Electronics &
Music Maker
INCORPORATING COMPUTER MUSICIAN
MAY 1984 95p

WANG CHUNG

REVIEWS: PPG WAVE 2·3 & WAVETERM
ROLAND JUNO 106
M&A ELECTRONIC DRUMS
MPC SYNC TRACK

MIDI SPECIAL

NEWCOMER'S INTRODUCTION
THE LATEST SPEC
COMPLETE PRODUCT GUIDE
THEORY AND PRACTICE

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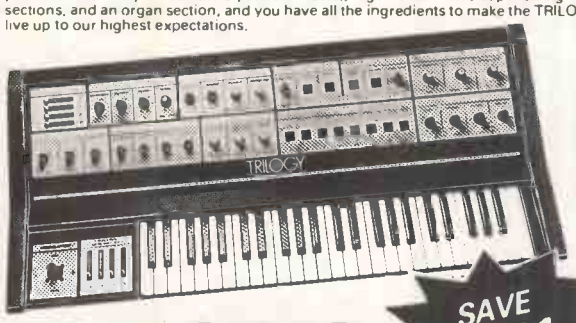

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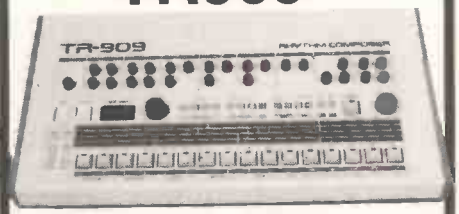

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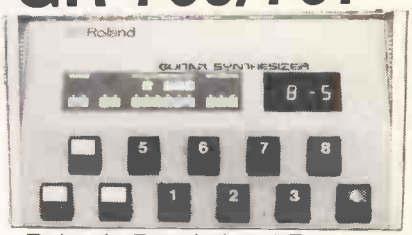

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May 1984 Volume 4 Number 3

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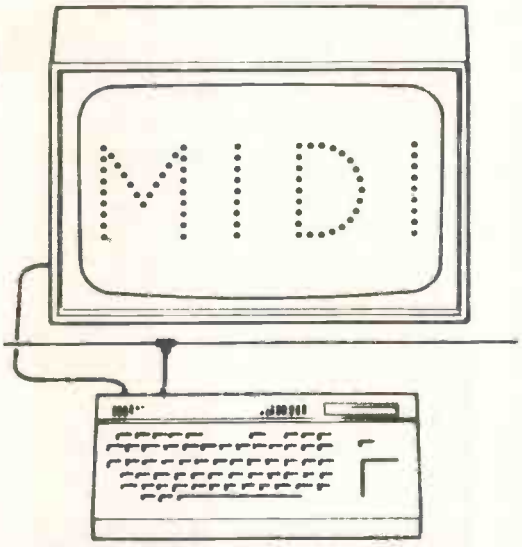

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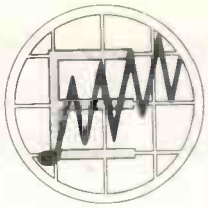

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May MIDI Madness

It's definitely been one of those months. You know, four weeks in which so much has happened that it's been difficult to keep up with it all, let alone manage to incorporate everything into the editorial pages of a magazine. To kick-off, two of this issue's major features – the MIDI supplement and the free flexidisc – need explaining.

Almost exactly a year has passed between the release of the first **MIDI**-equipped keyboard – SCI's Prophet 600 – and this Editorial being written, and it's a testament to the pace with which other manufacturers have adopted the new standard that it seems like an awful lot longer than that. A quick glance at our MIDI Product Guide will tell you that the rate at which new compatible instruments have been introduced comfortably exceeds three a month: manufacturers have not so much accepted the new interface gradually, more welcomed it with open arms.

So, given the enormous amount of interest in the MIDI system on the part of manufacturers, dealers and musicians alike, it seemed only natural to devote a small part of the magazine to the interface and the instruments that incorporate it. However, what started out as an ordinary four-page feature quickly grew into a fully-fledged pull-out special, and the story doesn't end there. Next month's E&MM will include the second part of the supplement, which, combined with this month's instalment, should provide the most comprehensive guide to MIDI yet published. Provisional contents (new developments are occurring so rapidly that anything could happen between now and the June issue, and probably will) include a technical introduction, a summary table of MIDI instruments' capabilities, an in-depth look at how the system works and MIDI interfaces for three popular microcomputers – the BBC B, Spectrum, and Commodore 64.

The second feature is in some ways just as exciting, though for entirely different reasons. The story behind the **Axxess** album – and this month's free record – is an extraordinarily complex one involving some bizarre personal associations (like ex-members of Tangerine Dream becoming friendly with bosses of prestigious Italian sportscar manufacturers) and possibly the most remarkable home-built synthesiser project ever undertaken by anybody anywhere. The album is reviewed elsewhere this issue, but suffice it to say for the moment that we feel *Novels For The Moons* to be quite a significant release, both in terms of technological development and in relation to the electronic music scene as a whole.

Give the flexi a listen and tell us what you think.

A little closer to home, E&MM's publishing operation has been expanding at a fair rate of knots in recent months, and May sees the appearance of a new sister publication for E&MM and *Home Studio Recording*. Called simply ***Guitarist***, the new magazine will feature interviews with prominent musicians from all sections of the modern music community, reviews of guitars, basses, amps, and accessories, features on playing techniques and customising, and a whole host of additional tests, reports and profiles that add up to the single most comprehensive specialist guitar player's magazine available.

And all for a mere 80p each month.

Finally, we'd like to extend a warm welcome to **Paul White**, who's now joined the staff on a full-time basis after contributing some consistently original and thought-provoking technical articles in recent issues. If you have a technical query related to music that you'd like answering, Paul wil be only too pleased to assist, but please bear in mind that a letter (with SAE if possible) is more likely to get a full and prompt reply than a telephone call. . .

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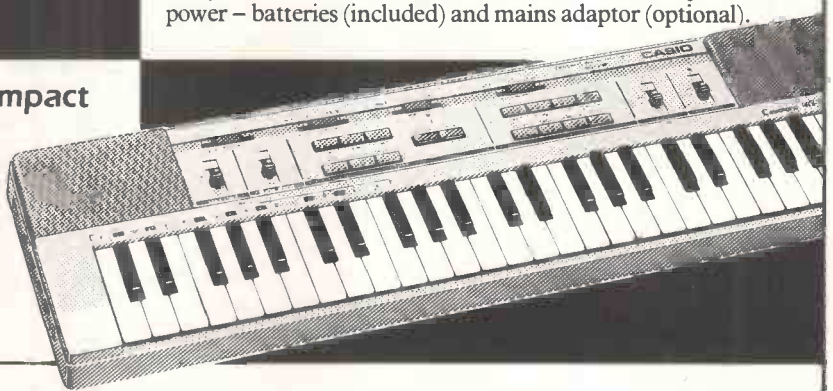

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READERS' LETTERS

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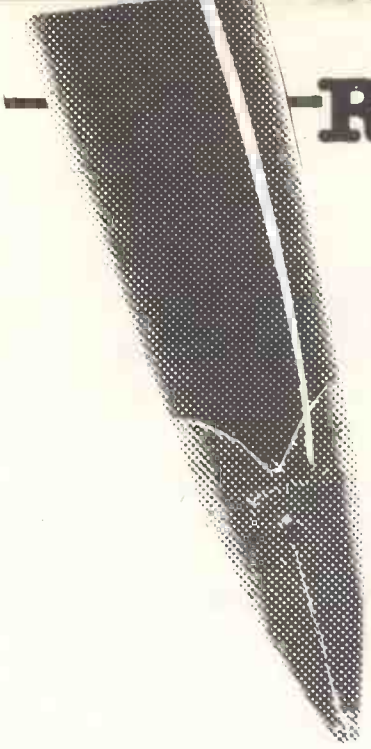


Radio Cento Fiori

Dear E&MM,

I work for a private radio station, 'Radio Cento Fiori 104 MHz FM', based near Verona, Italy. We have a programme called *Electronic Uber Alles* which is transmitted every Thursday. I also produce a programme of electronic music for another radio station in Frankfurt, Germany.

The reason I'm writing is to ask readers who produce their own electronic music (as well as those who are generally interested) to send me tapes, records and information – these will be included in the radio programme. This would be very useful for our listeners, and help to establish a link with the electronic music scene in Britain.

Please send all material to the address below, and may I take this opportunity to thank all readers in advance.

Claudio Belle
Via Case Popolari 14
37057 San Giovanni Lupatoto
Verona
Italy

Thank you for your letter. Its very encouraging to see an interest in the British electronic music scene, and we're sure many readers will respond to this request.

Doctor, Doctor

Dear E&MM,

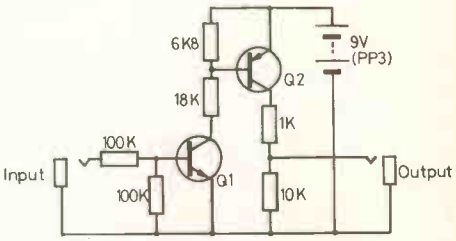
I am an avid reader of E&MM and through this have purchased a Pro-One and Juno 6. I recently bought a second-hand Dr Rhythm, hoping to run the sequencer off the Pro One from the CSQ output. Unfortunately, the Dr Rhythm doesn't trigger, whereas the DBS output works fine on the Multitrigger. When I read your 'S-Trigger Converter' article (E&MM March 84), I wondered if this would be the answer and, if so, would it be possible to buy one, as I haven't a clue how to build one myself!

P. Bridge
South Wirral

Your triggering problem is probably due to a difference in the triggering voltage requirements of the two machines, so an S-Trigger unit is not what you need.

We contacted Roland and they kindly sent us a simple circuit which may well solve your problem. It is simply a two-transistor amplifier which should boost the Dr Rhythm trigger pulse to a level that will operate the Pro-One.

Regarding your reluctance to construct projects yourself – this is where we hope the 'Readers Technical Directory' will come in – see below for details.



Q1 = Gen purp NPN transistor eg BC108
Q2 = Gen purp PNP transistor eg BC 214L

Readers' Technical Directory

We continually receive letters from readers who wish to construct projects but lack the knowledge and experience to do so unaided. In order to improve the situation, we're proposing to start publishing a Readers' Technical Directory, which will include experienced enthusiasts who are prepared to assist in the construction and debugging of other readers' projects.

If you wish to be included in this Directory, please send your name, address and telephone number to E&MM Readers' Technical Directory at the address at the top of this page.

Please include details of your technical ability and state whether you would render this service for the love of your fellow reader or whether some small fiscal remuneration would be anticipated.

CORRIGENDA

May 83

Following our interview with **Keith Emerson,** we've had many enquiries regarding the availability of his *Honky* album which was on sale from Bubble Records in Italy. Keith's management plan in the near future to release *Honky* in the UK but, in the meantime, copies can be obtained for £5.99 inc. p&p from: Copyright Control Ltd, 57 Priory Crescent, Cheam, Surrey, SM3 8LR. Tel: 01-644 5207.

February 84

A number of readers who tried to modify their **Roland Drumatix** as per the instructions on page 42 and ran into problems have in desperation contacted Roland UK for help. It should be pointed out that this project was nothing to do with Roland UK, and that all readers requiring assistance should contact E&MM by letter. It is also worth pointing out that any project involving modifications to shop-bought equipment appearing in E&MM – or indeed any other magazine – may invalidate manufacturers' warranties if carried out. Readers are therefore advised not to attempt any such modifications while their equipment is still under guarantee unless they are willing to surrender their statutory rights. It is important to remember that all work you do is at your own risk and that you should feel completely confident in your abilities before attempting modifications such as the one published.

Our constructional article on the **Voltage Controlled Clock** (pp 74-78) contained the following typesetting errors. Top right on the circuit diagram – 'Network 1' – capacitor value is 10nF; resistor should go to ground. Bottom right, 'clock out' 45 should read 15. Component overlay: top right, C9 should read plus, not minus. Bottom middle, TR1 should be shown next to R19, 20. In the final paragraph on page 78, the final sentence should read '. . . another control voltage input in parallel with R1, 2 and 3, whereby a small amount of heavily filtered white noise could be introduced to allow . . .' and so on.

April 84

The component layout for our **Bass Pedal Synth** project (page 94) was printed with one wire link omitted. This link is in the top left of the diagram and should join the hole shown under R3 to the hole one centimetre below it. The PCB does in fact show an etched link – this is an inaccuracy.

The circuit diagram for the **Syndrom** (page 91) contained two wrong voltage values. The voltages on IC7, pins 3 and 13 should have been –9V and +9V respectively.

Peter Maydew's review of the **Vox Venue PA** system (pp16-18) implied that the leads supplied with his review model were manufactured by Vox. This, in fact, is not the case – the leads tested by Peter were not of Vox manufacture, and production models of Venue do *not* include leads as standard. We apologise for any inconvenience this may have caused.

June 84

The member of E&MM's editorial staff responsible for compiling corrigenda has been admitted to Cambridge County Hospital, suffering from high blood pressure caused by over-working. An NHS spokesman described his condition as 'stable'.

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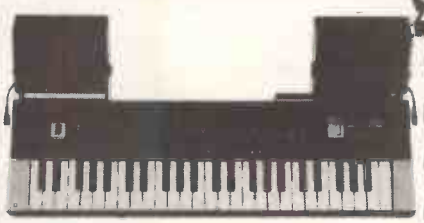

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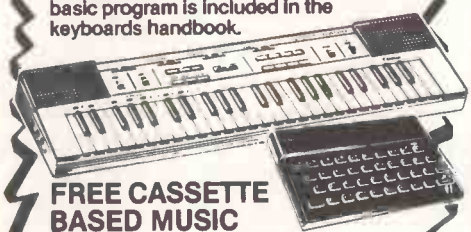

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NEW PRODUCTS

Yamaha have just released a new Portasound multi-programmable stereo keyboard. The 49-key MK100 uses the latest digital technology to provide a versatile instrument that includes user-programmable sounds as well as presets, a rhythm machine and auto bass accompaniment. All sounds can be stored in the unit's 3.2Kbyte memory, and songs can be recorded and played back on a built-in two-track recorder.
Further information from Yamaha, Mount Avenue, Bletchley, Milton Keynes, Bucks. MW1 1JE. Tel: (0908) 71771.

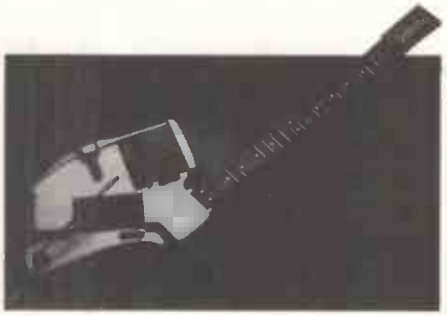
In response to considerable demand, **Court Acoustics** have supplemented their range with three new graphic equalisers. The GE30 is a single-channel 30band unit with 60mm travel faders, and allows precise control over the audio spectrum.

The GE1515 stereo graphic provides two channels with 15 bands on each, and is particularly suited to stereo PA or disco use, while in the GE1515X, Court have produced a similar unit to the GE1515 but have included a two-way electronic crossover.
Information from Court Acoustics Sales Ltd, 10–16 Mercer Street, London WC2H 9QE. Tel: 01-240 3648.

A new instrument from British company **SynthAxe** is not a guitar, or a guitar synth. It is in fact a control interface that allows the guitarist to use his playing skills to exploit the performance capabilities of a polyphonic synthesiser.

The SynthAxe is expected to be available in limited numbers this summer, though the initial cost wil be high due to the research and development investment. The instrument will operate *via* the MIDI system, while details of other interfaces can be obtained from the manufacturer.

The SynthAxe utilises two sets of strings. The set in the normal neck position is for pitch information, while

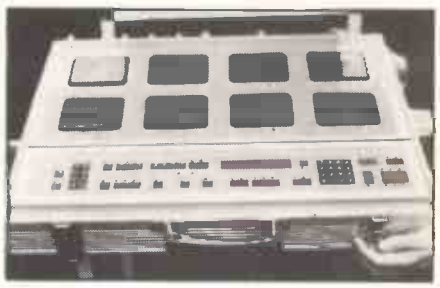


an additional set situated where the pickups would normally be handles string plucking information.

Innovative circuit design enables the nuances of the left-hand technique to be accurately interpreted by the system, whilst dynamic picking information is derived from the trigger strings and a variety of performance control keys built into the body; these keys allow control over effects such as sustain and vibrato. Tuning is digitally derived and is in no way related to the actual string tension.

As not all MIDI machines are capable of interpreting the full facilities offered by this instrument, SynthAxe will be supplying a continually updated list of suitable synthesisers which can be controlled by the guitar.
Further information from SythAxe Ltd., 34 Avon Trading Estate, Avonmore Road, London W14. Tel: 01-603 0929.

The Inpulse One drum computer previewed in the March edition of E&MM is now in full production. Manufactured by



Allen and Heath Brenell, this machine may be played in real time *via* eight pads or may be programmed in real or step time. The storage memory will hold 15 songs composed of up to 999 bars, which in turn are derived from 99 patterns. 16 digital sounds are available, eight in ROM and eight reloadable from cassette.
For further information contact Allen and Heath Brenell, 69 Ship Stree , Brighton, BN1 1AE. Tel: (0273) 2492

LEMI of Italy have introduced a MIDI interface board which fits into one of the expansion connectors on the Apple computer. This board enables the user to control MIDI synthesisers as well as providing an input for an external clock control. Software includes the AMP 83 real and step time polyphonic sequencer, with digital echo, display for presets and musical notation programs being currently under development.

The same company has also announced the Masterclock, a versatile rhythm controller to drive and control the majority of drum machines and sequencers simultaneously. Features are digital tempo readout, 3 to 400 beats per minute. selectable arpeggio with delay and gate, and sync to and from tape.
Details from, LEMI, Corso Matteotti, 37–10121 Torino, Italy. Tel (011) 54 16 54.

Roland Juno 106 Polysynth

Geoff Twigg **gives us a quick synthesis philosophy lesson and takes a look at Roland's latest budget polyphonic: he finds it's rather more than just a Juno 60 update.**

The Juno 106 is the successor to Roland's Juno 6 and Juno 60 polyphonic synthesisers. It has a five-octave C-C keyboard, and falls into the same approximate price bracket as the Korg Poly 800, Sequential Six Trak, and Yamaha DX9.

With two successful models already under their corporate belt, Roland obviously had the option of either following this design concept or developing a different range, perhaps based on digital oscillators and FM synthesis. However, rather than a totally new design, they have opted for the former course and produced this instrument, the latest in the Juno range; so what is it that makes the concept and design so successful?

It was the first instrument to be produced, the Juno 6, that set the basic pattern for the range. It had six Digitally Controlled Oscillators (DCOs) which passed through six voltage controlled filters and 6 voltage controlled amplifiers with conventional ADSR envelope shaping. This basic arrangement was retained on the Juno 60 and is still to be found on the 106. For ease of operation, each of these parameters is accessed by one set of controls, with sliding pots which allow more immediate and tangible control than on many competing machines.

This of course is an arrangement familiar to anyone who has worked with a voltage-controlled synth, whether mono or polyphonic. Isn't it perhaps a little old fashioned? The answer is very definitely 'no'.

The reasoning behind Roland's insistence on this presentation, this approach to generating sound, is the way most musicians wish to arrive at the sounds they use. There are two ways of arriving at a synthesised sound: you can either make it up with individual harmonics, each at the appropriate volume, until you arrive at the sound you require – this is called additive synthesis – or alternatively you can start with a full, fairly rich sound with lots of harmonic content and gradually chop it down with filters until it is the sound you require. The benefits of additive synthesis should be obvious to all. You need to produce only the actual harmonics required; there are fewer components in the system so that the sound produced is of superior quality; and you can produce unusual sounds by adding harmonics as and when you wish. The main problem is that many musicians simply don't know *what* sound they want. I don't mean that disrespectfully – can you describe your favourite brass sound in terms of its harmonic content? I know I can't.

What's much easier is to start with a sound approximate to the one you want and subtract harmonics from it, until you arrive at an acceptable result. The obvious basic difficulty with this subractive synthesis is that you need a very versatile filter stage to in any way approach the more unusual sounds that are obtainable from digital oscillators by additive means.

It's therefore desirable to have a filter that can remove only a 'notch' of sound from the middle of the note, as well as others than can remove the top (low pass) or bottom (high pass) or both together.

Roland's answer to this problem of how to approach synthesis shows a good understanding of how the typical musician (if such a person exists) would prefer to compose sounds. Not only have they used the principle of subtractive synthesis in providing the oscillator-filter-envelope layout described above, but they have extended the facility to apply to preset voices as well. The Juno 60 was provided with 56 pre-programmed voices, arranged in seven banks of eight: the 106 is given two groups of eight banks, each with eight presets – a total of 128 distinct sounds, each of which may be written in to memory by the musician at the touch of a single button. Each of these can be instantly recalled and edited using the performance controls, though of course this new version of the voice is not written into memory – it exists only as you have it on the keyboard until you decide you are ready to store it. The Juno 106 adopts the same system as the 60 to show that the sound you have is not an unaltered preset voice; as soon as any performance controls are moved, a dot appears on the central LED display after each number. To return to the original sound, you only have to press the preset number again. It is also unnecessary to reselect the bank every time you change presets – the instrument assumes the same group, bank or preset number unless you tell it otherwise. Therefore, in order to go from Group A, Bank 6, voice 3 to Group A, Bank 7, voice 3 it's only necessary to press 7 on the bank selector. Similarly there are one-button facilities for saving, loading and verifying on tape, accessed through quarter-inch jack sockets on the rear panel.

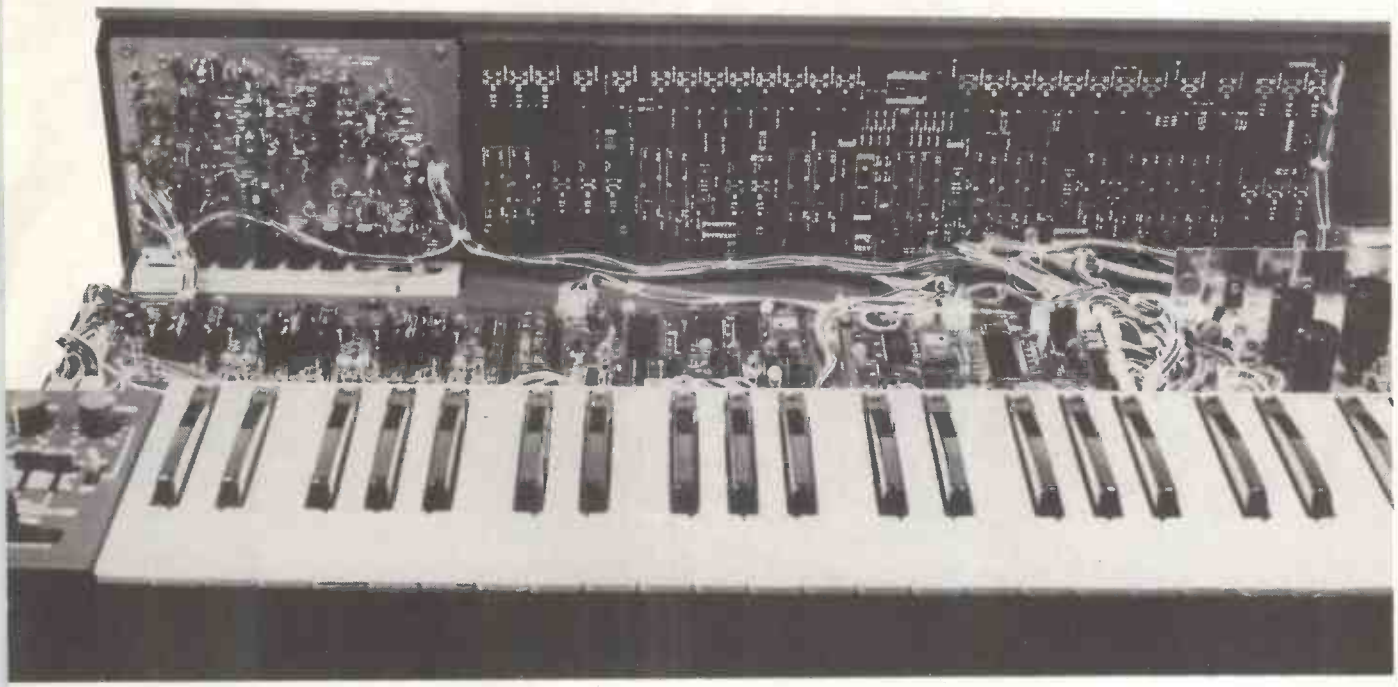
Layout

From a design standpont, the Juno 106 follows on logically from its predecessors: the front panel is beautifully clear and simple, and not unlike the Yamaha DX7 in that there is plenty of space around the main control section. In Roland's case, however, space on the Juno 6 was subsequently allocated to the extra program controls on the 60; I wonder whether the space on the 106 might indicate a further, more expensive and better equipped Juno yet to come? Mere speculation, you understand.

The new instrument has the same, very stable digitally controlled oscillators as on the other two models, with 16′, 8′ and 4′ options which were not strictly speaking available before, though of course this is represented on the 6 & 60 as Octave Transpose. Other features are similar to the Juno 60, with the following discrepancies. There is no arpeggiator section and no manual Hold select, though the facility for a Hold pedal, *via* a rear panel jack socket, remains. The LFO trigger mode is hard-wired automatic instead of offering a manual option, but DCO Pulse width modulation is now either LFO-controlled or manual. Unfortunately, there's no option to control PWM with the envelope shaper. The high pass filter is the same as that on the 60,

ith four settings of approximately OHz, 50kHz, 1kHz and 5kHZ, and although n the review model this filter emitted a ubstantial click as it fell into each of ese notches, I'm fairly certain this roblem will be eliminated on production odels.

two pedal inputs, one for Hold and one for shifting from one patch to another. At the other end of the rear panel lie the mains on/off switch, Memory Protect and three-way MIDI sockets (in, out and through) together with a function select



novations

Apart from the increase in the number presets over the Juno 60, the other pressive 106 innovation is on the rformance control panel to the left of e keyboard. Whereas before the con- ls provided were a Bender for DCO d VCF cutoff frequency modulation, LFO trigger switch and volume con- l, the 106 sports two pots, one for lume and one for portamento (with a rtamento on/off switch) and three ders – for DCO and LFO modulation pth on the bender or bender modul- on of the VCF cutoff frequency. The ite LFO trigger button used on pre- us Junos and Jupiters has now been blaced by an ingenious rocking ful- m for the bender wheel, constructed that it triggers the LFO if you push it wards. This works so well it really ould become standard Roland equip- ent. Two settings for the Chorus effect d the key transpose facility remain ndard features, and there is still a nge of three output levels so that you n match the synth to your own plification system; settings of 0dB, 5dB and –30dB are available. The se is of the same black metal as fore but the wooden ends of previous odels have been replaced by black oulded plastic, giving the instrument a ore contemporary look.

Jack sockets are provided for tape, ereo/mono outputs, headphones and for the precise information sent along the MIDI bus.

Inside, the Juno 106 is of typical Roland design, with fibreglass PCBs fitted with plug-in connectors for easy servicing. To minimise wiring, the front panel controls are mounted straight onto their circuit board, and all the boards are easily accessible. The ICs are mostly soldered in, with only the EPROMs fitted in sockets – this improves reliability and reduces the risk of chips falling out when you are shifting the instrument.

Given then that the 106 would appear on paper to be little more than a revamped June 60 containing little in the way of design innovation, it's particularly surprising to discover that the quality of the factory preset voices is considerably higher than on the 60, even if the degree by which those sounds can be altered is essentially the same as it was on the 106's predecessors. Not only are the sounds a good bit clearer and less noisy, but the aural range they cover is also quite a bit greater. While many of the factory voices on the Juno 60 were variations on the strings/piano/organ theme, the 106 is capable of generating all manner of acoustic and/or synthetic-type sounds, a goodly number of which bear more than a passing resemblance to FM-synthesised voices, which is no insult.

I would guess that a fair few internal modifications have been made to the Juno's oscillator and/or filter sections in order to bring about this sonic metamorphosis, but whatever changes have been made have certainly been well worthwhile.

Conclusion

To summarise, the Juno 106 is an impressive instrument, well-designed and a joy to play. Although it lacks an arpeggiator, this omission is not really all that serious when you consider how much the inclusion of MIDI sockets has widened the potential for storing your own compositions *via* MIDI-compatible sequencers such as Roland's own MSQ700.

The inclusion of polyphonic portamento is also a very worthwhile improvement over previous Junos, particularly when you consider the extent to which the Juno's voices lend themselves to this effect. The increased memory space is similarly welcome – surely there can't be many people who'll want to use more than 128 programs in one set?

A very strong contender for my favourite synth of 1984. . .

Geoff Twigg **E&MM**

The Juno 106 carries an RRP of £799 including VAT, and for further information you should contact Roland UK, Great West Trading Estate, 983 Great West Road, Brentford, Middx TW8 9DN. Tel: 01-568 4578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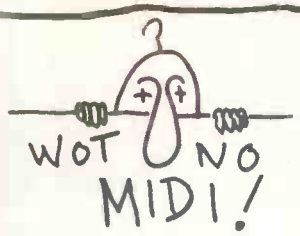

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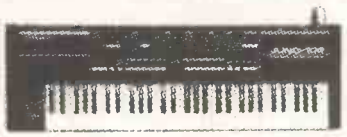

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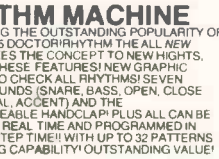

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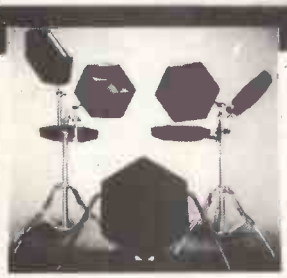

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Roland JSQ-60 DCB Digital Keyboard Recorder

The JSQ-60 is a polyphonic sequencer featuring the Digital Communication Bus (DCB) standard, and can therefore link directly to the Juno 60 and Jupiter 8, both of which have DCB. If your JP8 is prior to serial number 282879, you should contact your Roland dealer for modifications.

The sequencer can be loaded in either Step Load or Real Time mode, and when in the latter mode it is possible to overdub up to three times over the first sequence. The unit is small, compact and well defined, and all the controls are legible and easy to understand.

The JSQ-60 is powered by a DC 9V adaptor and when the power is switched on the Load Mode lights up in the 4/4 LED. For Real Time processing you have three selections which are changed from the Mode Select button, 4/4, 3/4 and Overdub.

Loading is quite straight forward; the Mode selector next to the power switch is for Play Only which protects stored memory, Load/Play and Tape. Having set this selector to Load/Play, the memory is at your disposal. If you change this selector lever whilst the unit is running then the stored data will erase – so take care! If the Load or Play indicators are blinking then you press Reset, having chosen 4/4 or 3/4, press Load and away you go.

Metronome

The Metronome will give a measure of beats visually and aurally before the Load is fully engaged, and there are two levels of Metronome and Off. To stop loading, press Stop and the process will continue to the last note of that measure – the Load indicator will then begin blinking. If you wish to listen to the recorded sequence, press Reset and Play.

Overdubbing is possible only in Real Time: by selecting the Overdub Load Mode and pressing Load you will hear your first sequence while you layer on top. Overdub Load engages after the fifth metronome pulse and automatically ceases at the end of the base data, so think about your endings! If you're using the Juno 60, as I did, you can load six notes maximum at any one moment, though with the JP 8 you can load eight.

To indicate the remaining capacity of the memory, there's a five-way LED line going from 25% to Full. The individual LEDs light up as the memory is used and if Full is shown, the data will stop at the end of the measure.

Step loading is just as simple, by selection of one of the three step-timing values – quaver, quaver linked to triplet and semiquaver – which you choose as the shortest timing value equalling one step. To add to these are Tie, Rest and Measure End buttons which I'll explain in a moment (or a few steps). Every time you enter a chord, rest or single note the metronome sounds and advances one step – when a bar line is written the metronome sounds with an accent but there is no step advancement.

Tie allows the step length to be lengthened and in doing so the note value increases, so if you're in semi-quaver mode and you wish to enter a crotchet chord, you play the cord, release the keys and press the Tie button three times. Similarly, if inputting a Rest command of a crotchet you would press Rest four times as the shortest value is a semi-quaver or a 16th note.

There are a couple of extra things you can do with the Tie button whilst actually playing the notes. If you wish to have a passage phrased with Legato you can play/input the first note of the line then keep the Tie button depressed and play the remaining notes. This can be combined with Tying and Legato together.

Step-Time

Playing in Step as opposed to Real Time offers so many new directions that your music and composing/arranging can take, but it's best to have a clear idea of what you are trying to do: if you're copying a bass-line or music from sheet music, you've got to know how to adapt the score for the JSQ to comprehend it.

Measure End is used to load bar lines; you might feel this process is a waste of time but if you wish to edit or add data you will find it almost impossible without it. In monophonic steps the JSQ-60 can input about 2,000 notes, and if the maximum memory is exceeded, the Memory Indicator Full LED lights up and no further loading can be accomplished. You will never be able to make a mistake regarding the loading process, because when you do the Memory Indicator flashes and beeps wildly at you!

The JSQ-60 allows editing by stopping the sequence just before the required measure and re-entering. This is where the bar lines are useful in Step Load mode, as the data will not stop playing until the very end, even if Stop is pressed, so you cannot edit data in the middle of a sequence.

Continue Load is the ability to continue entering data after a sequence has been stopped. This can be done by Loading instead of Resetting or, alternatively, you can change and so combine different Load Modes together in one sequence. When in Overdubbing mode, Continue Load is not possible, and this is also true when the Memory Indicator shows Full: if you exceed the maximum memory capacity during Continue Load after playback or over-dubbing it will erase the existing data.

Tape Storage

The JSQ-60 can Save, Verify and Load onto audio tape for retrieval of your sequence information. Using the cassette interfaces on synthesisers, sequencers and drum units, you've got to follow certain basic rules, otherwise you may not get verification of Saving/Loading.

Use new and high quality tapes – C15s if you can get them – check the playback level of the tape recorder and adjust it to suit this purpose, check your connections and, if you can, use the same tape recorder for Saving and Loading. Before you do all of these things, clean and demagnetise the head(s).

It is possible for the JSQ-60 to memorise the Patch Shift of the Juno 60 and load Patch presets on the JP8; this is due to the Juno 60 not receiving keyboard information, while still being able to transmit it. As I did not have a DP-2 pedal I couldn't check this out, but I'm assuming it works.

The rear panel houses the DCB connector, Patch Shift out and in, Start/Stop pedal in and the DC 9V in. In addition, there are mini tape outputs for Load and Save which can double for monitoring by headphones, plus two Sync 5-pin outputs for linking to the TR- and CR-series rhythm units and anything that features Sync In (DIN).

So that's the JSQ-60. I did try this unit *via* the Roland MD-8 DCB-MIDI interface and hooked it up with a JP8, Siel Opera 6 and Korg Poly 800, with some interesting results – but that's another article!

It is really easy to use, and once familiar (it doesn't take long!) will be a valuable musical friend to you for some time to come. The retail price of £250.00 makes sequencing even more beautiful.

Vince S. Hill **E&MM**

Further information on the JSQ-60 can be had from Roland (UK) Ltd., Great West Trading Estate, 983 Great West Road, Brentford, Middx TW8 9DN. Tel: 01-568 4578.

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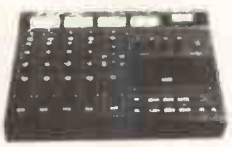

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Casio CT310 Electronic Keyboard

A full-sized example of Casio's 1984 line-up sampled by Dan Goldstein.

When giant calculator-makers Casio first ventured into the world of electronic musical instruments, their output was as inspired as it was unpredicatble. What other manufacturer could have come up with a keyboard as brilliantly versatile as the CT202, as well-conceived as the 1000P, or as mould-breaking as the original VL1?

Nowadays, however, Casio's marketing naïvété has given way to a more streamlined approach, with most of their keyboards being designed for a dual market consisting of domestic 'family' players and pro musicians needing a portable practice instrument.

It was with the latter function in mind that I approached the CT310, a fairly recent arrival to these shores and of more than just a passing interest to pro or 'serious' musicians because it features a full-size keyboard, 12 highly serviceable polyphonic preset voices and a choice of AC, DC or car battery power source. And all for a surpisingly modest £275.

Facilities

As well as being of sensible size (miniature keyboards may be portable and good conversation pieces but they don't do much for your playing technique), the 310's keyboard spans four octaves (C-to-C) and has a light, pleasant action not far removed from earlier Casio endeavours of the same type. All the preset voices are eight-note polyphonic, which is not less than an instrument of this genre needs to have, and the 12 are selected *via* a familiar arrangement of six dual-function push-switches and a seventh select button. As is so often the case with instruments of this type, the voices that stand up best to being put through external amplification (as opposed to the 310's built-in 12cm speaker) are those with percussive envelopes like electric piano, vibraphone, cosmic tone (think of it as being a bit like a synthesised Clavinet D6) and harpsichord. Organ tones are reproduced less successfully but still quite presentably, while the brass effects could pass for a fairly dry polysynth approximation.

All voices can be routed through a choice of four different effects – vibrato, delayed vibrato, sustain, and (something novel for Casio, this) reverb. These are selected by the use of two selector switches, meaning (unfortunately) that it's only possible to select two of the effects at any one time. This is a pity, since a combination of vibrato, sustain and reverb would have been quite something – however, since the last two are essentially products of the same circuity, it's not altogether surprising that their sonic union is an impossibility.

Accompaniment

Should you wish to give your 310's output a little more vitality without having to play particularly fast or connect up awkward auxiliary equipment, Casio's *penchant* for auto-accompaniment features provides this particular model with an almost mind-boggling quotient of typical functions.

To begin at the beginning, a drum machine incorporating 12 factory preset rhythms is located to the left of the voice selection switches, and is activated in much the same manner as the latter. The rhythm patterns themselves are nothing special, while of the drum sounds, only the bass drum stands out forcibly enough to really cut it, but you can't write this section off quite so easily.

It's when you add some form of tuned accompaniment to the rhythms that things start to get interesting. On the CT310, this accompaniment comes in the form of an arpeggiator, an auto bass line and a 'Casio Chord' instant-triad section, all of which have four variations selectable *via* slider-switches near the instrument's top lefthand corner. Ordinarily this arrangement would give a reasonable number of possible accompaniment combinations, but since each effect and variation is different for each separate rhythm pattern, the total number of possible arrangements is a staggering 768, which should keep most autoplay freaks happy.

That's the paper specification.

What's less encouraging is the way these accompaniments work in practice. Don't get me wrong: as auto-functions go, those on the CT310 are amongst the best, but without any form of sequence recording and playback, the section rules out any real creative input on the part of the musician, which is quite a serious flaw, in my opinion.

Conclusion

Bearing its low purchase price in mind, this new Casio continues the company's tradition of designing and building keyboards that offer consistently good value for money. Its facilities work well, its sounds are perfectly acceptable (if a mite lacking in imagination) and its control layout is logical and functional

That said,however,the feeling remains that the 310's designers have given adventure the thumbs down and plumped instead for the safety of a largely domestically-orientated product. I think that's a shame. There's no doubt in my mind that Casio have the skill, technology and production know-how necessary to manufacture first-class high-tech musical instruments that would grace the equipment lists of many a household name. Whether or not they have the inclination to do so is an entirely different matter, of course.

The CT310 is an instrument that accomplishes what it sets out to do very competently – it's just a pity that the market area for which it is principally intended is such a limited one.

Dan Goldstein **E&MM**

The Casio CT310 carries an RRP of £275 including VAT, and further information is available from Casio at Unit 6, 1000 North Circular Road, London NW2 7JD. Tel: 01-450 9131.

GIG Sounds

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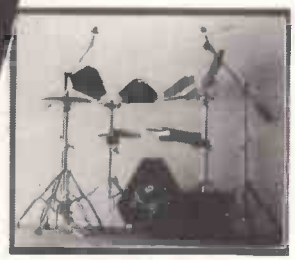

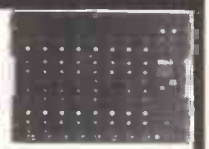

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Simple to use, a pleasure to own; unique sweepable bass and mid bands EQ section, should help you tune out of any tonal problem that mic technique cannot cure. From the incredible 8-2-1 mixer to the amazing 16-16-2, these decks could be twice the price. Luckily at Gigsounds they're not.
The 8-2-1 starts at an incredable £360, and the 16-16-2 is *under* £2000, yes that's right!

AHB

Allen & Heath are well known both in the UK and Europe. Their fame grew from consoles which were cost effective, and ergonomic. Their present series, the system 8 and series 21 are no exception to that beginning. The series 21 18-2 is an amazing £599 whilst the 16-8-2 system 8 won't break the bank at £1299.

TASCAM

TEAC Production Products

Not a name you'd normally associate with mixers, but the concept of expandability through the range, coupled with a quality you wouldn't find easy to knock, could well make their products top of the list for a wise starting point.
The model 2A, probably the cheapest 6-4 on the market at only £245.
The model 30, is an 8-4 mixer, with an 8-2 submixer built-in. The flexibility of this unit is incredible.
The MX80 is an extremely useful 8-2 rack mounting mic mixer, and is ideal in its own rights or as a submixer. Provision for Phantom powering, and insert points, are just two of the factors that make this a bargain at £340.

Fostex

The model 350 shows remarkable market awareness. Complete with sweepable EQ, stereo auxiliaries, RIAA preamps, and an 8-4 format, make this product ideal for many applications other than the A8, which it complements at £455.

GIG Sounds

Fostex X15 multi track notebook	£299
Fostex A8 The Revolutionary 8 tracks on 1/4"	£1195
Tascam 244 portastudio – ex-demo	£595
Boss DE200 delay with hold/trigger	£299
Roland SDE2000 delay ex-demo	Offers
Fostex 3040 4 Ch. Dolby C-noise reduction	£190

Special product feature of the Month

The Tascam 244, is a second generation portastudio, which has a host of facilities. Dual band sweep EQ, Stereo Auxiliary, insert points, Pitch control and 30dB noise improvement with built-in DBX make this machine an attractive proposition. This month we're making this machine even more attractive by offering it a special package price which includes – mic, headphones, and 3 cassettes, as a ready to use suitcase studio. The package price? £Phone to find out.

PACKAGES are available complete with leads, advice and back-up service

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Tascam 32 high speed mastering machine
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Roland SDE1000 digital delay, with patching memory
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2
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Fostex 350 mixer and meter bridge
Accessit reverb
Ibanez DM1000 digital delay line
Interconnecting cables and tape
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3
Tascam 22-4 four track on ¼" tape
Studiomaster 8-4 mixer
Boss DE200 digital delay line, with hold and trigger
"For the performance of a reel to reel on a tight budget this package could make you as famous as the Beatles"! £1785

4
Yamaha MT44 four track cassette (normal speed Dolby B/C allows use as an ordinary cassette machine, for copying etc).
Yamaha MM30, complete with built-in Echo and graphic
Yamaha RB30 Patchbay
"A great system that you can expand if the need arises" £

Recorders

TASCAM

From the 38 ½" eight track, which has built-in varispeed, provision for DBX, to the Tascam 234 4 track cassette recorder, which is the best quality cassette transport on the market, which rack mounts, switchable DBX, varispeed and self contained monitor mixer, the Tascam range still represents the best quality available for today's serious recordist.

FOSTEX

From the revolutionary A8, ¼" eight track which revolutionised the market both in technology and price, to the incredibly affordable 15 portable multitrack notebook, the Fostex range must have brought recording within the reach of many musicians.

Studiomaster

The studio 4 is the only suitcase studio to have a fully fledged mixer built-in. Six channels of Studiomaster desk is an incredible step towards serious home recording. The uses of the mixer extend outside of the home studio and incorporate, stage use and more besides. Once you've seen for yourself all this unit has to offer we think you'll agree it's a snip at £799.

YAMAHA

The MT44 system is a well conceived system. The four track cassette unit, has Dolby B & C, and runs at normal speed. This allows its use as an ordinary cassette deck, for making copies etc. £399.
The MM30 mixer has both an echo and a graphic built-in, and its modest size and price is very attractive. (4-2 format) £199.
The system can also incorporate a patchbay and a rack to house it all in, and the system can be nicely rounded off with a pair of Yamaha MS10 personal monitors, which have Bass & treble controls as well as a healthy rating of 10W.

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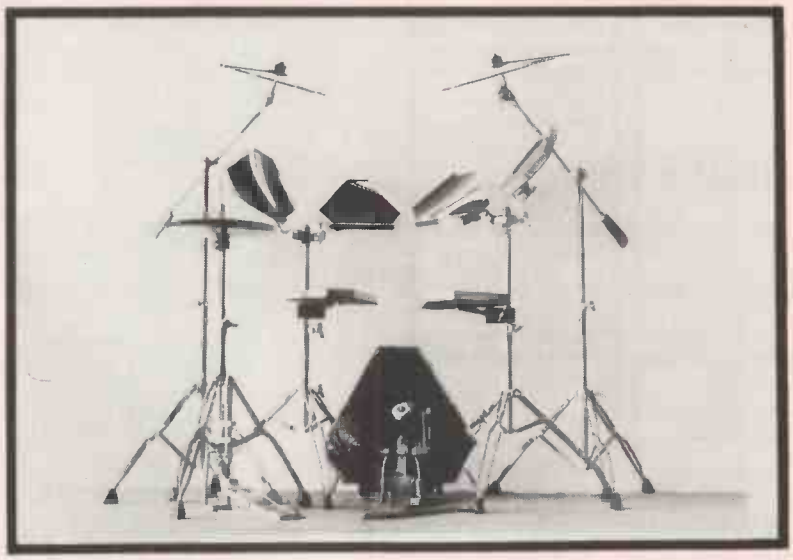
M&A Electronic Drum Kit

From the wilds of darkest Essex comes Magic Music's new electronic drum kit, with analogue sound generation and built-in sequencer. Paul White **puts it through its paces.**

The M&A analogue electronic drum kit typifies the new generation of affordable electronic percussion, combining striking visual design with the ability to produce a wide range of contemporary sounds. Manufactured and marketed by Magic Music, the standard eight-drum outfit represents the culmination of over seven years of experience in electronic percussion for engineer Mick West, who developed the system single-handed. The standard kit comprises eight drum pads and stands, complete with leads, hi-hat pedal and eight voice control modules.



Construction

All the drum pads are identical in size and shape, with the exception of the bass drum which is somewhat larger than the rest. The playing surfaces are formed from polycarbonate sheet (which is virtually indestructable), and are mounted on a foam-sprung base to reduce if not eliminate possible wrist discomforts on the drummer's part.

The shell of the drum is formed from pressed steel as is the chrome plated rim, and both the shell and the playing surface are finished in black. As can be seen from the photograph, the drums are joined together permanently in groups of three in order to simplify setting up and to increase the rigidity of the assembled kit. The mounting system is designed around a heavy-duty Premier stand, and the brass drum pad is extremely stable, having two large angled spurs and two stub spurs on the pedal mounting plate. All the leads have locking connectors at both ends, so you won't be embarrassed by a plug falling out mid-session.

There seems to be an air of secrecy surrounding the actual mechanics of the transducers, and all Mick was prepared to admit was that they have been designed to be virtually indestructable and are the product of considerable research.

Electronics

The rack-mountable control module houses eight channels of voice circuitry, each having independent level, pan and sensitivity controls. An external trigger input is also fitted, enabling each channel to be triggered individually from any external sequencer having a positive going output pulse. The module also features master level and EQ controls and – unusually – has a built-in sequencer which can play six different preset rhythms using the first three voice channels.

A Pulse button is fitted to each channel so that it may be driven from the sequencer clock to facilitate setting up of sounds. There is a factory preset sound available for each voice which may be altered by means of internal presets if required or, by operating a push button, the parameter controls may be used to create new sounds.

Internal construction is much akin to that of a non-modular mixer and the circuitry is simple but well thought out. Each voice has its own oscillator and a single noise source is distributed to all channels *via* a bus bar system.

The voicing of the modules is produced by mixing noise, the pitch oscillator, and the stick click together in varying proportions. Sweep of the oscillator pitch is possible in both upward and downward directions and a variable filter is used to modify the timbre of the noise component. Interestingly, the Decay control affects the preset mode as well as the user-programmed sound. The all-steel construction is rugged but attractive and internal composition should give no cause for concern.

For those players wishing to practice without upsetting the neighbours, a headphone output is fitted which provides enough power to make the average E&MM reader's eardrums meet in the middle of his head!

The complement of hardware is completed by the hi-hat pedal which enables channel 3 to be triggered by foot or by pad, and depressing the pedal chokes the decay of whatever sound is set up, enabling a reasonable simulation of the acoustic equivalent to be produced.

Hands On Test

The drum surfaces have a realistic feel and should not be a great source of discomfort, even on long sessions. Adjusting the Sensitivity control enables reasonable dynamic control to be achieved, and the range should accommodate most playing styles, even very heavy-handed ones. . . .

Setting up the bass drum sound resulted in a good meaty thump, and mixing in an appropriate amount of click added definition and bite. Checking out the factory preset revealed a very usable bass drum simulation with just the merest hint of pitch sweep.

The facilities on all the channels are identical and setting up new sounds is quite easy, the average user – I should imagine – requiring only a short time to become familiar with the available controls. Most of the drum sounds are modern and punchy, but as is so often the case with analogue kits, no totally satisfactory cymbal sound could be obtained, though since most drummers prefer to use real cymbals in any case this does not represent much of a problem. The hi-hat sound is passable but, again, I prefer the real thing, and would personally use real hi-hats and cymbals and set up all eight voices on the M&A as drum sounds.

Conclusions

The M&A kit is certainly visually attractive in spite of its rugged, almost indestructible construction, and the arrival of an eight-drum kit at this price has got to be good news. Of course, any kit of this type invites comparison with the new Simmons SDS8, especially as they are both in the same price bracket, but although the sounds and facilities are similar (with the exception of the M&A's built-in sequencer), both have their own distinctive character and sound.

In the final analysis, it's a matter of which sound appeals to you and what facilities you require, but either way, there's no denying the M&A kit represents good value for money.

Paul White **E&MM**

The eight-drum kit reviewed here carries an RRP of £699 including VAT. In addition kits made up of individual pads are available at £645 (five drums) and £860.75 (eight drums). Further details on all these are obtainable from Magic Music, Unit 13, Industrial Estate, Steeple Road, Mayland, Essex CM3 6AX. Tel: (0621) 742244.

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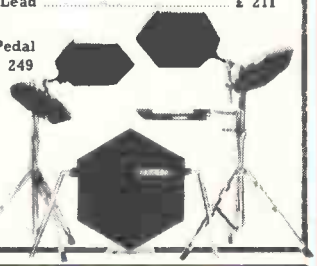

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244 Portastudio	£ 659
34 4 Track	£ 899
38 8 Track	£1749

Fostex

X15	£ 299
250 4 Track	£ 599
A8 8 Track	£1135

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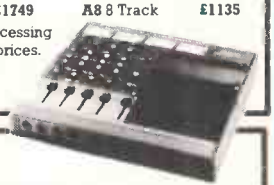

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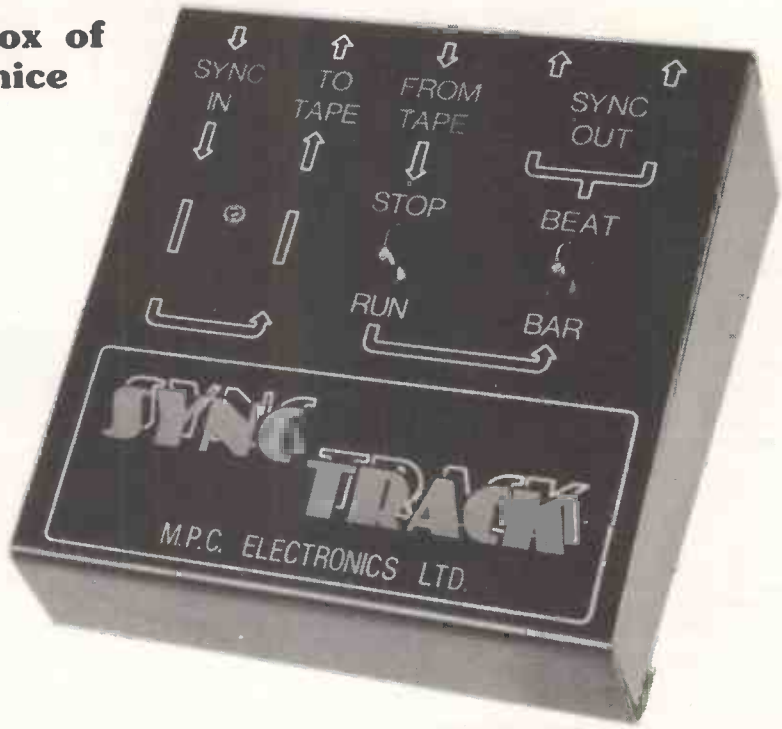

In conjunction with any drum machine fitted with a clock output, the Sync Track enables a string of pulses to be recorded onto one track of a multitrack tape recorder, and then, used in Playback mode, enables these pulses to be used to control the starting and tempo of various rhythm machines, arpeggio clocks, and sequencers.

The unit is configured such that it will interface directly to a number of electronic musical instruments, including the Roland TR808 Rhythm Composer, Drumatix, Bass Line and CSQ600 sequencer, using a standard 180-degree DIN-to-DIN lead.

The Sync Track is powered by a single PP3 battery, and incorporates Tape and Sync in and out sockets, a start-stop switch, and a beat/bar selector switch which may be used to ensure that the correct rhythm pattern starts from the beginning in the event of a particular track being stopped and then restarted.

Housed in a small steel box about five inches square and a little over one inch deep, the Sync Track comprises a single printed circuit board containing three ICs and a handful of other components. All the sockets are situated at the back of the unit, whilst the front panel houses the run/stop and beat/bar switches and a power LED indicator.

The tape in and out sockets are quarter-inch jacks, and inserting a plug into either socket connects the battery to the circuit. Sync in and out sockets are five-pin DINs, and the latter is split into two connectors so that two machines can be synchronised to tape simultaneously.

Operation

The clock output of a drum machine (for example) is fed into the Sync Track, which shapes the pulses and provides an output level suitable for feeding directly into a tape recorder. The recommended recording level is around -5dB, though in practice it's possible to get away with somewhat lower levels. This latter practice can prove quite advantageous as it reduces the risk of crosstalk onto any adjacent tracks.

In play mode, the unit receives the pulse from tape and reshapes and amplifies it to a level where it will drive the trigger input of a drum machine, sequencer, or similar.

The system has the advantage that a drum machine can be synchronised to the trigger track on tape and used to replace the original rhythm track if it's subsequently felt that a different rhythm would suit the piece better. The trigger track will hold the drum machine in perfect sync and ensure that both the recorded track and the drum machine start simultaneously.

If it is necessary to halt the drum machine during a composition – to produce a pause, for example – you simply switch the start/stop selector to 'stop' (surprise, surprise. . .), and if 'beat' on the beat/bar switch is selected, the Sync Track will restart your drum machine on the beat following the one on which it was stopped. If, on the other hand, you select 'bar' (this logic is really going to floor you), the drum machine will restart at the beginning of the *bar* in which it was stopped.

The Sync Track can also be used to drive a rhythm machine (eg. TR606 Drumatix) from a tape sync track and use this to trigger the arpeggiator on a synthesiser. One advantage of this mode of operation is that the arpeggiator rhythm need not be decided until the last moment. In fact, it's not even necessary to record the drum machine or the triggered sequencer/arpeggio at all: they can be connected directly to a mixer and treated as extra tracks at mixdown. This is obviously advantageous if you're short of tracks (who isn't?), and furthermore, it means that a drum machine with separate outputs can be used in stereo with the provision for level balancing and EQ to be selected during the final mix.

Track Test

The unit was tested with a Roland TR606 and a Tascam 38 eight-channel tape recorder. All functions worked as described in the owner's handbook and I was pleasantly surprised to find that I could get away with recording a much lower level of sync pulse on tape than the recommended value.

Similarly, playback presented no problems – the Drumatix waited patiently for the sync pulse track to start and then dutifully played along in synchronisation.

Summing-up, if you're like me and prefer to leave most of your musical decisions until the last minute, then this little box could prove a godsend. Likewise, if you're well stocked with musical hardware (drum machine with separate outputs, polyhonic sequencer, arpeggiator with separate trigger input) but not so well-endowed with multitrack recording equipment, the Sync Track should enable you to produce a considerably more ambitious piece of work *without* all that tedious track bouncing.

The only thing less than perfect is the user's manual which, though generally easy to understand, has unfortunately been written in badly-spelled, almost pidgin English in places (just like most of E&MM, really): perhaps it's an attempt to gain credibility amongst readers of Far Eastern instruction books. . .

Seriously, at only £39 this tiny unit represents a very worthwhile inveset-ment, and what's more, it's British!

Paul White **E&MM**

Recommended retail price for the Sync Track is £39.95 including VAT, and further information should be available from MPC Electronics, The Gables, Station Road, Willingham, Cambs., CB4 5HG. Tel: (0954) 60264.

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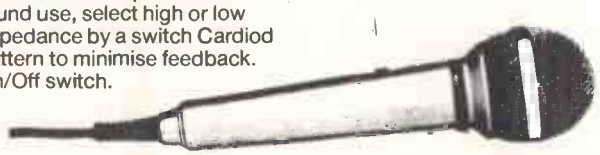

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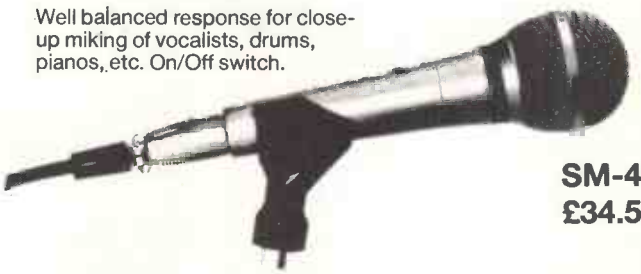

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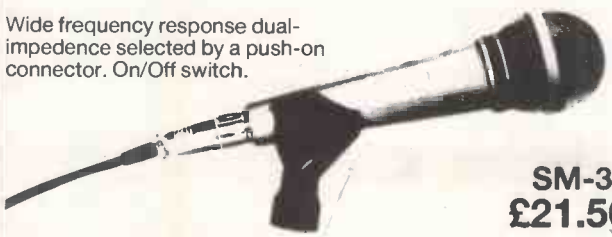

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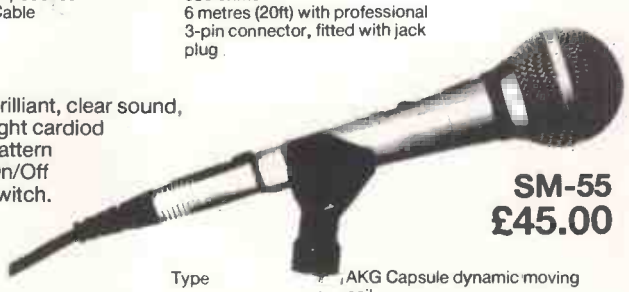

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Dynacord PDD14

Programmable Digital Delay

As the recent Frankfurt Music Fair demonstrated. 1984 looks like being something of a vintage year for respected German manufacturer Dynacord, with a whole host of new, high-technology musical products about to be unleashed from their Straubing factory. First of these to hit the UK will be the PDD14 programmable delay line, and Paul White **recently had the good fortune to cross its path.**

If last year was the year of the affordable digital delay, this current one will probably be the year of the affordable *programmable* digital delay, and the Dynacord model under review here is as good an example as any of what the marketplace has to offer.

Dynacord have been producing quality audio equipment since the sixties, but their profile in this country has never been anything other than a fairly low one. Although the construction of their products has always been rugged, it's probably true to say that, in the past anyway, the styling of their models would not have looked out of place in an army testing range. The PDD14, on the other hand, is both smart and conventional in appearance, which is good to see. Housed in a black 19" rack-mounting case 2U high, the Dynacord is fitted with small handles on the front (after the fashion set by the Roland Rack models) and features a visually pleasing, clearly arranged front panel layout.

Internal Construction

The inside of the unit differs noticeably in constructional syle to that of most Far Eastern units, and indeed is more reminiscent of the approach adopted by American designers of high-grade laboratory equipment. There are two PCBs, one carrying all the components related to the front panel and display, the other holding the main bulk of the circuitry, including the memory and EPROM operating system. The layout is well thought-out and makes good use of the available space, without resorting to cramming everything in for the sake of external appearance.

The circuitry generates delays of up to 760ms at a bandwidth of 15kHz for all elay times. Analogue-to-digital conversion is achieved by means of a quasi-14-bit non-companding system, and this results in a highly commendable 85dB signal-to-noise ratio.

The programs themselves are stored in non-volatile RAM, whilst the actual delay is produced by five 4164 dynamic RAM chips, giving a total of 320Kbits of available memory. Just how many bytes this represents depends on how many bits wide the memory bytes are, but I would guess that between 22Kbytes and 32Kbytes would be needed to produce a delay of this bandwith and resolution.

The block diagram supplied with the system pionts to a fairly conventional design philosphy, the only parts warranting further description being the programmable controls themselves. Being digital, the control range of each adjustable parameter must be resolved

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into a finite number of steps, and in the case of the PDD14, 64 of these steps are used. These are converted to a six-bit binary number which can be handled and stored by the internal processor system. Because of this digital control, all gain adjustments within the circuit such as 'level' and 'feedback' are handled by VCAs, which also receive their instructions from the microprocessor system.

Facilities

The controls are typical of most digital delay units with the exception of the programming section. A modulation oscilator is provided so that, in conjunction with the feedback control, all the usual chorus, flanging and echo effects can be reproduced to a very high standard. Eight sets of useful parameter values can be stored for instant recall, there being six programmable parameters from which to choose. These are Duration (Feedback), Tone, LFO Speed, Modulation Depth, and Mix and Output levels.

The front panel has a numeric display which indicates the program currently operating and also shows the delay time in milliseconds. Programming is achieved simply by setting up a suitable sound, pressing the Store button, selecting the desired memory and then pressing Store again. A Manual switch is provided so that sounds may be set up without interfering with settings already in the memory.

Also available is the PFS14, an optional footswitch bank that can be connected to the PDD14 *via* a multicore cable and locking plug. It really is an essential purchase if the Dyncaord's programming functions are to be made proper use of in a live situation, since it allows the user to change programs or bypass the effect completely, the program number being indicated by a single numeric LED display.

The footswitch unit is necessarily large to accomodate the eight selector swtiches plus the Bypass switch, but it is well made, easy to use, and has a fine non-slip base.

Connections

The signal connections are all made by means of standard jack sockets on the rear panel, and the input can be adjusted to accept any level between five millivolts and three volts. A hi-lo Gain switch is provided so that the input may be matched to microphones or instruments, and a ten-section LED meter is also incorporated to help optimise the input level. It's worth noting at this point that the only switch on the back panel is the ground-lift, so full marks to Dynacord's designers for a sensible layout, fairly rare in this field.

There are three separate outputs for direct, delayed, and mixed sounds, with a further socket being provided for an additional footswitch to activate the Repeat or Freeze mode, which causes the sound in memory to loop continuously every 760ms. The input and output sockets and the Repeat footswitch socket are thoughtfully duplicated on the front panel for convenient operation when the PDD14 is used as a freestanding unit.

Test Drive

The first thing I tried was to change the delay time using the increase-decrease buttons. The rate of change starts off very slowly and then accelerates until the switch is released. I found this procedure painfully slow and would much prefer an analogue rotary control or at the very least a 'fast' button of some sort.

Having set up and stored eight different effects, I tried the footswitch and keypad selector, both of which worked well without causing any switching noise. However, some odd effects were caused when switching from a short delay, modulation effect to a long, straight delay, as the contents of the PDD14's memory take a short while to flush out.

The sound quality of all the delay effects matched the high standard the written specification suggested, though flanging effects, as is so often the case, proved a little noisy due to the high levels of feedback involved.

All the common time delay effects were easily obtainable and a set of useful patches is provided in the handbook for those who want to set up a particular effect with the minimum of experimentation. The modulation range was particularly good, so flanging was not limited to the anaemic effect produced by some lesser units.

Conclusion

With the exception of the odd little annoying feature (such as the slow method of adjusting the delay time alluded to above) operation of the PDD14 should pose no problems and the sound quality is excellent. I'm quite surprised that there is no sampling facility on this unit, and even more surprised that in the Repeat mode, only 760ms loops are possible.

All in all, though, the PDD14 is a quality piece of equipment at a reasonable price, and as such is definitely worth checking out if you're in the market for a new delay unit, providing you can live without a sampling facility.

Paul White **E&MM**

The PDD14 carries on RRP of £589 including VAT, while the PFS14 footswitch costs a further £118, also including VAT. Further details from Washburn, 20 Victoria Road, New Barnet, Herts. Tel: 01-449 7765.

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Points on the Curve

Not so very long ago, Wang Chung were little more than a conventional rock band with some bright ideas about composition and arrangement. Now, a year at Abbey Road surrounded by high-technology musical instruments later, the band are enjoying singles success on both sides of the Atlantic and have just released their second album, *Points On The Curve*. Dan Goldstein **talked to them recently about the making of that album and their attitudes to music writing and playing generally.**

Nick Feldman, Jack Hues and Darren Costin began their joint musical career in a band called 57 Men, a six-piece whose necessarily loose format resulted in a rapidly-formed desire for greater musical compactness and the eventual formation of splinter-group Huang Chung, or Wang Chung as their present record company would prefer them to be known.

The basic line-up of the new band consisted of Nick on bass, Jack on guitar and vocals and Darren on drums.

Although the three of them shared common musical aims and desires, their backgrounds differed widely, Jack first picking up a guitar at the tender age of eight as an unpaid apprentice in his father's cabaret band – and taking classical guitar lessons at the same time – Darren taking up piano but rejecting it in favour of 'something more rhythmic', and Nick not beginning to play guitar until his post-school days, turning to bass upon the demise of 57 Men.

While neither members of the Wang

Chung rhythm section underwent any formal classical training, Jack Hues continued his 'traditional' musical education by spending four years at college, something about which he has slightly mixed feelings.

'There's no doubt it was a very valuable time for me. The course was quite a good one in that as well as majoring on the mainstream European composers in whom I was principally interested, it also incorporated the theory of Balinese, Javanese and Chinese music, which although I didn't study in any great detail, I did find enjoyable reading about without any other obligations.

'On the other hand, my writing suffered to an extent because I found that in many respects I was preaching to the converted. I'd be playing a piano piece I'd written at a recital, and I'd realise that most of the people in the audience were also writing the same sort of piano pieces and that the only way I'd be able to get out of that rather closed environment would be to apply my writing skills to rock music, which is what I subsequently did.

First Album

The trio's first break came when Arista Records picked up on a demo tape and signed them on a one-album deal. That album, entitled simply *Huang Chung* (the

HUANG CHUNG

reasons for the name change are still slightly obscure) is conventionally arranged, performed and produced, but nonetheless contains the germ of great songwriting talent at work. When the recording was completed, however, the band themselves were not altogether happy, as Darren explained.

'We went into Basing Street Studios completely green. The record company took the usual attitude of "You're a new band so you don't know what you're doing – we'll get a producer in who does", and I think that was where things went wrong, because although we didn't really know *how* to get what we wanted in practice, we knew about our own *ideas* far better than anybody else. We left most of the important sound decisions up to the producer, because we weren't confident enough to do that job ourselves.'

Nick has further thoughts on the subject.

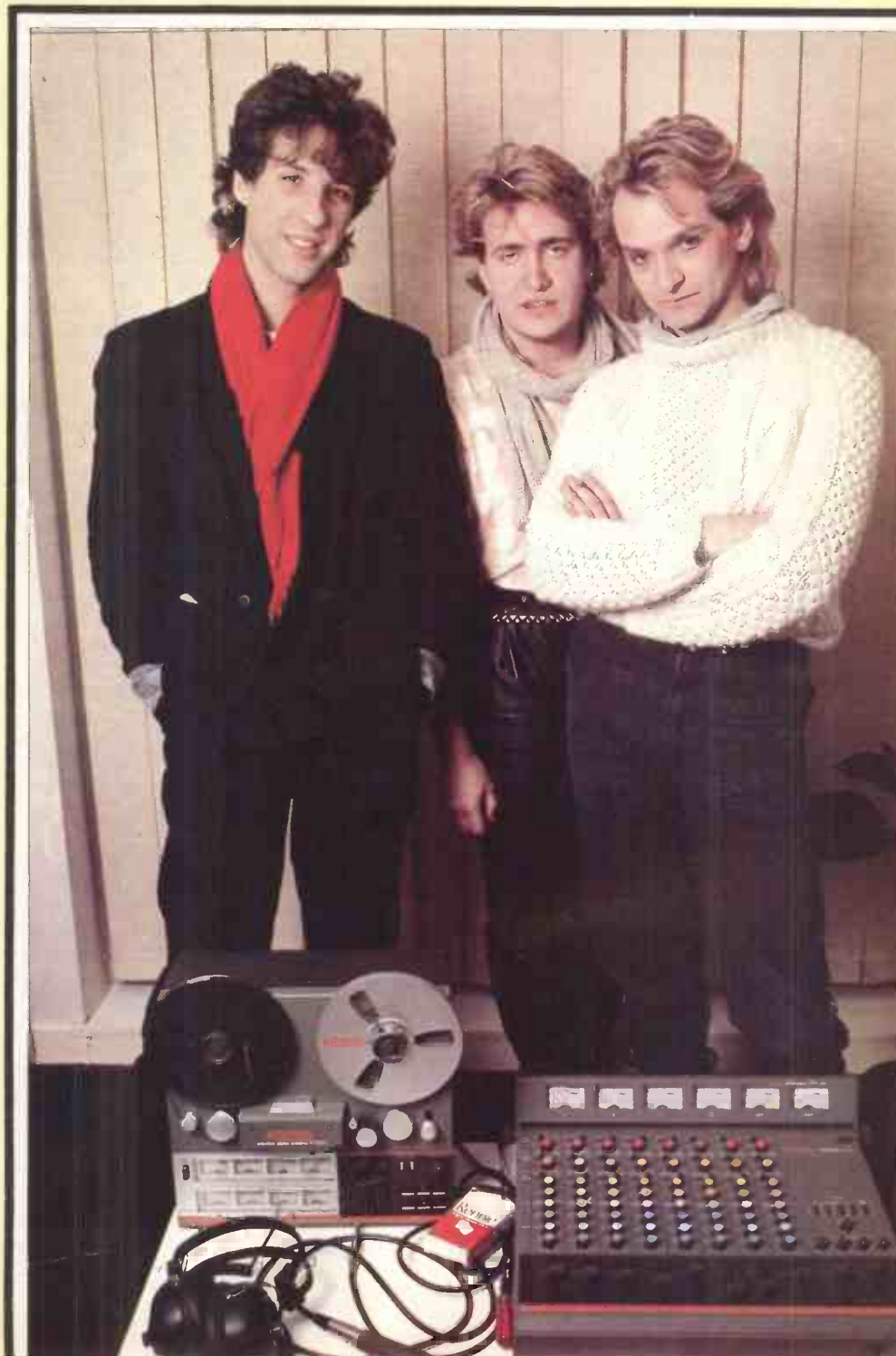
'I think we can probably look on the first album now with a certain amount of affection, but at the time we were a bit disappointed with what we'd done, simply because we hadn't been able to get the best out of what was some pretty decent material. It must be said, though, that I think our songwriting has improved immensely since then, and the new album shows that, I think.'

Regardless of its musical merit, however, *Huang Chung* fell far short of becoming an overnight success. The band left Arista, and there then followed a lengthy period of silence, during which time many people wrote the trio off as being missing, presumed dead.

Yet the band were far from that.

In reality, they had simply retreated temporarily into the hallowed chambers of EMI's studios at Abbey Road, there to record their second album – their first for their new backers, American label Geffen Records.

In these days of high-speed marketing and rocketing studio costs, a year is an



awful long time in which to make just one LP, but as Nick explained, there were several pretty good reasons for the delay.

'Prior to starting the recording we'd had very little experience of electronic or computer instruments, and working with them became very much a sort of extended learning process for us.'

An inkling into just how lengthy and contorted that process must have been can be gleaned from the equipment lists of the band before they went into Abbey Road. Nick was still suffering from nightmares about a Columbus guitar that 'totally defied tuning up, due I think to the intonation being wrong – it probably accounts in part for my slightly weird style!'; Jack was still plagued by 'an old Vox guitar with about 15 pickups on it, all of them sounding.exactly the same . . .', while Darren was just beginning to get used to drumming in time with a newly-discovered LinnDrum.

It wasn't only the band that had to acclimatise themselves to new musical tools, either. Chris Hughes – who was to co-produce the album with Ross Cullum – had just acquired a Fairlight CMI at about the time that Wang Chung began their recording work in earnest, and although he was familiar with the machine's operation at a textbook level, he knew little of how to get the best from the instrument's sampling capabilities.

Abbey Road

Another major change manifested itself in the form of studio environment, Abbey Road's solid institutionalism contrasting sharply with the commercial atmospheres to which the band were used. As with the other changes that took place, however, the move into a more workmanlike environment proved beneficial to Wang Chung's end-product. Nick again.

'Abbey Road really was a surprisingly good environment in which to work. The atmosphere takes a bit of getting used to simply because it is so "BBC" and totally unlike the brown shag-pile carpet of commercial studios; the change hit us particularly when we went to lunch, for example, and found ourselves queuing up in the canteen behind 50 members of the London Symphony Orchestra or something. It really is like a place of work, instead of a kind of leisure centre.

'It did have its limitations, though. We did a lot of our recording in Studio Two which, in those days, had an incredibly antiquated mixing-desk, with pull-over faders and a patchbay that always looked like Spaghetti Junction because routing everything was always so troublesome. On the whole though, we survived those technical limitations very well, partly, I think, because we worked in very, very close collaboration with the producers.'

That collaboration also resulted in a lot of headaches so often encountered with operating modern musical and recording equipment being removed, as Jack revealed.

'I think we probably would have spent even longer recording the album if we'd had to discover everything by ourselves. With Chris and Ross around we never had to worry about, say, getting the sync codes for the multitrack, LinnDrum and Fairlight spot-on – they'd have it all worked out before we even started recording.

'Another point worth mentioning is that because both of them are quite close friends of the band, we developed a very good understanding between each other. That is something I see as very important, because obviously there are restrictions on just how accurately you can verbalise about sound. There are only a few different words you can use to describe music, but the aural ranges that music can occupy are very wide. What was good about Ross and Chris was that they seemed to be almost instantly sympathetic to what we wanted to do, so we were complementing each other instead of competing.

Effects

The sympathetic producer-artist relationship held true for specifics as well as general attitudes: Jack went on.

'One of the things we did find was that on the Fairlight we were using – an older one without the latest voice cards and so on – a lot of the basic sounds were

pretty thin and lifeless, and they needed brightening up so that they could cut through the mix a bit better. So we used a lot of outboard effects, especially reverb.

Ross is an absolute genius with AMS systems and Lexicon 224X. Unlike a lot of engineers, he doesn't just set up something that sounds quite acceptable; once he's found the particular type of acoustic we're after, he'll spend hours trying out new things to see if he can improve it, to try and make it sound different from everybody else's reverb. He uses a Quantec as well and manipulates it in much the same way. In fact I'd say he's an adventurous producer all round, which suits us perfectly.'

Listening to the album – now on nationwide release and given a title, *Points On The Curve*, it's not difficult to appreciate the skill with which the songs have been arranged and produced. It's a colourful record, full of life and experiment without ever becoming remotely inaccessible. Apart from the traditional tones of a three-piece guitar combo and the Fairlight's unmistakable samplings, other sound textures on the album are provided by ordinary common or garden synthesisers, most notably the Roland Jupiter 8, SCI Prophet 5, and PPG Wave 2.2.

Given such a bewildering array of versatile electronic instruments, it would have been all too easy for Wang Chung to have slipped into the trap of letting the synths do most of the talking for their own sake. Instead, however there's a refreshing lack of synthetic special effects, most of the Fairlight and PPG voices being subtle and carefully weighted – striking without being obtrusive. I wondered what had led the band to choose those sorts of sounds in particular?

'When it came to selecting sounds on the PPG and Fairlight', Jack proffered. 'I think we deliberately avoided sounds that were obviously synthetic – we didn't use any tricks or aural fireworks. What we did do was create some orchestral-type sounds, partly I think because of my own preference for genuine orchestral textures. I don't think we ever consciously went after the sound of an orchestra as such, because for one thing i don't think any of the computer instruments are capable of imitating a full orchestra anyway. I see the Fairlight as being a machine that can put acoustic sounds in inverted commas, as it were, because when you listen to the way it replays a sampled sound, it doesn't really sound like the original at all – it just gives you the range of the thing, a vague air of the acoustic sound.

'When you think about it, acoustic sounds are quite a bit more complex in their harmonic construction than synthetic ones, which tend to have very simple waveforms, and I think that's why the manipulation of acoustic voices is more rewarding than working with synthetic ones.'

Mixing Samples

Nick brought the computer aspect down to specifics.

'What interests me about working with the Fairlight is the way you can mix, say, a cowbell with something totally alien – you end up with what you might call a perversion of the real thing, rather than an attempt to simulate it accurately. That's partly why we didn't use a real orchestra on the album at all, because although we'd decided we wanted those sorts of textures, we preferred to go for slightly approximated sounds – corruptions if you like – rather than clean, natural ones. There's a danger that if you rely too much on conventional sound sources, you can end up sounding like a band with a Barry Manilow string section.'

And as for the techniques used to create those 'corruptions'?

Jack: 'That was really where a lot of the learning process came in. At the start we could have thought of a sound and experimented on all the machines for hours on end and *still* not get it absolutely right, whereas by the end we'd know almost instinctively which keyboard to approach first to get a certain sound quickly.

'What we did find was that it was quite difficult to use just one electronic or computer instrument on a certain song. All the machines have their various strong points and they complement each other, so that for instance we found ourselves using the Fairlight for Chinese orchestral-type voices on 'Even If you Dream' and then backing them up with a sound from the PPG. Using one of the stock sounds on the Fairlight, if you try hard enough you can almost always find something that resembles it on the Wave 2.2 as well – you can then layer the sounds together so that the Fairlight provides the clarity while the PPG adds the punch and the warmth.

Composition

Given the amount of care with which Wang Chung's recent material has been arranged, it's perhaps surprising to learn that, at the songwriting stage at least, the actual sounds of the instruments are very definitely of secondary importance.

'Certainly with this new album', Nick commented, 'when I was writing from the keyboard I tried to set up as neutral a sound as possible on the Prophet 5 – my main writing instrument. Working that way, you ensure that none of what you write has come about as a result of going overboard on a particular sound. The emphasis is very much on melody, form and structure, and I think the album as a whole has a very definite individual style that reflects that neutrality of sound, and becomes very evident as you listen to it.

'Obviously sound textures are important to us – they're a significant part of what we do – but they're something that generally comes in at a later stage for us.'

Jack has more to say on the subject.

'What i think is quite important is that because most of our songs are quite strong as compositions, and because they don't rely on a certain synth sound for most of their effect, they stand up pretty well to the transition between recording and performance. Most of our material is worked out with a certain amount of detachment from what we're using, rather than simply being the result of messing about with a particular sound, and that results in songs that stand up equally well in a live situation as they do in a studio one.'

The subject of live performance is a topical one because, in the not too distant future, Wang Chung will be stepping-out on a major British tour to promote *Points On The Curve*. They'll be using an additional band-member to take care of the keyboards (in the studio they split that duty about 50-25-25 with Jack doing most of the work, but none of them has so far succeeded in mastering playing more than one instrument at once), and he'll be greeted on stage by a Jupiter 8, the Prophet and a PPG, possibly a new one. They'll also – rather astonishingly in this context – be taking an old Novatron out on the road with them.

Darren: 'We're using it as a sort of cheap sampling device, playing recordings of hi-hats backwards and so on. It's ideally suited to live use because it's so sturdy, though having said that, the only previous time we gigged with it, it blew up, though Adrian Lee, who was playing keyboards with us at the time and whose instrument it was, maintains that's the only time it's ever happened, and I believe him.'

Home Studio

At the opposite end of the performance spectrum, Wang Chung are also in the process of expanding their home studio facility, turning Nick's current Fostex A8 into a B16, complete with 16-channel mixer.

'I like the idea of somehwere I can just come to and work if I want to,' Nick commented. 'At the moment I've got the eight-track which is basically fine, but it does impose obvious limitations such as your having to use drum machines instead of kits and not being able to work on demos as hard as you might want to.'

The musical future looks like being a rich one, too. . . .

'We've already started writing material for the next Wang Chung album,' Nick assured me. 'And there's a possibility Jack and I might be working on some film music together. That would be nice if it comes off, because I think it's good to get away from the band format now and again. Whatever happens, though, I'll probably be writing with Jack for the foreseeable future – we seem to be able to work together very well as a team.

'The only thing I might consider doing on my own is production work, which is something we all became more interested in as a result of recording *Points On The Curve*.'

So there you have it.

A band who have successfully made the transition from conventional rock methods to being a group of thoroughly modern musicians who have found computers and synthesisers to be the key in their search for the right acoustic textures and colours. Their compositional skill is as distinctive as their choice of instrumentation, and the net result is a fine blend of the traditional and the futuristic.

Long may they continue.

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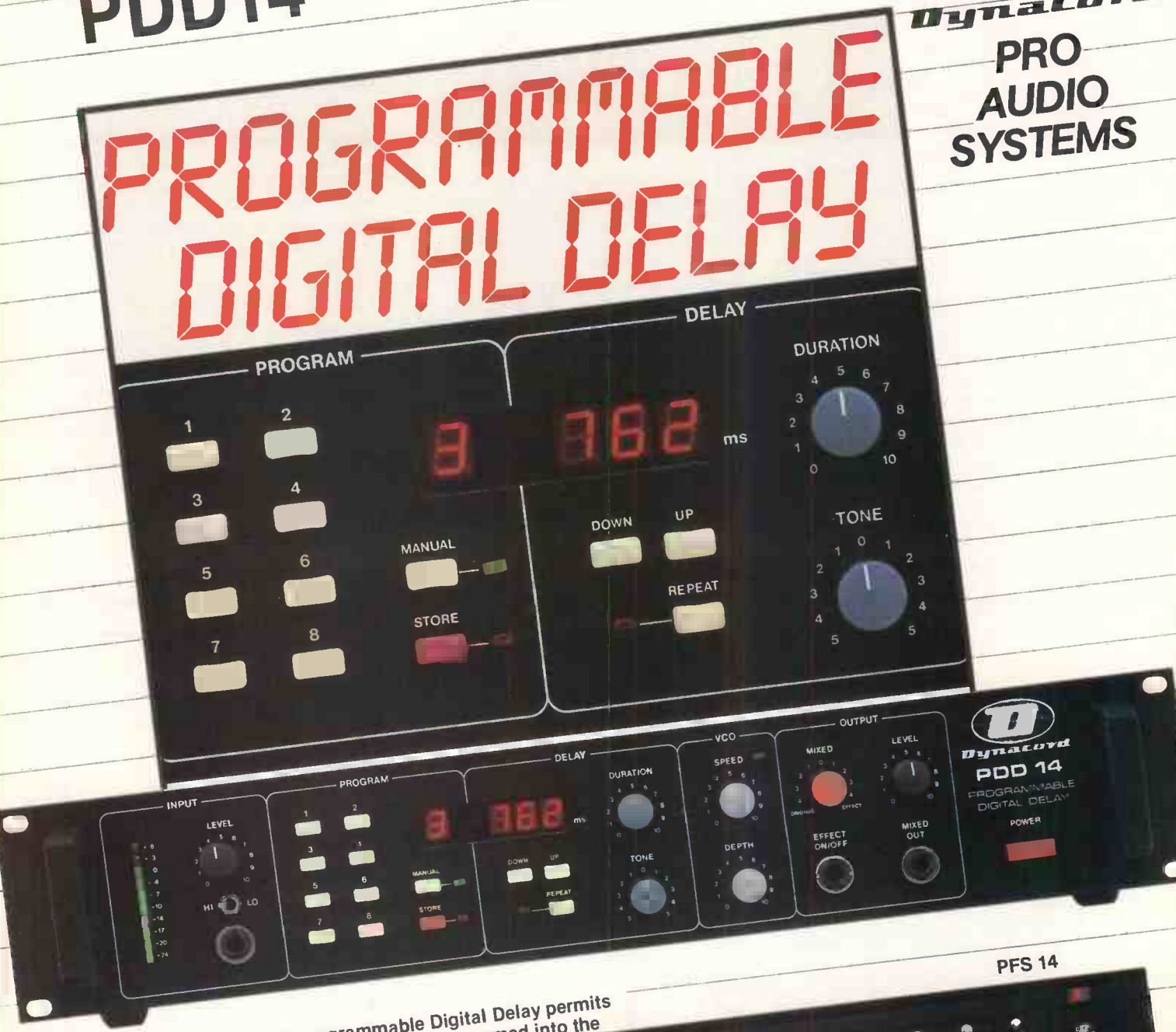

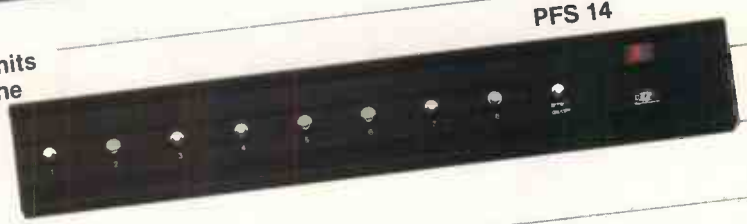

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PPG Wave 2.3 and Waveterm

With its distinctive blue livery, the PPG Wave 2.2 has become an instantly recognisable synthetic friend of the modern electronic musician. More than that, its designers' dogged determination to push the fusion of digital and analogue synthesis techniques to ever greater heights has meant that its sounds are just as much a fingerprint. David Ellis **takes a look at the latest products from this German manufacturer, the new Wave 2.3 and updated Waveterm.**

The Wave 2.3

The Wave 2.3 takes the development of PPG's total music system concept one stage further, and, at the same time, puts right some of the problematic areas of the 2.2, particularly the alpha-numeric display and some of the sequencing functions. It also adds some valuable features of its own, such as the ability to play eight different sounds from the keyboard or with the sequencer.

Development and testing of the Wave 2.3 was actually completed just before the Frankfurt Musik Messe, so only two or three systems have actually made it into the UK so far, and that's reflected in the fact that the documentation for the 2.3 supplied for review comprised a 2.2 manual and a few extra 2.3-specific sheets. Needless to say, however, a proper 2.3 manual is in the offing.

Wave 2.3 Hardware

Outwardly, things are much the same apart, that is, from the newly-incorporated, almost inevitable MIDI in, out, and thru sockets on the rear panel. Inside, there are a couple of PCBs for the Analogue panel and Digital Display Select panel, and a motherboard complete with four plug-in cards. First, there's the I/O board, with 6809 processor, EPROMs, program RAM, sequencer clock, and ADC for reading the front panel controls; second, the so-called 'PROZ' board, with lots of RAM and CMOS chips (about which little has been divulged!); and third and fourth, the two OF4 voice cards, each of which provides four sound channels *via* 12-bit AD7548 DACs (as compared to 8-bit AD558s in the Wave 2.2), SSM2044 VCFs, and CEM3360 dual VCAs.

The basic plan of action according to the PPG principle of synthesis is to use multiple waveform tables as the equivalent of analogue VCOs, and then pass these through DACs to VCFs and VCAs controlled in the usual way by CVs under micro control. In fact, the waveform table approach permits an incredible range of oscillation possibilities, because not only can you use the full whack of 64 waveforms available in each sound program, but it's also possible to select much shorter waveform segments, or even just one of the 64. In fact, the last segments of each wavetable also contain sawtooth, square, triangle, and pulse waves just in case you want to use more traditional raw synthesis techniques.

As with the 2.2, waveforms are supplied in 16K of EPROM (2 × 2764), in what PPG somewhat confusingly call 'wavetables'. Now, you or I have got accustomed to thinking of a wavetable as a series of bytes representative of one cycle of a waveform. PPG, on the other hand, think of their wavetable as a set of waveforms. So, in their parlance, there are 30 wavetables in that 16K of EPROM space, each of which contain 64 waveforms, and these, in turn, comprise 128 8-bit values. Now, a simple bit of mathematics would suggest that these 1,920 waveforms need around 228K of storage, so there's obviously a clever trick going on in PPG's Hamburg headquarters if they've succeeded in squashing them down into just 16K. I'd guess that what's happening is some form of harmonic encoding, so that when a particular sound program is yanked from EPROM, a fast Fourier is performed to actually put the right 128 8-bit values into the 2.3's sound program workspace. That's just academic conjecture and is neither here nor there as far as what the Wave 2.3 actually sounds like!

The Wave 2.3 keeps the 2 × 40 character LCD display of the 2.2, but adds (very significantly!) some back-lighting so that you're not perpetually hunting for a torch. As with the 2.2, this display is made to work for its living by means of the Display Select panel, which enables the display of parameter values for all the different areas of the instrument. In fact, the Wave 2.3 has 3,456 control functions, so it's understandable that not all of them are displayed at once. Mind you, I look forward to the day when instruments like this use the 8-line, 80-column displays that are now being used on some portable micros (the Gavilan, for instance). It's certainly a little on the boring side having to hop around from one set of display parameters to another.

Powering up

On powering up the Wave 2.3, various system checks are carried out, and a set of wavetables is loaded into the workspace RAM ready for action on the part of the user and processor. As with any programmable synth that comes equipped with factory presets, it's

temptation beyond endurance not to try them out, and, in the case of the Wave 2.3, there's a lot of them about. . . .

As with the 2.2, the sound programs efficiently cover the gamut of what's possible with the PPG synthesis approach, ranging from the utterly sublime to the equally ridiculous. There's certainly plenty of variations on metallophone-type percussion and plucked instruments (at which the 2.2 and 2.3 excel), but there are also some glorious waveform sequencing effects, including '05' (a chorus of amphetamine cats, perhaps?), '16' (a detuned choir with gut reinforcement), and a host of others. As a bonus, the sound programs supplied with the 2.3 also give you the opportunity of indulging in that favourite pastime of 'Spot the Tangerine Dream preset'.

In fact, the 87 sound programs are set up in 20 'combiprograms' (a feature new for the 2.3), which comprise the wavetables and parameter values for two Groups of sounds (*a* and *b*), including data for setting up split points. Anyhow, the first LCD display that greets the user is shown in Figure 1(a).

The top display line indicates the number of the combiprogram (CP), the nature of each of the eight sound programs in the eight banks (BK) of Group *a*, a global detuning parameter (DET), the keyboard mode (KBM) – ranging from eight-note polyphonic with two 'oscillators' per voice to monophonic with sixteen, the split points (SPL), the position of the split points (KEY), and the data transfer function (DTF) for storing or loading sounds, sequences, or whatever. Repeated jabbing of the left and right arrow keys on the keypad sends a cursor across the lines of the display so that particular parameters can be altered. It'd be nice if those arrow keys had auto-repeat, but I suppose you can't have everything. Sending the cursor past 'DTF' switches to an alternative display, illustrated in Figure 1(b).

This is equivalent to the main display of the 2.2 and, in the case of the 2.3, provides the option for putting the 2.3 into the 2.2 mode (ie. with just a single split point capability).

Modulation

One of the most impressive features of the 2.3 is the enormous range of modulation options available. Aside from the obvious use of different envelopes to control the 24dB/octave VCF and VCA, plus the LFO functions, it's also possible to control the accessing of waveforms out of a Bank's wavetable with keyboard pitch, velocity, or after-touch. This is achieved by going to the Digital display, and toggling one or other parameter (see Figure 1(c)).

Here, the display indicates sources and destinations. The former group includes K (keyboard), M (modulation generator), T (touch sensor), V (velocity), and B (bender), while the latter has W (waveforms), F (filter cut-off), L (loudness), and M (modulation intensity).

Thus, assigning a '1' to KW (keyboard wave control) varies the manner in which a wavetable is spread over the keyboard; doing the same to the TW (touch wave control) parameter results in digital keyboard digging going further into the wavetable (a very satisfying effect!); and MW (modulation wave control) switches the wave control over to the modulation wheel.

However, the really dramatic efects are created by using the ADSR Envelope 1 to determine the ways and means of waveform sequencing through the contents of a current bank's wavetable. In addition, the second or sub-oscillator of each voice can be treated in a similar fashion with the AD Envelope 3 – independent of the main oscillator. So, not only could you have sequencing upwards through the 64 waveforms going to one oscillator, but also sequencing downwards through another set of 64 waveforms going to the other – an affect that's utterly mind-boggling!

Sequencing

Each sequencer channel can be used with one of the eight sound-program Banks. However, because of the more flexible voice card management on the 2.3, several channels can also use the same Bank. Again, the sequencer has its own display lines selected from the appropriate button on the Display Select panel, and a sample display is shown in Figure 1(d).

SEQ sets the sequence or arpeggio mode, LOOPS determines the length of the sequence or arpeggio, RECM sets the record mode. TMC determines the quantisation applied to the note events, SP sets the speed, RUN starts and stops the sequencer, and CH indicates the status of each channel (0 = normal, 1 = record, and 3 = off).

There are eight individual recording Channels handling up to a total of 1,000 events, so if you're using a multi-sample program such as the 12-bit drum sounds supplied on one of the Waveterm disks, you preset the sequencer for 4 bars, go to Channel 1 and prime that for recording, run the sequencer to hear the 4-beat count-in of the metronome, and then start playing the bass drum pattern. Then, by switching channel 2 to record mode, you can overdub the snare, followed by the toms, hi-hats *et al* on the other Channels.

However, sequence recording doesn't necessarily have to stop with the note events, their Banks and their split points. On playback, eight of the pots on the Analog panel are assigned to the eight sequencer Channels. By assigning a value other than 0–3 to the Channels (the bottom line of the Sequencer display), the pots can be set to update the pitch (values of 4 or 5), loudness (6), filter cut-off (7), waveform sequencing (8), or filter attenuation (9). Playing back the sequence with one or more of the Channels assigned to these pots will result in any knob twiddles being stored in the sequencer memory, so that, next time around, those parameter updates will be included in the sequence playback. In effect, this feature transforms the humble polyphonic sequencer into something like a computer mix-down facility.

The 2.3 software is certainly a great improvement over the 2.2 as far as sequencing is concerned. The main new attractions are that you can set up a sequence in advance provided you know the number of events (bars) you require, and that you can also go straight into polyphonic record mode. Also, if you have a combiprogram with, say, five sounds across the keyboard, it's now possible to set one Channel only of the sequencer to record, play from the different split sections into that Channel, and then on playback you'll have not only the relevant note values but also the corresponding sounds with their split points.

The other point to bear in mind is that the sequencer also records dynamics of performance, and this is particularly useful with the Processor Keyboard. In fact, the Processor Keyboard includes a slot for its own multi-sampled sounds (grand piano, choir, or drums, for instance) and will interface directy with the 2.3 without requiring the facilities of the waveterm.

Interfacing

The Wave 2.3's back panel certainly has its fair share of interfacing sockets, and includes, from left to right: Cassette, Phones, Stereo outputs, Sustain (for a foot pedal), CV in (for controlling a single voice), Trig in (ditto), Trig out, Program (a DIP switch to adjust the output clock rate of the sequencer), Rhythm (5-pin DIN to control drum machines), Communications Bus (to the Waveterm), MIDI in, thru, and out, and last, but far from least, eight separate channel outputs. All pretty impressive stuff.

```
CP: 0 BK: 0a 10a 70a 30a 40a 67a 2a 38a
GR:a=BK:7 DET:0 KBM:0 SPL 1 KEY: 0 DTF:0
```

Figure 1(a)

```
PROG: 1 WAVETABLE:15 DTF:0 KEYB-SPLIT:0
KEYB:0 TTUNE:440 CASS:0 PPG-WAVE 2.3 V4
```

Figure 1(b)

```
PROG: 1 VW1 SVO KWO KFO KL4 MWO MFO MLO
GROUP:a BD1 BIO TWO TFO TLO TMO VFO VLO
```

Figure 1(c)

```
PR:38 SEQ:11 LOOPS:99 RECM:0 TMC:0 SP 64
RUN:0 CH 1:3 2:3 3:3 4:3 5:3 6:3 7:3 8:3
```

Figure 1(d)

The Waveterm

Excellent though the Wave 2.3 on its own may be, it's the Waveterm that's responsible for transforming it into a complete computer music system. This is really the controlling heart of the PPG empire, comprising as it does all the ins, outs, and processing of a quality 8-bit micro, a 12" green VDU, dual 5.25" disk drives, and an audio signal processor for sampling sounds.

In fact, the Waveterm has been through a rather bumpy ride as far as development is concerned, starting off in 1982 with a unit using a single 8" drive and one row of function keys below the screen, and ending with the present 1984 version using dual 5.25" drives and two rows of function keys. However, the insides are basically the same, with a single Eltec board holding the ubiquitous 6809, 64K, RAM, double-density disk controller, and video controller.

The quality of the display is really very high,

with both excellent resolution and absolute stability. Indeed, additional software is actually available for using the Waveterm as a word processor! To do this you'd obviously need a QWERTY keyboard, so PPG provide a socket on the back of the unit for connecting any standard ASCII-encoded unit. Also, for anyone making extensive use of the non-real-time entry side of the system, a proper alpha-numeric keyboard would be a useful addition. However, that's not to say that the standard Waveterm arrangement of one row of numeric keys and an upper row of software-defined function keys doesn't work well: in fact, it seems very user-friendly, and the non-typing musician may find this approach easier to get on with in the short term.

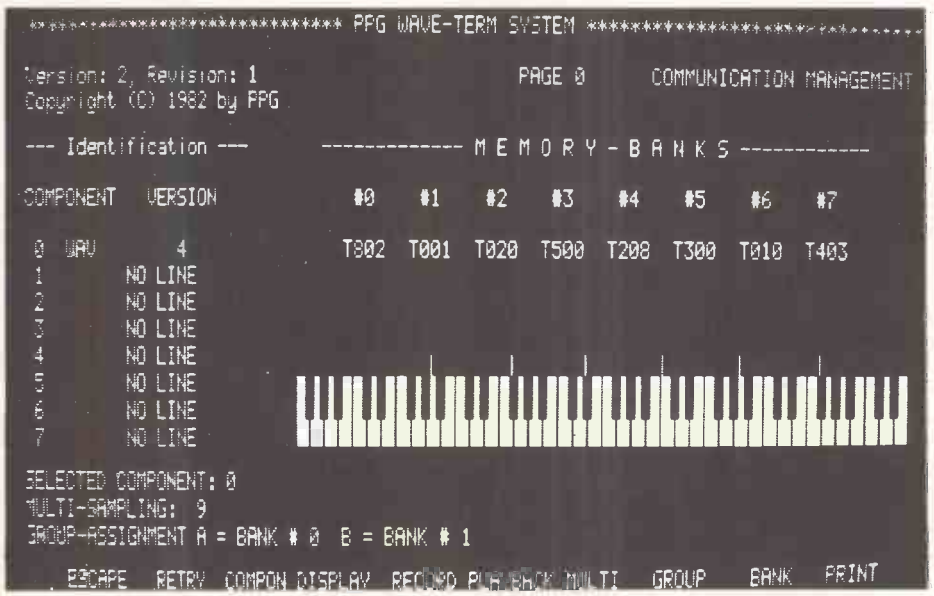
So what does the Waveterm enable you to do? Well, there are essentially two sides to the unit:

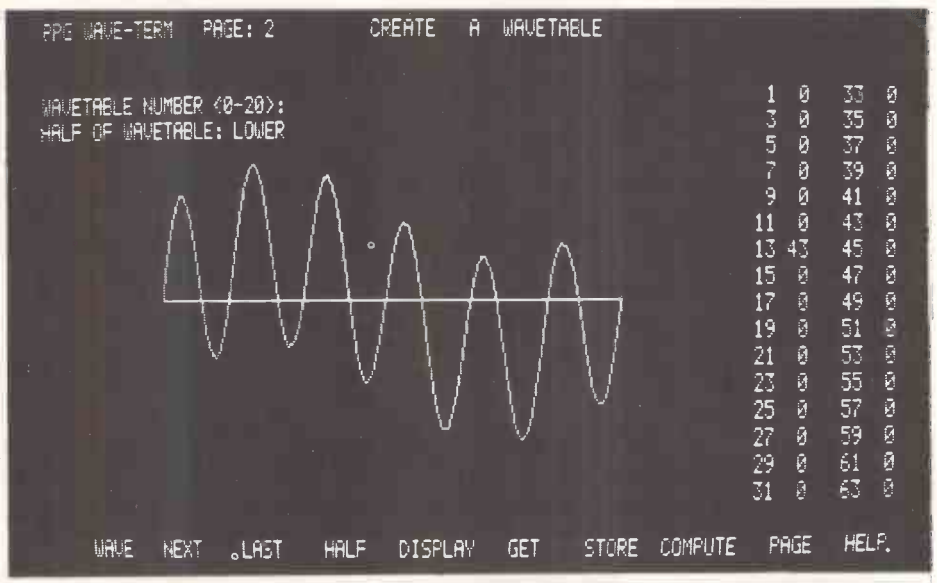
1 Creating sounds. Either by sound sampling or additive synthesis, or a combination of the two, with or without analogue modification.

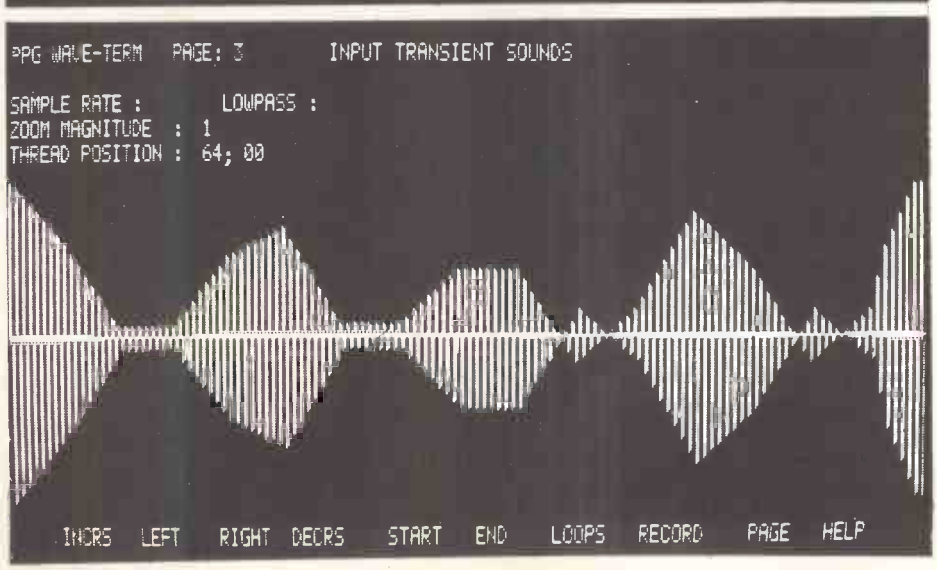
2 Composing. Either with real-time sequences from the 2.3 or wholly in non-real time with the Event Generator.

Page 0

To get to these various operations, you have to access one of the five current display pages.







Life in the Waveterm scheme of things starts with Page 0, which provides a 'systems check and communications management', but don't let that put you off! The left-hand column tells the user which components are connected to the three communications sockets on the back of the Waveterm. Apart from the Wave 2.3 which was connected in this case, other options might be the Expansion Voice Unit or the Processor Keyboard, and there are also other items to follow, such as a trigger box for use with the Even Generator (Page 5).

Page 0 also includes a keyboard map with the eight memory banks indicated above it. There's no immediate control over defining the sound until something is done to allocate a sound to one or more of the banks. So, for instance, the display shown of Page 0 indicates that five sounds have been allocated to banks 0–4, and the markers on the keyboard indicate the split points. These sounds actually represent sampled transient (hence the 'T' prefix) sounds of a string orchestra (an *ad hoc* one, judging by the sound of it), an opera chorus (shades of Tallis' *Spem in Alium*), and a fuzz guitar (much admired by Trevor Horn) taken from one of the demo disks provided with the Waveterm, but they could just as well have been your own sampled *via* Page 3. However, whereas these and other PPG-provided samples have 12-bit resolution, the Waveterm only provides the means for 8-bit sampling – hence PPG's current involvement in preparing a library of high quality samples.

Once these sounds have been loaded up from disk, they're then all playable from the 2.3 keyboard, and, what's more, the last sound played can be modified in real time by manipulating the 2.3's controls. For instance, an ADSR envelope (1) can be assigned to controlling waveform sequencing, the start point of the sample to the 'Waves-Osc' control, and the other envelope to the VCF and VCA.

The other point about the interface between the 2.3 and the Waveterm is that modifications made to a sampled sound – a change in the overall envelope or an alteration or two to one or more waveform segments, for instance – can then be stored back on the user disk as an update to the original sound, and this will be loaded with the original sound automatically next time around.

Page 1/2

Page 1 provides the means to 'Compute a Wave'. There's a mass of waveforms already on the system disk, and they can be called up simply by using the 'Get' softkey. This page's Fourier synthesis operates with up to 32 harmonics, each with relative amplitudes from 0–63. Going to Page 2 then allows you to assemble previously constructed and stored waveforms into PPG's idiosyncratic 'wave-tables'.

Page 3

This is the actual sound sampling facility. The sampling rate is variable from about 50kHz to 4kHz into 16K or RAM. Various facilities are provided for examining a sample, including the zoom facility which allows you to select the frame size of the sound snapshot from as much as the full 16K to as little as a single 128-byte set of values, and then display it. In addition, previously stored sounds can be recalled from disk for further analysis, and alternative start/stop points of the sample can be set up to make up new sounds. Although at present sampling is only 8-bit, PPG are working on building up a 12-bit sample sound library.

A recent software addition to Page 3 also allows two different transient sampled sounds to be 'merged' together (interpolated, in other words), and this also extends to using reversed segments of samples. So all in all, this is a page to watch out for. . .

Page 4

The area that many sampling systems tend to gloss over is what happens to the sound when it's played miles away from the original sample pitch. Real instruments *do not* simply increase or decrease their harmonic constituents in a blind arithmetic fashion according to the pitch played. Instead, subtle harmonic changes occur, so that by the time you've got to a high G on a violin, the harmonic constituents of the sound are vastly different to the open G string. If you don't take that into account when a sample is playing away from home, you end up with the whole gamut of Suzuki-type larger and smaller violins, or, with the human voice, the old Chipmunk syndrome. Page 4 provides the Waveterm user with the option of constructing a resonance curve that'll determine which frequencies are emphasised and which ones are attenuated over the range of the 2.3's keyboard, theoretically eliminating many of these problems.

Page 5

Page 5 is the Event Generator, and this can work in creating sequences either *via* Event Tables, or by using sample sequences played in real time and downloaded from the 2.3 at a later stage – as with the *Space Elegie* demo supplied with the review system. In fact, this was actually created for 16 tracks, using the Expansion Voice Unit in addition to the Wave 2.3, and also makes use of a special multi-sample set of sounds, including an authentic tambourine, a Queen Mary-type fog horn, a thumb-dislocating slapped bass, the Berlin Philharmonic at the end of their tether, the inevitable strings, fuzz guitar, and a banjo-picker's delight.

Using this demo piece as an example, the 70 or so separate sequences are chained together with the 'Play' command, so that pressing the softkey marked 'Execute' causes the Waveterm to read the corresponding sequences from disk and transfer them to whatever workspace memory is available in the 2.3. When 'ready to start' appears on the screen, the piece can then be run by keying 'Run' on the Digital Display Select panel and whatever play mode is required.

For instance, entering '1' on the numeric keypad instructs the 2.3 to change sound programs wherever they've been included in the sequence. In this case, however, where the same program is used throughout each part, '5' is more appropriate, as this ensures that the same sample is consistenty played for each part. Though this demo didn't actually make use of the facilities, the Waveterm Event Generator also enables each simple sequence to change program, tempo, tuning, and dynamics wherever and whenever the user feels like it.

The point about the Event Generator is that the number of note events is virtually unlimited. For example, you can write a Play command with constantly changing sequences and then exchange disks with new sets of sequences at relevant points during the composition. That's taking an extreme situation, though, because in reality the 0.5Mbyte disks provide ample sequence space for most musical mortals without recourse to Hal Chamberlin musical chairs. What the Waveterm actually does is to load up segments of sequences from disk and transfer these to the 2.3 as notes are played by the latter – a virtual memory situation, in fact.

Although downloading of a simple sequence from the 2.3 to Waveterm also provides the means for editing real-time note events, you can also work in non-real time by starting note event input directly from the 'Edit' mode of Page 5. Up to 16 tracks are available, and bars are displayed one at a time on the VDU. Parameter values that can be programmed for each note event include 'Time' (where a note begins), 'Gate' (the length of anote), 'Oct' (the register of a note), 'Sem' (the name of a note), 'Bank' (the sound program), 'Updat' (the update parameter – dynamics, filter cut-off, wavetable start, or whatever – applied to a note event by manipulating the 2.3's controls), and 'Ch' (the sequencer channel for the corresponding event). The numbers and columns approach to non-real time note entry isn't always the quickest way of going about creative pursuits, but the Waveterm's software is reasonably kind in this respect – particularly by virtue of the 'Copy' facility that enables bars or events to be copied from one part of the score to another with or without updates of transposition, program change, and so on.

There's no denying the impressive quality of the combination of Page 5 and 2.3. Still, it'd be nice to see PPG turning their attention to a more MCL-orientated from of non-real time entry.

Sound Conclusions

There's no doubt in my mind that the Wave 2.3 is one of the most versatile digital synthesisers around. In fact, it could be seen as the ideal foil to the recipient FM synthesis band-wagon. The only reservations I have about the sound quality lie with the limitations of 8-bit waveforms, but PPG's move towards 12-bit resolution is rapidly casting these aside.

Some of the preset waveform sequencing programs are very dramatic, others less so, and a few demonstrated slightly anoying glitches as the sequencing switched from one waveform to another. That's obviously hard to avoid given that waveform segments can't always be relied upon to start and stop bang on zero amplitude at the right point in a sample, but since PPG's own fctory presets also do that, it makes me think that a little more effort in this direction might not go amiss. However, as we go to press it seems that the company are in the process of curing these glitching problems. Another point worthy of attention is that the output is a mite noisy for a synthesiser of this calibre. It does sound rather as if some digital noise is leaking to the output without the intervention of the VCA. Still, that's a minor point, really.

Obviously, there are hardware differences between the 2.2 and 2.3 which help to account for its improved peformance. At present, people using the 2.2 with the Waveterm are only able to work with 8-bit resolution, and are limited to a maximum of two samples played across the keyboard. However, there will be an update available for their machines which will provide the means of assigning eight samples at once, though still only at 8-bit resolution. At least, that's how things are at present, though there are plans in the pipeline to ensure that 2.2 owners and their machines are brought right up to scratch, so to speak.

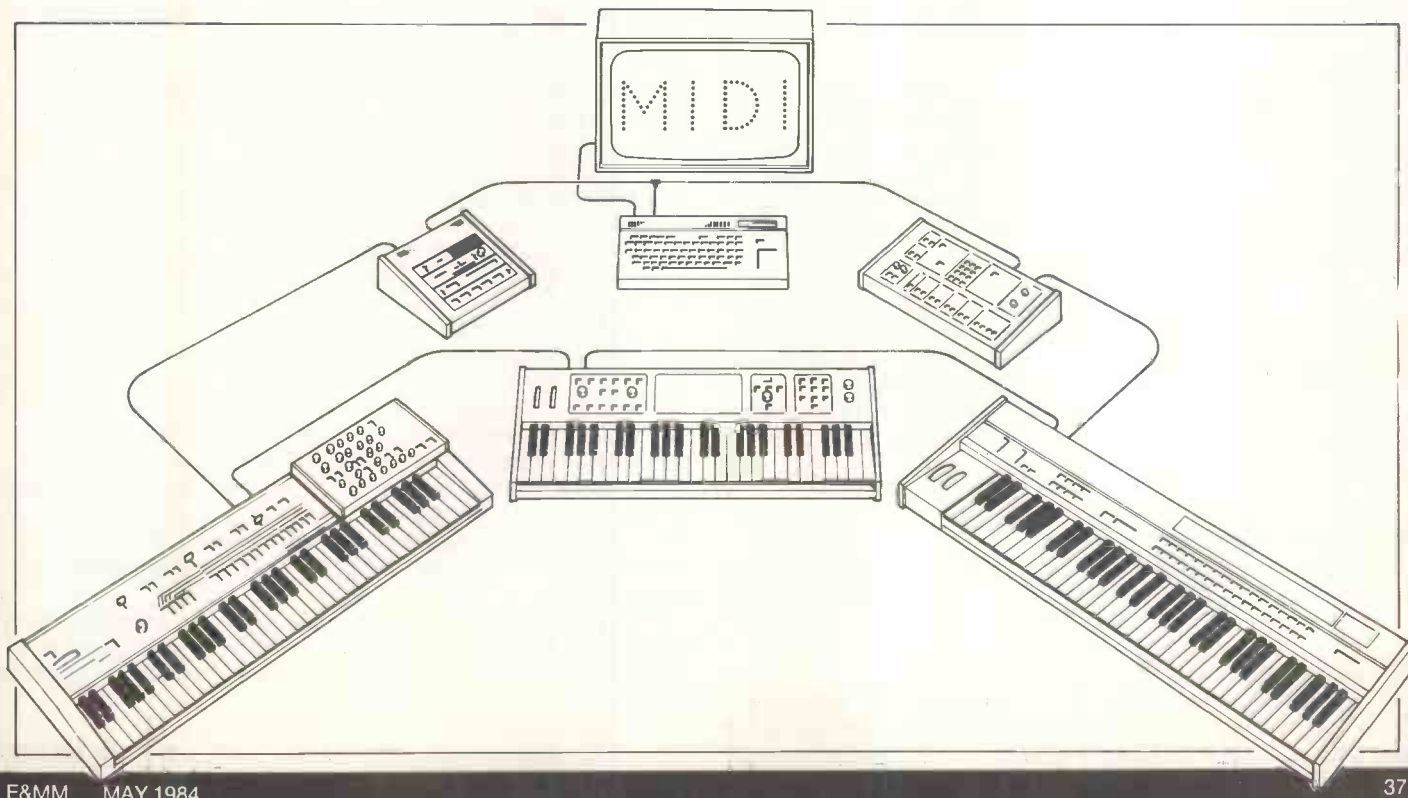
What can't be denied is that the potential combination of the Wave 2.3, Waveterm, Expansion Voice Unit, and Processor Keyboard, for something in the region of £12,000, would make for a quite superb computer music system that easily overshadows its competitors, and the fact that the system can be acquired bit-by-bit only makes it more attractive. Indeed, taking just the Wave 2.3 and Waveterm together (for a VAT-inclusive total of £8,585), you've got a system that's equally suitable for stage, studio, or use as a compositional tool, and does just about everything you might want with a great deal of panache.

David Ellis **E&MM**

VAT-inclusive prices for the Wave 2.3 and Waveterm are £3,995 and £4,590 respectively. PPG are now handling their own UK distribution, and their agent is to be found at 505–507 Liverpool Road, London N7 (tel: 01–609 8501/2). Alternatively, contact PPG-Vertrieb Duren KG, Neustrasse 9, D-5481 Waldorf, West Germany.

MIDI

An Electronics & Music Maker Special Supplement



INTRODUCTION

The Musical Instrument Digital Interface is a system for connecting instruments together so that one instrument may control one or more other instruments. Typical applications include causing machines to start and stop in synchronisation, play together in the same tempo, and change presets at the same time. More detailed control is also possible, such as pitch bend and modification of specific parameters such as filter cut-off frequency, but on synths from different manufacturers, design differences can complicate compatibility in these areas.

The MIDI as we know it today really came about as a result of two separate proposals for a universal synthesiser interface, one from Oberheim and SCI in the States, the other from some of the principal Japanese manufacturers. It was the amalgamation of these two ideas that brought about the first MIDI meetings between the major electronic musical instrument companies and the eventual announcement of the first MIDI specification – and the first MIDI keyboard, the Prophet 600 – in April 1983.

Since then, most of the world's leading manufacturers have agreed on a universal MIDI specification (spec 1.0, finalised in August of last year) and incorporated it into a whole host of new electronic instruments.

In theory at least, machines from the same manufacturer should be fully compatible, though there will still be limitations if the machines have different control systems, and of course a MIDI drum machine can't tell a MIDI synth what notes to play.

A fully MIDI-compatible instrument is fitted with three sockets, a MIDI input, a MIDI output, and a MIDI through socket so that several synths may be connected up in such a way that they are all controlled by one master instrument. The specification recommends the use of five-pin 180° DIN sockets for all MIDI connections though XLR connectors are to be found on some products, notably the Octave Plateau Voyetra 8.

The interface is fully digital and operates on a five-volt, current loop system and for reliable operation, the use of screened, twisted pair cable (similar to that used for balanced microphones) is strongly recommended.

Information comes in the form of binary 'words' which specify the type and destination of each instruction, and the operational speed of the system is such that at least three units may be linked together before any timing problems are experienced.

The messages carried by MIDI fall into two distinct categories, System and Channel.

Channel Commands

The Channel system was devised in order that communication could be established between the master instrument and any other specific instrument without causing all the others to respond. Any MIDI instrument may be set up to receive information on any one of 16 channels per instrument: split-keyboard synths may in some cases be made to respond as two separate instruments, for example.

Channel commands are normally used to tell a specific synth what notes to play and at what time to play them, and also to convey information relating to performance controls, the precise details of these depending on the model and type of synth. For example, on instruments which incorporate an after touch facility (for instance SCI Prophet T8 or Yamaha DX7) this information may be conveyed as a MIDI Channel command on a note-for-note basis.

System Commands

These may be divided into three types; System Common, System Real Time and System Exclusive.

System Common

These commands are intended for all units in the system and allow you to select a particular song or sequence, and start at a particular beat within it. There is also a system common message to request analogue synths to tune their oscillators (if such a tuning facility is provided on the synth in use).

System Real Time

System real time messages may be sent at any time and their main purpose is to synchronise the entire system to the clock in the master unit. This enables all units to start and stop in synchronisation and in addition transmits an active sensing message to all machines. In the absence of this message, the other machines will automatically revert to keyboard control.

System Exclusive

These commands precede a manufacturer's identification code which opens up a line of communication to a particular type of instrument. For example, if the number 240 (the system exclusive command) is followed by 67 (the code for Yamaha products) any following instructions will be obeyed only by the Yamaha machines. The system exclusive command is terminated upon receipt of system common command 247, "End of exclusive". Generally, each manufacturer selects a single system exclusive ID code which covers their entire MIDI product range.

MIDI in Action

Because all synthesisers have different facilities (number of notes, number and type of oscillators, FM or subtractive synthesis, type and number of controls and so on) it is impossible (and indeed undesirable) to expect all machines to behave in exactly the same way. MIDI channel voice messages contain varying amounts of information depending on the machine of origin, and may vary from basic key number only to a fully detailed description of all performance controls and key dynamics.

It follows then that only another machine of exactly the same type will be able to interpret all this information. If two machines from different manufacturers are connected, communication will be strictly limited, with perhaps only key number information being understood by the second instrument. Some combinations yield more useful results than others and this subject will be discussed elsewhere in the supplement.

Control Codes

The MIDI specification clearly states that the controllers are not specifically defined. A manufacturer can assign the logical controllers to physical ones as necessary. The controllers allocation table *must* be provided in the users operation manual. What this means is that the maker of your electronic instrument should provide you with the codes assigned to each feature on your machine that is accessible *via* MIDI.

For example, the code that enables you to address the cut-off frequency on the synth is unlikely to be the same as the code that addresses the same parameter on your other synth, assuming your second synth even *has* a cut-off frequency control.

This state of affairs explains why synths from different manufacturers can only communicate at relatively basic levels *via* MIDI, and to establish anything like full communication, a computer is needed to translate the commands in real time. As this would involve a different software package for every conceivable combination of MIDI machines, it's rather unlikely that everyone's needs will be serviced in the very near future. However, the original concept of MIDI was simply to provide the facility for 'triggering' contemporary instruments from each other as well as some form of pitch control. MIDI does this admirably, and what's more, if used properly and carefully, the system can communicate enormous quantities of information quickly and accurately.

It may not be the answer to all our problems – indeed it may even cause a few new ones – but if it is developed properly, MIDI will become a very powerful and effective aid to modern musicians.

Geoff Twigg **E&MM/MIDI**

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THE MIDI 1.0 SPECIFICATION

Following a meeting of interested manufacturers in Anaheim in January 1983, Sequential Circuits Inc. and Roland (the latter also representing Yamaha, Korg and Kawai have drawn up this basic specification for the Musical Instrument Digital Interface. It includes hardware, suggested part numbers and so on. The spec reprinted below is dated October 1983, and is the basis for all MIDI-equipped machines produced after that date. Dave Smith, President of Sequential Circuits, has assured us that he sees no need for, and will actively discourage any revision of the spec, to allow time for any initial teething troubles to be sorted out.

MIDI is the acronym for Musical Instrumental Digital Interface.

MIDI enables synthesisers, sequencers, home computers, rhythm machines, etc. to be interconnected through a standard interface. Each MIDI-equipped instrument usually contains a receiver and a transmitter. Some instruments may contain only a receiver or transmitter. The receiver receives messages in MIDI format and executes MIDI commands. It consists of an optoisolator, Universal Asynchronous Receiver-Transmitter (UART), and other hardware needed to perform the intended functions. The transmitter originates messages in MIDI format, and transmits them by way of a UART and line driver.

The MIDI standard hardware and data format are defined in this specification. Note that Status and Data bytes are given in binary, numbers followed by an "H" are in hexadecimal, and all other numbers are in decimal.

Hardware

The interface operates at 31.25 (+/−1%) Kbaud, asynchronous, with a start bit, eight data bits (D0 to D7), and stop bit. This makes a total of 10 bits for a period of 320 microseconds per serial byte.

Circuit: See Figure 1. 5mA current loop type. Logical 0 is current ON. One output shall drive one and only one input. The receiver shall be optoisolated and require less than 5mA to turn on. Sharp PC-900 and HP 6N138 optoisolators have been found acceptable. Other high-speed optoisolators may be satisfactory. Rise and fall times should be less than 2 microseconds.

Connectors: DIN five-pin (180°) female panel mount receptacle. An example is the Switchcraft 57GB5F. The connectors shall be labelled 'MIDI IN' and 'MIDI OUT'. Note that pins 1 and 3 are not used, and should be left unconnected in the receiver and transmitter.

Cables shall have a maximum length of 50 feet (15 metres), and shall be terminated on each end by a corresponding five-pin DIN male plug, such as the Switchcraft 05GM5M. The cable shall be a shielded twisted pair, with the shield connected to pin 2 at both ends.

A 'MIDI THRU' output may be provided if needed, which provides a direct copy of data coming in MIDI IN. For very long chain lengths (more than three instruments), higher-speed optoisolators must be used to avoid additive rise/fall time errors which affect pulse width duty cycle.

Notes on Channel Modes

Synthesisers contain sound generation elements called voices. Voice assignment is the algorithmic process of routing Note On/Off data from the keyboard to the voices so that the musical notes are correctly played with accurate timing.

When MIDI is implemented, the relationship between the 16 available MIDI channels and the synthesiser's voice assignment must be defined. Several Mode messages are available for this purpose. They are Omni (On/Off), Poly, and Mono. Poly and Mono are mutually exclusive, ie. Poly Select disables Mono, and vice versa. Omni, when on, enables the receiver to receive Voice messages in all Voice Channels without discrimination. When Omni is off, the receiver will accept Voice messages from only the selected Voice Channel(s). Mono, when on, restricts the assignment of Voices to just one voice per Voice Channel (Monophonic.) When Mono is off (=Poly On), any number of voices may be allocated by the Receiver's normal voice assignment algorithm (Polyphonic).

For a receiver assigned to Basic Channel "N," the four possible modes arising from the two Mode messages are:

Mode	Omni		
1	On	Poly	Voice messages are received from all Voice Channels and assigned to voices polyphonically.
2	On	Mono	Voice messages are received from all Voice Channels, and control only one voice, monophonically.
3	Off	Poly	Voice messages are received in Voice Channel N only, and are assigned to voices polyphonically.
4	Off	Mono	Voice messages are received in Voice Channels N thru N+M−1, and assigned monophonically to voices 1 thru M, respectively. The number of voices M is specified by the third byte of the Mono Mode Message.

Four modes are applied to transmitter (also assigned to Basic Channel N). Transmitters with no channel selection capability will normally transmit on Basic Channel 1 (N=0).

Mode	Omni		
1	On	Poly	All voice messages are transmitted in Channel N.
2	On	Mono	Voice messages for one voice are sent in Channel N for step time.
3	Off	Poly	Voice messages for all voices are sent in Channel N for step time.
4	Off	Mono	Voice messages for voices 1 thru M are transmitted in Voice Channels N thru N+M−1, respectively. (Single voice per channel).

A MIDI receiver or transmitter can operate under one and only one mode at a time. Usually the receiver and transmitter will be in the same mode. If a mode cannot be honoured by the receiver, it may ignore the message (and any subsequent data bytes), or it may switch to an alternate mode (usually Mode 1, Omni On/Poly).

Mode messages will be recognised by a receiver only when sent in the Basic

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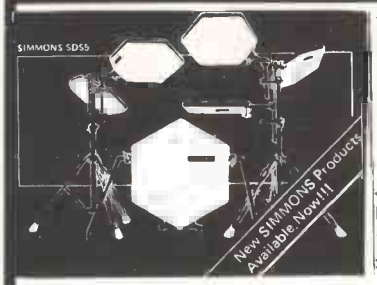

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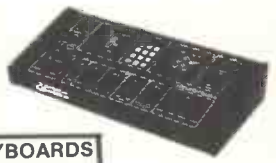

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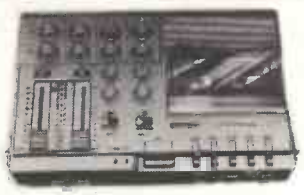

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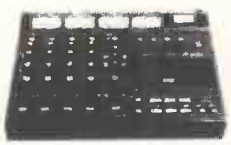

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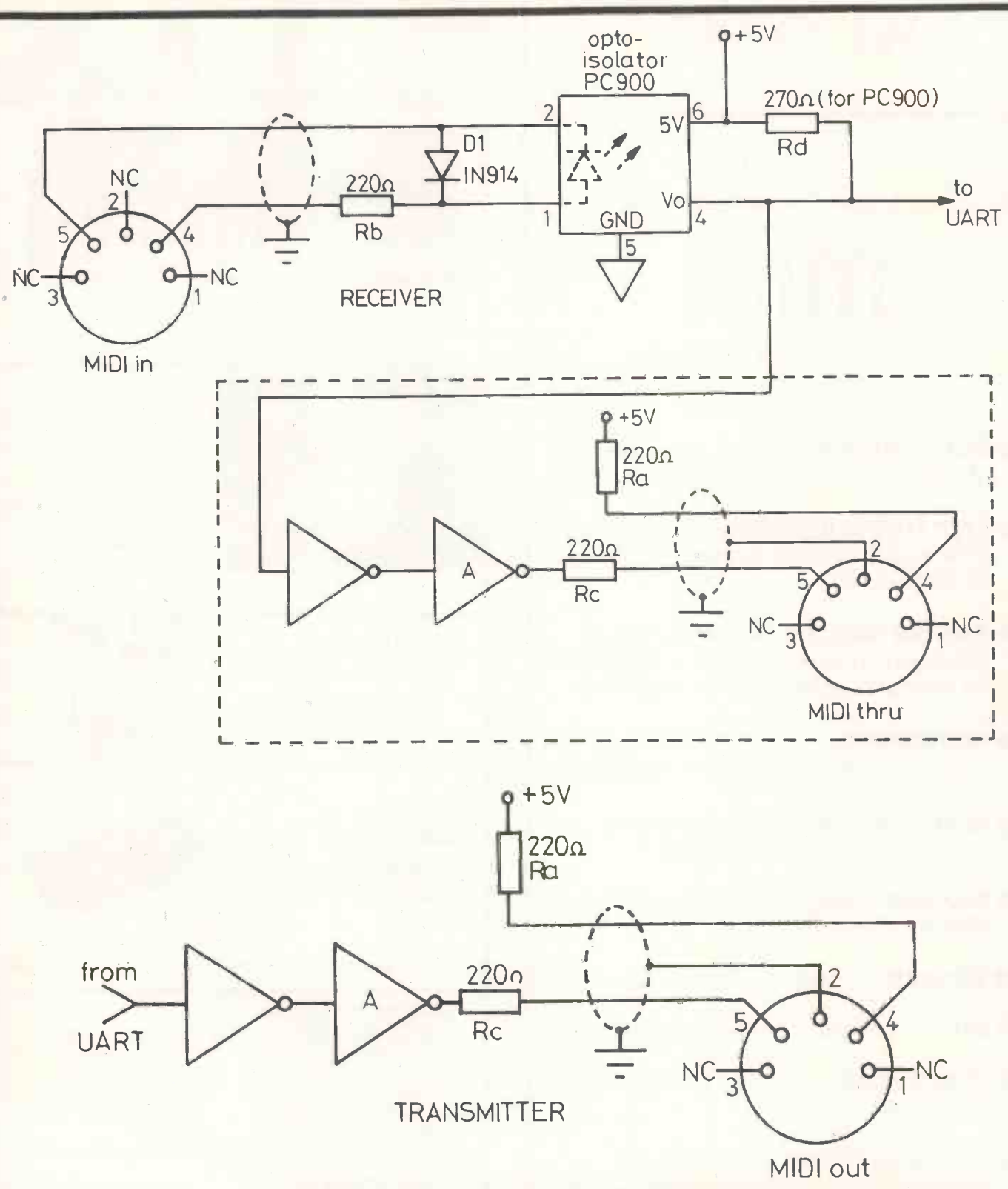

Notes
1. Optoisolator currently shown is Sharp PC900 (HP6N138 or other optoisolator can be used with appropriate changes)
2. Gates 'A' are IC or transistor
3. Resistors are 5%

Channel to which the receiver has been assigned, regardless of the current mode. Voice messages may be received in the Basic Channel and in other channels (all called Voice Channels), which are related specifically to the Basic Channel by the rules above, depending on which mode has been selected.

A MIDI receiver may be assigned to one or more Basic Channels by default or by user control. For example, an eight-voice synthesiser might be assigned to Basic Channel 1 on power-up. The user could then switch the instrument to be configured as two four-voice synthesisers, each assigned to its own Basic Channel. Separate Mode messages would then be sent to each four-voice synthesiser, just as if they were physically separate instruments.

MIDI DATA FORMAT 1.0

31·25 khz asynchronous 1 start, 1 stop bit

CHANNEL VOICE

STATUS: BYTE 1	Code	Channel
Note Off	1000	nnnn
Note On	1001	nnnn
Poly Pressure	1010	nnnn
Control Change	1011	nnnn
Control Change	1011	nnnn
Control Change	1011	nnnn
Control Change	1011	nnnn
Control Change	1011	nnnn
Control Change	1011	nnnn
Control Change	1011	nnnn
Control Change	1011	nnnn
Control Change	1011	nnnn
Control Change	1011	nnnn
Control Change	1011	nnnn
Control Change	1011	nnnn
Mode Messages	1011	nnnn
Mode Messages	1011	nnnn
Mode Messages	1011	nnnn
Mode Messages	1011	nnnn
Mode Messages	1011	nnnn
Mode Messages	1011	nnnn
Programme Change	1100	nnnn
Channel Pressure	1101	nnnn
Pitch Wheel	1110	nnnn

DATA: BYTE 2			
Pitch Number		0kkk	kkkk
Pitch Number	Middle C=60	0kkk	kkkk
Pitch Number		0kkk	kkkk
Continuous Controller	0 MSB (0)	0000	0000
Continuous Controller	1 MSB (1)	0000	0001
Continuous Controller	2 MSB (2)	0000	0010
Continuous Controller	3 MSB (3)	0000	0011
Continuous Controller	4 MSB (4-31)	0ccc	cccc
Continuous Controller	0 LSB (32)	0010	0000
Continuous Controller	1 LSB (33)	0010	0001
Continuous Controller	2 LSB (34)	0010	0010
Continuous Controller	3 LSB (35)	0010	0011
Continuous Controller	4-31 LSB (36-63)	0ccc	cccc
Switches	(64-95)	0ccc	cccc
Undefined	(96-121)	0ccc	cccc
Local Keyboard Control	(122)	0111	1010
All notes OFF	(123)	0111	1011
OMNI OFF	(124)	0111	1100
OMNI ON	(125)	0111	1101
MONO ON/POLY OFF	(126)	0111	1110
POLY ON/MONO OFF	(127)	0111	1111
Programme Number		0ppp	pppp
Value		0vvv	vvvv
LSB Value		0vvv	vvvv

DATA: BYTE 3			
OFF Velocity	default to 64	0vvv	vvvv
Velocity	00 (H)=OFF	0vvv	vvvv
Value		0vvv	vvvv
Value		0vvv	vvvv
Value		0vvv	vvvv
Value		0vvv	vvvv
Value		0vvv	vvvv
Value		0vvv	vvvv
Value		0vvv	vvvv
Value		0vvv	vvvv
Value		0vvv	vvvv
Value		0vvv	vvvv
All zero for OFF		0111	1111 (ON)
All zero for OFF		0111	1111 (ON)
		0000	0000
		0000	0000
		0000	0000
Number of Channels addressed	= N+M−1,>16	0mmm	mmmm
		0000	0000
MSB Value		0vvv	vvvv

SYSTEM

		Code	Channel
Exclusive	Dump Follows	1111	0000
Common	Undefined	1111	0001
	Song Position PTR	1111	0010
	Song Select	1111	0011
	Undefined	1111	0100
	Undefined	1111	0101
	Tune Request	1111	0110
	End of Exclusive*	1111	0111
Real Time	Timing Clock**	1111	1000
	Undefined	1111	1001
	Start	1111	1010
	Continue	1111	1011
	Stop	1111	1100
	Undefined	1111	1101
	Active Sensing***	1111	1110
	System RESET****	1111	1111

DATA: BYTE 2		
Manufacturer's ID	0iii	iiii
Undefined		
LSB	0111	1111
Song Number	0sss	ssss

DATA: BYTE 3	
Any number of data bytes	0*** ****
MSB	0hhhhhhh
Song starts on receipt of FA(H)	

**EOX also recognised by any Status except RT*
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****Optional sentinel up to 300ms*
*****Prefer only under manual control*

(where blank no byte is sent: Running Status is possible using Channel Voice Status codes only)

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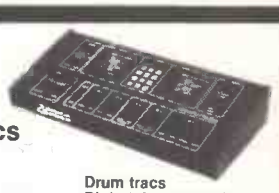

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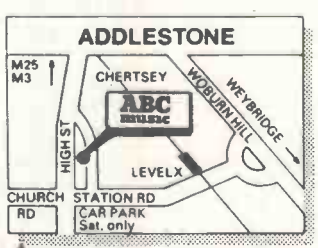

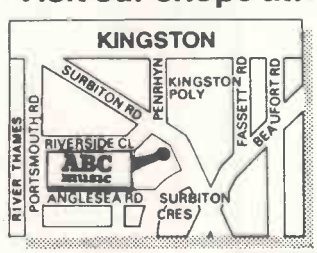

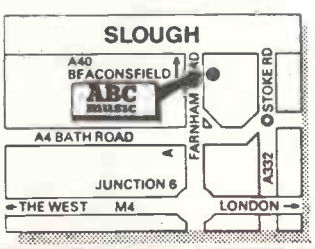

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MIDI Theory and Practice

At its inception, the Musical Instrument Digital Interface was hailed as the saviour of the experimenting synth player, the end to all triggering and interfacing problems. However, as musician and keyboard consultant Vince S. Hill **has been discovering, design inconsistencies between models have conspired to turn an elegant theory into a decidedly awkward practice.**

Whether you have heard it in your local music store or read about it in reviews and adverts, you will no doubt be trying to come to terms with the latest electronic music buzzword – MIDI.

The implementation of this interface is causing a great deal of excitement in and given a welcome boost to much of the musical instrument industry, not only to musicians, but also to those designing, manufacturing, selling, and – last but not least – writing about synthesisers and their hardware and software expansions.

Broadly speaking, MIDI means communication and compatibility, or rather, should mean. . .

If you're thinking of changing your synthesiser or adding a new device of some sort to your electronic instrument line-up, it's more than likely that MIDI will be thrown at you as a sales feature. With a glint in his eye and a theoretical thickening of his wallet, the salesman will point to the back panel of Product X and say, 'with MIDI you can link it up to any other MIDI-equipped instrument.' He's right, of course. The five-pin DIN lead will fit any of the sockets, but what happens next?

For some musicians, having a MIDI keyboard will mean either very little or nothing at all. They're not interested in connecting more than one such instrument together, and probably haven't given the technological implications of the new system more than a passing thought. Many others, however, will doubtless be interested in taking the interface to its limits, which at this stage are a little frightening in addition to being quite exciting on paper.

MIDI is a relatively recent development and, as is so often the case with such things, its adoption has been part of a learning process on behalf of all those involved with it, not least the instruments' designers. So, given that MIDI is still very much in its infancy, I thought I'd take a look-see at some connections between different synthesisers and add-on machines to find out what can and cannot be done.

Parameter Control

The first thing to realise when looking at MIDI in relation to your own equipment (real or potential) is that it can't be used to control parameters that aren't there in the first place. MIDI can transmit and receive data relating to noteplaying, velocity and touch, but if your synth does not incorporate a velocity- or touch-sensitive keyboard it will not be capable of receiving or sending that information *via* MIDI.

Another simple example is that of voice numbers. If you link a six-voice polysynth to an eight-voice one, then only six voices will be received by the former and so on.

Lesson number one: although MIDI is capable of transmitting and receiving considerable quantities of data, it can't turn a low-cost synth into a fully-specified one.

Rather more disturbing than the previous – and utterly logical – limitation are the headaches many synth-players were faced with when they tried to link instruments from early MIDI batches together.

DX7-owners will probably know what I'm talking about. Most early DXs to be sold in the UK were fitted with non-standard MIDI buses. The main problem was non-acceptance of the MIDI Off command, though in addition some models could transmit keyboard information without being able to receive it, or could not understand what was being transmitted by the second instrument.

The author has tried linking a low-serial number DX7 with an SCI Prophet T8. Both of these synthesisers have pressure- and velocity-sensitive keyboards, but while the T8 could receive this dynamic information from the Yamaha, the Sequential flagship's attempts at transmitting the same data to the DX were met with a total lack of response. Using a later model DX7, however, communication between the two instruments was immediately successful and trouble-free.

To illustrate the problem further, connecting the early and late model DXs in turn to an SCI Drumtraks rhythm machine showed a similar discrepancy between the two generations of Yamaha instruments. Whereas the later model could play the SCI's drum sounds with full dynamics according to how hard the keyboard was struck, the earlier one could not.

Nor is this problem confined to the DX7. The cheaper Yamaha FM synth, the DX9, also suffered from the same early design inconsistency, a point that was brought home to me rather forcibly when I connected an early 9 to the first ever MIDI keyboard, the SCI Prophet 600. The Yamaha received no MIDI note-off command and each note played droned on for eternity – not a very musical effect.

If you're one of the unlucky ones who bought a non-standard MIDI DX some time last year (there's no real way of knowing which serial numbers refer to which generation of production because

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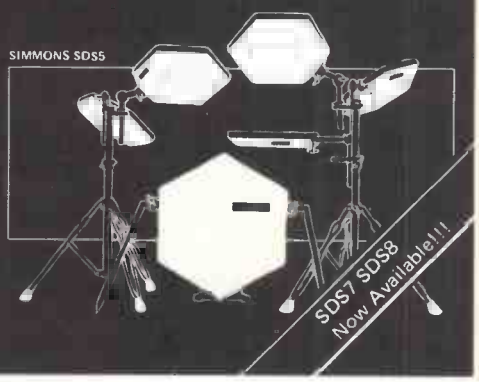

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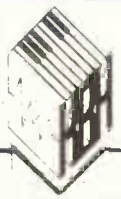

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Yamaha's spec has gone through several changes, not all of them widely publicised), then it should be possible to get your instrument brought up-to-date by your local Yamaha stockist. If, on the other hand, you're currently thinking of buying a DX – and you've reconciled yourself to the inevitable long wait – you need have no fear because as from March of this year, all Yamaha's MIDI instruments are to the same specification as the rest of the manufacturing world's.

Thus lesson two: all MIDIs are not equal, or at least, they aren't on early Yamaha DXs.

the Juno could not receive program changes, and could not even discern input notes when the Jupiter 6 was in Patch Preset mode.

Lesson three, then: although linking the earlier DCB standard to the MIDI one is a mildly wonderful gesture on Roland's part, technological inconsistencies will probably prevent an 'interface between interfaces' ever being more than 60% successful.

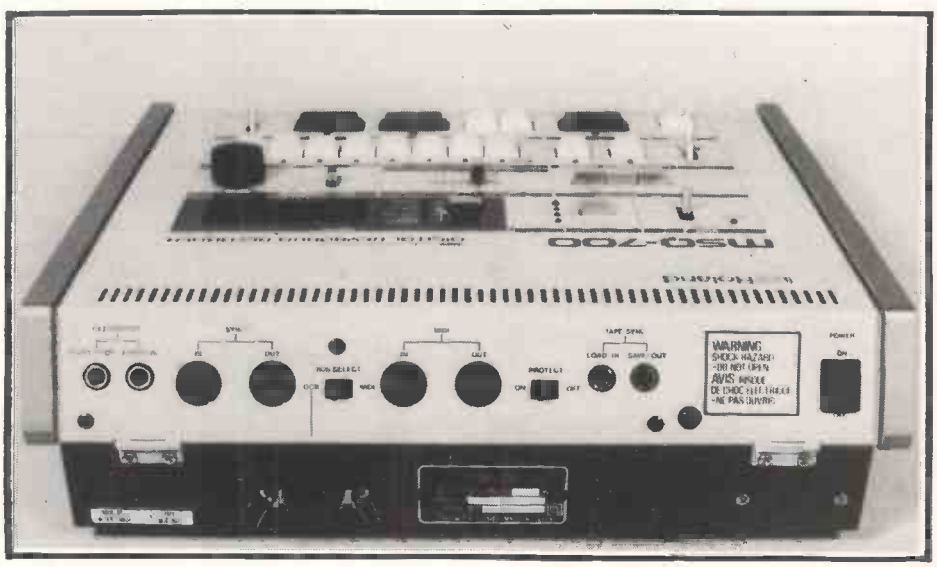
If you've read this far, you could be forgiven for thinking that MIDI is nothing other than a tale of false hopes and unfulfilled promises. In reality, though, it's because MIDI as a system can work so beautifully that so much light has been shed on its recent – and, we hope temporary – shortcomings.

MIDI 1, DCB 0

On a slightly different tack now, Roland's move to enable owners of instruments incorporating the earlier DCB interface to enjoy some of the benefits of MIDI by introducing their MD8 DCB-to-MIDI converter have been widely applauded elsewhere, and rightly so. However, not all in the DCB garden is rosy, as I discovered when using Roland's polyphonic DCB sequencer, the JSQ60 (*reviewed elsewhere this issue*). Used in conjunction with other DCB instruments such as the Juno 60 or Jupiter 8 synths, the JSQ is a well-designed and versatile digital keyboard recorder. However, used in conjunction with MIDI keyboards *via* the MD8 interface box, replayed sequencers were plagued by glitching, and some program patches changed their envelopes. This was true of Roland's own Jupiter 6 as well as several other models including the Korg Poly 800 and Siel Opera 6.

It would seem then that the solution for owners of DCB instruments wishing to 'go MIDI' would be to invest in the Roland MSQ700 MIDI/DCB recorder if they want to record sequences from synthesisers of both interface standards.

Even disregarding the problems of MIDI/DCB sequencing, there are signs that attempting to fuse the two standards into a cohesive, compatible network may prove rather fruitless. Simply linking a JP6 to a Juno 60 *via* the MD8,



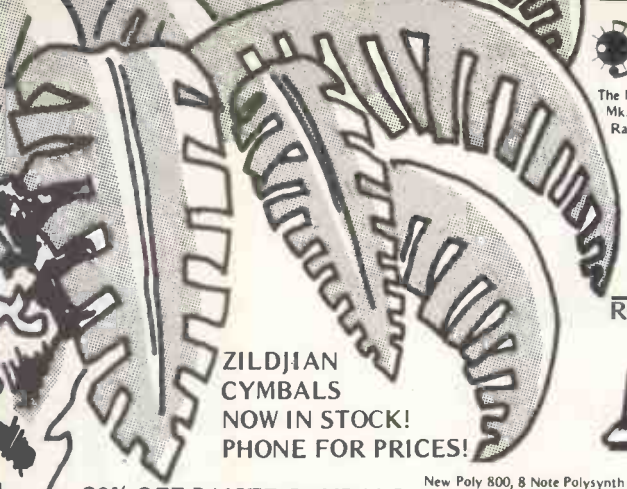
Anyone who's used a touch-sensitive MIDI synth to control a compatible drum machine dynamically – as mentioned briefly above – will know how effective such a combination can sound. At present there are only two MIDI-equipped rhythm machines available (the Drumtraks and Roland's TR909) but there are plenty more in the pipeline, while MIDI keyboards with pressure and velocity sensing are now available in almost every price category. The author has found Roland's HP300 and 400 electronic pianos to give the widest dynamic range when replaying drum sounds (from both the SCI and 909) *via* the notes on a keyboard.

At the time of writing, it would seem that most manufacturers are in the process of bringing their MIDI specifications into line or have already done so. If you're thinking of spending a not inconsiderable sum of money on new MIDI equipment, the most obvious attitude to take remains the 'one manufacturer, one system' approach. You really can't go too far wrong if you opt for a synth/drum machine/sequencer combination in which all the components are manufactured and marketed by the same company. However, that doesn't mean to say interfacing instruments from rival makers is impossible: in many cases it is not only feasible but also very rewarding, as I discovered recently when I coaxed an SCI Six Trak into controlling a DX9, DX7, Prophet 600 and Roland JX3P.

Undoubtedly the biggest problem you'll encounter if you attempt such a link-up will be that of program selection, since not all MIDI instruments are capable of transmitting this information. However, if all you want is control of two or more MIDI instruments from one keyboard and/or synchronisation to a MIDI rhythm unit, and assuming all the instruments you're using are of recent manufacture, you should be all clear for making the most out of MIDI.

Finally, if you have a MIDI- or DCB-equipped synth that has been in your possession a while, and are now in the market for some new – fully compatible – equipment, my advice is to take your own keyboard into the shop and try it out with your potential purchase yourself just to be on the safe side. Using the shop's own example of your keyboard simply won't do, for reasons which, I hope, have become fairly clear as this article has progressed.

Vince S. Hill **E&MM/MIDI**



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Cube, 40W, Keyboard Combo	£182
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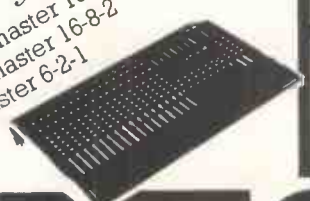

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MIDI PRODUCT GUIDE

As little as six months ago, the idea of a MIDI Product Guide such as the one below would have been almost unthinkable. There simply weren't sufficient numbers of compatible items to go round, and it seemed there was a danger that the new interface was not going to be as widely accepted as was necessary if it was to be a success.

Today, however, the situation is very different. It would appear that the marketing men of the world's electronic musical instrument manufacturers have all decided simultaneously that MIDI is now almost obligatory – the vital ingredient that every newly-introduced piece of equipment must include somewhere within its specification.

Of course, some companies have entered the MIDI race more wholeheartedly than others. A quick glance at the lists below will tell you that Roland have well-nigh twenty MIDI devices either currently available or coming shortly, whereas Korg have only one. All that means is that the wider acceptance of MIDI as an interface standard has happily (for Roland) coincided with a whole batch of new instrument releases. It's expected that most of the major manufacturers will soon be incorporating the new system with as much gusto as Roland – there are few anti-MIDI dissenters in the ranks of contemporary musical instrument designers.

Another interesting point is the degree to which manufacturers and private individuals have been developing MIDI retro-fit kits for synths and other instruments no longer in production. Such developments are of course entirely in keeping with MIDI's claim to being the first truly universal, non-supercedable interface, and if the modification is carried out properly it'll certainly breathe new life into what might otherwise have become an obsolete piece of equipment. If you are thinking of getting your equipment updated, however, do make sure that your MIDI spec is the same as everybody else's (as far as that's possible at the moment) and bear in mind that any work you have carried out will almost certainly invalidate remaining manufacturer's warranty commitments.

Happy MIDI shopping!

POLYPHONIC SYNTHESISERS

AKAI

AX80 ..... £TBA

CRUMAR

Bit One ..... £TBA

KORG

Poly 800 ..... £635

ROLAND

JX3P £795
Juno 106 ..... £799
Jupiter 6 ..... £1995

SEQUENTIAL CIRCUITS

Six Trak £795
Prophet 600 ..... £1495
Prophet T8 ..... £4795

Sycon

SIEL

Opera 6 ..... £1299

YAMAHA

DX9 ..... £799
DX7 ..... £1299
DX1 ..... £POA

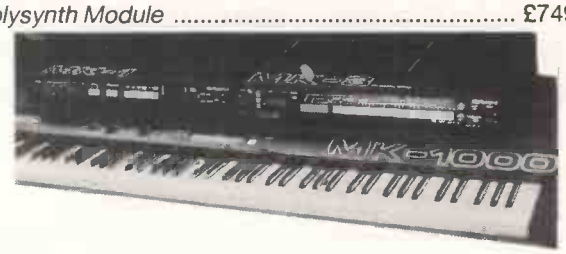
MODULAR SYNTHESISERS

OBERHEIM

Xpander ..... £TBA

ROLAND

MKB1000 Keyboard £1499
MKS10 Piano Module £899
MKS30 Polysynth Module £749



SIEL

Expander ..... £TBA

YAMAHA

T8PR DX Rack £3995

RHYTHM MACHINES

ROLAND

PB300 ..... £320
TR909 ..... £999

SEQUENTIAL CIRCUITS

Drumtraks £949

nection

MIDI at Syco

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MIDI

YAMAHA

RX15 ..... £499
RX11 ..... £749

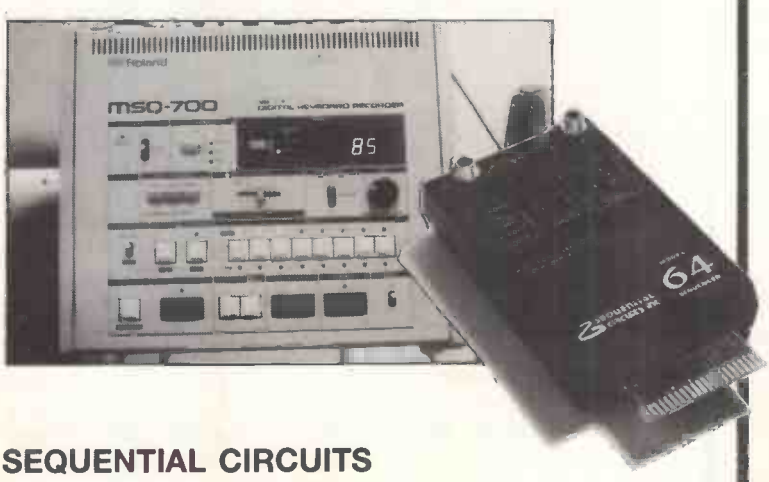
SEQUENCERS AND KEYBOARD RECORDERS

AKAI

MS16 Music Processor ..... £TBA

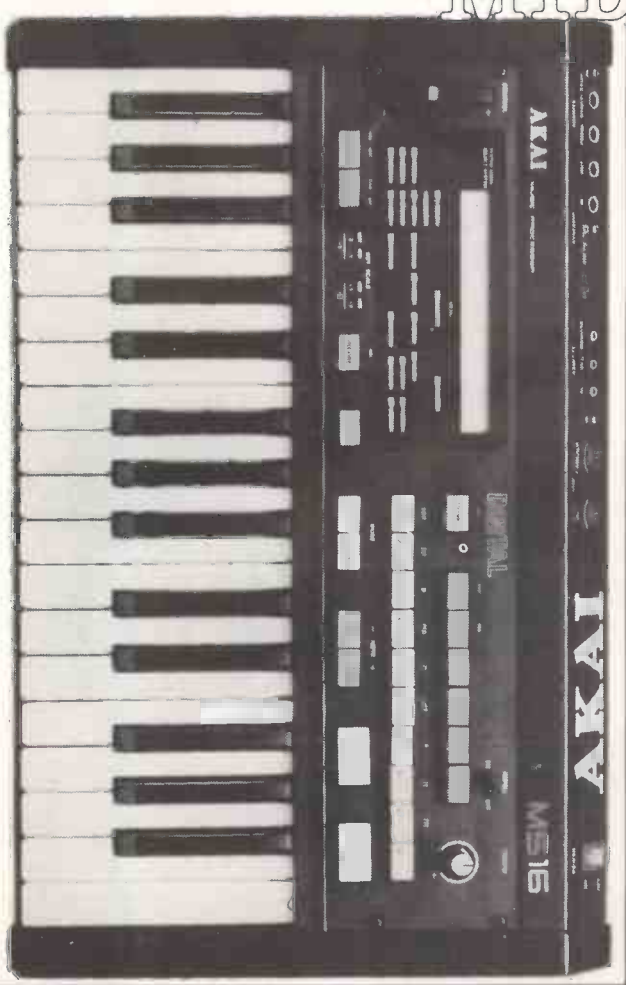
ROLAND

MSQ700 Digital Keyboard Recorder £935
PR800 Digital Keyboard Recorder £415



SEQUENTIAL CIRCUITS

64 Sequencer (runs off CBM 64 micro) £185



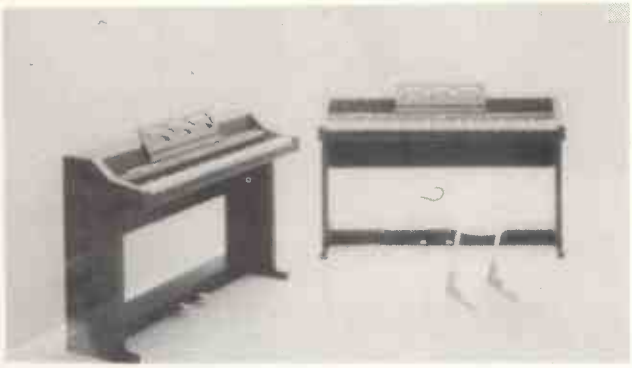
YAMAHA

QX1 MIDI Recorder £2399

OTHER KEYBOARDS

ROLAND

HP300 Home Piano £899
HP400 Home Piano £1125



WERSI

Alpha 300 Organ/Synth ..... Ready-build £4504
..... Kit £1356

ACCESSORIES

AKAI

MS404 MIDI/Analogue Converter ..... £TBA

ROLAND

MD8 MIDI/DCB Interface £265
MM4 MIDI Thru Box £49
MPU401 MIDI Processing Unit ..... £TBA
OP8M CV/MIDI/DCB Interface ..... £TBA

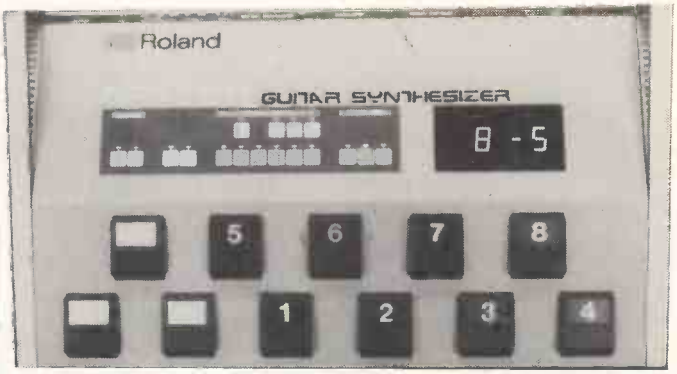
SIEL

Computer Interface ..... £TBA

MISCELLANEOUS INSTRUMENTS

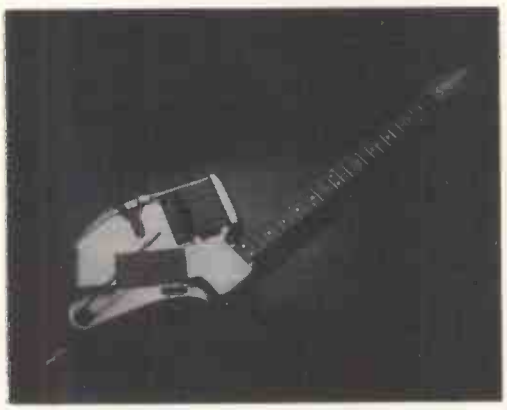
ROLAND

GR700/G707 ..... £1500/£699



SYNTHAXE

SynthAxe Guitar Interface/Controller ..... £TBA



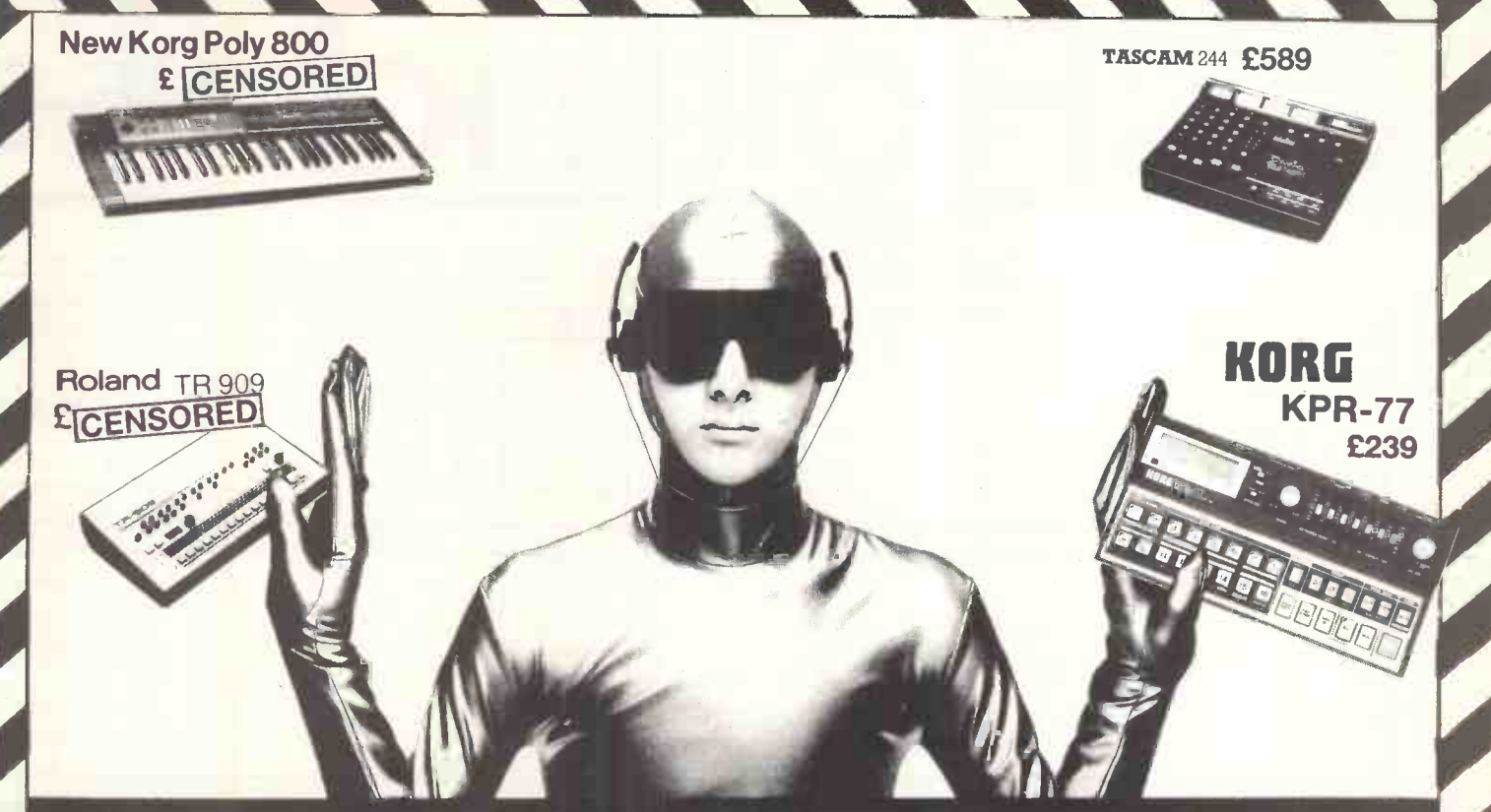
YAMAHA

CX5 Personal Computer £499
D1500 Digital Delay £639

In addition, several computer-based systems such as those manufactured by **Fairlight, Octave-Plateau, PPG, E-mu Systems, Kurzweil** and **Passport Designs** are also MIDI-compatible or will be in the near future.

Thus far, MIDI retro-fits for the following keyboards have been announced as being available, though it should be noted that with the exception of the Poly 61 and 0B8 mods, none of these are carried out in the United Kingdom. The keyboards are: **Korg** Polysix and Poly 61; **Memorymoog; Oberheim** 0B8; **Roland** Juno 6, Juno 60 and Jupiter 8; and **SCI** Prophet 5 and Prophet 10.

E&MM/MIDI



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SEQUENTIAL CIRCUITS, Prophet 600	£1395
YAMAHA DX-7, 32 Memories	Phone
ROLAND JUNO 106, Arriving soon	£800
KAWAI SX-210, 32 Memories	£799
KORG POLY 6, 32 Memories	£799
ROLAND JUNO 60, 56 Memories	£795
SEQUENTIAL CIRCUITS, Six Tracks	£795
YAMAHA DX-9, 20 Memories	Phone
KORG Poly-61, 64 Memories	£725
ROLAND JX-3P, 32 Memories	£695
KORG POLY-800, 64 Memories	Phone

NON-PROGRAMMABLE POLYPHONIC

ROLAND JUNO 6	£525
KORG MONO/POLY	£499
YAMAHA CE-20	£499
KORG SAS-20 with compu-magic	£485
KORG LAMBDA	£399
YAMAHA SK-15, Organ/Strings	£325
ROLAND RS-09, Strings	£325
EKO EM-10, Auto accompaniment	£295

MONOPHONIC SYNTHESIZERS

MOOG SOURCE	£549
KAWAI-TEISCO-110 F	£375
YAMAHA CS-30, With Sequencer	£299
ROLAND MC-202	£289
ROLAND SH101, With Modulator Grip	£249
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ROLAND SH09	£149
MOOG PRODIGY	£149
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EKO-P15	£125
JEN MARLIN	£99

ELECTRIC PIANOS

KAWAI EP-608, Electric Up-Right	£1349
KORG EPS-1, with String Ensemble	£895
YAMAHA PF-15	Phone
YAMAHA CP-35, Stage Piano	£799
KORG 80-S, With String Ensemble	£795
KORG 80, Symphonic	£649
YAMAHA PF-10	Phone
YAMAHA CP-30, Stage Piano	£599
YAMAHA CP-25, Stage Piano	£595
ROLAND HP 70	£435
FENDER RHODES MK II	£399
ROLAND HP 60	£359
WURLITZER EP-200	£325
YAMAHA CP-11	£285
ROLAND HP-30	£219
HOHNER CLAVINET D6	£125
ELKA PIANO	£125

SEQUENCERS

ROLAND MSQ 700, 6,700 notes	Phone
ROLAND JSQ 60, 2,500 notes	Phone
ROLAND MC-202, 2,600 notes	£289
ROLAND CSQ-600, 600 notes	£199
ROLAND TB-303, Bass Line	£199
ROLAND CSQ-100, 168 notes	£125
SEQUENTIAL CIRCUITS	£172

CASIO KEYBOARDS

CASIO CT 7000	£525
CASIO CT 1000	£245
CASIO CT 202	£199
CASIO CT 101	£169
CASIO MT 41	£75
CASIO PT-50, with Memory	£99
CASIO PT-30, with Memory	£69
CASIO PT-20 with Memory	£49
CASIO MT-800	£249
CASIO CT-501	£245

NEW CASIO KEYBOARDS

KX-101 Ghetto Blaster with Keyboard	£295
CT-310 S Replacement for CT-405	£199
MT-200 With Computer Interface	£129
MT-68 Replacement for MT-65	£129
MT-46 Replacement for MT-45	£99
MT-35 Budget Model	£79
VL-Tone, now only	£32

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Korg AT-12 Auto Chromatic	£79
Zenon Chromatic	£69
Seiko Chromatic	£49
Boss TU-12 Auto-Chromatic	£39
Korg GT-60 new model	£29

CASSETTE RECORDERS

TASCAM 244, Why pay more?	£589
TASCAM 234, Sync-Sets	£549
CLARION XD-5, 4-Track	£499
ARIA R-504, Multitracker	£399
CUTEC MR-402, Multitracker	£399
YAMAHA MT-44, Multitracker	£299
FOSTEX X-15, Now in Stock	£299

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TASCAM 38, 8-Track	£1699
TASCAM 34, 34-Track	£829
TASCAM 3440, 4-Track	£699
FOSTEX A-8, 8-Track	Phone

MULTI-TRACK SYSTEMS

CLARION XDS/XAS Complete with floor standing Console	£1399
CLARION XA5 Master Unit	£799
CLARION Floor/Rack Console	£125
CLARION Remote Controller	£29
TASCAM Sync-Set System with MX80, PE40 and Flight Case	£999
TASCAM MX80 Mixer	£239
TASCAM PE40 Pre Amp	£249
TASCAM Flight Case	£95
YAMAHA MT System inc. Mixer plus Patchbay & Rack Unit	£599
YAMAHA MM-30 Mixer	£185
YAMAHA RB-30 Patchbay/Rack	£129
YAMAHA PB-44 Patchbay	£69

DIGITAL DELAY LINES

KORG SDD-3000 Programmable	£775
ROLAND SDE-3000 Programmable	Phone
CUTEC CD-425 with Sub Delay	£345
ROLAND SDE-1000 Programmable	Phone
EVANS MDD-1500	£325
EVANS MDD-1000	£299
IBANEZ DM-1000	£299
WASHBURN WD-1400	£289
ARIA DEX-1000	£289
BOSS DE-200	Phone
IBANEZ DM-500	£245
BOSS DD-2, Pedal	Phone
H/H Digital Multi Echo	£125
H/H Digital Standard Echo	£99

ANALOG ECHOS

EVANS EP-250	£249
EVANS AE-250 + Reverb	£185
ROLAND DM-300 + Chorus	£185
KORG SD-200	£169
EVANS AE-250	£165
ROLAND DM-100 + Chorus	£145
CARLSBRO AD-1 Studio Echo	£139
EVANS EP-100	£115
ROLAND RK-100 Reverb	£109
ACES REVERB, Rack Mounted	£99
EVANS MX-101, Rack Mounted	£89
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VESTA-FIRE RV-2 Reverb	£245
CUTEC GS-2200 Spectrum/Graphic	£215
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CLARION STUDIO MONITORS	£399
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BOSE 101's 100 watts, Pair	£125
KORG MM-25 Powered	£125
YAMAHA MS-10 Powered	£115
BOSS MS 100, 100 watts	£69
BOSS MA-15, Powered	£85
BOSS MA-5, Powered	£49
SUZUKI MX-100 Powered, Pair	£39

SECOND HAND EQUIPMENT

Tascam 234, mint	£450
Tascam 244, mint	£499
Tascam 22-2, mint	£299
Teac 3440,	£525
Teac 144	£399
MM 16 into 2 mixer	£375
H/H 12 into 2 mixer	£325
Davoli 12/100 mixer	£239
Boss KM-60	£145

STEREO MIXERS

Promark MX-3 arriving soon	
Starsound Dynamix 6/2	£169
Starsound Dynamix 12/2	£259
Traynor QD-12, 12 Channel	£399
Cutec MX-1200, 12 Channel	£335
Korg KM-X8 8 Channel	£225
Korg EM-570 Mixer/Amp/Echo	£225
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Roland KM-60, 6 Channel	£199
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CARLSBRO M150 Marlin	£249
CARLSBRO M-300 Slave	£235
CARLSBRO M-150 Slave	£159
CARLSBRO S-300 Slave	£295
CARLSBRO S-600 Slave	£425
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BOSE 302 bass bins, 500 watt	£999
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BOSE 402 PA Cabs, 160 watt	£495
BOSE 101 Mini PA/Monitor	£115
BOSE 802 System Controller	£139
BOSE 402 Equaliser	£80
BOSE Stands, heavy duty	£159
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Kudos 653's 320 watt	£435
Kudos 351's 150 watt	£269
Kudos 251 100 watt	£149
Kudos KL5 Stands	£85
Kudos MX6406, 300 watt PA with 120 watt Foldback	£495

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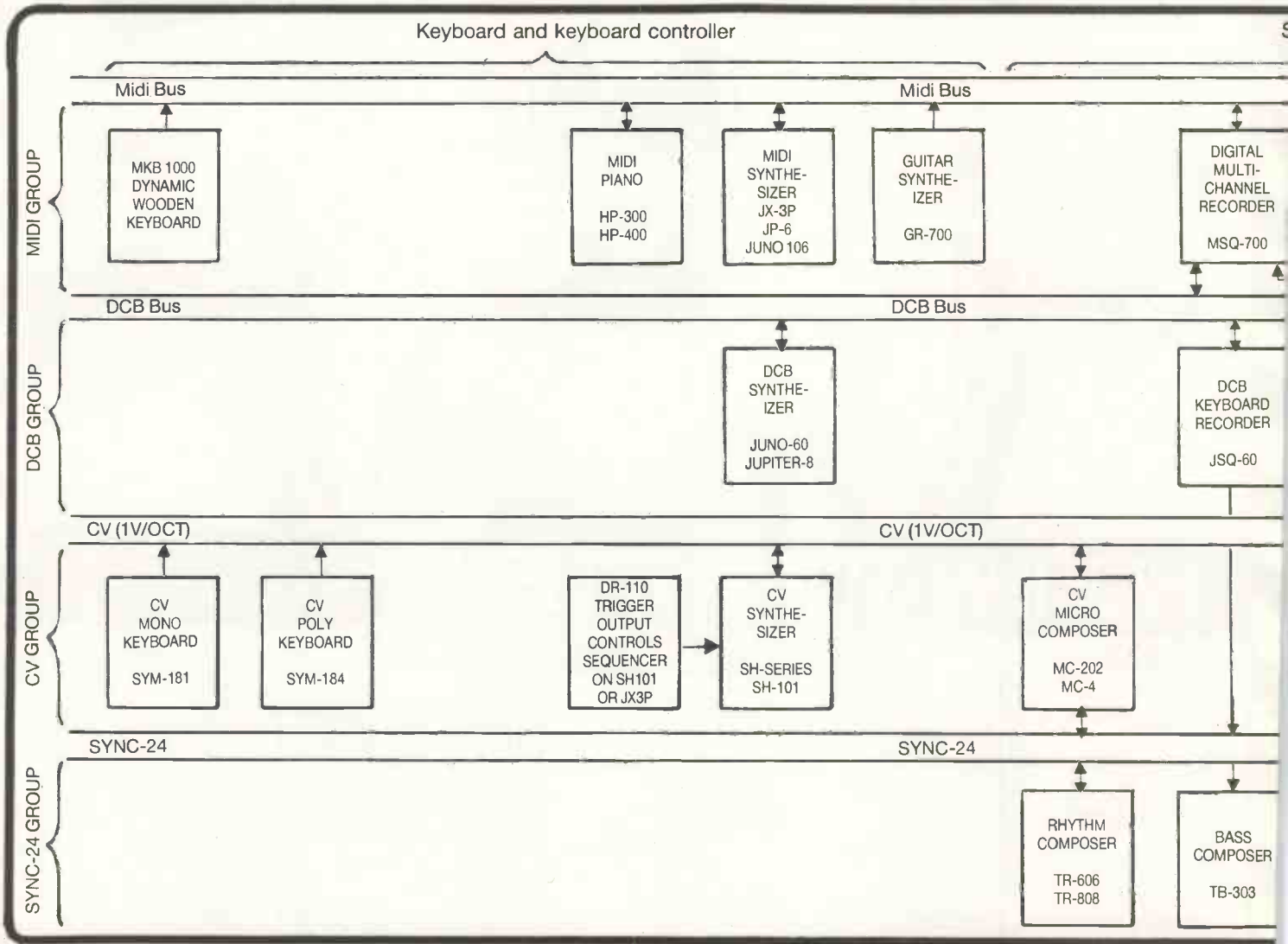
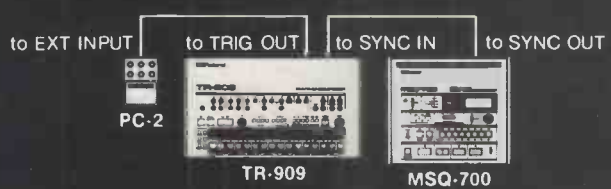


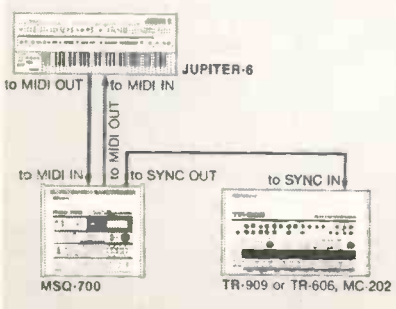
The sound sources of the TR-909 can be played using the keys of the PIANO PLUS 400. The volume changes depending on how forcefully the key is touched.

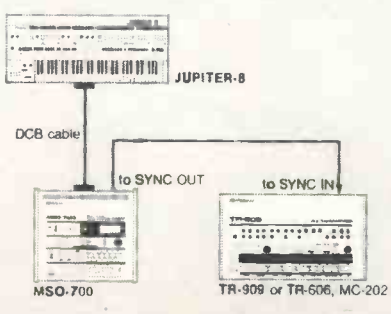


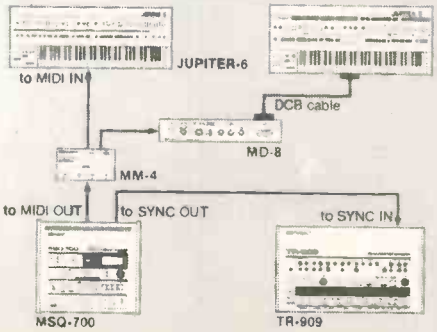
The data of the MSQ-700 synchronizes with the TR-909. It is also possible to control external sound sources, such as the PC-2 percussion synthesizer, using the TR-909's trigger signal.

The MC-202 data contro

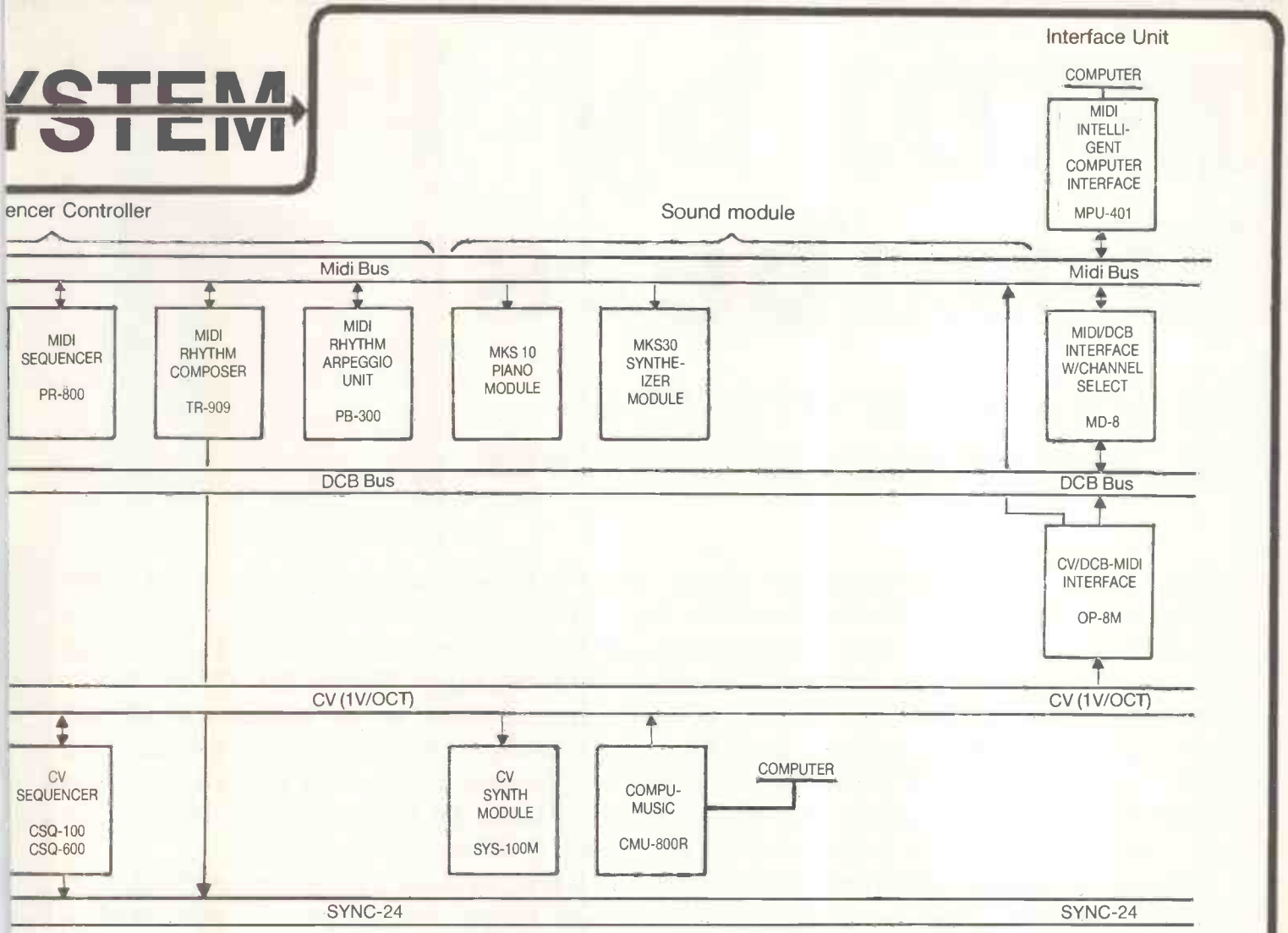
Sample TR909 U





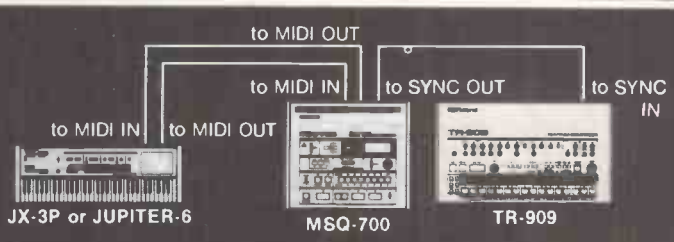


Sample MSQ-700 uses

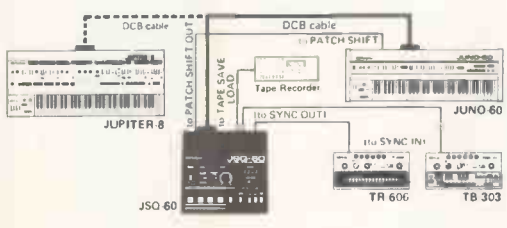


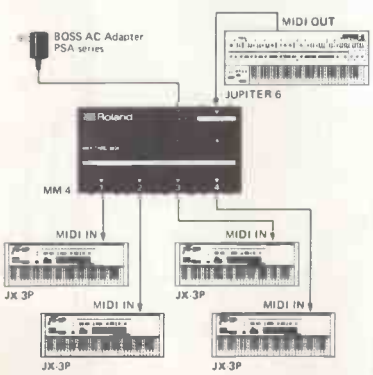
-909.

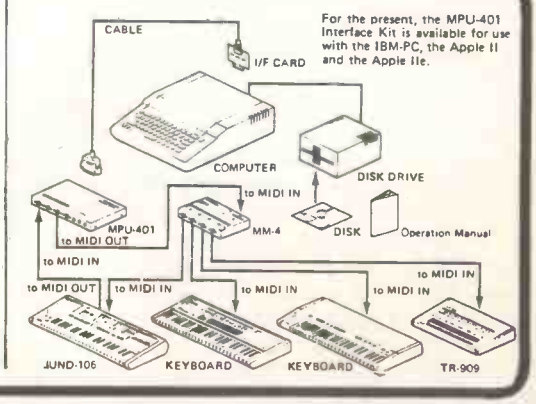
The PIANO PLUS 400 MIDI information controls both the MSQ-700 and TR-909. Turn the Mix Out switch of the MSQ-700 on to control the volume of the TR-909.



The MSQ-700 controls both the JX-3P and TR-909.



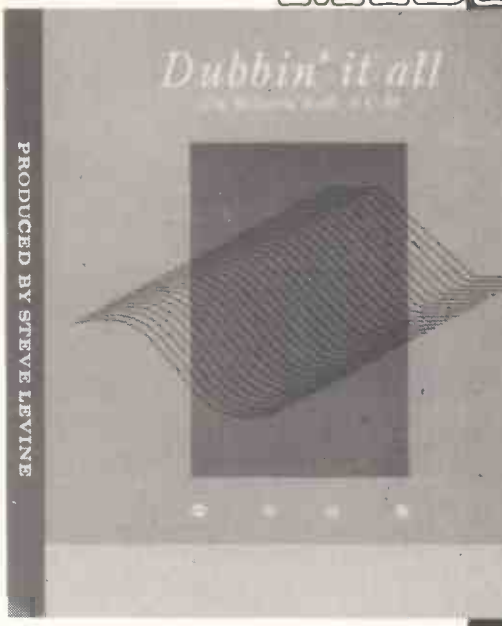




Sample Working Systems

MIDI by Numbers

An interview with the BPI's Producer of the Year.



From a fairly unpromising start as a school-leaver tape-op at CBS Studios in London, Steve Levine has risen to become one of modern music's most sought-after engineers and producers. His credits include all the Culture Club hits from 'Do You Really Want To Hurt Me?' onwards, and a host of other singles successes with names such as David Grant, Secret Affair and The Jags. More recently he has started work on albums by Helen Terry and The Beach Boys, but perhaps more excitingly, he has also been making an album in his own studio under his own name, to be released by Chrysalis later in the year.

Tim Oakes **spoke to him recently about his attitudes to recording and writing music, and how modern technological advances in general – and MIDI in particular – have influenced his method of working.**

'All the new technology that has become available has made the role of producer very different from what we understood by the term ten or even five years ago. I see my role now as someone who interprets the musical and technical ideas of songwriters – someone who offers a band a sort of technical advice centre, if you like. If a band wants a certain sound I have to be able to get it, and for me there's no question where that responsibility lies.

I also see an involvement for me in helping sort out the formula behind a song: getting all the bits into the right order. Quite often a band will come to me with some great ideas, but I find they've been living with a song for so long that they can't see the obvious – like a hook that could be extended, for instance.

I want to be able to offer my bands the very best service they could possibly have, and if something new and exciting appears, then I want it. I've got the only AMS rack in the world with a maximum 25 seconds delay, and that cost about £25,000 in all, plus of course I've got the Fairlight (£30,000), and the Emulator, though a lot of people ask me why I've got both. The reason really is that the Emulator's sampling is a lot better than the CMI because of their compression, and also there's the fact that the E-mu

Interface has almost negligible time delay, and can be driven very easily from the Roland MC4 Microcomposer.

Not all the equipment I use is so phenomenally expensive, though. I've got the complete Oberheim system (DMX, DSX and OB8), a Prophet T8, and I still use Prophet 5 now and again. I have got a problem at the moment though because it seems almost everything is going over to MIDI. I've actually got the very first MIDI OB8 – I had it converted. I'm pretty sure it's the first one because Chase Musicians – where I buy most of my synths – had only this one in stock: I got it for the studio and they wanted to keep it in the shop! *(An Oberheim-sanctioned OB8 MIDI retro-fit has been available since January.)* It's proved very useful for running the DSX sequencer with other synths.

I've just got hold of an SCI Six-Trak which I think is very good value for money, and I'm also beginning to get used to the DX7. I find it's one of the few synths that's really useful above 10kHz, though it can still sound pretty awful if you push it to the limit.

Even amongst all this high technology, I've still got time for a few older instruments. I stil use an old Korg Delta string synth – the first electronic instrument I ever bought. I used it on 'Do You Really Want To Hurt Me?', which surprises a lot of people. I've still got a Minimoog as well. We did a session not long ago using a Jupiter 8 for the bass, but I realised it just wasn't cutting through the sound at all. So out came the Minimoog and it was brilliant. It's the one thing the Moog is tremendous for – a big, fat, rich bass sound, quite unlike any of the newer synths. It stands out without interfering with any other synths that might be on the track. The David Grant sessions that produced 'Watching You, Watching Me' used the Minimoog with Prophet and Oberheim layered over the top. . .

More MIDI

Two other bits of MIDI gear that I've bought recently are the Roland MSQ700 and TR909 *(both reviewed in E&MM April)*. The MSQ is really good. Its' MIDI sequencing potential is very wide, but one reason why I've been able to use it so fully so early is that I seem to be getting better at understanding Roland's manuals. Either they're writing them better or I'm just getting the hang of them.

The TR909 is one of the few things I've been using on the drum side apart from the LinnDrum. I've used it on some of the sessions for Helen Terry's solo album, and it's worked very well indeed. It doesn't sound like the Linn at all, but I do think that sometimes the Linn can sound a bit samey, and I like to have some variation. What I like very much about the 909 is its' flamming ability, which is so easy to use.

I really do think it's important that when you use a complex piece of hi-tech equipment, you know what you're trying to do and how you're going go about doing it, or at least have the instrument long enough to be able to find out. It really is no use for me to go to hire companies to get equipment, partly because you never know precisely when you're going to need something, and also because you never really get to know the limitations of the thing.

Steve Levine at Red Bus Studios.

I saw a lot of that when I was an engineer in the early days. People would hire an ARP Odyssey without a clue how to work it or what it did. You can't possibly get to grips with a device like that if you're having to experiment all the time.

I get to practice with all the equipment after the sessions, and while I'm not a keyboard player by any stretch of the imagination, I can get to play some quite respectable parts because I know how the equipment works, and what little musical knowledge I do have goes so much further.

The Fairlight

My experiences with the Fairlight go a long way towards illustrating my point, I think. The first week I had it I got the most incredible Fender Rhodes sound, but I hadn't worked out what the Save commands were, so as soon as the power went off I lost it.

I've used the Fairlight quite a lot on my own album as a musical thing, but I've used it perhaps more because of the control capabilities that it gives over the rest of the system. I have a SMPTE generator for the control tracks which makes things a lot easier in the long run: clocking different machines and instruments together is still one of the biggest headaches as far as I'm concerned. I still have problems getting everything to run properly – there's even some trouble on 'Karma Chameleon'. I started off with a LinnDrum timing track, but the problem was that at that time I didn't have the Condutors and couldn't run the Linn from the Fairlight, so I put a Linn code down on tape with the drum machine running at full speed. For some reason there was a slight error on the code, and the Linn was speeding up all the way through the track. When we overdubbed the toms I noticed that they were flamming towards the end, which was very odd. It was all OK until we started doing the vocals, and then became really obvious – by the end of the song they're coming in a bit early to compensate.

Electronics

These clocking problems are part of the reason I'm interested in electronics, because you can build all sorts of useful things yourself. When I was at school my main hobby was electronics, and later on I built an E&MM Noise Gate. I actually used it on 'Do You Really Want To Hurt Me?' It isn't all that great as a noise gate, but it's a *superb* guitar limiter! An awful lot of people have asked me how I got that guitar sound, and they're always incredulous when I tell them I actually built the unit myself.

It's like the synths, really.

Almost all of mine have been modified to do a certain job. Before MIDI came along I managed to acquire a whole battery of little boxes for converting one thing to another – audio to voltage or whatever. Dave Simmons, who I knew when he was just starting out, put an interface into my first Linn that gave it the correct CV outs for the Simmons rack; then the guys at Chase Musicians put in another interface to give it the correct Clock Pulse out – I've got things like the Oberheim that require a very high clock, 96 – and they gave it the ability to double the available pulse.

So getting all the various interfaces has really been a bit of a bind. MIDI is still in its infancy and I think it's a bit misunderstood – people are expecting too much of it, perhaps – but as a system it works very well. With luck I won't need so many little boxes in the future!'

Tim Oakes **E&MM/MIDI**

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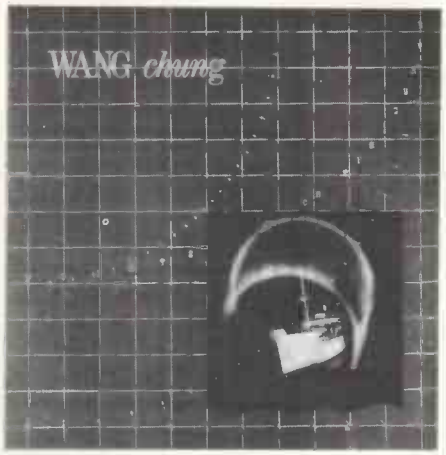
RECORD OF THE MONTH

Wang Chung
Points on The Curve
Geffen GEF25589



Recording an album over a period of more than about six months or so is a risky enterprise that only a very few musicians or composers seem to be able to accomplish with their integrity still intact. Too often, the end-product of such a mammoth endeavour is either self-indulgent or hopelessly inconsistent, or both.

Wang Chung, however, have not only survived their ordeal but emerged from it with a record of real innovation and character. True, the songs themselves are more often than not conventionally structured and sung, but rather than pursuing musical diversion for its own sake, the band have chosen to concentrate on making the most out of quite conventional material, by the use of colourful Fairlight and PPG effects and great attention to detail on the part of the album's co-producers, Chris Hughes and Ross Cullum.

That's not to say the songs on *Points On The Curve* are in any way below-par. If anything, it's the combination of catchy, commercial melodies, perceptive lyrics and thoughtful presentation that sets this album apart from the contemporary pop crowd.

The overall standard of songwriting is extremely high, but if I had to pick a couple of favourites, they'd be 'True Love' (an instantly memorable ditty with excellent vocal effects and some immensely powerful percussion playing and 'Don't Be My Enemy' (PPG tuned percussion sounds well to the fore – and surely they'll turn it into a single one of these days?)

It's not inconceivable that many 'serious' music fans will write off Wang Chung as being just another example of 1984 pop fodder, but believe me, they'd be making a big mistake.

K. Leimer
Imposed Order
Palace of Lights PoL17

Steve Tibbetts
Safe Journey
ECM 1270

Two records of great individuality from celebrated American 'esoteric' musicians. Leimer's is mainly synth-based, presenting something of a contrast to Tibbetts' guitar and percussion offering, though both records share a tremendous sense of atmosphere and some inspired compositional touches.

Leimer's work is comparable – both in concept and quality – to Eno's Ambient series, but in fact, *Imposed Order* is if anything a more interesting collection, since its music relies less on repetition and more on subtle changes in texture and dynamics for its effect.

There are eight tracks on the album and not one of them could fairly be described as in any way commercial, but then that's not its creator's intention.

Nor does commercialism play any part in determining the course adopted by Steve Tibbetts, a guitarist whom a friend of mine described as 'the thinking man's Carlos Santana', though that's more than a trifle unfair. *Safe Journey* is typical Tibbetts fare – lots of atmospheric, heavily treated guitar parts backed by sparkling, pulsating tribal rhythms. Occasionally, the guitarist lapses into shrieking, formless solos – though even these are beautifully executed – but in the main this new album is full of delicacy and sensitivity.

Both excellent albums, then: thoughtfully conceived, well played and brilliantly recorded, and well worth the time it'll probably take you to seek them out.

Please note that due to a combination of the MIDI supplement and unprecedented reader response, our survey of independent releases has been postponed until next month.

Watch this space.

Soft Cell
This Last Night in Sodom
Some Bizarre BIZL 6

An angry, violent farewell record from messers Ball and Almond, and sadly not one that really comes off. For whereas their earlier creations made up in charm and crystal-clear production for what they lacked in musical or compositional skill, *This Last Night* is merely a collection of ill-fabricated Northern Soul out-takes trading under the guise of blood-and-guts art.

Only on two occasions do the duo get down to some decent songwriting: 'Little Rough Rhinestone' is a pleasant pop melody that would not have been out of place on the initial *Non-stop Erotic Cabaret* album, while 'Meet Murder My Angel' that follows it is a gloriously haunting track, full of menace and atmosphere.

All I can really say about the rest is that it's just what you'd expect from a band in its death throes – dull, lifeless, pessimistic, and lacking in imagination. Which really is a bit of a pity when you consider that Soft Cell were once one of the freshest, brightest electro-pop acts around – just where that vitality has got to, I really couldn't say.

Axxess

Novels For The Moons
Lamborghini LMGLP 1000

Axxess is Patrick Mimram, multi-millionaire, Managing Director of the Lamborghini car company and electronic musician extraordinaire. *Novels For The Moons* is his first venture onto vinyl (though his label boasts several other artists on its catalogue, Steve Hackett among them) and it's a pretty impressive piece of work all round.

To begin with, most of the sounds on the album are generated by an enormous – and, to the writer's knowledge, unique – computer music system known simply as *Synthi*. The work of ex-Tangerine Dreamer Peter Baumann Berlin engineer Andreas Bahrdt, *Synthi* has at its heart a Hewlett-Packard personal computer, and is capable of both analogue and digital sound-generation as well as comprehensive sequencing in both real and step time.

Throughout the album, the instrument is played with a refreshing sensitivity – though I'd be the first to concede that *Synthi*'s sequencing capabilities are mildly over-used in this instance – and programming has clearly been undertaken with some care: some of the sounds really are out of this world.

Compositionally, *Novels For The Moons* bears more than a passing resemblance to early Klaus Schulze or Robert Schroeder, though that's not to say it's one-dimensional: each track has its own distinctive style.

A video of the album has also been made with the help of *Synthi*'s SMPTE code compatibility – it can drive VTRs in sync with sequenced music – and if it's anything like as colourful as its soundtrack, it should be well worth watching.

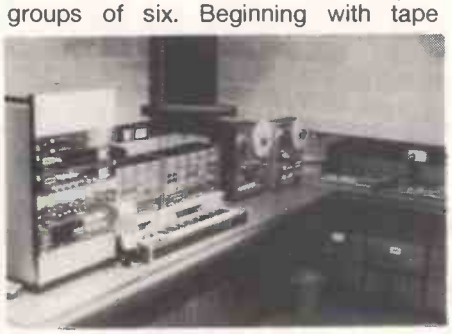
Electro-Acoustic Music at Huddersfield

Currently under development is a computer-controlled quadropanning facility which will be confined initially to the studio, though it will eventually be used also in live performance.

Custom-built equipment includes a standard interval timer which, apart from its function as a clock and counter, allows remote control of the four Revox recorders – these can be individually stopped or started in record or playback mode according to a pre-programmed time series. As quite a lot of the studio work involves the combination of tape with slide projection, a programmable digital dual slide fader has been designed and built. This allows manual control of two slide projectors with independent fading and slide change. Alternatively a sync tape can be produced to allow perfect syncronisation of slides and music.

Initially, the studio was housed in a large room converted for the purpose, with the technician's room being adjacent. However, we recently moved into purpose-built accommodation which is a vast improvement. The studio is now virtually soundproof and when we have completed the acoustic treatment it should provide an excellent working environment. It is housed in a separate building and when all work is completed, the unit will comprise the studio, technician's room, editing room, computer room and the author's teaching room.

All students in the Department of Music have access to the studio, electro-acoustic music being available as an option on both BA and Graduate Diploma courses. Students choosing to take this option need no previous experience in the medium of electronics, and the course consists of a two-hour weekly session in the studio with the students usually in groups of six. Beginning with tape



AMS, Roland and TEAC on the sideboard . . .

techniques and *musique concrète*, the course is structured so that if students continue with the option for two years, they end up with a thorough working knowledge of an analogue studio, plus experience of the alphaSyntauri computer music system.

Each weekly session includes a practical assignment which students have to complete before the next meeting. Because of this, the studio is available for use 24 hours a day, seven days a week, and it tends to be used very heavily!

After adequate technique has been acquired, students are able to submit tape composition for assessment as part of their course. (All BA and most Graduate Diploma students have to take composition as an important subject area for at least two years). Students who are particularly able in the medium can pursue electro-acoustic music as the sole composition element of their course, dropping notated composition completely, although many choose to submit a mixture of electro-acoustic and notated composition. Any student who has worked in the medium prior to coming to Huddersfield, having presented composition of suitable quality at interview, can pursue electro-acoustic composition as a major area of study from the beginning of the course. However, the subject is not compulsory for any student except those who come to the Department on a composer's syllabus within the Graduate Diploma course. Such students have to take the subject for one year and produce a tape composition: thereafter they may discontinue the option if they wish.

Soundcraft console and auxiliaries.

Church Conversion

As mentioned above, quite a lot of the composition produced in the studio combines slide projection with tape and we have excellent replay facilities available in St. Paul's Hall, a former church which has been converted into a most attractive concert hall and is on the Polytechnic campus. We have a small recording facility in the hall which enables recordings of concerts and recitals to be made. The original studio mixer (RSD 16-4-2) is used for this purpose and recordings can be made on a Revox B77 with dbx noise reduction or onto cassette. Four LED custom-built PPMs are available for monitoring purposes.

When an electro-acoustic concert is given we use four Tannoy SRM 15X and two Tannoy SRM 12X speakers, driven by three Amcron DC300A MkII amplifiers. We have an AHB 16-4-2 mixer for performance purposes. *Polyphony* is a group based on the studio at the Polytechnic which is dedicated to the performance of new electro-acoustic music, and concerts given by the group feature pieces produced mainly in the studio. Performances are given annually as part of the Huddersfield Contemporary Music Festival and in various venues in the North of England.

Although our studio still a 'young' facility, electro-acoustic music composition has succeeded in establishing itself firmly within the Department of Music. With the possibility of specialisation in this medium on both courses offered within the Department, the Polytechnic provides a stimulating environment for the production and performance of studio composition. Who says there's no life in Huddersfield?

Phil Ellis **E&MM**

For further information about the courses offered and entry requirements contact: The Secretary, Department of Music, Polytechnic, Queensgate, Huddersfield, West Yorkshire HD1 3DH. Enquiries specifically about the studio facilities should be addressed to Phil Ellis at the same address.

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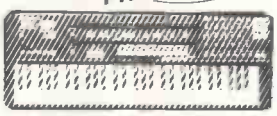

ROLAND JX-3P
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ROLAND PG200
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ROLAND JUNO 6 & JUNO 60
These superb six voice polysynths are packed with features making them high performance instruments at very affordable prices. The Juno 60 has the addition of 56 programmable patch memories and so is ideal for live work. Specifications include an arpeggio unit, 2 speed stereo chorus, high pass filter and key transpose. Great value for money.

YAMAHA DX7 & DX9
You've just got to come in and hear these digital poly's for yourself. They are both sixteen voice polyphonic and produce a superb variety of very 'acoustic sounding' instrumental tones. The DX9 has 120 factory set (but editable) presets and is fully programmable. The DX7 has 128 presets with more extensive programming possibilities and touch responsive keyboard.

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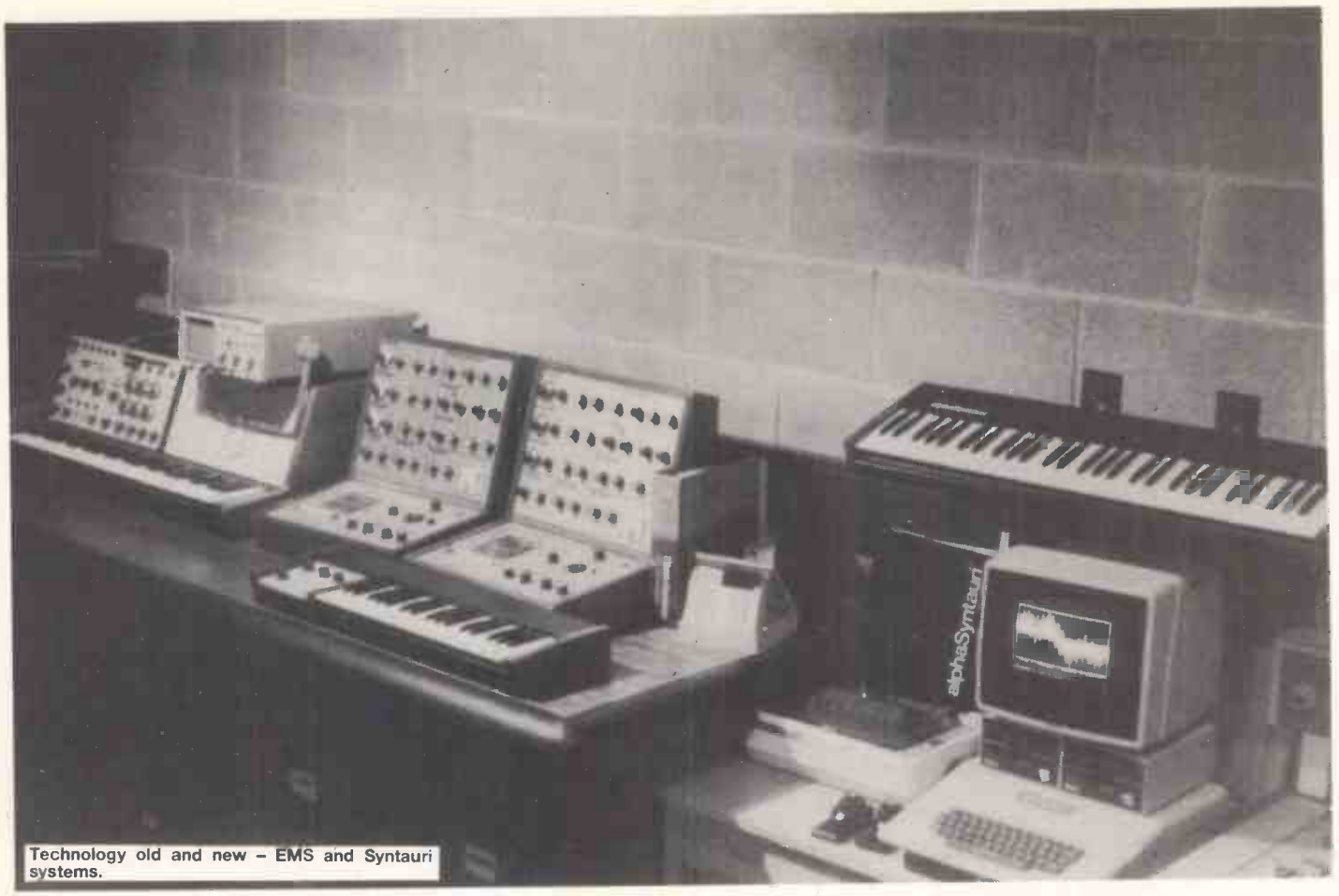

Technology old and new – EMS and Syntauri systems.

Electro-Acoustic Music at Huddersfield

One of the UK's lesser-known educational studios surveyed here by its Director, Phil Ellis.

Serving a Department of Music of about 200 students pursuing a degree or graduate-equivalent in music, the Electronic Music Studio at Huddersfield Polytechnic was opened in December 1979. At this time the basic equipment comprised one RSD 16-4-2 mixer with Penny & Giles faders, four Revox B77 two-channel tape recorders with remote control and varispeed, and one TEAC A3340S four-channel tape recorder. Electronic sound generation and treatment was limited to two VCS3 synthesisers, with one DK2 keyboard and 256-note sequencer and one EMS eight-octave filter bank.

Signal routing in the studio is *via* a 60 × 60 matrix patchbay and output levels are monitored through four BBC-pattern PPMs. Four Tannoy Berkley loudspeakers are powered by Quad 405 power amps.

The studio has been set up and maintained by Mark Bromwich, the full-time studio technician. Since 1979, considerable improvements and additions have been made including some equipment custom-built by Mark. We quickly replaced the mixer with a Soundcraft Series 400 18-4-2 model with Ernest Turner PPMs. A modification to this allows quadrophonic sound diffusion using two Penny & Giles quadropans. To enable four-channel work to be carried out, a second four-channel tape recorder was obtained, an Otari MX 5050 BQII, and a Studer B67 two-channel tape recorder was also taken on board for producing master recordings. Noise reduction – dbx – was also introduced and we now have eight dbx 155 and two dbx 150 units: this allows dbx recording/playback using up to 20 channels of simultaneously encoded/decoded sound! Most recently we have acquired a Sony PCM F1 digital tape recorder for field recording.

Vocoder

In 1981 we installed a custom-built 10-channel vocoder. This covers a frequency range of 30–16000Hertz with the facility, *via* a small patch field, of taking the speech detector voltages and feeding these into any of the carrier VCA inputs. This will also allow computer control of the 10 VCAs *via* DACs – a facility currently under development. We have recently installed a Roland System 100M modular synthesiser system to complement the two VCS3s, while a Klark Technik DN27A graphic equalizer has proved a most useful addition. A Musico 'Resynator' pitch-to-voltage synthesiser/converter provides a sophisticated sound generator. A Valley People 'Dynamite' dynamics processor is useful for microphone recording – in the studio we have three C-ducer contact microphones, four Calrec CM652Ds, and two AKG D200s.

Reverberation was, until recently, provided solely by a GBS reverb system (discounting the VCS3 reverbs!). However, we now have a highly sophisticated digital sound processing and reverberation capability. This is provided by an AMS DMX15R digital reverberation system (complete with a remote terminal) and an AMS DMX15-80S digital delay with two pitch-change cards, 3.25 seconds of memory and a deglitch card.

Computer Systems

Digital sound generation is available *via* an Apple II computer system, with alphaSyntauri five-octave keyboard and Metatrak and Soundchaser software. We also have an Apple IIe computer with Mountain Computer 16-channel D-A and the Gibson light-pen system. This second computer is used mainly for research and development by Mark Bromwich.

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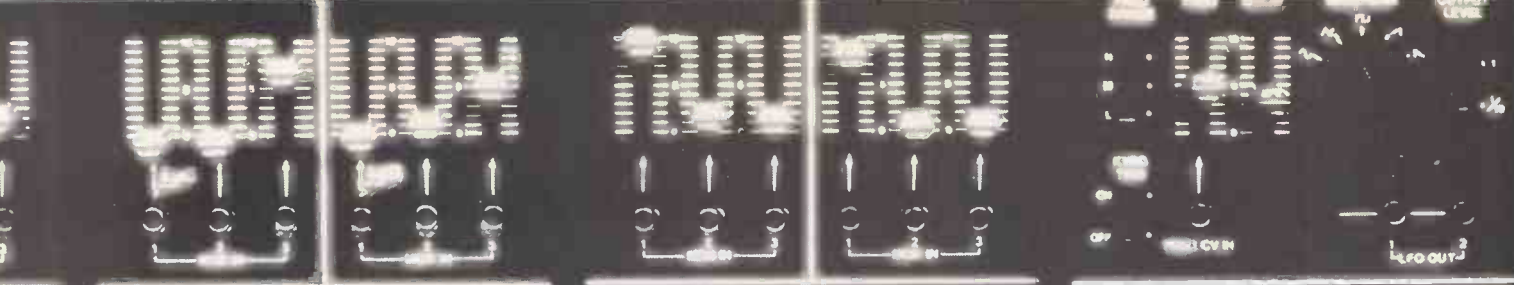


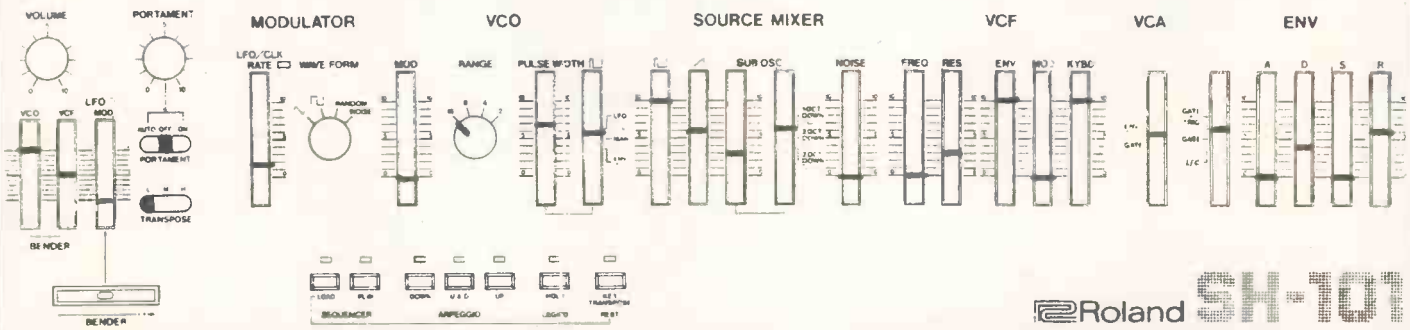
PATCHWORK

This is where the editorial staff of E&MM take a break from duty and let the readers take over. Whatever synth you play – be it Wasp or Fairlight, or anything in between – you're invited to submit your favourite combinations of parameter settings to Patchwork, E&MM, Alexander House, 1 Milton Road, Cambridge CB4 1UY.

One problem with a regular feature such as this is that readers whose particular needs are not fulfilled for a couple of months fall all too easily into the trap of assuming that their own specific synth has been forgotten by the column's participants. Yet while it's unavoidable that some keyboards are bound to be featured in *Patchwork* more regularly than others – simply through their being more popular instruments – what many players don't seem to realise is that many patches designed specifically for one instrument may in fact be easily modified to suit several others. Just how closely a modified patch resembles the original will depend entirely on the degree by which the two instruments' control sections correspond but when you consider that, for example, most analogue monophonic synths follow the same basic design principles, it follows that what works well on one model with probably work just as well on another if the same essential patch is adopted, if not better.

ROLAND SH101 — 'Bass Synth' — Simon Wynn, Essex

Our first patch this month comes from Simon Wynn (bassist with Some Other Year – reviewed in our *On Cassette* page last month), and his bass synth patch is reproduced below. Varying levels of rectangular and ramp waves are mixed with the square wave of the Sub Oscillator to provide a rich bass sound, which is then given a reasonably short envelope, ideal for those fast bass patterns.



KORG MS20 & CASIO VL-TONE — 'Casio Sequencer' — Roger Wilson, Middlesex

A novel idea for controlling an MS20 from a VL-Tone (*via* the former's External Signal In) has been submitted by Roger Wilson, providing a simple sequencing facility for the Korg synth. Vibrato can be added to the MS20 by the use of the mod. wheel, and VCO2 can be detuned to an interval of VC01 if desired. The two keyboards should be perfectly in tune (Roger suggests either using the Flute preset or 0.0379901 in ADSR mode for tuning the VL-Tone), and the MS20 can be triggered in the Sequencer, One Key Play or real time modes.

VC01

Waveform	Ramp
PW	N/A
Scale	32′

VC02

Waveform	Rectangular
Pitch	Slight Detune
Scale	16′

VCO MIXER

VC01	10
VC02	10

	HPF	LPF
Cutoff Freq	0	6.1
Peak	0	6.2

CUTOFF FREQ MODULATION

	HPF	LPF
MG/T.EXT	0	0
EG2/EXT	0	6.8

FREQUENCY MODULATION

MG/T.EXT	2.3
EG1/EXT	0

PORTAMENTO	N/A
MASTER TUNE	0

MOD GEN

Waveform	Triangle
Frequency	5.2

ENV GEN 1

Delay	0
Attack	0
Release	0

ENV GEN 2

Hold	0
Attack	3.3
Decay	3.9
Sustain	6.6
Release	1.2

Patch VL-Tone to External Signal Processor Signal In; 1st Out Socket to EXT Signal in; F&V CV Out to VCO 1+2 CV In; Trig Out to Trig In. ESP Settings – Signal level 8.1, Low Cutoff Freq 0, 10, 10, Threshold Level 10.

Mod Wheel Out to VCA Control input; MG Out to VCA In; VCA Out to Total.

YAMAHA DX7 — 'Wurlitzer' — Steve Parr, London SW15

One of the best DX7 patches submitted so far comes from Steve Parr, currently playing keys with Desmond Dekker as well as finding time to build a 16-track electronic video studio in Soho.

Steve describes the sound as extremely touch-sensitive. It reproduces with stunning realism every keyboard player's favourite sound of tortured tone bars on the verge of breaking when thumped with force. In fact, this patch is more like about five patches because of the extreme difference of tone over the dynamic range of the keyboard. Try it for yourself and see if you agree. . .

YAMAHA DX7

VOICE NAME: WURLITZER

PROGRAMMER: Steve Parr

ALGORITHM	FEED BACK	LFO WAVE	LFO SPEED	LFO DELAY	LFO PMD	LFO AMD	LFO SYNC	MOD. SENSITIVITY PITCH	MOD. SENSITIVITY AMPLITUDE
16	0	SINE	17	0	0	0	OFF	1	OP 6: 0
									OP 5: 0
									OP 4: 0
									OP 3: 0
									OP 2: 0
									OP 1: 0

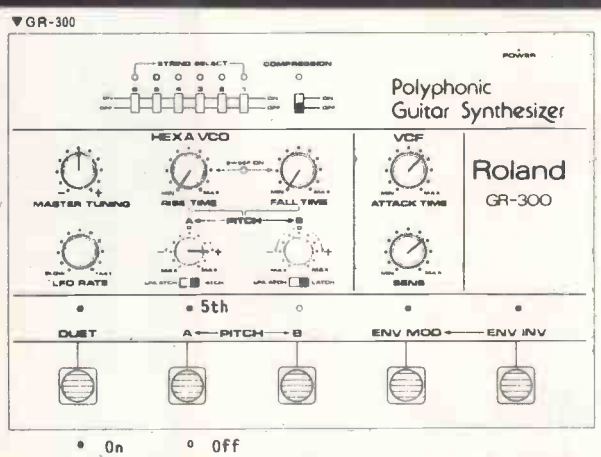
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	POLY/MONO	PITCH BEND RANGE	PITCH BEND STEP	PORTAMENTO MODE	PORTAMENTO GLISSANDO	PORTAMENTO TIME									
	POLY	2	0	FOLLOW	OFF	0									

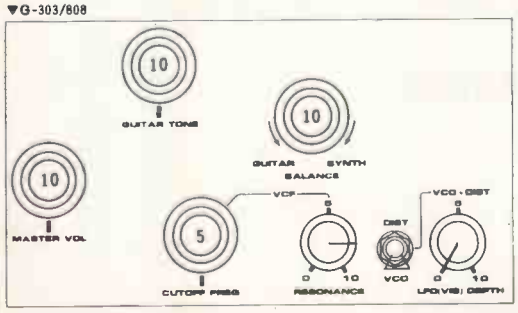
OP	OSCILLATOR MODE/SYNC	OSCILLATOR FREQ. COARSE	OSCILLATOR FREQ. FINE	OSCILLATOR DETUNE	EG RATE 1	EG RATE 2	EG RATE 3	EG RATE 4	EG LEVEL 1	EG LEVEL 2	EG LEVEL 3	EG LEVEL 4	KEYBOARD LEVEL SCALING BREAK POINT	KEYBOARD LEVEL SCALING CURVE L	KEYBOARD LEVEL SCALING CURVE R	KEYBOARD LEVEL SCALING DEPTH L	KEYBOARD LEVEL SCALING DEPTH R	KEYBOARD RATE SCALING	OPERATOR OUTPUT LEVEL	OPERATOR VELOCITY SENS.	PITCH EG RATE 1	PITCH EG RATE 2	PITCH EG RATE 3	PITCH EG RATE 4	PITCH EG LEVEL 1	PITCH EG LEVEL 2	PITCH EG LEVEL 3	PITCH EG LEVEL 4	KEY TRANSPOSE	VOICE NAME
6	R	OFF	1		0	94	99	0	85	99	99	0	0	G2	+EXP	-LIN	0	40	4	86	0										
5	R		11		+2	94	38	34	68	87	95	0	0	C3	+LIN	-EXP	50	0	3	53	6										
4	R		.51		-7	95	61	50	78	99	0	0	0	A-1	-LIN	+LIN	0	0	3	93	7	N/A	50	50	50	50	C2				WURLITZER
3	R		2		+1	80	70	35	55	99	90	0	0	F3	+LIN	+EXP	79	79	3	99	7										
2	R		1		+3	85	85	20	54	99	99	0	0	F2	+EXP	-LIN	0	0	2	75	2										
1	R		1		-1	90	85	20	54	99	99	0	0	A-1	+EXP	-LIN	0	0	2	99	0										

17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
MODULATION WHEEL				FOOT CONTROL				BREATH CONTROL				AFTER TOUCH			
RANGE	PITCH	AMPLITUDE	EG BIAS	RANGE	PITCH	AMPLITUDE	EG BIAS	RANGE	PITCH	AMPLITUDE	EG BIAS	RANGE	PITCH	AMPLITUDE	EG BIAS
23	ON	OFF	OFF	0	N/A	N/A	N/A	0	N/A	N/A	N/A	0	N/A	N/A	N/A

MOD. WHEEL FULL ON FOR CHORUS EFFECT.

ROLAND GR300 GUITAR SYNTH — 'ELP Fanfare' — John Harris, Malvern





John, session guitarist and lead axe-man with Ti-Na-Na, has submitted this patch for the GR300, which 'produces the instantly recognisable *Busfare for the Common Man* sound! Pitch A is tuned one fifth above the fundamental pitch, and the resonance control may be fine tuned to personalise the effect. The effect works well on single notes, but a little care must be exercised over the choice of suitable chords.'

Corrigendum to April 84 Regarding the patch for the Moog Prodigy, please note that the Filter Kbd Tracking selector should be set to 'Off' and not to 'Full', as published.

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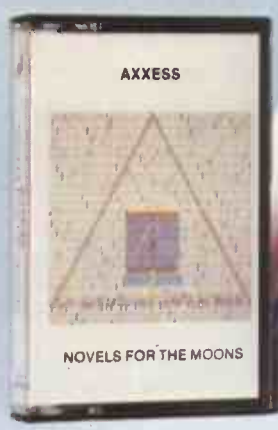

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The Prophet-T8 offers a choice of four keyboard modes: single, double, unison or split. In double mode, different program patches are layered on top of each other so that two sounds are triggered by each key. The split mode lets you play different sounds at different ends of the keyboard. This highly dynamic and precise keyboard is only part of the Prophet-T8 story.

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Understanding the DX7

Jay Chapman **begins his in-depth look at how the DX keyboards generate their sounds by examining one of the factory-programmed voices – 'E. Organ 1'.**

This article is the first of two in which I'll be analysing the make-up of two of the Yamaha-supplied pre-programmed voices. This will not be done in exhaustive detail – I'm not going to look at every single parameter setting – for several reasons, not the least of which being that we would probably all fall asleep after a couple of paragraphs!

The object of the exercise is really to pick out and discuss the important settings and the workings of the algorithm in use. In other words, the parts that give each voice its essential character.

I hope you find this approach a fairly logical one – if it's successful you should soon be able to explore the machine under your own steam, of which more in a later issue.

Analysis – 'E. ORGAN 1'

Voice ROM1 A17

If you have never downloaded any of the ROM voices into the DX7 internal memory (thereby overwriting the latter) you can simply press the green INTERNAL keypad (under the MEMORY SELECT legend) followed by the green '17' keypad, to call up this particular voice. Check the display:

```
INTERNAL VOICE
INT17 E.ORGAN 1
```

If you *have* overwritten this internal memory, press the green CARTRIDGE keypad instead of the INTERNAL one (having first set and inserted the correct ROM) and the green '17' keypad and you should end up with:

```
CARTRIDGE VOICE
CRT17 E.ORGAN 1
```

Having got to the correct voice we now want to examine its internals, so press the purple EDIT/COMPARE keypad to get into edit mode. Your display will change but exactly what it shows depends on what keypads you pressed last time you were in this mode. The information regarding the number of the algorithm used and which Operators are switched on will be present, though, so that's where we start the analysis – part of the top line of the display shows:

Figure 1

```
ALG32 111111
```

The algorithm used then is number 32 – the diagram for this algorithm, taken from the DX7 front panel, is shown in Figure 1.

Straight away we can see that this voice does not use any frequency modulation, as all six operators connect directly to the horizontal line (below the operators) which represents the output. The string of '1's in the display tells us which operators are actually in use and as we have a complete string of ones, ie. '111111', we know that all six are turned on. In fact we have six 'carrier' operators – they all contribute directly to the sound we hear.

OK, let's start some experimental keypad pushing.

Carriers

The first thing to do is examine the sound that each carrier is producing. To do this, turn all the operators off by pressing the green keypads '1' through '6'. The display should change to '000000'. Now turn on one carrier at a time by pressing the green keypad bearing the relevant Operator's number, and play a few notes. When you want to move onto the next Operator, press the same keypad again to 'toggle' the current Operator off. Your display of ones and zeros should cycle through the sequence '100000', '010000', '001000', '000100', '000010' and '000001' as you listen to each Operator in turn.

With the exception of Operator 6, you should hear a simple sinewave, of a different pitch for each Operator, which is turned on and off by the keyboard acting simply as a switch, with no hint of any envelope shaping. Thinking back to the 'drawbar organ' discussion in last month's introduction this state of affairs is not at all surprising, but don't be fooled, there is a little subtlety to be uncovered yet.

We know already that to create the timbre of a sound we must use frequency modulation and/or combine frequencies that are (usually) harmonically related. Since we do not have any modulating operators in use in this instance, we should look for what frequencies are being combined. To do this, simply press the green FREQUENCY COARSE keypad and turn all the Operators back on ('111111'). The display will not show the actual frequency of the Operator unless the operator is in Fixed Frequency mode (see last month's article). For most 'musical' sounds, Frequency Ratio mode is chosen so that the pitch output by the Operator is related to the keyboard note played and thereby indirectly to the frequency of other Operators also in Frequency Ratio mode – this is the case for all the Operators used in 'E. ORGAN 1'.

Operators

By pressing the purple OPERATOR SELECT keypad you can cycle through all the Operators displaying their frequency ratios. This is what you should find:

```
Operator Number:  1     2     3     4     5     6
Frequency Ratio:  0.50  1.01  1.50  0.50  1.00  3.00
```

It's always nice to start from a known base during investigations, so you'll be pleased to see the '1.00' for Operator 5. This means that the pitch produced by Operator 5 is exactly that selected by the keyboard note played. The ratio of 1.00 is usually, but not always, going to represent the fundamental pitch of the overall sound being produced.

Of the other Operators, number 3 is probably the easiest to consider next. The frequency ratio of 1.50 means that the pitch produced by this Operator is one-fifth above that selected by the keyboard note being played. To hear this, turn off all Operators except number 5 ('000010'), play middle C, turn on Operator 3 ('001010') and play middle C again. You should hear middle C and the G above middle C (this being the musical fifth above) at equal volume.

With Operators 3 and 5 on and all the others off, the sound produced has a slightly oriental flavour to it because the interval of a fifth is a characteristic of such music. If you feel brave enough, have a look at the voice 'PIANO 5THS' (ROM 1 B6) – you should now be able to work out how this voice produces the fifths.

What next? Well, let's consider Operator 1. Its frequency ratio is 0.50, so it is producing a pitch one half that played on the keyboard: in other words, we get a note one octave below that played. If you want to hear the difference, switch operator 5 on ('000010') and 'toggle' Operator 1 on and off whilst playing the same note ('100010' then '000010'). It's just like using the 'sub-octave' facility on a cheap synth that 'fattens up' the sound a little *without* the extra cost of another oscillator.

By this time you should be getting a bit suspicious about Operator 4, which also has a frequency ratio of 0.50. Isn't it just being wasted duplicating Operator 1? The answer relates to the subtleties referred to earlier. To explain what is going on we must look more carefully at the tuning of Operators 1 and 4.

As far as the FREQUENCY COARSE and FREQUENCY FINE parameters of the two Operators are concerned, both of these produce the same pitch because their frequency ratios are identical. There is, however, a last 'fine tuning' parameter we must consider – this can be displayed by pressing the green DETUNE keypad. Turn all the Operators except 1 and 4 off and use the purple OPERATOR SELECT keypad to select each of the two Operators in turn when the display will be either:

```
ALG32 100100 OP1
OSC DETUNE =-2
```

or

```
ALG32 100100 OP4
OSC DETUNE =+5
```

The difference in pitch produced over the −7 to +7 range of the DETUNE parameter is small and is, in fact, quite difficult to hear. To convince yourself there *is* a difference, try just Operator 1 on its own and play the C above middle C while (quickly) varying the DETUNE value between −7 and +7 using the Data Entry slider. This feature is also to be found on two- (or more) oscillator synths where slightly detuning the oscillators causes beating due to phase effects. Beating can be used both to 'fatten up' the sound and, in the case of 'E. ORGAN 1', manages to simulate something of the feel of the Doppler effect given by a Leslie cabinet. To hear the beating, get back to having just Operators 1 and 4 on and play a note. At the bass end of the keyboard the beat frequency is about ⅓Hz, rising to about 1Hz at the treble end.

If you look back to the frequency ratio of Operator 2, you will see that at 1.01 it is very close to Operator 5 at 1.00. Since the difference in tuning is greater than that between Operators 1 and 4 the beat frequency is slightly higher, but the idea is the same. Note that the difference is not as great as it looks at first, as Operator 2 is detuned *down* by −6 starting from 1.01 and Operator 5 is detuning *up* by +2 from 1.00.

Hammond Sound

As we have two pairs of Operators beating in this manner, we have two low frequency waves weaving in and out of each other which makes the overall effect less clinical and more ethereal (very subjective comment that last one!). As a last point on this detuning business, note that all the Operators are detuned slightly relative to each other, thus heading toward that good old Hammond tone-wheel sound, albeit from a completely different angle of approach!

The last, but by no means least, item on the agenda for 'E. ORGAN 1' is Operator 6 which has a very important job to do. Turn all the Operators except 6 off and play a note on the keyboard. You will hear a short burst of sound which is fairly percussive. The pitch of the sound is one octave and a fifth above the keyboard pitch played (frequency ratio 3.00) and it is the combination of percussiveness and a more piercing pitch that adds some 'bite' to 'E. ORGAN 1', emulating the famous Hammond 'key-click'.

The percussive effect is governed by the Operator's envelope generator which we will look at next. Make sure Operator 6 is turned on and selected, then press the RATE keypad under the EG legend (the keypad is green and has '21' on it). If you have just Operator 6 on, your display should look like:

```
ALG21 000001 OP6
EG  RATE  1  =99
```

Keep pressing the RATE keypad until you've seen the four rate values. Do the same with the LEVEL keypad just to the right (the word RATE in the display will be replaced by LEVEL) to see the four level values. The values are:

Envelope Step:	1	2	3	4
Rate :	99	54	22	90
Level :	99	0	0	0

Before you dive off into drawing a fancy eight-parameter envelope diagram *à la* the DX7 front panel, note that level values 3 and 4 are the same as level value 2 at zero, and their rate values are therefore meaningless (this is a simplification but it really is true enough in this case). The envelope is very simple and can be seen in Figure 2.

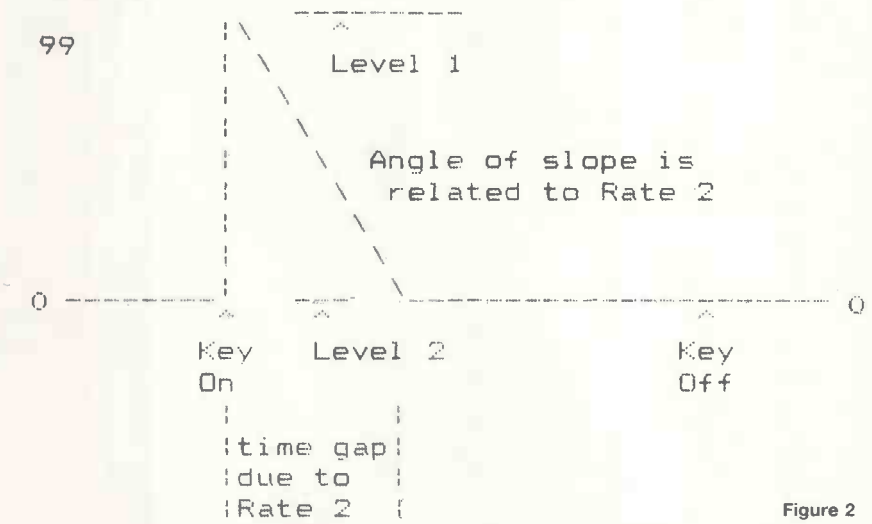

Figure 2

It's not too difficult to see why Operator 6's output comes and goes rather sharpish!

Well, that's quite enough time spent on just one voice . . . next month we'll move on to something a little more complex that shows off more of the DX7 features.

Jay Chapman **E&MM**

Readers may be interested to know that an introductory booklet on the DX synthesisers entitled 'Getting Started' and compiled by Dave Bristow is available free of charge from Yamaha. Just write to Martin Tenant, Yamaha Musical Instruments, Mount Avenue, Bletchley, Milton Keynes, Bucks, enclosing a stamped addressed envelope.

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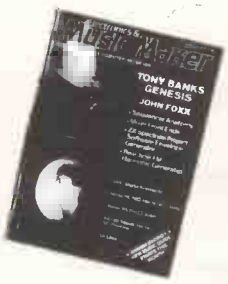


1981

APRIL Syntom Drum Synthesiser ★ Workshop Power Supply ★ Direct Inject Box ★ Ultravox ★ Paia 8700 review ★ Matinee ★ Spectrum Synth

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1982

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1983

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1984

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MODULAR SYNTHESIS

Synthetic Percussion Sounds

Last month Steve Howell **looked at the various ways of synthesising 'kit' drums. This month, as a logical follow-on from that, he takes a look at more electronic percussion effects, all of which can be played manually, sequenced or automatically triggered from a drum machine, clock, or LFO.**

The basic constituent of all these electronic percussion sounds will be for the most part a noise generator, preferably with a white noise output. You'll need only the one generator but this will be fed into a number of processing devices for more complex stereo effects, but more of that later.

One of the most basic electronic effects, in terms of ease of setting up, can be found in Figure 1. Here the noise generator is heavily filtered by a Voltage Controlled Low Pass Filter (VCLPF) which is 'opened' and 'closed' randomly by the Sample and Hold (S/H). The envelope of the sound is shaped by a straightforward EG/VGA combination, but the important factor in this patch is that the S/H is being advanced by the same trigger source as the EG. This can of course be anything: a keyboard, drum machine, LFO or even a drum pad such as a Simmons, MPF or Remo practice pad with a piezo transducer mounted inside. If you do elect to use a pad, the trigger pulse will probably have to be boosted to an acceptable level by a simple voltage multiplier. I would imagine, however, that most of you will be using a drum machine to trigger the sound, and if so, it can be an effective alternative or counterpart to the hi-hat pattern, especially if used with a sequencer and – a small but important point this – set off-centre in a stereo image.

An extension of this 'random' technique can be seen in Figure 2. Here, the CV output of the S/H is routed to the trigger input of the EG and the S/H is again advanced by a drum machine or similar. The principle behind this patch is that your percussion sound will only trigger when the CV from the S/H is higher than the EG's required trigger input level, so that both the tone and the actual firing of the sound will vary at random. This technique is a little too unpredictable for most commercial dance music (though it could be quite effective in a 12" remix!) but could be quite useful in more 'Enoesque' pieces, for example, You could, of course, trigger the S/H of a click-track and multitrack the effect. With an exaggerated stereo image, the net result can be quite astonishing as each sound triggers randomly around the stereo image. The filter controls can be set as desired but a high resonance setting will yield the most dramatic results. Likewise, the ADSR controls on the EG can be set as desired, but it's worth remembering, with many percussion sounds, a slow attack can be just as effective as a fast, hard one.

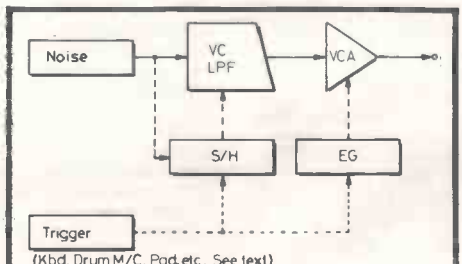


Figure 1. Patch for random percussive noise.

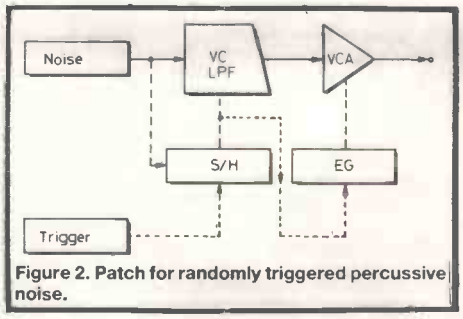


Figure 2. Patch for randomly triggered percussive noise.

Sequencing

S/H can, however, be replaced by a sequencer. This can be anything from a simple eight-note model to a spare channel of a Microcomposer. The CV output of the sequencer is fed into the VCF control input and the sequencer then programmed to give precise tonal changes. This can be a useful alternative to Sample & Hold as the noise can be tuned to bear a closer relationship to the rest of the piece.

If, however, you don't have access to a sequencer or S/H device (though I'd be very surprised if any of you modular synthesiser owners didn't have such things!) then a keyboard will suffice in their place, and one tip you might like to heed when recording is that should you wish to use an 8th or 16th note random noise pattern in the context of an uptempo track, simply record it at half-speed and play the keyboard randomly. This will give more or less the same effect when played back at normal speed.

It is also possible to sweep the VCF cutoff frequency with an LFO although the cyclic repetitiveness could prove somewhat boring. If this proves to be the case, you could use two or more LFOs to create some variation. By using

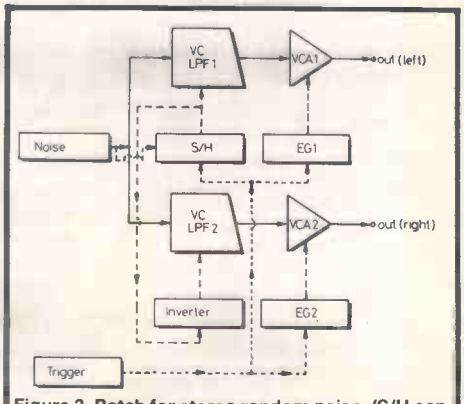


Figure 3. Patch for stereo random noise. (S/H can be replaced by LFO, sequencer, etc.)

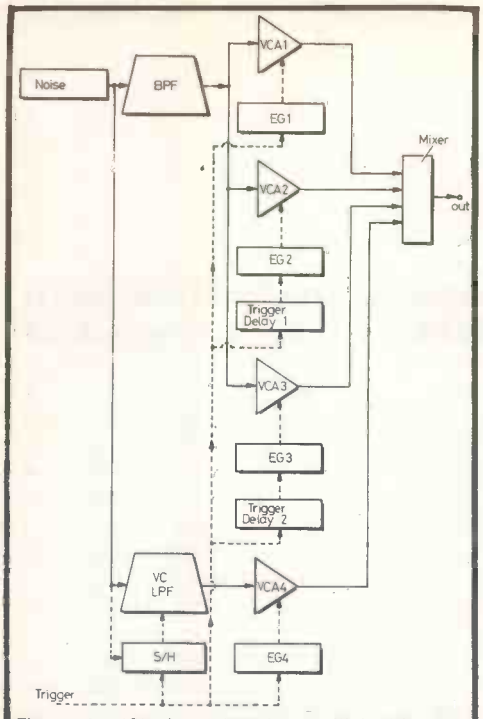


Figure 4a. 'Clap' patch using multiple trigger delays. (S/H can be omitted.)

different waveforms you should be able to create even more interesting effects but you won't be able to sync the sweep to the drum machine or sequencer, which could be a disadvantage.

Any of the above patches can be usefully employed in a rhythmic context but they will all be essentially mono sounds. They can, of course, be used with other percussion sounds in a stereo image. Many varied and novel effects can be created in stereo, however, by patching up as in Figure 3. Here, we use two VCFs swept by one controller, but one channel has its' CV inverted so that it goes in the 'opposite direction'. If you use just an LFO, one channel 'opens' as the other 'closes' and, if each channel is panned hard left and right, the sound will pan (obviously) from one side to the other dramatically. Using an S/H instead of the LFO will give the impression that the sound is actually 'bouncing' back and forth, as the CVs move abruptly in opposition to each other.

Clap Sounds

Moving now to a 'one-shot' percussion sound, one of the most sought after and popular sounds these days, especially in dance music, is the clap, and a synthesised clap is often used in preference to digitally sampled or real claps because of the variability of such sounds. To my ears, one of the best clap sounds around can be found on the Roland TR808 drum computer, but an identical sound is now also available in the shape of the Boss and Amdek Handclapper pedals. For those of you who don't have access to such devices, however, a modular synthesiser can be an effective substitute.

The sound of a clap is derived from passing a white noise source through a band pass filter which, in turn, is shaped by multiple envelope generators. The EGs have a delay so that the effect of multiple claps can be easily obtained. These factors can be set up in a number of ways on a modular synthesiser and patches are shown in Figures 4a and 4b.

In Figure 4a, the noise is fed into a VC Band Pass Filter (VCBPF) and the output from that is fed into a number of EG/VCA combinations, each of which have their own trigger delay. There is also another VCLPF which is 'opened' and 'closed' very slightly by a random S/H. This portion allows for the randomness that exists in 'real' handclapping, but the S/H can be omitted if desired. The VCBPF should be set to give a 'middley' sort of sound with a hint of resonance, though it can be varied to suit. The ADSR controls on each EG should be set to give a fairly clipped sound and the decay times could be slightly different for each one to make the clap a little more interesting. The trigger delay times should be set to give a few milliseconds delay so that the effect of multiple claps can be created, and if the delay time is voltage controllable then a slow sweep with an LFO will help create more variation. The VCLPF is fed into EG/VCA 4 and the decay/release times set to around 750ms, depending on the effect you require.

Figure 4b shows an alternative patch which is considerably easier to set up and requires much less in the way of hardware (I doubt if there are many of you who have two trigger delays). Here, Channel 1 is fed into a digital delay and this provides the effect of multiple claps. The delay time should be set to a few milliseconds and could, if you so desired, be swept slightly by an LFO: be careful you don't end up flanging the sound though. If a DDL is not available, an analogue echo will suffice – in fact, the restricted bandwidth of an analogue delay can actually help the sound, precisely because of its' 'middley' sonic character.

If, however, you don't have a band pass filter in your system, then an HPF in series with an LPF will give you much the same effect or, alternatively, you could simply EQ the bass out of the sound if you only have a low pass filter. Using a graphic or parametric EQ will also help greatly in creating the 'cupped' effect of hand claps.

When recording the clap, it's best to add some degree of reverb, while you could also try putting it through a chorus or a harmoniser to 'spread' the sound. Multitracking the clap will also give a much thicker and more powerful sound, especially if you make small variations to the sound with each track and/or use varispeed.

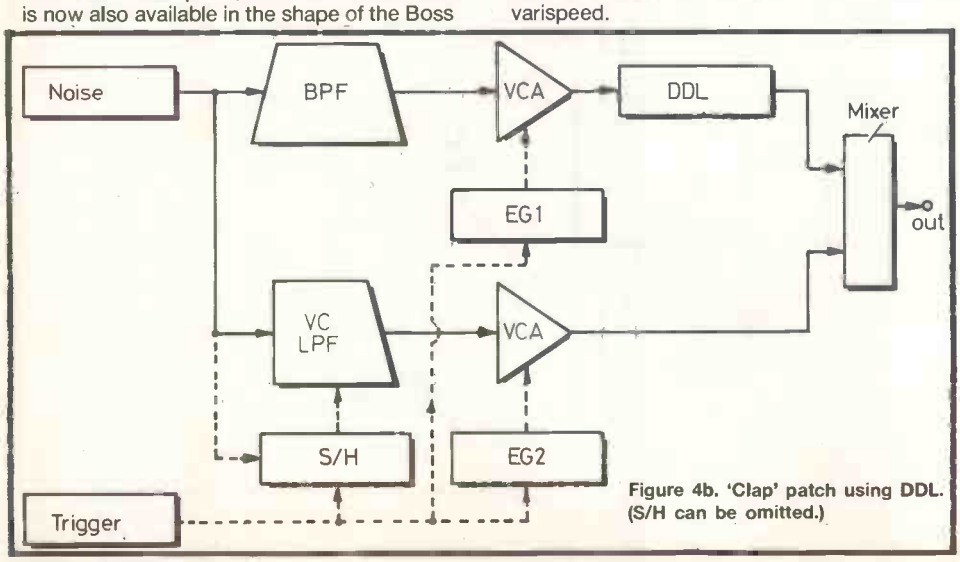


Figure 4b. 'Clap' patch using DDL. (S/H can be omitted.)

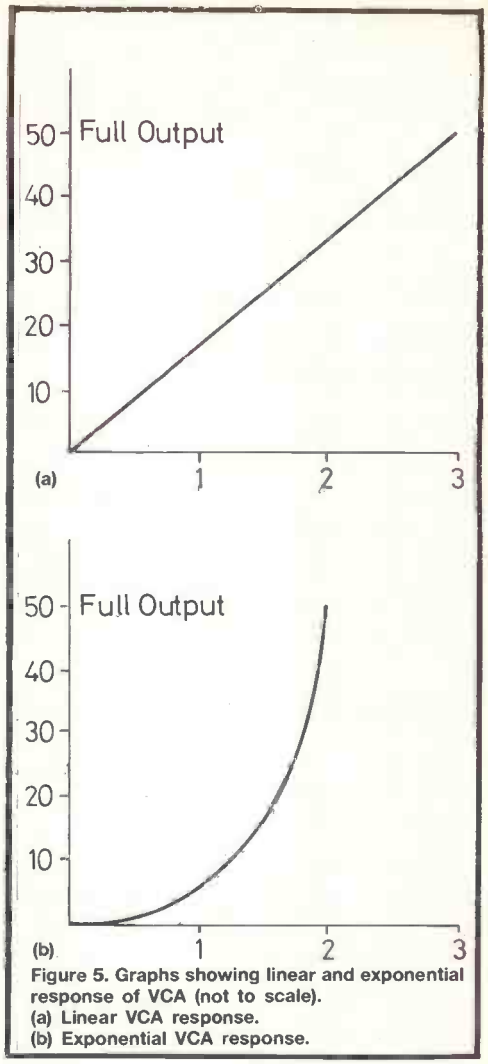


Figure 5. Graphs showing linear and exponential response of VCA (not to scale).
(a) Linear VCA response.
(b) Exponential VCA response.

Percussive Attack

Before we finish with percussion sounds, there is one technique which can be applied to any sound requiring a percussive attack if you have the appropriate facilities.

Many VCAs on modular systems give the user a choice of either linear or exponential response. Linear response is the more commonly used on synthesisers, but if an exponential response is used the rise and fall times of the VCA are effectively halved so, in other words, an attack time of 2ms will give an apparent attack time of 1ms: referring to Figures 5a and 5b should explain why. In the linear response graph, the attack time is set so that it takes three seconds to reach 3volts and so that the VCA takes three seconds to reach its' full level output. In Figure 5b, however, the attack time is still set at three seconds but the VCA response is such that it only takes *two* seconds to reach full output. The reverse happens on decay and release times.

As such, the exponential response is ideal for sounds that require more 'bite' if they're to be used to the full. If your synthesiser doesn't have this facility you can overcome this by using varispeed on your tape machine. By recording the sound slower than the correct playback speed, when the piece is played at the normal speed the ADR times will have sharpened-up considerably but you will have to adjust a tuned sound to compensate.

That just about concludes our look at percussion sounds for the moment, but before you all ask about congas, bongoes, tambourines, Mongolian clay cymbals, and Martian log drums, these (with the possible exception of the last two) will be covered in future issues. I think, though, that these patches should keep you rhythmically inspired for some time to come.

Steve Howell **E&MM**

The Poor Man's Guide to Clap Sounds

Paul White **proffers a few useful suggestions and tips to enable handclap sounds to be recreated using commonly available items of musical equipment. . .**

To synthesise any natural sound successfully, it is first necessary to understand the mechanism whereby that sound is produced, and in the case of the handclap, there are at least three parameters which must be examined before deciding which pieces of equipment are required to produce a reasonable electronic simulation.

Parameters

When you clap your hands, a single percussive event occurs which may broadly be analysed as follows:

The initial 'slap' is produced by the rapid displacement of air when the hands are brought together and this is filtered acoustically by the resonant cavity formed by the cupped hands. Depending on the shape of the hands in question, the sound filtering will vary and, in general, the more cupped the hands, the more resonant the sound. External acoustics also come into play and the reverberant effects of the environment contribute significantly to the final perceived results.

Having several people clapping together complicates the analysis further, as there will always be a slight difference in timing between individuals and the resonant frequency of each persons' cupped hands will to some extent be different. In terms of synthesis then, we have isolated at least three parameters that need to be simulated electronically.

Simulation

First, we need to produce the effect of the initial shockwave, and this is most readily done using a burst of white noise, having a sharp attack and a fairly rapid decay. A suitable source could be a percussion synthesiser such as E&MM's 'Synwave', or a noise burst set up on a conventional synthesiser. Good results can also be obtained by using the snare drum voice of a drum machine as the raw noise source, and the author has achieved very acceptable results with a Roland TR606 Drumatix.

The second phase consists of producing a short delay or echo to simulate the timing difference between individuals, and a digital delay line such as the Powertran unit should give excellent results, though an analogue until will also suffice. A delay time of between 20 and 60 milliseconds is generally most effective, and if your unit has no time readout, set the delay to minimum and then gradually increase it until the sound just starts to resolve into two separate beats.

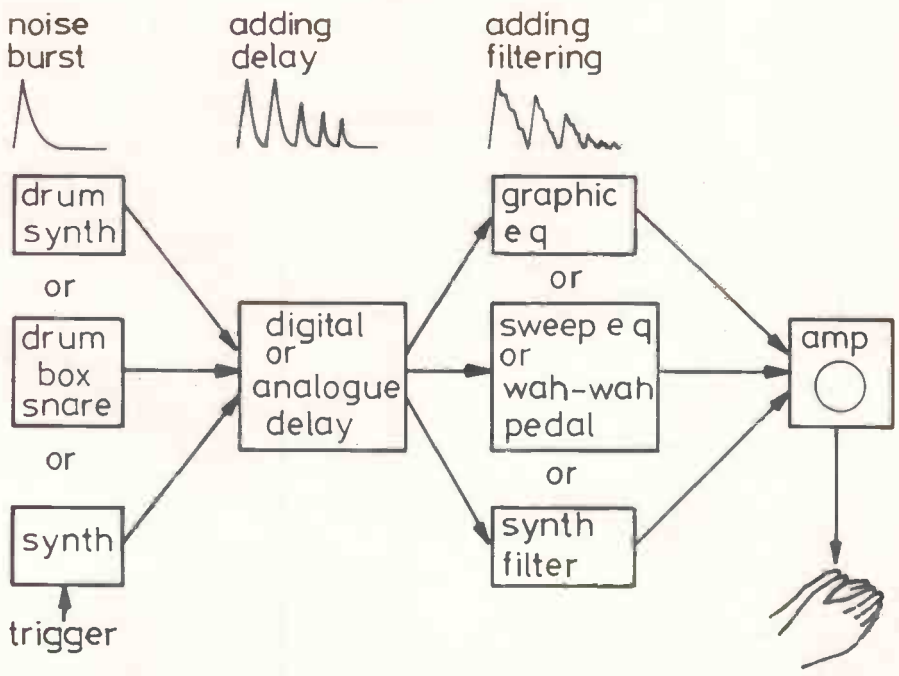
Experiment with delays in this area until you find the value that gives a good 'feel', and then add just a hint of feedback to spread the sound slightly. The delayed sound should be roughly the same level as the direct sound and it sometimes helps to overdrive the delay unit, as the extra harmonics produced by the distortion can add to the realism of the effect.

The final treatment, with the exception of reverb which can of course be applied at your discretion, is to pass the echoed noise burst through a band pass filter to simulate the 'cupped hands' resonance, and a small graphic equaliser is ideal for this purpose. Heavily boosting bands around 1KHz and cutting all the others, particularly the low frequencies, is a good starting point and the effect can be refined by further experimentation. If you don't have a graphic equaliser, you can use a parametric or sweep EQ (or even a wah-wah pedal) and don't forget the EQ on the mixer if you have one.

An alternative approach is to use the audio input of a synthesiser and manipulate the filter frequency and resonance controls to achieve the desired effect.

As an absolute last resort, you could try clapping your hands near a microphone, but be warned, the results are seldom as good as the real (electronic) thing.

Paul White **E&MM**



The complete handclap-generation block diagram. . .

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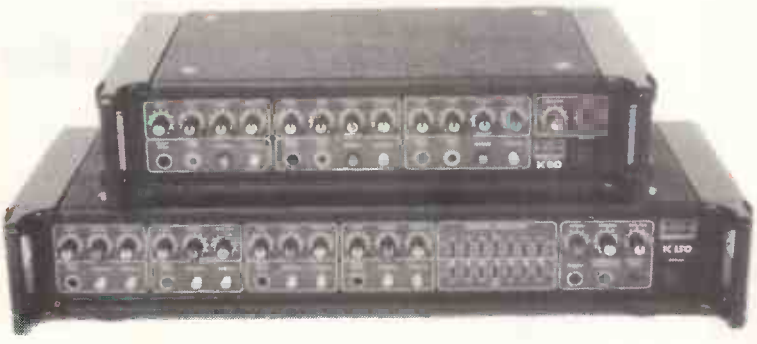

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COMPUTER MUSICIAN

This month's issue sees the first in the series of the new look CM. Well, it's not that drastic really. The point is that we've been wanting to balance the theoretical side of computer music with some decent projects for some time, but as with most technical things, it takes time to get them off the design bench and into print. So thanks for bearing with us during their gestation period!

First off on the project front is the Programmable Digital Sound Generator, a 32-channel add-on that has been developed principally for the BBC Micro by Alan Boothman. This month's article covers the design and operation of the hardware, but next month we'll get down to the nitty-gritty of interfacing it with the micro, discussing the software that's been put together to run it, and also providing details about prices and availability. Because we feel that the PDSG is so important, this month's CM pages have largely been turned over to it, which means that the second part of The Gentle Art of Transcription and the Syndrom project have been held over for next month.

We'd like to thank everyone that took the trouble to complete the Questionnaire – the results were certainly very illuminating, and any changes in editorial policy that you notice in the future will no doubt owe a lot to your constructive comments. The most obvious of these is that we'll be concentating on just a limited number of micros – the Spectrum, BBC Micro, and Commodore 64 (though the Apple is bound to surface now and again!) – in order to push these to their utmost in various musical directions. As it happens, these are also the micros that are attracting the most attention from the micro music industry as far as interfaces and add-ons are concerned, and next month's E&MM will see our own starting-point for a lot to come in the shape of MIDI interfaces for all three micros. The logic behind this moderate change of heart is simply a question of not wanting to spread the butter too thinly, and anyway, the overiding impression that we've gained from the Questionnaire is that readers want quality rather than quantity when it comes to musical applications of micros. One casualty of this change in policy will unfortunately be the *Which Micro?* series that we started back in November.

Obviously we're still going to bring to your attention any micro that looks particularly interesting from a musical standpoint (the new Yamaha MSX machines being a case in point), but there seems little rhyme or reason in going over the well-trodden ground of three-channel sound generators and their limited software support yet again.

This change also affects how the Software Panel will be put into effect straight away. A fair number of readers offered their services, and we've contacted some of them because of their particular abilities or ideas. However, once CM's projects get into full swing, more programming openings for other readers are bound to appear and, in the not-too-distant future, we'll also be featuring the Program Corner as a regular spot in CM.

David Ellis

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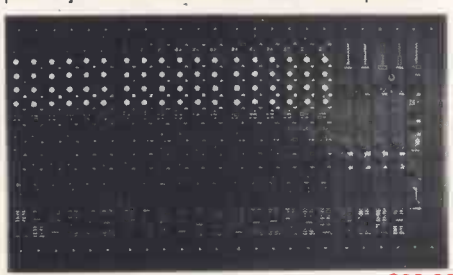

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RUMBLINGS

ver mindful of your mutterings (question 39 of the CM questionnaire, for instance), this month's 'Rumblings' does a three-point turn from last issue's extravagant ller-coasting to the three-wheeler of the computer music usiness, the basic micro. . . .

Music Construction Set

Sounds a bit weird, don't you think? Well, if I let you into a tle secret that this bit of software comes from the same able as Bill Budge's wonderful Pinball Construction Set oted by Steve Wozniak – he of Apple fame – as 'the best 8-bit ogram ever'), you'll see a little more sense in that name. ccording to the program's author, a 16-year-old by the name Will Harvey from Uplands High School in Foster City, alifornia, his program is 'simple, hot, and deep'. Very ifying.

In fact, Music Construction Set is an exceptionally intriguing ogram, available for the Apple II and Commodore 64, that es the idea of 'icons' (introduced by Apple's Lisa and much pied thereafter) to make composing music simpler and ore fun. So, for instance, by manipulating a joystick you're le to move a graphics hand about to collect notes and place m on the staves. Then, if you move the hand to the piano n in the lower right, you'll hear what you've put together yed back. After that, you can then go to the scissors to cut t whole measures, use the glue pot to paste them in mewhere else, and the house to return (home) to the ginning. Get the picture?

Of course, the Apple's sound is basically grotty, so a six- ce add-on soundboard (called 'Mockingboard' – sounds e someone's having a dig at Xerox's Mockingbird tran- iber!) is needed as well. In the case of the Commodore 64, internal SID chip suffices, but you're limited to just three ces at a time. However, with both micros, playback is companied by notes scrolling past on the screen – very pressive indeed.

nother add-on that can be used in conjunction with the sic Construction Set is the KoalaPad from Koala Tech- ogies. As the Americans would have it, 'the pad is smaller n a TV dinner and weighs about as much as a paperback ok'. Basically, you plug the pad into the joystick port of the ro and then prod at the thing with your finger in order to ister the changes, X- and Y-axes-wise. What the KoalaPad s to your interaction with the Music Construction Set is to ed the rate at which music can be put together: using the stick alone is very slow and tedious by comparison.

Music Construction Set retails for just $40, and is produced Electronic Arts at 2755 Campus Drive, San Mateo, CA 03 (tel: 415-571-7171). The Mockingboard add-on for the le costs $125 and comes from Sweet Micro Systems at Chestnut Street, Providence, RI 02903 (tel: 401-273-5333). finally, the KoalaPad is available for $125 from Koala hnologies, who can be found (eating eucalyptus leaves) at 2 El Camino Real, Suite 125, Los Altos, CA 94022 (tel: 415- -2992).

acrofusion

can't resist quoting from an advert that's been appearing ularly in an august journal of computer music – complete a fuzzy photo of a lank-haired, bearded, NHS specs- ring, shirt-hanging-out-of-trousers Californian reminder he sixties surrounded by all the paraphernalia of the ties (Synclavier, Roland modular system, a couple of 4s, and various terminals scattered left, right, and centre) macrohippy, perhaps? Anyway, we're invited to 'explore worlds of computer music' with the following slice of OTT e:

id you think you'd "heard it all" when it comes to puter music? THINK AGAIN. Think about full-bodied al and orchestral music or Arabic-sounding heavy rock, ncannily realistic East Indian music or Japanese flute nes. Think about audio universes you can't even begin to imagine, derived from a combination of synthesis and digitisation of real sounds, such as voices, instruments, whales and much more. In fact, think about the music of mankind through the ages blended into textures and compositions never before possible, all rendered 100% under program control. THINK SYNTHESIS IN ITS BROADEST MEANING. THINK MACROFUSION.'

Yes, quite.

Like, how can you think about something that you're told you can't think about? Arabic-sounding heavy rock? God forbid. Come back, Def Leppard, all is forgiven! And as for those whales, there must be more to life than being squashed onto a Winchester – hope they've filled in their PRS returns. . . .

Anyhow, Macrofusion Computer Music invite you to part with $3 for a half-hour sampler cassette, and they'll also send you a 'descriptive color catalog' for another 12 cassettes if you write to them at Suite 12d, 40879 Highway 41, Oakhurst, CA 93644. Best of luck!

Ariel Analyser

Just about the first sound add-on for the IBM Personal Computer has appeared in the shape of the Ariel RTA 331 one-third octave, real-time audio frequency analyser. The analyser divides the audio spectrum into 31 third-octave bands from 20Hz to 20kHz, and displays the results on the monitor. In

addition to spectrum analysis, the RTA 331 will also convert the incoming audio signal into 8-bit samples and store it in the IBM's memory. Since this micro has a capacity of half-a-megabyte, more than 20 seconds of good quality audio can be accommodated. The sounds can then be played back at different sampling rates or manipulated with user-written routines. Other features of the RTA 331 include on-board, software-controlled pink noise generation plus averaging, weighting, and peak hold functions.

All in all, this looks like a solidly professional item, but at $650 it's not exactly cheap. Models are also available for the Apple II, Tandy TRS80, and Commodore 3000 and 4000 series machines. Ariel Corporation are to be found at 600 West 116th Street, 84 New York, NY 10027 (tel: 212-662-7324). In the UK, the RTA 331's distributor is Marquee Electronics, 90 Wardour Street, London W1V 3LE (tel: 01-439 8421), and they're retailing it for £510 plus VAT.

David Ellis CM

Computer Musician Questionnaire- The Results Part 2

David Ellis **takes a belated look at the second half of the recent C questionnaire, with some thoughts on your responses to questions 21 to 5**

The latter half of our readers' questionnaire concentrated mainly on the editorial content of the supplement. Your reactions to the various features, projects and reviews – and the direction they should be taking in the future – make pretty interesting reading!

Questions 21/22

80.2% (162) of the readers responding to the questionnaire were interested in seeing articles on programming techniques. From these brave souls came the following suggestions for particular topics of conversation:

Language	Votes
Pascal	5
Forth	39
Spectrum BASIC	6
Machine code	98
Z80 assembler	5
6502 assembler	20
CP/M	2
LOGO	3
CBM-64 BASIC/machine code	3
Microsoft BASIC	3
C	2
General BASIC	18
Fortran	2
BBC BASIC/machine code	33
Music programming	11
Oric BASIC	2

The overwhelming impression was that people wanted help in getting to grips with the essentials of programming – particularly in machine code. However, some readers were more specific in their requests.

Questions 23/24

A high percentage of readers (80.2%) thought that we should concentrate more attention on what can be done musically on the basic micro. Point taken! The micros you thought should be treated to such programming delights were as follows:

Model	Votes
ZX81	24
Spectrum	52
Oric-1	12
Electron	5
Dragon	10
MTX-500	1
Jupiter Ace	1
Commodore 64	65
Apple IIe	36
BBC Micro	73
Atari	9

That column of figures translates to a Top Four of the BBC, Commodore 64, Spectrum, and Apple. No great surprises there.

A few people felt that the choice of micros should be geared around what's available in the way of MIDI and other hardware, the point being that there's little sense in having a micro that's good at music on a basic, self-contained level if there's no scope for future expansion. One reader went so far as to suggest that we should consider 'only 16- or 32-bit micros capable of direct digital synthesis'. Well, in five years time, maybe we could get away with such a policy, but now. . .?

Question 25

The idea here was to get suggestions for using a micro's basic attributes, ie. without vast amounts of expensive add-on hardware. Here's what we actually got:

- Real-time synthesis techniques (11)
- Non-linear distortion techniques (1)
- Real-time controllers for analogue synths and drum machines (28)
- Sampling techniques (19)
- Auto-composing (5)
- Advanced sequencing/composing (17)
- Chord diagram calculator for guitar or keyboard (1)
- MIDI interfacing (37)
- Music transcribing/printing (5)
- Interactive MCL (6)
- Correlating sound to graphics (1)
- Speech synthesis and recognition (1)
- Mixer interfacing and control (2)
- Music education (5)
- Rhythm generators (4)
- Use of the AY-3-8910 (1)
- Library of envelopes and sound effects (1)
- Spectrum analyser (4)

Questions 26/27

Again, another high percentage (83.6%) for the affirmative response to the question of whether or not we do time on the technical side of the fence. Whilst it's true that a lot of this tends towards being organistic, there's no denying that the main driving force for developments in computer music presently comes from the hardware rat-race, so you're almost obliged to give this some sort of priority.

Anyhow, these are the suggestions received as regards the technical sid things:

- Memory expansion modules
- Problems with DACs/ADCs and using th for sampling
- Digital signal processors
- How commonly-used chips work and w of improving them
- New developments in sound chips with applications
- Digital sound recording
- Instrument imitation
- How digital drum machines work
- Design and operation of the Fairlight
- How the Emulator works
- Design of and using MIDI interfaces
- Computer mixing techniques
- How to go about micro control of analogue modules
- Computer-controlled stage lighting effe
- Synthesis using 16-bit devices
- Pitch input devices other than keyboar
- Digital filtering
- Z80 music applications
- Digital oscillators
- Synchronising micro music with clock ses
- Design of analogue interfaces
- Digital FM synthesis
- Design and use of microprocessor circ
- Design of Fourier series oscillator
- How micros can be used as real-time music processors
- Hints on data transfer *via* interfaces

Phew!

Well, expletives apart, it's obvious many readers would like to know more a the design and operation of the po micro-based systems currently doing rounds. One individual said: What a technical discussions on the way comme systems work, (eg. the DX7), including cuits so that the owner can alter and sonalise them? Well, as much as we'd li help in this direction, and we do t

wherever we can, manufacturers are extremely loath to part with any info that might possibly give their competitors an inkling of what's going on in their systems. However, we'll keep on digging for more.

Question 28

Auto-composition is something of a thorny topic in computer music. In fact, it's the one area that seems to be of interest to both ends of the user spectrum – from University computer music labs to what computer magazines insist on perpetrating as 'music courtesy of the Spectrum's BEEP command.' The truth is that there's no point in charging into random number generators unless you're prepared to work out what sort of statistical funnel is needed to 'musicalise' the results. In short, auto-composition should reflect both Man and Machine. In fact, a fairly high percentage of readers (69.4%) expressed an interest in auto-composition, so we will be following this one up, despite the controversy.

Questions 29/30

We think interviews are a good way of bringing into the open how musicians actually *get on* with musical technology – the proof of all the technical pudding, if you like. Fortunately, most of you (77.3%) seem to agree, so we'll do our best to seek them out from the list you've given us (that's if we haven't already covered them in a previous E&MM – date in brackets after if we have)

Musicians: Brian Eno, Milton Babbit, Tim Souster (*May '81*), Iannis Xenakis, Pierre Boulez, JK Randell, Charles Dodge, Thomas Dolby, Landscape (*Nov '81*), Steve Hillage

Brian Eno . . . will E&MM *ever* get an interview?

(*June '83*) Human League (*Feb '83*), David Vorhaus (*June '81*) Kraftwerk (*Mar '82*), New Order, Peter Gabriel, Larry Fast (*June '83*), Hans Zimmer (*July '83*), Depeche Mode, Jean-Michel Jarre (*June '82*), Isao Tomita (*Feb '83*), Tangerine Dream (*Mar '83*), Pete Shelley, Dave Bristow (*July '83*), Vince Clarke (*Mar '84*), Mainframe (*Feb '84*), and The Enid.

Systems and Designers: Robert Moog, Tim Orr, Dave Simmons, Synclavier II, Fairlight CMI, Yamaha DX7, PPG Wave/Waveterm, E-mu Emulator, Sequential Circuits, Roland Digital Group, John Chowning, Harold Alles, James Beauchamp, and alphaSyntauri.

Micros: Commodore 64, Sinclair Spectrum, and the BBC Micro *(I'd never have guessed it . . .)*.

Well, this thoroughly eclectic selection certainly meets with my approval. It only goes to prove that E&MM readers have excellent taste!

Questions 31/32

The last thing we want is to bore people by going over ground that's of minority interest. That's the reason for the question about the history of computer music. In fact, the yes/no split was as near as dammit to 50/50, so we'll take this as an indication to go easy on peeks into the past. Anyway, the subjects that were of interest went as follows:

The evolution of MCL
The future of computers and music
IRCAM past and present
The history of computers in rock music and in studios
The evolution of FM synthesis techniques
How computer analysis of natural sounds has developed over the years
Further developments of MIDI (*see supplement this issue!*)
The development of synths from analogue to digital
The history of real-time computer music
The development of programming techniques
Advancements in Artificial Intelligence as applied to music
How the Fairlight has been used.

Question 35

A wide range of suggestions in response to this question. As someone said, "you get as good as you give". . .

Mods to existing equipment for greater versatility and compatibility
The printing of music after playing a keyboard
Hardware FM digital synthesisers
Micro interface for Casio keyboards
Just intonation theory in practice
Synthesis algorithms encyclopaedia
Parallel processing languages
Computer light effects
Multiplexing circuits for CVs from micros
Analysis of programs and algorithms used in commercial products
Anything with good practical applications backed up with projects
The possibilities of AI in computer music synthesis and composition
Survey of MIDI software
The basics of programming in a musical context
Using micros in a live situation
The link between philosophy/psychology and computer music
A series on composers of computer music
More specific projects for the BBC Micro
The use of computers in music education
The use of synths in classical music
Computer music record and book reviews
Computerised multitracking
Getting the reader to do things
Readers' software and hardware designs for popular micros
A selection of programs for different micros
News of USA computer music
More programs listings and hands-on projects
How to obtain recording facilities for unemployed musicians/engineers!
An investigation of the musical possibilities of networking

Er, no comment!

Question 36

Always a problem, this. Does speech synthesis fit into the musical scheme of things, or not? Well, as it turned out, only 52.7% of respondees felt that it was worth having more articles on speech, so, again, we'll curb our enthusiasm in this direction somewhat.

Questions 37/38

79% of readers seemed to feel quite happy about reviews of expensive computer music systems. That's a good thing – because we enjoy reviewing them! Suggestions for reviews went as follows:

Fairlight CMI (43)
Crumar GDS (11)
Synclavier II (17)
McLeyvier (3)
Prism (2)
Con Brio ADS200 (2)
Buchla (3)
Yamaha DX7 (21)
SCI MIDI software (9)
Chroma/Polaris software (6)
PPG Wave/Waveterm (5)
Apple systems (9)
Emulator (4)
Roland CompuMusic (3)
Doepfer VTIS (1)
Jen Musipack (1)

Well, we last looked at the Fairlight back in June '81, and a lot of sampled waveforms have passed under the bridge since then! So, watch out for a Page-by-Page account of the current Fairlight in *CM* shortly. The Synclavier II has been well-covered in the Feb and June '83 issues, so we're not likely to tread that ground again unless New England Digital feel like parting with more technical info or new software comes onto the market. The Crumar GDS, McLeyvier, Prism, Con Brio ADS200, and Buchla are all fascinating systems, but for one reason or another, they're not yet available in this country. So, dear manufacturers, if your system is actually in production, please let us have one for review!

Yamaha's DX7 and their other FM-based systems will be receiving lots of attention shortly, so watch this space. . . . CBS/Fender have recently hinted that they may be curtailing further activity on the Chroma and Polaris front, but if new software comes out (we did look at some in April '83), we'll take a look at it. And just in case you hadn't noticed, a full review of the PPG Wave 2.3 and Waveterm appears elsewhere in this issue of E&MM.

Apple systems probably get more attention than most, and their cost-effectiveness has been criticised, so we're being careful not to overstate their case. When Roland release their new BBC Micro and Commodore 64

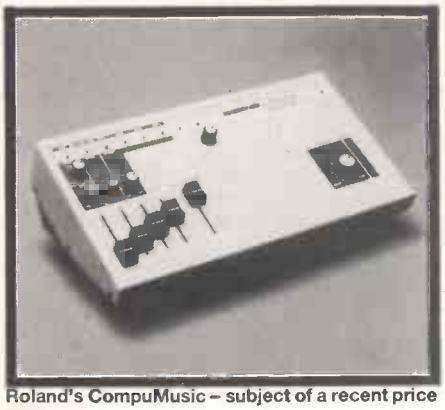
The McLeyvier computer system. A review will follow as soon as we can get our hands on one.

software for the Compu-Music (now down to an RRP of less than £300, incidentally, and generally on sale for around £250), we'll take another look at it. Lastly, we're finding out about the Doepfer VTIS (a sound synthesis/sampling system from Germany), and we'll be reviewing the Jen Musipack and the new-model Emulator in the very near future. . . .

Questions 39/40

Down from the pinnacles of technological development to ground floor level, we find 88.9% of our reader sample supporting reviews of budget musical software for the basic micro. However, when pressed for suitable examples, there wasn't an awful lot to play with:

MusiCalc (*Commodore 64*) (1)
Music Construction Set (*Apple/Commodore 64*) (1)
MMI Music CAI software (*Apple*) (1)
Music Composer (*Commodore 64*) (1)
Musicomp (*Apple*) (1)
Quicksilva MuProc (*BBC Micro*) (2)
System Music Editor (*BBC Micro*) (1)



Roland's CompuMusic – subject of a recent price drop.

Romick Multisound Synth (*Vic 20*) (2)
William Stuart Systems Composer (*ZX81*) (1)
Synthy 64 (*Commodore 64*) (2)

Question 41

A printer's error put this question in the wrong place! In fact, it should have come immediately after question 38 – the idea being to check that our readers still had the right priorities, ie. music before technology. Still, placed as it was, it did reveal that 88.5% were still thinking about the music at the end of the technological rainbow, and that can't be a bad thing!

Questions 42/43/44

The rationale behind this trio of questions was to give us some sort of guidance when it comes to looking (or not looking) at the vast number of new micros and games trundling off production lines. 72.9% felt that we should include reviews of new micros, and 80.8% suggested that these should concentrate on the sound side of these machines. That's fine by us. Reviews of games were given the thumbs down, as only 32.4% voted for reviews of those with a strong sound FX or music element. Again, that's no love lost as far as we're concerned.

Question 45

The trouble with all this computer music stuff is that it's all too easy to end up hopelessly blinkered to what's going on around you. So, to redress the balance, we're constantly looking for ways of adding to the review repertoire. These are some of the possibilities you suggested:

Artificial Intelligence software
Databases for cataloguing music and records
Graphics linked to sound production
Fast, versatile languages
Decent plotters, joysticks, and mouse/trackball input devices
Anything on speech recognition and synthesis
Video interfaces

Questions 46/47

Well, 78.2% of questionnaire respondees thought that the OMDAC was worth pursuing in the direction of their own micros. Regular readers will recall that the OMDAC was originally conceived around the Acorn Atom. Unfortunately, that's about as dead as a dodo nowadays, so translation of the software onto other micros is essential of OMDAC is to be reincarnated, which it almost certainly will be. Software for the Spectrum is definitely imminent. . . .

When pressed for ideas for *CM* projects, these are what you came up with:

Synth interface module
Improved Band Box with better sounds and larger memory
Companding DAC/ADC board for sampling and digital delay
16-bit digital reverb unit
MIDI interfaces and software
Computer-controlled sound mixer
Intelligent sound-to-light unit
Digital sound processors
Music score reader
Add-ons based on Yamaha's FM LSIs
More software/hardware for Alphadac
SID boards for various micros
Self-contained sampling system
Modular micro-controlled analogue polysynth

Questions 48/49/50

The question about interfacing Casio keyboards with micros provoked a good deal if ribaldry from some readers. Quite justified, really, if you start imagining marrying a VL1 with an IBM PC, or an Osborne with Casio's new KX101 keyboard-inclusive ghetto blaster (a 'portable' computer music system for Mr Universe). . . . But seriously, folks, the Casio MT65 has a wealth of untapped synthesis potential (see *Rumblings* back in September '83) that's crying out for release from the confines of the hard-wired approach. In fact, 78.2% of *CM* readers were for us pursuing something in this direction, though exactly what remains to be seen.

On the subject of MIDI, a resounding 88% of readers supported the notion of some MIDI hardware and software. And no doubt if we took the same poll now (ie. post-Frankfurt and post-NAMM), that vote would be even nearer the 100% mark. So, as they say in the movie biz, 'Coming Shortly . . . .The Midicomposer!'

Finally, 74.8% of respondees agreed that projects should be presented as personal computer add-ons rather than as stand-alone units. What a sensible lot you are!

David Ellis **CM**

E&MM Digital Music

The Programmable Digital Sound Generator

This month sees the start of a major new series following the design and construction of the Programmable Digital Sound Generator, a newly-developed, highly versatile add-on music system for microcomputers. Initially, the PDSG will be available to interface principally with the BBC Model B micro, though other versions should become available in due course. In the first article, designer Alan Boothman **of Clef Products outlines the principles behind the unit's operation, far removed from that of conventional synths and add-on systems.**

PDSG SPECIFICATION AT A GLANCE

PDSG HARDWARE

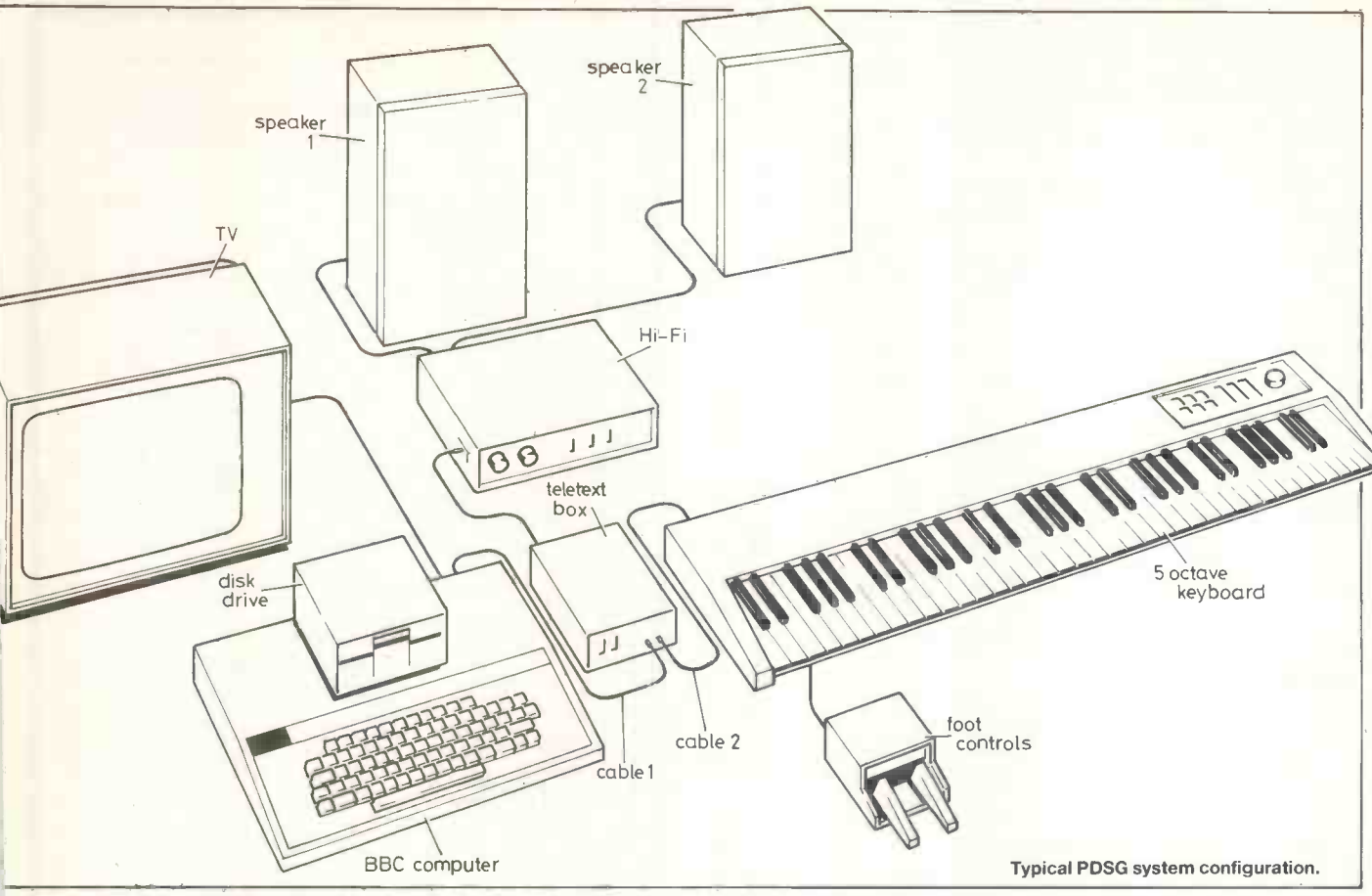
Logical oscillators	32
Clock frequency	1.8–2.0MHz
Sample rate	30kHz nom.
Nyquist frequency	15kHz nom.
Bandwidth	11–12kHZ nom.
Onboard Wavetables	32–64
(dependent on RAM/ROM Configuration)	
Wave table size	128 × 8
Music Oscillator Parameter Control	
Frequency increment	2 bytes
Output level	0–255
Output waveform	0–63
Output channel	L,R, Centre
Operating Functions	
Set control register	
Load music parameter	
Load new waveform	
Read music keyboard	
Read write auxiliary hardware	
Interrupt period	2mS
Address space in host	1 Page
Stereo audio output (adjustable)	500mV
Supplies +5V Regulated	700mA
+/– 10 to 12 Volts	50mA
PCB dimensions in mm. (nominal)	
	PDSG 220 × 180 × 15
	Power Supply 200 × 70 × 35
Connection to computer	34-way IDC
Connnection to keyboard	20-way IDC

CURRENT SOFTWARE (PROVISIONAL)

18 Instruments in each set
8–32-note polyphony, programmable
1–4 Logical Oscillators per note
11 Characterlstlcs Per Oscillator
4 Touch Tables (on/off)
4 Frequency Tables
32–64 Waveform selections
3 Channel positions
Edge rate control of attack
Decay, sustain & release (2)
Level control of attack & decay
Routines
Play keyboard
Play record sequence
Replay sequence with keyboard active
Repeat play sequence continuously
File a sequence
Load a filed sequence
Inspect instrument specification
Alter instrument specification
Alter instrument parameters
File a single instrument spec
Load a filed instrument
Create an 18-instrument set
Load an alternative instrument set
Load an alternative wave set
Create a single complex waveform
Play up to four waveforms under creation within an Instrument Spec
File single complex waveforms
Analyse single waveforms
Create a 16-waveform set

KEYBOARD HARDWARE

Musical compass 61 Notes C-C
Two foot controls
Key velocity-sensitive action
Powered from PDSG *via* 20-way cable



Typical PDSG system configuration.

his series of articles will describe a polyphonic digital music system, developed by Clef Products (Electronics) ted, which has been conceived to fulfil requirements of the musically-inclined e computer owner, and to have a per- ıance specification which will attract all ls of musical involvement. During the es, the sound-generation peripheral and a -in keyboard unit will become available ıse with the BBC Model B micro. A major ose of these articles is to promote erimentation by readers involved in all ts of computer music, both amateur and essional, by presenting an explanation of principles involved in the technology and tailed description of both the hardware software interfaces with the host com- r, which will allow complete flexibility of ramming and a link to other computers if are more readily available. It is envisaged the price of the music system will be nd £400, roughly equally split between ound generation package, which can be alone for non real-time input activities, he keyboard unit.

und Generation ripheral

e traditional method of sound synthesis start with oscillators, of either voltage ol or multi-divisional type, which generate le waveforms such as square wave and ooth. These waveforms contain many onics which, in order to give a variety of cal sounds, need to be filtered to shape udio spectrum and remove unwanted ponents. Using multiple VCOs, wave- can be mixed to produce more complex ds, but the cost of this sort of hardware rapidly become very high and relative g stability can be difficult to maintain. e heart of the music system to be de- ed has been termed the Programmable l Sound Generator (PDSG), and it was ly designed to cope with some of the ems mentioned above.

Oscillators are replaced by the concept of logical programmable digital sound generators, which are capable of feeding out any cyclic waveforms which have been fed into their waveform memories, thus eliminating the need to add harmonic shaping by the use of filters and allowing precise control of harmonics which would otherwise have to be provided by multiple oscillators.

The frequency (or pitch) of the emitted sound can be accurately controlled by calculated data fed from a controlling (host) computer. The use of electronic multiplexing allows efficient utilisation of sound-generating hardware to produce 32 identical logical generators, each with a wide audio bandwidth, from one piece of hardware. Envelope control of each generator is independent and is represented by a stream of data from the host computer, and since the shape of this is automatically stored in memory, complete recall and modification of the parameters is instantly available.

The PDSG has been enhanced to give programmable spatial placement of the sound output in terms of three-position stereo, and waveforms can be freely and instantly selected for each generator individually, a minimum of 32 different waveshapes being available.

Coupled with a DC power supply, the PDSG provides a complete non real-time sound-generation system which can be programmed to use between one and 32 generators per note and may typically be configured as eight-note polyphonic, each note having four accurately tuned generators with different complex waveforms and separate envelope and stereo positional control. This results in effective dynamic tonal sweeps in the simulation of conventional or other musical instruments, which can be taken to the extreme of a monophonic system using all 32 generators!

Real-Time Control

The PDSG has been designed to include an auxiliary computer bus which, although primarily intended to cover the optional keyboard input, also provides a two-way hardware link for extra input/output facilities, which at this stage have not been dedicated to any particular function on the assumption that a music system of this performance will invite further expansion when its full potential is realised.

The keyboard is 61 notes in length and incorporates foot controls and a velocity-sensitive action. Real-time recording on the keyboard provides touch-sensitive data which can be used with the required instrumentation at or after the time of recording. It has been well demonstrated that touch-sensitivity can be an extremely useful effect, sounding particularly dramatic when used in conjunction with voices replicating non-touch-sensitive acoustic instruments. For example, using a rich three-generator string ensemble effect (10⅔ notes polyphonic to handle sustain), high levels of output can be reduced dramatically by replaying the chord with progressively less energy – the conductor diminuendo? Future programming for music keyboard operation is expected to cover multitrack recording and keyboard splits to give greater freedom in the use of multi-instrument orchestrations.

The requirements for a complete music system using the BBC Model B computer are illustrated in Figure 1. The PDSG and PSU are mounted in a box next to the computer, working off the 1MHz bus, and the keyboard plugs into the PDSG.

All controls are programmed into the computer keyboard, and the monitor provides a display of all activities from instrument selection to waveform creation and analysis. Whilst stereo output is available to connect with a normal Hi-Fi system, easy connection to group amplification is also possible.

Waveform Sampling

The method used to generate audio tones is illustrated in Figure 2. Depending on the type of waveform memories used in the PDSG, between 32 and 64 waveform tables can be stored on the board. The normal

configuration is for 16 or 32 to be stored in EPROM, whilst 16 are fed into RAM from the host computer, and may be altered as required. A second RAM can replace the EPROM to give 32 programmable waveforms, or two 2732 EPROMs may be used to give a total of 64 non-adjustable waveforms.

Each waveform table contains 128 bytes, ie. numbers between 0 and 255, which define the instant amplitude or contour of the waveform, and normally cover the values required over the period of one cycle. Since it is diagramatically difficult to show a 128 byte table, the number of entries in Figure 2(a) has been reduced to 16 to explain the basic principles and the amplitude values are between 0 and 15.

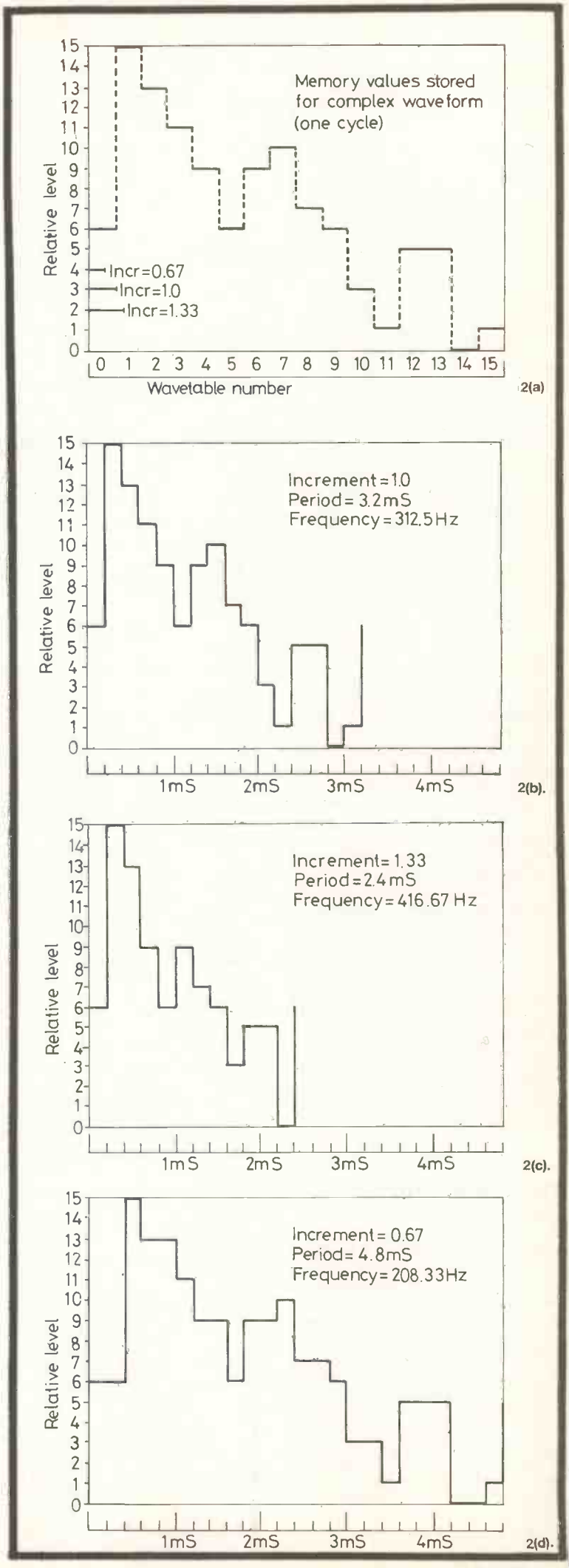
In order to produce a sound from the sequence of stored values, it is necessary to convert each number to an analogue voltage and to allow a period of time to elapse between the production of each amplitude step, and this is achieved by the use of a digital-to-analogue converter (DAC). If this period were to be adjustable, then increasing the time between steps would result in a longer time being taken to scan through a complete cycle and give a lower-frequency audio output.

The method used to achieve variable frequency in the PDSG is to adopt a fixed time interval but vary the distance moved along the x-axis of the diagram after each time period. There are 16 steps (0–15) shown in the diagram such that if, for example, a time interval of 0.2ms were chosen and the distance moved (incremented) after each time interval was 1, then it would take 3.2ms to scan the complete cycle, which would correspond to a frequency of 312.5Hz. This is shown in Figure 2(b) and it can be seen that each step appears in the resultant waveform.

If, however, an increment of 1.33 were chosen with the same time interval, then the cycle would be completed in 2.4ms corresponding to 416.67Hz, and as shown in Figure 2(c), some of the amplitude steps would be missed to compensate for the increased scanning rate through the table. Figure 2(d) illustrates the situation when the increment is less than one, and in order to compensate for the lower rate of scan, some amplitude steps are repeated to fill in the waveform. This is achieved by counting in such a way that an increment of 0.67 (which gives a sum of 0, 0.67, 1.33, 2.0 etc.) results in obtaining table values at 0, 0, 1, 2 etc. simply by dropping the fraction. When the maximum count of 15 is reached, the movement along the x-axis is folded back, (eg. 15.5 becomes 0.5) and the process continues to cycle.

This technique has a number of attractive features, the first of which is that a single waveform table can be used to achieve a number of audio output frequencies at the same time, using the technique of multiplexing. In the simple example above, 0.2ms is available to add 0.67 to the previous number along the x-axis and output its corresponding amplitude value to the DAC.

Since much higher mathematical speeds are available to us, it is possible to carry out a number of such additions within the overall time interval, each using different increments. Thus, if we wish to obtain the three waveforms in Figures 2(b)-2(d) simultaneously, we can allocate one third of the time interval (67us) to each. This is illustrated in Figure 2(e) where the waveform of Figure 2(d) has been chopped into time segments containing the amplitude value of that waveform in the first 67us, leaving the remaining 133us to be split between waveforms 2(b) and 2(c). At a later stage, it is necessary to produce a composite audio signal by analogue addition but with individual waveforms available in this chopped state, the second feature of the technique can be seen – namely that, before combination of

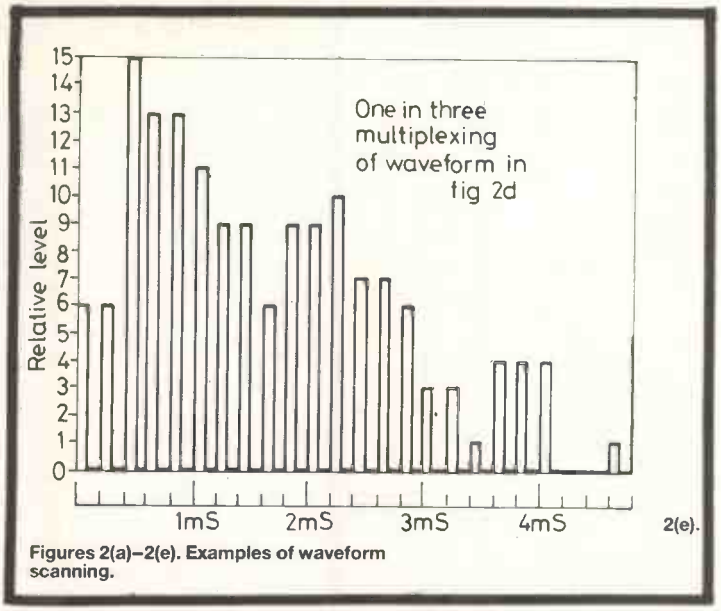


2(a)

2(b).

2(c).

2(d).



Figures 2(a)–2(e). Examples of waveform scanning.

the signals, circuitry may be incorporated which directs individual signals to a chosen output location. In the case of the PDSG, this represents three-position stereo.

Logical Oscillators & Performance

The above describes the concept of Logical Oscillators, where a group of components constitutes a single hardware circuit which may then be used to give a simulation of multiple oscillators. The limits on how the technique may be used are determined purely by the performance required.

The first area for consideration relates to the situation which prevailed in Figure 2(c) where parts of the waveform table were being skipped. Although increasing the increment will only gradually reduce the detail of the waveform as more steps are missed, there will come a point (when the increment reaches eight) where if it were exceeded the waveform would suddenly make no sense, since even its cyclic information will then have disappeared. The time interval of 0.2ms used in the examples above – when converted to a frequency of 5kHz – is known as the *sample rate*. With an increment figure of 8, the time to scan the values would be two amplitude values or 0.4ms, giving a square wave of 2.5kHz. After that point, the square wave would break up giving considerable distortion and noise. This is called the *Nyquist frequency*, and results from a theorem which states that in a sampling system the maximum bandwidth, before distortion, is slightly less than one half of the sample rate.

Even if all frequencies used were held below the Nyquist frequency, a second effect has to be considered which is fundamental to a sampling system.A signal frequency of 2kHz sampled at 5kHz produces an unwanted difference frequency of 3kHz. This is called the *alias frequency*, and if heard it normally appears as non-harmonically related distortion. The term 'aliasing' is used to cover the onset of audible distortion as it occurs. Sharp low pass filters are used to attenuate the alias frequency above the Nyquist frequency, thus reducing the distortion, but since the difference frequency for a signal frequency of 3kHz sampled at 5kHz is 2kHz, which is in the required pass band, filters cannot compensate for the limit set by Nyquist. The challenge, therefore, is to achieve a high sample rate to obtain a good audio bandwidth.

The 5kHz (0.2ms) sample rate chosen for the explanation of the theory comes from a real system where the audio bandwidth requiremennt is extremely modest, and represents the capability of a single microprocessor carrying out a considerable amount of control work, in addition to producing polyphonic music by executing the mathematics outlined above. However, the PDSG requirements cover a much broader audio spectrum and were initially chosen to be based on a Nyquist frequency around 16kHz, giving a sample rate of 32kHz. Within the resulting available sampling interval of 32us, a typical microprocessor could handle two or three Logical Oscillators if it was used as dedicated hardware, whereas standard computing hardware running at 2MHz can perform the addition and output-to-DAC routines for one oscillator in a period of one microsecond, thereby giving the potential of 32 Logical Oscillators with a good audio bandwidth. The latter technique is the basis of the PDSG, which in its practical form is clocked at approximately 1.9MHz, giving a Nyquist frequency of around 15kHz.

The Practical System

A schematic of the PDSG is shown in Figure 3. Stepping along the waveform tables is achieved by adding an existing value in the hardware accumulator to an increment stored in the Frequency Register which corresponds to the required audio frequency for one logical oscillator. The register and accumulator are actually RAMs and require 64 bytes, giving two bytes per oscillator. Seven bits of data are fed through a latch (Music Address Low) to the address lines of the waveform memory to give the 128-byte cycle, and the remaining nine bits from the two bytes are used as fractional numbers in the addition process to give accuracy in frequency definition. Using the two bytes, therefore, two additions take place within one microsecond to determine which steps of the waveform should be fed out to the tone DAC. The remainder of the 64 bytes are then processed in the same way to give independent positions within the waveform for each of the other 31 logical oscillators.

The frequency section of the PDSG spends most of its time continuously cycling in this manner, and is controlled by the PDSG clock which has a fine frequency adjustment to give overall audio tuning. The counter splits the overall cycle into 64 parts and is always connected to the accumulator. When a new frequency is required from one of the oscillators, the Music Load Buffer isolates the counter from the Frequency Register, which is then forced to the location on the Music Address Latch corresponding to the oscillator requiring a change to the value presented by the Music Data Latch (*via* the Frequency Load Buffer). This transfer occurs automatically, in synchronisation with the counting operation, when the host computer sends a new piece of data (increment) for that location.

Tuning Accuracy

Unlike many standard generation techniques, the method described is most accurate in tuning at high frequencies, where the theoretical accuracy is approximately 0.02% and drops to 0.73% at 65Hz. However, since the PDSG has onboard fine tuning, it is possible to table a set of increments for a musical scale where the worst notes in the bottom octave are better than 0.2%, without the need to add further expensive bytes of fractional addition. Furthermore, it is also possible to construct and use tables of alternative tunings such as Just, quarter-tone, or mean temperament.

Level Register

In order to determine the output level of each logical oscillator to give envelope control, a further RAM, known as the Level Register, has 32 bytes (one for each oscillator) containing a number between 0 and 255. This number represents the output level. There are also a further 32 bytes to determine which waveform and which output channel should be used by each oscillator at a particular moment. This 64 byte sequence is cycled in parallel with the Frequency Increment data such that every 32 microseconds, each logical oscillator is told which segment of which waveform table to output to which channel and at what level. The Level Register can be synchronously updated by the host computer in a similar manner to the Frequency Register.

Waveform Loading

A single table in the waveform memories is usually addressed by the numbers cycling in the accumulator *via* the latch labelled Music Address Low, but synchronous loading of a new table is possible by disabling MADL and forcing the data from the Wave Data Latch into the waveform memory location determined by the Waveform Address Low Latch. 16 waveforms can be stored in a 2K × 8 RAM or EPROM, with 32 in a 4K × 8 EPROM. The choice of waveform table is made *via* either the Music address High Latch from the Level Register, or the Waveform Address High Latch which has been loaded from the host computer.

Analogue Processing

The data from the waveform memories is taken to the tone DAC, which converts each byte to an analogue voltage The tone DAC is controlled by the level DAC, which converts envelope information in the Level Register. At this point, the multiplexed waveform data can be directed to one or both of two Sample and Hold circuits, splitting the final destination of each oscillator as required. The S&H circuits are controlled by logic which receives its instructions from the Level Register *via* two bits of the MADH Latch. The low crosstalk circuit used in the Sample and Hold is also designed to act as a noise gate to give a quiet quiescent state, and in addition to splitting and stretching the signal for the two channels, it balances the third stereo position to the centre with reduced volume in each channel. The final part of the audio chain sums the multiplexed signals in each channel, and is followed by a sixth order low pass filter giving 40–50dB attenuation at the Nyquist frequency and a useful audio bandwidth in the region of 11–12kHz. Output level adjustment is provided to cope with high-sensitivity amplification equipment.

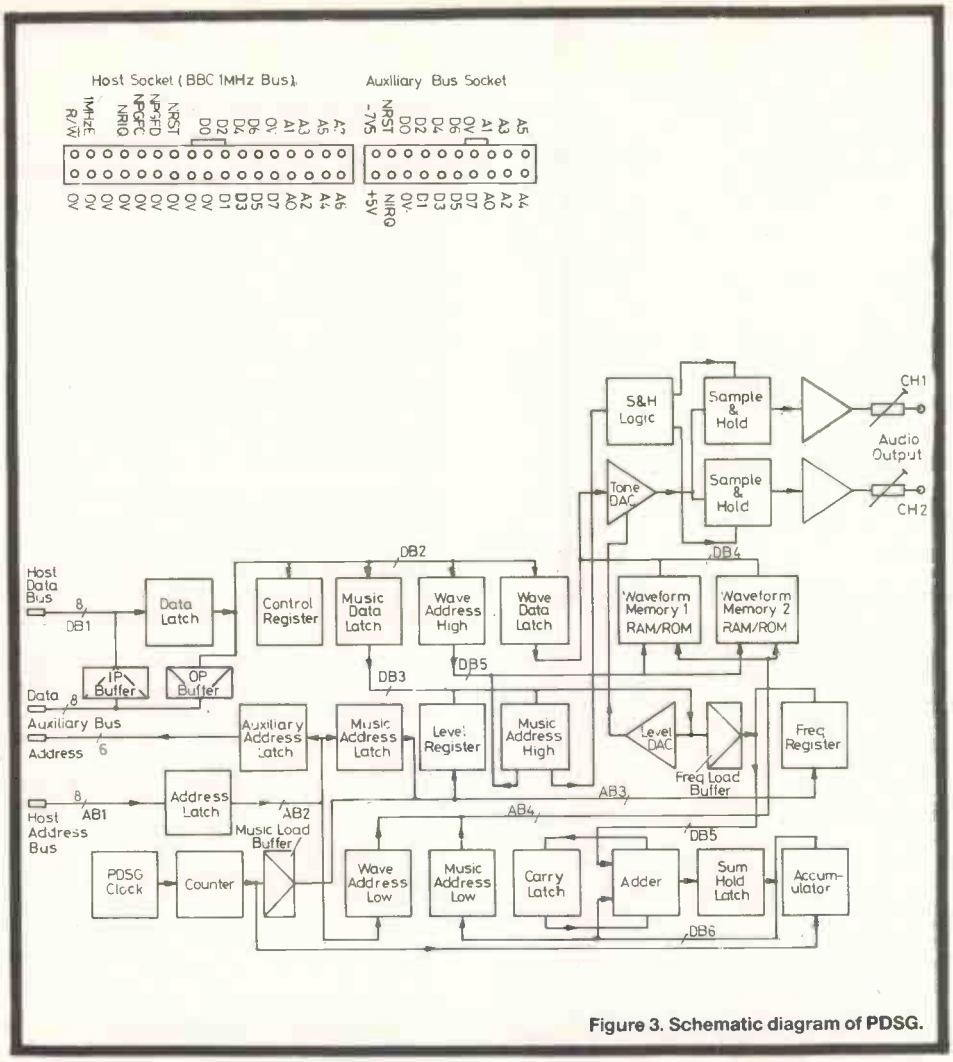


Figure 3. Schematic diagram of PDSG.

Auxiliary Activities and Logic

The above covers the fundamental operation of the PDSG, but it should be remembered that most activities are occuring at a rate of around 2MHz, leading to a requirement for very precise timing and therefore quite a large number of additional logic gates. In order to give a reliable interface with the host computer, and to cope with the fact that the PDSG is operating asynchronously to the host, both data and address latches are provided on the PCB. The BBC decoding and operation of the latches will be described in more detail later on in the series when hardware assistance will also be given for linking to other computers. An interrupt oscillator is included in the PDSG, which provides pulses at 2ms intervals, and can be inhibited by the control register, which also determines which mode of operation is currently active on the board.

The auxiliary bus consists of three devices which give two-way buffered operation and these devices are normally omitted from the PDSG when keyboard operation is not envisaged. Connections for this bus and the 1MHz link to the BBC are given in Figure 3.

Supplies to the PDSG are +5volts regulated at 700mA, +10.5V at 50mA and −11.5V at 50mA. The higher voltages are reduced to +/− 7.5V using Zener diodes on the PCB.

Alan Boothman **CM**

Next month's article will describe the various uses to which the PDSG can be put, and there'll also be an in-depth technical analysis of the system's workings. Pricing and availability details for the hardware will be announced shortly.

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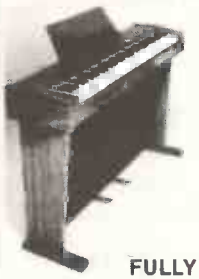

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DO-IT-YOURSELF
The String Damper

Designer Paul Williams **introduces an easy-to-build project capable of providing the guitarist (or indeed the synth-player) with automatic damped string effects, as well as a range of envelope and gate processing. The String Damper comes housed in a neat footswitch case with easy battery access, and the complete kit of parts is available from E&MM.**

Although damping the sustain of strings presents no physical problem to most guitarists, this neat little unit will not only accomplish effortless damping, but also achieve it more consistently, and over a much wider range, right down to thin 'pops'. The other effect available from the E&MM String Damper – that you will have great difficulty in producing manually – is the slow attack sound that Hank Marvin uses frequently to great effect. This too is adjustable over a wide time range from instantaneous through a 'bowing' sound to an almost painfully slow, gradual build-up.

The very low switching noise inherent in the design coupled with the optional non-latching footpedal operation means that an occasional slow attack or damped note can be 'dropped-in' wherever the musician wishes. This also allows for manual tremelo (amplitude modulation), or volume pumping effects to be easily achieved.

Although originally intended for use with guitars, the String Damper will operate satisfactorily with most key-boards, giving the synthesist another useful performance control to waggle away at with an unused foot, perhaps in conjunction with last month's Bass Pedal Synth project. . . .

Although battery consumption is minimal, a jack socket is provided for the connection of an external mains-operated DC supply. The battery is housed in a recess under the footplate that simply unclips to reveal the battery for quick changing.

Construction

Most of the components are contained on the PCB, and what little wiring is left should present no problem. Since the standard footswitch unit comes with a jack socket and switch mounted on a PCB, the first job is to remove the PCB assembly from the case and de-solder the switch and socket: the PCB can then be discarded. If you don't have access to a solder pump, then the solder can be removed from the joints using the bared ends of stranded wire applied with the soldering iron tip to the joints.

The assembly of the String Damper starts by inserting from the track side, and soldering the seven veropins. Next, insert and solder the IC sockets, but leave the ICs out till later. Insert and solder D2-5 and all the resistors, referring to the component overlay for positioning. Note that some of the resistors are mounted vertically.

Mount and solder the capacitors, taking care with the orientation of the electrolytics. The jack sockets and the switch can now be soldered in place, making sure that they are pushed firmly down onto the PCB whilst doing so. Note that the socket removed from the original PCB is JK3. Having completed the PCB assembly, it must be checked carefully for correct assembly and component orientation, and with an eyeglass on the track side for dry joints or bridged tracks. The ICs can then be loaded into their sockets, and again, be careful with orientation.

Now is the time to decide whether you require on-off or momentary operation. If you want momentary operation, then the end of the wire detent which locates into the mechanism of the switch must be

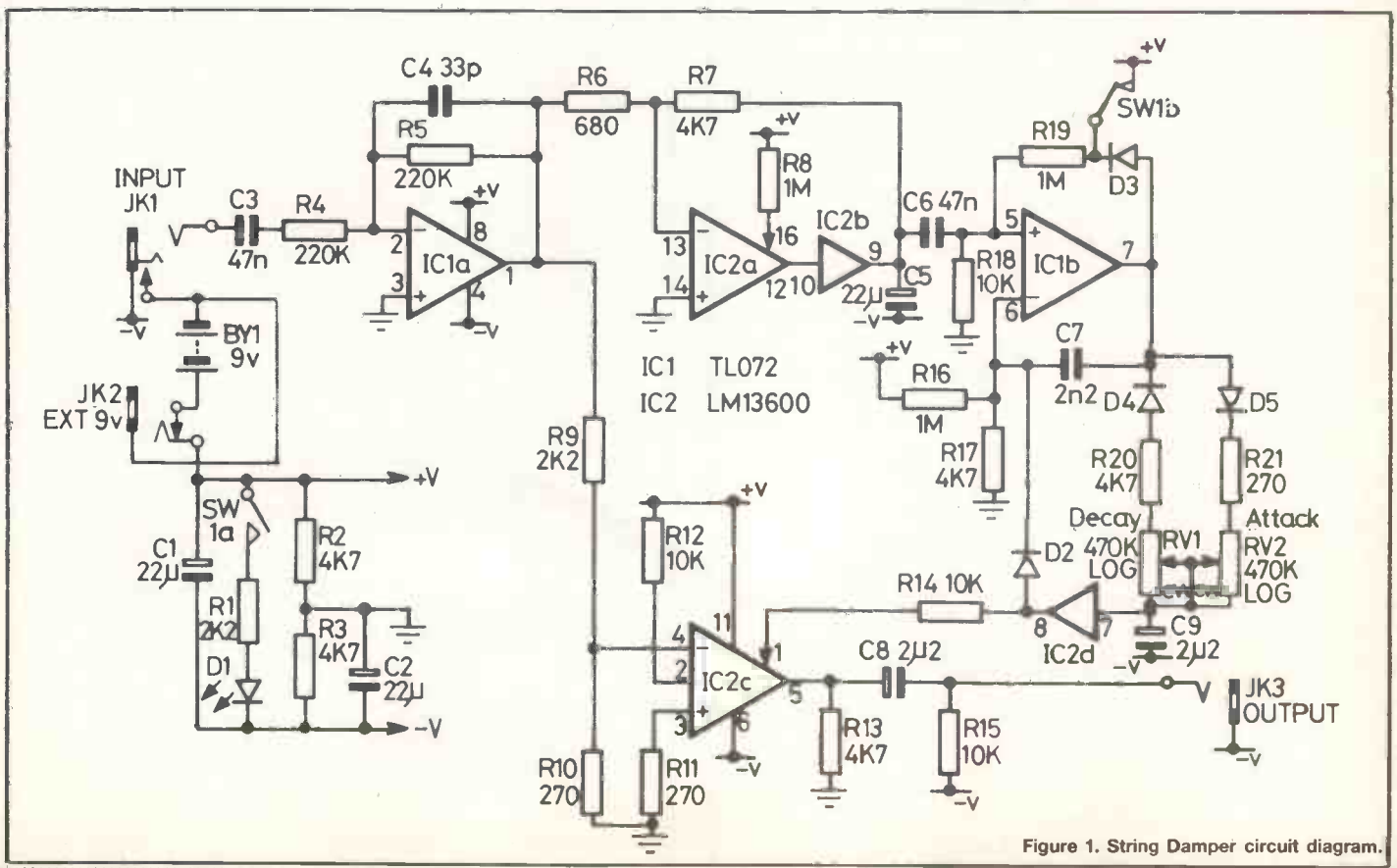

Figure 1. String Damper circuit diagram.

pulled out and allowed to rest on the side of the switch body. The coil spring will retain it in this position, ready for changing to on-off operation if required.

Remove the inner moulding from the footswitch case by withdrawing the two securing screws, and prepare the two mouldings as shown in Figure 2. Thread the free end of the battery connector wires through the small hole in the corner of the battery compartment. Before fitting the LED in place using a clip and collar, solder 100mm-long insulated wires onto the leads and sleeve the joints: identify the anode wire by bending over the free end.

After the pots on the inner moulding panel have been mounted, they can be connected to the PCB assembly veropins using 100mm-long insulated wires, along with the battery clip wires. Now drop the inner moulding back into the main moulding, guiding the LED wires through the hole in the inner moulding, and screw it in place. The LED wires can now be soldered to the PCB assembly, though remember that the bent-over wire is the anode connection. Feed the jack socket bushes into the appropriate case holes and locate the PCB on the inner moulding pillars so that the switch lever drops into the actuator arm.

All that remains now is to screw on the jack nuts (no need to secure the small jack), fit the control knobs, and screw on the base plate. Now pop in a fresh PP3 battery (preferably a mercury type), and away you go!

Circuit Description

The circuit diagram shown in Figure 1 reveals that the amplitude of the signal is controlled by that old favourite, the LM13600 dual Operational Transconductance Amplifier (OTA). IC1a buffers the input, presenting a high impedance to the guitar and a nice low-output impedance to the following stages. IC2a&b form a precision rectifier, storing the peak value of the input amplitude on C5. C6 and R18 form a simple differentiator whose purpose is to detect when the signal amplitude increases at a high enough rate and by a great enough amount – to indicate that a new note has been played. The bi-stable formed around IC1b is then triggered, its output on pin 7 going positive. This condition is latched for the time being by D3 and R19.

C9 will now charge via D5, R21 and the attack pot, RV2. The voltage on C9 is buffered and followed by IC2d. When the voltage is sufficient to forward bias D2, causing current to flow into R17, the bi-stable IC1b becomes re-set. This signifies the end of the attack period, the length of which is obviously determined by the rate of charge of C9 *via* RV2. The maximum attack and decay times can both be increased by making the value of C9 larger.

C9 now discharges via D4, R20 and RV1, the decay pot. R14 generates a control current for the OTA IC2c, proportional to the voltage across C9. The output signal is thus equal to the product of the input signal and the voltage across C9. When the footpedal is released, SW1b closes, forcing the bi-stable IC1b to be permanently set, so that the input signal is allowed to pass through to the output unattenuated. Note that the signal path does not change during switching, so that very little noise is induced when switching in or out.

The input jack JK1 has a make contact which automatically switches the battery on when the guitar plug is inserted into the input jack.

In Use

Assuming that the unit now works correctly, as it should do if you have followed the assembly instructions carefully and checked all your work thoroughly, once the Damper is connected to a guitar and amplifier you will find that the signal from the guitar is passed to the amplifier unchanged. If you have decided to opt for the on-off mode of operation, ensure that the footswitch is positioned so that the LED is extinguished.

Now with the footswitch operated, and the controls both turned fully anti-clockwise, notes played on your instrument will only be heard as very short 'pops' since the damping is at a maximum. Advancing the decay control will broaden the 'pops' into more recognisable damped strings, up to the point fully clockwise where little damping takes place. Each new note played, regardless of how far the previous note has decayed, will trigger the unit into a new envelope cycle. When playing chords it is advisable to damp the strings manually to prevent re-triggering during decay.

Advancing the attack control will give each new note a more gentle entrance, up to the fully clockwise position where the attack time will be over one second. With the attack control at 12 o'clock and the decay control fully anti-clockwise, a 'reversed' sound can be obtained, since a slow attack will be followed by an abrupt decay.

With both controls at 11 o'clock, a gentle effect not dissimilar to bowing a violin will be produced. Playing notes in rapid succession without manually damping the previous ones will result in an eerie chord effect, where each new note is accompanied by a short sample of all the notes previously played. With this same setting, it is possible to produce manually-controlled tremelo and volume pumping effects by continuously pressing and releasing the pedal.

If you prefer your effects to be subtle and unobtrusive, then you may wish to introduce an envelope effect just on an occasional note. For instance, to give a note a slow attack only, press the footswitch just before the note and, as soon as the note has reached its loudest, release the pedal. Don't expect to get perfect results first time, since the String Damper is a performance control and as

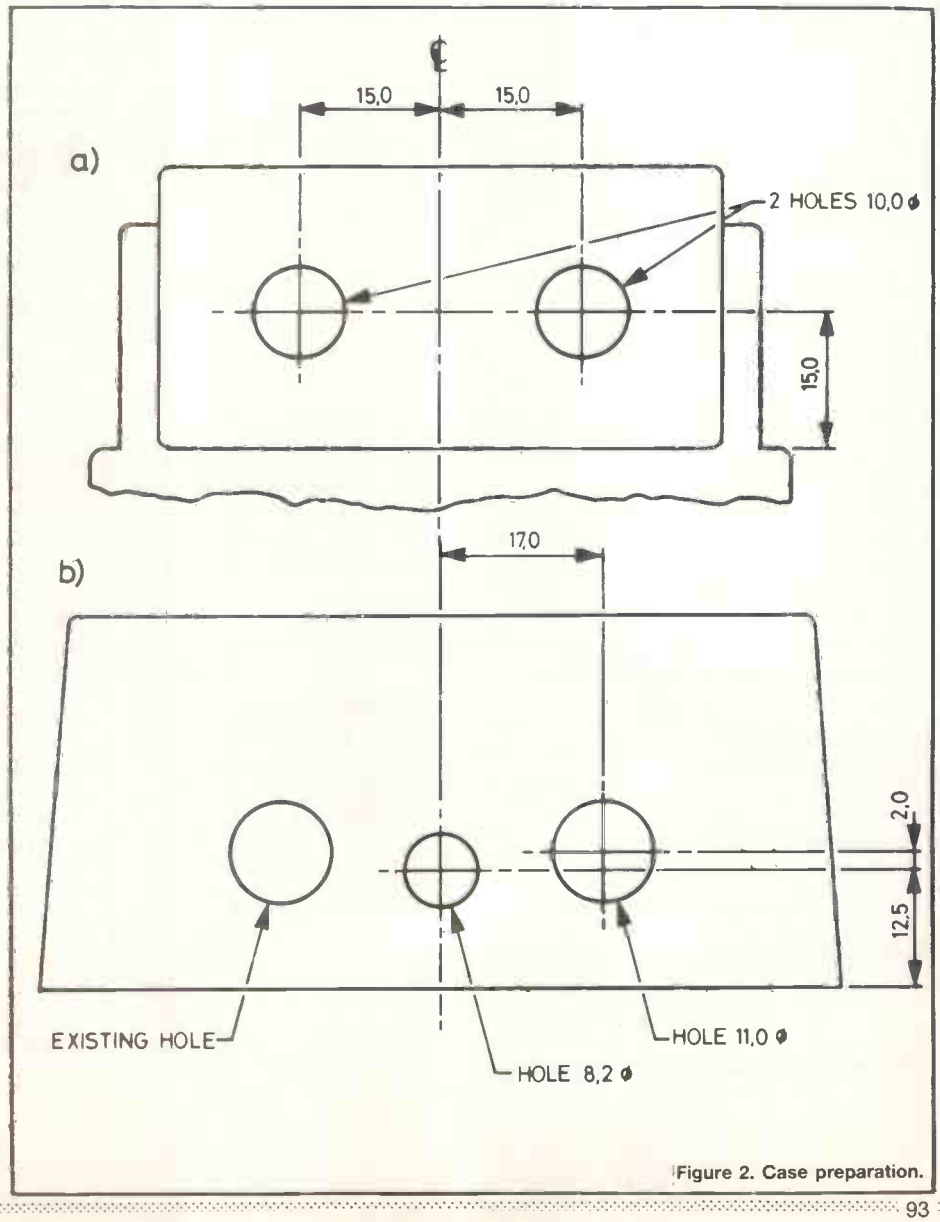

Figure 2. Case preparation.

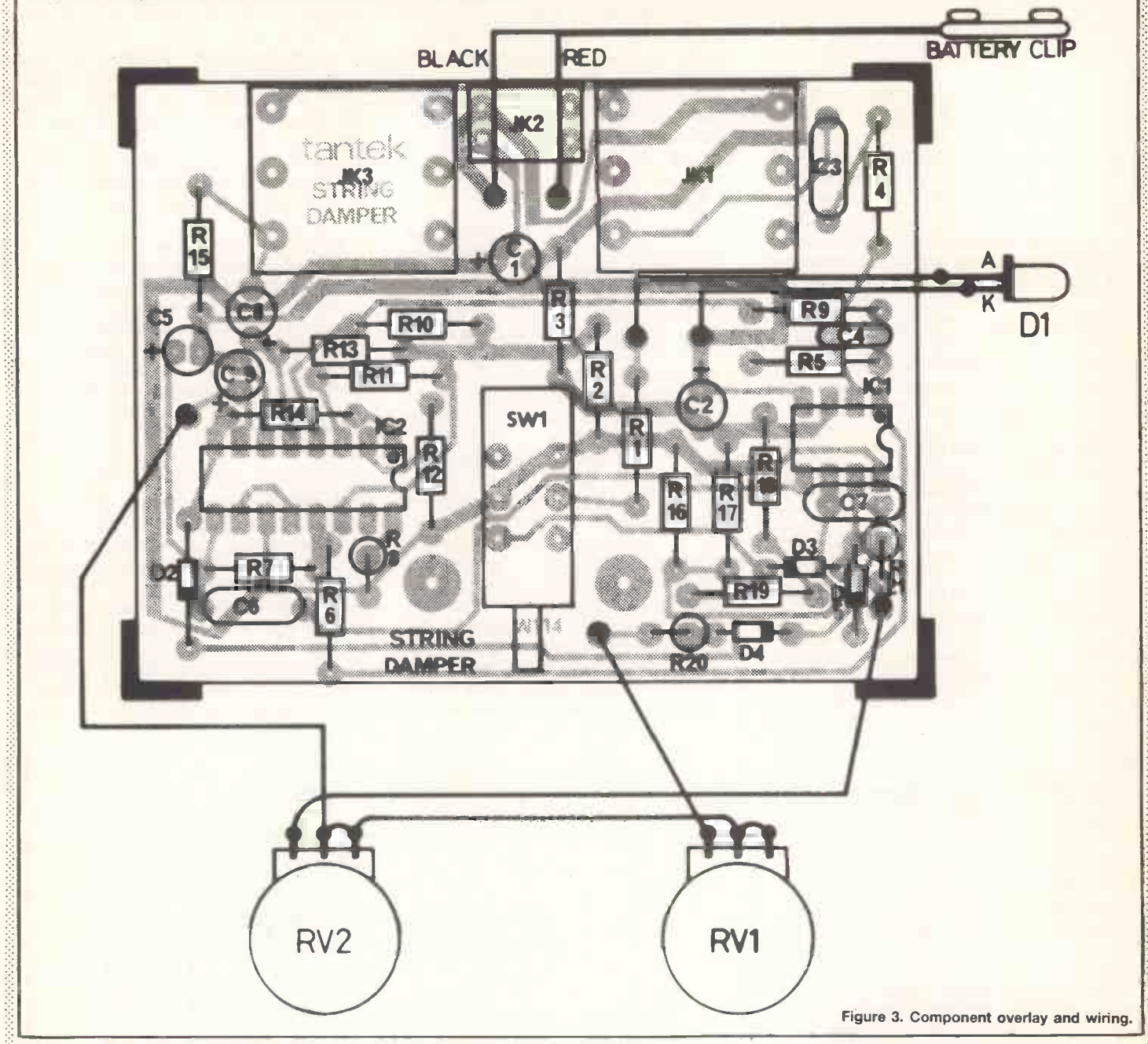

Figure 3. Component overlay and wiring.

such needs practice to achieve artistic results.

If you wish to run the unit from a mains power supply, then this should be of the regulated 9V DC variety. Remember to withdraw the jack plugs after use to preserve the battery life.

As with all new effects, the name of the game is experimentation: the musician prepared to try out new techniques will soon find that he has a whole new spectrum of sounds to draw on.

Paul Williams **E&MM**

The String Damper is obtainable as a complete kit of parts from E&MM at the editorial address, price £23.95 including VAT, postage and packing. Cheques/POs should be made payable to Glidecastle Publishing Ltd. Please allow 28 days for delivery.

Typical Specifications

Frequency response (−3dB)	15Hz to 18kHz
Output noise (open)	−87dBm (A)
Output noise (closed)	−100dBm (A)
Attack time	0.5ms to 1 sec
Decay time	10ms to 1 sec
Battery drain (active)	8mA
Battery drain (standby)	5mA

String Damper Parts List

Resistors – all ¼W 5% carbon film

R1, 9	2K2	R8, 16, 19	1M
R2, 3, 7, 13, 17, 20	4K7	R10, 11, 21	270
R4, 5	220K	R12, 14, 15, 18	10K
R6	680	RV1, 2	470K log pot

Capacitors

C1, 2, 5	22uF 16v radial electrolytic
C3, 6	47nF polyester
C4	33pF ceramic
C7	2n2 ceramic
C8, 9	2u2 50V radial electrolytic

Semiconductors

D1	LED
D2-5	1N4148
IC1	TL072
IC2	LM13600

Miscellaneous

JK1 ¼" PC Jack socket with make contact
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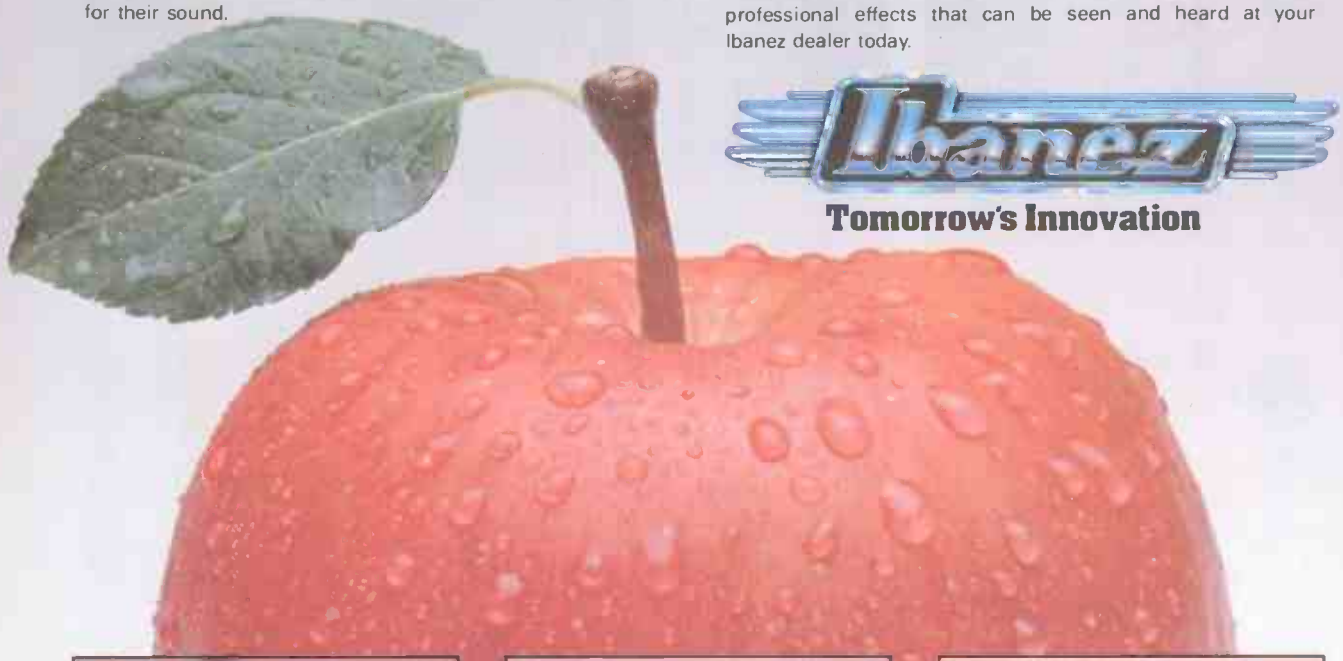

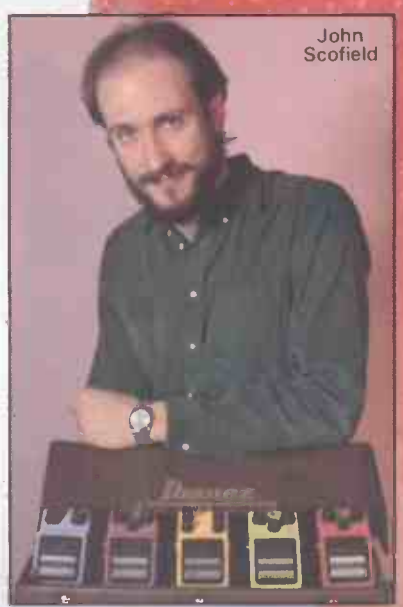

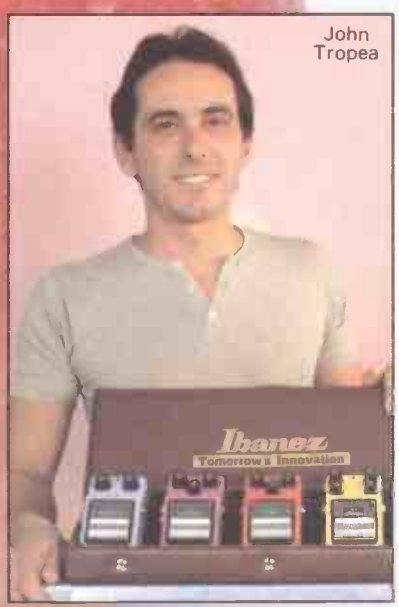

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