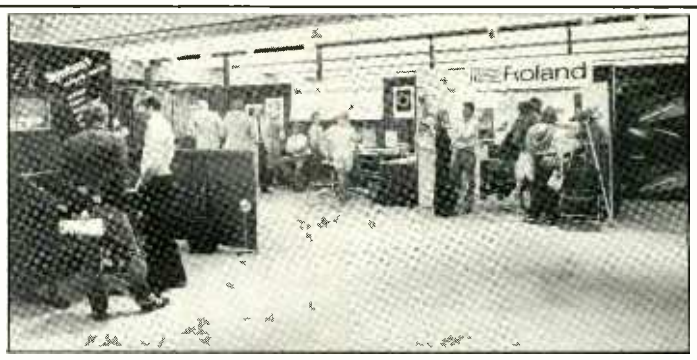

The unsuspecting city of Vancouver, Canada, was the host for the First International Conference on the Digital Arts, during last summer. Paul Lehrman relates his experiences over the three day duration.

"Are you going to Vancouver?" my friend at the computer show last Spring asked. Now I've been looking for an excuse to visit that part of Canada ever since I saw the jewelled city appear just beyond the mountains in the 360° Canadian travelogue film at EPCOT but I wasn't sure this was it. "What's there?" I inquired. "Digicon, of course," he replied. "Of course," I muttered.

I felt better when I called a few other friends, and discovered I wasn't the only one who hadn't heard about 'The First International Conference on the Digital Arts'. But the more I found out from those who had heard of it, the more I was intrigued. The idea behind the conference, I found out from administrator Cindy Noakes, was to bring together artists and musicians using computer technology to expand 'the edge of the art' while leaving the hackers and data-processing freaks at home.

The 3-day conference was the result of three years of planning by the Computer Science department of the School for Continuing Education at the University of British Columbia. Why Vancouver? For one thing, that's where the University is. Maybe just as important, it's probably the only city on the continent with civilised weather in the middle of August.

So I made my plans. Fly to Seattle, meet some old friends, catch some scenery, rent a car and head for the border for three days of lectures, demonstrations, public performances, commercial and artistic exhibits, and some high-tech partying.

Prologue

From the border between Washington state and British Columbia to Vancouver, Route 99 goes 30 miles through farmland, with unimaginably high mountains looming on the horizon. Suddenly there's this metropolis, stuck precariously between the mountains, now quite imaginable but just as high, and the Gulf of Georgia. Even without its great weather, Vancouver may just be the most beautiful city on the continent. The rented car goes into an underground garage, and from my hotel room, once again I am confronted with mountains.

Downstairs in the Harvester coffee shop, I find a friend, weary as I from travelling, so of course we launch into a heated and completely pointless argument over the limitations of keyboard-based synthesisers. I'm agin' 'em.

Morning the first

By any standards, Digicon is not a big conference; attendees have come from as far as Japan and South Africa but all told they number only about 300. In the coffee shop again, I feel like I'm back in college: half the convention delegates are lining up behind me at the coffee shop, anxious to grab a quick bite before running down the block to the Hotel Vancouver for the 9 am lectures. Over at the hotel ballroom, it's more hurry up and wait, while an obviously overworked stage crew tries to get an enormous PA system going, and then we are formally welcomed and made to appreciate the historical grandeur of the situation by various administrators and grant-givers. I am reminded why I religiously avoided early-morning classes.

Toronto composer Bill Buxton is the first musician to speak and he has an axe to grind—mine, as it turns out. "It's time to rethink the interface between electronic instruments and the user," he says. "We have gained control, in that we now have a great deal of precision and a vast potential for making music but at the same time we have also lost it. We have to get away from the 'overblown electronic organ' syndrome."

Buxton's solution for re-humanising electronic instruments is 'gesture controllers'. "Gestures have meaning," he says, "for both performers and listeners. If we want to expand the range of musical expression, why can't we use new gestures—blowing, sucking, squeezing, kicking, caressing—instead of emulating the past?"

After the lecture, I ask Buxton about such notable failures as the Avatar and the Lyricon, synthesisers that used guitars or woodwind-like instruments for input. "They weren't given a chance," he says. "They need time to evolve, the way keyboards have. The small synthesiser makers can't afford the research and development: academic and scientific institutions have to take the lead."

Later I wander over to the Robson Media Centre, a subterranean exhibit hall *cum* lecture hall and cinema, complete with Tourist Centre and a bunch of fast-food counters making up a 'Food Faire' serving everything from sauerbraten to tacos. Downstairs a dozen or so manufacturers of various kinds of hardware are hawking their wares.

Roland is showing its *CompuMusic 800R*, a fairly useful device for synthesising pop music tracks. Although it contains six voices, a drum machine and interfaces for microcomputers and slave synthesisers, it has no keyboard and is therefore not programmable in real time (although it does have editing capability) and the preset synthesiser voices are unalterable. Every time someone approaches the booth, the guy showing the thing pushes the start button and it swings into a painfully slow (and loud) version of some pop tune so obvious I didn't bother to write down the title in my notes.

A few feet away is Oberheim's booth, where a bunch of their synthesisers are hooked up to and playing each other, and this little orchestra sounds pretty good. I mention *MIDI*, the new serial synthesiser interface that will be discussed at length tomorrow, and the Oberheim folks put it down. "It's not fast enough to do 16-voice polyphony," says one. Oberheim has developed its own parallel interfaces, which it's not about to abandon. "We like them too much to give 'em up," he says. "Maybe we'll do both."

Yamaha is being represented by a local music store, and the personnel at the booth don't seem to know much about the FM synthesisers they're showing, the *DX7* and *DX9*. FM is nothing new for big-time computer synthesists, but it's a relatively recent development in consumer-level equipment. Handled correctly, it can produce some fascinating sounds; simulations of 'real' instruments and original ones. These units sound amazing (you'll be hearing them soon on a lot of records) although no one can tell me why.

Syntauri Corporation, makers of the *Apple*-based alphaSyntauri digital synthesiser (see *Studio Sound*, September 1983) is showing off its 'Simply Music' education program, which teaches keyboard technique with a software disk, a song disk and various music books. It uses adaptations of 'methods' by Jane Bastien and Nelson Varon, two approaches to music education I studiously avoided during my own piano-teaching days. The nice part of the program is that it simulates the old *Music Minus One* records: the computer plays one hand and you play the other. But it also has a feature that stops the music until you play the right note, which one visiting music teacher vehemently objects to: "It's no better than hitting the kid with a stick if he makes a mistake," she argues.

Syntauri's closest competitor, Passport Designs, maker of the *Soundchaser Apple*-based synthesiser, doesn't seem to be particularly interested in selling systems, although their people are giving out software catalogues while someone is muttering darkly over an editing problem on a unit stashed in a corner. What they are actively doing, however, is handing out a puzzling questionnaire asking how folks feel about the concept of *MIDI*. Are they planning to implement it on their systems? "We're just trying to see what people think," says one fellow vaguely.

There's a booth for the Fairlight *CMI*, the Australian super-synthesiser, but there's no way to get close enough to it to see what's happening. Manned by one company rep, there are at least a dozen people crowded around the lone terminal, most of whom, I suddenly realise, are from the other synthesiser companies.

But there is satisfaction to be found on the floor: a German machine called the *PPG Wave 2.2*. It's being demonstrated by a local rep, who has the demo routine down pretty well. It's pretty popular in Europe, he explains, especially among syntho-poppers like Thomas Dolby, but it's only been available over here since March. It comes in two parts: a keyboard and a mini-sized computer. The keyboard combines digital waveform generation with analogue filtering, which gives it the organic 'feel' of the early analogue machines. The filter controls are digitally addressed,

and their function can be changed to provide envelope control or even automatic mixing, using a built-in 1000-note capacity 8-voice sequencer. Any note can be run sequentially through up to 64 waveforms, giving the sound a sense of life totally impossible with single-wave synthesisers. The 'instrument' programmed in for the demonstration is a motorcycle: it starts, ticks over, roars, takes off, switches gears and disappears into Doppler-shift oblivion.

The optional computer (*Waveterm*) uses a *6809* processor and two 8 in disk drives to provide an incredible range of functions. On the screen, you can draw waveforms, equalisation curves, and in envelopes, there is even 'zoom' capability for zeroing in and adjusting individual sections of the drawings. It can sample real sounds and, of course, it can do off-line note editing, looping, and all the neat stuff most such instruments can handle. It can even, according to the rep, be hooked up to an *ASCII* keyboard and printer and used as a mainframe computer. But neither he nor anyone else seems to know any details.

Afternoon the first

'Commercial applications' the conference schedule says but no one expects an hour of Levi's commercials and computerised disco. Instead we get to see clips from *Star Trek II* and look at some unusual synthesisers.

Rock star Todd Rundgren makes a quiet entrance into the ballroom and is hanging around the periphery to hear his keyboard player, Roger Powell, describe two projects he has designed for himself. The first is a self-contained live-performance digital synthesiser he calls *Databoy*. What he needed, he explains, was a machine that could quickly switch between a variety of voices, that was plenty versatile in terms of voice design and that could stand up to the rigours of the road.

Databoy is built around an *S-100* mainframe with a *Z-80* microprocessor. The choice of oscillator card was easy: only one such card, made by Casheab, can plug directly into an *S-100*. It uses 12-bit D/A conversion, with 16 oscillators available. The voices are arranged in 32 registrations, each of which contains 12 instruments.

"The parts were ordered through ads in *Byte*," he says. "The machine is very reliable: all the parts are standard items you can get in any major city"—he pauses—"with a few months' notice. The most fragile parts are the disk drives, but since the operating system only takes up 8K, we could conceivably put it on EPROMS and do away with the drives altogether."

The other project is *Texture*, an *Apple*-based sequencer. A multichannel D/A converter is plugged into a port on the computer and it feeds voltage levels and trigger pulses to key notes, rhythms and other parameters in a variety of outboard synthesisers. Data is typed in like a word-processor text file and the Texture program then 'compiles' it. Since all the data manipulation is resident in the *Apple's* memory, there is no need for disk compilation. The computer can perform mathematical functions on the data files in real time, changing notes and tempos, and even has a built-in random note generator.

Ralph Dyck demonstrates MIDI

Later that afternoon

Everyone's running late today and the lecture scheduled for 3.30 doesn't get started until after 4.00. An unfortunate problem is beginning to make itself evident: the crews responsible for the audio and video set-ups in the lecture halls are having a pretty hard time of it. The chief disadvantage of the conference venue is coming out: "This is Vancouver, not New York," Cindy Noakes tells me later. "We did an incredible amount of research with the artists and musicians and got the best equipment and people available. We practically cleaned out every dealer, studio and production house in town. Given the tools and the time restrictions, the tech personnel did pretty well." Nonetheless, it's obvious that few if any of the staff have ever done anything this complicated, on this scale, before.

The 3.30 lecture is called 'Production Techniques for Digital Music'; an innocuous enough title that gives no indication that one of the biggest bombshells in our collective experience is about to be dropped. The speaker is James A ('Andy') Moorer, leader of Lucasfilm's Digital Audio Project. A conservatively dressed gentleman, he immediately gets the audience laughing by flashing a slide of a Moviola film-editing machine and announcing: "We meet the enemy."

Music for film, he explains, is totally at the mercy of the film editor and at any one time, various parts of the film are at different stages in the editing, making the music production a living hell for the composer—who has only had six or eight months to work on the thing before it's released. "During the editing of *Jedi*," he recalls, "there were four people who did nothing but carry reels of film back and forth between studios for recutting."

So his division built a self-contained digital audio processing station that could handle effects production, dialogue modification and replacement, sweetening, mixing, and music production, and storage. It's known as the Lucasfilm Audio Signal Processor (*ASP*—a peculiarly apt acronym) a prototype of which has beeen around for 18 months.

At the heart of the *ASP* are eight digital signal processors, each one using up to eight Motorola *6800*s and eight Studer D/A converters, all linked up with a 10 Mbaud network. Storage is handled by eight 300 Mbyte *CDC 9766* hard-disk drives per processor, each disk containing about 14 min of mono sound. The software is written in C, for a UNIX environment.

The system is built for flexibility: it can be run with any kind of front end that an engineer or musician might feel comfortable with, like a mixing board, an editing console, even a keyboard, violin, or touch-pad synthesiser. Moorer says he would like to see specialised front ends for score editing, orchestration and graphics-based composing. Likewise the machine specifications are variable: there is no limit to the number of oscillators available and both sampling rate and word size are adjustable. "No word size is going to be enough for all applications," says Moorer, "so we have up to sextuple precision built in."

He talks about a couple of specific applications: cleaning dialogue, in which the computer extracts the loudest signal (the voice) and eliminates all the others—like mechanical noises and people falling on the set and screaming; and 'funny voices' for *Star Wars'* famous alien creatures. But it isn't until someone asks, half-jokingly, if the unit is going to be commercially available that the audience realises the implications of what Moorer is saying. "By Christmas of '84," he says quite seriously, "it will cost about $700,000.

"Our R&D cost was about $2 million, which is a lot less than Neve's," he says. The commercial version of the *ASP* will record and manipulate 32 channels of audio and will hold 800 min of monaural sound on line at a time. Considering that it can replace a studio's tape recorders, sound processors, mixing console, most of the musical instruments and a large proportion of the musicians, it's a bargain.

First night

In the spanking-new Queen Elizabeth Theatre, something called The Electric Night Show is scheduled for 8.30. When the doors finally open about 8.25, several technicians and performers are still scampering around the stage and it's another half hour before the concert starts. At least one member of the audience, looking at the printed programme, is heard to say "I thought we were going the hear the Electric *Light Orchestra*!" The opening number isn't on the printed programme either: it's a spunky little video called *Act III* by Dean Winkler and John Sanborn, with music by Philip Glass. Then we are confronted by someone named Steve Miller, who claims to be the host of the programme.

I figure I'm missing something—that this guy is probably a big deal in Vancouver—but I find out later that I am not alone in my ignorance: Cindy Noakes has never heard of him either. He is a perfect cross between a truly bad stand-up comic and a UHF game-show MC. He tells execrable, pointless jokes and brags of his ignorance about what the concert is about but at least he pronounces everyone's name right.

We are relieved by a stupefyingly boring 'computer-choreographed' dance piece called *XT-N-BA*, which consists mostly of glides and turns by half a dozen dancers in two-tone leotards, accompanied by unusually static live and taped music. None of it makes any sense at all, and everyone on stage seems a little anxious and confused.

The next event, fortunately, is far more successful. The piece is called *Night Satellite* and features Vancouver composer Jean Piché playing a Fairlight *CMI*. Piché it turns out, is not performing alone—two other composers, Osamu Shoji and Martin Wesley-Smith, are also working their Fairlights but we can't see them, because Shoji is in Tokyo and Wesley-Smith is in Sydney, Australia. They are linked to each other by satellite which, I am told later by technical assistant David Kelln, leads to some interesting

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problems: because of a satellite hop's built-in 300 ms delay, Australia has to hold back its entrances for a beat after hearing a cue from Canada, who in turn has to pause after getting a cue from Japan. The machines are also set up to play *each other* in a continuous round-the-world loop.

Some of us get a little uneasy before the piece starts—the communication line between the three performers is piped on to the house PA and it has a bad echo and sounds dreadful. There is no such problem with the audio lines, however, and the sound is remarkably clean. It's hard to determine exactly who is playing what (a situation exacerbated by an unbelievably inept video cameraman who insists on showing images of Piché's feet on the projection screen) but it seems that Piché likes to play Morse-code like patterns and percussive riffs, while Australia is into sounds of guns, whips and ripping metal, and Japan is predisposed to heavy synthetic rock and roll. Although the music seems a little disjointed, there is no mistaking the energy of the performance and when it is over, the usually-unsmiling Piché cracks a wide grin. The communication line is put back on the house PA, revealing that all is not perfect: "Do you want the bridge again?" asks an Australian voice. As the three audiences, thousands of miles apart, applaud each other, Piché proclaims, "Next year, Africa, Europe and South America!"

After intermission comes *Scenes from the Reflection Afterwards*, a piece by Bill Buxton and John Celona, a composer from Victoria. We know we're in trouble when one of the speakers of the 'octophonic' sound system starts buzzing and crunching uncontrollably. Buxton leans precariously over a couple of thousand dollars worth of delicate equipment to adjust a console fader that someone apparently forgot to turn on. He then starts to play on his custom-built touch tablet (called *Drum*) which refuses to make a sound. His hands are visibly shaking as he wiggles the thing's cord, to no avail.

Celona, meanwhile, is playing a 4-chord rock riff on his *Synclavier*, which is getting louder and more obnoxious by the second. This is supposed to be Buxton's *Drum* solo but Celona appears to be oblivious to his partner's problems. The audience is getting restless and someone (reportedly Todd Rundgren) throws a paper airplane at the stage.

A few days later we find out what happened: the *Drum*, which was not designed to go on the road, was shipped across the country by Air Canada, who for some reason decided to disassemble it before Buxton could pick it up. Most of the piece's rehearsal time Monday afternoon was spent trying to put it back together.

The finalé of the programme is *Visual Music*, performed by Roger Powell and laserist Richard Vanceunebrouck-Werth. The piece features Powell's *Texture* machine controlling a bank of Roland *SH-101* synthesisers (which, I am told, he has never worked with before) and a couple of live keyboards. Halfway through the final movement, the lasers start shutting off and Vanceunebrouck-Werth keeps running to the back of the stage. It seems that somebody has plugged all the lasers into one 15 A electrical circuit and the breaker keeps tripping. Finally, he gives up, and the concert sort of ends.

Later that night

After the concert, a few of the Syntauri people head over to The Garden Lounge at the Four Seasons, with a couple of friends: Herbie Hancock, a Syntauri user, who slipped into town earlier in the day, and me.

After a couple of rounds, and some breezy talk about tax brackets, German Steinways and plastic oboes, the elderly black gentleman playing the Yamaha grand piano over in the corner starts to lock it up. Hancock calls over, "Please don't!" They exchange pleasantries, and the gentleman—who is still sceptical of the identity of the guy he's talking to, even though Hancock is wearing a Digicon badge with his name on it—invites the younger man to play.

After 15 min of beautiful melodic improvisations, the older man reaches out his hand. "My name is Linton Garner," he says. "My late brother Erroll and I have been following you for years." The two musicians talk quietly, while the rest of us drink in the moment—all this technology is fine but when you come right down to it, art and music are about people communicating with people and we've just experienced that in its highest form.

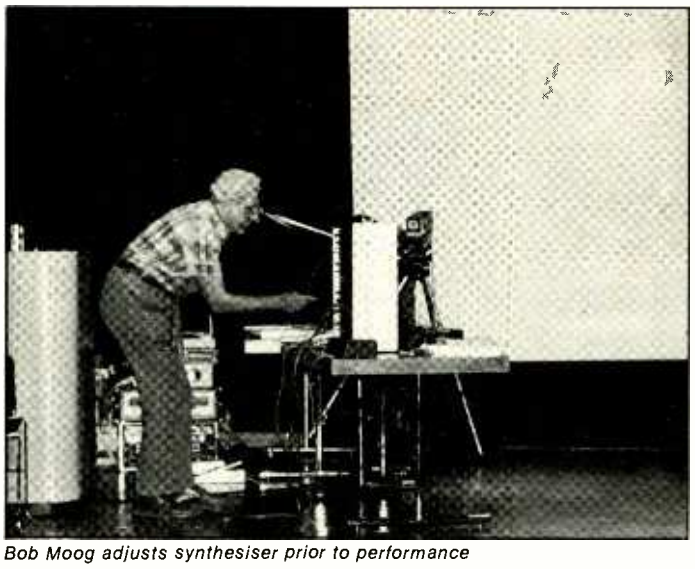
Morning the second

Once again, we are dragged out of bed for an early-morning lecture, this one by Dr Robert Moog, father of the keyboard synthesiser, a conception that some will never forgive him for. The lecture hall at the Robson Media Centre is packed to hear a living legend talk about the next step in the development of electronic instruments: *MIDI*.

The talk is very technical. *MIDI* is a digital, serial, bi-directional data stream, with a current level of 5 mA and a transmission rate of 31.25 kB. It runs over standard audio cable—two conductors and a shield—and terminates in a 5-pin DIN plug.

Through *MIDI*, properly-equipped synthesisers can talk to each other: notes played on one can sound on another, rhythms set up on a keyboard can play a drum machine, etc. Up to 16 data channels are available. The whole shebang costs about five bucks at the manufacturing level, and it can be hooked up to any synthesiser that uses microprocessor control.

Half of the audience is rapt, while the other half is yawning uncontrollably. Moog is a terrible public speaker: his delivery is full of long, meaningless pauses in the middle of sentences, which makes his thoughts exceedingly wearying to try to follow, especially first thing in the morning. There will be another lecture on the subject, with a demonstration, this afternoon, so within 30 min half the audience, including me, sneaks out the door.



Bob Moog adjusts synthesiser prior to performance

Back in the lecture hall a little later, Andy Moorer is substituting for John Chowning, who unfortunately had kidney-stone troubles en route and is now lying in a hospital in Seattle. (After the conference, Chowning recovered completely—in fact, he got married.) Moorer's delivery is a great contrast to Moog's: it is short, sweet, articulate and coherent. The talk is a simple plea that in the rush to perfect the ultimate live-performance synthesiser, we should not forget the advantages of off-line synthesis. As the complexity of a composition increases, he reasons, it becomes more important to get away from real-time synthesis, so that the composer can maintain proper control over a larger number of parameters.

Over in the ballroom, the only event of the conference that even approaches the prurient level is taking place. Of course, with a name like 'Performance in Visual Media' nobody expects a strip show. A corner of the room is filled with Jean Piché's music equipment, a mean-looking aluminium patchbay, and TV cameras, monitors and lights, while California video artist Jody Gillerman is walking around dressed in black leather and a huge red LED bracelet.

She sits down on a stool and takes off her jacket, revealing a black leotard. Piché starts playing string-like drones, punctuated by tiny explosions. A tape of computer graphics can be seen on a small video monitor and on a projection screen, and slowly the image on the larger screen starts to change.

Camerman Jim Whittaker is tightly focusing on Gillerman's neck and the image of her caressing her bare skin starts to mix with the taped graphics. The music builds and Piché begins to coo and sigh into a microphone. The camera angle on Gillerman is so tight that unless you can see her in the corner it's hard to determine exactly what she's doing. It's an exciting, very sensual performance and the audience applauds enthusiastically when it's over.

The patchbay, Piché then explains to us, is a custom image mixer that responds to incoming sound as well as its own internal program. "We rehearsed everything on headphones," he says, "so an unexpected thing happened just now—the sound coming out of the speakers was getting into the microphone and setting up an extra loop. Actually, I think it came out better."

Afternoon the second

Tuesday afternoon's lectures begin with an apology for the dance piece on last night's programme. The problems were technical, we are told: the choreography program doesn't work too well, and the computer broke down at a crucial point. So it goes.

Then, local composer Barry Truax introduces us to PODX, the synthesising language he wrote for his lab at Simon Fraser University. He has a few important points to make: "The music we hear today is incredibly traditional—as if 50 years of experimental music never happened. We now have the ability

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to design the *process* of composition. Among the tools we can use is the incorporation of randomness in meaningful ways."

One of the more interesting functions of Truax's programming language, which breaks down into several 'pods' for various applications, is to develop 'tendency masks': parameters *within* which random values can be generated. The boundaries can change over time, so that, for example, a piece can start out with a series of random pitches in a low octave and gradually get higher, without sacrificing the random quality of the sound. A special application of the tendency mask is a 'trajectory map' which indicates left-to-right and front-to-back location in space of a sound event.

Back at the Media Centre, the lecture hall is once again packed, this time for a *MIDI* demonstration by Ralph Dyck, a well-known Los Angeles studio musician (Elton John, Toto, Average White Band) and now also a designer for Roland. On stage with him are assorted synthesisers, a couple of Roland electronic pianos and an IBM PC. In a laid back, sardonic tone, he tells us that he's been 'kluging' synthesiser interfaces for years but since each design was unique to a specific application, they were all 'dead ends'. *MIDI*, he hopes, will change all that. "What you're seeing now is already obsolete," he says. "It's slow, it has no editing capabilities and it only uses one data channel."

For his first demonstration, he plays on the piano keyboard, but we hear the notes from one of the synthesisers. The second demo is a piece recorded on the computer and played on the piano. He won't tell us who recorded it but after a few bars it becomes obvious: Oscar Peterson. "He's digitised," Dyck smiles. "We can analyse his playing at any time, slowing it down without changing the pitch. We're setting up a 1200 baud transfer network for *MIDI* data: Oscar could play a track in Toronto and phone it in to a Toto session in LA. "Everyone's nervous about paying $4 a minute in the studio," he says. "With *MIDI*, the producer and the synthesist can get together at home with a rough mix and work out the voicings and the parts and then record all of them into a microcomputer. When the musician gets into the studio, all he has to do is set up and push the 'start' button."

The third demonstration manages to convince almost everybody. Dyck sets up two synthesisers, one generating brass sounds, the other strings, and instructs them to respond to key-velocity data at two different levels. He pays a chord progression on the piano, then repeats it a little louder. The brass comes in, giving the sound a nice fat character and spreading it out across the stereo image. Then he plays it again, still louder, and the strings, an octave above and below, soar. The audience, having just experienced a new definition for the phrase 'conducting from the keyboard', quietly freaks out.

Second night

At the MacMillan Planetarium, located across a narrow channel from downtown Vancouver, conference delegates line up to buy tickets for the wine-and-beer cash bar while they stuff themselves on obscenely rich (and free) cakes and chocolates. After an hour or so, the whole crowd moves upstairs.

Half the group goes inside the dome for the specially-commissioned planetarium show, while the rest of us are more interested in catching the sunset over the city and figure we'll wait for the second show. The planetarium staff have pulled out a bunch of stock slides and fired up a couple of lasers but even given the quickie-production approach, the show is pretty impressive. The first piece of music is *Phone* by the absent John Chowning, a fairly undistinguished collection of computer bleeps and bloops. The last piece, on the other hand, grabs everybody.

Love in the Asylum, by Peter McNabb, may be one of the most emotionally-effective pieces of electronic music ever devised. String-like pulses build to a frightening climax, horrifying pseudo-human cries emanate from various corners of the dome and the whole thing finally collapses into a beautifully-crafted pseudo-calliope—which seems to use no real pitches or natural sounds; rather, it recreates the *impression* you would get hearing a calliope at a great distance. Charles Ives would be proud. The visuals are just fine, too: green and red lasers chase each other around patterning higher and tighter as the music builds and then disappear, leaving a grainy, sepia-toned 360° image of a sleazy country carnival.

After the show, everyone crowds around the planetarium's new computerised image console and the operator, obviously delighted at the attention, launches into a zippy dissertation on its workings.

Day the last

The programme in the lecture hall promises 'When is it art, and what is technology doing to it?'. Certainly a question for the ages. One of the speakers is composer Herbert Brün who, after 20 years in the field, is one of the undisputed fathers of computer music.

Brün speaks with a thick German accent but his command of language is described by one observer as 'Way beyond English'. The way he uses his adopted tongue is highly reminiscent of Victor Borge—full of outrageous puns, bitter irony and wild similes—but unlike that Great Dane, this man is dead serious.

"With most compositional systems," he contends, "it's difficult to avoid drones, sequences and infinite loops. MUSIC V (a popular mainframe composition program) is ingenious but it helps to perpetrate existing compositional techniques, which are obsolete."

In the process of creating an alternative, he decided "People who are always squeaky-cleaning never see the message in the dust." Therefore, he named his new composing language 'Sawdust'.

"I don't like sentences like 'You're late, Herbert', or 'I told you so'," he proclaims. "I can't shoot the people who say them, so I decided to bury the phrases alive; musicologists won't touch anything that's buried alive." He proceeds to play a piece composed with Sawdust called *I Told You So* which consists of little FM-like structures that follow the spoken pattern of that hated phrase. Unfortunately, the sound system is breaking up something fierce, so he stops the tape. "Some other time," he mutters.

He's not done. The audience fires questions at him, like "What about aesthetics?"

"Aesthetics is the listener liking himself in the presence of art," he rejoins. " 'I didn't like myself while I was listening to your piece', is the beginning of a worthwhile discussion. 'Your piece is lousy,' is not."

Across the hall in the Media Centre's Cinema, Bob Moog, Bill Buxton and Rensselaer Polytechnic Institute video freak Tom DeWitt are setting up for one final performance. A half hour after the scheduled starting time, Moog is still fiddling with a device that sounds suspiciously like a *Theremin*.

Finally, he begins with a brief history of control devices for electronic instruments. "Leon Theremin experimented with different control devices," he says. "The sound-producing circuits were not as important as the electro-mechanical devices used to control them. He devised a dance platform whose capacitance varied with how much of the dancer's body was on the floor. Unfortunately, he couldn't find any dancers who could 'carry a tune,' and *Theremin* players were not a graceful bunch. Apparently, the only performance was by Clara Rockmore, who played *Ave Maria* by standing up and sitting down."

He then talks about his current work. "By the late '70s," he says, "the big guys had gone into making synthesisers. We didn't want to go head-to-head with them, so we picked a small corner of the market: gesture controllers."

He shows a *Trazer*: a cursor controller that responds to finger position on a tablet. He has been working, he says, on putting such a controller on each key of a keyboard. "It's as close as you can think of using all of the functions of the finger: it's sensitive to left-to-right, front-to-back and up-and-down position, as well as the force of the motion." The scanning program for the keyboard is so complex, he says, that so far the largest working model he has made has only eight keys.

Bill Buxton then offers the opinion that the only way to get support for new music systems is to call them something else. On a remarkably amateurishly-produced videotape he makes his case for *Drum*, his touch tablet that refused to co-operate Monday night. On the tape he discusses only home computer, industrial and engineering applications, not music.

Tom DeWitt talks about a system he devised for generating images with live action. Dancers on a stage wear small infra red generators whose motion is picked up and processed by fixed sensors. *Painter Power*—a program written for the *Apple*, lets the movement of the dancer control the direction of movement of video brush strokes, the character of which are predetermined by an artist.

Then we get to see and hear all this in action. A dancer flits around the stage, while thick coloured lines fill a large projection screen behind her. Moog and Buxton make weird noises on their various devices, which all seem to be working for a change. It's all extremely avant-garde but not particularly interesting.

Epilogue

And so Digicon comes to a close. Although Cindy Noakes is exhausted and although she says the attendance figures didn't fulfil her 'dream scenario', she is mightily pleased.

"People were talking to each other," she says. "I heard someone say, 'Boy, I would have stayed on the same track the rest of my life if I hadn't met the guy sitting next to me'." And of course, that's what it's all about. Computer artists and musicians are a solitary bunch, and any opportunity for them to come out of their basement laboratories and see what everyone else is doing is welcome. "I don't know if Vancouver was ready for this," she says. "But this one won't be the last." A few weeks after it's all over, she calls me to announce that Digicon II will take place in Vancouver, in August, 1985. She makes me promise to show up.

And I'm pretty tired too. Now I go home and digest 100 pages of notes, no doubt exhausting the capacity of my word processor. I also have some ideas about tricking my alphaSyntauri into making sounds it's not supposed to be capable of. But first, I think I'll head for those mountains. ■

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The Digital Business

Many studios are today locked into a price war which the majority will not survive: a price war which has its origins in the unwillingness of record companies to pay a sensible rate for studio time. In Britain, studio rates have not kept pace with inflation over the past 15 years, while capital expenditure and overheads have been forced up dramatically. If this trend is not reversed, in a few years time the only remaining studios will be those owned by record companies, or those who have diversified into non-record work. And even if they do survive, says Chris Stone, president of Record Plant Los Angeles and chairman of the US studio owners' organisation SPARS, they won't stand a chance of being able to re-equip with digital audio equipment to meet modern standards and stay in business. Things must change if the industry is to survive but before then, there are still some courses of action a studio can take, although they might not make many manufacturers happy.

This article is based on lectures given at the APRS/Music Week digital audio seminar at Advision Studios, London, on October 24 and 25, 1983.

Chris Stone (President, Record Plant)

From the business point of view, with all this marvellous digital gear, the first question is, "Who pays?" I can remember when we built our first studio in New York in 1967. The total cost of construction and equipment (even in a place like that, which is much like London) was $85,000.00. We were getting $85.00 an hour for our studio time. Thirteen years (to the day) later, we opened Studio D in Los Angeles and the same-sized facility cost $1,300,000. We are getting a lot of money compared to what some studios get today in the United Kingdom; we were getting $165.00 per hour. If my addition is correct, if I were to purchase one of these magnificent digital consoles, which I would love to do, and if I were to purchase the latest and the greatest of the digital multitrack tape machines and all of the outboard equipment to go along with it, I would be up to around $2 million for a studio and even though we are the highest priced studio in Los Angeles, I think I might be able to squeeze another $10 an hour...$175 an hour maximum. Economically, that is not very viable. What does that say? That says, basically, that this magnificent equipment is going to wind up in the subsidised studios. I think we already know that.

But digital in the United States started back in 1979 when 3M delivered their first multitrack to Record Plant Los Angeles. We had two sets of them and we had a very good arrangement with 3M; they said that if we could show them that this was not a profitable item that we could return it. Three years later we *did* return them—along with a ton of paper showing that, in spite of the fact that we had done everything possible to make it a viable situation, we did not break even.

About three or four years ago, what we suggested to the industry was, very simply, 'diversify or die'. So we now are in three different businesses and that is how we are doing it. The record business is going to die out at Record Plant, although Record Plant has always been a leading pop studio; it made its reputation with rock 'n' roll. Our first hit was *Electric Ladyland* with Jimi Hendrix and our first remote recording was at a then-unknown little concert called *Bangladesh*.

We are now in the remote recording business, we are in the record business and we are in the film scoring business. We operate the scoring stage on the Paramount Pictures lot in Hollywood. We make more profit from scoring than we do from records and remotes combined. We make twice as much profit on remotes—even though those prices have gone down in the last three years—than we do on records. Record recording is where we lose money. But record recording is a basis for the rest of the business, so we have remained in it with a positive bottomline. Financially, black ink is better than red ink, which is what we have only because we have been able to mix these businesses together. Whereas 100% of our remote recordings just a few years ago were record recordings, now 70% of our remote recordings—and we do over a million dollars a year in remote with four remote trucks—are what we call 'visual recordings', meaning film or video. The vast majority of our film scoring is television because a feature film—due to the nature of the film business—is usually done in three days. Whereas television, if it's a sitcom, is a day or a half a day a week for thirty weeks. So we fill up our days with television.

The fault with the digital equipment was not 3M's. It was a beautiful machine. After the first year (which we knew about) it worked wonderfully well and still does. The problem was, of course, what I refer to as 'the crash of '78'. The studio business went down the drain almost exactly, or maybe even a little bit before 3M introduced their machine. As a result, there was no one out there who was willing to pay the extra price for better quality. Worse yet, because there was not a CD, when you did get down to that black vinyl disc, it really didn't sound noticeably different.

We do a lot of work with Rod Stewart. We have done his last five or six albums and we talked him into going digital; so he did *Foolish Behaviour* totally digital. When it got down to the vinyl, he came in to see me and sat, not next to, but *on* my desk and said, "Alright mate, why in the hell did I spend an extra $25,000.00 to get the same think I would have got if I had done it analogue?" And I said, "But Rod, when CD comes out..." and I talked like my life was at stake (and it probably was for those of you who know Rod). He said, "I don't care. I'm out to sell records today." That was the beginning of the end.

Today, of course, we are in a different situation because now we have the Compact Disc. We have the future of digital and 3M, bless their hearts, have dropped their prices. That makes it even nicer.

At the AES Show in New York, I was talking to 3M about the possibility (since we are finally starting to, apparently, get a standard with the announcement of Sony DASH), of going along with DASH at some future date because, again talking from the recording studio business point of view, we'd love to be standardised. The answer I got, at a very high level, was "I hope not".

So that means that 3M will have a 'standard', other than DASH. Hopefully they will join Mitsubishi (who also plan not to go along with DASH) so that we can at least have some kind of 'alternative standardisation'. Because, sure enough, back in the late '70s when we had the first digital recorders, one of the first problems that we had was that you had to take the mixdown machine to the cutting room with you because there was no other way that the master could be properly cut. The 4-track had a built-in preview head which had to interface with the cutting lathe. That didn't work very well because sometimes we were going to cutting rooms that were really quite presitgious and the machine wouldn't fit through the door. So we had some severe problems—but again, we are at the beginning of the digital age, and things are going to get better.

We were quite fortunate in those early 1979 days that we had some

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The Digital Business

pretty good sales people working for the Record Plant; so when we first got digital, besides Rod's *Foolish Behaviour*, we did *Chicago 8*. We agreed to be the guinea pig and I have to tell you that the 3M Company stands by their word.

The machine in those days was anything but stable: it would drift, and when it drifted, the engineer would get up and go over and shake the technician who was literally sleeping in the studio and bring him over. The session would stop, they would take a break and the technician would fix the machine and get it back into position. The engineer and artist could then come back and record. They kept doing that and sending their people out until they made it work properly.

Sony, of course, has come out with a totally stable 24-track and it's over $100,000. We recently did Neil Diamond live with two of them and experienced absolutely no problems. Most of the people in the United States that are buying them are on the East Coast because 3M had made its debut on the West Coast in the early days. The East Coast is doing a great deal more digital multitrack work than the West Coast. Hopefully that is not going to continue. A lot of the Sony machines that are being purchased are being purchased by artists. Stevie Wonder has purchased one, Frank Zappa has purchased one, Neil Young just purchased one, Georgio Moroder just bought three. It says a great deal that the artists (who are really the people who pay the bills) are purchasing them for themselves!

When we got our 3M's we figured out the costings very very quickly; we leased them. We had to charge an additional $25 an hour for 40 hours a week in order to break even. We were not trying to make money on it; we were simply trying to break even. Very few clients would use it at that rate and we finally tried to make the amount of money that it took to keep the machines in our studios simply from the sales of tape. We dropped the price down to $10 an hour and even that didn't work. Because there was not a CD at that time, there was not a digital recording world.

Today, we are saying OK, now we must equip ourselves for digital, but by the same token, the people in the record companies must maintain minimum cost for the making of an album—with the exception of their superstars, which we understand. We just had Queen for nine weeks; it was delightful. They walked out with twelve tunes and they were very happy—so was I! Unfortunately, all albums are not like that. We find ourselves in a situation where the average album budget in 1978, when the bottom dropped out, was about $125,000 and today we are finding that the average price is about $85,000. Our price at Record Plant is an example because we keep track of average prices per hour and—as everybody in this business knows—the price list of a studio is where the negotiations begin. Our prices have gone down by more than 20% in the last 24 months. Now that is competition; that's free market economy; that's my problem. But at the same time, it's killing the goose that lays the golden egg, because the studio business, by its very nature, must re-equip and re-invest virtually every penny of positive cash flow in order to maintain the excellence that clients demand. That's Catch 22. How can we go out and equip

Chris Stone

a studio with a half-million dollar digital console and a $150,000 digital tape machine when the rates are going down?

The answer is, we can't, unless we are subsidised. But we are not subsidised so what that leads us to believe is that in the long run, the independent recording studio as we know it will disappear, just like the buggy whip, and just like the dinosaur. Many of the studios today are in fact dinosaurs with the owners sitting in their chairs grasping their platinum records that they got four or five years ago and waiting for the booking phone to ring. It's not ringing, which is driving a great number of studios out of business. In Los Angeles County, as an example, three years ago there were 264 24-track rooms; today there are about 150 rooms. That's OK, we are used to attrition. But pretty soon it is going to get back, I think, to where we began...the record label recording studio, where the artist does not have a choice where he goes, if he wants to get the best equipment. Other than that, we are going to have a series of philanthropists that might still be in business. I think some studios in the United Kingdom today must be philanthropists because I don't see how they do it, offering 3M 32-track digital at £80 an hour—but maybe I just don't know. I have been in the business only 15 years and I only plan to stay in it for about another 15. We'll stay alive one way or the other.

What does all this mean? It means that we have to make some decisions economically in terms of how and when we are going to invest in new equipment, and what that equipment will be. But then there is another major problem, and that major problem is something that is totally illogical on the client's side of the line. If a piece of equipment is in a studio, they do not expect to pay for it. Regardless if it's a $150,000 tape machine or not. But if that piece of equipment rolls into that same studio from a rental company, of course, they pay for it. No questions! So, I'm not going to buy a 24-track digital tape machine for my studio—that would be... stupid, since the clients won't pay for it. I'll rent it and they will pay for it, and it will go down without a ripple. A thousand dollars a day, four day week, three week month; Go for it! I'm a businessman; why should I put a loss item in my studio when clients will pay to bring it in from the outside? I will, therefore, buy a digital multitrack machine and place it with my rental company, because the "buy for rent or buy for studio" decision is made in the following manner: gather all the information that you can to justify a studio purchase by being able to project additional revenue in terms of hourly rate or buy and re-rent the item for a minimum of 1% per day of its initial cost.

When a stranger asks me what I do, I don't say I own a recording studio, I say I'm an entrepreneur. If you're an entrepreneur, you know that you have got to make money to stay in business because you don't have any subsidies. Today, more and more, if you are a recording studio owner you are either subsidised or use the studio as a tax shelter to provide a haven for your losses. The point is that things have got to change. Both sides of the industry must work together as we do quite well. The studio is in the middle between the label and the artist. The studio wants to be there. The studio is 'the people who make the music'. The studio is the people who are now, particularly with CD, recording the entire creative process. The studio must give clients the environment that they demand. The studio must remain as an independent organisation so that the artist, for God's sake, can make up his mind about the environment in which he wants to record and not go back to white walls, fluorescent lights and hardwood floors—the sterile kind of studio of the early '60s.

That is one of the reasons we formed SPARS so that we can all get together and jointly make up our minds about what's going to happen. It is really the only way that it works.

The APRS is much older than our organisation. We only formed our group in 1979, but I can tell you the major thing that we found and the thing that I'm finding in talking to British studio owners, is that we all have the same problems and the biggest problem is 'Who pays?' Who pays for the digital multitrack? Who pays for the digital console which we all undoubtedly need? How long can we remain competitive without those items? I think the answer is pretty clear. Right now, we cannot afford to buy the equipment that we must in order to do the kind of music recording that needs to be done for digital disc. So, clients are going to rent it.

I think another part of the answer lies in software availability. The major factor will be the day that new releases come out simultaneously on CD. Because right now, as you all know, in the United States anyway, it isn't like that. We just finished Eddie Money's album, for example. Ten days later there were 2 million copies in the stores because they hired every pressing plant in the country to make the record and ship it.

The Compact Disc Group on the 22nd of September 1983, very proudly announced that there would be three CD pressing plants in the United States some time in 1984; that the major one, of course, would be CBS/Sony in Terre Haute, Indiana; and that it would have a capacity of a million units a month. A million units a month, from my point of view, is still not enough for every new release to come out on Compact Disc. Until that happens, I will rent and not buy the equipment necessary for tomorrow to record for the Compact Disc—which is already here today. ■

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letters

Holophonics

Dear Sir, I feel compelled to write to you to comment upon the article entitled 'Holophonics an investigation' that appeared in the July issue of your publication. I am appalled by the stance taken by Barry Fox.

Let me start by telling you that whilst I was at home this summer, I took the opportunity of visiting Hugo Zuccarelli at his house in north London. I too had read articles about Mr Zuccarelli's system and was full of mental hypothesis about how it might work. I gladly subjected myself to the tests and demonstration that are obviously standard fare for the inquisitive visitor—and why not? After all, there are not too many interesting new ideas in the audio field these days! Whereas it is true that Mr Zuccarelli guards his art jealously, that should not be held against him. As one who has made a number of contributions to the field, I can say that I wish I had been less willing to tell all to anyone who asked.

I very much resent Mr Fox's pontification in a manner that can only be described as deliberately demeaning. As to his comments about how one goes about protecting intellectual property, they should be ridiculed. I can only assume that Mr Fox does not have any intellectual property worth protecting! I can assert to the fact that one only puts into patent applications what is absolutely necessary in order to get the patent through. One always tries not to disclose any proprietary information that really makes the system fly, as opposed to limping along. After all the basic uses for a patent are: (1) to keep the flies away and (2) to form the basis of a financial transaction.

Surely the pith and marrow of the matter is that Mr Zuccarelli has come up with some interesting new ideas, which are significantly different to what has been demonstrated previously. Even if his system has not reached perfection, it appears to have brought pleasure to a meaningful part of our industry. I do feel profound revulsion at the lack of the English sense of fair play. Whether or not Mr Zuccarelli eventually succeeds in a manner that is satisfactory to himself, time alone will tell. In the meantime, I for one wish him the best of British luck!

Yours faithfully, John Mosely, PO Box 38795, Hollywood, CA 90038, USA.

Training

Dear Sir, In response to your editorial published June 1983, I am writing this letter to assure you that the future of the recording industry is not as grim as your article conveys. I believe that our school, The Ontario Institute of Audio Recording Technology, is advancing towards the 'entry level' course you described.

We began classes officially in September and they include: Recording Technology, Music Theory, Music Business, Acoustics, Recording Production, Studio Maintenance, as well as lecture/seminars by staff and industry professionals on a variety of topics.

I should mention that this institution is fully approved and accredited by the Ministry of Colleges and Universities, making OIART one of the few such teaching institutes in the country. The fundamental education philosophy here is to provide the individual with a balance of instruction between the technical and creative sides in the music business. This course's existence is a result of my having taught in an accredited recording arts programme at Fanshawe College, also located in London. After having taught at this College for seven years, I discovered that the student could not be properly educated in the College environment due to educational budget cuts, which you mentioned, and the inhibitions of the administration.

Our teaching facility itself consists of a 24-track recording studio that is modern and fully-equipped. Also, all the acoustic environments have been specially designed with the aid of an Acoustic Analysis computer program we developed ourselves.

I truly believe that with the complement of equipment and the staff we have we could become a large source of talent for the recording industry.

It would be our pleasure to establish a rapport with your magazine or some of your subscribers on this topic of education.

Yours faithfully, Paul Steenhuis, Ontario Institute of Audio Recording Technology, 500 Newbold Street, London, Ontario N6E 1K6, Canada. ■

business

BARRY FOX

Big band miking

There is usually a good reason for tradition. Big bands, which are always making a come back or have never been away, depending on your point of view, are always laid out in the same way. Four or five trumpets at the rear, as many trombones in a row in front of them and as many saxes again in the front row. Look at any photographs of big bands in the swing era, back in the '30s and '40s and you will almost always see the sections in this layout.

Look closer at the old photographs and you will see that there were only a few microphones, mostly out front for vocals and announcements. The band played truly live. So it made sense for the louder, more directional, trumpets to sit at the rear of the quieter, and less directional, trombones and saxes. Soloists stood up, not just to show off, but to cut through the band sound. When a whole section soloed, for instance the saxes on a tune like *Four Brothers,* the whole section stood up. When the brass stood up and played over the heads of the trombones and saxes, they sliced through like a knife. In other words the band had internal balance.

For an audio reference point on all this listen to the recordings, still available, of Benny Goodman's famous Carnegie Hall concert, on January 16, 1938. Albert Marx was a booking agent married to swing vocalist Helen Ward. Without Goodman's knowledge he arranged for a single mono mic to be slung over the audience and the feed piped to disc recorders at CBS studios. Goodman didn't know about the recording until a day or two after the concert, when Marx offered him a set of acetates. He said "Thanks", (musicians weren't yet up in arms over bootleg recordings) and put them in a tin box in his Park Avenue pad. They lay there for 12 years, unplayed. So when Goodman cleared out his apartment and played them in 1950 with Hal Davis and Irving Townsend of CBS, they were in pristine condition. Transfer to tape was at Empire Studios, on Lexington Avenue and 47th Street.

Listen to the Carnegie Hall LP and you'll hear what a big band really sounded like, in the raw. Now listen to a modern big band, either live or recorded and hear the difference. Although the musicians are usually sitting in the same traditional positions, they are now blowing close into mics. The result, especially if the PA or recording engineer isn't familiar with the original big band sound, is a screeching blast, top heavy with close miked brass. This is fine if that's what the producer wants. But it's got nothing to do with the traditional big band sound.

Britain seems worst afflicted with the big band screech disease. Perhaps it dates back to the Ted Heath band, which made a career out of sounding trumpet heavy, or the short lived Eric Delaney big band, which didn't have any trombones at all. The BBC all too often mixes big bands this way and the National Youth Jazz Orchestra, although a fine band, seems terminally infected. The worst musical evening of my life, was listening to the wonderful Buddy Rich big band at Ronnie Scott's Club. Although it's a small room, the club had close miked the trumpet section and piped it through speaker stacks firing ear height into the audience at point blank range.

Fortunately there are still a few big bands around that either resist, or can't afford this electronic disease. Bob Wheal's rehearsal band from the Watford area proudly bills itself as 'the band that is *not* amplified'. Young Jazz, another youth band, may not be as good as NYJO musically but with minimal amplification it sounds a whole lot better. Young Jazz played recently in the Music Box, in the Royal Festival Hall. The Music Box used to be old ever-so-posh RFH restaurant. Now, under the GLC, it's an admission-free venue for music over the weekend. Inside the Festival Hall, the London Philharmonic was performing Mozart and Mahler for up to £8.50 a seat. As the concert ended the po-faced audience filed glumly down the stairs and past the Music Box where the 20 piece youth band was romping through the Nelson Riddle arrangement of *I've Got You Under My Skin.* In they poured, with "I wish I'd been listening to this," written all over their Mahlered faces. It was probably the first time many of them had heard the real sound of a big band in full cry.

Concert PA

You can't please everyone, though. The Count's Men, a lovely big band featuring some of the best musicians employed by Count Basie over the years, played the Chichester Festival Theatre at the end of October. I winced at the sight of a dozen mikes and six PA speakers at floor level firing from a few feet into the front rows. But in the event they hardly used the PA and the band played almost entirely acoustically, ofter virtually ignoring their mics. From the front it was a delight. But at the back of the theatre, the audience was complaining that it sounded thin. Doubtless, that's why, when you look at photographs of big bands in the '30s and '40s playing for dancing, there is always a crowd of listeners crushed along the front of the bandstand. That was where the band sounded best. Today bands usually sound best at centre front, halfway up a large hall, where the sound mixer sits. That's the only way the promoter can cram in enough people to pay the kind of money bands now charge to perform.

As I say, you can't please everyone. Just behind me at the Chichester, a local dowager complained to her retired-general partner that the music was far too loud. Presumably she had thought that The Count's Men was an Ibsen play. At the end, after the band had encored with *One O'Clock Jump,* she stood straight up, waiting for something which never came, "Don't they play the National Anthem any more?" she asked her partner with a puzzled frown. Actually, madam, only one big band ever played the British National Anthem, and that was Stan Kenton. His special arrangement of *God Save the Queen* became a jazz classic. But somehow I don't think the Chichester dowager reads *Studio Sound* or was a Kenton fan.

Ambisonically speaking

The British Government, through BTG (the British Technology Group) and NRDC (National Research Development Corporation) has now spent £½ million over 10 years on Ambisonics. There is a good selection of UHJ discs but you still can't find a decoder in any shop. Movement is still all on the professional front. Producers of AV shows, using slides and tape, are finding that ambisonically encoded surround sound adds punch to their presentation. Disney is looking at the possibility of reproducing a 360° hemisphere of sound, recorded with a Calrec *Soundfield* microphone, to match Disney World's famous all round picture shows. Audio and Design at Reading are selling electronics that effectively convert a multitrack studio desk into an Ambisonics desk. This opens the door to ambisonically recorded pop.

Because the editor of *Studio Sound* and *Broadcast Sound* is a long term supporter and user of Ambisonics, this kind of development will get some publicity which may eventually help get decoders into homes. But imagine what would have happened if the editor of these magazines hadn't been an Ambisonics convert. I wonder if the Government and BTG have any inkling of how fortunate they are in this respect. Having talked recently with the man at BTG in charge of the Ambisonics project, I very much doubt it. Not to put too fine a point on it, I was horrified at how little he seemed to know about any aspect of the audio business, even after 10 years on the project. He admitted that he'd never even tried to set up his own home UHJ system. In fact I came away from BTG's plush new headquarters near the Elephant and Castle in London, with a far better understanding of why Ambisonics is where it is today and why only the most devoted convert knows how to buy a decoder by mail order. How different things might have been if the people at BTG in charge of Ambisonics had some interest in hi-fi and audio reproduction.

Viewed from the outside the Ambisonics team looks hopelessly split into factions which have only one thing in common and that's despair at the way BTG and NRDC have handled their project.

Recently behind the scenes, rumblings surfaced. Professor Peter Fellgett of Reading University went on the record with a quotable and attributable comment that says it all:

"After the way the promise of the invention has been dissipated, and the disruption that has been caused, I am sorry that I ever had the ideas that led to the Ambisonics project, I regret that I ever referred the matter to NRDC in the first place and I am heartily sick that I spent over a decade of my research time developing it. If this and other cases known to me are typical of how British inventors and British innovation are treated by national bodies, it is no wonder if other other countries so often reap the benefit of British originality".

The tale of Ms Golden Ears in our November issue reminded one of our readers of a recent experience...

'I was entertaining an acquaintance who was a self-confessed 'Hi-fi Enthusiast' and played him a Mahler symphony on my hi-fi-cum-monitor system (which has elicited unsolicited praise for its naturalness from every musician who has heard it). He thought that my system compared poorly with his own, Linn based system, though he did have a good word for the stability of the stereo picture.

'The record being played was transcribed from 78s made in 1951 and was, of course, 100% mono.'

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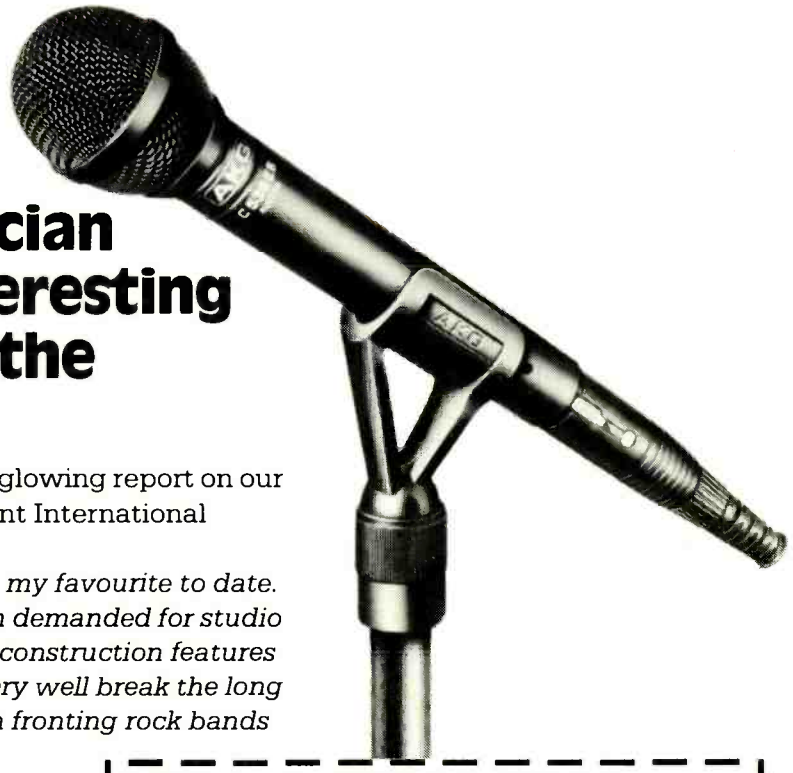

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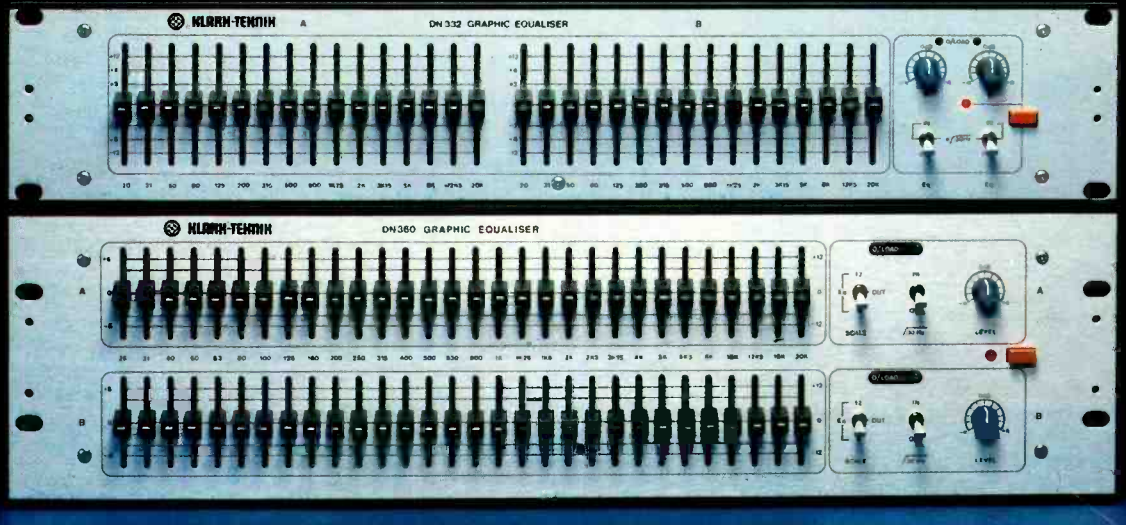

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Arny's Shack, Dorset

Arny's Shack is one of those places that everyone has heard of, but nobody quite seems to know who they are and what they do. The amount of active publicity is, and always has been, nil, but somehow word still gets around—Arny's is definitely a place to go. Arny himself (alias Tony Arnold) has his mind filled with enough anecdotes about the recording industry and his experiences in it to keep many an avid reader going for plenty of months to come.

Not your typical 'industry man', Tony seems to have been everywhere and met everyone and the studio which he runs with his wife, Natalie, is so beautifully cared for it would almost seem more in place at the Ideal Home Exhibition than being utilised by those creatures we have come to know and love—musicians.

Tony's tales go back to the days before even the tape recorder was just a twinkle in some magician's eye. When he came out of the army, he discovered with great excitement that someone had actually opened a shop called Tape Recorder but when he went along to eagerly offer his services it was only to be told that he was too old. He was 21. So for a while it looked as if his heart's desire was never to be attained.

He got a job as a steeplejack. The budding recording specialist was, however, not so easily put down. He heard on the grapevine that Radio Solent were looking for a producer for a country and western programme and walked in to the job thus: it was decided that it would be a good wheeze if they recorded some of the local bands who would otherwise find it impossible to get airplay. So Tony borrowed £400 from the bank to buy a 4-track tape recorder which he intended to use for the short series of programmes, resell and thus repay the money to the bank. Things didn't quite work out that way.

The local bands very much approved of this idea and managed to persuade the rock show to do the same thing. The bank, however, wasn't quite so thrilled. Tony had to pay the money back somehow or sell the machine. So he started to record bands who didn't make it on to the shows for £1 an hour, and his recording career was launched.

The first 'Arny's Shack' was in the garage/shed at the bottom of his garden. And although he insists that the whole thing was always a hobby, the place to go for a Monday night jam rapidly became Arny's Garage. Now this was all good fun and there are plenty of anecdotes flying around about this period of the Arnold development. For instance there was the time when the ever so tall opera singer got her boufant hairdo irretrievably entangled in the screwdrivers stuck into the beams of the low ceiling, whilst her small mousey accompanist requested a pair of 'cans'—"Oh no, please don't plug them in, it's far too loud as it is." And what about the time Rolf Harris and his producer were let down over their studio booking and Freddie (of Freddie and the Dreamers) recommended Arny's. Having got over the initial thrill of having such a star come to his place, Tony soon started puffing and panting with outrage as Rolf referred to his studio as "This is a nice little corridor" and "Where's the studio?" until at the last minute they all saw the funny side of it and decided rolling around on the floor was a much better idea.

Maintenance in the control room

Changing cards on an Ampex 440C

Arny's place became busier and busier—Freddie and the Dreamers did an album and a single, Don McLean had been in, etc, etc, and the council inevitably got to hear of it. What it all boiled down to was that Tony owed a small fortune in taxes and had somehow got to find a way out of it. Once again the choice was to expand, or sell up and pay up. So he went professional and 8-track and so the story continues.

At the 16-track stage he was all for packing it in because the fun had gone out of it all. He was still very interested in repairs and maintenance and even today his workshop is in great danger of taking over the studio area. At one stage he was working for TR Maintenance and was able to get involved with developing their interest into the professional market as well as the domestic. So keen was his thirst for knowledge he attended evening classes at Bournemouth college for two years and it was here that he met one of his all-time heroes. He had always been a long distance admirer of Alec Tutchings (who was with *Studio Sound* for many years) and was absolutely thrilled to meet him and form what became a long and fruitful friendship. Alec was, Tony reminisces, a constant source of inspiration and support and is responsible for much of what Tony Arnold is today. This touching tribute was followed with "My other heroes are Lee Herschberg, Glyn Johns and Raindirk!"

Arny's Shack today has moved in to what used to be a sausage and pie factory, and although Tony proudly announces that the drum booth is steel lined, it turns out that this is simply because it used to be the fridge! "But it's not as cold as it used to be."

Our first port of call was indeed the workshop, and it is easy to understand the urge for it all to spill out into the surrounding rooms! The room is lined from floor to ceiling with machinery of every description, and probably one of the most impressive collections of recording journals in existence.

Tony's passion for machinery means that he is quite often happy to leave the studio in the capable hands of his engineer Steve Isaacs (whom he trained) and devote himself to repairs and conversions, etc. His latest project has been to convert several old mono Ampex machines to stereo and then four tracks upwards.

The musician in Tony is immediately made apparent by the way the walls of both studio and control room are lined with a beautiful guitar collection, the way the drum booth is packed with drum kits and everywhere else with amps, keyboards, pianos and drum machines. In short, a musician's paradise.

Building the studio was not without its problems. "We didn't really do much to the rooms. It is basically a room within a room on a solid timber frame. We just put Rockwool in the ceiling, hung some beams, the walls are wallpaper hardboard and the studio is really very ambient. In the control room we can dampen the sound by drawing the velvet curtains but it's quite a good sound; I like it. The studio area is approximately 18 × 24 ft and the control room 12 × 18 ft. We did have terrible problems with the sound in the control room at first though didn't we?" He looks to Natalie for support in this matter. "And in the end I had to buy a phase correlation meter in order to sort it all out."

But it seems it was the ceiling that

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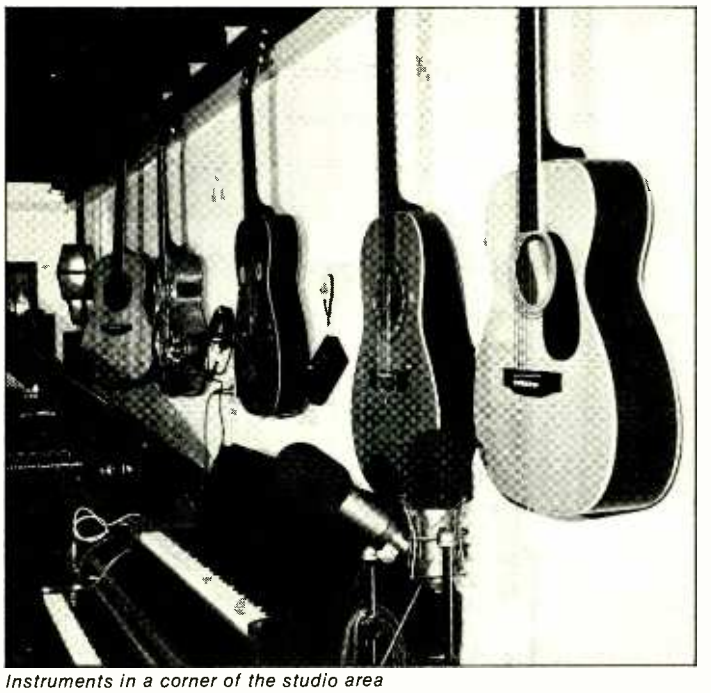
caused the most trouble in the end. It was in the days when Punk was at its peak: "I loved punk. I was so glad when this carpet deteriorated," he adds by way of explanation. The ceiling problem occurred when they had a band in called Slum Clearance. Tony's Punk recording technique consisted of filling the studio up with so much gear that the band were all squashed in to a corner so that he could work with just overheads and some close mics and record live. The session got off to quite a good start with everyone nice and enthusiastic, but unfortunately as time wore on and the drummer had more and more difficulty in getting his fill completed without dropping his sticks or falling off his stool, the other band members became more fraught and frustrated.

Take 17. "That was really good boys. Let's just have another go, I'm sure it will be great this time." Drum fill coming up. From the control room Tony watched aghast as the drummer's headphones slid in slow motion downwards over his forehead and as he launched into the fill, landed firmly on his nose right across the eyes. At this moment all hell broke loose as the ceiling, which unbeknown to anybody had secretly filled itself up with rain water, came crashing earthwards and, impaled by the guitarist's head, came to rest across his guitar, inspiring the guitarist to do a Laurel and Hardy impersonation as he swung round with a "What the _____?" sending the drummer and his drums crashing to the ground. Chaos reigned, and Tony, once again indulged in his love of rolling around on the floor helpless with hysteria. Happily the ceiling has since been sorted out.

Back to the nitty gritty. The control room centrepiece is the Raindirk 26/8/24 console which, although three and a half years old, is so loved that it looks as if it could have been born yesterday. It incorporates a 360-way patchbay, 12 parametric echo returns and eight echo sends. Metering is both VU and PPMs. The vast array of tape machines includes an Ampex *MM1200* 24-track machine, two Ampex 2-tracks— one stereo 15/7½ in/s NAB and one CCIR with a mono headblock—and a 4-track Arnold conversion Ampex specifically for the songwriting clientele who might need to add another vocal, for example, to their stereo mix. There is also a Revox *A700* with variable EQ and bias as well as an NAB cartridge machine in order to gain airplay on local radio.

Monitoring is on Tannoy *Super Reds* in either Lockwood *Major* or *Universal* cabinets. Reference monitoring is primarily on Auratones but as you can guess there are plenty of other makes around the place to choose from right down to the various stereo systems in Tony's various cars.



Instruments in a corner of the studio area

Tony Arnold enthusiastically wields a pair of 78 disc cutting test discs

Ancillary equipment includes a further 360-way patchbay, a full Rebis rack, a *Scamp* rack, a Klark Teknik 31-band graphic EQ, five Audio & Design sweep EQs, an Audio & Design *Express Limiter,* Drawmer noise gates, a Korg *SDD3000* digital delay, two Roland *1000* DDLs, two EMT stereo plates, an RDG (which later became Bel) *BP-10* phaser, an EMS vocoder for speech and a Roland vocoder for choral work, a Roland P/V converter, a Roland *555 Chorus Echo*, an Alembic bass preamp and an Ashley bass preamp with parametric EQ, and a spectrum analyser.

Arny's also boasts 84 different types of microphone and, no, I didn't write them all down. The collection does, however, include over 30 Neumann and AKG valve mics—a collector's dream.

Moving on to the instruments—there are over 30 guitars from Alembic to Ovation through Fenders, Takamines and the Roland guitar synth. The grand piano is a Steinway concert and the upright is a Steinberg and extremely honky tonk! In the fridge, sorry, the drum booth, the drummer may choose from a full Camco kit with three toms, a 22 in bass drum and a wide choice of brass and wooden snares including Ludwigs, Pearl and Yamaha. As you may have guessed, Tony beliéves more in getting the sound right in the first place than trying to compensate for its shortcomings on the mixer. All these instruments are as lovingly cared for as the rest of the gear.

The workshop houses a complete range of Bruel & Kjaer test equipment: sound level meter, white noise generator, pink noise generator, random noise generator, etc. There is a Revox *A700* with 10 Tandberg cassette machines for real time copies, as well as the facility to copy any tape to any tape. "I've never thrown any of my machines away." he says as he drags out the very first machine he ever owned, "and they all still work!"

The shack doesn't restrict itself to rubbing shoulders with industry greats (although he did happen to mention that Cliff Richard and Leo Sayer were coming in along with Andy Summers and Robert Fripp) but on the whole he feels that they tend to meet bands on the way up and again on the way down. "I must hear a band before I let them book the studio so that they don't waste their money. I listen to about 30 cassettes a week. It's not fair on the bad bands to take their money because in the end they'll just be wasting it when the A&R man packs them in. That's why the big studios are so successful, because all their business comes through the A&R departments."

A genuine interest and concern with the people who pass through his studio leads him to speak his mind at all times, even if it means a turning away from the Arnold fold: "Better they fall out with me than waste their money on expensive recordings when, for one reason or other, they haven't got what it takes. Studios don't vet musicians—I've got several session guys who can help out if one member of a band isn't quite up to the standard of the rest. And A&R departments have been known to say 'I'd like to hear some more tapes,' because it's easier than saying, 'You haven't got a chance in hell,' so I try to help the young bands avoid beating their heads against brick walls.

"By the way Andy Summers comes here to work up his tan." You mean tone. "We've whitewashed the walls in the yard and it's a real suntrap."

"Oh yes, and the studio band has got a deal with PVK records—it's sort of Irish with American overtones using drums." Er, yes. "And I've done some Indipop—I love Indian music. We've done a track on the *Compilasian* album.

"Oh, and by the way, I've also got the Sony *PCM F1* system and . . ."

Well I am convinced but it really is time I went home and your dinner party have phoned you three times to ask why you haven't left, so Arny, *au revoir.* **Janet Angus**

Arny's Shack, 7c Bank Chambers, Pennhill Avenue, Lower Parkstone, Poole, Dorset. Tel: (0202) 743394.

64 ▶

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studiofile

Majestic Studios, London

If the Man On The Clapham Omnibus ever actually existed, he would have liked the suitably ordinary-looking, not to say sleazy, bingo hall opposite Clapham Bus Garage. But beyond the discarded sweet wrappers and Dayglo posters lies an altogether different world of earnest risk-takers, trying to get the numbers right and occasionally getting very excited, shouting even. Maybe it's not that different after all. But you don't usually find many blue rinses at Majestic Recording Studios.

The Majestic building is a former cinema which was converted into a bingo hall 14 years ago, with the balcony and upper gallery sealed off as a studio with 45-musician capacity, a large control room and two overdub/separation rooms. This strange combination of bingo and blues came about because the owner—who also runs Cinatra's club in downtown Croydon and the company producing the MOR music series called 'Unforgettable' there for Channel 4—used to play in a big band many moons ago.

A lot of water has passed under the bridge since the heady 4-track days of 1969, including hits like *Gonna Make You An Offer* by Jimmy Helms, *Sky High* and *Who Do You Think You Are* by Jigsaw, and several numbers from Harry Secombe, Vince Hill, Tony Hatch, and even the Glitter Band. In fact, if you ever find yourself wondering what happens to all those names of former glory, then it seems that a lot of them go to Majestic Studios. Since the Unforgettable series got started last year, Majestic has been busy recording miming tracks with such names as Del Shannon, Billy Fury, Martha Reeve and the Vandellas, Georgie Fame and Helen Shapiro. Not to mention the Ivy League.

"We used to record a lot of big sessions with separate string, brass and wind sections," says studio manager Richard Austen. "We still record a 30-piece band each week with Hadmore Productions," he adds. Hadmore is the company owned by David Hadfield and Mike Morton which video-tapes Unforgettable in Croydon. "But now over half our work is recorded entirely in the control room."

Four years ago the studio suffered a fire, and has since re-equipped with a Trident *TSM* 32/34-track desk and a Lyrec 24-track recorder. "We are one of the few studios to offer the choice of Dolby or dbx noise reduction," says Richard, adding that some customers definitely prefer dbx. "In fact Ramport—the Who's converted-church studio in neighbouring Battersea—is the only other one I can think of with both systems. We started off with dbx originally but had to add Dolby for compatibility with other studios."

The monitoring system comprises a pair of JBL *4350*s driven by 750 W BGW amps—plus a pair of Auratones of course. Surprisingly there is no graphic EQ on the system. "We're really pleased with our acoustics—a lot of people have commented on the feel of the control room," claims Richard. The control room oversees the long studio from what would have been the projector level through the usual double glass. "Similarly the studio's format is such that we can easily physically separate or partition instruments," adds Richard.

Mastering is on two Studer *B67* ¼ in machines, one with varispeed. These don't use any noise reduction, which Richard seems happy with, although he would prefer 30 in/s versions. Processing equipment includes the aforementioned Eventide *Harmonizer*, a Marshall *Time Modulator*, a couple of *Scamp* noise gates, some de-sibilance devices, and four dbx limiter/compressors. "I want to get an AMS digital delay line soon," says Richard, "although we can use the *Harmonizer* for certain delay effects.

"We do a lot of work with the Linn drum synthesiser, which can be used to trigger Simmons and keyboards. We've also developed an umbilical cord for the Linn so that it can be quickly straight plugged into the desk without the usual number of individual connections."

The two wedge-shaped overdub rooms are separated by a plate room containing two EMT *140*s. Both are fairly dead with carpet and curtains rather than parquet and mirrors. "But if we want a really 'live' sound we can always use the fire escape."

In fact the fire escape is not as makeshift as it sounds. It's the concrete stairway leading down to the ground level that you'll find in any cinema, even ex-cinemas. Take away the hordes of picture-goers clumping towards the nearest pub for a final drink, and you've got yourself a remarkably effective natural reverb system. Even when, as in this case, the lower reaches double as a wood store!

"We sometimes put electric guitar or sax in this area," says Richard, "or use it to send and receive signals from the desk." And lo, the tell-tale signs of a reclining Fender and a vaguely permanent-looking amp stack. Happily, the stairs begin just outside the control room. All nice and handy.

Majestic has retained a rather pleasant feeling of recording in a cinema—the sort of fantasy you might find yourself in the back row of the local Odeon, but with radically improved acoustics.

"It's surprising what we can handle," says Richard. "The studio was built for large-scale acoustic numbers and multi-piece big band sound, and we still do a lot of MOR. But we recently recorded a world champion hula-hoop single for Tokyo Charm, and we've found we can adapt to modern electronic work. We're actually quite close to the centre with a tube stop (Clapham Common) and food and drink close to hand, but without any West End parking charges. Also the rate is only £30 an hour." **Richard Dean**
Majestic Recording Studios, 146 Clapham High Street, London SW4.
Tel: 01-622 1966/1228. ■

Control room, Jam

Main Studio, Jam

Ralph Denyer

Jam, London

Jam Studios in North London's Tollington Park was opened towards the end of 1979 by the Swedish brothers Hans and Anders Nordmark. They were brought to England by their father, classical pianist and scientist Jan Nordmark when he settled there in 1976. Hans and Anders both play keyboards and originally looked for premises that would be suitable for them to set up a small private studio. Finding the right place was proving a bit of a problem when the fact that Decca were selling their Tollington Road studio came to the brothers' attention. The building was quite large and the Nordmarks decided to use it to open a commercial studio which could also serve their personal needs. John Etchells is the resident studio engineer and freelancers Peter Williams and Colin Fairley are often in support. Mark Boyne is the tape-op.

John became involved with the Nordmarks during 1979, having previously been engineering at Super Bear Studios in France as well as freelancing in England. John's background in studio engineering goes back to the 1960s when he worked for the Beeb. He recalls with some relish recording almost live with very little in the way of overdubs: "I started out at the BBC for 10 years during the '60s and '70s. You had 12 channels and two with EQ," he smiles, remembering. "We used to do four songs in three hours with Led Zeppelin. We could only do two overdubs before the quality was too bad."

John still enjoys the opportunity to record bands using the live approach on occasions. "In fact we did Dire Straits *Twisting By The Pool* here which was almost going back to that approach. They had spent over a year doing their *Love Over Gold* album in the States. They

just wanted to play a bit of rock'n'roll and have some fun. I think we did about two overdubs, just vocals and guitar. So it was put down live with everybody together, finished by eight in the evening and everyone down to the pub."

John's appreciation of the advantages of having variable acoustics was to prove to be an important factor in the character of the studio. When he became involved during 1979, the studio was already being refurbished by the Nordmarks. It had been built for Decca with a very large main room with a floor area of around 1,200 ft² and a ceiling height of 20 ft. Much of the equipment was already on order and the Nordmarks had commissioned Eddie Veale to redesign the control room. A false ceiling was planned in the main room but John suggested he check out the acoustics before anything was installed. He recalls "It was just about that period when people were beginning to go for liver sounds. I told them to hang on. We got a couple of people in with a drum kit, Revox and a couple of mics and stuck them up to see what it sounded like without any extra treatment. It was an amazing sound." The decision was taken to leave the room as it was and to spend the extra money at a later date if necessary. So it remains.

Two early users of Jam were to provide two excellent and extreme examples of how the natural acoustics could be controlled to produce entirely different sounds.

John relates "One of the first things to come out of the studio, which I didn't work on, was Stray Cats' *Runaway Boys* which had a ridiculously ambient sound. That sort of started it off."

Then in contrast, Richard Burgess of Landscape worked fairly extensively producing Spandau Ballet at Jam. *To Cut A Long Story Short* was a hit with its tight disco recorded type of sound, totally different from the Stray Cats' single. Within a very short space of time Jam had established a reputation as one of the more versatile London studios.

Relative to the studio, the control room is small, with a floor area of around 260 ft² and a ceiling height of 8 ft. The JBL *4350* monitors fit in recesses in the angled walls. The console is somewhat unusually positioned sideways on to the window giving visual access to the main studio, in order to make best use of the floor area. The console is also on a raised level in order to give greater visual contact with the studio.

A glass door situated between the monitors connects the control with the isolation booth which in turn connects with the main studio.

One of the main problems with recording at a London studio, especially for a name band, can be a seemingly constant flow of interruptions and distractions. The layout of the Jam building alleviates this problem considerably. The front entrance leads directly into the reception area. The kitchen, dining area, TV, video and games area, pool table and garden area are all accessible without entering either the studio or control room. A long purpose-built leafy conservatory come passageway allows access to the control room without entering the studio. Various quiet corners, nooks and crannies provide places where studio users can relax and get away from the studio—and maybe each other—during heated moments or perhaps to deal with visitors without halting work. People find that Jam feels more like a country studio. There is also a side entrance which allows equipment to be easily unloaded through large double doors.

The Harrison *MR3* 36-input/24-output console was chosen for its general high quality, compactness, clean sound, and the fact that it is transformerless. It has Melkuist automation which John finds both convenient and time saving. The rest of the equipment is of the general high standard to be expected from a major 24-track studio. The tape machines are Studer *A800* multi-track, a Studer *A80 RC* ¼ in mastering machine and Studer *B67* with both ¼ and ½ in heads. There are 24 channels of Dolby in a *TTM* rack. Effects include a comprehensive ADR *Scamp* rack with *Vocal Stresser,* an effects module, ADT/phaser, mic, preamp, two comp/limiters and four noise gates. Other sound processing equipment includes two Lindsay graphic equalisers, Lexicon *224* digital reverb unit with all available programs, Lexicon *Prime Time,* EMT *140 Echoplate,* Eventide *H949 Harmonizer,* Orban de-esser, two dbx comp/limiters, two UREI comp/limiters, AMS digital delay and two Drawmer noise gates.

The main control room JBL *4350* monitors are bi-amped with BGW. Auratones appear in the control room while Tannoy Reds are used mainly in the studio.

The piano, a Malmsjo (Sweden) 7 ft 6 in Grand was brought to the UK by the Nordmarks. The range of microphones includes Neumann, AKG, Sennheiser and Shure models, while the acoustic screens are by Audio Kinetics. Hiring of additional equipment can be easily arranged at short notice. Various instruments and amplifiers live in the studio but the studio recommends that clients check with them what is available at any given time. **Ralph Denyer**

Jam Recording Ltd, 106 Tollington Park, London N4 3RB, UK. Tel: 01-272 7545. ■

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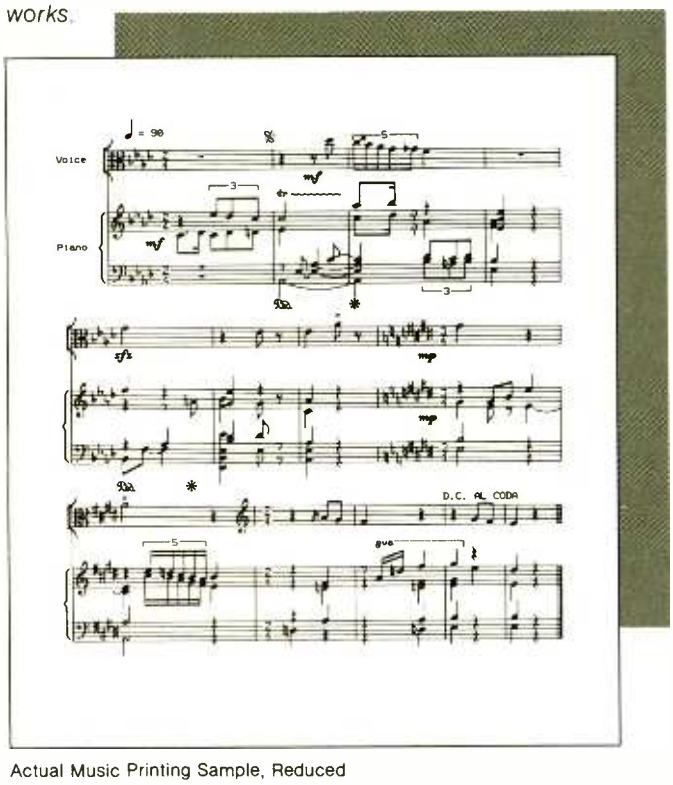

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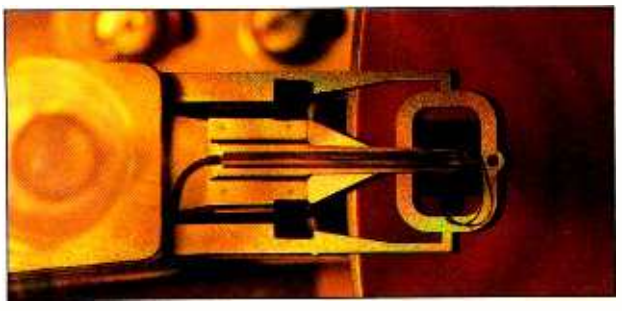

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Synclavier II Instruction Manual
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Inside the

To those of us who make a living playing or recording music, the advent of the new computer-controlled synthesisers is both exciting and frightening. Exciting because the new machines open up entirely new areas of sound generation and control, give us access to powerful new compositional and arranging tools, and promise to make our lives easier by eliminating so many of the tedious tasks always associated with making music and putting it down on tape. Frightening because the technology will soon be so prevalent that those who are not comfortable with it, or lack the skills to take advantage of it, may well find themselves out of work.

Among the most interesting and versatile of the new machines is the Synclavier (formally known as the *Synclavier II*—the company's first model was discontinued in 1979). The Synclavier (pronounced, for the record, 'SYN-kla-*veer*') is at once a synthesiser, a recorder, a transcriber, and a tool for sophisticated computer-controlled composition using either real-time inputs or off-line programming.

The *Synclavier* developed out of a research grant to a group of musicians and computer scientists working at Dartmouth College, in Hanover, New Hampshire. The team's first project was to design a digital synthesiser module, several of which could be hooked into Dartmouth College's Data General *Nova* time-sharing system, so that up to 16 students could use the computer simultaneously for individual composition projects. The grant stipulated that if the project was successful, the results should be taken out of the academic sector—ie somebody should make a few bucks out of 'em.

Successful it was, and in 1976 New England Digital was formed and set up shop just across the Connecticut River in Norwich, Vermont. Two years ago, the company moved downstream into bigger headquarters at White River Junction. Today, the company manufactures, assembles and tests the *Synclavier* in a converted plumbing-supply house, employing some 35 full-time staff.

Although it's not always readily visible ("In 1980 it was hard to sell musicians on the concept of a computer," says software development director Jeff Risberg), at the heart of the machine is a proprietary 16-bit 64K rack-mountable minicomputer, designed expressly for real-time control and manipulation. According to company president Sydney Alonso, the computer used in today's machines is essentially the same as the Dartmouth team's first model—although the software has developed quite a bit. (The computer has other uses as well: about 30% of New England Digital's sales are non-musical, mostly in the fields of laboratory data gathering, manufacturing automation and communications networks.)

In the basic *Synclavier*, the computer is controlled by a 5-octave piano-type keyboard, above which is a panel containing 128 lighted buttons, a single control knob, and a 4-digit LED readout. Storage is handled by a double-density 5¼ in disk drive. Optional disk configurations include 8 in floppies and 5¼ in and 8 in Winchester hard disks and the computer itself is expandable, in increments of 32K. All of the components (except the larger disk drives) can be packed into custom-designed ATS hardshell travel cases.

Making waves

Inside the computer are the oscillators—digital-to-analogue converters which are also a proprietary design. Each synthesiser 'voice' starts with a pair of oscillators. The voices are available in hardware packages of eight pairs—as many as 128 voices can be installed, although the usual configuration is either 16 or 32 voices.

The oscillator pairs use a combination of additive and FM synthesis. One oscillator is the 'carrier'. It sets up a sine wave, over which 24 harmonics can be generated and balanced. The individual harmonics are called up—singly or in

Paul D Lehrman

Synclavier

groups—from a section of the panel buttons, and are adjusted with the control knob. As each is adjusted, its relative level shows up on the readout. The completed carrier wave is then given an envelope (called, not surprisingly, the 'volume envelope') with six parameters: delay, attack rate, peak level, initial decay rate, sustain level, and final decay rate; all of which, again, are controlled with the knob and read on the display.

In fact, on the basic *Synclavier*, the control knob and the LED readout are the only way of adjusting and examining the many synthesiser parameters—the last button pushed dictates which parameter is being addressed. (Pitch, of course, is determined by the keyboard.) Four single LEDs next to the readout indicate whether the units for the parameter chosen are Hz, ms, dB, or are on an arbitrary scale.

The second oscillator in the pair is an FM modulator. It, too, starts as a sine wave (and stays that way), whose frequency is determined by a setting called 'ratio'. A 1,000 Hz carrier modulated with a sine whose ratio is 0.1, for example, will produce sidebands to the carrier that are 100 Hz apart. (The modulator can also be set to a constant frequency between 0.1 and 999 Hz, independent of the carrier frequency.) This creates non-harmonic tones, which have the potential to be much more interesting than the harmonic ones created by the additive synthesis process.

The modulator wave is then given its own six-parameter envelope: the 'harmonic envelope'. The higher the modulator wave's amplitude, the more sidebands are created (and the greater their level) which makes for a 'denser' sound.

While the volume envelope controls the overall shape of the sound, the harmonic envelope independently controls its density, so that a sound can change from dense to simple, or *vice versa*, and maybe back again, as it plays. (A recent software update allows the amount of FM to be varied across the keyboard, so that lower notes can be made to sound more brilliant, with more sidebands, while higher notes are less 'grainy'.)

Adding effects

The composite waveform can then be assigned vibrato, which is another form of frequency modulation but uses only low frequencies. One of five simple waveforms can be used for vibrato (which can be applied to both carrier and modulator or to the carrier alone) and rate (up to 50 Hz), depth (up to two octaves) and attack time (up to 10 s) can be specified. The vibrato wave can be inverted, biased (so that it only acts to above the played pitch) or quantised, so that instead of altering the pitch smoothly, it jumps in discrete (usually semitone) intervals. 'Tremolo', or amplitude modulation, can also be added, completely independently of the pitch vibrato.

The synthesised wave can also be given portamento (glissando) which can be set to sweep from one end of the keyboard over an interval of as long as 60 s, with either linear or logarithmic motion. The volume envelope can be told to automatically repeat, at a rate of up to 100 Hz, or to attack separately (arpeggiate) each note of a held chord in sequence.

The scale of the keyboard can be adjusted so that each half-step can sound anything between $\frac{1}{8}$, of a semitone(!) and a minor third, and each note within an octave can be tuned separately, allowing just, Pythagorean, mean-tone, or non-Western intonations. In addition, a custom Morley foot pedal can be plugged in to control certain 'real-time effects': overall volume of the synthesiser output, vibrato depth, portamento rate, attack time, decay time and/or peak and sustain level of either or both the volume and harmonic envelopes.

Designing instruments

All of these parameters—carrier and modulator waves, envelopes, vibrato, portamento, tuning and effects—define what New England Digital calls a 'partial timbre'. (The choice of nomenclature is admittedly unfortunate but it persists, according to Jeff Risberg because it exists in some of the system's patent documents.) Up to four partial timbres, each with its own distinct set of parameters and each tunable over the full audio range in intervals of 0.1 Hz, can be combined to create an instrument. Individual partial timbres can be 'chorused'. By duplicating the settings into another pair of oscillators and detuning them—either slightly, for phasing effects, or grossly, for automatic harmonisation—and then the entire instrument can be 'double-chorused'. Parameter settings for one partial timbre can be 'bounced' to another and then altered slightly, which allows the rapid creation of incredibly rich, fluid sounds.

The keyboard can be split into segments as small as one note, each calling up different combinations of partial timbres and the volume of each partial timbre can be set to taper off at the upper and lower edges of the keyboard segment. Each partial timbre can have its own set of split points. This allows authentic reconstructions of instruments, like piano, harp, or strings, whose timbre does not remain consistent throughout their range.

At present, the *Synclavier* keyboard is a simple switching type but a pressure- and velocity-sensitive version should be available soon. Two prototypes are on the workbench at New England Digital: one is a simple weighted lever, while the other uses a fairly sophisticated acoustic-piano-type escapement.

A new option allows sophisticated control of the sounds within a stereo field. Individual partial timbres can be placed at any of 100 left-right locations. Twenty different stereo modes are available, including static, keyboard- or control knob-based panning and automatic panning with selectable waveform and rate.

The stereo option is a good example of how New England Digital can add new features to the

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Inside the Synclavier

Synclavier without changing the basic control hardware. The panel buttons marked 'vibrato' have three modes: off, on, and 'blinking'. The first two are self-explanatory but in the blinking mode, these buttons control the stereo effects without affecting the vibrato settings. Potentially, all 128 buttons on the panel could have multiple functions. One planned update, which will no doubt be controlled somehow from the panel, will be individual audio outputs for each partial timbre.

Another effect that can be used in real-time performance is pitch bend, which can be defined either with the main control knob or with a ribbon controller. Other foot-pedal jacks allow access to sustain, hold and on/off switching of the portamento, repeat, and arpeggiate functions.

The instruments are stored on disk in groups of eight. Eight 'timbre banks' fit on a 5¼ in floppy. Access to an instrument within a bank is instantaneous—switching banks takes a few seconds for the disk to load it in.

Recording

The amount of control over synthesised sounds in the *Synclavier* is impressive but it is only a small part of the story. Another important feature is the machine's built-in 16-track 'memory recorder'. Each track can play only one instrument but multiple keyboard lines can be overdubbed on a single track without erasing. While notes are being recorded, they can be rhythmically 'justified'—the timing of the beginning of a keystroke can be automatically corrected to sound right on the money of a user-determined rhythmic pulse.

The recorder includes the usual functions associated with multitrack tape recorders, like start, stop, record, play, erase, solo and punch-in and punch-out (operable from the control panel or foot switch) and a few not available with analogue tape: rewind and fast forward do not change the pitch of sound, just the speed, although the two controls can be shuttled, with automatic slow-down and speed-up, just like on a tape machine. There is a loop function with independent start and stop points for each track. Pitch or speed of an individual track can be altered, each without affecting the other, or any other track. Notes recorded on one track can be bounced to another (containing a different instrument) erasing the original track or not, allowing automatic orchestral doubling; their start time can be altered in the process. Timbres of already-recorded tracks can be changed without altering the notes.

A digital metronome (click generator), which is independent of the speed control and can read out in Hz, frames, or milliseconds, is included. Information from the pedal is recorded separately (either in real time or after the track has been recorded) so that track-by-track dynamic mixes can be accomplished. Depending on the size of the computer memory, up to about 8,000 notes can be stored. Up to six compositions (of 8,000 notes each) can be recalled instantly from the *Synclavier* control panel, and individual tracks recorded in one sequence can be loaded into another.

Studio interfacing

Because the number of voices available in the system is limited (128 voices *is* a lot but putting all that hardware into the machine raises the price to well over $100,000) and because 16 oscillator pairs can be eaten up by a single note (if it uses four partial timbres with chorusing and double-chorusing) it makes sense to be able to dump the *Synclavier*'s output to multitrack. This is provided by an external synchronisation system that generates a 50 Hz pseudo square wave, which can be recorded on a tape track and which the *Synclavier*'s recorder can recognise and lock up to on subsequent passes. The sync system can also lock two *Synclavier*s together and can read external pulses generated by timing generators, drum machines, or other synthesisers.

Terminal Support Option

The combination of the digital metronome and the sync function makes the *Synclavier* particularly useful for film and video composers because the metronome can be controlled by the software, it can be set to count frames at any rate, for any format, real or imagined. Speed and timing of individual tracks and complete compositions can be controlled with a very high degree of precision, so music can easily be made to fit the most unwieldly of film edits. There is no full SMPTE interface available as yet but the company is working on it.

In addition, there are several other ways to link up the *Synclavier* with external equipment. Keyboard trigger, gate, and voltage signals appear at separate output jacks, where they can be patched to control other synthesisers or processors. In addition, programmable control voltages that track key motion and are settable from the front panel can be output to external high pass, low pass, or bandwidth filters.

Getting into the computer

Up till this point, we've been talking primarily about your basic *Synclavier II*, costing between about $14,000 and $30,000, depending on the number of onboard oscillators. But there is a wide range of options to the system and new ones are being developed all the time. These options use the identical computer as the basic *Synclavier* (although some of them require extra memory and/or storage) but provide more sophisticated ways of controlling it.

For about ten grand you can get the 'Terminal Support Option' (TSO), the first major add-on that New England Digital developed. About half of the 500-odd *Synclavier II*s sold to date, have left the shop equipped with this option.

The TSO consists of an ASCII keyboard attached to a video display terminal and the appropriate software. It increases the flexibility and speed of the system dramatically. (It also increases the size of the exceptionally well-written manual—from a manageable 140 pages to, when all the software documentation is included, well over 600 pages. Luckily, it all comes in a loose-leaf binder.)

One feature of the TSO is the Timbre Display System. This augments the *Synclavier*'s readout functions by simultaneously displaying multiple parameters. A menu of alphanumeric and graphic formats can show various combinations of envelope, spectral and effects parameters for one or all of the partial timbres in an instrument. Displays are automatically updated when any parameter is changed and new and old settings can be displayed simultaneously. Data can also be output to a printer.

Another very useful section of the software is a composing and editing language called 'Script'. With this program, both note files and timbre control settings can be entered from the computer keyboard. A sequence can be entered, note by note and track by track, in a form that specifies pitch, timing, volume, timbre and articulation for each note, and it can then be edited much like text in a word processor.

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Inside the Synclavier

Groups of notes (called 'motifs'—I suppose if the system used a lightpen, you could call them 'lightmotifs'...sorry) can be transposed, inverted and reversed. Loops can be defined, just as on the keyboard control panel and various global functions can be performed on a finished composition, such as tempo, key, volume and articulation.

Perhaps most important: sequences entered into the *Synclavier*'s memory recorder in real time from the piano keyboard can be converted into Script files, so they can be edited off-line—mistakes can be corrected, individual tracks can be 'slipped', and many other useful functions can be performed.

Yet another section of the TSO is 'MAX', a musical programming language based on a subset of XPL, that gives the user direct control of the *Synclavier*'s computer. It is a powerful tool for the serious computer composer who is not necessarily interested in limiting his input control to the piano keyboard and foot pedals—it can perform complex mathematical functions on notes, loops and other functions, and can design infinitely complex envelopes. The range of MAX's functions is a little beyond the scope of this article but suffice it to say it allows the ambitious user to customise quite completely the *Synclavier*'s operation to suit his needs and also allows New England Digital to continuously develop alternative operating systems for the *Synclavier*.

Guitar interface

Another way for musicians other than keyboard players to take advantage of the wonders of digital synthesis is New England Digital's recently-released guitar interface for the *Synclavier*. The interface (which was extremely well demonstrated by Pat Metheney at the last New York AES) works with a Roland *GR* guitar, and costs about $4,500, plus the price of the guitar. It uses the guitar's built-in 'hexaphonic' pickup and preamps to generate six channels of pitch and amplitude information, which are then processed by the interface circuitry at a rate of better than 200 samples/second. Unlike many other guitar synths, the signals from the *Synclavier* guitar interface do not emerge as voltages—rather they are converted into digital codes, which are fed directly to the computer. This method is designed to eliminate drifting and improve pitch-tracking accuracy on transients.

The option comes with a 16-button control panel which attaches to the guitar body. Not surprisingly, the buttons serve multiple purposes: they choose instruments and timbre banks, they select tracks for the memory recorder and control its 'transport' functions and they switch among several control schemes for reading the guitar data having to do with whether, and how, the pitches being read will be quantised. Notes entered on the guitar are treated by the system exactly the same as notes entered on the keyboard and can be used in all of the other *Synclavier* functions, including Script files. A control on the guitar allows real time mixing of straight guitar and synthesised sounds.

Transcribing

Just as drummers have become some of the best customers for drum machines, music copyists are beginning to look into *Synclaviers* as a way of protecting their careers—in particular, due to the Music Printing Option (about $3,000 including a Prism dot-matrix printer, plus the cost of the Terminal Support Option). The printing program uses Script files for input, and the click generator for timing. Under direct control of the composer are such features as time signatures, key signatures, transposition (for non-concert-pitch instruments), choice of any of four clefs, note resolution, whether accidentals are to be treated as sharps or flats, and which tracks in a note file are to printed out. All of these parameters can be changed in mid-piece. (For now, all tracks must share the same note resolution and time signature but a planned software update will allow those parameters to be assigned independently.)

A lot of sophisticated printing routines are available. For instance, ties between notes are optional: in the 'classical' format, off-beat sustained notes are tied, while in the 'jazz' format they are treated as single notes. Triplets, quintuplets and any other odd tempo divisions can be printed accurately. Markings like dynamics, tempo, articulation, titles, instrument names, vocal texts, and page and measure numbers can be added. Vertical and horizontal spacing can be adjusted. Separately-recorded

The author ponders...

tracks can be combined on one staff (with stem directions indicating two different voices, if desired) or printed out in orchestral-score form. The only limitation to the size of the score is the size of the printer paper—but it is not difficult to print scores in sections and then paste them together. Except for a few microscopic jaggies, the output of the dot-matrix printer is just about as good as that produced by a linotype or plotter—and it's much faster.

Playing with real sounds

The *Synclavier* feature that holds the most promise (and for some the biggest threat) is the Sample-to-Disk option—about $10,000 or so on top of the TSO. The system samples with 16-bit words in a PCM format at a rate of up to 50 kHz. Depending on the amount of disk storage available and the sampling rate used, it can theoretically store up to 54 minutes of sound.

A sound to be sampled is entered from a microphone or other analogue source and converted through a D/A into a computer file. The file is displayed on the screen—first in its entirety, so its overall envelope can be viewed and then (in larger form) in smaller time increments, with resolution as high as one sample, to give a close-up view of the individual waveforms recorded. Different segments of the file, of whatever length is desired, can be called up for display, and the vertical (amplitude) scale can be adjusted.

Once the file is in memory, it can be called up on the *Synclavier* keyboard, which will play it at different pitches by changing the playback sampling rate. (If a playback rate higher than 50 kHz is called for, nothing will happen—so you can't play a sound recorded at the highest sampling rate at a higher pitch. To overcome this, the system allows files to be automatically resampled at different rates.) New attack and decay parameters can be impressed on the sound, vibrato can be added and individual segments of files can be extracted, looped or spliced together with exquisite precision so a sound can begin say, as a trumpet, and end up as a human voice.

Again depending on sampling rates and storage space, up to eight files can co-exist in the memory. Many of the keyboard effects can be used on sampled sounds, including split and pitch blend and some of them can be under foot-pedal control.

In addition, there are a wide variety of analysis and filtering functions included in the software. Fast Fourier Transforms can be performed, with resolution of up to 8,192 points. Analysis can take the form of spectral density, or of relative amplitudes of the waveform's component harmonics. All these displays are two-dimensional graphics but a pseudo-3D display mode is available that shows the change of spectral parameters over time. Images on the screen can be saved as hard copy, using a printer interface that matches the screen graphics pixel for pixel.

Filtering in the system is performed at the digital level, which gives a high degree of precision and good phase-linearity but has the drawback of being rather slow—computations of a filtered waveform taking several minutes are not uncommon. The range of filters available is almost unlimited—bandpass, bandstop, high-pass and lowpass, combs, impulse-trains and various kinds of time- and phase-dependent functions. (According to Jeff Risberg, samples recorded at the factory are subjected to a 14 kHz deep-notch filter, to overcome the whine of the air-conditioning system.) The filters can also be designed to model the impulse response of an acoustic space, so that they can add (or remove) room effects to a sound.

For now, the Sample-to-Disk option is homophonic—although several sounds can be accessed from the keyboard, only one at a time can actually sound. Using the various *Synclavier* functions, it is possible to lay down sampled sounds polyphonically, with the assistance of a multitrack tape recorder: synthetic patches that resemble the real sounds (especially in terms of their envelope) can be set up and played into the *Synclavier*'s memory recorder and then each track of the recorder played back individually, using a sampled file for its timbre and dumped (using the sync function) on tape.

As it stands, the Sample-to-Disk option is a fairly sophisticated version of an *Emulator*, although it does have far greater modification capability and control. (Reportedly, a famous American singer who is not known for accurate tracks recorded vocals into a *Synclavier*, so that the record producer could correct them for pitch and timing before dumping them onto the master tape.) But New England Digital hopes this spring to bring out the first of a series of polyphonic sampling options that will do much more.

The first version will support four simultaneous voices, while subsequent updates will be 'N-voice'. Plans are to have the new software to be able to automatically analyse sampled sounds and resynthesise them, which will allow most of the *Synclaviers* control functions—now usable only with internally synthesised sounds—to be applied to real sounds. In addition, sampled sounds and synthesised sounds will be able to be played simultaneously.

At that point (and with the addition of a mammoth amount of storage, which will no doubt cost a bundle), the *Synclavier* will take the next evolutionary step beyond synthesisers and emulation machines. It will become a true digital recorder and more—it will in effect be a complete studio in one package, lacking only microphones and speakers. Wait for it. ■

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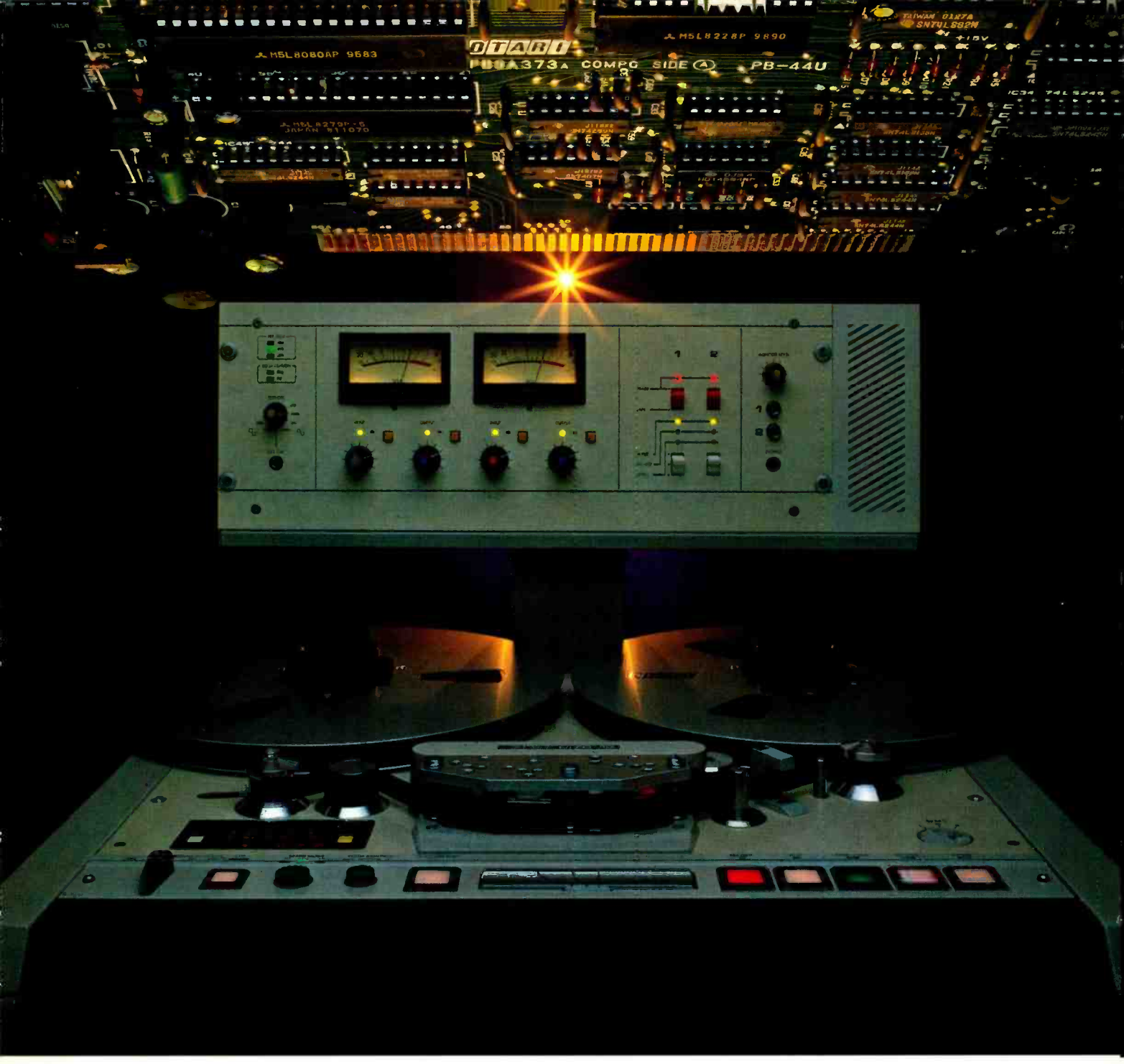

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Dave Malham of the University of York has been experimenting with a digitally-controlled unit designed to manipulate the B-format signals generated from, for example, a *Soundfield* microphone. Apart from obvious Ambisonic uses, the system has applications in stereo and gives an insight into cost-effective digital control of analogue audio.

Digitally programmable Soundfield controller

I've been interested in Ambisonics since the start, or at least since the first articles in *Studio Sound*. A lecture by Peter Fellgett at the University and early experiments with an Integrex decoder and the circuits from Michael Gerzon's 1975 *Studio Sound* articles convinced us that Ambisonic techniques could be used for electro-acoustic music. As soon as we could afford it we purchased a *Soundfield* microphone, although economics forced us to build the control box ourselves rather than buy Calrec's. This included my own design of digital attenuator for better gain tracking over a wider range than the original passive 'B' gain control and also a built-in UHJ encoder. It did not, however, include any of the mic movement controls of the original unit.

It became obvious that for the type of work done in our studio, some means of rapidly varying the sound field parameters—azimuth, elevation, dominance, etc—was essential. I started thinking about building a digitally programmed sound field controller. This would be a box into one end of which went the four components of the B-format signal X, W, Y and Z. Out of the other end would come a new set of B-format signals X', W', Y' and Z' each consisting of a blend of all the input components with independently controllable polarities and gains. I knew other people were considering pulse width modulation techniques for this application but the thought of all those clock pulses running around in audio circuits gave me the heebie geebies and as it seemed unlikely that VCAs would consistently track to sufficient accuracy the choice of gain control element settled very firmly on multiplying DACs.

In late 1981 the studio got a grant from the NRDC's seedcorn fund and I started design work on what was then called an 'Ambisonic Cross Blender'(!). Cost considerations limited the DACs to 14-bit types with a switched polarity (sign bit) amplifier. Geoff Barton of the Ambisonic Technology Group suggested that this resolution was not going to be adequate but I went ahead anyway and fortunately, in practice, it has proved to be something of an overkill.

The design that evolved consisted of four input cards with active balanced input circuitry (**Fig 1**). Four Hybrid Systems' HS3140 14-bit multiplying DACs and their associated sign bit switches are included on each card to control the amount and polarity of each B-format input signal that is fed to the outputs. The output mixing card (**Fig 2**) has track-hold switches on each of the four channels to remove any glitches that may occur when the values are changed. As the control values essentially form a 4×4 matrix changing the input/output relationship requires 16 15-bit words to be updated. This data is sent over the internal data bus from the interface card at a 10 MHz rate causing an update glitch of length 1.6 s with an extra 2 s for the DAC settling time.

The interface card consists of a high speed bipolar memory and some TTL control logic (**Fig 3**). Data is preloaded into this memory from an external controlling micro at a relatively slow rate then when an update is required it is dumped into the input card registers. The interface is entirely general and can be easily configured for any 8- or 16-bit computer. At the moment we are driving it from a Z80 based Tuscan machine using software written in Pascal. This does present a problem in that Pascal rather slows up the calculation sections but rewriting the slow bits of the program to use machine code and look-up tables will solve that.

With the current program we can rotate complete sound fields in the horizontal plane while changing the step size and the effective resolution of the DACs. This is being used to investigate just how much it is possible to get away with in reducing the resolution before it all falls apart. This is important commercially since 16 14-bit DACs tend to make a big dent in your wallet.

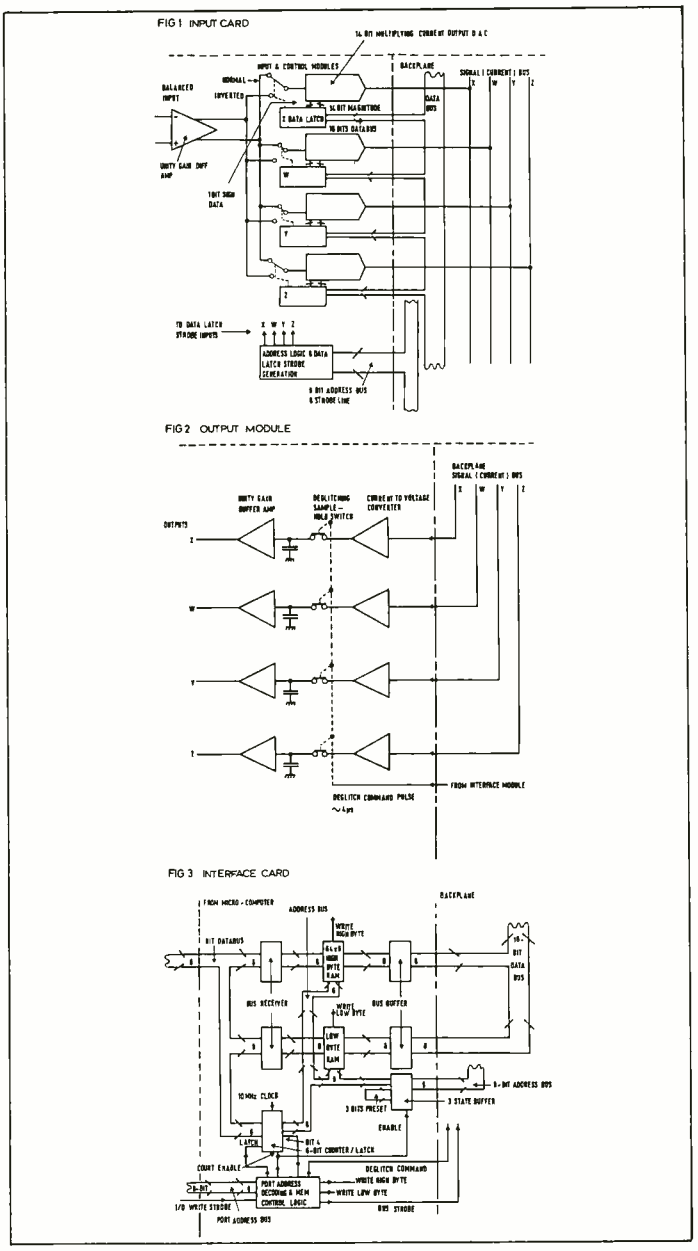
The box could be programmed to do all the things the *Soundfield* mic box can do, plus a lot of other things besides. (Will somebody invent a 48 hour day so I can get it all done please?) For instance, feed it with a B-format signal and you could generate four independent microphone outputs with individually specified polar diagrams and directions, all under real time control. Or you could produce a B-format output with steerable dominance—not just selected between front-back or up-down.

On the other hand, if you feed in four independent signals you could use the unit as four independent full-sphere - with - interior - effects Ambisonic panpots having overall azimuth / elevation / dominance control on the output B-format signal.

In fact, with suitable programming all the Ambisonic effects not having any sort of frequency dependence could be produced and controlled in a highly effective manner.

I am currently trying out a multiplexed system, using only four DACs, in a system commissioned by the electro-acoustic music group, Electric Phoenix. This will have a built-in 16-bit microprocessor which will translate commands sent from a controller into the coefficients that are fed to the DACs. The load on the controller will be reduced since it will only have to send data giving information on what type of modification is to be done to the signal, the starting and finishing points and rate of change. Given this, the on board micro will handle the rest. Thus the speed of the controller, which could almost be any sort of personal computer, will have much less effect on the speed of operation than is presently the case. In fact, it should be easy to get things whizzing and tumbling about fast enough to make even an astronaut dizzy.

Apart from this, any other application for this device seems to be sunk in the general malaise suffered by the whole Ambisonic system and we can only hope that this will change if, by some miracle, we do ever get the long promised economic recovery. ■ **Dave Malham**



Matchamp XTX129 microphone preamplifier

Hugh Ford

MANUFACTURER'S SPECIFICATION
Supply voltage range: ±15 V to ±18 V.
Maximum gain: 60 dB.
Maximum input level: + 16 dBV (.7 V).
Maximum output level: + 21 dBV (.7 V).
Minimum output load: 2 kΩ.

Performance at 60 dB gain and ±18 V supply
Relative input noise: with 200 Ω source, 20 Hz to 20 kHz RMS, – 129.3 dBV (.7 V), typical (– 129 dBV (.7 V) minimum); IEC A-weighted – 131.3 dB typical (– 131 dB minimum).
Common mode rejection ratio: at 1 kHz 110 dB typical (102 dB minimum); at 10 kHz 100 dB typical (92 dB minimum).
Distortion at 0 dB output: < 0.006%.
Manufacturer: Broadcast Designs Ltd, 21 Victoria Drive, Great Wakering, Essex, UK.

The *Matchamp XTX129* is an extremely low noise microphone amplifier embodied in a small encapsulated block measuring 30 × 20 and 15 mm high. At the bottom of this block are 10 terminations on a 0.1 in standard spacing.

Very sensibly the input and the gain control connections are at one end of the encapsulation with the other connections well separated at the other end. The number of external components depends upon the desired configuration with the basic circuitry being shown in **Fig 1**, where the supply rails can be between ±15 V and ±18 V.

The combination of R3 and C2 controls the high frequency roll off with the recommended combinations being 150 Ω in series with 1 nF or 2.2 nF.

The gain is controlled by the combination of C1 in series with R1 and R2 with the gain increasing as the value of R1 + R2 decreases. Thus the maximum gain is controlled by R2 and the minimum gain by R1 + R2. The operational gain is 10,000 divided by the total resistance with the recommended value of 9.1 Ω for R2 giving 60 dB gain allowing for the end resistance at R1 of 0.9 Ω. Similarly the recommended 4.7 kΩ for R1 gives a minimum gain of 6.5 dB.

The recommended value for C1 is 2,200 μF rated at 3 V, with the capacitance affecting the low frequency gain particularly at the maximum gain setting where with the stated component values the – 3 dB point is at 7 Hz.

This basic circuit does not provide any input protection or DC isolation at the input or output. Placing the circuit in **Fig 2** at the input provides input protection, with the tolerance of the 3.3 Ω resistors affecting the common mode rejection. Here the use of 1% resistors is recommended.

Phantom powering may be added using the circuit in **Fig 3**. Here R1 and R2 have the

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FIG.1
MATCHAMP XTX 129
BASIC CIRCUITRY

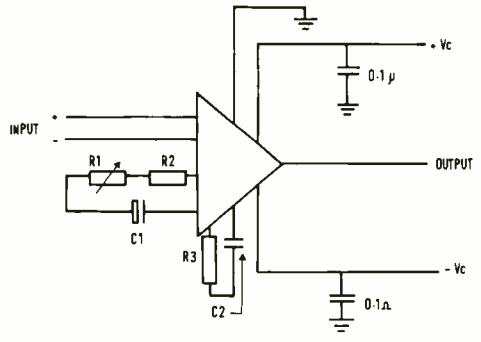


FIG.2
MATCHAMP XTX 129
INPUT PROTECTION CIRCUITRY

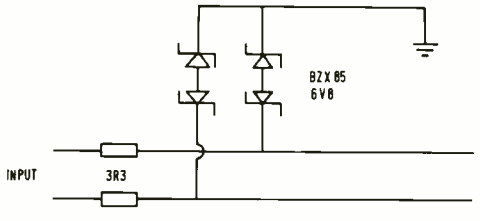


FIG.3
MATCHAMP XTX 129
PHANTOM POWERING CIRCUITRY

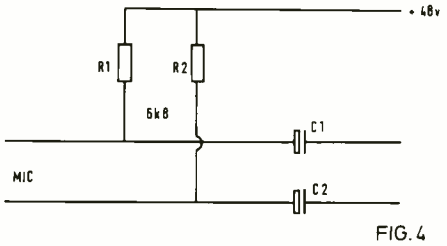
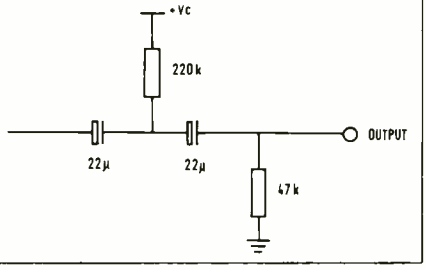


FIG.4
MATCHAMP XTX 129
DC OUTPUT ISOLATION CIRCUITRY



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Richard Elen
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Link House
Dingwall Avenue
Croydon CR9 2TA

14th December 1983

Dear Richard,

It's a shame you could not attend the Synclavier Seminar last month.

From NED's point of view, the presentation of the new guitar synthesiser and the latest software update, were well received. In response there was an encouraging degree of productive feedback and interchange of ideas between owners and the designers from NED.

There are now twenty systems in Britain. Applications range from speech analysis to film music, and from multitrack jingle composition to animal sound manipulation for children's records.

The constantly updated software and hardware options keep everybody moving and on their toes!

Incidentally, on the basis of our success with Synclavier II in Britain, we have now been appointed as official European representatives for NED.

If you call me, I'll be happy to tell you more about the current users and applications of Synclavier II.

Please try not to miss next years seminar.

Best regards,

Dave Whittaker

P.S. All the new features are described in our dps ad in the February issue of Studio Sound.

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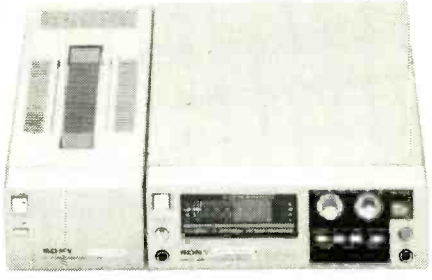


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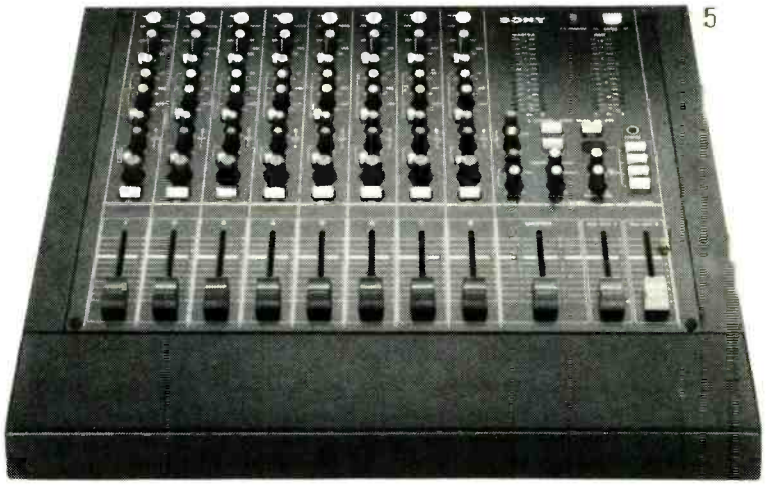
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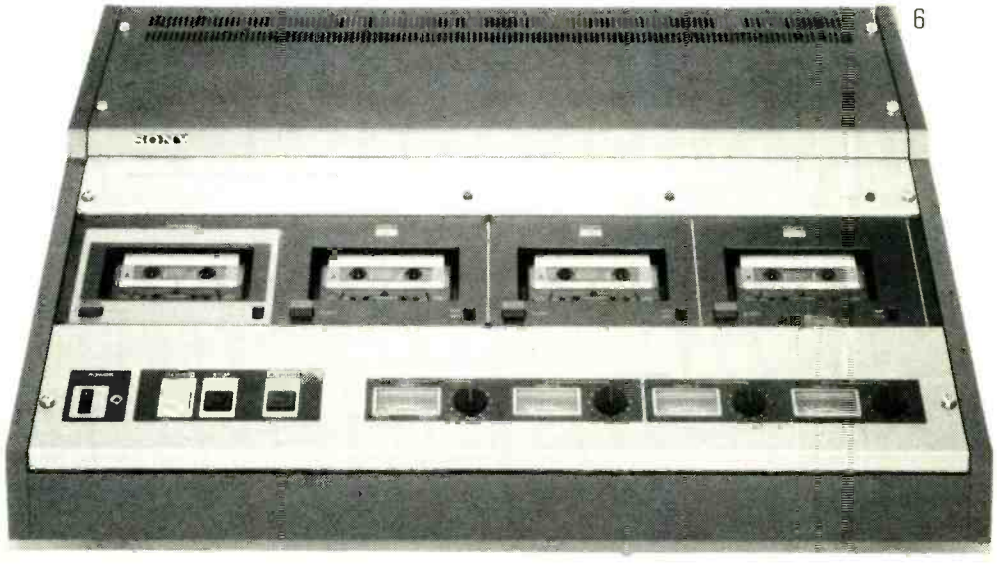
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standard (DIN) value of 6.8 kΩ, but must be very closely matched if the optimum common mode rejection is to be achieved with 0.02% tolerance being suggested. The capacitors C1 and C2 must be low leakage types with at least 48 V rating. The suggested value of 100 μF is a compromise between the low frequency performance and the charging time. For the best low frequency common mode performance these capacitors must be closely matched to better than 5%.

The final circuit provided by the manufacturer gives DC isolation at the output. **Fig 4** shows this circuit where the component values are not at all critical, with the minimum recommended load being 2 kΩ.

For the purposes of evaluating the amplifier the actual values of the input components were measured accurately, the input isolating capacitors being 102 μF and 104 μF and the protection resistors 3.29 Ω and 3.26 Ω. The phantom powering resistors were omitted as their insertion has no effect upon the performance of the amplifier.

Inputs and output

In the balanced mode the input had an impedance of 9.6 kΩ in parallel with 2.2 nF, remaining constant with the gain setting which varied from 6.3 dB to 61.3 dB at 1 kHz. Using the inputs single ended, with the unused side grounded, led to an impedance of 8.1 kΩ in parallel with 2.5 nF with no significant variation in gain.

The maximum input level that could be handled without excessive distortion was 5.5 V or +17.0 dBm, with the excellent common mode rejection being shown in **Fig 5**. The degradation in the common mode rejection is due to the tolerance of the input capacitors, where the calculated rejection at 50 Hz is 86 dB coinciding with the measured performance.

At the output, using the DC isolating circuit shown in **Fig 4**, the drive at the onset of waveform clipping was as measured in **Table 1**.

The current consumption was 18 mA from ±18 V rails, or 17 mA from ±15 V rails. The output impedance was extremely low with the drive capability being limited by the manufacturer's minimum recommended load of 2 kΩ.

Frequency response and gain

The frequency response is controlled by the components identified in **Fig 1** as R1, R2, R3, C1 and C2. With C1 = 2,200 μF, C2 = 1 nF, and R3 = 150 Ω, the frequency response at a

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TABLE 1

Supply rails	High impedance	2200 Ω
±18.00 V	10.0 V + 22.2 dB .7 V	9.80 V + 22.0 dB .7 V
±15.00 V	8.2 V + 20.5 dB .7 V	7.95 V + 20.2 dB .7 V

FIG.5
MATCHAMP XTX 129
COMMON MODE REJECTION

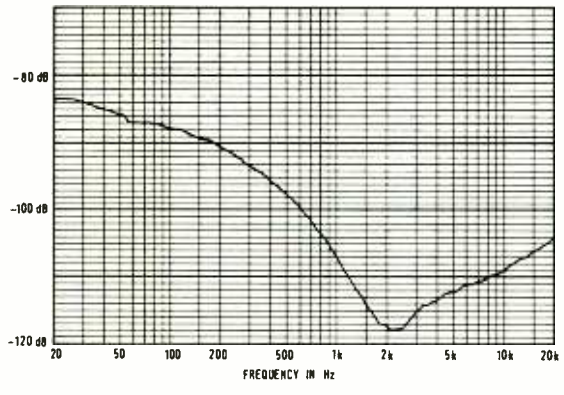
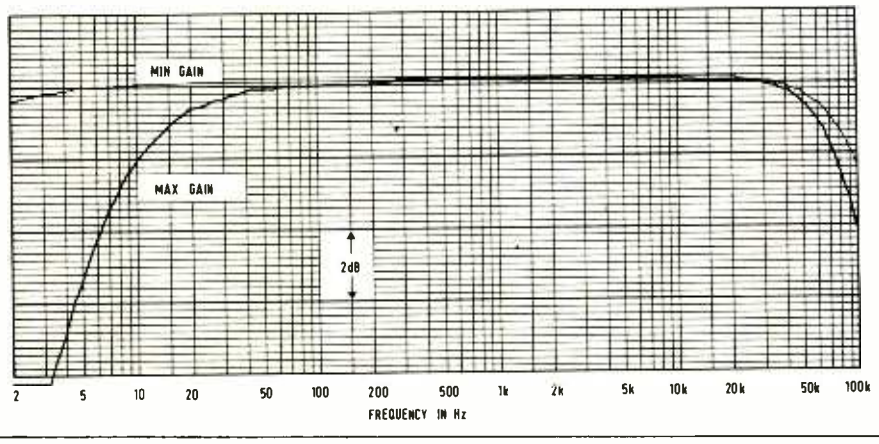


FIG.6
MATCHAMP XTX 129
FREQUENCY RESPONSE AND GAIN



minimum gain of 6.3 dB and a maximum gain of 61.3 dB is shown in **Fig 6.** As can be seen there is little variation in high frequency gain, but the low frequency performance varies. This is related to the value of C1 with the −3 dB point at $\frac{1}{2\pi RC}$ Hz.

At the high frequency end the roll off is controlled by R3 and C2. Using 150 Ω for R3 the effect of changing C2 is shown in **Fig 7**, offering a sensible performance.

The gain was found to be proportional to 10,000/(R1 + R2) with a maximum available of 100 dB with the resistors shorted. With the recommended components the gain varied from 6.3 dB to 61.3 dB.

Noise and distortion

Noise referred to the input was quite remarkably good. With the input shunted with a nominally 200 Ω resistor, the actual value of which was 196.9 Ω, the results were as **Table 2**.

Comparison of the 20 Hz to 20 kHz effective noise bandwidth performance of −129.2 dBm with the theoretical Johnson noise from the resistance of −129.8 dBm shows just how good the amplifier performance is.

At 0 dB .7 V output or lower levels the second or third harmonic distortion remained below 0.01% from 20 Hz to 20 kHz irrespective of gain. However, at levels above 0 dB .7 V output it was found that harmonic distortion was related to the output level, gain and the microphone source impedance. As might be expected the worst case was at maximum gain with **Table 3** giving worst case results. In practical terms the use of a source impedance in excess of 200 Ω is unusual so that the characteristics will be of little consequence. If, however, this amplifier is used for other purposes due note should be taken of these characteristics.

Intermodulation distortion to the CCIF twin tone method was good at all operating levels, the results at 60 dB gain and 0 dB .7 V output being shown in **Fig 8**. At higher input and output levels the third order component remained effectively constant, the second order component (f1-f2) rising about 10 dB at +10 dB .7 V output.

The squarewave performance was also very good as shown in **Fig 9** for a 10 kHz squarewave at any gain or level below clipping. The alteration of the frequency limiting capacitor from 1 nF to 2.2 nF completely removed the slight overhsoot, with the optimum square wave performance requiring an intermediate value.

Other matters

Rejection of signals in the power supply rails was good. The signal in the output resulting from series signals in the supply rails was −36 dB relative to the negative rail and −27 dB relative to the positive rail irrespective of amplifier gain.

The DC offset at the output remained constant at −300 mV irrespective of the gain setting, this confirming the need for DC blocking capacitors at the output for most applications.

Summary

This microphone amplifier offers an excellent performance from all points of view and is simple to use with few external components. Unlike some similar devices the amplifier appeared to be extremely stable with no tendency to oscillate at RF or exhibit other annoying stability problems. Particular strengths of the design are very low noise and excellent common mode rejection extending to 90 dB even at 50 kHz. ■

FIG.7
MATCHAMP XTX 129
HF ROLL OFF AT MAXIMIUM GAIN

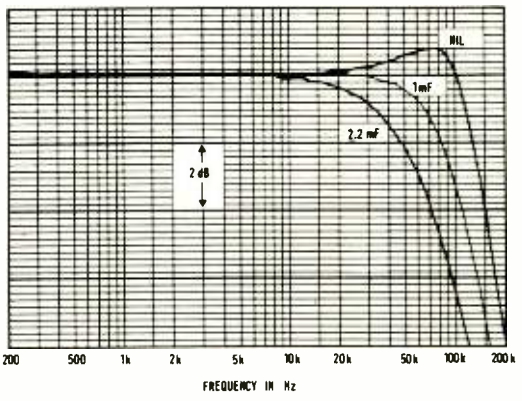


FIG. 8
MATCHAMP XTX 129
INTERMODULATION DISTORTION
60 dB GAIN AND 0 dB OUTPUT

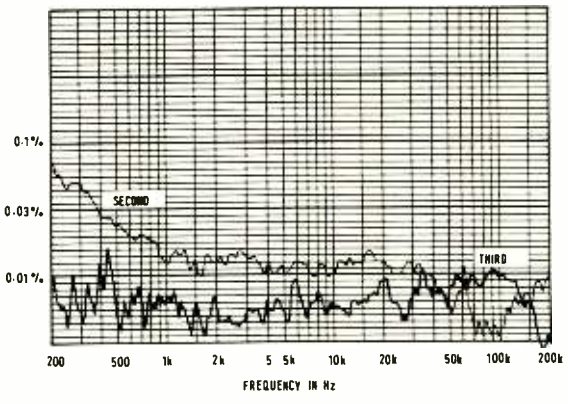


FIG 9

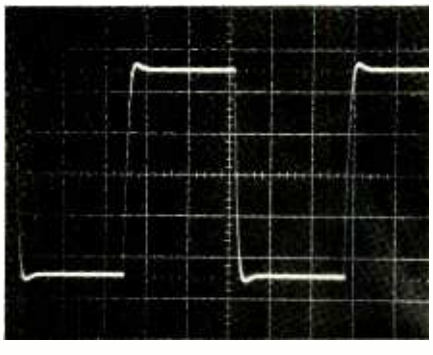


TABLE 2

Measurement method	Noise referred to input
Band limited 20 Hz to 20 kHz RMS	−129.2 dBm
A-weighted RMS	−131.1 dBm
CCIR-weighted RMS	−122.2 dBm
CCIR-weighted quasi-peak	−117.8 dBm

TABLE 3

Source Z	Output dB .7 V	Total harmonic distortion 200 Hz	1 kHz	10 kHz
10 Ω	+20	0.0075%	0.011%	0.076%
10 Ω	+10	<0.008%	<0.009%	0.024%
200 Ω	+20	0.042%	0.056%	0.087%
200 Ω	+10	0.02%	0.032%	0.053%
1 kΩ	+20	0.17%	0.023%	0.023%
1 kΩ	+10	0.10%	0.12%	0.12%

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Crest 5000 power amplifier

Hugh Ford

MANUFACTURER'S SPECIFICATION
Power output: (per channel) 8 Ω stereo—350 W THD 0.06%, 375 W 1 kHz at clip; 4 Ω stereo—600 W THD 0.01%, 650 W 1 kHz at clip; 2 Ω stereo—800 W THD 0.1%, 900 W 1 kHz at clip; 8 Ω mono—1,100 W THD 0.1%, 1,200 W 1 kHz at clip; 4 Ω mono—1,600 W THD 0.1%, 1,700 W 1 kHz at clip.
Frequency response: 0 dB 30 Hz to 10 kHz; – 0.2 dB 20 Hz to 20 kHz; – 3 dB 100 kHz balanced input bypass.
Crosstalk: – 55 dB at 20 kHz, – 85 dB at 1 kHz.
Intermodulation distortion: less than 0.04%.
Damping factor: 400:1 20 kHz to 1 kHz.
Rise time: 3 μs.
Slew rate: 60 V/μs.
Input sensitivity: 1.13 V for 350 W.
Voltage gain: 40 ±1% (32 dB ±0.1 dB).
Hum and noise: – 100 dB (A-weighted).
Output devices: fully complementary circuit design utilising a total of 28 × 200 W, 20 MHz output transistors.
Heatsink: aluminium heatsink utilising special multidirection surface area designed for maximum heat dissipation. 158 in²/channel.
Cooling: forced air, rear to front, utilising 105 CFM fan, automatic 2-speed, activates at 50° C.
Power supply: dual independent power supplies utilising 2 kVA semi toroidal transformers and two 17,500 μF 100 V capacitors per supply.
Protection: DC—relay activates at turn-on to allow stabilisation DC protect, 8 Hz or DC at 10 V; thermal—sensor activates 'hi-temp' circuit for channel shutdown at 90° C; surge—circuit activates against high in-rush current peaks at turn-on.
Inputs: (per channel) connectors—two ¼ in phone jacks, active balanced and unbalanced; two *XLR* connectors, active balanced and unbalanced; parallel wiring of ¼ in and *XLR*s for easy amplifier patching.
Impedance: balanced (¼ in and *XLR*) 9 kΩ; unbalanced (¼ in and *XLR*) 14.6 kΩ.
Stereo-mono selection: switchable.
Outputs per channel: four sets of 5-way binding posts permitting multiple speaker connections.
AC: protection—two fast reset circuit breakers 15 A; Power cord—12 gauge SJ3 conductor.
Distributed lines: (mono) will drive 70 V lines.
Controls: two gain controls.
Indicators: (per channel) one clip LED, one limiting LED, one temp LED, one protect LED, on-off power switch.
VU meters: dual channel LED VU metering 0 dB to – 57 dB scale; multicoloured fast response for accurate 'peak and average' readings.
Construction: totally modular. Locking type 'quick disconnect' connectors; PVC covered wiring; chassis—14 gauge cold rolled steel; front panel—¼ in heavy aluminium with scratch resistant finish.
Dimensions: low profile 4U standard rack mount—(whd) 19 × 7 × 15½ in/480 × 180 × 390 mm.
Power requirements: selectable 100 V, 120 V, 220 V, 240 V AC. 50/60 Hz.
Net weight: 75 lbs/34 kg; shipping weight 80 lb/36 kg.

Test conditions
Power output: FTC rated continuous average sinewave over a bandwidth from 10 Hz to 20 kHz.
IMD: from 250 mW to rated output (60 Hz to 7 kHz 4:1) SMPTE.
Line input: regulated at 120 V AC.

Manufacturer: Crest Audio, 150 Florence Avenue, Hawthorne, NJ 07506, USA.
UK: Nexus Distributors Ltd, BM-Music House, London WC1.

The Crest *5000/5001* is a truly massive amplifier capable of delivering well over 1 kW when operating mono into 4 Ω or 8 Ω and just short of 1 kW into 2 Ω when operating in stereo—not

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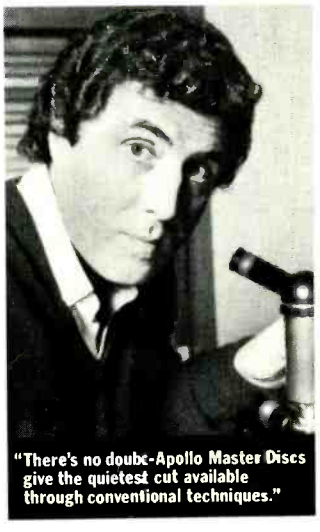
"Our artists demand the best, so do I -Apollo Master Discs."

Malcolm Davies
Chief Mastering Engineer
PRT Studios, London



"The Apollo has all the pluses mastering engineers look for."

We designed into the Apollo lacquer all the features the mastering engineers have been asking for: better flatness, less noise, clean cutting, longer stylus life, better uniformity and consistency. Ultimately, the Apollo results in better records.

"Absolutely flat."

All aluminium blanks used for the Apollo are micropolished using a process originally developed for magnetic computer disks. This multi-step process resurfaces the aluminium blanks and creates a fine finish, free from defects and with an improved flatness.

"Free of ticks and pops."

Our elaborate lacquer manufacturing process insures that all particles and gels which could cause cutting problems are removed. Moreover, the new formulation resists lacquer buildup on the stylus, thus reducing groove wall scoring and loose debris in the groove, which contribute to ticks and pops.

"Least abrasion."

The unique Apollo formulation reduces the cutting friction when contacted by the heated stylus. This results in lower abrasion, thus extending the stylus life. And, of course, the formulation does not use any abrasive ingredients in the first place.

"Very consistent from batch to batch."

The excellent consistency of the Apollo lacquer masters is the result of complete control we have over the critical raw materials and the blending of the formulation. In addition, the extensive process and quality control methods assure the maintenance of tight manufacturing tolerances.

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surprisingly it is very heavy at 75 lb (34 kg). The only difference between the model *5000* and the *5001* is that the latter does not include metering.

To the front of the 4U rack mounting unit (with rubber feet provided) are two substantial carrying handles which protect the front panel controls. These consist of an illuminated power rocker switch and two channel gain potentiometers. Above the latter are two vertical rows of four red LEDs indicating the status of each channel, giving warning of clipping, excessive temperature, limiting and protection circuitry in action. To the left is the output level indicator in the form of two vertical arrays of LEDs, one for each of the channels, with a common scale in between extending from −57 dB to 0 dB in 3 dB increments. From 0 dB to −12 dB the level display shows square red segments, from −18 dB to −27 dB yellow squares and at lower levels green rectangles. The only other front panel feature is a grille to the right of the panel which serves as an air outlet for the forced air cooling which has its intake at the rear of the amplifier.

At the left side of the rear panel the electronically balanced audio inputs are paralleled with each channel having male and female *XLR* connectors plus a pair of 3-pole ¼ in jack sockets for placing amplifiers in parallel. In this section a slide switch selects stereo or bridge connected mono operation, the latter using the channel A inputs only. A useful facility for sound reinforcement work is that the output from each channel is available at four sets of terminals/4 mm sockets in the standard ¾ in spacing. Finally at the rear are two buttons for resetting the mains protection circuit breakers, one for each channel, and a massive power cord about ½ in thick and 6 ft long.

In construction the ¼ in thick alloy front panel supports a 'U' shaped steel structure which forms the back and sides, the top and bottom being quite substantial steel covers which bolt to the front, back and sides plus the power transformer mounting and the output transistor 'tunnel'.

To the left of the front panel, the level display is supported on a plug-in printed circuit board behind the front panel with the massive twin laminated core power transformers and other power supply components occupying the left side of the amplifier. Switch on surges are minimised by a PTC thermistor with a 7 A fuse in series being placed in series with the mains for the period of a switch on delay. Mains voltage setting is by changing over push connectors on terminal blocks near the power transformers, the latter being exceedingly noisy in operation particularly if the mains voltage exceeded the rated voltage by even a small amount.

To the right of the amplifier the electronically balanced input stages are located on printed circuit boards soldered to the input connectors. The outputs from this board feed the two driver boards secured to the side of the amplifier both of which have plug and socket connections. Mounted centrally is the heat sink tunnel with a printed circuit board either side feeding the 14 output transistors for each channel in the form of complementary *2SA1170*s and *2SC2774*s mounted on to the heatsink tunnel. Included on the tunnel are two thermal sensors which increase the cooling fan speed nominally at 122° F plus further sensors which close down individual channels at 194° F. At the entrance to the tunnel at the rear next to the fan is an air filter but this is

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TABLE 1

Load	Rated power	Onset of clipping	Burst power	Clip indicator
8 Ω	350 W	390 W	400 W	397 W
4 Ω	600 W	690 W	760 W	700 W
2 Ω	800 W	1,130 W	—	1,050 W

TABLE 2

Indication (dB)	−6	−12	−18	−24	−30	−36	−42	−48
Actual level	−5.5	−11.0	−15.5	−20.0	−25.0	−28.0	−30.5	−37

TABLE 3

Measurement method	Maximum Gain	Minimum Gain
22 Hz to 22 kHz RMS	106.5 dB	108.4 dB
A-weighted RMS	110.0 dB	116.0 dB
CCIR-weighted quasi peak	97.7 dB	106.7 dB
CCIR-weighted ARM ref 2 kHz	108.7 dB	117.7 dB

TABLE 4

Total harmonic distortion

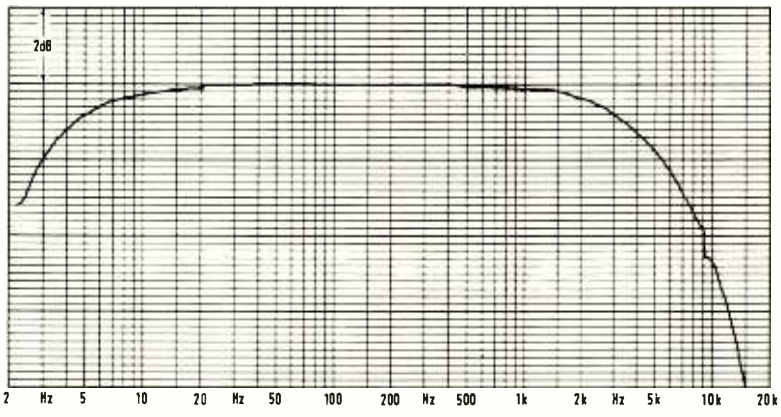
8 Ω	1 W	10 W	100 W	350 W
63 Hz	0.012%	<0.005%	0.0025%	0.0022%
1 kHz	0.012%	0.0055%	0.0045%	0.004%
10 kHz	0.06%	0.033%	0.024%	0.03%
15 kHz	0.083%	0.053%	0.032%	0.045%
20 kHz	0.10%	0.072%	0.04%	0.063%

4 Ω	1 W	10 W	100 W	600 W
63 Hz	0.04%	0.013%	0.0055%	0.0038%
1 kHz	0.026%	0.01%	0.0055%	0.005%
10 kHz	0.056%	0.04%	0.022%	0.032%
15 kHz	0.078%	0.045%	0.028%	0.045%
20 kHz	0.10%	0.054%	0.03%	0.062%

TABLE 5

Indicated level (dB)	0	−6	−12	−18	−24	−30	−36	−42	−46
Actual level (dB)	0	−5.5	−11	−15.5	−20	−25	−28	−30.5	−32.0

FIG 1 CREST 5000 FREQUENCY RESPONSE, 1W 8Ω



very awkward to clean as its removal needs taking off the top and bottom amplifier covers.

Within the unit the standard of construction is quite tidy with good access for servicing. No component identifications are provided and the internal fuse is unidentified, however, the technical literature includes layout diagrams and circuits.

Power output

Unfortunately one channel thought better of life rather earlier in the proceedings, thus the performance is quoted for a single channel driven—although the use of separate rectifiers and smoothing components would suggest that the performance would be similar with both channels driven.

With a stabilised 220 VAC input to within 1% and using 0.5% forced air cooled loads the power output at the onset of 1 kHz waveform, clipping was noted when driving 8 Ω, 4 Ω and 2 Ω. The latter is of interest not only when driving nominal 2 Ω loads but also when driving nominal 4 Ω loads which sometimes have wide impedance variations approaching 2 Ω in severe cases.

In addition to continuous operation, the onset of clipping was noted in terms of burst power capability when driving the amplifier with 1 kHz 10 ms tone bursts at 100 ms intervals.

Table 1 shows a good burst power capabilty but the clipping indicators are marginal. It was also noted that the clip indicators were rather slow in action with the level indicators being fast in action and easily read even on short bursts.

Zero dB on the level indicators corresponded to 200 W into 8Ω or 400 W into 4 Ω with the lower increments being somewhat inaccurate as shown in **Table 2**.

It was noted that the amplifier required about 10 A at 220 V when driving a single channel at 1 kW into 2 Ω—hence the gigantic power input cable designed for 110 V operation.

The input sensitivity for the rated output of 350 W into 8 Ω was found to be 1.30 V corresponding to a voltage gain of 40.

Frequency response and noise

The frequency response when driving 1 W into 8 Ω as shown in **Fig 1** was within +0/−0.4 dB from 8 Hz to 20 kHz with a sensible roll off at high frequencies which varied little with the setting of the level controls.

Whilst noise in the output and hum components varied with the gain setting the amplifier was quiet as shown by the figures in **Table 3** which relate noise to the rated output of 350 W into 8 Ω.

Whilst the predominant 100 Hz power line hum component varied with gain setting, being worst at minimum gain, it never exceeded −110 dB below 350 W into 8 Ω.

Distortion

Total harmonic distortion was measured at various frequencies and levels when working into both 4 Ω and 8 Ω with generally good results. It was, however, noted that harmonic distortion increased at lower levels with a tendency for crossover distortion to predominate. **Fig 2** shows the crossover artifacts when driving 1 W at 10 kHz into 8 Ω this being fairly typical of other frequencies.

Total harmonic products are shown in **Table 4.** The second and third harmonic products when

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FIG 2

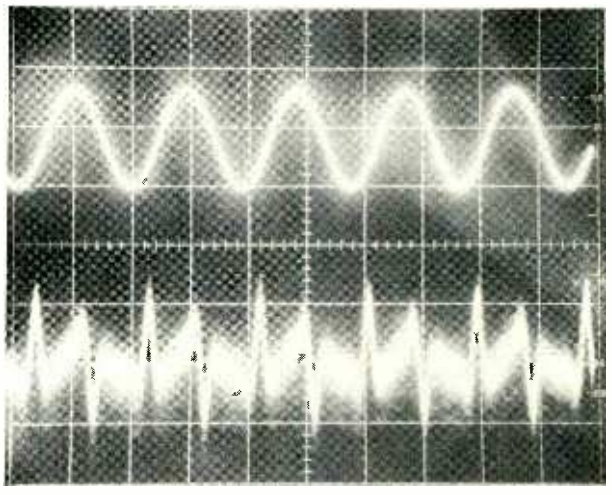


FIG 3 CREST 5000 HARMONIC DISTORTION, 1W 8Ω

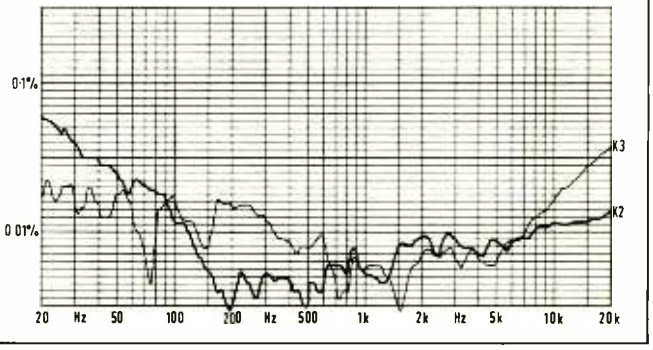


FIG 4 CREST 5000 IM DISTORTION, 1W 8Ω

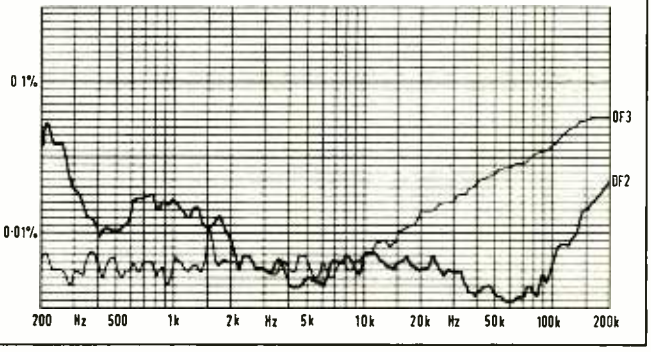
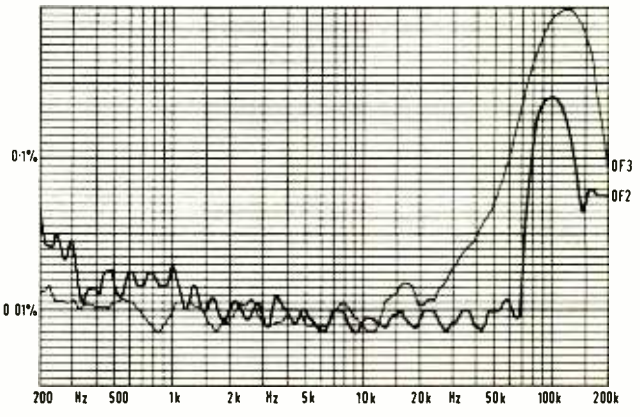


FIG 5 CREST 5000 IM DISTORTION, 350W 8Ω



working at 1 W into 8 Ω are shown in **Fig 3** where these harmonics are low in level; the total harmonic performance includes the higher harmonics associated with the crossover distortion.

Intermodulation distortion to the CCIF twin tone method using tones separated by 70 Hz is shown in **Fig 4** and **Fig 5** for 1 W and 350 W peak equivalent into 8 Ω with the performance into 4 Ω being similar. Whilst the figures are not corrected for frequency response it should be noted that at ultrasonic frequencies the distortion rises in a rather alarming way.

Driving a 1 kHz squarewave into 8 Ω in parallel with 2 μF showed the overshoot displayed in **Fig 6** irrespective of drive level below clipping, the rise and fall times being 4 μs with a slew rate of 20 V/μs.

The application of very low frequencies at fairly high levels operated the safety tripping relay with the 'protect' light being illuminated before the relay operated which occurred at 0.5 Hz at >±20 V output.

Recovery from severe asymmetrical overloads was excellent with a complete absence of level shifting with the output being free from any DC offsets.

Inputs, outputs and metering

The input impedance of 9.2 kΩ in the balanced mode remained constant with the level setting, the impedance being 4.6 kΩ in the unbalanced mode. Common mode rejection was good as shown in **Fig 7**.

Fig 8 shows the relation between the output impedance and frequency with the effective damping factor being about 300 related to 8 Ω from 20 Hz to 1 kHz.

The metering showed true peak levels with the rise time being fast at 80 μs and the fall time of 100 ms to −30 dB giving good readability.

Zero dB indication corresponded to 400 W into 4 Ω or 210 W into 8 Ω—perhaps a little low in view of the fast metering. Whilst the level accuracy of the metering is rather academic the low level indications had significant errors as shown in **Table 5**.

Other matters

The good phase response of the amplifier is shown in **Fig 9** there being little phase shift in the audio band.

At no time was there any suggestion of instability with the amplifier running cool under all conditions. However, as is all too common, the cooling fan was decidedly noisy when in operation.

Summary

Whilst this amplifier is exceedingly bulky this may not matter for fixed installations where the cooling arrangements allow amplifiers to be stacked in rack mounts.

Acoustic noise would be a problem in studio installations as not only was the cooling fan noisy but also the power transformer was noisy.

In other respects this is a good amplifier with a sensible distortion performance and other parameters being good.

In construction the casing is particularly solid with access for servicing being reasonable. The multiple input and output connections making the amplifier particularly easy to use in fixed installations when many amplifiers must be operated in parallel. ■

FIG 6

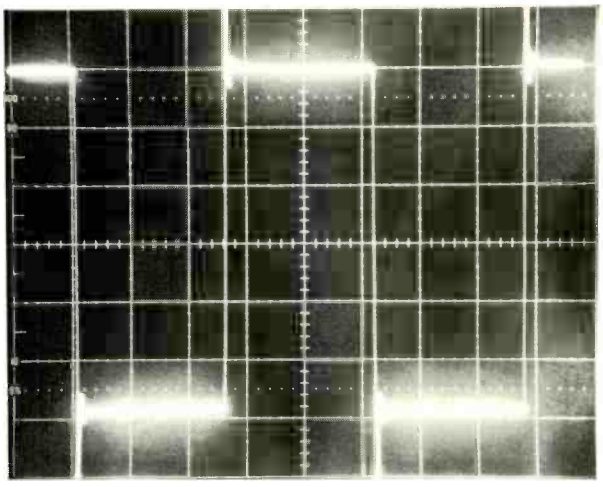


FIG 7 CREST 5000 COMMON MODE REJECTION RATIO

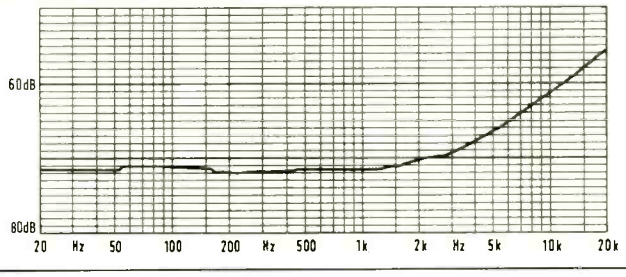


FIG 8 CREST 5000 OUTPUT IMPEDANCE

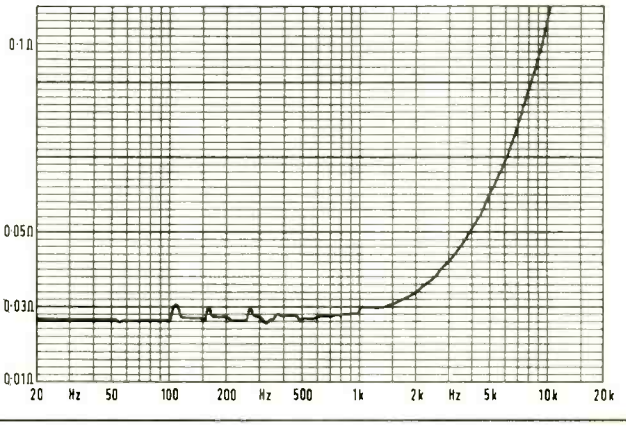
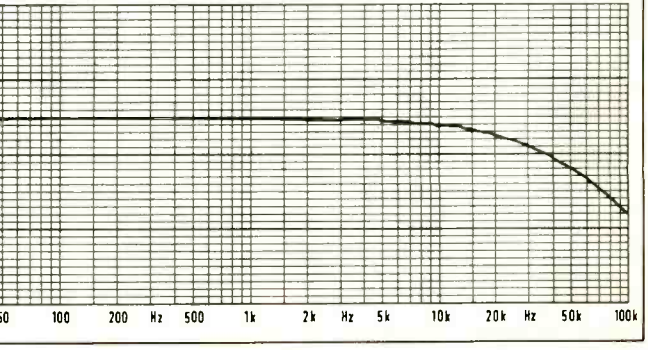


FIG 9 CREST 5000 PHASE RESPONSE



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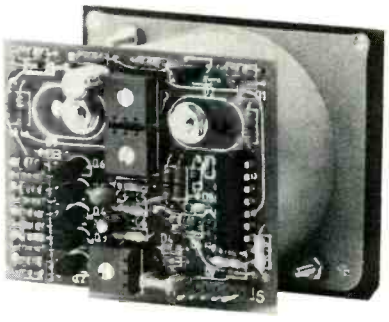

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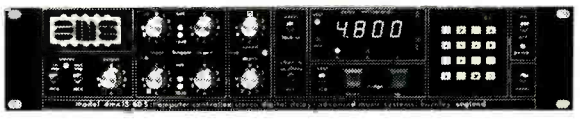

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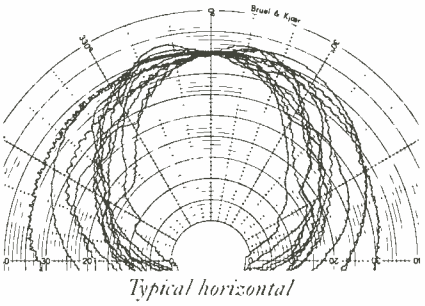
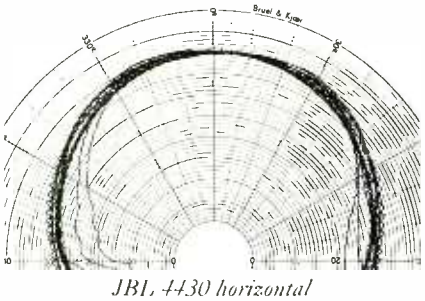
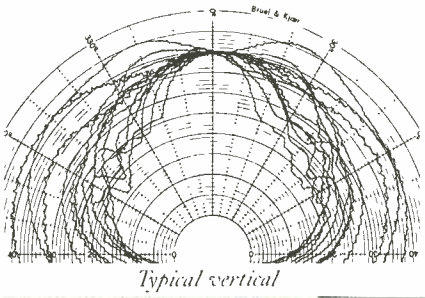


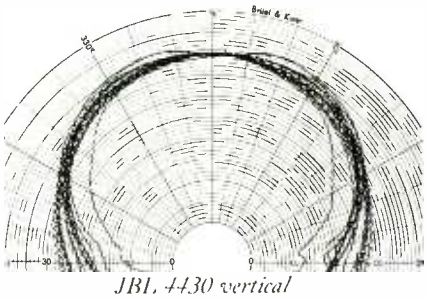
Typical horizontal



JBL 4430 horizontal



Typical vertical



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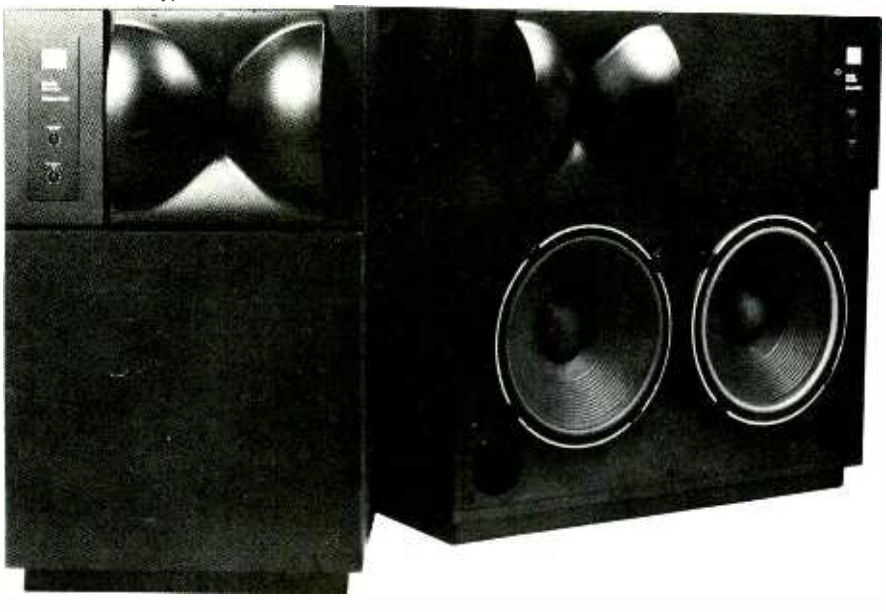

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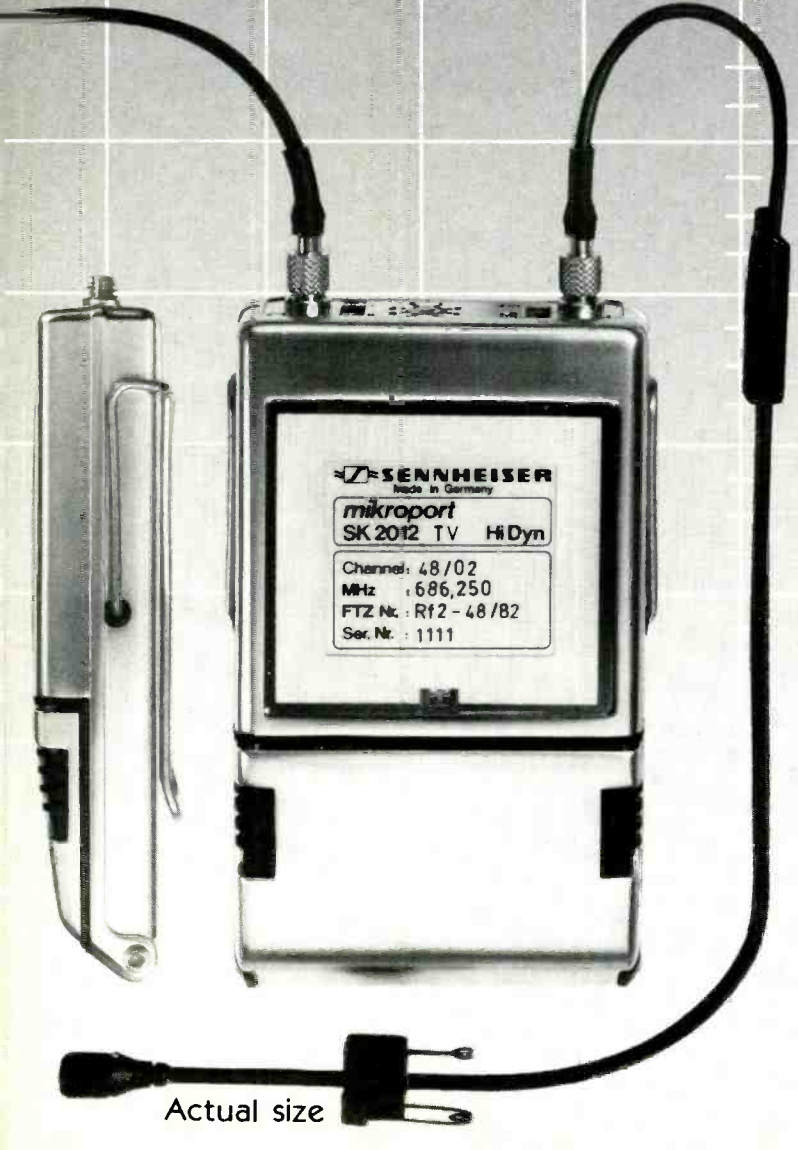

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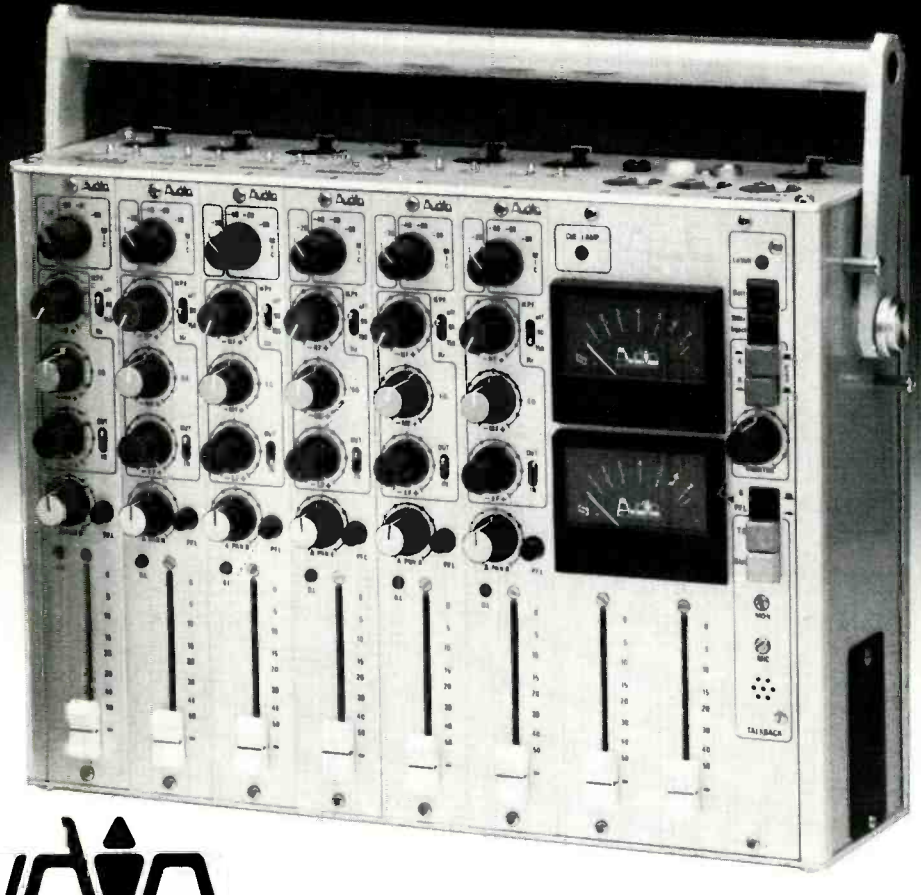

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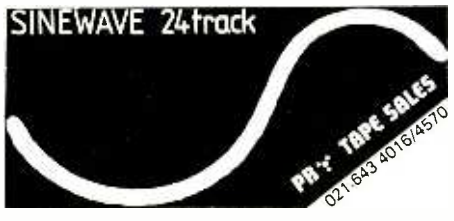

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