

Electronics &

MAY 1982 75p

# MUSIC Maker

DEPECHE  
MODE



- \* **HOLGER CZUKAY**
- \* NEW KEYBOARD BUYERS GUIDE
- \* SOUND ON STAGE - P.A. INTRODUCED
- \* HOT WIRING YOUR GUITAR FOR STEREO
- \* HOW TO MAKE MUSIC PROJECTS
- \* A STATE-VARIABLE FILTER
- \* PROJECTS:  
SOFT DISTORTION PEDAL \* QUADRAMIX
- \* Plus Reviews, Features and Practical Information  
for the Electro-Musician





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S/N Ratio - 63dB [3% THD Level, weighted] NAB +65dB [3% THD Level, weighted] IEC - THD 0.8% at 0 VU, 1,000 Hz, 185 μWb/m

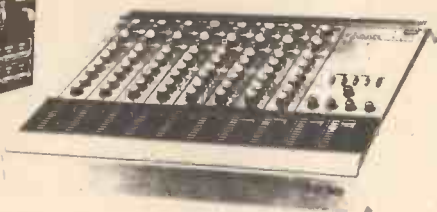
DX-2B. OPTIONAL DBX UNIT - S/N Ratio - 92dB A weighted (NAB).

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- 3060: Meter bridge for above
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- 3030: 2 x 10-band graphic equaliser



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- Cube 60/100
- Spirit 30/50
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- CR 8000/5000
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- (Bass Line TB-303)

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- Dimension D
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- Mixer/Amps PA 150/250
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- Hamer
- Jaydee
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- Roland
- Kramer
- Chandler
- Yamaha
- Ibanez
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- + secondhand

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- Yamaha
- Jaydee
- Roland
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- Ibanez
- + secondhand

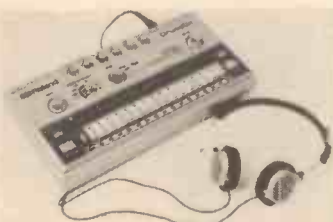
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- Boss
- MXR
- Dod
- Yamaha
- Fostex
- Carlsbro
- Whirlwind
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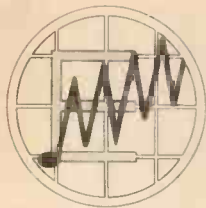
Dear Rose-Morris, please send me details of the Korg Mono/Poly and Polysix and of my nearest Korg Key Centre.



Name \_\_\_\_\_  
Address \_\_\_\_\_

Rose-Morris & Co. Ltd. 32/34 Gordon House Road,  
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E&MM/5/82



# Electronics & Music Maker

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MAY 1982

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E&MM APRIL 1982

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# Readers Letters

Send to: Reader's Letters, Electronics & Music Maker  
282 London Road, Westcliff-on-Sea, Essex SS0 7JG.

## Better and better

Dear Sir,  
Having become a reader of your excellent magazine since it became more musically orientated (November), I have discovered that as each issue becomes available each one outclasses the previous issue. As a young home electro-musician, I find the instrument reviews very helpful and I would be extremely pleased to see a review of the new Juno 6 and Bassline synths as soon as possible. I find some of your interviews aimed at older readers (fans of Tangerine Dream, Rick Wakeman) so for younger readers could you please interview Depeche Mode and/or the very amazing Thomas Leer who produces very classy synth/soul music, or Bauhaus or Cabaret Voltaire or the Associates or Deutch Amerikanische Freundschaft.

Paul Atridies  
Ballasalla, Isle of Man

The Bassline was reviewed in the April issue and an article on Depeche Mode is in the issue. As for the rest, keep reading the magazine.

## The IMS

Dear Mike,  
My son talked me into taking him to the recent International Music Show at Wembley. We enjoyed it greatly, and especially your lecture on Electro-music. You demonstrated a type of electro-autoharp, and I thought you said it was reviewed in the current issue of E&MM (we have all the issues from the first). We have searched everywhere in vain. Can you help please? We might like to buy one.

D. G. Walling  
Hayling Island, Hampshire

The electro-autoharp to which you are referring is the Suzuki Omnichord and it is reviewed in this issue, page 18.

## Organ info

Dear Sir,  
Would you please send me details of books available covering the theory of electronic circuitry in modern electronic organs, from basic to advance stages.

R.F. Tucker  
Penzance, Cornwall

There are several books which you might find helpful and these include: 'Electronic Musical Instruments' by Richard Dorf (Audio Library), 'The Electronic Musical Instrument Manual' by Alan Douglas (Pitman), 'Electronic Organ Handbook' by H. Emerson Anderson (Foulsham-Sams) and 'The Electrical Production of Music' by Alan Douglas (Macdonald). The last of these may be out of print now, but the other books are revised and re-published from time to time. I should warn you that it is difficult enough to get these books in London — so Penzance or Truro will be even more so.

In London, Foyles sometimes carry a few books of interest but the best technical bookshop is the Modern Book Co, 19-21 Praed Street, London W2 1NP (01-402 9176).

Having answered your question, I should point out that circuitry is always changing in the electronic organs. Thus you may find that even the most recent publication is behind the times and may only just touch ICs — with discrete circuitry still the main preoccupation. You will get some ideas if you join the Electronic Organ Constructor's Society where a magazine is published every couple of months: write to Ralph Purdy (Membership Secretary), 11 The Avenue, Station Road, Billericay, Essex CM12 9HH. This Society has a few Cornish members with whom you may be able to get in contact.

The articles on the Matinee should give you food for thought, representing an inexpensive state-of-the-art instrument. On the whole, books you buy will not be so up-to-date so your best course is to read current magazines and attempt to contact others who live in your vicinity.

Ken Lenton-Smith

## Hexadrum

Dear Sir,  
Concerning the 'Hexadrum' project. It was stated that the output of the piezo ceramic plate was almost white noise. Is it possible, as white noise is the basis of the cymbal sound, to bypass the filter in the Hexadrum circuit and produce a reasonable cymbal sound.

Anthony Moon  
Haywards Heath  
West Sussex

The sound of the piezo-ceramic plate by itself does not last long enough to produce a cymbal effect. You would need extra circuitry; in fact, the Syn-wave does exactly what you require.

## Guitar mods

Dear Sir,  
I've got a Shergold Masquerader guitar. Would it be possible to convert this to a 6-string bass, and if so what alterations would I have to do. Secondly, do you know any way I could increase the output of the pickup when in 'single coil mode' without losing the specific quality. Thirdly, without changing pickups do you know any way I could boost the top end of the frequency scale (not active). Finally what pickup would you suggest to keep a heavy bass but greatly increase the top end (DiMazio power plus)?

Paul Straker  
Orpington, Kent

A 6-string bass differs from a normal 6-string guitar in two ways: the scale length is longer, and the spacing between the strings is much more. So

to effect a conversion, you'd need a longer neck fitted with heavy duty machine heads, and a new bridge and pickups with a wider string spacing. There wouldn't be much left of your original guitar after you'd replaced all these bits, even if you could get the appropriate parts: it would be much simpler to trade your Masquerader for a Shergold 6-string bass.

You don't seem to have decided what you want to do to your guitar, other than wanting to pull the poor thing apart! You want to boost various things, but without active circuitry or even a change of pickups in one case. Replacing the pickups is your best course if you want to avoid built-in circuits, and the standard size hum-buckers should fit. You would need a type with four conductor wiring to keep the Masquerader's triple sound switching options, and I would go for the DiMazio Dual Sound; the X2N isn't that much of an improvement in my opinion.

Peter Maydew

## Foxx music

Dear Sir,  
I am extremely impressed by your magazine and have found it most useful. I am at present building the Spectrum Synth which, I feel, is extremely good value for money. Probably my favourite interview was that with Tangerine Dream, and I was wondering whether it would be possible to do a similar article on John Foxx, as, I have been enjoying his music for some time now, and, I would like to see what instruments etc he uses.

C. C. Kennedy  
Brook, Nr Ashford, Kent

## Help!

Dear Sir,  
Being an Electro-Musician I bought your magazine (1st issue) and read it with great interest and ever since I have been reading it, even though it arrives here two months late! I wonder if there is a kind souled E.M. who would like to help out another E.M. in a RED TAPE wrapped country where one cannot send out money. I purchased a Vox Flanger for a great deal of money Rs 3600 (approx. £200!) and found that the device does not work! After diagnosing it I found that the Charges Coupled Device SAD 1024A is dead. I wrote to all the spare part dealers to find out if this device is available and guess what! You can't get it, they haven't heard of it. So I wonder if somebody could send me one. I, of course, cannot pay cash but could send something in return and would be very grateful to this person. I would also like to correspond with other Electro-Musicians who would like to exchange ideas and views. E&MM is a great mag.

David Doss  
New Delhi, India

Can anyone help? Address supplied.

## Contact

Dear Sir,  
I am writing to complement you on your superb magazine of which I have been a fan since last July. I have enjoyed your Kraftwerk, Tangerine Dream and Rick Wakeman interviews and I am pleased to see you are featuring Klaus Schulze in your March issue. I would like to know when you are going to feature other great electro-musicians such as Peter Baumann, Patrick Moraz, Vangelis and Jean Michel Jarre.

I would be grateful if you could get a synthesist in the Merseyside area, who would enjoy composing electronic music, to get in touch with me. My only requirement would be for the person to share their equipment. I am 17 years old, enjoy Tangerine Dream, Vangelis and other such music. I also play guitar.

Paul Walker  
Wirral, Merseyside

Address supplied.

## Speaker cabs

Dear Sir,  
Do you know of any publications dealing with speaker cabinet and bin design. I'm trying to find details on building bins and cabs because I can't afford to buy new.

D. W. Humphreys  
Bangor, Gwynedd

One useful book published and written by B. Babani is called "1st Book of Hi-Fi Loudspeaker Enclosures", available from technical bookshops.

## Matinee organ

Dear Sir,  
Would you please tell me how I can obtain information about Maplin Matinee Kit Organs mentioned in the February issue of Electronics & Music Maker? No address for suppliers of kits appears to be in the magazine.

Harold Wiln  
Grange-over-Sands, Cumbria  
The Matinee Organ Kits are available from Maplin Electronic Supplies Ltd, P.O. Box 3, Rayleigh, Essex SS6 8LR.

## Editorial note

Due to some enquiries on the availability of carbon conductive paint we would draw your attention to the following: The supplier of this paint will only supply very large quantities, there being two types; water based and spirit based.

Due to the small quantities needed in respect of guitars, Mr Peter Cook of Peter Cook Guitars, 69 Station Road, Hanwell, London W7 (tel: 01-840 1244) has agreed to supply small quantities. The charges will be £3.00 for water based paint and £6.00 for spirit based paint, plus 50p for postage and packing. Mr Cook has asked that when writing you send a small bottle suitable for the amount required.

# You'll find it cheaper at Chase

**SX2000**  
R.R.P. £299 £129



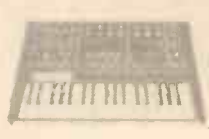
3½ octave keyboard • 3 Waveforms  
• 7 Presets octave selector • VCF •  
VCA • Vibrato • Portamento. Great  
value at £149!

**SX1000**  
R.R.P. £229 £149



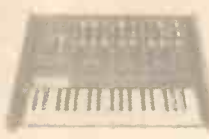
3 octave keyboard • Octave selector  
• Waveform selector • Pulse width  
modulation • Portamento • Vibrato  
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Great value at £149!

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combinable waveforms • 24db filter  
for bigger, fatter sound • Sample  
and hold circuit • Noise generator •  
Interfaceable with most variable  
synthesisers.

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features you would expect from a  
mono synth. However, the Pro-One  
goes well beyond standard by in-  
cluding a sequencer, arpeggiator,  
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and numerous other features un-  
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**CASIOTONE VL10**  
R.R.P. £29 £26



Casiotone VL1 R.R.P. £39 £35  
101 R.R.P. £225 £195  
202 R.R.P. £325 £275  
MT31 R.R.P. £79 £69  
MT40 R.R.P. £125 £99  
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601 R.R.P. £555 £495

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8 preset draw bar configurations •  
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sounds.

**CRUMAR PERFORMER**  
R.R.P. £499 £299



Crumar's completely new Performer  
is a professional quality strings and  
brass synthesiser at a not so profes-  
sional price. As a matter of fact you  
could pay much more and still not  
get all the features the Performer  
has to offer, like: two distinct 8- and  
16-foot string voices, an on-board  
Graphic Equaliser, variable cres-  
cendo, full brass filter and envelope  
controls, delay modulation, a 4-  
octave range keyboard and trouble-  
free LED switching. The Crumar  
Performer does a number on your  
ears without doing a number on  
your budget.

**ARP SOLINA**  
R.R.P. £799 £299



4-octave fully polyphonic keyboard  
with violas, violins, trumpets and  
brass, all mixable, to produce un-  
limited range of sounds including  
organ, electric piano, etc. Separate  
bass section, Attack and crescendo  
facility. Interfaceable with other  
synthesisers to produce polyphonic  
synthesiser sounds. Reduced from  
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This is the best bargain we have ever  
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professional musician a wide range  
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and piano — plus combinations of  
any or all these voices — at the  
touch of a button. The Quartet is the  
first state-of-the-art instrument in  
its price range featuring LED func-  
tion indicators, electronically latch-  
ed switches, low noise specifica-  
tions, colour-coded controls, and  
both high and low level outputs. The  
sound quality is what you would  
expect from any ARP product:  
superior.

**CRUMAR MULTIMAN S/2** R.R.P. £699 £499



One master console on Crumar's versatile Multimann S/2 controls string,  
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upper registers. Compactness, flexibility and a redesigned new look,  
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**CRUMAR ROADY** R.R.P. £399 £299



Keyboard of 61 keys (5 octaves) Bass section — Volume, on/off and  
sustain on/off controls. Vibes section — Volume, on/off switch, tremolo  
rate and depth, percussion volume and decay controls. Piano section —  
Volume, left, right, voices 1, 2 and 3 controls. Master volume control.  
Other controls: Master pitch sustain pedal input.

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their products in the UK  
• Polyphonic synthesiser with 24 pre-set voices • Strings, brass,  
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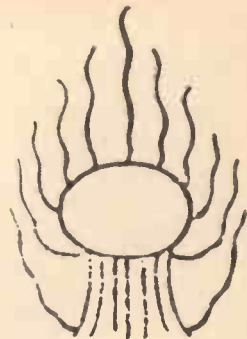
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# HOLGER CZUKAY



**E**ccentric, exuberant, emotional, strong-willed and above all, inspiring are the words you could use to describe Holger Czukay. His music is a fascinating, and in many ways, unique exploration of the sound medium, embodying all the experience of his years. At a recent interview, Holger eagerly discussed the background to his latest album 'On the Way to the Peak of Normal'.

"I can say that I have been involved with music since I was a very small child, but my first real experiences with music were, let's say, right after the war, when the American soldiers occupied a town near Frankfurt. So I learnt very quickly how to sing chorales to them in return for a Coca-Cola which was something you could not obtain. I started to read music at school, but my interest at this age, around 10, was diverted towards 'electricity'. Later, I obtained a very old Third Reich radio and I enjoyed using this as it had a 'feedback' control that could let me crudely transmit to a girlfriend using morse code. At High School I still concentrated on learning about electricity although I did not understand a lot! Even then I thought that music and electricity were 'biting' each other and I had to decide whether I was to be a musician or an electricity engineer. This conflict about my future eventually made me turn to music, because I felt I wasn't good enough to be an engineer. So I went to the Conservatory in Duisburg, a heavy industrial town north of Düsseldorf, and said I wanted to be a composer. But the comment was "What, a composer who is eighteen years old has to be recognised as a wonder child! If not, it is too late for you". That shocked me and I saw the only chance to participate in music by playing jazz. I joined a Dixieland band then, participating in a Festival, and from there I got out of composition."

**What did you play?**

"Guitar, through a radio with a four watt amplifier. I still remember that concert because my amplifier crackled all the time and I kept trying to put it right — but everybody thought it a joke and just part of the act!"

**Was jazz very popular in this part of Germany in the late fifties?**

"Yes, yes. Modern jazz too, was there as well — Lee Cornitz impressed me a lot. I did mainly improvisation because I hated reading music. Of course, I knew more than just chords because I was studying harmony, theory and basic composition in order to improve my jazz playing. Although my main study instrument was the classical guitar I tried to learn as many instruments as I could."

**So that's where you learnt to play the French horn used on the 'Peak of Normal' LP?**

"Not at all. I just found the horn in a shop, and without learning to play it properly just started getting sounds out of it."

**So pitching the notes of the horn was by experiment to you?**

"I found out very quickly by trial and error and had little difficulty in blowing notes."

**Were you influenced by jazz guitar players in these early days?**

"I became a jazz fanatic and listened to many other guitarists, especially Les Paul. I realise now that the whole studio set-up I use today may be similar to what Les Paul has done."

**Did you learn all the extended chord harmonies used so much in jazz e.g. Minor 9th, 11th, 13th etc?**



"Yes — I tried to learn these things first, but quite soon I forgot about them. I was not so much interested in the vertical aspect — more the horizontal, the polyphonic aspect of music. Then you have to go to Bach and Baroque music — you can't avoid it because it's equally important and has become an essential element in its own right for my music — *polyphony*. I believe it's still completely underestimated today."

"It's a question of listening — people listen easily to 'background' music but find it very hard to listen to music in a concentrated way. That's something — maybe 20 years ago quality of listening was much higher. Furthermore, we are in danger of losing all our spiritual aspects of a human being? We seem to be reducing ourselves to a 60kg portion of meat! — without any spiritual things. I think it's something to do with my age — I found out that all this seems to be important to me now. When you are young you just try everything, but now I reconsider many areas of music."

"Moving back to my training, whilst I was studying music, I had a jazz group that played in public which didn't please my teachers. Consequently, I didn't pass my exams because of my music — it was my worst result since the teachers had completely underestimated me. Just three days later, I had my first performance on the radio (exactly 21 years ago)!"

"Then in another festival not long after, the examiner told me 'I can't judge you at all so I'll withdraw your group from the competition and invite you to play on the radio station instead'. That was the beginning."

"After this event, I quit with jazz and started to notate my own music. Although you could say the jazz influence is still there, somehow my fellow jazz musicians at the time seemed to be ignoring the great chance to explore other areas of music."

**I have a word for musicians that make music with electronics — I call them *electro-musicians* rather than electronic musicians, because there are no barriers to the music we play — it's not just electronic music — it uses *Musique concrète* and as many influences of Western, Folk and Modern as you may find.**

"Yes, you are right. I wanted to learn, learn, learn ... and this has not changed for me today. I take in every kind of music I have the opportunity to hear." **Tell me about your association with Karlheinz Stockhausen.**

"First, I started studying in the Berlin University, but within two months my professors had dismissed me — I was a difficult person to get on with and was often rude and full of my own importance. The trouble was they insisted that I should learn the early methods of notation, and that made no sense to me: I wanted to be a practical musician. In fact, I felt that traditional notation needed to be improved for modern music."

"In 1963 I met Milton Babbitt, who was working in Illinois, USA with one of the first valve computers — but it was really able to function like a big synthesiser. He had brought tapes of his music to Darmstadt for a holiday course I attended."

"I was not over impressed by him at the time — other composers like Cage, did fascinate me. I was looking for the musician in a person. Now Stockhausen — he had it. He could take in his hand whatever he wanted. Somehow he could be intellectual, he could be explaining as much as he wanted. I always learnt about the music that came out of it — with other composers it was often just the ideas, and therefore I was fascinated by Karlheinz Stockhausen."

"I studied composition with him for three years and he would give us ideas for working out a piece. Of course, he was well established by this time (and regarded by many as the no. 1 composer worldwide). For me, he was the best teacher I can imagine. He could inspire people — I can't explain how."

"Somehow, I slowly 'finished' my studying with Stockhausen. He was such a strong personality — it reminds me when I first started with him when I was 17; one day he said to me 'Czucar, you are far too intellectual', but I felt that he was wrong and I said 'Oh, Mr. S., that doesn't count for your knowledge as a human being', and he said 'Don't get me wrong — I see how you put many questions on every note you write down'. He then referred to a fellow Belgian composer who put so many questions on each note that the result was he was unable to compose any music!"

**But isn't that something that affects us more as we get older?**

"Yes — and Stockhausen then told me: 'You are reaching the barrier where you don't know how to go on, and so many musicians never reach this barrier. At this point, you must leap over it or you won't be a composer. It depends on you how you solve this problem'. He said 'I am in the same situation too! He didn't know how to go on as well and I felt that he was rolling off a big stone out of my heart and I was really sad about that."

"The music we composed with K.S. was in whatever form he wanted — I never showed him my music. Everybody else did, but I didn't have the courage. He did finally see my music and he said 'Yes, it was interesting'. After three years, I finally stopped attending and moved to Switzerland to take a teaching post."

"Incidentally, the first music I wrote was for a drum kit which I didn't even recognise when it was performed!"

**Has Rock music become as viable for you as classical music?**

"Yes — slowly. That happened really through my pupils. I was teaching music in a Swiss Public School — all the usual traditional music and the occasional concerts. The pupils encouraged me to listen to the Beatles and Rolling Stones. One of my pupils was Michael Karoli, later guitarist with Can. Together we experimented with a kind of swing music on our electric guitars."

"Shortly after, I attended a rock concert with Tony Eshen and we agreed (when he was rather





Holger Czukay in his home studio.

drunk!) to start an experimental rock group together. I quit my teaching job and eventually joined with Can.

"My first album was Canaxis 5 (not available now, originally made on a private label: Music Factory). It sold very well and even then I took music from many parts of the world; Vietnam, Asia, Africa, Australia, using the radio to collect a lot of the extracts. I mixed the completed tape recordings with European music, e.g. choral music using tape loops.

"Recordings were monaural and were made in the West German radio station at night when nobody was there. Now, 20 years later, I can admit that I took the key without permission and went into Stockhausen's studio after he had left, to work through the night on my music. I really couldn't have done my composing any other way at the time. The basic equipment consisted of three tape recorders that were used to record sounds and tape loops from which two or three layers were built up."

**Are you working from a structured composition or just experimenting when you collect your taped sounds?**

"The planning beforehand is not so important for me. I feel more like a dog who follows his nose — you think about it very strongly and then you make your decision. There's a logic in the music whatever you do and one step requires another one. If you have these thousands of steps you have to balance them with each other, and this balancing comes from the decision you make.

"Whenever you are doing this editing, you obviously come nearer to the end of the piece, but you can change one step and a whole series of steps then will need restructuring. That's how my music is produced and that's perhaps why other people call it 'magic'."

## Movies LP

*We discussed the excitement of this album through its polyphony of sounds (melodic, noise orientated electronic and natural) that Holger wanted to use. In many ways he was referring back to this early style of composition.*

*[Polyphony — layers of sound that weave their individual, distinctive melodies and are perceived horizontally rather than as vertical lines of chord harmony. Analysis of polyphonic music also shows*

*that the vertical chord structures are still present within the flow of the melodies. Originally applied to 16th century vocal music, it later was applied to instrumental music such as J. S. Bach, Fugues, and in modern classical music an example is the final part of Benjamin Britten's 'Young Persons Guide to the Orchestra'. No doubt the term will be used increasingly in electro-music as the micro-computer becomes part of the New Music.]*

"There is a common relationship between all music wherever it comes from — that includes even the most primitive music from Africa, Thailand, in the jungle, in the rice fields, where I heard a blind man playing his own handmade primitive instruments and participated with him in his music. The media makes it possible to bring them together. You feel the excitement yourself when you find out how they work together, and that is the first experience you have.

"The 'Movies' Album has been successful for me — not taking over like a hit, it's a long term thing. I don't want things to grow too quickly. The money helped to balance everything out to have a modest bachelor life — I'm happy with that, I don't want more."

## Holger Czukay



Do you have a special reason for the title of your new album 'On the way to the Peak of Normal'?

"You see, I was considered to be a 'flipped-out' man, making this kind of extravagant music, and I thought, OK, if people think that it is all flipped-out then make this flipped-out thing so normal that everybody thinks that it is just ordinary! It's like a medicine that tastes good and then after a while begins to have an effect on you. Incidentally, I believe music has become more and more of a therapy today."

Although you like to use recording tape as the medium for your music, do you perform it live?

"I wouldn't like to reproduce something that you listen to on record — that is somehow unfair. When I first completed this latest record, EMI were very slow to accept it."

### Composing

"I am working in three studios at the same time. Everything starts in my own studio — it's a simple 2-track studio with very old machines. I've been using the Telefunken M10 which I consider to be one of the best machines ever constructed! It's a Rolls Royce recorder, with just two speeds, but it weighs a ton. I have also been fascinated by the old valve radios and tape recorders that are almost impossible to obtain these days and found the source of supply in the basement of a local undertakers shop!"

How did you make movies?

"Just with an old Studer B62 tape recorder and plenty of tape editing. I think the quality was still really good — it was actually worked out on a 16-track, but the first steps were done on the Studer."

"The first thing is that you have to somehow compose a piece. So I'll take my guitar and play something — nothing in particular, and then you get on with it and by editing just this guitar music — picking out a rhythm or riff — that's how I often begin. 'Ode to Perfume' started this way."

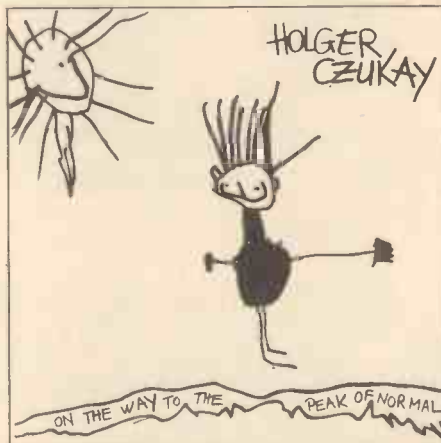
"It takes me two months to play a guitar which doesn't do anything, yet has everything in it. It is a real cooled down atomic power station which is completely quiet in itself. Every note gives me information about the overall sound. That is the reason why these first guitar recordings take such time and concentration."

Can you now manage on your income from your records to work as a professional musician?

"Oh yes, that exactly — nothing else. I've had to have a low standard of living — but I'm a man with a strong will to succeed!"

"So my studio now has just one Revox tape recorder, and I don't even use my little mixer any more. You must avoid everything that might impose on the signal — that is the first step. Whatever you do — don't mix sounds at this stage — just put one thing on tape at a time. I then put these separate tape extracts on the 16-track at the Can Inner Space studio and start picking them out alone. When it's all recorded and erased: that's the biggest problem — how to erase something! In all the tracks are 'holes', all the time."

"It is not only the tapes that are available for me to use, for they are not so important, actually. What is important is the balance between me playing as a musician, using the studio as a whole 'instrument', and not as something that I use. The mixer is



Holger's latest LP 'On the way to the peak of normal' EMI EMC 3394.

also the same; every screw in it for me is a living being and that's how I treat it. I've built it up myself and therefore I want to be completely into it and this 'balance' between me as a musician and something that I don't know. This 'something' is the radio, some 20 metres in the background of the studio. I would sit there for a complete hour in complete quiet, having the 16-track tape recorder and mixer in front of me, and, of course, all the parts of the music in my mind. Suddenly, something comes over the radio and I run on the tape recorder and begin to synchronise something, using varispeed if necessary. That means if you listen later to the direct recording off the radio and, let's say, 'Persian Love' you just wouldn't recognise it at all."

Do you fill your track with long sections of music that can be faded in or out in the final mix?

"No — you see, the musical decisions have to be made right away, that's the thing. In the second you make the music spontaneously — that's where you must make the decision and not just fill up the tracks and say 'let's see what comes out later'."

"By the way, this is a criticism of the later Can albums that I made. At the beginning we simply recorded on stereo machines and this forced the group to make something right away. But when we got the 16-track everybody said let's play and make the decisions later. That was the end of the Group!"

So you come into the Can studio with a tape and nothing else?

"Just one tape — this is the piece actually, not the worked out piece, but the horizontal 'layers' lasting about 18 minutes, where the composition is completely compressed into the melodies and harmonies played on the guitar only."

"So the whole instrumentation of the piece comes from the extraordinary facilities at the Can Studio: the radio, instruments, synths, and so on. The guitar music I produced was sufficient for me to know that I had a piece ready to work on."

### Peak of Normal LP

"The first track title 'Ode to Perfume' came from an evening spent with a rather strongly perfumed girl! My flat is right in the centre of Cologne, a very noisy area. What is quite rare is that I am living here

like an ordinary person with a lot of contacts who may meet me in public — at the cafes etc., but talking to every musician I can, and then going back to my flat and switching off the telephone, doorbell and cutting myself right off from anyone."

"I have been using drum machines in the past, but they are in fact being replaced more and more by acoustic instruments. 'On the Way...' has a drum machine rhythm (from an old Crumar organ) that was treated in different ways, such as through a Leslie Cabinet."

"The way I record is important. It's a kind of 'classical' stereo recording (so called middle-side stereo MS stereophony). There are three different types of stereo: AB, XY, and MS. In the Can Studio are two fixed microphones that remain in place during the months spent recording. These mics are switched via a 'sum and difference' transformer creating A+B and A-B signals."

"All my recordings are made in stereo and therefore I have only 8 layers to mix down finally on the 16-track mixer. I make great use of the instrument positions in the studio and this means that all the sounds have the same ambience — that is very important. I found that if you mixed different room ambiances on mixdown, a detrimental effect often occurred, with a peculiar final background. All tapes are also played through this system — even the opening guitar is re-recorded, actually on 4 channels."

"I have been thinking a lot about phase correlation of mics and the way sound waves disperse from a source in a concentric fashion — I measure my distances carefully and that is why I don't need to use much treatment from 'artificial stereo polishers' — digital echo units and so on. My procedure is to strictly calibrate the positioning of the units — it's an old method that's very typical of Germany. Our radio broadcasts of orchestras tend to use a centralised minimum stereo mic arrangement, whereas in America individual mics are used and mixed down later. I believe it is better to make use of the sound and acoustics present at the time of recording."

"Coming back to drums, Jäki Liebezzeit is able to complement rhythmically my musical ideas and that's really why I've moved away from machines. On 'Persian Love' (Movies LP), Jäki worked for three days until he was feeling the music. We then slowed down the music tapes to half speed for the whole of this track while we added other lines, including drums. I often use this method for parts of my pieces."

"I use the Korg Vocoder in 'Ode to Perfume' to use my voice as a sort of vocal interpretation of the almost infinite variations of perfumes. The voice has to be used in such a delicate way, and the whole sound system right to the monitor systems plays its role. I also use the Leslie to rotate the voice sounds. There is only one layer of the Vocoder at any time."

"The mixing is done extremely carefully by making strict decisions at the very moments you work with the music and completely erasing specific parts in a way that makes no turning back!" I found 'Peak of Normal' to be an interesting example of the vocoder's use. There is also the jazz influence, with offbeat rhythms and riffs."

"That's so simple you know, played many many times, the impact is the wave or vibration that shows the kind of person you are. I use the Fender





Jazz Bass and Fender Stratocaster for bass and main guitar parts. The bass line holds the music together and is done mostly without a plectrum, although there are some occasions where I use it with damped strings for special percussive effects. It is a very old-fashioned bass line, just summing up the harmony of the whole music, that's all."

**Referring to the Harmony, I hear root notes with chords that climb up to the climaxes . . .**

"But most of the time, the harmony is the result of the polyphonic music. In terms of sound layers, the bass is one of the last things I put on.

"In 'Ode to Perfume', the drums were only used when Jaki heard the vibrating guitar, because I wanted him to feel it, so it was a test for him. He thought the result was very bad but when I tried it again he could not do it the same, and of course, I had recorded his first attempt without him knowing — that's why the drums fit the music perfectly. There's the special quality of the moment.

"I do all the vocals myself and the French horn is done by experimenting just once, so the recording is done very quickly. I also use a Lotus flute (a short tube with a recorder mouthpiece and a moving base to change pitch) and the mouthorgan. Jaki also has a large collection of instruments, not only percussion, from all over the world, many of which he brings to the studios for us both to use.

"As for structuring the pieces, the guitar imposes the climaxes so much that you have to follow them through in the music. I have no real restriction on studio time at the Can Studio, and so I keep on until I have got what I want — it would be impossible to do this kind of music any other way.

"Music is an experience of time. I mean, the time flows in a condensed way. You are, I think not a good musician if you don't know how to feel responsible for every micro-second of the music. That means that you have the 'balance' feeling for minute no. 5 until minute so and so, and this must all be 'in harmony'. Of necessity, I too always have to come back to traditional music for much of my composing techniques.

"Nevertheless, there is another side. For example, the group Public Image, which I consider very highly, have not studied music as far as I know and have showed me that I still have to take their music very seriously. You can feel that these people have made very strict decisions and reduced their music to the minimum, removing all that is unnecessary. They are different to the freaks who put all the gimmicks in and say 'how good I am' and who will be forgotten tomorrow as a result. You don't need to have studied classical music, but somehow you have to get that traditional appreciation and awareness of what to do with your music. It all depends how strict you are in your decisions.

"On the first piece 'Ode to Perfume' too, I sometimes use tape reversal, i.e. recording the usual way and then playing it back by turning the tape in the other direction — it may only be a centimetre long!

"There are thousands of edits in my albums — I did 'Movies' with a minimum of 50,000 edits! — all

cut on the splice block. Now you know why it takes two years constantly working.

"The positions of the tape joins are very important — you have to find the 'magic' points. I use mostly 30° splices and that's the point — where do you put your cut in? Usually editing is done by saying this part's not good, so we'll take it out etc., but that is a very primitive way of editing. No, what I'm looking for are the 'magic' points: 'Where can I put the scissors on, in both parts, and join them together so that they fit musically together. 'Hiss'N'Listen' uses 8 mixers into 1 and I edited the tapes in a way that seems to me musically logical.

"Listen, for example, to the drums in every piece of mine — they are never constant; they are forward, tape reversed, with sudden crescendos and diminuendos, disappearing suddenly — every instrument is changing all the time and the only constant aspect is the room."

## Choosing Titles

"There's one thing here. Of course, English is not my mother tongue. Now you can imagine it's easy for me to use words that I select by listening to in a musical way — not because of their literary meaning. And that's the way I choose my pictorial titles. 'Out of the Fog Bank' originally had a section with vocoder and guitar melody and when I removed part of this, it really seemed to me just like a thick fog.

"'Welcome to the Chorale of the Majestic' is for me so German and hymn-like, (we love to crash in walls by creating sounds — I hope I have enough humour to take it this way but I'm really very serious about it).

"'The Ballad' is the more gentle part. Then 'The Males are Marching in' — is there any significance there? It is just the way I feel when I'm dancing to it. I'm always marching when I listen to 'Ode to Perfume'. The final Chorale is somehow different from the beginning and there's nothing schematic about it, because of the extremely harmonic vocoder sound that dominates it.

"As for my LP cover comments 'Recommended Listening whilst Roller Skating', I'd bought a Sony Walkman and listened to 'Ode to Perfume' at night, and you know, Stockhausen once said, 'You should

listen, Concentrate to music'. I think this is a fantastic invention to do so without having to sit in a concert hall where you can be influenced by the responses of other listeners. I take it into the local forest and the town too, with the heavy traffic of Cologne all round, whilst I'm listening to say African 'water' music, it helps me take in so much more music in a concentrated way.

"The group S.Y.P.H. worked with me on the 'Peak of Normal' tracks. The presence of the radio in the studios made them play quietly and this 'magic' atmosphere interested me very much.

"Later on in the album, the Eventide Clockworks Harmoniser was used more and more. This is for me a new musical instrument — not just an effect — with the glitches actually being used to advantage. I use very little echo and then only carefully. I say 'no effects, please' — if you just use echo because it sounds better, then you can forget it! Of course, I use reverberation, but so controlled and in such harmony with the whole music. The Cemetery Synth Violin came about because Conny Plank said 'This is the melody of 'Les Vampyrettes' from the Pierre Lachesse Cemetery in Paris.'

**You have so much at your fingertips, other musicians might only use their instruments — but your music seems to draw sounds from wherever you choose.**

"And this is only possible when you work completely alone and have every step under your own control. This gives you this feeling of balance.

"In 'Multiplication Table', Jaki had decided the cross rhythms would be as simple as possible, so you can hear the drums in 2, bass and guitar in 3, then the flute in 3 with the voice added on top. By the way, the rhythm comes from low pass filtered drum machine and then panned, plus real maracas on top.

"The 'Two Bass Shuffle' was a very spontaneous thing done at home. I just put it on a cassette recorder and then transferred it to 7½ inch tape, adding a double bass with it. Once again the music is conceived thinking horizontally, never as vertical chords.

"The 'Hiss'N'Listen' has reminiscences of my youth — then I felt I would live in a place like I have today, but with one difference — I thought I would be married, having children, everything perfect (and Holger is now turning the knobs and making music over radar). That's somehow how I had my idea, but I really couldn't stand being married!

"The radio in 'Hiss'N'Listen' is most important in the piece even though it came later in the composing of the music. There's a point where I felt the radio should be there — it's like having a special kind of nose — it's the radar principle of switching in a micro-second from transmitter to receiver. As the musician you are a radar station — you have to listen and you have to give something. Somehow both don't go together in a perfect way easily, you have to learn it.

"That is the only professional aspect that I say is important being a musician — you must be able to listen to something and then reduce your playing so that your listening is not getting disturbed. I know how difficult that is and that is why I say I will train until I die."

**Do you want a studio with all the effects and computer control?**

"Nothing — I want to carry on as simply as I can because the technical development is very fascinating, but somehow so far people are forced only to use it and not celebrate it. They do not have an inner relationship with the whole thing and I say, let's learn from the under-developed countries, as we call them so easily. Learn how these people manage with the lowest technology you can imagine — and the fascinating way they do it. One example is Lee Perry, a Jamaican hero of mine, who shows that if you've got the 'magic' in your music, because you are this kind of musician, you'll make it even with a stone!

E&MM

Mike Beecher

## DISCOGRAPHY

HOLGER CZUKAY	"On The Way to The Peak of Normal"	EMI EMC 3394
HOLGER CZUKAY, JAH WOBBLER, JAKI LIEBEZEIT	12" Maxi EP: "How Much Are They?" "Where's The Money?" "Trench Warfare" "Twilight World"	
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Lowrey MX-1 review ★ Apple  
Music System ★ Matinée ★  
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Vorhaus ★ Matinée

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Keyboard Controller ★ Synwave  
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### 1982

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A-8 8-track Recorder, Tokai ST50  
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Music ★ Projects: Digital Delay  
Effects Unit, Spectrum Synth,  
Percussion Sound Generator  
★ Resonant Filters

**MARCH** Klaus Schulze ★ Robert  
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124AV, Wersi Comet, Hamer  
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Power 200 Speakers, 1.6 sec Digital  
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League in the Studio ★ Cardiff  
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★ Reverberation explained ★  
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Synthesiser, Fostex 350 Mixer,  
Roland TB-303 Bass Line  
Sequencer ★ Projects: MF1 Sync  
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# Moog Source Moog Rogue

Two rather interesting products this month, both from Moog Music Inc, the company that really started it all in the late Sixties and early Seventies. Technology has moved on quite a bit since those early days, but if you look closely at these two synthesisers, they still have a great deal of similarity with the Minimoog, the first real performance synthesiser, that appeared in 1971.

The Source is Moog's top line monophonic, and its design is unlike that of any other synthesiser (with the possible exception of New England Digital's Synclavier systems). Instead of having banks of control knobs and switches, Moog have utilised a device known as an Incrementor. This is the large control knob located just above the performance control wheels, and is attached to a flywheel as can be seen from the internal shot. Also mounted on the same spindle is a spectroscopic disc — a clear plastic film, with a hundred or so 'spokes' drawn on it. A sensor is positioned alongside this disc, so that every time the Incrementor control knob is moved, the sensor generates a number of pulses corresponding to the number of spokes that have passed through its 'beam', and hence the amount the control has been rotated has been accurately translated to a digital signal from which the Source's microcomputer can set to work.

Okay, so you have this very pleasing control medium, which will rotate as many times as you wish, and that has a pleasing, substantial feel to it, thanks to the inertia of the heavy flywheel, but how do you use it to control all the various parameters of a synthesiser? Moog use an interesting system, that relies heavily on almost 70 membrane switches. The Source's control panel looks quite amazing, it is arranged in a fairly standard configuration with oscillator, modulation, mixer, filter, envelope, and VCA sections; but there are no control knobs — just a graphics set in an attractive and colourful "easy-wipe-clean" plastic film. To control a sound, you first select a program from the instruments' memory banks, and then proceed to tailor it to your own particular requirements, by selecting a parameter using the touch panel, and then modifying or editing it using the incrementor. A positive benefit from using this system has been capitalised by Moog; just above the Incrementor control knob is a dual seven segment LED display which reads out the value (from 0-99) of the parameter being varied, so the Source is a very precise instrument in terms of control. Not all the parameters are fully variable, for example the footage selection is done simply by touching the appropriate part of the control panel — the footage of an oscillator is either 16', 8' or 4' — there's nothing to increment.

## The Source's Voice Circuitry

The Source is a monophonic dual oscillator synth, each oscillator generating three waveshapes — ramp, sawtooth, and pulse, the latter is width variable using the



The Moog Source synthesiser.

Incrementor, but without a modulation Source. Incidentally, all parameters that can be varied using the Incrementor are set in yellow, and those just switchable in light blue (a bit silly as the background to these graphics is also blue, though a little darker), and of course in a black and white photo it is almost impossible to distinguish between light blue and yellow! As previously mentioned, the oscillators can be set at 16', 8', or 4', and there is of course an Interval control that enables you to set Oscillator 2 at any pitch with respect to Oscillator 1. Moog have used their skill here, as the Incrementor control can be set to give an accurate setting of the Interval. When the display reads 0, the two oscillators are in tune, and by the time the figures read 49, Oscillator 2 is one octave up, and at 98 it is exactly two octaves above its start position, but to get it there, we've had to turn the Incrementor control round a full 28 times! So in effect we are using a 28 turn pot for tuning Oscillator 2. Finally, with respect to the oscillators, there is a syncing facility, whereby Oscillator 2 is synced to Oscillator 1, and the pitchbend performance wheel bends just Oscillator 2, making it more of a high powered tone control. Each oscillator has a separate output level control facility and there is also provision to mix in at this stage the desired amounts of white noise.

The filter is almost identical to that found in the Minimoog — using the dual ladder system, and this imparts that typical warm

colour to the overall sound of the instrument. Cut-off, Emphasis, and Contour (envelope) Amount are the variables here, and OFF/HALF/FULL are the switchable selection for determining how the filter tracks the keyboard. The tuning of the filter is remarkably good — even when putting it into oscillation and modulating it with the filter ADSR envelope — a practice that generally destroys any semblance of tuning.

There is a second ADSR envelope for use with the VCA, and both sets of envelopes are, of course, fully variable using the Incrementor.

The modulation section is fairly basic — a single LFO provides either a sawtooth or a square waveform which can be routed via the performance modulation wheel to either the VCOs, the filter, or both. The only variable in this section is the modulation rate, and I'm glad to see that Moog have inserted an LED above the modulation wheel to relay the speed at which the LFO is running.

The final section that relates directly to the voice circuitry is the keyboard controller and portamento facilities. The keyboard can either be operated in single or multiple trigger mode which is surprisingly handy, but even more useful is glide facility, which relies on the Incrementor to determine its rate, so you get a digital readout of the slew rate which enables the player to accurately determine exactly when the note is going to reach its destination — it takes a bit of practice to get right, but once mastered it is a



The Moog Rogue synthesiser.



# Rod Argent's Keyboards

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## MOOG SOURCE

The Source, from Moog Music Inc, is a microprocessor controlled monophonic, and illustrates a new concept in synthesizer design. Moog have developed a touch panel in order to eliminate banks of knobs and switches, which used to select a certain parameter of the sound; this area can then be modified, using a controller known as an Incrementor. In this way sounds can be accurately programmed into the Source's memory banks. Other features include 2 VCOs, Moog's patented low pass VCF, 2 x ADSR envelopes, VCA, performance wheels, a 3 octave keyboard, a sequencer with up to 176 notes of memory, and an arpeggiator. Truly a remarkable machine both in appearance and performance.

**ARGENTS PRICE £662**

## MOOG ROGUE

Moog's Rogue is a monophonic offering a wide range of facilities at an unbelievably low price. The instrument is equipped with 2 x VCOs, which can be overdriven to give inter-modulation effects, a noise source, low pass VCF, keyed and contoured (ADS) envelopes, and VCA. The Rogue incorporates triangle, square, and even random modulation, and of course there are the famous Moog performance wheel controllers.

**ARGENTS PRICE £223**



## MOOG OPUS 3

The Opus 3 is a polyphonic ensemble producing String, Organ and Brass Voicings, either individually, or in combination. The tonal characteristics of the Opus is quite remarkable, employing as it does, much of Moog's filtering technology. A chorus unit is provided for enhancing the Strings and Organ sounds, and the Organ section also features five sliders for mixing footages. The Brass and Strings have independent attack and decay contours which can be used to great aural effect when layering sounds. All in all the Opus 3 gives you an orchestra at your fingertips.

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worthy bonus of the Incrementation system.

The performance control wheels sit to the left of the keyboard, and operate in the usual proficient manner — but above them are two key-push buttons, like those found on alphanumeric keyboards, which are used to transpose the Source up an octave. These are really great to use as it makes it extremely easy to transpose up an octave in a fraction of a second, and as Moog have stuck them so close to the performance wheels, one's left hand is generally hovering over them, so this really is a case when the transpose button does effectively add another octave to the keyboard.

There are 16 touch pads situated just above the keyboard; these operate in two levels — first, there are the selectors for the 16 program memories, and in Level 2 they operate the sequencer, arpeggiator, automatic triggering, sample and hold and cassette interface. The sequencer will record two 88-note real time sequences with transpose facilities, with the rate controlled by the LFO. A nice feature about this sequencer is that you can load program changes during the course of the pattern. The arpeggiator is also rather interesting in the way it is programmed and it can store up to 24 notes. To load it, you simply play the desired pattern and end it with the first note you played. The Source then instantly replays the programmed line at the LFO's clock rate. You'd be amazed how useful this facility is — especially if you are as cack-handed as yours truly.

On the rear panel there isn't too much: CV and Trigs in and out, a cassette DIN link, audio out, a Europlug mains socket, and a fine tune control. It would have been nice to have had a foot release switch and portamento switch facilities, but most people will survive without them.

I think that the Source looks great, and it is remarkably small and light, but I think it certainly looks the part with the 'colourful', though not gaudy control panel, and smart brushed aluminium casework, complete with wooden facings. The keyboard, three octaves C to C, is a pleasure to play, and incidentally it uses metal strips instead of the old J-wire system of contacts. Inside the instrument things are much tidier than the photograph would suggest. Everything is socketed and most of the wiring utilises ribbon cables. There are three main control boards — the power supply which at over 2 amps is surprisingly hefty, the microprocessor board, and the voice board. No circuitry is directly mounted on to the switch panel, which forms a sealed unit with two ribbons leading off from it. All in all it's a very nice piece of design work, and with next to no moving parts the servicing required by the Source should be minimal.

## Playing the Source

Again, I've spoken to several people with respect to using the Source, and the opinions I've received have been mixed. The touch panel and the LED readout is generally great to use, however, one main drawback is that you cannot tell at a glance the relative settings of all the parameters, and what is worse, the settings of the switchable pads can only be determined by listening to the sound being produced. This is fine if you are in a studio, but live! I suppose that you will have loaded up the sounds you want in the programmer, but even so... My major criticism with the Source lies with the doubling up of the control switches to two levels. It is a nightmare to operate the Source in level 2 as it keeps reverting to level 1 and you don't know where you are. For goodness

sake next time don't try and save those extra few pennies you guys at Moog, and put in separate control switches.

I can't really fault the sound quality of the Source, save that the tuning is out for the first five to ten minutes of operation — then it's fine. At £895 it is an expensive synthesiser, but it certainly is a brave attempt by Moog to do something new, and they've got three-quarters of the way there to producing a really revolutionary product.

The Rogue is quite a different kettle of fish — basically because it is cheap, i.e. £318, but I'm sure that if you pop down to your local Moog stockist clutching crisp brown £20 notes (are they brown? it's been so long since I've seen one) that they'll let you have one somewhat cheaper.

For some reason Moog have stopped making the Prodigy, which was great, and sold in its thousands. The Rogue (to rhyme with Moog) is a budget version of the Prodigy, though because of fluctuations in the value of the pound it looks like it is going to be more expensive, or at least the same price as the Prodigy.



Internal view of the Source.

The first thing to realise about the Rogue is that it doesn't have a complete built-in power supply. Moog present you with a little white box that houses an AC adaptor which feeds 24 volts AC to the instrument via a rather flimsy and suspect looking mini-jack socket. So rather cleverly, Moog can sell exactly the same product in both the US and Europe by just including a different adaptor. However, this kind of adaptor is really messy to have kicking around on stage, and I would have much preferred to have seen a Europlug mains socket on the Rogue's back panel.

The Rogue has a 2½ octave F to C keyboard which feels okay, but obviously is of comparable quality to that found on the Source. One aspect of the Rogue's design is that nearly all the circuitry is mounted on a board behind the front panel, and to make the instrument both simpler to construct and physically smaller the two performance control wheels have been shifted up above the keyboard, rather like the Opus 3's wheel. When I first saw photos of the Rogue I thought that this was too much of a compromise — but after having played the Rogue for a short while I found this positioning quite acceptable, and in fact one's left hand is closer to the rest of the controls for those quick changes.

There are, however, one or two aspects of the Rogue's design that I am less happy about. The Rogue is a dual oscillator synth with two free running VCOs, but both oscillators share the same octave and waveform switches — if you set VCO 1 at 32', then VCO 2 is set at 32'; if you want VCO 1 to produce a sawtooth wave, then VCO 2 must also produce a sawtooth wave. Would it have cost that much extra to have had separate toggle switches for each oscillator? I should

mention though, that VCO 2 does have an Interval control which does allow for independent frequency shift of up to an octave, but this system is still restrictive. There are two positions to the waveform switch — sawtooth and rectangular; in the latter position VCO 1 produces a square wave, and VCO 2 a pulse wave.

Three sliders are used to mix the signals from the oscillators and a noise source. On the control panel there is a section of these sliders marked overdrive, which, I venture, is supposed to introduce some form of intermodulation or harmonic distortion to that particular signal — I tried three different machines, and I could only just detect, aurally, a tiny amount of distortion. With an oscilloscope it was possible to find about 10% of the sawtooth waveforms being clipped on the output of the mixer summer, so I would suggest to Moog that they beef up this stage if they are going to put overdrive markings on the front panel. It is a good idea, though.

The Rogue may be a low-cost synth, but it does have oscillator synchronisation, which can't be bad. Oscillator 2 can be synced to Oscillator 1, and it can either be a contoured synchronisation, whence Oscillator 2 is swept by the envelope generator; or continuous, when the pitchbend wheel is used to vary just Oscillator 2 as with the Source. This is an important facility to have on a synthesiser, and one that isn't too common on the lower priced machines.

The voltage controlled filter is, of course, a 24dB/octave low pass type. However, it hasn't the characteristics that produce the typical Moog sound. Instead, the tonal colouration is much harsher and abrasive, but this isn't a bad thing as it does give the Rogue a powerful brassy sound. Cut-off frequency, Emphasis (resonance) and Contour Amount controls are all sliders, whereas the keyboard track facility is a rotary pot — strange. The envelope generator is of the AD type, though a toggle switch will transform this into an AR envelope by switching the sustain level from zero to maximum. This envelope is used to modulate the VCF, whilst for the VCA there are three options: Hold — which simply turns the VCA on; Keyed, which takes the gate pulse from the keyboard and uses that to modulate the VCA; and Contoured, which uses the AD/AR envelope. Simple but effective.

The LFO puts out triangle, square and random waveforms at frequencies varying from 0.3 to 30 Hz via the modulation wheel, and can be used to modulate the oscillators and/or the filters as necessary. An Auto Trigger function also enables the envelope generator to be fired by the LFO.

On the rear panel Moog have fitted CV (1 volt per octave) and Trigger Ins and Outs, using stereo jack sockets, which is unusual, and offer both V-triggering (using a voltage pulse between 3 and 10 volts) and S-triggering (the system used on Moog's earlier machines whereby the terminal is, shorted to earth potential). An audio Out socket is present (just as well) and an audio In feeds any line level signal into the VCF for limited processing.

Overall I like the Moog Rogue, in fact the name is rather appropriate — it has got its faults and weaknesses, which on a lesser machine would be quite damning, but because it is simple and easy to play, and it really is easy, and because it has a good pokey sound characteristic, that is widely variable, I can recommend this synthesiser to the non-pro player.



# KEYBOARD

Beyond the normal gamut of synthesisers, listed in the last buyers' guide, are the next two most important keyboard instruments for the modern player: the electric or electronic piano, and the preset string synthesiser. Once again, there are many varied types to choose from, as you will see from our listing — you can get a kit that you'll have to assemble yourselves, or you can pay a lot of money for a real top-line job, in both areas. Or you can go for something in between. Our advice, as ever, is

to make sure that you get plenty of demos of the various instruments in your price range before committing yourself, and get as many opinions — as diverse as possible — from fellow musicians.

To guide you and your purse through the myriad collection of keyboards that, next to synths, often come under the generic heading 'other keyboards', we've split this month's buyers guide into the two relevant bits: one headed 'Electric and

## ELECTRIC PIANOS

<b>ARMON</b>		
CBL Musical Instruments Ltd, 163 High Street, Staines, Middlesex. 0784 52471.		
Armonpiano II	5oct C-C	299.00
Superpiano	6oct F-F	395.00
Superpiano	+ cabinet	595.00
Compact	5 oct	239.00
<b>CLEF</b>		
Clef Products (Electronics) Ltd, 44a Bramhall Lane South, Bramhall, Stockport, Cheshire SK7 1AH. 061-439 3297.		
Domestic 'furniture style'	7¼oct	675.00
Complete kit	(inc cabinet) of above	399.90
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Sovereign Organs Ltd, Unit 1, Coppice Side Industrial Estate, Brownhills, West Midlands WS8 7EX.		
Montreal		294.00
EM61		331.00
<b>ELVINS</b>		
Elvins Electronic Musical Instruments, 40a Dalston Lane, London E8. 01-986 8455.		
TS55 Stage	5oct	537.00
TS55T Stage	5oct Teak finish	579.00
TS55L Stage	5oct Teak amp + speaker	647.00
TS66T Stage	6oct Teak	737.00
TS66L Stage	6oct Teak amp + speaker	822.00
<b>H/H</b>		
H/H Electronic, Viking Way, Bar Hill, Cambridge CB3 8EL. 0954 81140.		
P73	5oct	1187.14
<b>HÖHNER</b>		
M Höhner Ltd, 39-45 Coldharbour Lane, London SE5 9NR. 01-733 4411.		
Pianet T		265.00
Clavinet E7		325.00
Duo (Pianet/Clavinet)		495.00
Legs for either of above instruments		57.50
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<b>KAWAI</b>		
Arthur Butler & Co Ltd, Maple Chambers, St Peter's Road, Bournemouth.		
EP308	7¼oct	2995.00
EP308S hand built, transparent	7¼oct	7850.00
<b>KORG</b>		
Rose-Morris & Co Ltd, 32-34 Gordon House Road, London NW5 1NE. 01-267 5151.		
LP10	5oct	425.00
<b>RHODES</b>		
CBS/Arbiter Ltd, Fender House, Centenary Estate, Jeffreys Road, Brimsdown, Enfield, Middlesex. 01-805 8555.		
Stage 54		790.26
Stage 73		944.14
Stage 88		1193.69
Suitcase 73 top		863.03
Suitcase 88 top		1019.00
Suitcase enclosure		586.44
<b>ROLAND</b>		
Roland (UK) Ltd, Unit 6, Great West Trading Estate, Great West Road, Brentford, Middlesex TW8 9DN. 01-568 4578.		
MP600	5¼oct	699.00
HP60	5oct	499.00
HP70	6¼oct + chorus	599.00
Piano Plus 11	5oct + rhythms	345.00
Piano Plus 30	5oct + arpeggio	299.00
<b>TEISCO</b>		
John Hornby Skewes & Co Ltd, Salem House, Garforth, Leeds LS25 1PX. 0532 865381.		
PRO5 Piano	5oct C-C	199.00
T77	5oct C-C	399.00
<b>WERSI</b>		
Aura Sounds Ltd, 14/15 Royal Oak Centre, Brighton Road, Purley, Surrey. 01-668 9733. Also Electro-Voice, Maple Cross Industrial Estate, Denham Way, Rickmansworth, Herts. 09237 75381.		
Pianostar T	6oct, various voices and effects	1917.00
Pianostar T kit	As above	1115.00
Pianostar S	7oct, various voices and effects	1977.00
Pianostar S kit	As above	1197.00





# BUYERS GUIDE

Electronic Pianos', the other 'Preset String Synths+'. The little plus on the end of string synths is there because we've included some combination keyboards where necessary.

All the prices are INCLUSIVE OF VAT, and were correct at press time as recommended retail figures. We suggest that you check with the distributor listed for current bargains. Our descriptions are necessarily brief, but once again you'll

find the distributors helpful for more info. Please remember it helps us if you mention E&MM when making enquiries.

## ABBREVIATIONS USED

approx — approximately; avail — available; br — brass; oct — octave; org — organ; polysynth — polyphonic synthesiser section; spkr — speaker; str — strings.

### WURLITZER

Wurlitzer UK Ltd, Parkgate Industrial Estate, Knutsford, Cheshire WA16 8DU.  
0565 52621/2.

EP200A Mains	735.00
EP200B Battery-operated	735.00

### YAMAHA

Yamaha Musical Instruments, Mount Avenue, Bletchley, Milton Keynes MK1 1JE.  
0908 71771.

CP10	5oct	389.00
CP11	5oct spkr/rhythms avail May/June	429.00 approx
CP20	5oct, 4 voices	899.00
CP25	5oct, flanger etc avail May/June	1279.00 approx
CP30	6½oct, 3 voices	1299.00
CP35	6oct avail May/June	1679.00 approx
CP70B	6oct electric grand	3699.00
CP80	7½oct electric grand	3949.00

## STRING SYNTH+

### CLEF

Clef Products (Electronics) Ltd, 44a Bramhall Lane South, Bramhall, Stockport, Cheshire SK7 1AH. 061-439 3297.

String Ensemble 4oct component kit only	179.00
Casing for above	49.00

### ELKA-ORLA

Elka-Orla UK Ltd, 3-5 Fourth Avenue, Bluebridge Industrial Estate, Halstead, Essex CO9 2SY. 0787 475325.

Twin 61	5oct polysynth/br/str etc	975.00
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### GODWIN

Sisme (UK) Ltd, Wembley Commercial Centre, Unit 3.8, East Lane, Wembley, Middlesex. 01-908 2323.

749 String Concert	4oct	499.00
849 Symphony str/br etc	4oct	599.00

### HOHNER

M Hohner Ltd, 39-45 Coldharbour Lane, London SE5 9NR. 01-733 4411.

Orchestra String Performer	695.00
Legs for above	57.50

### KAWAI

Arthur Butler & Co Ltd, Maple Chambers, St Peter's Road, Boumemouth.

Strings	3oct	565.00
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### KORG

Rose-Morris & Co Ltd, 32-34, Gordon House Road, London NW5 1NE.  
01-267 5151.

Delta polysynth/str	4oct	775.00
Lambda br/org/str etc	4oct	1199.00
Micropreset br/str etc		320.00

### MOOG

11 Forth Wynd, Port Seton, East Lothian, Scotland. 0875 812033.

Opus 3 str/org/br	4oct	POA
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### PHONOSONICS

Phonosonics, 22 High Street, Sidcup, Kent DA14 6EH. 01-302 6184.

SET77 String Ensemble kit	214.47
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### POWERTRAN

Powertran Electronics, Portway Industrial Estate, Andover, Hants SP10 3WW.  
0264 64455.

Transcendent DPX	5oct str/br etc	339.25
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### ROLAND

Roland (UK) Ltd, Unit 6, Great West Trading Estate, Great West Road, Brentford, Middlesex TW8 9DN. 01-568 4578.

RS09 org/str	3½oct	525.00
VP330 Vocoder/str	4oct	1299.00

### TEISCO

John Hornby Skewes & Co Ltd, Salem House, Garforth, Leeds LS25 1PX.  
0532 865381.

EX300 strings	4oct C-C	649.00
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### YAMAHA

Yamaha Musical Instruments, Mount Avenue, Bletchley, Milton Keynes MK1 1JE.  
0908 71771.

SK10 org/str/br	4oct	429.00
SK15 polysynth/org/str avail May/June		749.00 approx
SK20 org/str etc		1089.00
SK30 org/str etc	5oct	2069.00
SK50D org/str etc	2x5oct	2799.00



# SOUND ON STAGE

## PA — An Introductory Appraisal

Part 5

Although instrument amplifiers and drumkits are inherently loud, the energy of music is readily depleted in cavernous halls and outdoors. However much the guitarist, bassist and keyboard player augment their amplification, a good, if sweaty drummer can only (phew!) consistently generate sound pressure levels (SPLs) of around 130dB(A) at 1 metre. This figure implies around 10 to 20 watts of acoustic power, which is in turn equivalent to 100 to 1000 watts of amplified drumkit, using speakers of 5% to 10% efficiency. Bearing in mind that we have to raise our power at least *threefold* (and preferably *tenfold*) to produce an audible intensification of SPL, it's clear that auxiliary power amplification (or PA) for drumkits alone demands a bare minimum of 300 watts of amplifier power; with less power, the drums *per se* will be as loud — or louder — than the PA!

As soon as we add other instruments, our minimum power requirements inflate, though these will be modified according to the efficiency and dispersion properties of the speakers. Unfortunately, it's considered chic for all up-and-coming bands to shove everything through the PA. Yet with a little hindsight it's clear that in the majority of cases where the PA is used as a tool in small venues, only the kick drum and vocals need share the sound system's facilities. And the fewer the instruments we mix together and attempt to reproduce as a unity, the less the *intermodulation distortion*: The spurious and obnoxious interaction of 'chord' formations between notes emanating from different instruments. Following this line of thought, a novel PA wouldn't *mix* the instruments, rather it would comprise a number of discrete sound systems with the speakers being tailored to each instrument.

Returning to convention, to mic up a three piece band with two vocalists 1 to 2kW is a ballpark minimum; with less power, the PA is not only contributing little to the overall SPL, but is also likely to muddy the sound (intermodulation again . . .) and alienate the audience. Bad PA's then can have ironic and destructive results. At the other extreme, it's apparent that good music, *cleanly amplified* has unexplored physical limitations. In other words, the pursuit of 140dB peak SPL's and corresponding PA megawattage isn't inherently senseless, dangerous or masochistic. Indeed, possibly the opposite. The experience of cleanly reproduced music at levels above 130dB (theoretically beyond the pain threshold), particularly when presented in harmonious environments along the lines of the Glastonbury Fayre is commonly considered to lie beyond words, but the many who have deemed it "beautiful" will echo the sentiment "Good music reproduced cleanly can never be loud enough".

But PA is not merely an instrument for ensuring that a large audience can experience majestic emotional intensity or voluptuous Dubb and gain access to the inner space generated by loud electric music: It's also a tool in its own right. In common with all creative people, be they inventors or artists, musicians are relieved to delegate the crude



Jazz-Funk at Glastonbury Fayre 1981.  
Venue: Worthy Farm, Pilton, Glastonbury.  
Date: 11.40 a.m., 21/6/81.  
Sound: Turbosound Ltd 40kW O/F 10k/M  
Lights: Power Leasing 20kW

mechanics — the infrastructure — of performing music on stage to others.

Having a mixing desk outfront and stage monitoring enables musicians to exclusively direct their energies into musical expression, virtuosity and the regulation of higher energies within the music through the medium of themselves and the instrument in their hands; and this aside from the profanities of stage dramatics and stage showmanship, which are also given rein once musicians have relinquished the need to worry about their sound balance as perceived by the audience.

Meanwhile, at the outfront mixing desk, the sound engineer's role is as a translator and balancer, striving to ensure that the music is displayed as a whole in a manner which suits musicians and audience alike. Backstage, the monitor man's task is to ensure that each musician can hear exactly what he needs to hear to play with attunement — often an impossible aim in the context of a loud and improvised set.

Of course, sound systems, like most things are imperfect, yet within their shortcomings lies the opportunity to use the PA as an instrument in its own right. This perverse potential for creativity is something to be explored in forthcoming articles. At the same time, we'll aim to seek out the means of achieving essentially accurate reproduction (*viz. clean sound*) if only because experience suggests that Rock music has the capacity to become greater than the sum of its constituent sounds under these conditions. And in closing, remember that when — as a musician — you invest in a PA, you depend on this instrument to *communicate* with your audience. So it really deserves just as much attention as your Strat's pickup wiring or the brand of drumsticks you choose.

### Y'realtime country orientated scenario

Angus Mac'leod writes from the Isle of Skye as follows:

"I'm a drummer in a country orientated band, seeking advice on how best to set up our gear on stage. The guitarist's set-up consists of an Aria Diamond semi-acoustic amplified by a Sound City 120watt valve amplifier, feeding a 1 x 15" Fane speaker, whilst the bassist uses a Fender copy being amplified by a WEM Dominator 50 watt valve amp driving a 1 x 15" Fane speaker."

On the basis of the information supplied, you need have no worries about the bassist's gear, and the Sound City amp, assuming it's well maintained would be hard to improve upon without expending large sums of money. However, the 15" Fane (indeed, almost any 15" driver) isn't capable of reproducing the upper harmonics of the guitar, and your guitarist should audition some 12" speakers, beginning with the 2 x 12" in your PA; well worn 4 x 12" cabs à la Marshall can often be picked up cheaply, but whatever you choose, be sure to compare it to your 15" Fane to gain a feeling for the direction in which 12" driver(s) will enhance the tonality of the instrument.

"Can you take more than one slave off one slave input and can a slave output be taken off a speaker?"

The multiple slaving (A.K.A. "daisy chaining") of ten or more amplifiers is quite in order, and I hope we can look at subtle aspects of this topic in future editions of E&MM. A more immediate problem is presumably the lack of a 'link out' socket, and if you're not prepared to remedy this by drilling a hole to accommodate a socket, which is simply wired in parallel with the input, then a 'Y' lead is the simplest alternative. This is essentially a Jack to Jack lead with a paralleled line jack socket hanging off one end. If several amplifiers suffer from 'lack of input socket', then a more robust and possibly cheaper cure is to mount a number of chassis jack sockets in a



by Ben Duncan

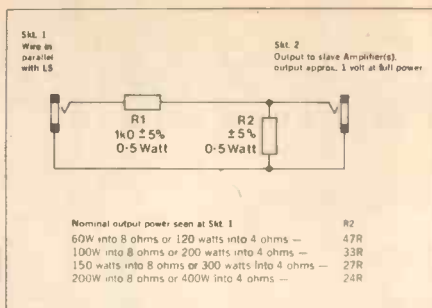


Figure 1. Attenuator for slaving off speaker outputs.

into two 1 x 12" Fane drivers. We have three Shure Unisphere B Mics, an Acoustic guitar with transducer pickup and an accordion with strip mic fitted. What is the best way to get all the instruments and mics into a monitor system as I can't hear the band very well with all the speakers in front of me, and what kind of power monitor system would you advise? Is there any easy way of avoiding feedback from the mics, and what kind of PA to guitar power ratio is necessary for clean vocals?"

Tackling your howlround problems is best begun by scrapping your existing microphones, and looking for vocal microphones with a more uniform frequency response. In order of ascending cost, audition a Calrec CM654D, an Electrovoice PL80 and a Shure SM58. The cost of this improvement in itself will probably approach your budget, but look out for secondhand versions of the above mics, and bear in mind that the upgrading should make a significant difference to the sound levels you achieve on stage, not to mention vocals clarity and quality.

The next task is to relinquish the Selmer amp, because whilst it's a commendable instrument amplifier, it's not likely to make a very good slave amplifier. You could either aim for a cheap 100 watt slave (e.g. Carlsbro M130, Custom Sound 702) or go a step further with an elementary 6 channel mixer (e.g. Canary 6/2, Custom sound 701, MM MP180). In the latter case, you'd attain useful equalisation facilities, which with skillful application would ameliorate the problems of vocals. v. guitars you imply. The problem here is not so much one of power, but of technique — fitting the guitar into gaps in the time-amplitude-frequency dimensions of the vocals, and vice versa. Compare Ronnie Montrose's classic 'Space Station No. 5' with the maladroitness New Wave HM to gain a feeling for the way intelligible vocals can exist amongst the wildest lead guitar. EQ would also give you some control over the feedback threshold in acoustically nasty venues; but best of all, it would enable you to derive a monitor signal, and along with the now abandoned Selmer amplifier and the 1 x 15" driver (ex-your guitarist) you'd have a rudimentary monitoring system to help your drumming. **E&MM**

diecast box. All are wired in parallel, one being connected to the source amplifier, and the others leading to your slave amps.

Deriving line level signals from across your speakers is also in order but do it only if it results in a useful or desirable sound, viz, to amplify the effect of a good valve instrument amplifier. Otherwise, you can expect unnecessary and unpleasant distortion, hum and hiss. The connection is always in parallel and an attenuator (Figure 1) is essential to avoid severe and involuntary overdriving of the succeeding amplifier's input stage.

"Would a graphic equaliser make a worthwhile difference if used with either guitar or accordion? Would a preamp make any difference to the guitars?"

A graphic equaliser would certainly make a difference to your guitarist's sound, but it's most unlikely to be worth pursuing until you can afford expensive toys without feeling guilty about the status of your PA system. The preamp is also strictly unnecessary, if more worthy, unless your music suffers significantly from boring hum and noise. "Our PA consists of an HH MPA 100 feeding two 1 x 12" Mackenzie and a Selmer 'Treble 'n' Bass' 50 watt valve amp running

## NEW PRODUCTS

### AUDIO CASSETTES



A new audio cassette tape, the UCX-S has been developed by Sony who claim it is more sensitive than any type II cassette currently available.

The UCX-S is a high coercivity tape whose increased sensitivity is due to the development by Sony's engineers of micro-fine magnetic particles. This gives the tape the highest retentivity of any type II tape to date and thus a wider dynamic range, higher output and superior all round performance.

Independent comparison tests have shown that the UCX-S has a superior print-through which makes it ideal for Dolby C and dbx noise reduction.

Each cassette incorporates a section of head cleaning tape at each end. Sixty and ninety minute versions will be available.

Sony (U.K.) Ltd, Pyrene House, Sunbury-on-Thames, Middx. TW16 7AT. Tel: 0932 81211.

### PCM CASSETTE DECK

JVC have developed a PCM cassette deck. It is capable of one hour stereo PCM digital recording and playback on both sides of a cassette tape and has been made possible through the development of a high density (46.3K BPI) recording technique.

The high density is achieved with a two way, four track per channel recording system which JVC assure gives high stability through a biparity system giving a high error correction.



The deck uses metal tape with a high coercive force suitable for digital recording. The tape transport system is a direct drive capstan motor combined with a newly developed tape tension servo system.

For further information contact: Richard Sturman, JVC (U.K.) Ltd., Eldonwall Trading Estate, Staples Corner, 6-8, Priestley Way, London NW2 7AF. Tel: 01-450 2621.

### IN-CAR ENTERTAINMENT

Bosch, the West German Group, with its Blaupunkt division have produced some new lines for in-car entertainment; a radio cassette called Toronto, Hi-Fi Speakers and the Autoflex aerial range.

The Toronto radio/cassette combination has the following features: 3 wavebands LW, MW, FM (stereo) with mono/stereo switch; microprocessor controlled memory touch buttons providing 6 FM and 6 MW/LW pre-selected stations; self-seek tuning with high and low sensitivity settings; automatic noise suppression on FM; digital frequency display on all wave bands; a panel dimmer for night use; separate bass and treble controls; Dolby noise reduction; metal/CrO2 tape bias facility; permalloy tape head giving a frequency response of 40Hz- 15kHz.

The set can deliver 4 x 7W via four separate audio amplifiers with built-in fade (for front to rear volume) and balance controls. Price excluding VAT £275.

The Hi-Fi speakers are suitable for flush mounting in door panels or on



the rear shelf and are listed below (all prices are per pair and include VAT): SL1225 (single cone) 25W at £30.76 DL1025 (dual cone) 25W at £29.15 DL1525 (dual cone) 25W at £34.44 DL1680 (dual cone) 30W at £34.44 CL1340 (triple cone) 40W at £63.25

The Autoflex aerial is miniaturised, aerodynamically designed to reduce wind noise, and it is claimed, virtually indestructible. It provides both FM and AM reception and comprises a slim glass fibre rod on which a two-direction copper spiral is wound and measures 450mm. A resilient flexible section at the base is designed to stop the aerial being snapped off and this coupled with a weather resistant polyamide coating enables the aerial to be car-washed without removal or retraction.

Various mountings are available depending upon the situation of the aerial on the car's bodywork. Prices range from £21.85 to £26.16 including VAT.

For further information on any of the above items contact: Blaupunkt, Robert Bosch Limited, P.O. Box 166, Rhodes Way, Watford, Hertfordshire, WD2 4LB.



# Suzuki Omnichord



The Omnichord is one of the latest musical offerings to come from those masters of the microchip and the balance of payments deficit. This time, though, it's not Casio but Suzuki that are behind it. And whilst the Omnichord costs just about a ton (£99 in fact, inclusive of VAT, if obtained direct from the U.K. distributors), the particular Suzuki concerned has absolutely nothing to do with those manufacturers of 100 mph instant machismo.

Suzuki have sensibly elected to opt for a control format for their instrument that's utterly unique and a refreshing break from the well-trodden keyboard path so successfully exploited by Casio. This makes sense, because the Omnichord is unashamedly directed towards the nonmusical (but not unmusical) member of the public who may well be sent into paroxysms of despair at the sight of all those white and black keys on conventional synthesisers, organs and soon.

## Points of Play

The Omnichord has three levels of activity embedded in its vaguely lyre-shaped body:

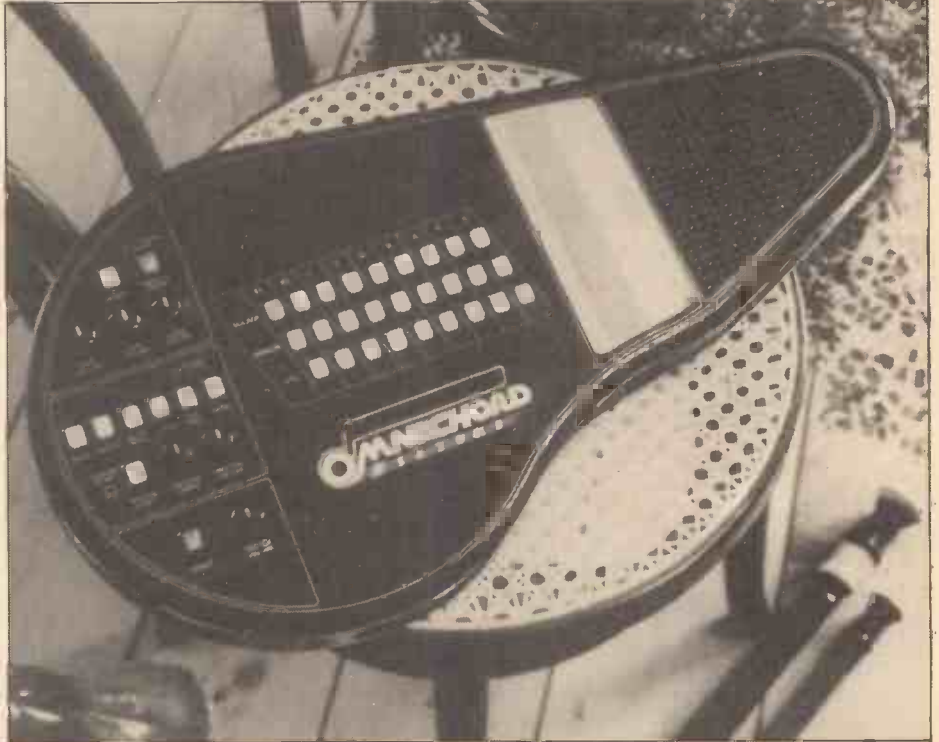
(1) A percussion generator offering any permutation or combination of rock, waltz, slow rock, latin, fox trot and swing rhythms, variable tempo and section volume.

(2) A chord generator providing 27 different major, minor and 7th chords (9 each), either as organ-like chords or walking bass, a release sustain option (called 'memory') and section volume.

(3) A 'sonic strings' section producing an arpeggio, or isolated notes, of a chosen chord over a 4-octave span, as a result of triggering from touch strips. Triggering is achieved from finger touch alone or by using a carbon-coated rubber pick. Sustain and section volume are also variable.

The quality of the percussion is surprisingly good. Suzuki have limited their attention to just bass drum, snare, hi-hat and wood block, so one doesn't have to suffer the usual uncomfortably metallic bongos or t-toms found in other instruments. Though some of the basic rhythms are hardly particularly inspiring (rock is probably the most effective), considerably more interest can be generated by combining various rhythms, but this is obviously something of a hit or miss affair! One minor criticism of this section of the instrument is the small amount of crackle that accompanies the percussive sounds. It's far from obtrusive, really, but a decent PA will obviously show up more than the internal speaker.

An important fact about the chord generation side of the Omnichord is that it's child's play to devise complex harmonic progressions. It's certainly possible to change chords much faster than on conventional keyboards or string instruments, though you're obviously limited to root positions, and this ability to make light of heavy chord work should encourage people to investigate the way in which harmonic changes can heighten the emotional flow of a tune.



The selected chords play in two ways: firstly, as organ-like chords; and secondly, as a walking bass accompaniment. The latter is by far the most interesting and the majority of rhythms give quite effective (and usable) patterns. A synchro-start button is provided so that the percussion generator only starts when a suitable chord button is pressed, and whether or not the chord sustains and rhythm continues until a subsequent chord button is pressed depends on the 'memory' button being down.

The third side of the instrument is the area that makes the final effect rather less mechanical than the foregoing might have led you to expect. This is what Suzuki call their 'synchro strings' and it's the feature that makes the Omnichord very much a technological update of the traditional auto-harp. To the left of the speaker, there's a narrow strip of contacts that are capacitively triggered by the touch of a finger. Moving a digit upwards results in a 4-octave, ascending arpeggio for whatever chord has been selected. A downward strum obviously does the opposite. A carbon-coated pick can also be used to make contact with the strips, and this is particularly useful for picking out notes from the arpeggio. Each technique has its drawbacks. The finger technique works well with dry fingers but not when the fingers are covered with the sort of gubbins released from the sweat glands under the excitement of playing music. This obviously varies from one person to another, and, if you're cool, calm and collected in performance, then you should be fine! The pick is much more dependable, but the problem with the pick supplied with the Omnichord is that it deposits carbon on the fingers holding it — and on whatever those fingers touch after playing the instrument! Great if you're wear-

ing white trousers... I ended up using a piece of conductive foam used for packing ICs — not so elegant as a pick but much cleaner.

The duration of the auto-harp strum can be varied to a considerable extent, from a pizzicato-type effect to a rich sustain, and, like the other sections, the volume is variable. Something I did notice was that the harp sound tended to be omnipresent (albeit at a very low level), and well as omnichord, when no strum was actually being executed. Like the percussive crackle, this isn't obtrusive unless one's just playing the harp section alone.

## Summing Up

The quality of the Omnichord's sound belies its cost and certainly warrants external amplification. Unfortunately, inserting a jack into the output socket doesn't cut out the internal speaker, and this is something that should be changed to satisfy the more demanding user. The internal speaker is quite reasonable, but its position isn't ideal since it's under the flight path of the hand indulging in sonic stringing. Nit-picking apart, the Omnichord is a splendid instrument. It has obvious appeal for anybody with the remotest interest in music, and the richness of sound that's available from it must ensure a great deal of attention right across the musical board. The Omnichord is likely to be stocked by many music shops in the near future, but it can also be obtained direct from the distributors, Craftmaster (U.K.) Ltd., at Tower House, Lea Valley Trading Estate, Edmonton, London N18 3HR (tel: 01-803 8941).

David Ellis

E&MM





A 3D Quadrophonic bass pickup from **Zeta Systems**, claimed to have greater frequency response and dynamic range than magnetic pickups. Price including brass bridge assembly and electronics \$295 ... **Di Marzio** release a Vintage bridge which incorporates the custom string spacings and tracking saddles of their solid brass bridges. Price \$79 ... An in-line audio transformer for matching microphones to audio cassette tape recorders from **Sescom Inc.** ... Two new **Peavey** guitars, the T15 and T30. Also a replacement for their VT speakers, the VTX Classic with a boosted output of 65W ... **Superwound** announce that they are now the exclusive manufacturer of strings for **Steinberger** basses ... **Revox** have added a bookshelf unit to their range of speakers, the Revox Piccolo rated at 35W. Also a pair of headphones, the RH3100, the speakers retail at £90 plus VAT per pair and the headphones £42.50 plus VAT. Further

information from F.W.O. Bauch Ltd, 49 Theobald St, Boreham Wood, Herts ... Two new monitor loudspeakers and a studio monitor from **IMF Electronics**, they are the Reference Standard Professional Monitor Mark VII and the Professional Monitor, more information from David Sears, Westbourne St, High Wycombe, Bucks (0494) 35576 ... **Rose Morris** announce the appointment of Gerry Lewis as their U.K. Field Sales Manager ... Another Beatles record/cassette was released on 29th March, Reel Music (TC) PCS 7218, comprising fourteen tracks from their films ... **Vox** announce a two-year warranty on all their products at no extra cost ... **HHB** have just completed the installation of a new sound system for the Albany Theatre in London ... Two new stereo headphones from **Sennheiser**, the HD40 and the HD230 priced at £16.55 and £74.95. For details ring (02813) 88447 ... **Hitachi, JVC, Matsushita, Philips** and **Sony** have reached agreement on the main engineering parameters of the development of a world wide standard video system ... **CEL Electronics Ltd** have developed an NTSC version of their Chromascope P135 Video Synthesiser after the success of the PAL 625 version, for details ring (0279) 418611 ... **Atlantex** now distribute **AKG** microphones.

## EVENTS

**May 14th-18th THE 1982 BRITISH MUSIC FAIR** will be held at the National Exhibition Centre, Birmingham. 20,000 square feet of space has already been reserved by exhibitors and reservations are still being taken. Those expected to attend are Carlsbro, Custom Sound, H&H Electronics, Laney Amplifiers, Tannoy and Roland. For more details Tel. 01-834 1347.

**June 3rd-5th THE THIRD INTERNATIONAL COMMODORE COMPUTER SHOW.** The Cunard Hotel, Hammersmith, London. Over 100 exhibitors of microcomputer systems demonstrating products for specialist business applications, educational uses and communications. Also seminars throughout the show introducing people to the world of microcomputers. For details ring Slough 79292.

**June 23rd-25th APRS 82 INTERNATIONAL EXHIBITION OF PROFESSIONAL RECORDING EQUIPMENT.** Kensington Exhibition Centre, Derry St, Kensington, London. The world's leading manufacturers will display the latest professional recording equipment. Over 90 exhibitors. For details write to APRS, 23 Chesnut Ave, Chorleywood, Herts.

**July 17th-25th THE 17th B.A.E.C. AMATEUR ELECTRONICS EXHIBITION.** The Shelter, The Esplanade, Penarth, South Glamorgan. All aspects of amateur electronics and the B.A.E.C. activities will be demonstrated. For details ring 0222 707813.

**July 18th NEW SOUNDS 82 COMPETITION.** Woking Centre Halls. This competition, devised by ABC Music, to find the most promising sound of 1982 starts with the heats during May (closing date for entry 30th April). Entry forms are available from any of the ABC music shops or from Harmony House, 85 High St, Esher, Surrey KT10 9QA. Tel: Esher 66195.

**April 20th-22nd THE ELECTRONIC ECIF SHOW.** The Barbican Exhibition Centre, London. This will be the largest and most comprehensive display of the electronics industry the capital has seen for many years. So far there are approximately 300 exhibitors to occupy the four halls of the Barbican Centre. Times of opening are 10.00 a.m. to 6.00 p.m. except Thursday, when it will close at 5.00 p.m.

For more information contact: Miss Samantha Clarke, The All Electronics/ECIF Show, 34-36 High Street, Saffron Walden, Essex, CB10 1EP. Tel. (0799) 22612. Telex: 81653.

**April 23rd-25th THE COMPUTER FAIR.** The Computer Fair will be designed to be of interest to all those involved in personal computers from home computer enthusiasts to businessmen. The aim of the exhibition is to assist in the government campaign to promote computing. For further information about this Fair, Tel. 01-643 8040.

### CORRIGENDA

**Nov 81.** Basically Basic. Page 30, String Arrays, line 40 of program should read: 40 FOR I = 1 TO 4.  
**Jan 82.** Circuit Maker. Page 34, Pseudo Phaser, C2 should be taken from the right hand side of C1 not as shown from R1.  
**Feb 82.** Spectrum Synthesiser. Page 67, Figure 17 IC28a pin 2 connects to C50 and R279, also pin 9 connects to C51. Page 69, VCO Parts List, transistor references TR15, 16 and 17 are used again in later parts lists, ensure that the correct transistors are used. Page 70, Filter Board Parts List, add

D31 and 32 to D33-35 IN4148 and change quantity to 5 off.  
**Mar 82.** Synthesiser Buyers Guide. Page 48, Moog Rogue has 2 oscillators. Digital Delay Line. Page 71, resistors R92 and R91 situated below R100 should read R95 and R94 respectively.  
**Apr 82.** Micromusic. Page 41, Parts List, uA78L05AWC regulator (QL26D) should read uA78M05UC regulator (QL28F). Change the 40 way ribbon cable to read 40 way DIP jumper cable single ended and delete the Maplin reference.

# FREE

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*Offers are subject to availability. We reserve the right to proffer alternatives of equivalent value. Gifts must be requested when ordering.*

For more information ...

# READ ON

... to pages 21 & 23

## TEMPUS & Casiotone

# Organ Talk

Ken Lenton-Smith

## The Changing Scene

Strange things can happen to an organ installation that has operated without trouble for a long period. This example may be taken as a warning — if the cap fits!

A reader bought an organ some years ago and, pleased with his progress, wired in a separate tone cabinet. Not satisfied with the electronic vibrato, he decided that a Leslie speaker be added to the installation. The sound was now magnificent but it really needed an additional rhythm unit — so that was also wired in.

Recently, the Chorale/Fast switching started to become somewhat noisy and eventually the organ 'died' completely while he was playing. A post mortem revealed that the main switch was being used to operate four mains transformers simultaneously and — yes, you can guess! — the contacts became so badly burned that they went open circuit by degrees.

Though it is easy to fit control boxes and borrow power from internal points in an organ it should not be forgotten that the rating of components takes into account the design of the original instrument. Adding mercilessly to the burden of the main switch can cause the dying organ syndrome. The remedy, of course, is to replace the main switch with something that can handle the surge involved: the original switch is often barely adequate in the first place. The single-switch-for-everything is not a bad idea on those occasions when making music happens to be more interesting than technical considerations.

## Synorgan?

The home organ was not all that common two decades ago but, thanks to solid-state circuitry, its rise in popularity has been enormous. Much of the credit is also due to competition between manufacturers to give good value, new tonal effects and facilities and instruments which were attractive pieces of furniture in the home.

The electronic organ started its life imitating the conventional cinema or classical organ. A trumpet stop was a reasonable copy of its pipe-organ counterpart, for example, and the *orchestral* stops generally were those of the pipe organ. It has always been a type of 'synthesiser' in its attempt to duplicate the sounds of its acoustic brother. Indeed, drawbar organs use harmonic synthesis, allowing the performer to mix sine waves of fundamental and overtones as he thinks fit.

Certain drawbar organists such as Lenny Dee used to manage to 'pump' a handful of drawbars whilst holding a chord with the other hand — so giving an effect that was the forerunner of the programmed VCF.

Brass had hitherto been an organ, rather than orchestral, timbre. The synthesiser brought with it pitch-bending and the ability to alter the harmonic content for the duration of the note. Once the Moog had accustomed us to sounds which were imitative of orchestral instruments — and surprisingly realistic — the eventual development of electronic organs was bound to acquire new dimensions.

Current production models are likely to feature both organ tone generators and a synthesiser section for presets or user setting. It would seem that the organ is progressively becoming a polyphonic syn-



The superb Godwin SC600 with built-in synthesiser — with organ tones and pedals.

## Metamorphosis

One's own musical background will colour one's view of this progression: organists are likely to spring from three separate sources.

The classical organist, who may well be a church organist in his spare time, will have purchased an instrument for practice at home. Johannus, Conn, Viscount or similar classical organs are voiced to give results similar to a church organ and on the whole this player will not be interested in synthesised sounds unless they can be applied to pipe organ registrations, which is perhaps unlikely. He will shun the many 'extras' and spend his money on a straight organ.

The second category is those who as children were fascinated by the organ in the local cinema. The average age of members of organ clubs indicates that a fair number of enthusiasts first became interested through this medium. The cinema organ was the perfect example of a one-man-band: percussion sections could be coupled to manual or pedal (rather than being operated through a ROM), complete pianos occupied the pipe chamber and the voices were rather more orchestral than those of classical instruments. The entertainment organist finds that biting brass, synthesised string choruses and lush trombones are ideal for his type of music and will appreciate and find many uses for the more recent circuitry in getting his message over.

A large proportion of E&MM readers will be in the third category — those who have grown up with the synthesiser. They will be conversant with voltage-controlled modules, sequencers and their manipulation so this method of sound generation will have great appeal — quite as much as pure organ sound. The recorded music they buy will be dominated by modern, polyphonic keyboard instruments and their own keyboard technique will be influenced accordingly.

## Market

Naturally, manufacturers are very alert to this last category as, counting aside equipment bought by groups, it accounts for a fair proportion of sales of keyboard instruments. Particularly at a time when industry is under pressure worldwide, there could be a tendency to reduce the number of models available.

For example, Thomas Musical Instruments is closing down many of its operations and ending distribution of instruments in the U.K. This is sad news for Thomas enthusiasts but I gather that spares and servicing will still be available for the time being.

Organ manufacture is a very competitive business and the many companies in this

field look closely at their sales figures to see which are the least profitable lines. The entertainment organ is still the best seller but even so it is to be hoped that manufacturers realise that tastes vary. My own interests are strictly rhythmic but not everyone appreciates a rhythm unit, one finger chords, synthesiser facilities etc. The present choice of instruments is perhaps too wide but if there is any contraction in the market I hope that the baroque organists will not suffer.

It seems that the trend in recent years has been to turn the organ into a polyphonic synthesiser increasingly. It may still be an organ (definition: an instrument by means of which anything is done) but organ tones are slowly taking second place to voltage-controlled waveforms.

## End Product

In most forms of art, the means are less important than the end. Multi-tracking has been around for a long time and has been used to produce some of the best organ recordings. The build-up so achieved is impressive and only the occasional small timing error gives the game away.

The musical abilities of recording groups varies enormously, which is painfully evident if listening frequently to Radio 2. Given a group of musicians who really know their music and can utilise studio facilities to the full, their disc can be both interesting and enjoyable. The same group playing 'live' may not sound quite the same.

The rising popularity of keyboard instruments with sequencing (so that the player can play along with a pre-recorded passage at any speed) and multi-voice memory recall owes much to the need for special effects in concert.

For those not adept at the keyboard but with knowledge of music, a computer can be used to play written scores. The Apple does this admirably, with full control over envelope and harmonic synthesis: each part may be entered one note at a time and, though somewhat laborious, the end product is intriguing. To an organist, the most interesting feature of the Apple system is ability to see both waveform and harmonic content on the screen. The mixing of sine waves is similar to that on a drawbar organ though in this case they extend up to the 24th harmonic. I have not had the privilege of being let loose on this equipment for any length of time but I have a feeling that the fascination would slowly wane and I would turn back to organ keyboards with some relief.

Will today's technology alter the face of conventional music by the end of the century? Solid-state circuitry has revolutionised keyboard instruments and costs have, if anything, come down in real terms. Acoustic musical instruments are becoming very expensive indeed because they are largely hand-made: a tenor sax costs more than many organs these days.

The education system, pressed financially, could have difficulty in teaching conventional musical instruments to future pupils of brass, strings and woodwind. However exciting an overture may sound played on a synthesiser, a concert orchestra takes a lot of beating! It would be a pity if the invention of the transistor signalled the death-knell of music as we know it today.

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3	(3)	Abba Music Show vol II .....	Intervision
4	(7)	Rock Flashback — Deep Purple .....	BBC/3M
5	(4)	Adam & The Ants .....	Home Video Productions
6	(8)	Pink Floyd Live At Pompeii .....	Spectrum
7	(6)	Queen — Greatest Flix .....	EMI
8	(5)	Olivia Newton John — Physical .....	EMI
9	(9)	Abba Music Show vol I .....	Intervision
10	(10)	Elvis — Comeback Special .....	Mountain Video
11	(—)	Bob Marley & The Wailers .....	EMI
12	(11)	Elvis — King Of Rock 'n' Roll .....	World of Video 2000
13	(16)	Jethro Tull — Slipstream .....	Chrysalis
14	(18)	Iron Maiden .....	EMI
15	(15)	Videostars .....	EMI
16	(17)	The Kids Are Alright — The Who .....	Spectrum
17	(13)	E.L.O. Live In Concert .....	VCL
18	(14)	Alice Cooper In Concert .....	20th Century Fox Video
19	(19)	Elton John In Central Park .....	VCL
20	(12)	Paul McCartney & Wings Rockshow .....	EMI

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# Hot Wiring your GUITAR

Peter Maydew

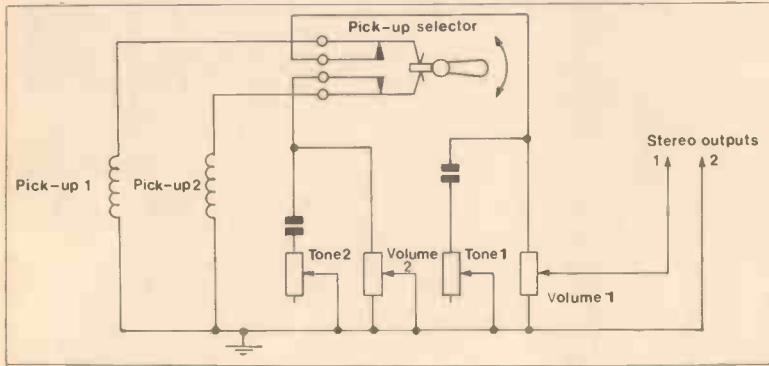


Figure 1. A typical stereo guitar circuit.

## STEREO

The term 'stereo' when applied to guitar wiring is something of a misnomer. 'Two channel' would perhaps be a better name: the first point to be made when talking about stereo guitars is that they don't really give a stereo image as such, except in very rare cases. You might expect the sound of different strings to be heard from different places in the stereo image, but what in fact happens with the well-known 'stereo' instruments from Gibson and Rickenbacker — and the wiring described in this article — is that each pick-up is connected to its own independent output on the guitar. If that doesn't sound as exciting as you'd hoped at first, read on; as far as I know, stereo wiring has been around longer than coil-taps and phase switching, and can be very useful both on stage and in the studio.

In a live performance, the important feature is that you have two signal paths which can be on separately or together, selected by the guitar's pick-up switch. Thus, you can have a separate effects unit (or string of effects units) on each output, and switch between them from the guitar. You don't need to stand near the effects to switch them on and off — they can stay on all the time. You only have two combinations of pick-ups and effects to choose from, true, but that's one more than you had before, and it's often quite sufficient.

In the studio, or anywhere that a bit more flexibility is required, the ability to treat each pick-up completely separately is a great boon: Normal non-active guitar tone and volume controls interact with each other in various weird and wonderful ways, and although players usually get used to these peculiarities, there can be very few who actually like them. Try connecting a stereo graphic or parametric equaliser to a stereo guitar and see how many sounds you can get that you didn't think your instrument was capable of! Many guitar amplifiers have two input channels with separate volume and tone controls, and the same sort of effects can be had using these, although on a more basic level.

Another useful trick which works especially well for solo players is to have a separate volume pedal on each pick-up channel, allowing continuously variable tone

control whilst playing — you'll probably need to sit down for this one! Finally, and contrary to what I said in the opening paragraph, routing each pick-up to opposite sides of a stereo mix can give interesting effects. This technique is useful for broadening out solo or sparsely-instrumented music.

## Converting Your Guitar

By far the easiest guitars to convert are those with two volume and two tone controls, such as Gibson Les Pauls, SGs etc. and some copies (oops, what have I said?). It's important that the pick-up selector switch should be of the 'open' type with four contacts, like that shown in diagrammatic form in Figure 1. These have two pairs of 'leaves', which contact each other when the switch knob is in the central position, but one or other circuit is broken to switch off the appropriate unwanted pick-up in the 'rhythm' and 'treble' positions. Some Japanese guitars have an enclosed switch with three contacts, and these don't allow separation of the two pick-up circuits; it's an easy matter to replace these with an American style selector.

The first thing to do is to separate the two outputs on separate screened cables. Once you've got the guitar unscrewed to the point where you can see the major electrical components, start from the output jack and trace its wire back to the controls. It should go either to both volume controls, or to two tags on the selector switch if it's the four tag type. Disconnect something appropriate so that the output cable goes to only one volume control/switch tag. Now connect the centre conductor of a fresh piece of screened cable to the tag you've just freed, and connect its screen to the same point as the screen of the original output wire. The circuit should now look something like Figure 1; there are many variations, however, so don't worry if the selector switch comes after the controls on your guitar, or if the volume controls are wired a different way round. The effect will be the same.

We now have to connect these wires to the outside world; the easiest way is to use the ring and tip connections of a standard stereo jack socket, but this limits you to using a stereo lead all the time. A SPDT mini-toggle may be wired as shown in Figure 2 to give the option of reverting to mono if

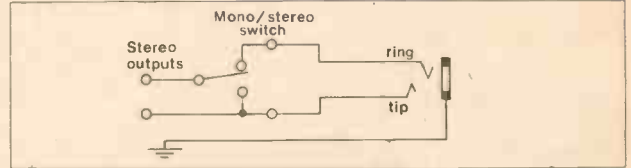


Figure 2. Switchable stereo/mono output wiring.

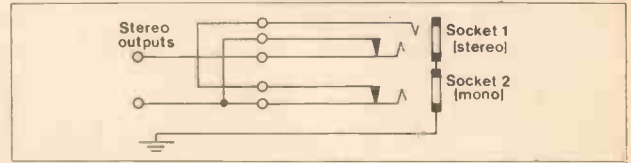


Figure 3. Dual jack socket wiring.

required without having to use a special lead.

If you're building your own guitar, or you can make space for an extra jack socket (careful with that drill, Eugene!) the most flexible arrangement is that shown in Figure 3. This gives mono or stereo simply by using the appropriate socket, together with a third option best described as 'twin mono'. The three conductor jack is the neatest connector, as it only requires one (twin core and screen) lead, but these leads can be difficult to obtain; home made ones tend to be unreliable, especially where they split into two mono jacks at the amplifier end. The Figure 3 arrangement allows the use of two mono leads, one in each socket, to give exactly the same results. Note that the jack sockets used in this circuit are the type with break contacts fitted, not the normal guitar jack.

If you wish to convert a guitar which doesn't conform to the ideal outlined above, don't despair; a bit more work is needed, that's all, and a bit more common sense since I can't cover all the possibilities. You should aim to end up with a circuit similar to that in Figure 1, but in some cases that may be tricky. The biggest problems will arise with guitars which have less than four controls, and no space to add more. On such instruments, any controls which there are only one of should be replaced with ganged potentiometers of the same value, one section for each pick-up channel; the tone control capacitors should also be duplicated.

Another solution you may care to consider is to do away with the tone control(s) altogether, and just have two volume controls if there is only room for two pots on your guitar. I don't have tone controls on either of my lead guitars, and I don't miss them at all. I prefer to use coil-taps and such to get tonal variation, and all these techniques (described in previous issues of E&MM) will combine comfortably with stereo wiring.

Finally, if you've got a weird guitar and you can't work out how to make it stereo, write to me care of E&MM with a clear wiring diagram and a SAE and I'll do my best to help you. Just don't ask me how to convert a Stratocaster (or any three pick-up guitar) since I can't think of a sensible way of doing it without losing one of the pick-ups, or at best radically rewiring it.



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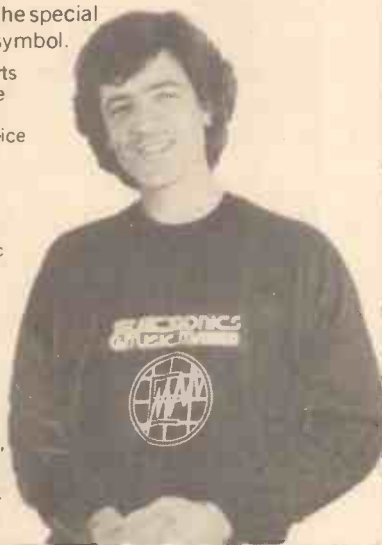
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# A HISTORY OF ELECTRONIC MUSIC

Derek Pierce

In the days before synthesisers were commercially available in Britain, the BBC's incidental music composers had to rely on their own highly developed qualities of enthusiasm and dedication, rather than sophisticated electronics. One of these composers, Daphne Oram, working with Jimmy Burnett and Dicky Bird, produced incidental music using the conventional studios late at night when they were otherwise unoccupied. Using ideas and equipment that she had developed during the previous twenty years, Daphne Oram paved the way for the 'Radiophonic Workshop'. Her imagination, foresight and knowledge of what was happening in the world of experimental and electronic music led her to try and convince the authorities of the need for an electronic music studio in the BBC along the lines of those already in existence in France and Germany.

A play 'All that Fall' by Samuel Beckett, written for the Third Programme in 1956, and first broadcast in 1957, was unique at that time in employing a new sound convention, rather than using music in its 'normal' form. Experience gained in doing the programme led to similar techniques being employed in a very different play, 'The Disagreeable Oyster', by Giles Cooper. It was a comical fantasy being extremely stylised — the radio equivalent of a cartoon film.

A 'radiophonic poem' followed. It attempted to take words and sounds specially written and described by author Frederick Bradnum and tried to build up something that could not be written on the printed page — a pattern of words which were then manipulated as sounds to illustrate these words.

These programmes paved the way and created interest in electronic music within the BBC. Daphne Oram's enthusiasm for the works of Stockhausen, Cage *et al* led to a visit in 1958 to the Brussels World Fair. Accompanying her on this trip were composers Roberto Gerhard, Humphrey Searle and Bernard Keefe. On their return they were able to convince the BBC of the need to set up a 'Radiophonic Workshop', with the aim of "developing techniques to produce electronically the special sounds and incidental music required for radio and television productions". The Directors agreed and the Workshop was started.

The original premises for the Radiophonic Workshop was in the BBC's music studio building in Maida Vale, London. They comprised one large room with a small annexe used as a studio. It was equipped initially with sub-standard semi-professional equipment such as two Moto-Sacoche 30 i.p.s. tape machines, several Ferrographs and most usefully a Reflectograph Vari-speed machine. A mixing desk was procured from the Albert Hall, utilising the then popular 'stud' faders which introduced considerable distortion into the wave forms. It was, however, replaced by one of the first desks to use 'carbon faders' in the BBC. Also at hand were a number of signal generators, a third octave filter plus a multifarious selection of sound sources including an old piano frame, a water cistern, an enormous



The BBC Radiophonic Workshop at Maida Vale in 1958. Donald McWhinnie (right) listens to a montage of electronic effects, with Desmond Briscoe (foreground) operating filter units in association with particular oscillator sounds controlled by Daphne Oram. In the background, Richard Bird is adding artificial reverberation.

range of bottles — in fact anything that would make an interesting noise!

Joining the team of Daphne Oram, Jimmy Burnett and Dicky Bird on occasions was Desmond Briscoe. Products of this early team, supplemented by producers from other departments, included 'Bloodnocks' Stomach' for the Goon Show; the first electronic signature tune, 'Science and Industry' (used for many years by the BBC's World Service), and the music for 'Quartermass and the Pit'.

Within the following year Daphne Oram had left and a post was created for a full time

An early workshop studio in operation.



Head of Radiophonics. This position was filled by Desmond Briscoe, who still occupies it today.

A technical operator, who was at that time responsible for 'Bloodnocks' Stomach', was Dick Mills, and along with Desmond Briscoe has become the longest serving member of the Workshop. Having transferred to the creative side in 1972, he's now responsible for the incidental music for 'Dr Who'.

Most of the initial output was for the Drama department. Some of the more notable pieces produced included the theme for a play entitled 'The Ocean' by J. Hanley. This was realised using the clarinet as the sole sound source. One request typical of the many they received was "to produce the sound of a rainbow" to be used in the play 'Noah'. It was synthesised by using signal generators and became one of the Workshop's first examples of additive synthesis.

Despite the lack of sophisticated equipment, imagination was never in short supply. For example, in order to overcome the lack of a multi-track facility, several Philips Pro 20 tape decks were started simultaneously and



## Part 5

# The BBC Radiophonic Workshop



their speeds were so accurate that they remained in sync for long enough to complete the piece, during which several layers of sound were built up. With the increase in demand and the success of early work, the Workshop grew so that within three years the existing team were joined by Brian Hodgson, Phil Young, Delia Derbyshire and John Baker.

In 1963 the BBC had planned to start a short series entitled 'Dr Who'. The producer needed a signature tune, and having given due consideration to the science fiction nature of the programme he decided to employ the services of the Radiophonic Workshop. Together with the composer Ron Grainer, new recruit Delia Derbyshire and engineer Dick Mills, they created the most familiar piece of electronic music in this country, the 'Dr Who' theme. Although the theme music has been revised from time to time, the programme still continues to attract science fiction viewers. The team also produced signature tunes for programmes as diverse as 'PM' (a news programme), 'Choice' (consumer affairs) and 'Womans Hour'.



The EMS Synthi 100.

By 1962, a Levers-Rich multi-track variable speed tape deck had been pressed into service, but although too noisy for multi-tracking, its 2-40 i.p.s. speed variance was useful. By the use of keys it was possible to alter its speed in semi-tone intervals enabling it to be played much like a keyboard. Gradually equipment and innovations grew, enabling even greater possibilities to emerge. Carbon faders replaced the noisy studs, 18 oscillators used via simple envelope generators provided a useful sound source, especially when played via a keyboard arrangement. (See early workshop photo, far right of the picture on bench.)

It wasn't until 1968, however, that they received their first synthesiser, the EMS VCS3, developed by Peter Zinovieff. This addition of a synthesiser speeded up the turn around time for a composition, something which was to prove very useful in this ever popular department. They were being employed more and more, both for television and radio work.

The need for some form of sequencing led to the development of the Synthi 100 (see photo above), a computer driven synth capable of storing 256 bits of information on each of its eight sequence tracks. As is usual, needs gave rise to developments, one of which was to prove both fascinating and unique — a mixing desk was built which combined both the 'pan-pots' and level faders, and this enabled the movement of images within the stereo mix to be made considerably easier than was previously possible. With the knowledge and experience that they gained it is not surprising to note that composers of the Radiophonic Workshop were quite often involved with extra mural activities. Delia Derbyshire and Brian Hodgson, working in conjunction with David Vorhaus, produced one of the most interesting and unusual rock records to be released entitled, 'An Electric Storm', under the name 'White Noise'. It contains a lot of innovative material with some almost 'disturbing' tracks (particularly side two which consists of two tracks: 'The Visitation' and 'Black Mass: Electric Storm in Hell'). The production on the album was credited to 'Kaleidophon' which proved to be an enduring studio set-up run by David Vorhaus, who has since released two other 'White Noise' albums. (See E&MM feature in June 1981.)

Personnel changes in the early seventies include the departure of Brian Hodgson, Delia Derbyshire and the arrival of Malcolm Clarke, David Caine, Peter Howell and Paddy Kingsland. Brian Hodgson returned in 1977 to become organiser of the Radiophonic Workshop. Paddy Kingsland was formerly a tape editor, then studio manager, chiefly for

Radio One. He is a firm believer that instrumental sounds combined with electronics are essential for signature tune composition.

Peter Howell realised 'Greenwich Chorus', utilising 'ticking clocks' recorded at Greenwich Observatory as well as 'voices' created through a vocoder. In the title music for 'Merry-Go-Round' he uses a simple synthesiser line with syncopated echo. He adopted a completely different approach to that employed by David Caine, who was involved with the production 'The Seasons — Drama Workshop', noted for its musical portrayal of the months of the year and the seasons.

Although its primary role is to service the various production departments in the BBC, the Workshop had begun to devise its own productions by 1979. To celebrate their 21st anniversary they broadcast 'Wee also have Sound-Houses', a history of the Radiophonic Workshop. The title was being taken from 'The New Atlantis', Francis Bacon (1624), in which Bacon describes the concepts developed by the Radiophonic Workshop. RW producers have won a number of major awards, with Desmond Briscoe winning three for his 'A Wall Walks Slowly' and Malcolm Clarke gaining an award for 'August 4th 2026'.

On the technical equipment front, things improved dramatically, the Workshop went 16 track in 1977, and gained the following equipment to date: a Roland Jupiter 4, Prophet 5, Yamaha CS80, Oberheim and of course the Fairlight CMI.

Since 1958, the Radiophonic Workshop has made a slow but steady development in its range of work extending its facilities and output. Its producers read like a Who's Who of British Electronic Music, but it has often not received the credit due to it. Examples of its output can be found on the records listed below.

Daphne Orams' original idea has led to an expansion of the horizons of electronic music in this country. She was approached by various rock groups in the sixties, to help provide both the information and equipment necessary for the electronic revolution within rock music. Her contributions to electronic music have undoubtedly been underestimated by the public at large.

E&MM

Further information on the Radiophonic Workshop is given in E&MM March 1981.

### Discography.

*White Noise 1.* ILPS 9099 Island Records.

BBC.

*The Seasons - Drama Workshop.* REC 7.

*Radiophonic Music 21st Anniversary.* REC 354.

*Through the Glass Darkly.* Peter Howell. REC 307.

# MAKING NOTES

## Playing a piece in a new key

## PART 5

Most musicians start to play in the two keys of 'C' and 'F' Major and may feel that these two keys are adequate. They can be, but to the listener with a good musical ear the music can all sound the same, despite variations in the melody.

Transposition in relation to music simply means 'to change from one key of music to another'. Learning how to transpose a favourite well played tune into a new key can create new interest and a great sense of achievement.

Professional musicians can often transpose on sight but unless gifted musically this can take quite a while to achieve.

There are various ways of transposing music. One method is to establish the Tone and Semitone distances between the original Key and the new Key and move every note accordingly. For example, when transposing from the Key of 'F' Major to 'E' Major there is a *One Tone* distance in a downward movement. Every note on the original manuscript must be moved down by a Tone distance on the new manuscript. This can be a complicated exercise if every note has to be moved by greater Tone and Semitone distances which can occur between other Major Keys.

Find time to experiment with my simple method. The only requirements are a clean sheet of paper, a page of manuscript, a pen, 'Making Notes' article 3 (on Key Signatures) and your favourite arrangement in the Key of 'C' Major which is going to be transposed into the Key of 'G' Major. After learning a few simple rules it is possible to transpose music

to and from any Major Key.

### From C to G

(1) Write down and number 1 to 8 the note names of the 'C' Major Scale and underneath it write down the scale of 'G' Major:

	1	2	3	4	5	6	7	8
'C' Major Scale	C	D	E	F	G	A	B	C
'G' Major Scale	G	A	B	C	D	E	F#	G

(2) On the new manuscript write the Treble Clef and the new Key Signature for the Key of 'G' Major and the Time Signature of the music.

(3) Identify the melody note on the original manuscript as note numbers of the 'C' Major Scale and transpose them into the same note numbers of the 'G' Major Scale. See Figure 1.

In the first bar of Figure 1, the note of 'E' in the original Key of 'C' Major, becomes 'B' in the new Key of 'G' Major. The second note of 'G' becomes 'D' and the third note of 'E' goes back to 'B'. In the second bar the original notes of 'F', 'A' & 'C' become 'C', 'E' & 'G' in the new key. Now alter the third and fourth bars, ensuring that note values and any Rests in the music are transferred correctly to maintain the timing of the music.

The Bass Staff can now be transposed in exactly the same way, remembering to place the Key Signature and Time Signature first. See Figure 2.

Music can now be transposed into any Key of your choice. Using this method transpose

the Key of 'F' Major into the Key of 'E $\flat$ ' Major. The note numbers of the 'F' Major Scale will be transposed to the same note numbers of the 'E $\flat$ ' Major Scale. Remember to write in the new Key Signature and the original Time Signature first (Figure 3).

Figure 3

If you are one of the many musicians using 'Chord Symbols', their transposition to the new 'Key' is very simple. As with the melody notes, a Chord Symbol of 'C' (note No. 1 of the 'C' Major Scale) on the original manuscript becomes a Chord Symbol of 'G' (note No. 1 of the 'G' Major Scale) on the new manuscript. The transposed Chord Symbols and Pedal Notes are included on Figures 1 and 2. Any additional chord information '7', '6', 'm' etc. must always be included with the transposed chord.

### Further chords for L.H.

ADVANCED LEFT HAND CHORD FORMATION requires an understanding of Major Scale sequences. As each note of a Major Scale is numbered 1 to 8, note No. 8 is also note No. 1 in a continuing sequence of the scale. Note No. 2 is also note No. 9, note No. 3 is also note No. 10 etc., to a maximum of 13 notes. The scale sequence of the 'C' Major Scale is shown in Figure 4.

In the following chord formations the chord name appears first, then the note numbers of the Major Scale, with the 'C' Major Scale as an example, then the Chord Symbol and the notes which feature in the chord. See Figure 5.

The Root Note is not included as part of the Left Hand Chord in formations higher than major Seventh. When playing an instrument with a pedal board, the Root Note is the Bass Pedal Note, leaving the left hand to accommodate the three or four notes of the chord. The chords of 'Cmaj7', 'Cmaj9' and 'C9' need to be inverted to be played between the octave 'F' to 'F'. The Eleventh and Thirteenth chords are in their playing positions.

When the chord of Major Seventh is played as an inversion, a semitone discord occurs between the 7th and Root Note of the chord. Because the Root Note is duplicated as the pedal note it is a personal choice if the Root Note is omitted from the chord. The Major Ninth Chord consists of four notes and starts its formation upon the 3rd Note of scale 3 - 5 - 7 - 9, with the Root Note as the Pedal Note. The Ninth Chords are similar to Major Ninth Chords apart from the '7th' Note of scale which is flattened to '7 $\flat$ '. The Eleventh Chords start their formation upon the 5th Note of scale, the 3rd Note is omitted and the Thirteenth Chords start their for-

Figure 1

Figure 2



## by Brenda Hayward

mation upon the '7<sup>b</sup>' Note of scale, with the 3rd and 5th Notes omitted.

With the exception of the 'Maj9' Chords, their logical build up highlights that in any chord above 'Eighth' such as Ninth, Eleventh and Thirteenth the '7<sup>b</sup>' Note of the scale will always be included.

The musical rule is now established for the formation of some of the advanced chords, which can simply be found by writing any Major Scale Sequence (1 to 13) and using the appropriate note numbers. Create Inversions of Chords, if in their formation position they are too high or too low on the manual to be played between the notes of 'F' either side of Middle 'C'.

Thirteenth Chords are not usually played as an inversion, as a semitone discord occurs between the '7<sup>b</sup>' Note and the 13th (6th) notes in the chord. They can be played an octave lower if their formation position is too high on the manual, or to cheat a little, a 7th Chord is adequate when the 13th Note is the melody note.

When playing advanced chords, you will be using the same notes as the simple chords you have already played. For example, the 'C9' Chord (1st Inversion) G - B<sup>b</sup> - D E played with a 'C' pedal is a 'Gm6' Chord when played with a 'G' pedal. The 'Cmaj9' Chord (1st Inversion) G - B - DE played with a 'C' pedal note becomes a 'G6' Chord when played with a 'G' pedal note. An 'Eleventh' Chord uses the same notes as a Minor Seventh Chord. A 'G11' Chord D - F - A - C is a 'Dm7' Chord when played with a 'D' pedal note. Therefore the only difference is in the pedal note which gives the chord its name. This exercise also shows that every Left Hand Chord, with the exception of 'Thirteenth's', can be played between the octave 'F' to 'F' on the lower manual and advanced chords are no more difficult to play than easy ones.

### Playing pedals

As this month I have included Bass Pedal Notes with the Left Hand Chord formations, a few hints on Bass Pedal techniques may be useful. It is not necessary to remove shoes when playing the pedals. Apart from being definitely anti-social, it does not really help to achieve the smooth movement of coaxing the pedal down rather than hitting them sharply. A lighter shoe or slipper may help to get the feel of the pedals initially. Try to keep the left foot hovering above the pedal notes rather than lifting the foot in the air, to create a similar technique to 'Crawling' over the melody notes on the manual.

If you are reading the Bass Staff, you will obviously be shown the pedal notes to play with each chord. If you are reading single stave music, the Chord Symbols tell you that the pedal note is the ROOT NOTE of each Left Hand Chord and also the Root Note of the Scale from which the chord was formed. I am using the Major Scales once more, (what would we do without them!) to extend the basic knowledge contained in the Chord Symbols.

Initially, one pedal beat in each bar is sufficient whether playing in 3/4 or 4/4 time (Figure 6A). When playing to a semiquaver

C	D	E	F	G	A	B	C	D	E	F	G	A	B	C
1	2	3	4	5	6	7	8	9	10	11	12	13		
							(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)

Figure 4

MAJOR SEVENTH	C	E	G	B	'Cmaj7'	
	1 - 3 - 5 - 7	7th (Semitone below 8th)				
MAJOR NINTH	C	E	G	B	D	'Cmaj9'
	1 - 3 - 5 - 7 - 9	5th, 7th, 9th added to 3rd				
	PEDAL - CHORD -					
NINTH	C	E	G	B <sup>b</sup>	D	'C9'
	1 - 3 - 5 - 7 <sup>b</sup> - 9	5th, '7 <sup>b</sup> ', 9th added to 3rd.				
	PEDAL - CHORD -					
ELEVENTH	C	G	B <sup>b</sup>	D	F	'7 <sup>b</sup> ', 9th, 11th added to 5th
	1 - - - 5 - 7 <sup>b</sup> - 9 - 11					
	PEDAL - CHORD -					
THIRTEENTH	C	B <sup>b</sup>	E	A	'C13'	
	1 - - - - - 7 <sup>b</sup> - - 10 - - 13	10th, 13th added to '7 <sup>b</sup> '				
	PEDAL - CHORD -					

Figure 5

	C				F				G			
A. Single Pedal	C				F				G			
B. Double Pedal	C	C			F	F			G	G		
C. Root & 5th.	C	G			F	C			G	D		

Figure 6

rhythm, the single pedal note may seem inadequate and the foot will want to move in time. Sustain the Left Hand Chords while a second pedal note is played on the 3rd Beat in each Bar - the same pedal note as played on the 1st Beat in each Bar (Figure 6B). When proficient on the 'same note double beat' pedal technique, adopt a 'Root & 5th' pedal rhythm (Figure 6C). On the 1st Beat of the bar play the Root Note of the scale and on the 3rd Beat play the 5th Note of scale. For example, 'C' Chord Symbol: 'C' Pedal Note 1st Beat - 'G' Pedal Note 3rd Beat. The first and fifth notes of the 'C' Major Scale.

When the Left Hand Chord changes, the

pedal notes are the Root and 5th of the scale from which the new chord was formed. In the second bar the 'F' Chord Symbol indicates the 'F' and 'C' Notes, the Root & 5th Notes from the 'F' Major Scale.

The pedal notes in Bar 3 are 'G' & 'D', the Root and 5th from the 'G' Major Scale. This rule will apply for all Root and 5th Pedal playing. The oblique lines represent the 4 Beats in each bar.

In the next Making Notes, I will be gathering together some of the information from my previous articles to begin an explanation of 'Harmony'.



Jeff Macaulay

## TONE CONTROLS

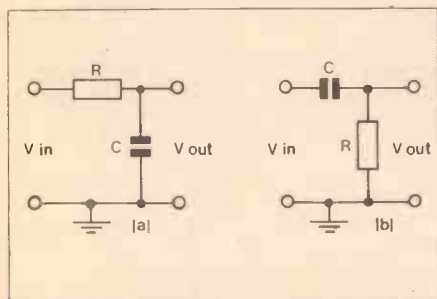


Figure 1. (a) Low Pass filter. (b) High Pass filter.

In response to a recent letter I thought I would concentrate on tone controls this month. Basically there are two opposing views on this subject. There are those who deny totally the need for controls. Others argue, just as vociferously, that even with the perfect system the listening room will adversely affect the sound.

To understand the operation of tone controls we need to go back to basic electronic theory. Figure 1a shows a low pass filter and Figure 1b a high pass filter. Both these filters rely on the behaviour of capacitors when fed with AC voltages. Capacitors exhibit an impedance to an AC signal which, like resistance, is measured in ohms. Unlike resistors though capacitive impedance alters with frequency. As the frequency increases the impedance decreases. Knowing this information we can understand qualitatively the action of the circuits shown in Figure 1.

Look at the low pass section. The input signal is applied through the resistor which forms a potential divider with the capacitor. The output signal is taken from across the capacitor. At low frequencies the impedance of the capacitor is much higher than the resistor's value. Because of this the output signal at these frequencies is hardly attenuated by the capacitor's impedance. At high frequencies the capacitor looks like a low impedance. In consequence the output signal is highly attenuated.

The high pass filter section works in the reverse manner because the components have been transposed.

Now it is possible to obtain relative boosts and cut in both the bass and treble regions with modifications of the simple passive circuits shown. The big breakthrough as far as hi-fi is concerned came when these simple circuits were replaced with active circuitry. Before passing on to this let's look again briefly at the simple filters.

The impedance of the capacitor can be found from the following equation,  $Z = 1/2\pi fC$ , where  $Z$  is the impedance in ohms,  $f$  is the input frequency in Hertz and  $C$  the capacitance in Farads.

The cutoff point of the filters shown, the legendary 3dB point, occurs where the impedance of the capacitor is equal to the resistance to which it is connected. To take an example let's assume that the resistor is 100k and the capacitor is 100nF. The 3dB point will occur when the impedance of the capacitor is equal to the value of the resistor, 100k. By rearranging the equation for  $f$  we get,  $f = 1/2\pi CZ = 1/(6.28 \times 10^{-7} \times 10^5) = 15.9\text{Hz}$ . The high pass filter will have a response flat above that frequency, that falls at 6dB/octave below it. The low pass filter will have the converse response.

At this point Peter Baxandall enters the picture. The tone control circuit that bears

his name and is found in virtually all pre-amplifiers has been around for a long time now (it first saw the light of day in the fifties!).

To understand how it works once again requires an excursion into basic circuitry, this time amplifiers. Look now at Figure 2a. This shows an op-amp circuit, the so-called virtual earth circuit. To understand its operation it is important to know what the op-amp is doing. The non-inverting input is held at earth potential. The op-amp operates to ensure that both its inputs stay at the same potential. If a positive voltage is fed into R1 with respect to earth a current will flow through the resistor equal to  $V_{in}/R1$ . In order that the inverting input stays at earth potential it is necessary that this current

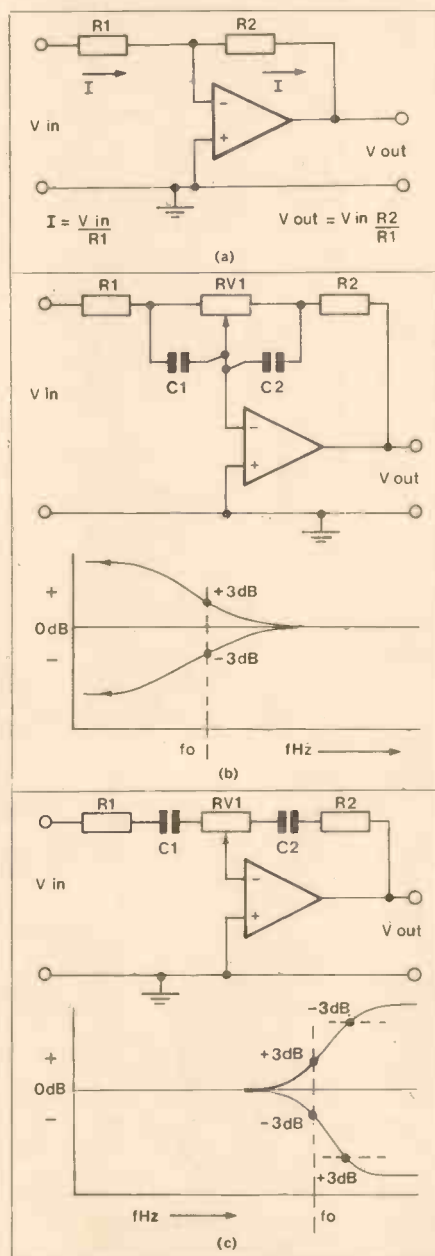


Figure 2. (a) Virtual earth amplifier circuit. (b) Bass boost and cut circuit. (c) Treble boost and cut circuit.

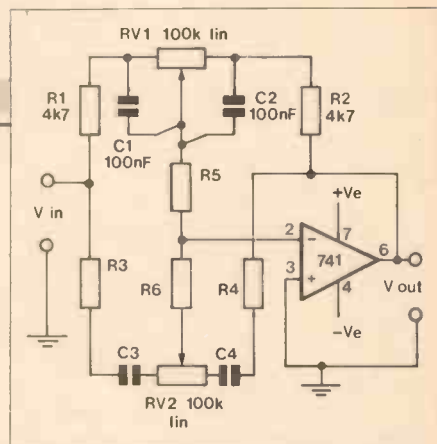


Figure 3. The Baxandall tone control circuit.

flows somewhere. The 'somewhere' is to the output stage via R2. The output voltage will therefore go negative to sink the input current.

Because the same current flows through both resistors the gain of the circuit is  $R2/R1$ .

If either resistor were to be replaced with a capacitor the same relationship holds true, but the gain will vary with frequency. Figure 2b shows how this information is used to construct a bass boost and cut circuit. With the slider of RV1 in the midway position the gain of the circuit will be unity since the network is symmetrical. Now let us assume that the slider, and hence the inverting input is at the right hand end of its travel, C2 will be shorted out and the whole of RV1 will appear in the input circuit.

At high frequencies C1's impedance will be negligible compared with either RV1 or R1. The gain of the circuit will be determined by the ratio of  $R2/(RV1+R1)$  unity. As the input frequency is lowered a point will be reached where the impedance of C1 is equal to R1. Here the response will be 3dB down. The response will continue to fall until the impedance of C1 equals the resistance of RV1. At this stage the response is 3dB up referred to the minimum gain of the circuit which occurs at DC.

What we have just described is a bass cut control. The beauty of this circuit is that with the slider at the opposite end of the pot, bass boost is obtained. Imagine the situation, C1 is effectively shorted and RV1 is between the output and inverting input. At very low frequencies the gain is  $RV1 + R/R$ . As the frequency increases C2 will begin to shunt RV1. The response starts to fall when C2 equals RV1 then falls to the +3dB point where  $C2 = R$ .

Figure 2c shows the treble boost and cut control. With the slider in the central position the gain of the circuit is again unity at any frequency. With the slider to the right maximum cut is obtained since at high frequencies the impedance of C is negligible. The gain being  $R2/(RV1+R1)$ . With the slider to the left maximum gain occurs at high frequencies.

The full circuit of a Baxandall tone control is shown in Figure 3. As you can see this consists of both of the sections discussed. Note though that R5 and R6 have been included to prevent interaction between them. The circuit shows only one channel. For stereo duplicate everything but use dual gang pots for RV1 and 2 to ensure tracking.

E&M

MAY 1982 E&M



# America

Ian Waugh

**D**igital is the word. If it's digital it must be new and it must be better. Digital processing has been applied to most areas of the music business, from mixing desks to effects units, and one day all instruments will be made this way. Synthesizers are still favourite for digitalisation (not an Americanism — it can be found in Collins) and recent additions include the Basyn Minstrel and the Voyetra series of synths.

The Basyn Minstrel from Gray Laboratories is a 5-octave, 4-voice polyphonic instrument with 32 preset sounds and facilities for programming a further 32 voices of your own choice. Thirty-two separate waveforms are available from the internal memory and more are accessible through a cassette. Other parameters controlled directly from the front panel include a transform filter (the digital equivalent of an analogue filter), transform filter mode and texture, digital envelope and four keyboard modes. Pitch-bend and modulation wheels are standard and a joystick is available from the factory. Price is around \$3,995.00.

The Voyetra series of synthesiser modules from Octave-plateau Electronics Inc. includes a mono module which can be driven off an existing keyboard or their VPK-5 polyphonic keyboard controller. The Voyetra Eight module is an 8-voice polyphonic unit whose programs can be edited by the Voyetra One, a computer or cassette. Operation is by way of a calculator style keypad and it has been designed to make all functions and features as easy as possible. The modules fit a 19" rack system and the VPK-5 is pressure and velocity sensitive and houses a joystick. A Polyphonic sequencer, string unit, organ and piano modules are planned for the future.

Two keyboards from Crumar, unavailable in the U.K. as far as I know, are the Trilogy and the Stratus. Of similar design and operation, their grey fascia and black rotary dials and LED push-buttons form an attractive package. Both have single and multiple triggering which can be assigned to different voices so that different modes can be used at the same time. Both contain a 'cathedral organ' sound which can be varied using four square wave footage. Six separate 24dB lowpass filters, six independent 4-parameter envelope generators, and six high performance VCAs span the keyboard controlling the two independent oscillators. The Trilogy contains a preset section and one variable mode to allow you to create your own sounds. It also contains the famous Crumar string sound consisting of selectable 8 and 16 footages with variable timbre, attack and release controls. The Stratus is priced under \$2000.00.

Performance Music Systems have launched their Syntar performance synth which is similar in design approach to the Moog Liberation. It weighs 14lb and has a neck like a guitar for the left hand to control pitch-bending, sustain, filter sweep and modulation etc. The keyboard spans three octaves.

Still with keyboards, Multivox have produced a drawbar organ called the FO-999 (I



Firstman 4-voice synthesiser.

wonder what *that* stands for?) in competition, I would think, with the Korg CX-3 organ and the Roland VK-1. It weighs 17 lbs and has the rotating-speaker sound. The bass can be split and has a separate volume control. There are full pitch and vibrato controls, expression pedal input, stereo output and percussion. It is priced at \$899.00. Multivox are also promoting the Firstman 4-voice synthesiser. Each voice has its own 24dB/octave LP filter, envelope generator, variable rectangular and sawtooth waveform VCO, noise generator and LFO. An open-panel arrangement allows the user to pre-set sounds and pre-programmed electronic piano, brass, clav, woodwind and filter sweep sounds are supplied. A separate string section has 16', 8', 4' and 2' voicings, an independent mixer, tone controls and a variable trigger mode. A sensor bar is used for pitch-bend and filter sweeps. Price is \$1895.00.

Ibanez have a new multi-effects unit called the UE405. It is a rack-mounting unit containing four effects: a compressor/limiter, a stereo chorus, a parametric equaliser and an analogue delay. You can connect an external effect which is treated as a fifth effect unit. The patching sequence can be altered with a 5-position 'insta-patch' selector switch, while remote FET switching controls individual effects and the master in/out. LEDs indicate the status of the unit and a separate output is provided for the stereo chorus. The UE405 is AC powered and the effects work from a regulated DC supply. Available from local Ibanez stockists.

Running along the lines of the auto features found on organs and now incorporated in many small keyboards such as those by Yamaha and Casio, Microtune of Boston has developed the Micro Tune IV which is a small (9½" x 5½" x 2½") instrument capable of producing chord progressions and simple tunes of arbitrary tonality and temperament. There are three fixed-scale temperaments and one user-programmable range, all quartz crystal controlled insuring accurate frequencies. Chords of up to four notes may be played at durations from 50 milliseconds to one second and tunes of up to 16 chords may be programmed. All programmed notes, chords and tunes are stored in a non-volatile memory. Sixteen tunes can be stored and the memory displays the tunes in bright 7-segment characters. The unit contains a loudspeaker and runs from rechargeable batteries. A battery charger is included. At a price of \$950.00 it may be of interest to many experimental electro-musicians and is an alternative to look at in the range of auto-feature instruments.

Just to confuse the buyers (that's you and me), there appears to be two Time Machines

on the market. One, simply called the Time Machine from Blacet Music Research, allows voltage control of all major functions. This includes delay, cancel, LFO rate, LFO RST, modulation depth and regeneration. It also contains an envelope follower, Curtis VCAs, Bi-Fet Op Amps, Brickwall Filters, and a Componder in the circuitry. Ideal for use in a computer orientated set-up, the Time Machine comes in kit form at a price of \$298.

The other Time Machine is also called the EEM-2000. (I prefer Time Machine. At least if you say that to someone they have a fighting chance of knowing what you're talking about. What wild and extravagant electronic wizardry is conjured up by the name EEM-2000? Are musical instruments not human too?) Anyway, the EEM-2000 is an analogue delay line with a range from 20 to 200 milliseconds. It will accept two inputs with independent mixing controls and selectable input and output levels allow signal matching to just about anything. Two outputs provide a dry/delayed signal output and an output of the delayed signal only. It will produce effects ranging from reverb and doubling to slap-back and discrete echo. An optional footswitch is available. Available from Audio Sales.

Bode Sound Co. have developed the ultimate phaser called the Barberpole Phaser. "Infinite Phasing is here!" they claim. And they are very excited about it. It provides infinite phasing in either direction, multiple phasing, rotating effects, built-in variable fuzz and a variable number of comb filter banks. There are no glitches and no splices and the unit has many other features which would take a review to explain. Details from Bode Sound.

With NAMM and Frankfurt shows now well behind us, my money is on more digital products and more manufacturers showing interest in Casio-type instruments. Where is the great synthesiser/electronic instrument revolution? Wherever it is, you will read about it in the pages of E&MM.

E&MM

Manufacturers and companies mentioned:  
Gray Laboratories, 1024 Lancer, San Jose, CA 95129.  
Octave-plateau Electronics Inc., 928 Broadway, New York, NY 10010.  
Crumar, Trevor Daniels & Co Ltd, 49 Potters Lane, Till Farm, Milton Keynes, Bucks.  
Performance Music Systems, P.O. Box 6028, Bend, Oregon, OR 97708.  
Multivox, P.K.P., 1, Clareville Street, London SW7.  
Ibanez, Chesbro, Box 2009, Idaho Falls, ID 83401.  
Microtune, 104 Charles St., Boston, MA 02114.  
Blacet Musical Research, 18405 Old Monte Rio Road, Guerneville, CA 95446.  
Audio Sales, 101 Townsend St., San Francisco, CA 94107.  
Bode Sound Co., 1344 Abington Place, North Tonawanda, NY 14120.

# Sinclair ZX81 Personal Computer the heart of a system that grows with you.

1980 saw a genuine breakthrough – the Sinclair ZX80, world's first complete personal computer for under £100. Not surprisingly, over 50,000 were sold.

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**New BASIC manual**

Every ZX81 comes with a comprehensive, specially-written manual – a complete course in BASIC programming, from first principles to complex programs.

## Kit: £49.<sup>95</sup>

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Quite simply, by design. The ZX80 reduced the chips in a working computer from 40 or so, to 21. The ZX81 reduces the 21 to 4!

The secret lies in a totally new master chip. Designed by Sinclair and custom-built in Britain, this unique chip replaces 18 chips from the ZX80!

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- Able to drive the new Sinclair printer.
- Advanced 4-chip design: micro-processor, ROM, RAM, plus master chip – unique, custom-built chip replacing 18 ZX80 chips.



## Built: £69.<sup>95</sup>

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You'll be surprised how easy the ZX81 kit is to build: just four chips to assemble (plus, of course the other discrete components) – a few hours' work with a fine-tipped soldering iron. And you may already have a suitable mains adaptor – 600 mA at 9 V DC nominal unregulated (supplied with built version).

Kit and built versions come complete with all leads to connect to your TV (colour or black and white) and cassette recorder.





ter-



## Available now - the ZX Printer for only £49.<sup>95</sup>

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# Acorn Atom Synthesiser Program

Acorn Computers are fortunate to have a software house producing programs specifically for their machines. One of Acornsoft's latest products is of particular interest to music makers, the so-called Synthesiser tape. The Atom computer has a small loudspeaker built-in, so once you've loaded the program from cassette — a process that takes about seven minutes — no more equipment is needed to start producing tunes. If you prefer, the Atom's audio output is available on a socket on the back and could be fed to an external amplifier, and to other sound processing devices if available.

The first section of the cassette is the INDEX file, which lists the tape's contents and contains a test sequence consisting of the computer's character set repeated both normally and in inverse video. Even if you've been successfully recording and playing back your own programs, Acornsoft's level may not be the same as yours; the test sequence enables you to set your playback volume accurately. My little portable recorder proved to be woefully inadequate for the task of playing back the Acorn's CUTS encoded tape, and I eventually used the Tascam 124 (reviewed last month) with every success, and 100% reliability. It shouldn't be necessary to go to such elaborate lengths, however; I only used the Tascam because it was handy.

The bulk of the tape is the SYNTH program itself. When run, it displays the prompt: M/R/P/E/S/L/T. Entering one of these letters will make the program do your bidding, any other characters it just ignores. M is for manual, and in this mode the ASDF . . . line of keys becomes a 1½ octave keyboard (from B to F — a strange choice) with some of the QWER . . . row being used as accidentals (black notes) where appropriate. As you're playing, a row of staves display the notes as black blobs, or hollow blobs for sharps.

Different note lengths aren't differentiated, because there is only one length; if you hold a key down, the note and blobs repeat rapidly like musical machine-gun fire. In other words, the musical notation that appears on the screen is a bit unorthodox, and it's a pity that more conventional note symbols aren't used in view of the Atom's high-resolution graphics capability.

You can only play one note at a time, and there is a choice of four different 'instruments' which can be selected by typing a number from 1 to 4; and you can change instruments as you're playing. The Atom's loudspeaker is driven by one bit of an output port; in other words, the sounds are made solely with rectangular waves without filtering or envelope shaping, and it would be churlish to complain about the instruments' sounds. Waveform 1 is called harpsichord (it sounds more like a clarinet), 2 is electronic synthesiser, 3 is bass guitar and number 4 is Hammond organ; Hammond ought to sue for libel! None of the instruments is particularly realistic, except for number 2 which has no reality to relate to, but number 4 sounds like a steam calliope with a collapsed lung!



By typing R, a tune can be recorded as you play it again with waveform changes if any. There are four locations available to store tunes in, each one 255 notes long, specified by letters A to D. Wrong notes may be deleted easily, and rests can be inserted using the space bar. If you can play, and it's difficult on the typewriter keyboard, the tune can be entered in real time; if you can't play, it's equally easy to enter a piece "blob by blob".

Once the tune is entered, it can be edited by typing E. A cursor can be moved back and forth above the music, and notes may be inserted, deleted or changed with ease.

The music can now be played. There are seven tempos to choose from, with a reasonable range, specified by typing T followed by a number from 1 to 7. The letter P can then be followed by letters A to D and numbers 1 to 4 in any combination. This string is read from left to right; a letter causes the corresponding tune to play, whilst a number changes the waveform if you haven't actually specified this within the tune itself. So for example, P2AA3C causes tune A to play twice, using waveform 2, followed by

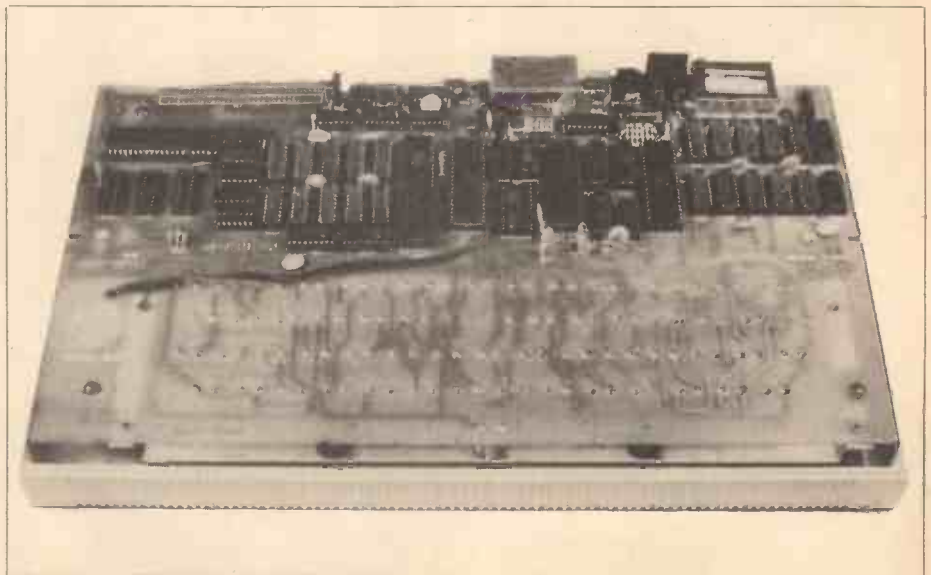
tune C played with waveform 3. Quite long strings can be set up this way, with the limitation of only four tunes to choose from of course, and tempo cannot be changed in the middle of a string. The longest tune that can be set up without repetition is 1020 notes, which should be long enough for most users.

Finally, each tune of up to 255 notes may be saved as a file on cassette, and reloaded as required, using commands S and L. Three demonstration pieces are provided on the cassette to get you started.

The name Synthesiser is a bit of a misnomer when applied to this program, since you can't get at the sounds and mess about with them to create your own; perhaps Music Box would be a better title. It's good fun for all ages though, and it must be better than continually blasting alien life forms from the screen.

The Atom Synthesiser cassette costs £11.50 including VAT and postage from Acornsoft, who can be found at 4a Market Hill, Cambridge CB2 3NJ. You will need 5K of program memory and 6K of graphics memory to be able to run the program.

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Internal view of the Acorn Atom.



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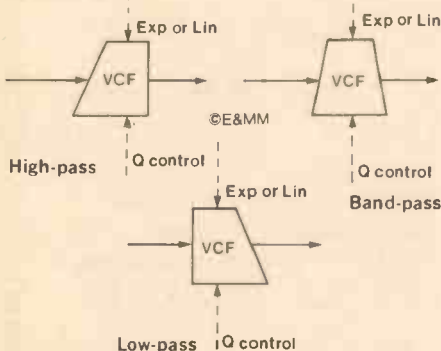
# GUIDE TO ELECTRONIC MUSIC TECHNIQUES by David Ellis

## PATCHWORK

Continuing on from where we left off in March, this PATCHWORK finishes the less than edifying business of shaping-up synthesiser modules, but fear not, gentle reader, great things are around the corner!

### VCF

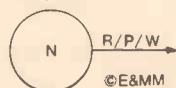
The variety of ways in which VCFs are configured warrants some attempt to give them distinguishing shapes in patch diagrams, and so, for high-pass, band-pass and low-pass filters, we've gone for the following:



There's nothing much that's controversial here, and it seems perfectly reasonable to use the filter's approximate response curve for its shape. The only problem with this is when you have awkward things like notched filters — shark's teeth here we come!

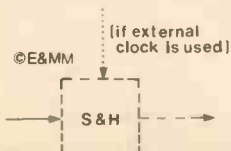
### Noise

We thought of using a broken line for the circle (noise isn't exactly cyclic, is it?) and colouring-in with pink or red when the noise wasn't white, but, in the end, our noise generator is just a plain and simple circle with R, P or W at the output to indicate the complexion of this universal panacea for all synthetic ills.



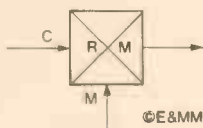
### Sample and Hold

Some synthesists treat the combination of Noise and Sample and Hold like their bread and butter; others can tell marge from the real thing and exercise a bit more caution in extolling the virtues of such auto-synthetic techniques. Still, the old S&H is invaluable for deriving CVs from audio inputs and deserves to be considered with a little more care than the average prepackaged, pre-processed pat of non-dairy origin.



### Ring Modulator

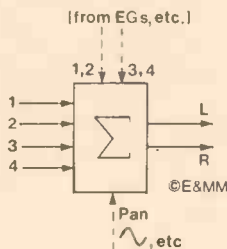
Without ringing the necks of a few waveforms, the Daleks would never have arrived on the scene and, though these cuddly creatures' voices could hardly be described as being particularly melodious, today's ring modulators make much better musical sense and are invaluable for synthesis of those inharmonic timbres typical of bells, gongs and the like.



Note the C for 'carrier' and M for 'modulator'.

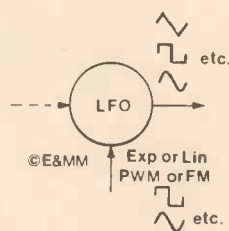
### Mixer

With multi-modular systems, some mixing prior to the final output is necessary to put everything into some sort of perspective. For many synthesisers, mixing is something of an afterthought and rarely goes beyond the passive variety. In the case of the mixers in the Spectrum synthesiser and the Digisound '80 range, this humble unit is transformed into an important sound-shaping module, and, in the case of the latter's voltage-controlled mixer, includes voltage control of each of the four inputs as well as control of stereo panning. Taking a 4 into 2 mixer as our example, a typical voltage-controlled mixer might be represented as follows:



### LFO

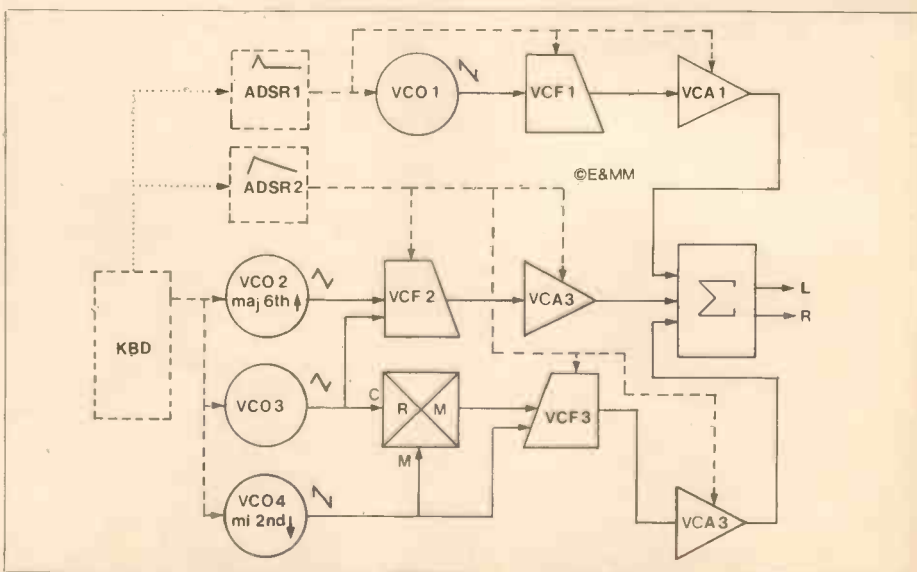
The difference between LFOs and VCOs is only really a question of the degree of oscillation, and so the VCO circle is employed for this module as well.



Manual control of LFO speed is obviously more often the rule than voltage control, and the same point applies to the option of PWM or FM, but there are some LFO modules which allow for this (the Digisound LFO, for instance). Esoteric stuff!

That completes our round-up of basic synthesiser modules; next month we'll progress into patch building proper. To ring out this PATCHWORK, I've included a BELL patch on which to practice your campanology.

The tuning of the VCOs is particularly important to realistic simulation of bells and the suggested major 6th and minor 2nd offsets are one way of getting a good sound. The ring modulator helps to beef up the sound, and the contrary motion of VCF2 and 3 duplicates the curious harmonic envelopes of large cathedral bells. The top section of the patch, i.e., that around VCO1, VCF1 and VCA1, is a clapper simulator and it's obviously important to choose a reasonable pitch setting for VCO1. A further ADSR could be added in to control mixer panning, but maybe that's just gilding the lily! ©E&MM



BELLS (modified from a patch by Jim Aikin)



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# WORKING WITH VIDEO

With musical promotions employing the video medium increasingly, Andy Emmerson explains how to do-it-yourself

## The Video Studio

Your own video studio — an impossible dream or quite feasible for £200 or so? The choice is in fact yours but it can be done if you are prepared to — produce in monochrome — do some shopping around, and — wait for bargains. In fact, my system cost under £200. I'll also tell you how you can set up your own production system, too.

First of all you must have the cameras, and I have not included these in the £200 outlay. For hobbyist or amateur video productions these cameras need not be anything flashy, and you'll find that even viewfinders are not even necessary if the cameraman can see a monitor set at the same time. Old surveillance cameras will do and you can buy these for £50 upwards at secondhand shops and dealers who advertise in the *Exchange and Mart*. What is essential, however, is that they accept external synchronising signals ("syncs") from a central source (sync pulse generator, SPG). Otherwise, if the cameras are free running, you cannot mix or switch from one camera source to another without a visual disturbance. While not harmful, such a "glitch" looks distinctly unprofessional!

The heart of your production facility is the SPG and this will supply the signals to synchronise your cameras and the special effects generator (SEG). Many SEGs contain an SPG as well, and a secondhand unit can be bought for £75 to £100. Likely sources are professional video dealers who have accepted them as trade-ins — they won't advertise them so you'll have to ring around and do some persuasive talking. Some of the better endowed technical colleges sometimes have old gear they will pass on to amateur groups, or sell at scrap value: if you know what you are buying you can get a real bargain.

Finally you will also need two monitors — monitors are simplified TV sets which take and display a direct video input. Normally they contain no audio or broadcast tuner sections. You need two — one for preview and one for line or output. Monitors come in all shapes and sizes; the little 9-inch and 12-inch screen models are ideal. Unfortunately they

are also eagerly sought after by the home computing fraternity with the result that secondhand models are not as plentiful as they might be. Ancient valve monitors are much easier to find, but they tend to be hot and bulky, in fact you won't need any central heating in winter! Expect to pay from £20 to £60 for a small secondhand monitor or £10 to £30 for a large one.

Your video sources, say two cameras, are connected to the inputs of the SEG. The basic function of an SEG is to select one of two input signals and switch between them. Independent of which input has been selected for output to line, the preview switches enable you to monitor either of the input signals without affecting the output, which is connected to your video recorder. The output monitor displays the signal going out. So far I have assumed that the SEG has only two inputs: in fact it will probably have more, up to six, but there's no need to make things complicated! Most SEGs enable you to switch from one signal to another in a variety of ways, by *cutting, wiping, fading or mixing*.

Cuts are straightforward instantaneous changes; one moment you are looking at picture A, the next at picture B. The switching is done electronically to avoid disturbances on the screen. Wipes are more elaborate; one picture is pulled away like a curtain to reveal another picture. You can have horizontal wipes, vertical wipes, a mixture of both or diagonal wipes. More expensive machines also permit circle and diamond shape wipes or random square effects. You must have seen these visual effects on *Top of the Pops*; they look fine on this type of programme but like jingles on the radio they are best used sparingly.

Fades are where you fade a picture down to black or up again. If you mix or crossfade you fade up picture B as you fade down picture A and the two pictures appear on the screen simultaneously for an instant.

Let's be honest — visual effects are great fun and presumably you're into the video hobby for entertainment. If you've played with an audio mixer and enjoyed mixing sounds just wait till you get your hands on a

video effects unit! Until the novelty wears off there's untold fun... most budget SEGs use slider pots for controlling wipes and fades, and the better ones incorporate micro-switches to switch out the resistance at the end of travel. On the professional machines you have levers which are geared to rotary potentiometers and these have a superb "feel" to them.

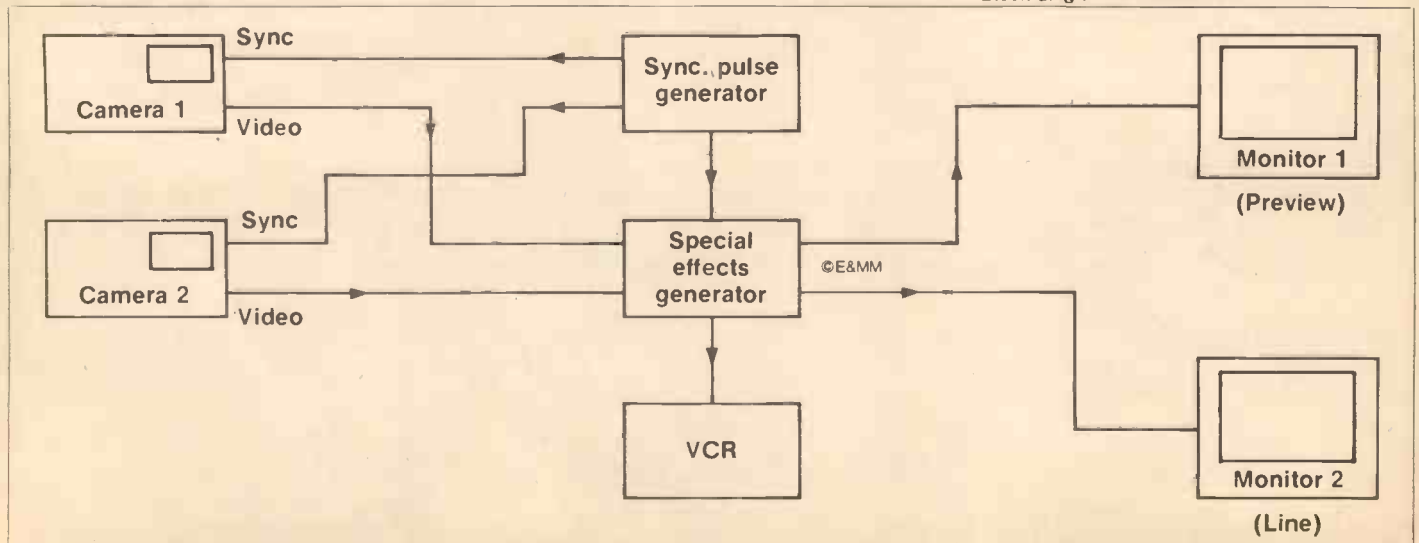
When you go shopping for an effects unit you'll probably be offered a Japanese made machine about ten years old. Reliable makes include Sony, Panasonic, Shibaden and Ikegami. Most models are desk-top devices with built-in power supply and SPG. If you buy your cameras together with the effects unit all well and good — otherwise describe what cameras you have (or take one along). This way you should avoid buying something incompatible; there are traps for the unwary. The one volt video signal is universal but some of the older Japanese cameras had non-standard sinewave drive signals. Avoid buying gear with unfamiliar sockets — if you don't possess matching plugs check that you can still get hold of these. And make sure you get an operating manual with any device, ideally you should have a service manual as well since nobody will repair it without one.

You may need to make up new cables to connect your cameras to the SEG, normally this will be no problem. Coaxial TV feeder cable, the thinner and more flexible VHF type, is ideal for this purpose, and most video equipment uses either BNC or UHF (PL-259) connectors. You can buy these at professional video shops but they come cheaper at CB or amateur radio shops.

Be sure to make a good job of soldering plugs. A small iron is useless on the PL-259 type since there is a lot of metal to heat up and you don't want to melt the plastic parts by slow cooking. If in doubt ask in the shop. Many mysterious losses of signal can be put down to loose strands of the braiding shorting the signal to ground or dry joints giving poor connections.

This article will be completed in the next edition of 'Working With Video'. **E&MM**

Block diagram of a video studio.





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# DEPECHE MODE



L to R: Vince Clark, Martin Gore, Andy Fletcher, Dave Gahan.

**D**epeche Mode are part of the new breed of groups — the all electronic band. But where they differ from other synthesiser bands such as Tangerine Dream or Kraftwerk is that they are producing electronic music which is acceptable to the record buying public (although Kraftwerk are enjoying chart success at present). Because of this commerciality, though, Depeche Mode have been frowned upon by some 'stuffed shirt' purists who believe that synthesiser music begins and ends at 8 note sequences, sustained string synths and rambling solos. Both styles of music are equally valid but bands such as Depeche Mode and the Human League who are producing high quality, purely electronic music may well stimulate interest in other forms of synthesiser music later.

Depeche Mode have released an album, 'Speak and Spell', and two singles, all of which have enjoyed considerable success and their latest single seems destined for the top end of the charts as well. Entitled 'See You', it was written by Martin Gore who has taken over the songwriting since the departure of Vince Clark. It features a great melodic sequencer bass line (using a Roland MC4 Microcomposer) and some truly wonderful vocal and bell sounds courtesy of the newly acquired PPG Wave 2 digital/analogue synth. The band were at the end of a British tour when I spoke to Daniel Miller, their producer, about the band.

*How long have the band been playing synthesisers?*

"About 18 months now. When they started they always used a drum machine and they were playing more conventional instruments. Andy

(Fletcher) was playing bass guitar and Vince was playing electric guitar. Only Martin had a synth but when the others saw the possibilities it offered they both got one as well. Then they started to like bands like Human League and Kraftwerk so they gradually changed their instrumentation."

*What equipment did they originally have?*

"Martin had a Yamaha CS5, Vince had a Kawai 100F and Andy had a Moog Prodigy."

*What are they using now?*

"Live, Martin uses the PPG, Andy uses a Moog Source and Alan (Wilder, who has joined the band recently) uses a Roland Promars. In the studio we use the PPG a lot and also an RSF expander module."

The RSF is a 19" rack mounted unit from France in which every parameter is voltage controlled. Attack, decay, filter resonance, even the selection of waveforms are all voltage controllable so you could, for instance, sweep through the waveforms with, say, an LFO or you could apply the keyboard CV (via an inverter) to the release time so that low notes will have a long release whilst higher notes will have a shorter release time, thereby simulating acoustic instruments more closely. The VCOs and filter are really fruity and the envelope generators are the fastest I've ever heard.

"We're using a Roland TR808 rhythm unit now instead of the Korg KR55 because it is more compatible with the other stuff we have and it's more versatile. We're fairly happy with our set-up for the drum sounds; we still use the ARP 2600 for the bass drum

and we use the TR808 for the snare sound.

*You've just got a PPG Wave 2. What made you go for that instead of, say, a Prophet 5?*

"It was Martin's decision. He tried one out and was really impressed with it, but one of the main reasons he bought it was that the sounds were so different and so clear, whereas the Prophet sounds like an analogue synth. Don't get me wrong, it's a really good sound but he thought it would be better to have something that provided unique sounds."

*Do you use its sequencer at all?*

"We haven't really used it that much yet. We're trying to get something designed to link it to the MC4."

*Have you tried the interface made by PPG?*

"No, we've not tried that. To be honest we've not had much time to experiment with it. We only got it just before we did the new single."

*Are you using the MC4 much?*

"Martin's using it a lot. We've done different things with it really. Again, we're only just getting into this. We've done one track where the MC4 controlled the three VCOs on the ARP 2600 for a chordal brass sound; that's worked really well. It interfaces with the ARP and the RSF module perfectly. The MC4 is a great compositional tool, though. There's a new song called 'The Meaning of Love' which, when Martin presented it, was very basic so we worked out a bass line on the MC4 but while they were playing along with it Martin did this little riff, so we just edited a space in the MC4's memory and inserted it. This means that you can work out the structure of a song and get it exactly



right without having to put it down on to tape and then you don't have to mess around with tape editing at a later date."

*I know you've had problems interfacing sequencers with click tracks and drum machines. Can you explain how you've overcome these?*

"When we were using the Korg drum machine with the ARP we had to invert the trigger pulse to make them compatible. The ARP 2600 has a lot of really useful voltage processors that help sort out problems like this. On the album we used the ARP sequencer to lay down the click on to tape and we spent some time getting that right but the more we did it the more reliable it became. It's still difficult to interface the Moog with anything because of the S-trigger system they use."

*What plans do you have for the future?*

"Martin's exploring a lot of different ideas on the PPG and MC4. We've just moved into an office and we've got some space that we might try to use as a studio. I still like working at Blackwing, where we recorded the album, but I'd like to be able to work 'at home', so to speak, where you have complete freedom to experiment."

*Have you any advice for any would-be synthesists?*

"When you buy a synth, try to buy something you can build around . . . I think that's very important. You can get quite inexpensive synths now which you can expand with sequencers, etc. Musically speaking, though, it's very easy, especially with electronics, to copy other people's style. I think that is a great danger so it's important to develop a style of one's own. It's good to listen to other people's music and be influenced but, at the same time, it can be dangerous to listen to other people too much."

## In Concert

It was at this point that we had to finish our alcoholic refreshment and make our way to the coach and to the gig which was at Cardiff's Top Rank Suite. Although it is the capital city of Wales, Cardiff is despicably low on music venues so bands have only the Top Rank or Sophia Gardens Pavilion. The latter was recently wrecked by snow (its roof caved in) so now the choice is even more limited.

The Rank is not the best venue in the world but the band coped with it very well. The PA was by Showtec of Bristol and was superb — one of the best sounds I've heard for a long time in fact. The prerecorded rhythm track was very tight and punchy; the bass drum really 'kicked you in the stomach'. David Gahan's voice sounded better than ever and any reservations I might have had about his vocal capabilities were dispelled. The rest of the band provided backing vocals and were, for the most part, spot on and pretty accurate.

Most of the songs from the album were featured as well as some new ones (including the new single 'See You'). The band played for about 1¼ hours and they played very well. I'm sure they won't object when I say that their keyboard virtuosity is not as flash as, say, Wakeman's or Emerson's, but then Depeche Mode's range of style is not as wide as those artists. Their arrangements are economical and effective, and instead of cramming as many notes into a bar as possible they use melodic and rhythmic motifs, which bounce around with the rhythm and sequencer bass backing tape to provide very hypnotic and solid rhythmic patterns. I thought that Alan, the new addition to the band, played particu-

larly well and Martin's use of the PPG was also very impressive.

There were slight technical problems which no-one seemed able to explain which resulted in the programs on the PPG and the Source switching back and forth but the band coped with the hitches very well.

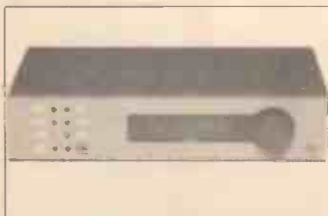
The gig was packed with all sorts of people of all ages. It was not, thankfully, an exclusively futurist occasion and, judging from the reaction the band got, everyone seemed to enjoy the gig as much as I did. The album had impressed me very much and I was curious to see how they would fare live. The last time I heard them live was on Radio 1 on a Peter Powell show outside broadcast and they were a bit shaky then, to say the least. But that was a while ago before they had released their album and obviously they have improved a lot since those days.

Depeche Mode enjoy their music and believe in what it has to offer. They are an unpretentious and modest group of people who, instead of donning silver capes, space suits, eye-liner or any of the other 'men-like-gods' accoutrements that have now become synonymous with certain synth players, have concentrated on writing and performing good pop songs and using synths and electronics as intelligently as possible.

It seems to me that while we have the current rock and roll, heavy metal or Latin-American revivals (I always feel revivals come about because of a total lack of imagination), Depeche Mode are forging ahead and creating something original. As far as I'm concerned, they have breathed new life into a flagging pop music scene. **E&MM Steve Howell**

## NEW PRODUCTS

### QUAD FM TUNER



Quad's FM tuner, the FM4 is now available from their appointed retailers. Designed primarily as an adjunct to the Quad 44, the FM4 uses microprocessor control for performance and ease of operation. It has seven preset programmable stations and once the user has pressed the appropriate button the microprocessor recalls the required station from memory and tunes it in taking care of muting and A.F.C.

A conventional tuning knob can be used to find the desired frequency when programming, this being shown in figures by the 7 segment display. A bar graph displays signal strength and centre tune simultaneously.

Acoustical Manufacturing Co Ltd, Huntingdon, PE18 7DB. Tel: 0480 52561.

### MORE MEMORY

MEMOTECH announce the completed development of Memopak, a 64K RAM memory extension for the ZX81. The extension increases the RAM of the ZX81 by 56K. It plugs directly into the rear of the ZX81 and does not inhibit the use of the printer or other add-on boards. The price of the Memopak is £79.00.

For further information contact: MEMOTECH LTD., 3, Collins Street, Oxford, OX4 1XL. Tel: 722102.

### SPEAKER CABINET KITS

Wilmslow Audio are offering speaker cabinets in flat pack form for all the designs in the new Kef Construction drive unit range. All the cabinet components are manufactured in MDF board and are machined for home assembly.

The kits can be supplied complete with drive units etc., or cabinets only. Prices for the cabinet kits per pair including VAT are as follows: CS1/CS1A £19.95, CS3 £22.95, CS5 £44.25, CS7 £57.95.

Further details from: Wilmslow Audio Limited, 35-39, Church Street, Wilmslow, Cheshire, SK9 1AS. Tel: (0625) 529599.

### DIGITAL REVERB



URSA MAJOR, Inc. has announced the production of a remote unit for its 8X32 Digital Reverberator. The remote provides all the controls and

displays of the mainframe front panel in a box that measures 5" x 9" x 1.5". The 8X32 now also features capability for computer automated mixdown interface. Early Reflections, Initial Reverberation, Decay Time and Low and High Frequency Decay are push-button adjustable within each of four basic programs (Plate I, Plate II, Hall and Space). Non-volatile registers can store 64 complete patches of user-derived programs for immediate recall. LED displays show all settings in use and a readout of the input and reverberation levels. The system will synthesise reverberation over a wide range of natural and unnatural spaces, including decay times up to 20.0 seconds.

For further information contact: URSA MAJOR inc., Box 18, Belmont, MA 02178, USA. Tel: (617) 489 0303, Telex 921405 URSAMAJOR BELM.

### DIGITAL MULTIMETER

Black Star Limited have released a new hand held digital multimeter made by Sabronics International Limited, the Model 2033. Features include 0.5% DC accuracy, large 3½ digit LCD, pushbutton function and range switches and a tilt stand.

The meter will measure AC or DC voltages 100 µV to 1000V in 5 ranges, resistances from .1 ohms to 20M

ohms in 5 ranges, AC or DC current from 10µA to 2A in 3 ranges and is powered by either a single 9V PP3 battery or an AC adaptor. The meter can also be used with the Sabronics high voltage probe.

The Model 2033 comes fully assembled with test leads and costs £36.75 (plus VAT).

For further details contact: Black Star Limited, 9a Crown Street, St. Ives, Huntingdon, Cambs. PE17 4EB. Tel: 0480 62440.



# RECORD REVIEWS

**Magnetic Fields**  
by Jean-Michel Jarre  
Polydor Super Pols 1033

The Jean-Michel Jarre 'sound' is unmistakable. His meticulous layering of synthesizers is more reminiscent of fellow countrymen like Debussy in 'La Mer' than any antecedents in rock and pop music, and, as an example of synthetic orchestration, it would be hard to improve on the sound of his latest album, 'Magnetic Fields'. It's a shame, then, that Jean-Michel Jarre seems to have put most of his musical eggs into the technical rather than compositional basket.

Taking the one long (18') track on Side 1, the main musical substance is the sequence: F/G\E\F (F major) x 2, Db/Eo\C/Db (Db major), Bb/Eb\Bb/Eb (Bb major), C/F/G\F (C major), E (C major). This is played by a horn-like lead synth (probably an Oberheim judging by the filter quality) after a few bars of F major introduction along the lines of archetypal syncopated sequences bounced across the stereo image. Indeed, it's this incessant autopanning, whether of sequences or percussive lines, that characterises the entire album, and, since the sound is rarely in one place long enough for it to establish a spatial 'fix', this is undoubtedly one explanation for the clarity of sound, and definitely a reason for its sonic attractiveness.

The other Jarre hallmark is the use of cascading scales and arpeggios streaming in and out of focus, again with liberal stereophonic disorientation, and these are added to the picture once the initial exposition of the theme is over. As with his 'swinging' sequences, Jarre also seems fond of repeated rhythmic groupings of a semiquaver and a dotted quaver to provide propulsion, or, in effect, a bass line that gallops into your inner ear. All this leads into a chordal section (with much use of an ARP) with some wonderfully light, sugar frosting-type percussive sounds, but musical development is limited to melodic variation rather than harmonic change.

After repeating the exposition and development (Jarre's classical background showing through here), there's a bridge passage based on the opening sequence and a foretaste of things to come with a wonderfully inventive sound in the bass that sounds like a synthetic growl.

Promoted to the depths of E minor, the main theme re-appears as a woodwind voice languidly searching for a lost chord, meandering along the lines of: E/G/A/B, E/G/A/G, E/G/B/A, E/G/A/G, before finally deciding on D minor with: E/F\D. Jarre makes stunning use of concrete techniques in this section, with mocking, guttural vocalisations and extraordinary 'grunching' sounds. I suspect that much of this was courtesy of the Fairlight CMI and it's interesting to see that this instrument is rapidly establishing its own character, just like the Prophet 5.

When the original motif of the first section returns on strings, one feels somewhat cheated, as the tonal structures tend to destroy the spell created by the use of less earth-bound techniques in the concrete section. After some heavy organ chords, a C major second subject appears in the form of a slow, rich

'cello solo (the Fairlight again): C/C/D x 2, C/C/E x 2, C/C/F x 2, C/C/E x 2. This fades, leaving sweeping pink noise and waves of swelling string chords. A jet then flies overhead, not once, but three times (once is clever, thrice is overkill), and we're back with driving drum machines plus sequences and chordal figures drifting in and out of view. A fast synth line enters, using a pattern of repeated notes, like: FFFF/G\D, moves from D to Bb major and back, and then there's a return of the track's opening chord sequence with the ever-popular galloping bass line. The synth line becomes more improvisatory and the Fairlight sax (probably the best 'preset' on the instrument) enters to end the track with an utterly charming jam session, culminating in the sax having the last word with itself courtesy of a brief duet. A beautiful track, but as ephemeral and glossy as candy floss. The central concrete section shows what Jean-Michel Jarre is capable of; surely he could afford to take a few more risks now?

Side 2 consists of a curious mixture, more like bonbons than candy floss, and still lacking in anything remotely strong enough to drive a stake through the heart. The first track is obvious single material, particularly because of its driving drum track sounding (accidentally, I presume) like the much-quoted Barundi drums of Adam and the Ants. The tune here is pleasantly innocuous, and consists of the usual cyclic falling and rising theme: G/A/B/A/G G x 2, F/G/A/G\F F x 2, E/F/G\F/E E, D/C/B/D/F/G.

Some 'natural' sounds of a Parisian train terminus (not Fairlight-sampled, as far as I could tell) segues into what I assumed from the record sleeve was "Sound of Mountain", supposedly titled from the 3-D waveform display of the Fairlight, but, in fact, it's probably just plain 'Magnetic Fields 3'. The main interest here is the counterpoint of natural mechanical noises, rather than yet another drum track, derived from sampling what sounds like the innards of a clock and/or a weaving machine! Musically, this doesn't exactly lead anywhere, and certainly doesn't live up to my original (but, I guess, erroneous) expectations of super-complex waveforms a la Fairlight, and so we have to be content with some rising synth figures and another languorous Oberheim solo with lots of slow LFO modulation.

'Magnetic Fields 4' passes happily enough, with some nice use of vocoding techniques, but I expected more of the playful punning of 'chants' with 'champs', so obvious on the sleeve, but only really evident in the central section of Side 1. Still, there are some nice percussive gong sounds above another version of the galloping bass line, but the solo line is too repetitive for my taste. More trains take us into 'Magnetic Fields 5, The Last Rhumba', which is fairly anti-climactic, but, just at the end, one gets a taste of a more romantic side of Jean-Michel Jarre's character, kilometres away from the detached coolness of the other tracks, with a luscious bit of synthetic jazz guitar fading in and out of a dance hall ambience — a message from the pre-magnetic tape past, perhaps?

/ = rising interval  
\ = falling interval  
• = short note  
— = long note

David Ellis



**Solid State Survivor**  
by Yellow Magic Orchestra  
Alfa ALF85664

YMO are the perfect example of a new electronic band. The comparison between them and the earlier bands, like Tangerine Dream or Ash Ra, is identical to the comparison between hard science fiction (Asimov, Arthur C. Clarke) and modern science fiction (J. G. Ballard, Norman Spinrad). The earlier people worked with ideas concerning outer space, while the new ones deal with inner space, the workings of the human mind.

Solid State Survivor, recorded in 1979 but only now having U.K. release, finds YMO poised on the brink of becoming a new electronic band. Side one is fairly traditional electronic instrumental music, with a film soundtrack feeling. Nevertheless, their percussionist, Yukihiro Takahashi, knew even then that traditional

rock drumming does not sit well with electronic music. He explores everything from Pollard Syn-drums to conventional tomtoms to produce an unflinching beat which is electronic but also human and varied. When, at one point, he uses the dreaded disco-style swept down sine wave whoop, his manipulation of the stereo images and use of double tracking maintains interest.

The fact that all three members of YMO contribute to the writing of their material, helps diversify their sound, without detracting from the overall group feel. Ryuichi Sakamoto is, at times, almost a concrete composer, while the others work in more traditional rock and classical veins.

On side two they offer four songs best described as Oriental Electronic Beatles in style, and this is where their exploration of inner space begins. In Kraftwerkian treated vocals they deal with the problems of humanity coping with the electronic age. They are, indisputably a pop band, but they have worked consistently on the fringes of that medium, producing intelligent, original and remarkably melodic modern music, spanning the gap between the Japanese scales and harmonics they grew up with and western futurism with no apparent difficulty. Music is changing radically, and YMO are in the vanguard of those changes.

Johnny Black

## VIDEO REVIEW



**Queen — Greatest Flix**  
Running time: 60 minutes

"We will rock you" because "We are the Champions". Watching this cassette I realised this was a complete understatement. Their performances have never been anything less than the complete show — one of the world's most visually exciting. Though the effects used have often been criticised as excessive and unnecessary, they are now being termed revolutionary. Four brilliant musicians, four very clever businessmen. This compilation under Queen Productions Limited does justice to both attributes; no, it isn't your average "20 Greatest Hits" album with a few random home movie clips, it is an up to date compilation of original films to accompany Queen's hits since 1974 (except the opening tune "Killer Queen") set out in chronological order to trace the development of both their music and their performances (on a scale of great to brilliant).

"Killer Queen" is accompanied by short, tabulated, biographies, concise but interesting (did you know for instance that Brian May has a Physics Degree at Imperial College, London or that John Deacon's favourite drink is tea?...). This is followed by the classic "Bohemian Rhapsody", the accompanying video being a milestone at the time. "You make me live" cries Freddie Mercury amongst a beautiful set of flickering candles. "Somebody to Love" and "Tie Your Mother Down" precede a complete change of scene for "We Will Rock You" which finds the band's defiant

chants cutting through the crisp snow in a forest clearing. There is then a short live version of the same song before the memorable scenes accompanying "We are the Champions" where Mercury in a black and white cat suit entices the live audience of screaming fans to claw at him.

The film accompanying "Bicycle Race" was brilliant, with such diverse elements as a penny farthing, and period dress. I do not remember seeing it at the time and was glad not to have missed it again! "Fat-bottomed Girls" leads into "Don't Stop Me Now" where Mercury sings "We're having a Good Time" — I didn't need reminding! A live version of "Love of My Life", the fifties style "Crazy Little Thing Called Love" and "Save Me" bring things almost up to date before the chic-style "Another One Bites the Dust" and the theme from "Flash Gordon" play us out.

The films are always appealing, and I don't think even Dulux have all the colour blends used at some time or another. The editing is remarkable, and it seems that every drum beat switches the scene, and without loss of continuity. The scenes from concerts were so life-like I wouldn't have been surprised if smoke had started pouring off the stage and out of the screen!

This video must therefore be thoroughly recommended not only to the Queen fan (who should have seen it by now anyway!) but also to anyone who only has seen a vague interest in the group.

Neil Johnson



# BOOK REVIEW

**New Rock Record**  
by Terry Hounsome &  
Tim Chambré  
Published by Blandford Press  
Price £5.50

The intentions of this book will be made clear from some quotations on the back cover: "It provides an invaluable, accurate and enlightening listing of rock music albums and the musicians, bands and groups who appear on them." And: "New Rock Record contains over 5,000 groups, bands and individual artists coupled with details of more than 30,000 long-playing record albums on which they appear. In total, some 40,000 musicians are listed..."

A challenging and daunting feat but co-author Terry Hounsome has more modest aims when he says in his introduction: "New Rock Record contains some 4,500 entries, 30,000 LP records and 25,000 different musicians." One claim must be wrong!

The contents, however, show the amount of work and time (five years according to Hounsome) spent in organising such a directory. It contains over 500 pages and includes a 68-page index of musicians' and groups' names (about 25,000).

The book is easy to use and understand once you have looked-up and cross-indexed a few names and if you like the sound of a particular bazouki player on an album you can find out which other albums he played on.

The introduction states that: "The editor is aware that some entries are incomplete and that there are some omissions." In a volume of this size and nature it is to be expected but some of the errors and omissions seem unnecessary and sometimes the logic is a little hard to follow. While looking up some of my favourite artists (and getting sidetracked in the process) in a book which intends to take in "... all forms of Rock music from its roots to the present day; as well as mainstream Rock it also contains much information on Pop, Soul, Reggae, Jazzrock, Blues, Country and Folk." It was strange to see no listing for, for example, Donna Summer or Barbra Streisand while Boney M and Kris Kristofferson have a section to themselves.

(Actually, a *Barbra Streisand* is listed as doing vocals for Kris Kristofferson on his 'A Star is Born' album but she is not even listed in the index.)

Abba has a full listing with Cliff Richard and the Crusaders (although Randy Crawford is credited here on vocals, her solo album is ignored). Country music is mentioned although Jim Reeves and Slim Whitman are not. Dolly Parton is credited with vocals on other people's albums but not given a separate listing of her own.

Obviously, the line had to be drawn somewhere and no doubt each reader will have their own opinion as to where it should have been.

Some errors are blatant. Jim Steinman of Meatloaf fame is listed as *John*. Wanda Jackson had a release on Capitol in 1967. The Residents' Commercial album (1980) is not included. Larry Fast is not credited with the Synergy albums (no one is) about which very little information is given; even their release on Passport Records is not given apart from the number of the 'Cords' album for which the year is omitted. Numerous albums do not have their year listed.

While cross-indexing the B. B. King discography with that listed in his biography (see review) there were

several anomalies although the New Rock Record did list several foreign printings of US releases.

The book is intensely interesting and fascinating and once you start cross-indexing a few musicians you could easily spend several hours tracing musician to band and following them from group to group.

It does not have all the answers and if used to settle wagers of the ... but Randy Brecker did play trumpet in 1968 for the McCoy's ... type then the loser could possibly justify non-payment on the grounds of a possible error.

For all that, an elucidating work but certainly not definitive.  
Ian Waugh

**Video Questions and Answers**  
by Steve Money  
Published by Newnes Technical Books  
Price £1.95



Both the author of this book and the series to which it belongs are well established so I had great expectations of 'Video Questions and Answers'. I was not disappointed!

In the 112 pages of this little book Steve Money has managed to cram a vast amount of useful information on all aspects of video and television, all presented in convenient bite-sized chunks. There is no padding to fill up the book, just enough information to answer all the average person wants to know on a topic. Each topic is prefixed with an introductory question (just a little bit bogus, this) but the answers are all solid fact. It is clear that a lot of thought and checking have gone into this book and I didn't spot a single error. Separate chapters cover the characteristics of the video signal, TV broadcasting, video screen displays and colour television. Also covered are video cameras, videotape recording and even allied subjects such as teletext and viewdata, TV games and videodisks.

The book is an ideal first book for someone starting at technical college or a keen hobbyist but it will also appeal to anyone who wants to know a bit more about how things work. For instance the author explains the operation of touch switches, digital remote control and Surface Acoustic Wave Filters. He gives the answers to questions on lag in vidicon tubes, lenses for cameras and similar issues. The book is remarkably up to date, covering video recorder formats down to the new 1/4 inch CVC one and is completely clued up on the new extra-long video cassettes. The more basic principles are not ignored either.

You don't get many good books for under £2 these days but this is one of them. For the price it is difficult to fault and is certainly recommended.  
Andy Emmerson



**The Listeners Guide to Jazz**  
Alan Rich  
Blandford Press Ltd  
£4.95

"The history of Jazz doesn't lend itself to precise categories" is the author's opening line. True. So if it is an in depth history of jazz you are after, this book will disappoint you. Instead, Alan Rich has produced a simple worthwhile listener's guide neatly laid out, and in under 200 pages! The book does categorise, but in chronological sections of jazz development from New Orleans through swing and be-bop to fusion and beyond, with a chapter devoted completely to Duke Ellington and Miles Davis (though I must question the justification in singling out the latter).

In each chapter a brief outline of the jazz form under discussion is given which is informative yet concise. This is followed by sections on the most important jazz musicians

related to the jazz form, such as Parker in the be-bop section and Cecil Taylor in Avant Garde.

Unless you are a specialist, all the jazz names likely to be encountered as a listener are dealt with and a short bibliography given, enabling unfamiliar artists and their recordings to be explored. A small criticism must be given, however — the bibliography never exceeds ten record titles and more than four is rare, the remaining space being devoted to rather subjective comments on the recordings which, considering the title of the book, should perhaps be left to the listener to conclude, reading relevant facts off the record sleeve itself.

A photograph of each musician accompanies a brief yet concise musical history which dips into their private lives where necessary, revealing facts which would certainly swell most jazz buffs' knowledge. It was nice to see that this American author includes our own John Surman in the modern section.

So, a very commendable book, ideal for someone with an as yet passive interest in jazz. By picking the cream of jazz recordings Mr Rich has given the opportunity for positive development of that interest and progression to either more serious listening or reading up of these musicians' private lives (most of which are fascinating).

"The Listeners Guide to Jazz" is a compact, interesting and, therefore, useful stepping-stone to the world of jazz.

Neil Johnson

MUSIC DIRECT  
BY MAIL

**THE COMPLETE SYNTHESIZER:** A comprehensive Guide by David Crombè — tells you everything you need to know about synthesizers the way they work, how to get the best out of them. In clear easy to follow language, backed up by diagrams, the book deals with the three elements of sound, standard tuning, frequency & music, types of synthesizer, voltage control, the filter, synthesizer accessories and much more besides. With the aid of this book, a whole new area of music is opened up to you. And it ensures that you know what to look for when acquiring a synthesizer.  
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BLOCK LETTERS PLEASE

# The Peak Programme Meter

The following article is an explanation of the design of Peak Programme Meters, followed by a look at a PPM kit, the 402/K from Bulgin Electronics (Soundex) Ltd. by David Strange

Since the inception of mixing desks and recording equipment in general, there has been a need for some kind of recording level meter to monitor the signals being processed. Record at too low level and on replay the system noise consisting of tape 'hiss', mains hum and general amplifier noise will be present. Record too high, to avoid the noise and there is a danger of running out of head room into distortion.

The most common type used is the Volume Unit (VU) meter, however, the difficulty in interpreting the needle's action led to the development of the Peak Program Meter (PPM). This type of meter which was pioneered by the BBC over forty years ago is most valuable for setting the correct recording level and resolving visually the ear's perception of the sound level.

## General Description

From Figure 1 it can be seen that a PPM has four main sections: a full wave rectifier, time constant, processing amplifier and meter.

### Full wave rectifier

The full wave rectifier is required due to the nature of the audio signal. If this was a pure steady tone, half wave rectification would suffice, since both positive and negative parts of a sine wave are the same. However, most audio signals lack this symmetry as shown in Figure 2, and therefore require full wave rectification.

As well as being able to rectify all types of audio signal, the rectifier must also be free from any threshold effects. A simple diode will not suffice because each of the diodes requires a voltage threshold to be reached before it begins to conduct. This would mean any meter connected to such a system suddenly coming alive as the audio level increased beyond a certain point.

To overcome this problem, an active rectifier is used with the diodes placed in the feedback loops of operational amplifiers (see Figure 3). This has the effect of linearising the diodes by removing their threshold voltage for conduction. In addition this type of rectifier can be used down to very low signal levels and has the advantage of low output resistance.

One other important characteristic of the rectifier is that it must have a flat frequency response throughout the whole audio spectrum.

### Attack/Decay Time Constant

Having obtained a rectified or unidirectional version of the audio signal, it is not enough to simply apply it directly to the input terminals of the meter. In the case of a moving coil instrument, the average of signal rather than peak value, would be indicated and although a light column may indicate the peak of the signal, readings would be very confusing. It may be wrongly assumed that an instant response by the meter is the ultimate goal of a PPM and that this is reflected in the general popular market shift away from mechanical meters to light columns, however, two things should be taken into account when setting the speed of

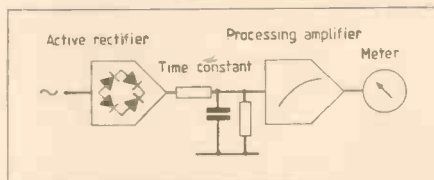


Figure 1. Block diagram of typical PPM.

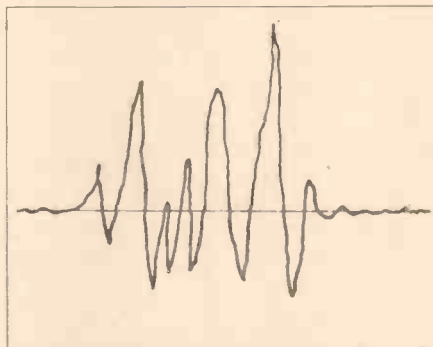


Figure 2. Typical audio signal.

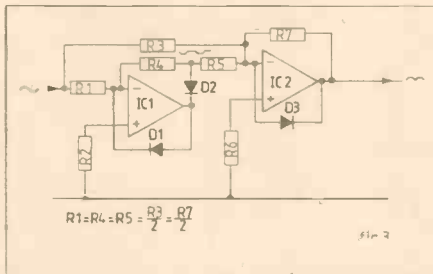


Figure 3. An active full wave rectifier.

response of a meter, these are: the ear's perception of distortion and the perceived level of pulsive sounds.

Firstly, the ear will only recognise distortion if it lasts longer than a certain period of time. Hence a click will always sound like a click even if it is over the top. Secondly, the perceived level of pulsive sound depends on the duration of the event as much as the real level. A super-fast meter can present totally confusing information. The two totally different signals shown in Figure 4 may be perceived by the ear to be the same level simply because duration as well as level is being taken into account.

One way in which the PPM may be made to take into account the ear's response to pulsive sounds is to be given an attack time constant. A resistor and capacitor as in

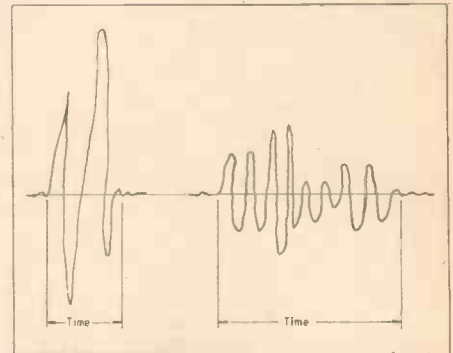


Figure 4. Two different signals may be perceived the same.

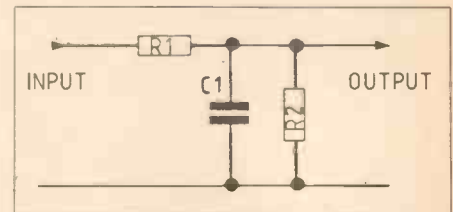


Figure 5. Time constant components.

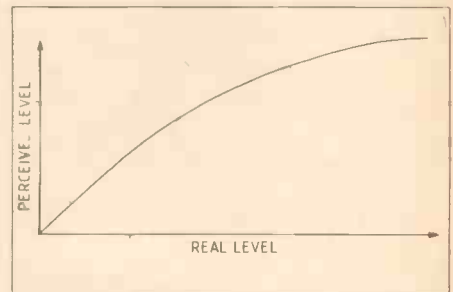


Figure 6. Graph of real against perceived sound levels.

Figure 5 will do this function. Audio events of sufficient duration will always charge C1 to the voltage on the input side of R1, but shorter duration events, because of the time taken for C1 to charge through R1, will be over before C1 has time to fully charge. The voltage on C1 is therefore a measure of the duration as well as the amplitude of the incoming signal. R2 is used to leak away the voltage stored on C1 and will determine the return time of the meter needle when the audio is removed. A fairly long return time, 2 seconds or so from full scale deflection, does much to relieve eye fatigue when watching the meter.



## Processing Amplifier

When audio is not of a pulsive nature, but more steady, the perceived level is almost entirely dependent upon amplitude (within the normal frequency response of the ear). The relationship between perceived and real level is logarithmic, so for example, two real level changes of 10mV to 100mV and then 100mV to 1000mV are interpreted by the ear as being two equal changes, even though the actual range of voltage covered by the second change is much greater than the first. To put it another way, the ear perceives as equal changes what are in fact equal ratio changes (10:1 in each case) as shown in the graph Figure 6.

The temptation is, when faced with this logarithmic relationship, to reflect the perceived level using a linear response meter calibrated with non linear scale markings. The VU meter is classic in this respect but close scrutiny reveals the scale to be far from ideal, since one third of the scale is taken up with a red overload region, where because it presumably means what it says, the needle is not supposed to go; another third where most audio is never consistent enough to remain; and lastly a lower third where the scale markings are cramped and lack resolution, this being part of the scale where most resolution is required.

The PPM overcomes scale calibration problems by processing the applied input voltage to the meter in an amplifier that, as the input level increases, reduces gain logarithmically, see Figure 7. The logarithmic processing is generally achieved piecewise by a series of straight line approximations that allow minimisation of errors individually at various points along the scale as shown in the graph Figure 8. The actual error allowed at each point of the scale is closely specified, and at important points, despite the scale's apparent crudeness, is as low as  $\pm 0.2\text{dB}$ .

The 1-7 PPM scale preferred by British broadcasters is shown in the photograph. It represents 24dB in 4dB steps, but there are many other acceptable scales, some of which cover different ranges of levels. It should be said also that the meter movements used for PPM systems are of special design to provide fast reliable response with minimal overshoot. The electrical characteristics of the drive circuits may differ slightly

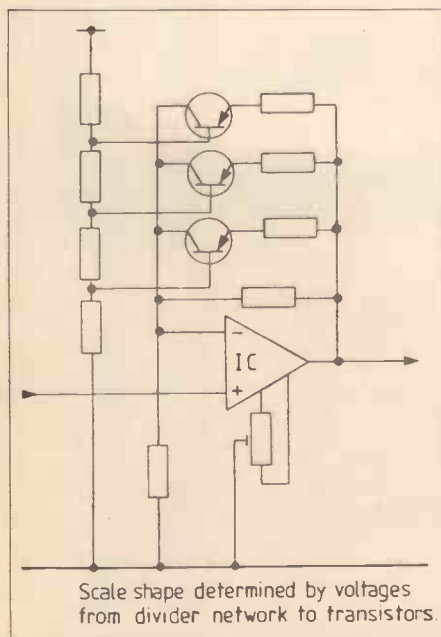
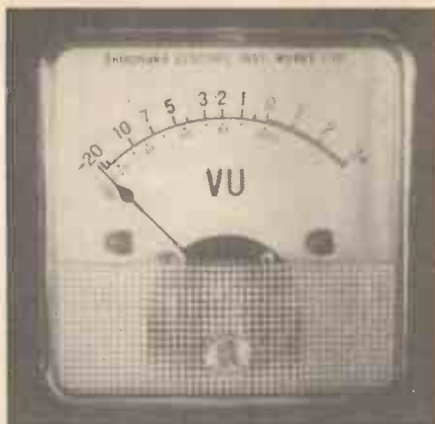


Figure 7. Typical processing amplifier.



VU meter scale.

for these various meters but all function to the same basic principles as previously described.

## Bulgin 402/k PPM kit

We are not able to present this in our normal project style since certain components of the circuit must be selected and the meter must match the associated electronics. However, Bulgin Soundex have made available to us three versions of their range of PPMs at reduced prices, see the special offer details at the end of this article.

The specification for the 402/K is given in Table 1. From this it can be seen that it will work with a wide variety of supply voltages and covers the complete audio spectrum. The last three categories; overshoot, response to tone bursts and decay time indicate the action of the meter's needle — very little overshoot but a fast reaction to sudden bursts and because of the 1.75s decay, no rapid swinging back and forth that is characteristic of VU meters.

### Circuit

The complete circuit for the PPM 402/K is shown in Figure 9. RV1 determines the sensitivity of the circuit. IC1 is a preamp. IC2 and 3 with the associated resistors and diodes form the active rectifier as described earlier. R14, 15 and C7 form the meter time constant. The needle attack time is approximately 0.6ms and the decay time 1.75s.

IC4 and associated components form the processing amplifier. As described earlier, a series of straight line approximations are made using transistors to form the real and perceived sound levels. In the circuit for the 402/K only one approximation stage is employed. This is formed by resistors and diode D5. Diodes can be used in the same way as the transistors, viz: with an increasing signal more diodes begin to conduct.

The PCB photograph illustrates the straightforward construction of the PPM 204/K and the following text explains the procedure required to build the kit.

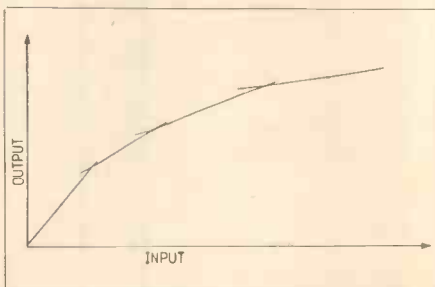


Figure 8. Processing amplifiers approximation to sound level.



PPM scale.

Supply voltage:	+11V to +27V DC
Supply current:	22mA at 12V, 30mA at 24V
Frequency response:	25Hz to 20kHz within 1dB
Input impedance:	20k $\Omega$
Sensitivity:	variable up to 75mV (-20dBm) by potentiometer
Calibrated scale range:	26dB
Calibration accuracy:	better than 0.5dB all points between -16 and +2dB
Overshoot:	less than 1dB (measured by suddenly applying a steady signal whose amplitude would give 0dB indication)
Response to tone bursts:	100ms — 0dB $\pm 0.75\text{dB}$ 10ms — -2dB $\pm 0.75\text{dB}$ 5ms — -4dB $\pm 0.75\text{dB}$ (measured by applying steady 5kHz tone bursts whose steady amplitude would produce a 0dB indication)
Decay time:	1.75s $\pm 0.2\text{s}$ (time taken for meter to fall between 0dB and -25dB when the signal is suddenly removed)

Table 1. Specifications of the PPM 402/K.

### Construction

Check against the parts list that all components have been supplied in the kit. Identify all the components and observe their layout on the PCB. Note that IC2 and 3 may be supplied as either eight pin DIL or metal can types. Solder the components to the PCB ensuring that the polarity of C2, C7 and the diodes is correct. Also, note that IC2 will be coloured red so ensure that this is inserted in the correct location. R14 and R15 are the two resistor elements of the time constant circuit and to facilitate later alterations to the constant it is advisable to mount these on pins.

Observing polarity, mount the meter on the board using the meter studs, nuts and washers provided. Connect the power leads to pins 24V DC POS and NEG. Connect audio leads, screen to LO INPUT (same as 24V DC NEG) and signal to HI INPUT. The meter will then be ready for calibration.

### Calibration

The sensitivity of the meter is adjustable over the range 0 to -20dB. To calibrate the instrument against an existing VU meter (this being the simplest method since most people will have VU meters) a source of steady tone is required, say a 1kHz sine wave. With the PPM across the output of the equipment sending the tone, the gain of the recorder is adjusted so that its VU reads 0 with the PPM reading -6dB below reference. The reference level at 0dB on the PPM is 0.775V RMS. Mark 6 on a 1-7 PPM is the reference so the PPM is adjusted to indicate 4½. Note on the Soundex 402/K the -6dB point is marked on the scale. When using 1-7 scale PPMs, the peak audio level is indicated by the 6 mark.

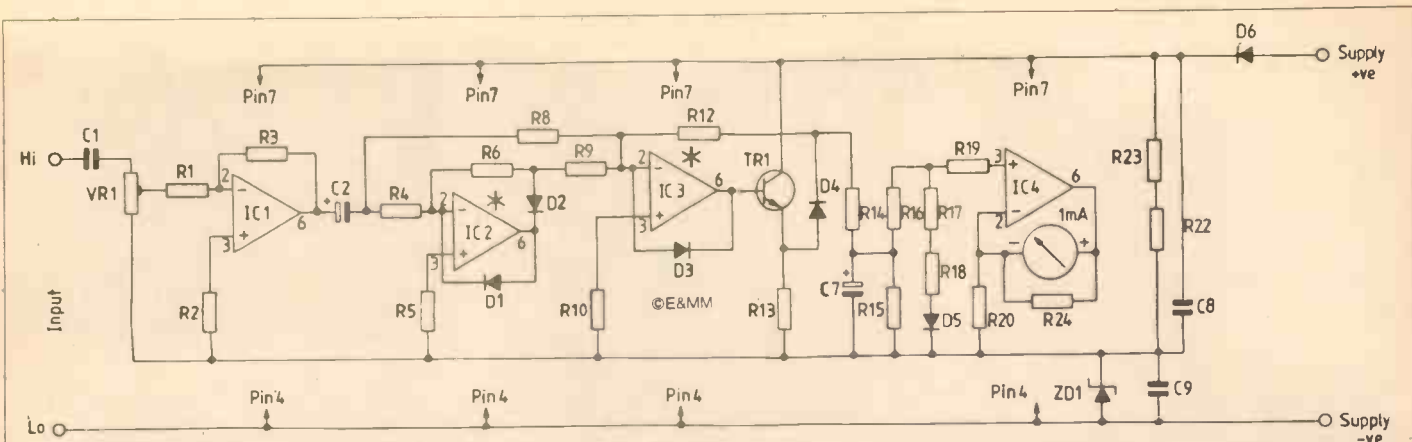
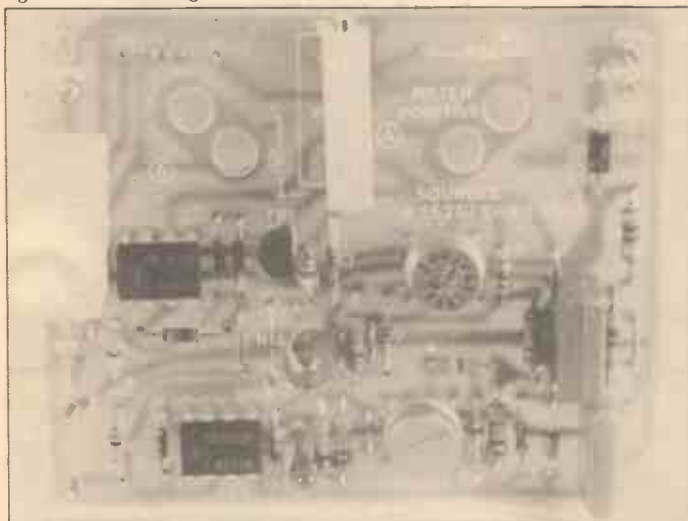


Figure 9. Circuit diagram of PPM 402/K.



## Special Offer

Bulgin Electronics (Soundex) Ltd, have made available to E&MM readers in the U.K. three of their current range of PPMs. The PPM 402/K (described in the article), the PPM 402/24 and the PPM 404 (shown in the photograph). PPM 402/K kit comprises: PCB, components, and one uncased meter. **Normal price £45.98. Special Offer price £40.** PPM 402/24 comprises a built version of the uncased 402/K. **Normal price £55.13. Special Offer price £49.**

Please note that both the above items require a separate power supply of between +11V to 27V DC.

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Further details of all the Bulgin meters can be obtained from: Bulgin Electronics (Soundex) Ltd, Park Lane, Broxbourne, Herts EN10 7NQ.

PPM PCB component and wiring slides.

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# ELECTRONICS & MUSIC MAKER DEMONSTRATION CASSETTES

Electronics & Music Maker is the first monthly publication to produce its own cassettes that will provide a unique aural complement to the magazine. Produced in our own recording studio, these C60 cassettes will allow you to hear the sound of instruments and electro-musical effects in our features and reviews.

**Demo Cassette No. 1 (March/April issues) contains:**

1. Matinee Organ. 2. Yamaha SK20 Synthesiser. 3. Guide to Electronic Music Techniques. 4. Sharp MZ-80K music/sound effects. 5. Warren Cann plays Syntom Drum Synthesiser project. 6. Paia 8700 Computer music. 7. Frankfurt Music Fair.

**Demo Cassette No. 2 (May/June issues) contains:**

1. Tim Souster. 2. Adrian Wagner plays Wasp & Spider. 3. Lowrey MX-1 Organ. 4. Apple Music System. 5. E&MM Word Synthesiser. 6. Fairlight Computer Musical Instrument. 7. Sharp Composer program. 8. Yamaha PS20 keyboard. 9. Vero musical projects. 10. David Vorhaus LP 'White Noise' excerpt.

**Demo Cassette No. 3 (July/August issues) contains:**

1. PPG Wave 2 Synthesiser. 2. Syn-

wave project. 3. Wersi Pianostar played by Hady Wolff. 4. Alphasac 16 music. 5. Atari 400/800 music. 6. Duncan Mackay. 7. Hexadrum project. 8. MTU music. 9. Casio VL-Tone. 10. Irmin Schmidt's Toy Planet LP extracts.

**Demo Cassette No. 4 (Sept./Oct./Nov. issues) contains:**

1. Linn Drum Computer. 2. E&MM Harmony Generator project. 3. City University music. 4. Casio MT-30. 5. Roland Instruments: Jupiter 8, TR808, MC-4, & GR300. 6. Steve Howell piece. 7. 'Ecstasy' LP by Georg Deuter excerpt.

**Demo Cassette No. 5 (Dec./Jan. issues) contains:**

1. Teiscó SX-400 Synth. 2. Poly ZX81 music. 3. Study Music 1: Synth backing for you to play solo of Dec. '1984' Rick Wakeman music. 4. Casiotone 701. 5. Yamaha CS70M. 6. Roland CR8000. 7. E&MM Synclock project. 8. Study Music 2: 'Exit' music from Jan. issue minus theme for you to solo with. 9. Alpha Syntauri Computer pieces. 10. Elka X-50 Organ. 11. Soundchaser. 12. Ian Boddy music. 13. Richard Mitchell's electronic music for film.

**Demo Cassette No. 6 (February/March 1982 issues) contains:**

1. Yamaha GS1 played by Dave Bristow. 2. Korg Trident Polysynth. 3. Roland Drumatix sounds. 4. Study Music 3: Ike Isaacs performs his 'After Hours' music in Feb. issue. 5. Firstman Sequencer. 6. Wersi Comet played by Mark Shakespeare. 7. Sequential Circuits Pro-One Synth. 8.

Study Music 4: Kraftwerk's 'Computer World' sample backing music to play solo with. 9. Home Electro-Musicians: Johnny Demestos, Gerry Taylor. 10. Digital Delay Line Effects Project. 11. Percussion Sound Generator Project. 12. E&MM Spectrum Synth sounds.

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E&MM/5/82



# Calrec Soundfield



## A versatile microphone — and its British!

Calrec Audio of Hebden Bridge in Yorkshire, have developed their SOUNDFIELD microphone over a number of years, based on the mathematical theory of sampling on the surface of a sphere developed by Michael Gerzon at the University of Oxford. Physically it is more than a microphone as such — it's a complex electronic control unit with the provision of linking the microphone part with up to 150 metres of multicore cable. The price of £2,600 should not be seen as anything other than representative of the superb beast it is...

It has basically two areas of use — as a superb truly coincident stereo microphone with some unique features, or as a 4-dimensional Surround Sound microphone. The Surround Sound aspect should not be thought of as the disastrous quadraphonic sound of the early seventies. It is the microphone heart of the NRDC Ambisonics Surround Sound system which goes way beyond the achievements of the discredited quadraphonic era.

My temporary use of the Calrec Soundfield mic has been as a stereo microphone so I will mainly comment on this aspect. It was for a rather unusual line-up of four double basses.

There are four capacitor capsules in the microphone head with the usual low noise amplifiers in the body proper. The capsules are arranged uniquely in a tetrahedral form close together, contrasting dramatically with other attempts at coincidence. I am struck by the clarity of the stereo imaging due to the true coincidence (up to 10kHz) produced by this close



Calrec Soundfield Microphone.



Microphone head with cover removed.

positioning as well as the compensation facilities in the control unit's electronics, which provide a host of extras not normally available with stereo microphones. Opportunity is also taken in the electronics to create a wider and flatter frequency response and to improve the polar patterns over the frequency range (with further imaging improvements), apart from coincidence compensation.

A few stereo microphones feature remote control of the polar patterns. So does the Soundfield — from omni through to figure of eight. But additionally the angle of the capsules can be continuously adjusted between 0 degrees (i.e. mono) and 180 degrees at the control unit.

Further, suppose the microphone is not properly lined up for an orchestra or large group in a concert hall (and this can easily happen in slung situations) — no problem — an azimuth control allows a continuous 180° 'electronic' rotation! Suppose one needs the mic tilted up or down — no need to walk to it to mechanically move it — a control unit knob movement suffices. An amazing control is that for dominance — it gives the effect of moving the mic nearer to or further from the performers! Almost an uncanny feature.

But that's not all. If four channels are accurately recorded (the B format signals), then the whole of the above processing can be done subsequently on playback! So the balancer can keep his options open on azimuth, elevation, polar pattern, capsule angle and dominance. This way subsequent replay in ideal monitoring conditions can allow the correct decisions to be made.

The rest of the control unit deals with the Ambisonic monitoring or playback. PPM metering, level control and headphone monitoring are also included.

To sum up — a superb British microphone system with an unsurpassed versatility. With the return to simpler mic techniques (brought about incidentally by the revealing nature of digital recordings), there should be a great future for a system with more options than normal crossed pairs — especially when the use of these options can be delayed until later.

Mike Skeet

E&MM

Calrec Audio Ltd manufacture and sell the Soundfield microphone under licence from the NRDC. A hire service for this system is also operated by Whitetower Records, 2, Roche Gardens, Bletchley, Milton Keynes MK3 6HR, Tel: 0908 73969.



Control unit for Soundfield.

# CASSETTE REVIEW

Electronics & Music Maker's CASSETTE REVIEWS aim to give an indication of what readers are up to musically, and also include a short appraisal of their work.

To this end we invite home electro-musicians to send in a cassette of their work for possible inclusion in future issues.

The recording method used is, of course, entirely up to you.

The range we seem to get is from sound-on-sound on a stereo tape machine, through bouncing in stereo between two machines, up to small 4-track multitrack recordings. But if your method comes 'above' or 'below' these in technique or application, don't hesitate to send your cassette in as well. It can be a one-off demo-type tape, an independent cassette-only release or anything in between.

You should send one cassette, mono or stereo, clearly marked with your name and address on the cassette itself, information on instruments used and recording method adopted, and a relevant black-and-white photograph. Send to: E&MM Review, 282 London Road, Westcliff-on-Sea, Essex SS0 7JG.

Subjective 'scores' given at the end of each listing below are out of a maximum 10 for each category; tapes are generally given 4 for basic ferric types (e.g. TDK D, AD, etc), 5 for chrome types (e.g. TDK SA etc), and 6 for metal (e.g. TDK MA etc), with sometimes a point either way for variations.

If you'd like further information on any of the cassettes mentioned, such as contact addresses, please write to 'E&MM Review' at the above address.

Tony Bacon

## EXCLUSIVE OPPORTUNITY FOR E&MM READERS!

Our Tape of the Month Winner will have the chance to discuss their music with Martin Rushent, top producer for Human League, Altered Images, etc. at his Genetic Sound Studio.

### Tape Of The Month

**NOISE REDUCTION** 'An Infinite Number Of Monkeys'; 'Private Eye'. Simon Trezies: Fender Stratocaster; Aria bass; Roland JP4; Roland SH2; Roland VP330 vocoder; EDP Wasp; drums; vocals. Paul Ludgate: synths as ST; Roland CSQ600 sequencer; Aria bass; Linn LM1 drum computer; drums and percussion; vocals. Alison Jarvis: backing vocal on 'Monkeys'. Both pieces recorded at Sound Suite, London, 24-track, engineered by Paul Ludgate. Simon and Paul are 'very grateful to those who loaned the above equipment'.

An adventurous couple of tracks from the two-man Noise Reduction, using instrumentation and recording facilities that few of our readers have access to. Nonetheless, there are a sufficient stock of good ideas and neat technical juggling on these two pieces to earn them this month's TOTM tag. 'An Infinite Number Of Monkeys' is a strong, sequencer-based arrangement — indeed the team ran out of space on the CSQ600 and had to record each layer of the sequences in two sections bounced into one track. The multilayering of the sequences themselves was achieved by converting an on-tape audio click track into a digital clock signal to step the 600. The vocals are the weak spot of the piece, but this is more than made up for by the overall control, especially the -12dB/oct filter rasp of the Wasp for the 'brass' interjections and the concise guitar break. 'Private Eye' is a voyeuristic song again boasting a strong arrangement, only this time with the benefit of a better vocal performance. The fade is enchanting: white-noise-vocoded voices, noises off, a clanking Linn and heaving bass sliding into the tape hiss. Trezies and Ludgate plan live work with additional musicians and/or backing tapes — we look forward to hearing more.

Music: 7 Production: 8 Presentation: 5 Tape: 4

You can hear 'Noise Reduction' on E&MM Demo

RECORDED ON  
CASSETTE NO. 7



Paul Ludgate and Simon Trezies.

**THE FURNITURE BEETLES** alias Dave Warren. Independent cassette release, 16 pieces. Main instruments: self-built ETI 4600 synth; ARP Solus; Roland TR808 drum machine. Recorded on Teac 4-track reel-to-reel. TDK D. Dolby.

While Dave Warren spends a lot of time putting his own tapes together — The Furniture Beetles cassette collects a range of more recent odds and ends — he also does a fair amount of recording of standard songs, instrumentals, film music, and local Chelmsford musicians. His own stuff is distinctly fascinating: by his own estimation 'the main techniques used are fairly standard (multitracking, loops, speed changes), and musically it consists of synthesisers, drum machines, and musique concrete'. Standard techniques they may be, but Warren mobilises them in a creative, entertaining and witty fashion, from the hilarious 'Now It's 9.30', a cut-up-and-thrown-around phrase from a radio announcer over a doctored classical piece, via more straightforward multi-synth tunes like the pleasing 'Lumps' (two versions) or the so-called 'jolly little jingle' entitled 'Play For Today' (nothing to do with the Cure), and on to the noisy and disturbing 'Iglax Pops', Warren's personal favourite. The Furniture Beetles cassette is a welcome oddity, bringing style and humour to Cassette Review and easily landing Dave this month's E&MM Gold Star for Effort.

Music: 6 Production: 6 Presentation: 5 Tape: 4



Dave Warren.

**CHRIS AND COSEY** 'Heartbeat' Independent cassette release, Rough Tapes COPY008. Chris Carter: Roland 100M synth (3 x 3mod systems and 2 x 5mod systems); Casio MT30 (heavily modified); Roland TR808 drum machine; Roland CSQ600 sequencer; two modified guitars; taped voices; vocals. Cosey F Tutti: synth (as CC); cornet; Casio MT30; tapes; vocals; guitar. Alex Ferguson: guitar and vocals on 'Useless Information'. Recorded on Teac A3440 4-track reel-to-reel: approximately half the cassette mixed from the 4-track, the other half transferred from 4 to 16-track for overdubs and additional effects, including various echoes, harmonisers and delay units. 16-track transfer engineer: Mick Garoghan.

Chris and Cosey's joint offering following the demise of East Eight's fabulous Throbbing Gristle, this cassette version of 'Heartbeat' has two additional tracks, 'Pressure Drop' and 'Tight Fit', over the Rough Trade vinyl version. Plenty of found voices and sequencer-based rhythmic underpinnings provide a rather more accessible whole than some of the Throbbers' more outlandish soundscapes. The flow between 4 and 16-track recording is smooth and virtually undetectable (programming differs between the cassette and the vinyl versions). Recommended, although our copy has annoying low-level crackling noise throughout, implying that it is indeed rough tape.

Music: 7 Production: 7 Presentation: 6 Tape: 2



## Cassette Review

Andrew Cox



**THE THOUGHTS UNWIND** 'What About The Workers', 'Germaine'. Peter Barnett 'and two friends'. Instruments: Korg MS700 synth; Hohner Pianet T; Westone Thunder electric guitar; Sony Rhythm Capsule for drum machine; bass guitar; drums; FX. No recording details given — 4-track? Gurand LN.

'What About The Workers' features a suitable spoken/sung female vocal over a rather weak mix; wishy-washy azimuth misalignment (we suspect) spoiled our copy. The whole track lacks guts and is too long. What about the workers indeed, my friend. 'Germaine' is much better, with a slightly mid-60s Pink Floyd feel about it. It's played rather straight with little imagination in the arrangement — with some tightening up and a more muscular approach this pleasant song could do well.

Music: 4 Production: 4 Presentation: 5 Tape: 4

**XENON** Four pieces by Dave Hunt. Instruments: Korg MS20 synth; EMS VCS3; Simmons SDS-V plus home-made percussion modules; Synton vocoder. Recorded via Soundcraft desk to 8-track recorder (unspecified), mastered on to Revox reel-to-reel. Signal processing includes Delta Lab DL2; Ursa Major Space Station; MXR Pitch Transposer. TDK SA. Dolby.

Beautifully expansive music, utilising the full range and potential of Hunt's impressive equipment line-up, as on the soothing 'Lotus Eater'. The Caribbean influences in 'Jah Works' don't quite suit the synthetic treatment, but 'When', the only vocal piece, improves things, helped along by a guest sax. Promising stuff.

Music: 5 Production: 7 Presentation: 4 Tape: 5

**ANDREW COX** 'Hydra' Independent cassette release, YHR017. Instruments: Jen SX2000 synth (modified); Kay electric guitar ('horrible'); percussion; recorder; piano; harmonium; electronics; voice; reed organ; fuzz; wah-wah; phaser; echo. Recorded on Sanyo and Hitachi portables; Grundig and Truvox reel-to-reels ('very old').

Cox formed the YHR label with 'Neumusik' editor David Elliot, the idea being that cassette sales would offset the losses made on the magazine. Cox's current unemployment makes financial support even more precarious. This is his third YHR cassette in solo guise: it continues his self-styled 'rather odd music', and features a wide range of musics. None of the ten tracks is typical of the overall scheme — some, like 'Primal', are virtually formless, noise-based and overlong; others, like 'Athea' which features wonderful half-speed percussion, work far better, due as much as anything to their concision. Cox concludes: 'Hydra is by no means perfect but shows the variation in my work.' He also wonders how come E&MM didn't mention Throbbing Gristle's termination, 'surely one of the most innovative British electronic groups'. See elsewhere on this page, Andrew.

Music: 5 Production: 4 Presentation: 6 Tape: 4

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# SOFT DISTORTION PEDAL

by Dave Rogers

- ★ Highly controllable frequency weighted distortion
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GUIDE £15

This circuit is a far cry from the standard 'clipping box' type of effect that only works satisfactorily on single notes and a very limited dynamic range. The big difference is made by instead of directly sending the input waveform on to a non-linear network (usually a pair of diodes) this unit applies different amounts of distortion to different sections of the spectrum of the incoming signal.

A block diagram is shown in Figure 1 and from this it can be seen that the input signal is filtered into two channels. Distortion is applied to one channel then the signals are recombined to form the output. The amount of distortion is controlled by altering the filter characteristics to increase or decrease the bandwidth of the 'distort' channel.

The non-linear distortion network uses germanium diodes and this, along with the configuration employed makes the voltage/current characteristic smoother than most of the standard circuits.

## Circuit

Input to the unit is via JK1 a DPDT 1/4" jack socket which is arranged to connect the battery supply when the jack plug is inserted. The gain of the preamp IC1b is determined by R2 and R3 and set to a level suitable for most guitars. If a very low output instrument is used the preamp gain should be increased by raising the value of R3.

IC2a and associated components form the 'pregain' circuit. This is a two stage, split

gain control which has a superior 'law' and also performs some frequency tailoring.

The soft distortion generator comprises C8 to C10, R9 to R11 and germanium diodes D1 to D5. There is the equivalent of three diode drops — each approximately 0.3V — in each direction, so the maximum swing across the diodes is 1.8V. This gives a better noise performance than if a single pair of diodes were used which would require greater amplification at the 'postgain' stage.

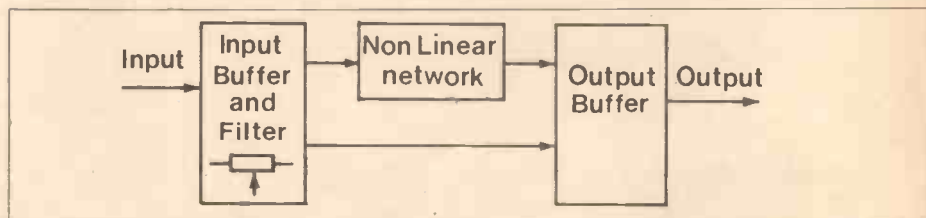


Figure 1. Block diagram of the Soft Distortion Pedal.

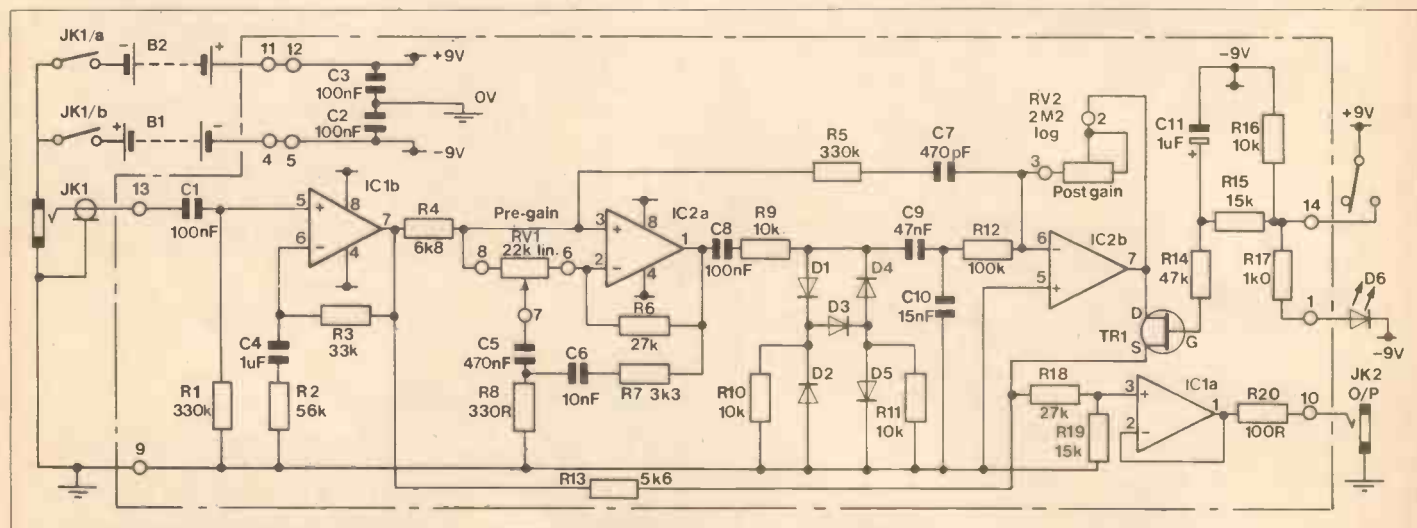


Figure 2. Circuit diagram of the Soft Distortion Pedal.



The 'postgain' circuit determines the relative volume required between the normal and effect modes.

TR1 is switched on when the footswitch, S1 is operated, allowing the signal through to the output stage where it is combined with the normal signal from IC1b. The LED D6 lights when the circuit is in the 'distort' mode.

In the 'normal' mode with S1 open, the pedal remains active and thus retains the advantages of its buffered high input and low output impedances. (Many designs simply route the input straight to the output whereupon clicks can occur and the loading seen by both instrument and amplifier vary.) The normal signal from the preamp IC1b is not combined with a distorted signal but is passed to the output stage IC1a. The gain of the output stage is determined by R19 which is designed to give an overall gain of about 2 in the 'normal' mode. Consequently the pedal is a useful buffer/preamp which can be inserted prior to the effects devices.

Note the centre frequency of the filtering section which comes in at full pregain can be moved by altering the value of R8. The



Internal view of the Soft Distortion Pedal, PCB in position.

timbre can also be modified by adding a 1nF capacitor between R9/C9 and R4/R5. These two options do not affect the sound of lower pregain settings.

## Construction

The pedal uses a PCB which is shaped specifically to fit inside the pedal footswitch case. This case has an integral push-on,

push-off switch operated via the large area hinged pad.

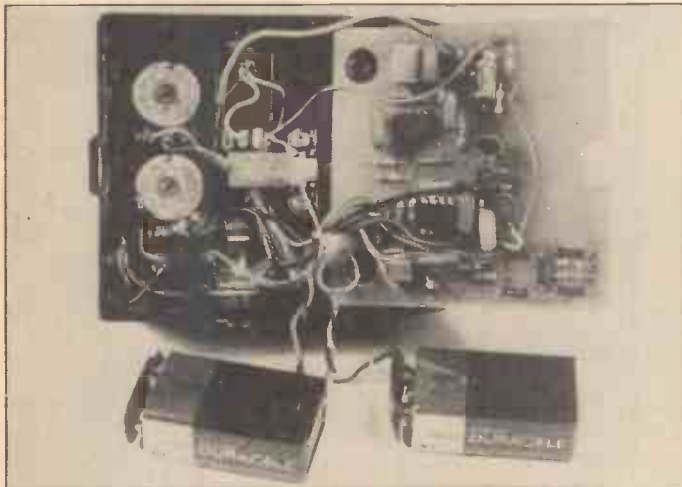
Start by drilling the holes in the case for the pots and jack sockets according to Figure 3. The LED position has a plug which can be pushed out from the inside.

Clip off the top set of contacts on the footswitch so that they won't foul the PCB. Bend up a pair of the bottom set of contacts.

Trim down the ledges around the base of the case by a few mm where the PCB is to rest. Cut the pot spindles to length and bend the contacts back through 90°. Mount the pots and sockets in the case, both pots with their contacts facing the LED opening.

Before mounting the components on to the PCB and if you have a multimeter, test all the diodes for a reverse impedance of at least 2MΩ. Ideally, to maintain symmetry, if one diode shows a marked difference from the rest, use it, as the 'central', D3 diode, if two diodes differ markedly from the rest, use these as the pair D2, D5.

The track layout and component overlay of the PCB are shown in Figure 4. Solder the components in place using sockets for the



Internal view of the Soft Distortion Pedal, PCB removed.

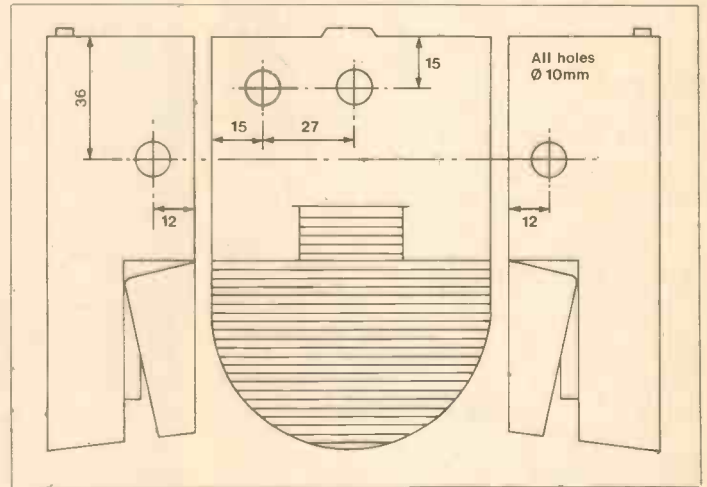


Figure 3. Drilling diagram of the case and the pedal label.

## PARTS LIST FOR SOFT DISTORTION PEDAL

Resistors — all 1/2W 5% carbon

Value	Quantity	Mapin Code
R1,5 330k	2 off	(M330K)
R2,13 5k6	2 off	(M5K6)
R3 33k		(M33K)
R4 6k8		(M6K8)
R6,18 27k	2 off	(M27K)
R7 3k3		(M3K3)
R8 330R		(M330R)
R9 to 11,16 10k	4 off	(M10K)
R12 100k		(M100K)
R14 47k		(M47K)
R15,19 15k	2 off	(M15K)
R17 1k0		(M1K0)
R20 100R		(M100R)
RV1 22k lin pot		(FW03D)
RV2 2M2 log pot		(FW29G)

Capacitors

C1 to 3,8 100nF polyester	4 off	(BX76H)
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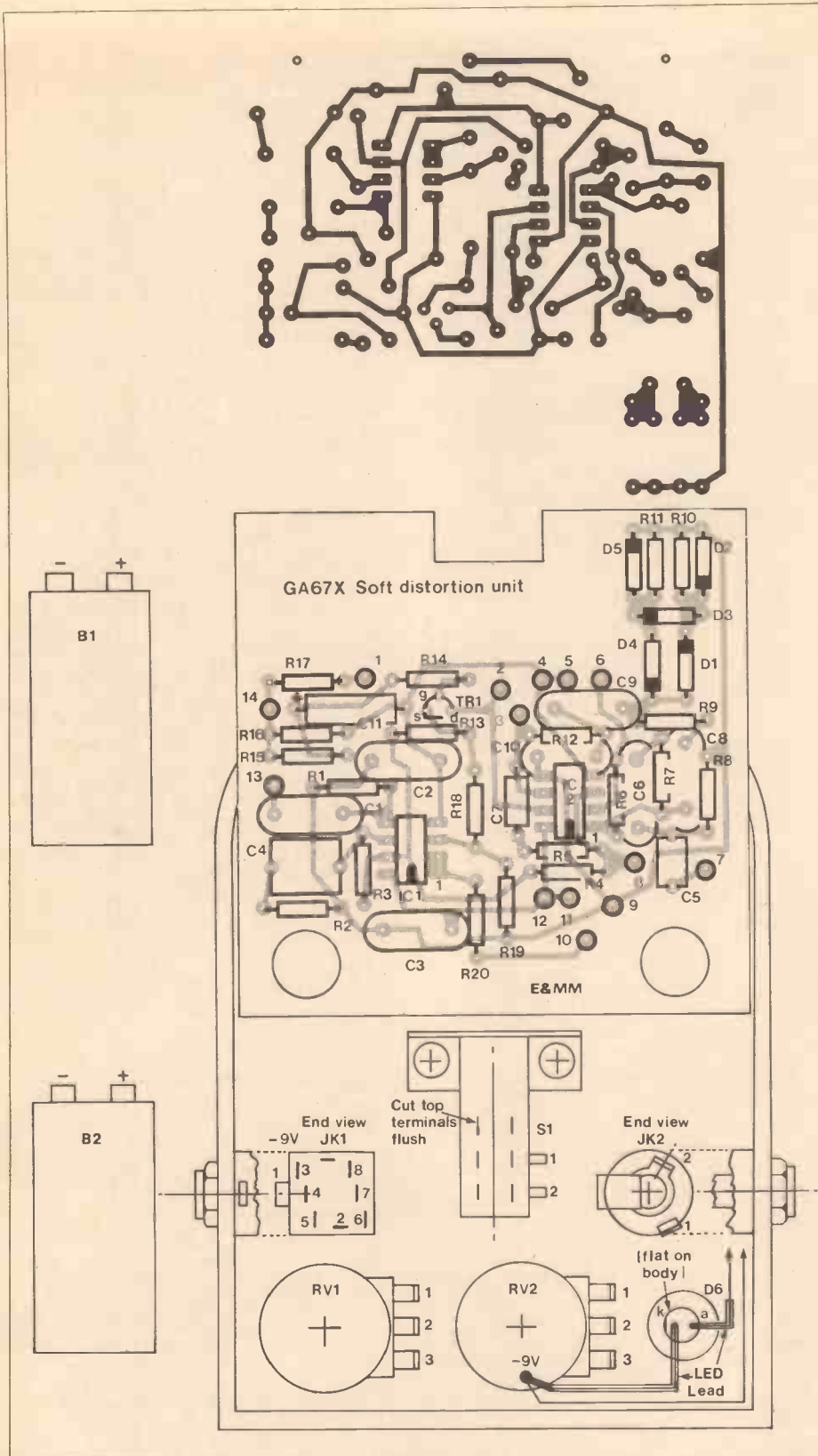
C4 1uF carbonate		(WW41U)
C5 470nF carbonate		(WW37S)
C6 10nF polyester		(BX70M)
C7 470pF polystyrene		(BX32K)
C9 47nF polyester		(BX74R)
C10 15nF polyester		(BX71N)
C11 1uF 25V electrolytic		(FB12N)

Semiconductors

IC1,2 LF353	2 off	(WQ31J)
TR1 BF244		(QF16S)
D1 to 5 OA91	5 off	(QH72P)
D6 LED red		(WL27E)

Miscellaneous

JK1 DPDT jack socket		(BW80B)
JK2 Jack socket open		(HF91Y)
Case		(YK26D)
Knob 0-10	2 off	(RX11M)
PP3 batteries	2 off	
PP3 battery clip	2 off	(HF28F)
Veropiins		(FL24B)
Wire		



**SOFT DISTORTION UNIT WIRING CHART**

From	To	Remarks	From	To	Remarks
PCB/1	D6/a		PCB/11	B2/+ve	
PCB/2	RV2/2	Link RV2/2 to RV2/3	PCB/12	S1/1	
PCB/3	RV2/1		PCB/13	JK1/2	Conductor
PCB/4	B1/-Ve		Not used	JK1/1	Screen
PCB/5	D6/k		PCB/14	S1/2	Screened wire
PCB/6	RV1/3				
PCB/7	RV1/2		JK1/1	JK1/4	Link JK1/4 to JK1/7
PCB/8	RV1/1		JK1/3	B1/+ve	
PCB/9	JK2/2	Link JK1/1	JK1/6	B2/-ve	
PCB/10	JK2/1				

Figure 4. PCB track layout, component overlay and wiring diagram.



ICs and taking care with the orientation of the diodes, ICs and C11.

With the PCB resting component side upwards upon the rounded end of the case, wire up the pedal by following the wiring chart. Veropins are advisable for connections on to the PCB. The main circuit is not sensitive to interference since it operates at low impedance and relatively high signal levels. The input is, however, at high impedance so screened cable should be used from the input socket to the PCB. Note that the screen should be connected to earth at the socket end only, the socket itself is connected to earth by a separate lead.

Once complete the PCB can be hinged over and rests, components downwards, on the small ledges around the sides of the case. One battery sits on top of the pots and the other in the rounded end of the pedal.

**Operation**

Soft distortion effect is suitable for guitars, basses and all monophonic instruments, but is of limited value with polyphonic unless single notes are played. With polyphonic the intermodulation products caused by the distortion often sound out of place. This intermodulation effect can be reduced by replacing C8 with a direct link, but this will give a less rich sound when used with guitar.

At low pregain settings the effect of the distortion is subtle and does not sound like 'distortion' as such, but it gives a warmer, thicker quality to many sounds, as in the 'valve sound'. C7 and R5 allow a degree of bypass for any higher harmonics that would otherwise be missing due to the treble cut by R9/C10 in the distortion path.

With an increase of pregain more of the diodes conduct and the effect becomes rougher and more obvious but remains soft enough to enable full guitar chords to be played without intermodulation being audible.

At high pregain C5, C6 and R8 cause a pre-emphasis of the midband frequencies, i.e. IC2a becomes an active bandpass filter, which makes the distortion circuit produce a distinctive and sustained sound suitable for guitar solo, heavy rock etc.

E&MM



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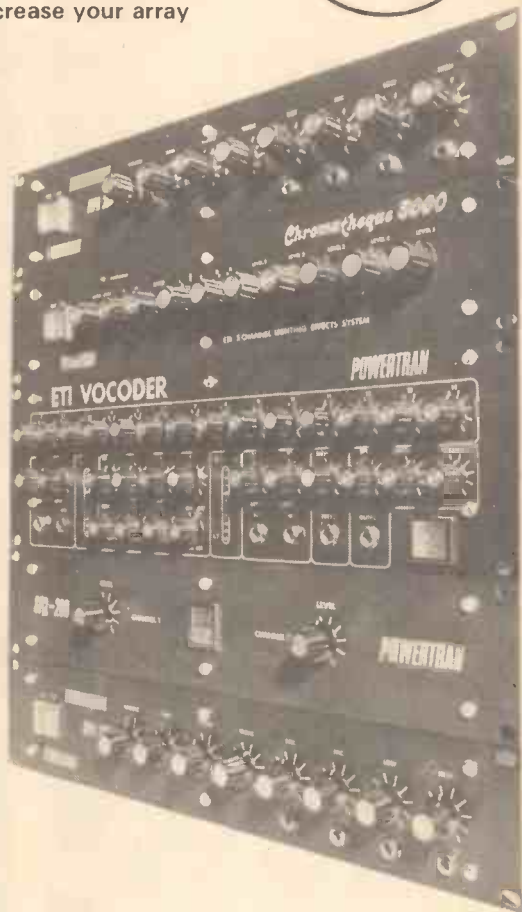
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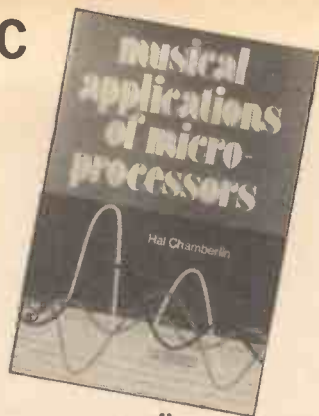
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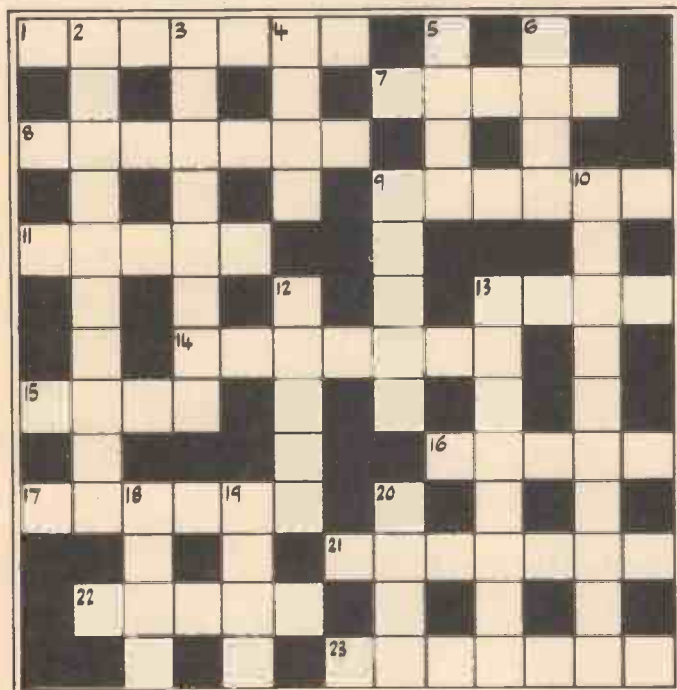


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# ELECTRO-MUSIC CROSSWORD COMPETITION No. 1



Here's a chance to win a copy of one of the most important books for the electro-musician — "Musical Applications of Microprocessors" by Hal Chamberlin. This valuable prize, worth £20, will be awarded for the first correct crossword drawn out of the hat at the end of April. Send your completed crossword, including your name and address to:  
**E&MM CROSSWORD,**  
282 London Road, Westcliff-on-Sea, Essex SS0 7JG.



## Across

1. A case of potential? (7)
7. The signing banknote? Sounds like it anyway (5)
8. Computer language (7)
9. Snakes alive — and carry one! (6)
11. Surname of famous singer songwriter; his songs include 'Fifty Ways To Leave Your Lover' (5)
13. Concerts (13)
14. Hard rubber insulator, often used for coil formers (7)
15. Looks fishy — a low instrument (4)
16. Pass it on about the switch unit (5)
17. Metallic element, atomic No. 76 (6)
21. Can make a capacitor seem like an inductor — watch it move (7)
22. The pulse express? (5)
23. Certainly NOT the same (7)

## Down

2. Catholic meeting in the nuclear age? — it could be a bit weighty (6, 4)
3. Rett's ode about his tubes (8)
4. Basic way to obtain data (4)
5. Output to effects unit, etc. (4)
6. Confused 7 has no right to make a sound (4)
9. Under water direction finder (5)
10. Those powerful controllers of our potential (10)
12. The ins and outs of telephone data transfer (5)
13. Mix green tea. — Make with the electricity (8)
18. Give him space to oscillate! (4)
19. Standard quantity (4)
20. Nancy lost her head about this colour (4)

## Last Month's Answers

Across: 1. Beams; 7. Envelope; 8. Boost; 10. Horizontal; 12. Elements; 14. Neon; 16. Bead; 17. Ammeters; 20. Folded horn; 23. Yodel; 24. Language; 25. Meter.  
Down: 1. Bubble; 2. Mesh; 3. Anti; 4. Meson; 5. Voltmeter; 6. Teflon; 9. Totem; 11. Delay line; 13. Tim; 15. Ferry; 16. Baffle; 18. Scaler; 19. Debug; 21. High; 22. Note.

Last month's winner: Mr K. Drew from Nottingham.

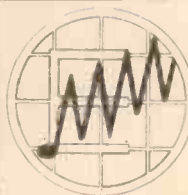
We acknowledge with thanks the cooperation of John Wiley & Sons Ltd, who distribute "Musical Applications of Microprocessors" in the U.K.

This book, reviewed in E&MM July 1981 issue, is available from:  
Maplin Electronic Supplies Ltd order ref. WG40T price £22.65 inc. p&p.

## Questionnaire Subscription Winners

The following people were the first 25 questionnaires to be drawn from the box and will receive a year's subscription to E&MM.

- Mr C. J. Dolan, Moss-Side, Manchester.
- Mr L. Laszlo, Budapest, Hungary.
- Mr E. Flint, Aberdeenshire.
- Mr A. C. Read, King's Lynn, Norfolk.
- Mr B. Amatruđa, Zurich, Switzerland.
- Mr K. J. Williams, Ealing, London.
- Mr D. A. Cracknell, Harrogate, N. Yorks.
- Mr M. Ashton, Kidsgrove, Staffs.
- Mr J. L. Meaton, Warminster, Wilts.
- Mr B. D. Jackson, Gramlington, Northumberland.
- Mr S. Strubing, Tottenham, London.
- Mr P. Walker, Wirral, Merseyside.
- Mr R. Hubbard, Heaton, Newcastle-upon-Tyne.
- Mr M. Dennis, Chingford, Herts.
- Mr F. Nordberg, Gjøviu, Norway.
- Mr R. A. C. Ward, Sevenoaks, Kent.
- Mr G. D. Lloyd-Jones, Leith, Edinburgh.
- Mr R. J. Lewis, Southampton, Hants.
- Mr A. P. Norris, Newport, Isle of Wight.
- Mr P. J. Hurt, Croydon, Surrey.
- Mr R. A. Davis, Clapham, London
- Mr S. Wocial, Bromley, Kent.
- Mr L. J. Dickson, Hornchurch, Essex.
- Mr R. Matthews, Grayshott, Mindhead, Surrey.
- Mr B. Walker, Scarborough, N. Yorks.



# Electronics & Music Maker

## ASSISTANT EDITOR (ELECTRONICS)

We require immediately an Assistant Editor having practical experience of electronic design and construction, with the responsibility for preparation of submitted projects and technical articles for publication.

This is a special opportunity for an energetic electronics engineer with a strong involvement in music technology (including microcomputers).

## ASSISTANT EDITOR (MUSIC)

We require immediately an Assistant Editor having sufficient practical and theoretical music experience and qualifications with responsibility for preparation of music reviews, interviews, features and workshops for publication.

This is an exciting and challenging position for an energetic, experienced musician with a wide interest in the techniques of music making, as well as the ability to interview people in the music business and review the latest music instruments.

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Salary will be negotiable at the time of the interview.

Please write stating relevant experience, with C.V. to: The Editor, 282 London Road, Westcliff-on-Sea, Essex SS0 7JG.



Steve Gray Sky



"Emotionally and intellectually I'm a pianist, although I dabble with other keyboards. There are a lot of interesting ideas now from people who wouldn't necessarily regard themselves as pianists — I can see 'the pianist' and 'the keyboardist' coming to inhabit totally different worlds. I think I'll become more of a keyboard player, but I'll always be a pianist first."

#### Keyboards

At home: Yamaha C3 acoustic grand; Steinway upright; Rhodes Stage 73; Roland JP8; Sequential Circuits Pro-One; Sandy Rodgers harpsichord; Casio VL1. With Sky: Roland JP8; Oberheim OBXa; Oberheim OB1; Hohner Clarinet; William De Blaise harpsichord; hired grand; unknown accordion and Weltklang trumpet for comedy spot. "The JP8 is the main polysynth, the OBXa for lead. All the programs in the JP8 are duplicated in the OBXa, so if anything goes down I'm covered — the OB1 is emergency-only stuff now. On the JP8 there's a bit more choice of waveform to originate on, on the OBXa you've only got two choices. De Blaise make harpsichords with piano-sized keys, which suits my fairly thick hands."

"I am amazed that so much is happening to synths at so little price. There's so much sensitivity in the human hand that doesn't translate through a synthesiser keyboard yet. I've never actually come across a synth that's got everything I want, but that's because I suppose I'm not even prepared to learn how to play a Fairlight or a Synclavier."

#### Playing Live

C-Ducer on piano; 'ordinary pickups' on harpsichord; rest DI'd. JP8 or OBXa can be triggered from harpsichord keyboard.

#### FX

Boss Flanger on stage.

#### Percussion/drum machines

Roland CR68; Boss DR55; "probably getting a Roland TR606".

#### Favourite studio/engineer

Abbey Road/Haydn Bendall, Tony Clark. Lansdowne/Adrian Kerridge, Chris Dibble. "I also like John Kelly."

#### Home recording

Teac A3440 4-track; Prokit mixer; mastered to cassette at present. "Most of the Accessit boxes", plus Yamaha analogue delay.

Keith Levene Public Image Ltd



"My role in the band is: anything I can do, I do. I really know about music, I keep changing my mind on the way I feel about it. I don't think my main thing is music, it's just one of the things I do. My main obsession at the moment is computers in relation to graphics, video or music, or all three."

#### Keyboards

Prophet-5 Rev 3.1; Moog Source; Roland MC4; Synclavier II. "At the moment we have to settle with the Prophet for live use. The Source I like the look of, I like the one-knob approach. It's being used — we've prepared four or five tracks for the next album. When it comes to writing software for the Synclavier we're, how shall I put it, 'coming along'. We make a point of not calling in a programmer. We're gonna buy a Synclavier — we're borrowing and leasing it at the moment, it makes everything else obsolete. If I had the money I'd just buy one. Once it's programmed up it's wonderful for live use."

"There should be a lot more information on micro-technology, in general, and as applied to the music industry. We need a better 'Computer Music Journal', not written by academic people. When it comes to creative programming, I'd like to see people get hold of the hardware publically and use it and understand it."

#### Sequencers

Sequential Circuits Poly Sequencer (to Prophet). "I don't like it that much, it reminds me of Muzak City, but we get some pretty odd sounds."

#### Playing Live

"We're more into communicating with the audience now, a live video situation. It's separate from what we do in the studio." All synths DI'd.

#### FX

"We use a lot of effects: the Lexicon 224 and the UM Space Station just to mention two really good pieces of technology."

#### Percussion/drum machines

Linn LM1 drum computer.

#### Favourite studio/engineer

Nick Launay at Town House 2; Nick Cook. "They completely opened up to us."

#### Home recording

"Nothing special."

Nick Rhodes Duran Duran



"I started with a Wasp, but I grew to take synths a bit more seriously. To me now, synths are the most interesting instruments, or I'd be playing guitar or something. I do feel they have a place, particularly in this band — we use synth as just one of five elements. I like our balance, not totally synthetic — even though I like a lot of totally synthetic stuff."

#### Keyboards

Roland JP4; Roland JP8; Roland SH2; Yamaha CS40M; Crumar Roadrunner; Prophet-5. "The JP4 was a great price when I bought it — it still stands out as one of the most comprehensive synths: the arpeggios are useful, and the sound of the oscillators is good. The split keyboard on the JP8 is particularly useful. I think the Crumar has a quality most string synths haven't got: the Moog tries to be too real; the Roland is too synthetic; the ARP I quite like; but the Crumar with reverb is amazing. The Prophet I'm not all that keen on at all, I'm not pleased with it."

"I'd like to see all synths compatible with each other. Polyphonic sequencers will be interesting when they're developed properly — the new Yamaha CS70M's got one in it, as has the Prophet-10, but I'm not all that impressed with any of those. There are a lot of improvements that could be made: I'd really like a nice Roland string synth, and a synth that layered sequences on top of one another — I think PPG are attempting that."

#### Sequencers

Roland CSQ100 — "The memory loss when you switch off is irritating."

#### Playing Live

"We used to DI everything; now I have my own eight-channel mixer/amp feeding JBLs."

#### FX

Roland Rack including Space Echo, phaser, "I'm especially fond of the MXR Flanger, mainly on the JP4".

#### Favourite studio/engineer

Air 1; Chipping Norton. Colin Thurston (producer) engineers too: "He has a lot of patience with experimentation."

#### Home recording

"Only a Revox" at home, but band's Birmingham HQ, called the Rum Runner, is suitably equipped.

# ELECTRO-MUSIC ENGINEER

by Charles Blakey

## State Variable Filter

A well known keyboard player recently stated that he was disappointed with the lack of progress in synthesiser design in the last few years. In the context of the interview he was obviously not referring to technical innovations, such as, the numerous polyphonic synthesisers introduced in recent times, the major improvements in stability and reliability or the general trend of offering better value for money. As a musician he was more concerned with the apparent failure to increase the sound capabilities of the instruments.

Undoubtedly most, if not all, manufacturers will disagree with the above particularly in respect of their top models. At the low to medium price bracket, however, they are faced with a dilemma as to whether additional facilities will maintain the 'value for money' concept and would make playing the synthesiser more difficult (an ever present problem). In the writer's view the addition of more filtering capabilities could be justified. After all it is largely the subtractive synthesis technique of removing or attenuating partials from a complex waveform which provides a synthesiser with its wide range of tone colours. Increasing the filtering capabilities would, therefore, increase the range available.

In many synthesisers the only filter used is the low pass type which attenuates the harmonics above its cut-off frequency. Since this effect is characteristic of many acoustic instruments it is clearly the most useful filter. The roll-off rate of such filters has a marked effect on the sound. For example, a 12dB/octave low pass filter produces a more 'electronic' sound because the raw waveform is still noticeable above the cut-off point. While this sound can be useful it can also be unpleasant during extended playing.

The majority of synthesisers now incorporate a 24dB/octave low pass filter and this steeper roll-off gives a more 'natural' character to the sound. The latter filters are also more effective when being swept by an envelope generator to vary both amplitude and tone dynamics during the course of a note.

Invariably these filters have means to control feedback, or regeneration, of the signal to provide resonance. With a low pass filter the effect of this is to emphasise a band of frequencies at the cut-off point. This is illustrated in Figure 1 which shows the response from a 24dB/octave low pass filter with and without resonance. At low to medium resonance the effect is akin to the resonant filters described in the February 1982 issue of E&MM and although one does not have independent control over the resonant frequency the additional boost is very effective. As the resonance is increased the sound again becomes more 'electronic' but this time the effect arises from ringing, or oscillation, to generate well-worn 'synthesiser' sounds.

To progress beyond the ubiquitous low pass filter one could use a switchable design, as employed in the E&MM 'Spectrum' synthesiser, although to a large extent a single filter with low, high or band pass responses, or combinations of these, is most useful for special effects. The suggestion earlier, however, was to have more than one filter with independent controls and with at least one of them having switched responses. Application of additional treatment to a low pass filtered waveform greatly increases the scope for both imitative and creative synthesis.

Experimentation with different filter types and combinations of filters will prove very rewarding. Furthermore you do not have to discard your existing synthesiser since

most make the keyboard control voltage and gate available for driving external equipment. A filter may be treated as an 'effects' unit and used to treat the output signal. It will also be obvious that when one wishes to explore a specific response that is only available on the external filter then the filter incorporated in the synthesiser may be set to pass an untreated waveform. To assist this exploration the design below is for a voltage controlled filter with band pass, low pass and high pass responses at two rates of roll-off which for the latter two types are 12dB/octave and 24dB/octave. The resonance control allows ringing and induced oscillation but the filter will not self oscillate. The design utilises the CEM 3320 voltage controlled filter IC which is configured in what is known as a 'state variable filter'.

The complete circuit diagram is shown in Figure 2. At first sight it may look complicated but closer inspection reveals that it is simply two state variable filters connected in series. Simplified explanations are always dangerous but an examination of the first stage built around IC1a, IC2a and IC2b will show the general principle. The signal enters via RV1 and R1 and the maximum gain of the circuit is determined by the ratio of R1 to R4. The design is based on a 10V p-p input and for lower signal levels R1 would be reduced proportionately. This would maintain the signal level within the filter at the design level but to maintain a nominal unity gain it will also be necessary to reduce the value of R22. R5 converts the signal into a current required by the gain cells of the CEM 3320 and the first cell is IC2a. The output from this stage is a single pole band pass response, marked B1, and a second integration in IC2b produces a 12dB/octave low pass output (L1). The output from IC2b is inverted with respect to the input signal and it is subtracted from the signal at IC1a to

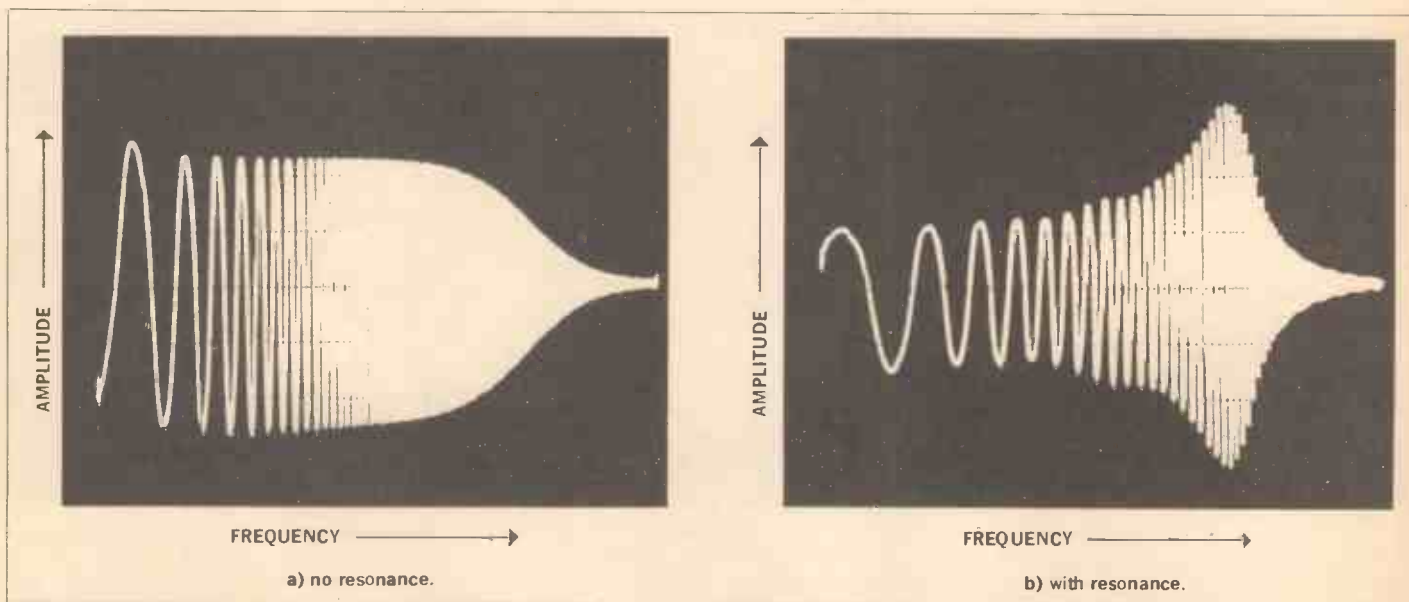


Figure 1. Response from a 24 dB/octave low pass filter.





# UNDERSTANDING ELECTRONICS

A regular column that explains the electronics of music

Robert Penfold

## How To Make Music Projects

If you have never constructed an electronic project, building even one of the more simple ones described in this magazine may seem a daunting task. While it would be misleading to suggest that without any previous knowledge of electronics or practical experience at electronics construction it would be possible for anyone to build any project, it is a fact that anyone who is reasonably practical should have little difficulty in successfully completing a relatively small project. This article is aimed at those who would like to build their own equipment but need a little encouragement to get started.

Many people are deterred from building an electronic project simply because they do not understand the way in which the circuit operates, but it is not really necessary to understand the technicalities in order to successfully build it. Technical knowledge can be helpful when fault finding, but is otherwise not of great importance when constructing projects.

Undoubtedly the greatest asset to have when project building is practical experience of electronics construction, and obviously the only way of obtaining this is to 'take the plunge' and try your hand at building a few small ones. Most people rapidly learn the few simple skills required, and have no difficulty in building quite complex pieces of equipment.

A point that should not be overlooked is that project construction is an interesting and enjoyable pursuit in its own right, and should not simply be regarded as a cheap way of obtaining items of electronic equipment.

### Getting Started

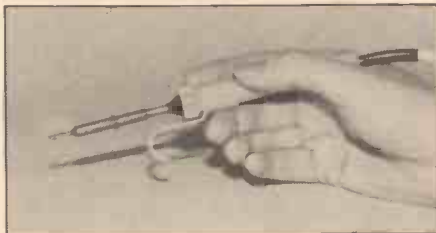
The first thing to do when considering any project is to read the article thoroughly to ensure that the finished piece of equipment is capable of fulfilling your requirements — a 12V 50mA power supply will not be much use for recharging flat car batteries. Having decided to go ahead, any points that are not fully understood should be resolved when the components have been obtained. Do not commence building until you understand all aspects of the construction.

#### Tools

Only a few tools are required for the electronic part of the construction; a 15 to 25W soldering iron, side cutters, long nosed pliers, wire strippers and in case of errors some form of solder remover, e.g. copper braid, solder sucker, or desolder tool.

More tools are required for the mechanical parts but these are the type that most people will already possess; screw drivers, adjustable spanner, junior hacksaw, files, drills etc.

There are two important facts to remember when purchasing tools; always buy good quality, cheaper versions are a false economy and secondly apart from the basic tools buy any others as you require them, it is very easy to spend a great deal of money on tools that are never used. And while we are



A soldering iron with small bit.



Example of a bad (left) and a good (right) solder joint.

on this subject, do not use tools for any task other than they were intended; a colleague's ultimate test for a *small* pair of side cutters was if they could cut through the plastic spindle of a potentiometer! (Anyone want to buy half a pair of side cutters?).

#### Work Area

For the construction of the electronics an area approximately 1m x ½m is required. It is not essential to use a proper workshop bench and the wife's or mum's kitchen worktop will suffice. However, it is advisable to cover this with a sheet of plywood to avoid damage to the worktop and the subsequent naggings.

Modern electronic components tend to be quite small and are easily mislaid or lost. So in order to stop the frustrated cry of "well it can't just of disappeared!", use the readily available small plastic draws or small tins to store your components. An alternative is to use a piece of expanded polystyrene into which the component leads or tags can be inserted.

The mechanical construction is best carried out at a proper workbench, otherwise the naggings could develop into eviction or divorce.

### Circuit Boards

Most projects these days are based on a printed circuit board of some kind. The usual single sided board simply consists of a thin piece of glassfibre board (other materials such as S.R.B.P. are sometimes used) in which holes for the leadout wires of the components have been drilled, and there are areas of copper on one side of the board. The

components are fitted on to the plain side of the board, the leadout wires are trimmed almost flush with the underside (copper side) of the board, and then the leads are soldered to the copper tracks. The latter carry the appropriate interconnections between the components.

There should be little difficulty in identifying the components and fitting them on to the board correctly. There are a few things here that must be understood, such as resistor and capacitor colour codes, and these have been covered in previous parts of 'Understanding Electronics'. Ready-made printed circuit boards usually have the component layout marked on the appropriate side of the board, complete with the polarity of any electrolytic capacitors (which must be fitted on to the board the right way round) and any other necessary information, which greatly reduces the risk of mistakes being made.

It is not difficult to make your own printed circuit boards at low cost, and this will be covered in a future 'Understanding Electronics'. However, when building the first one or two projects it is best to use a ready made printed circuit board.

Many projects are based on a proprietary form of printed circuit board generally known as 'stripboard'. This type of board is drilled with a matrix of small holes with a hole spacing of 0.1in or 0.15in, the former being by far the more popular these days.



Tinning the bit.



How to solder.





A piece of stripboard.

Strips of copper run across the underside of the board and carry the connections between components, like the copper tracks of an ordinary printed circuit board.

Whereas an ordinary printed circuit board is normally designed for use with a single project, and could not easily be used for any other circuit, stripboard can accommodate any circuit. Stripboard often has a cost advantage over an ordinary printed circuit board, but is perhaps a little less easy to use and gives a slightly less neat appearance.

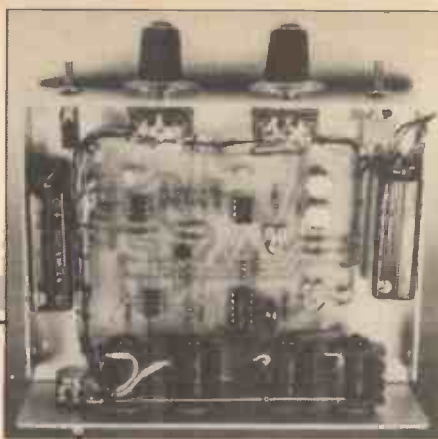
In use stripboard is slightly different as it is usually necessary to cut down a board to the required size, and this is easily done using a hacksaw to cut through a row of holes rather than between them. This is likely to give cut edges having a rather rough finish, but a file can be used to smooth these. Most designs require breaks to be made in some of the copper strips, and the positions of these breaks will be clearly shown in a drawing of the underside of the board. A special cutting tool is available, but it is quite in order to make these breaks using a small twist drill of about 4mm in diameter, or a modelling knife. Whatever you use, make sure that the break covers the full width of the copper strip, and avoid damage to other copper strips.

## Soldering

For soldering components to a printed circuit board a soldering iron having a power rating of about 15 to 25 watts and a small (say about 2.3 or 2.4mm diameter) bit is ideal. This will also be suitable for soldering leads to controls and sockets. It is unusual for a modern electronic project to have large soldered joints, and you are unlikely to ever need a powerful iron having a large bit. The solder normally used for electrical connections is a resin cored, 60% tin, 40% lead type, and most component retailers supply this in two thicknesses. The majority of constructors prefer the thinner 22 swg type to the 18 swg solder, but either type is suitable.

Before trying to solder the components on to a printed circuit board for the first time it would be advisable to try soldering a few odd pieces of wire together, or perhaps trying to solder a few bits of wire to a piece of stripboard would give some useful and inexpensive initial experience.

It is a good idea to have a proper stand for the soldering iron as this will help to prevent it from overheating as well as providing a safe place for it. There is no need to panic if the iron gives off a certain amount of smoke when it is first switched on, this is merely a protective coating burning off the bit. The bit needs to be tinned with solder, and this simply entails applying a small amount of solder to the end of the bit. Again, there is no need to get alarmed if a certain amount of smoke is produced as this is simply the cores of flux burning away. The flux helps the



Layout of a small project inside its case.

solder to flow over the surfaces which are to be joined so that a strong joint is produced.

When making a soldered joint do not try to apply the solder to the bit and then to the joint. Apply the tip of the bit to the joint and then feed in sufficient solder to produce a strong and reliable connection. If you use too little solder it is likely that it will not flow off the iron and on to the surfaces to be joined. Too much solder is likely to result in 'blobs' of solder short circuiting adjacent copper tracks, and any excess solder must be removed.

Ideally you need four hands when soldering: one to hold the iron, one to feed in the solder, and one to hold each of the two items to be joined. With a little practice you will soon learn to cope without plastic surgery, the easiest way being to lay the component board copper side up on the workbench with the component to be soldered in place trapped under the board. This method works fine provided you start with components like small resistors which do not protrude far above the board, and gradually solder in the larger components. If this is not done it is likely that the small components will not fit flat against the board, and apart from looking untidy this is not a very sound method of construction since any pressure on the components could lift and break the copper tracks on the underside of the board. Do not feel that you have to use this method, tackle the problem in any way you find easy and convenient.

Soldering leads to the tags of controls and sockets is quite easy if you generously tin both with solder first. With the bit also well tinned with solder, placing the end of the lead in position on the tag and briefly applying the iron should produce a good joint without the need for any additional solder.

When stripping the plastic insulation from connecting wire always use a pair of wire strippers, and not scissors or a knife. This avoids nicking the wire (which would severely weaken it and probably lead to it breaking before long). It is usually better to use multi-strand connecting wire rather than the single core type which is far less flexible. The single core type is mainly used in large projects where a number of leads are grouped together and are shaped to neatly run from one part of the unit to another.

## Mechanical Construction

The majority of projects are housed in a metal or plastic case. When deciding upon which one of the many available to use, consider what controls, plugs, sockets etc are to be mounted and their most practical position. Also since the case is often the most expensive item, try to avoid the false economy of buying the smaller of the possibles. Better to err on the large size so that there is ample room in which to wire the components and perform any repairs.

Applying gentle pressure with the left boot to squeeze everything in is definitely not on!

Printed circuit boards are sometimes designed so that they slot into guide rails moulded into the case specified for the project, and in such cases you will probably run into difficulties if you use an alternative housing. The common method of mounting the printed circuit board is to simply bolt it in place. It is normally necessary to use extra nuts or spacers (which are simply small pieces of metal tubing) over the mounting bolts between the case and the board so that the underside of the board is kept clear of the case. Sometimes this is necessary because a metal case is employed for the project and allowing the underside of the board to touch the case would result in the copper tracks being short circuited. Even if a non-metallic case is used it is advisable to use a small amount of spacing, otherwise the board may buckle slightly as the mounting nuts are tightened, due to the soldered connections protruding on the underside of the board.

An alternative and neat method of mounting a printed circuit board is by using plastic stand-offs. The stand-offs plug into holes of the appropriate diameter drilled in the case, and then the printed circuit board is clipped on to the stand-offs. This enables the board to be easily and quickly mounted or dismantled from the case.

The mounting holes for the printed circuit board must be positioned fairly accurately or at best the finished article will look rather scrappy, and at worst the circuit board will refuse to fit in place. Using the printed circuit board as a template helps to minimise any errors, and when drilling any sort of mounting hole it is advisable to first drill a small guide hole and then drill this out to the correct size.

Many types of control and socket have a built-in 10mm diameter mounting bush, and require a single 10mm diameter mounting hole. A 10mm twist drill is one size that it is essential to have, and you will find that quite a variety of other sizes are required from time to time. Sometimes rectangular or irregular shaped cutouts are needed, and a set of miniature files are then likely to prove invaluable.

Most controls are fitted with long spindles that will normally have to be trimmed down to a more suitable size. This is easily done by gripping the spindle in a vice and then cutting the spindle at the appropriate point using a hacksaw. Do not grip the body of the component in the vice as this could easily damage the component, and the spindle may tend to rotate as it is sawn through.

## And Finally...

When you choose your first constructional project try not to be over ambitious, and select something reasonably simple where there is relatively little opportunity to make mistakes. It is also advisable to choose a battery powered project rather than a mains powered one. If a mistake is made in a battery powered project it is unlikely to cause any damage or be at all dangerous, and you can search for errors in complete safety even when unit is switched on. E&MM

# QUADRAMIX

Robert Penfold

Most mixer designs are fairly complex and expensive to construct, but have a great many useful facilities and features. However, there are occasions when the most basic of mixers is all that is needed, with a gain control at each input not even being necessary. An example of such a situation would be when using a few of E&MM's very popular 'Syntom', 'Synwave', and Hexadrum projects, with the outputs fed to a single amplifier. The relative output levels of the effects units could be adjusted using the output level control on each of these sound making projects, and all that is needed is a basic mixer circuit to combine the four outputs and prevent any interaction between the output level controls.

The 'Quadramix' is a basic four-into-one mixer which has unity voltage gain from each input to the output. The input impedance is 100k at all four inputs and the output impedance is low so that the unit also acts as a buffer amplifier. The noise level of the circuit is too low to be of any consequence, as is the distortion level, provided the input signal is kept below the clipping threshold of approximately 6 volts peak to peak — more than enough for most musical instrument outputs. Power is provided by a PP3 size 9 volt battery which has an extremely long life since the current drain of the circuit is only about 2mA.

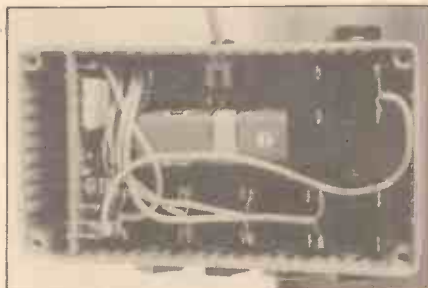
## Basic Mixer

Modern mixer designs are invariably based on an operational amplifier used in the configuration shown in Figure 1, and this design is no exception.

If we ignore input 2 and RB for the time being, the circuit is a straightforward inverting mode operational amplifier circuit. Due to a negative feedback action, the circuit stabilises the inverting (-) input at the same potential as the non-inverting (+) input. The latter is normally biased to the 0V rail in a circuit having dual balanced supply rails, or at half the supply voltage if a single supply is used. With no input signal, the output is at the same voltage as the two inputs, and this optimises the output voltage swing before the onset of clipping.

If RA and RC have the same value, an input voltage will produce an identical change in the output voltage, but a change of opposite polarity. For example, an input voltage of +2 volts would produce +1 volt at the inverting input if we assume no change in output voltage. This is caused by a simple potential divider action across RA and RC, and in practice it would result in the output swinging negative in order to balance the input potentials. This state of balance would be achieved with the output 2 volts negative of its quiescent level, since a potential divider action gives a potential at the inverting input which is half way between the voltages at input 1 and the output. The circuit thus acts as an inverting buffer amplifier.

With an input to input 2 as well, the circuit operates in much the same way, but the output must now respond to the sum of the two input voltages. If input 2 is also at +2



Internal view of the Quadramix.

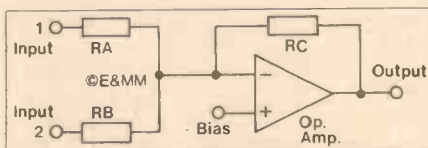
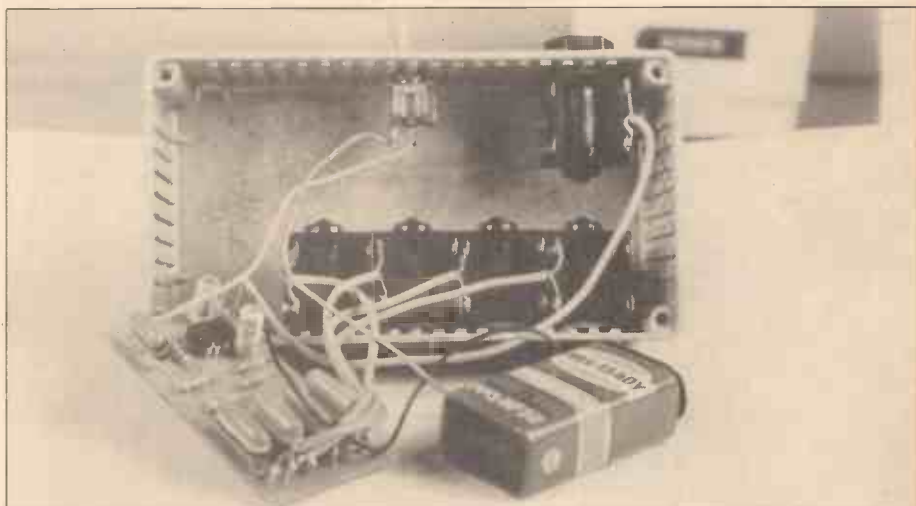


Figure 1. The basic operational amplifier mixer circuit.



Internal view with components removed.

volts, for example, the output would have to be 4 volts negative in order to counteract both input signals and maintain the balance of the input voltages by a potential divider action. With input 2 (say) 2 volts negative, the two inputs would counteract one another and the output voltage would remain at its quiescent level.

This configuration is known as the 'summing mode', and it obviously provides

the required mixing action. Although only two inputs are shown in Figure 1, it is possible to have any desired number of inputs with an extra input resistor being used at each additional input. An important property of this circuit is the constant voltage produced at the inverting input, and what is termed a 'virtual earth' is formed here. This isolates the inputs from one another so that changes at one input (such as connecting or

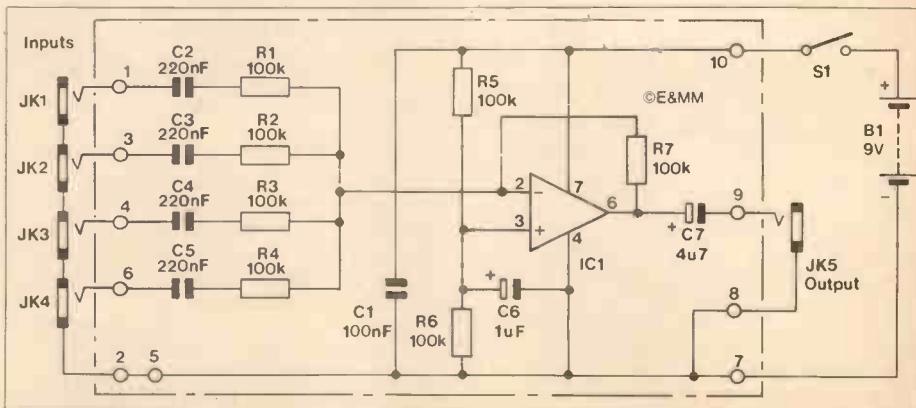
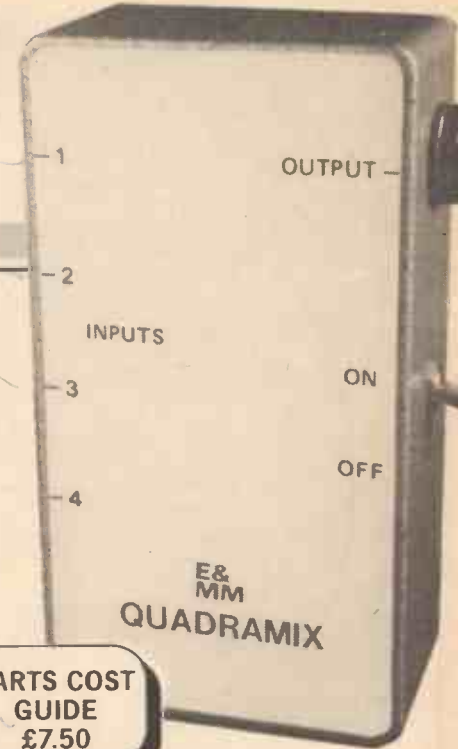


Figure 2. The circuit diagram of the Quadramix.



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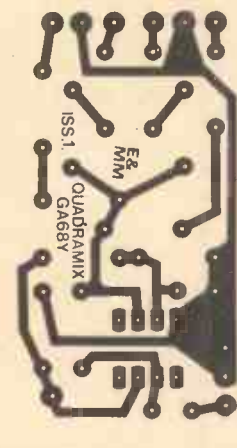
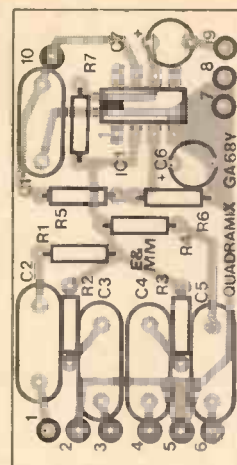
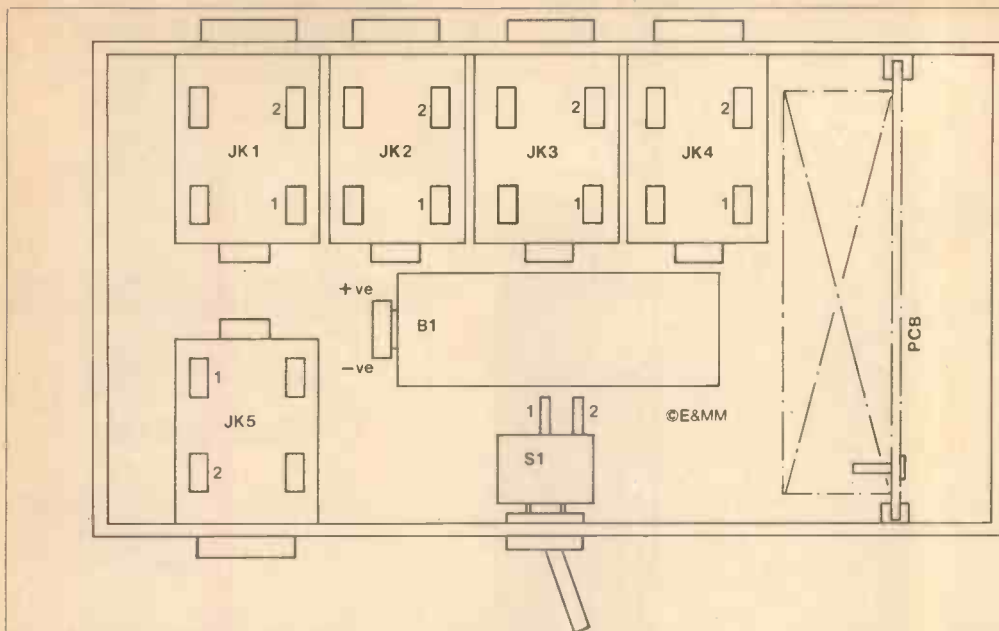


Figure 4. Construction details of the Quadramix: socket and battery wiring, plus component positions and PCB track layout.

disconnecting a piece of equipment) have no effect at the other inputs.

## The Circuit

The full circuit diagram of the 'Quadramix' is shown in Figure 2, and has obvious similarities with the basic configuration of Figure 1. One obvious difference is that four inputs are provided in the practical circuit and this necessitates the use of four input resistors (R1 to R4). A DC blocking capacitor is also used at each input, and these are C2 to C5. The non-inverting input is biased by R5 and R6 since a single supply rail is used. C6 filters out any noise which might otherwise find its way to the non-inverting input due to stray coupling.

C7 provides DC blocking at the output and C1 is a supply decoupling capacitor. The circuit only has one control, and this is on/off switch S1.

## Construction

A suitable housing for the unit is a diecast aluminium box having approximate outside dimensions of 120 by 65 by 40mm. The four input sockets are mounted on one side of the case with the output socket and on/off switch on the other. The positioning of these, especially the four input sockets, is quite critical as there is not a great deal of excess space inside the case. Figure 3 shows the positioning of the on/off switch and sockets, and it is strongly recommended that this layout is copied accurately. The mounting hole diameters are correct for the specified components, but note that other components might need mounting holes of slightly different diameters.

Details of the printed circuit board and wiring of the unit are shown in Figure 4. Construction of the board is quite simple, but it is easier if R2 and R3 are soldered into place before C2 to C5. Veropins are used at the points where off-board connections are made to the board.

Screened leads are used to connect the board to the input and output sockets. Provided the specified case is used, the completed printed circuit board is slotted into the lowest set of guide rails in the case, once all the wiring has been completed.

E&MM MAY 1982

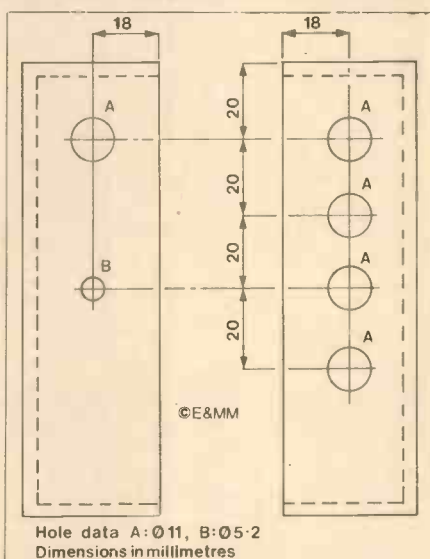


Figure 3. Drilling of the mounting holes in the case.

There are suitable spaces for mounting holes in the printed circuit board if a different case is used.

The battery fits into the space between S1 and the input sockets. A piece of foam material can be glued to the removable base panel of the case so that the battery is held firmly in place when the base panel is screwed in place.

The unit is connected to the other components in the system using normal screened audio connecting cables. As the circuit has unity voltage gain, a fairly high

input impedance, and a low output impedance, it should not produce any problems with incompatibility when it is added into a system. In fact, it can be used as a buffer amplifier in situations where a relatively high impedance signal source is driving a fairly low input impedance and loading effects are producing poor results.

As described here, the unit is only suitable for mono operation, but for stereo operation it is merely necessary to use two units, one in each stereo channel. If more than four inputs are required the circuit could easily be modified to have any desired number of inputs, as explained earlier. Alternatively, two 'Quadramix' units connected in series will accommodate seven inputs.

E&MM

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JK3/2	PCB/5	screen
JK4/1	PCB/6	conductor
JK4/2	PCB/5	screen
JK5/1	PCB/9	conductor
JK5/2	PCB/8	screen
B1/+ve	S1/2	Battery clip leads
B1/-ve	PCB/7	
S1/1	PCB/10	

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C2-C5	220n polyester	4 off (BX78K)
C6	1u 50V min. p.c.m.	(YY31J)
C7	4u7 25V min. p.c.m.	(YY33L)
Semiconductor		
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Miscellaneous		
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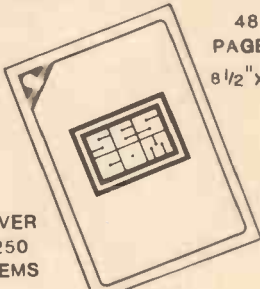
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C=CLASSICAL  
J=JAZZ  
P=PROGRESSIVE  
R=ROCK  
E=EXPERIMENTAL  
B=BEAT

G=REGGAE  
V=VARIOUS

**ELECTRONICS**  
D=DESIGNER  
C=CONSTRUCTOR  
N=NEITHER

(Fictitious example) →

NAME	TOWN	COUNTY	TELEPHONE	INSTRUMENT	LEVEL
BILL JONES	SOUTHEND				
ESSEX	0524 61232		STD Code + no		
K	M				
MUSIC	ELECTRONICS				
E	C				

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# THE POWERFET AMPLIFIER



**PFA 80**  
(100W plus  
into 8Ω)

### Elegant Simplicity

Advances in high technology should make life simpler. A cluttered power amplifier board may well perform superbly, but its busy elaboration is an indication that its design is pushing the limit of its component technology.

There are now many first class bipolar power amps on the market. All of them are complex and consequently expensive. Any additional improvements in the areas where they are weak (e.g. H.F. distortion) can only be obtained with yet further complexity and cost.

Only a new technology can provide the sort of "quantum jump" in component performance necessary to reduce the clutter on the board, reduce the cost and make the highest fi once more affordable.

### Powerfets

So far 29 semiconductor manufacturers have invested in this new technology. Clearly powerfets are something special.

Their enormous power gains eliminate conventional drive circuitry in power amps, permitting delightfully simple designs. Their freedom from secondary breakdown and their tendency to shutdown when thermally overstressed, result in inherently stable and destruction-proof output stages, not needing protection circuitry. And perhaps best of all, their lack of charge storage make them fast and responsive, producing amplifiers of wide bandwidth and low distortion even at high frequencies.



**Power Supply**  
Components available



**PFA 120**  
(150W plus  
into 8Ω,  
300W INTO 4Ω)

The PFA is perhaps the perfect realisation of the classic powerfet amp design. The superb PCB allows the use of either one or two pairs of output devices, providing easy expandability for those starting with the smaller system. (The extra output pair of the PFA120 results in lower distortion and improved efficiency, particularly into low impedance loads).

The components used in the PFA have been chosen with extreme care. The lowest noise input devices and lowest distortion gain stage devices were selected regardless of cost. 140V powerfets were chosen against the more usual 120V to give improved safety margins.

Specification	PFA80	PFA120
Bandwidth	10Hz —	100KHz ± 1dB
Output Power	80W (Vs ± 50V)	120W (Vs ± 55V)
R.M.S. into 8Ω		
THD (20Hz—20KHz)	≤ 0.008%	≤ 0.005%
(KHz at rated output)	0.004% typ.	0.002% typ.
SNR		120dB
Slew Rate		>20V/μS
Gain		X22
Rin		30K
Vs max		±70V
Cost (built)	£17.95	£24.85
(kit)	£14.95	£21.85

P/P 75p

### Power Amp PAN 1397

A high quality 20W power amp board based on the HA1397. Easily modified for bridge operation, providing high powers from low supply voltages.

Specification	
Output power RMS	20W into 8Ω at ± 22V 20W into 4Ω at ± 19V
THD	0.02% at 1KHz 1W to 12W
SNR	90dB
Input	100mV into 50K
Cost (Built)	£5.80

P/P 40p

**PAN 1397**



**PSU 101** Power Supply Board for 1 or 2 PAN 1397s. Provides ±22V at 3A and +27V with 2 second run-up (for anti-thump circuit on PAN 1397). (Built) £3.95. P/P 75p

**PSU 101**

Mains transformer for above 17-0-17v. 50VA. £3.95 P/P £1.10p

### Pre-amp PAN 20

The design is unique. Equalisation is applied after a flat gain stage, resulting in one of the best noise performances available. Superb overload figures are ensured by a front end incorporating a special gain/attenuator/control (volume control to you!). The inputs are uncommitted and can be used with any combination of signal sources in the 1mV to 10V range. RIAA equalisation is provided for mag Plus and space on the board is available for different equalisations.

Specification	
B.W.	20Hz-30KHz ± 1dB
THD	0.003% typ.
at rated o/p	
SNR	85dB (ref. 5mV RIAA) 105dB (ref. 100mV flat)
Vs	± 20V
Output	1V (clips at + 20dB)
Cost (built board less controls)	£6.75 2 needed for stereo P/P 40p

# pantechnic

(incorporating J. W. Rimmer)  
Dept E&MM5, 17A Woolton Street,  
Liverpool L25 5MH  
Telephone: 051-428 8485

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CRAFTSMANSHIP  
RELIABILITY

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he Sennheiser name has been associated with high quality yet affordable audio products for nearly half a century. In order to fully service and support the ever-growing customer base, Sennheiser now announce the opening of their UK offices in High Wycombe.

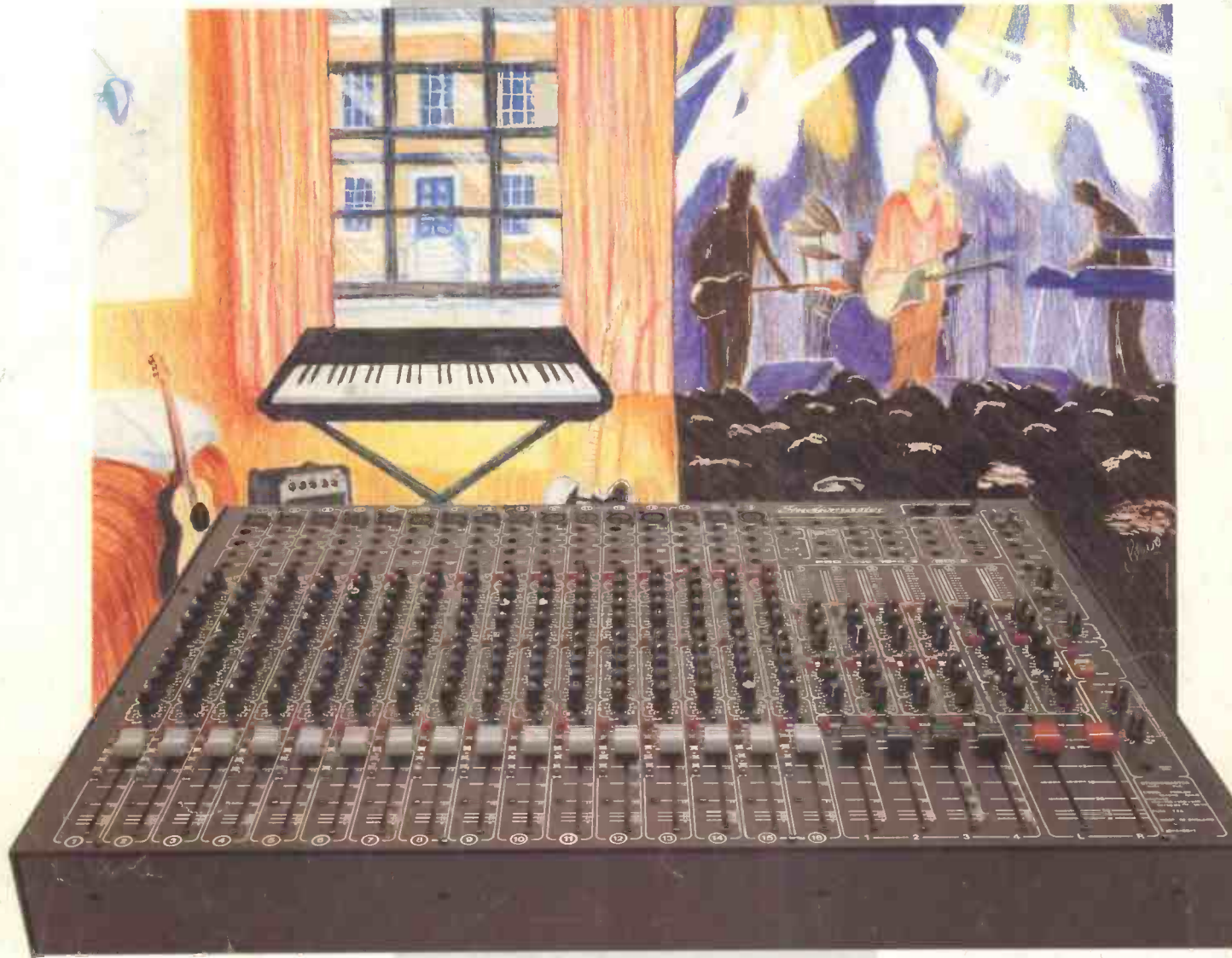
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## PRO-LINE

Here is a range of mixing consoles that combines the features and sonic excellence demanded for recording, with the rugged reliability essential for live performances.

### The Studiomaster Pro-Line

This rare combination of virtues makes for extraordinary versatility. The 16.4.8 Pro-Line (pictured) is just one of a range of 4 consoles – including rack mount and expandable versions – which can be used for applications as diverse as 16-track recording and disco installations.

As you would expect of Studiomaster, each Pro-Line is well equipped with features like 3-band EQ, 4 aux busses and 100mm faders. Stereo inputs and MIDI Controlled muting are also available on certain models.

Contact your dealer, or call us for a brochure, to find out more about the Studiomaster Pro-Line 8.4.8R, 16.2R, 16.4.8 and 16.8.16.

*Studiomaster*

The Artist's Expression