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Editorial Offices
282 London Road
Westcliff-on-Sea
Essex SS0 7JG
Tel: (0702) 338878/338015

Advertisement Manager
Alan Gibbs Tel: 01-527 3376

Advertisement Sales
Terry Day
Dennis Hill

Advertisement Offices
Electronics & Music Maker
Hillcroft House
16 The Avenue
Highams Park
London E4 9LD
Tel: 01-527 3376

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Sinclair ZX81 Personal Comp
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.

In March 1981, the Sinclair lead increased dramatically. For just £69.95 the Sinclair ZX81 offers even more advanced facilities at an even lower price. Initially, even we were surprised by the demand – over 50,000 in the first 3 months!

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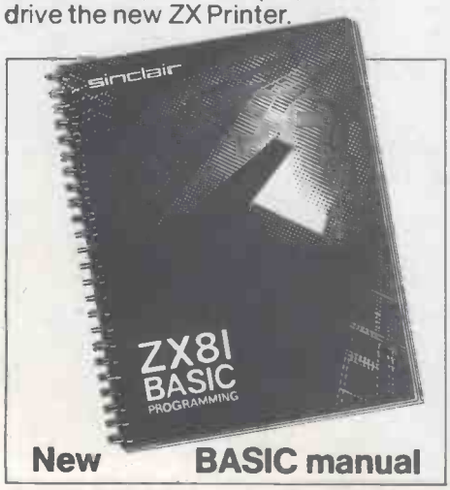
And the ZX81 incorporates other operation refinements – the facility to load and save named programs on cassette, for example, *and* to drive the new ZX Printer.



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Kit: £49.95

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- Able to drive the new Sinclair printer.
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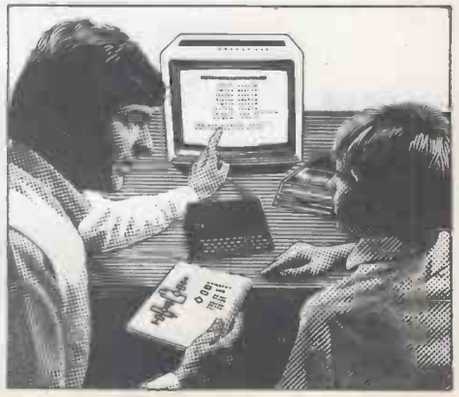
Kit and built versions come complete with all leads to connect to your TV (colour or black and white) and cassette recorder.



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Available now- the ZX Printer for only £49.95

Designed exclusively for use with the ZX81 (and ZX80 with 8K BASIC ROM), the printer offers full alpha-numerics *and* highly sophisticated graphics.

A special feature is COPY, which prints out exactly what is on the whole TV screen without the need for further intructions.

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ELECTRONICS & MUSIC MAKER

Music to the fore!

by Mike Beecher, Editor Electronics & Music Maker.

Understanding and using traditional music notation is often a frustrating and difficult task for many people, particularly for the electronics hobbyist who adeptly constructs a musical project, only to find that his or her eagerness to be creative on a newly-built instrument is thwarted by an inability to write down melodies, rhythms, harmonies or understand the musical concepts involved in its performance.

Because E&MM aims to educate the potential electro-musician, we are broadening our editorial in one sense and narrowing it in another. Broadening by expanding our 'workshops' to include areas not yet covered (such as learning to read music), and narrowing by restricting our pages to technical and musical material of direct interest to the electro-musician.

In addition, we continue our policy to up-date the professional musician, electronics or studio engineer.

Articles on hi-fi, video, studio, guitar, synthesiser, computer, organ and percussion are all in this month's issue, along with musical projects that offer something different at various levels of construction.

We've had quite a few 'think tanks' with experienced musicians in order to find the new directions that music is taking, whether it's classical or rock. Of course, categories in music these days are of little consequence and what is more important is the need to study the techniques of making music. Certainly, many of the people I meet are classically trained and have been able to usefully apply their musical knowledge to electronic music. Yet, there is another side to the story, with the growing number of young people who enjoy computing and making electronics projects, and so are better equipped with the technical knowledge necessary for the production of electronic music.

Although musical and technical aspects both demand elements of creativity, maybe the traditional emphasis towards the importance of musical talent will be counter-balanced by the young Space Invaders expert who could be the composer and performer of tomorrow's music!

Mike Beecher

Readers Letters

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

Dear Sir,
As a musician (pianist, organist, guitarist and teacher) I have read your August and September editions of E&MM with interest. I did wonder whether you were aiming at too wide a market however. The majority of musicians who read E&MM are probably not interested in projects such as a digital petrol gauge or a car race starter. It was the inclusion of so much material of this nature which caused me to consider for some time before deciding to subscribe to your magazine (the pennies not being over abundant). I would like to learn about electronics and so your 'Starting Point' series would hopefully be of value to me.
Is there any chance of more articles on computers and music? Topics such as composing with a computer (both traditional and contemporary styles), sound synthesis and teaching of music notation (using some computers music display and play capability) would be welcomed. Many home computers have very useful musical capabilities now, and advice on getting the most out of these would be welcomed. The musical applications of the computer are sadly neglected by all the computer magazines I have seen. E&MM would be the ideal magazine for such material.

Roger Bush
Dent, Cumbria

E&MM, of course, continues to look at micro music in its specialist way.

Dear Sir,
Having read Ken Lenton-Smith's 'Organ Talk' in the September '81 issue of E&MM I must take issue with him on some of his points and arguments. He has been misled, I fear.
(1) The illustration is not of the standard Klavar stave, but someone's hotch-potch of it. It was never published by us in this form.
(2) All Klavar music published by us does show the key in which it was written.
(3) Leger lines are used in Klavar notation, but reading notes on them is as easy as reading those on the stave (very easy indeed!)
(4) A 'raw beginner' who successfully worked through a Klavar course would not remain 'at that level', but would by then reach a playing standard equivalent to the Associated Board's Grade VI for the piano. Klavar organists give regular public recitals with enormous success. He (or she) will have a very good idea indeed of the 'pictorial chord' and the 'key concerned'.
(5) A Klavar player can 'really learn something about music'. Theory is not essential in order to read Klavar music, but all our courses contain a basic grounding in the subject - for the very good reasons given by Mr Lenton-Smith.
One of the reasons for using a vertical stave is that notes to be played on the right of the keyboard then appear on the right of the stave; those to be played on the left appear on the left of the stave. It is not for the benefit of oriental musicians! We keep a complete stock of Klavar music here at Lincoln, and offer a 'by return of post' service.
More than a million people have learnt Klavar, world-wide, and more than 55,000 in Great Britain. The reason there are not more Klavar players in this country is the high cost of telling people about it. (The Klavar Music Foundation of Great Britain is an Educational Trust and is strictly non profit-making).
As that doyen of English musicologists Sidney Harrison has written: "Every teacher knows that the conventional music notation is difficult to read in relation to a keyboard instrument, perhaps because it was devised, a thousand years ago, by a choirmaster. It indicates, though imperfectly, the pitch of each note. However, pitch has to be translated into finger position, and many aspiring keyboard players have wished for a system that would tell them, quite directly, where to put their fingers on the keyboard. This requirement is quite brilliantly met by Klavarskribo. It does not present music visually, on paper, as the composer wrote it, but it is exactly faithful, enabling a pianist or organist to 'see' music in terms of keyboard positions."
I should be happy to send anyone full details about Klavar, without charge or obligation of any kind. Please let your readers judge for themselves - after studying all the facts!

Michael Magnus Osborn
Klavar Music Foundation
171 Yarborough Road
Lincoln LN1 3NQ

PS: Klavarskribo is Esperanto for 'keyboard writing' by the way.

Dear Sir,
Being an electronic engineer interested in computer programming and also a very amateur musician, I purchased and read my first issue of your magazine. I found a great deal to interest me in its pages. However, I feel I must take up pen, sorry typewriter, and complain about the article by Mr Lenton-Smith.
I know there are two widely separated schools of thought regarding the conventional and the Klavarskribo method of writing music. Mr Lenton-Smith is very obviously firmly with the conventionals. He has of course, a perfect right to his views, but I do think in discussing Klavarskribo he should at least get his facts right and present a fair picture.
The piece of Klavarskribo music shown in the article is a travesty of what a typical piece would look like, and is very misleading. He says there is no indication of key. This is incorrect as the key is shown by the small note shown on F with the circle round it, indicating the key of F major.
There should be tails to the notes, tails running to the left for notes played by the left hand and tails to the right for notes played by the right hand. When the tails are properly added, the reason for the vertical stave becomes obvious.
Mr Lenton-Smith says that only in conventional music can chord structure be appreciated and harmony understood. In Klavarskribo the chords show a very definite pattern, more so as the pattern is the same for bass or treble stave. Most Klavarskribo music also gives the names of the chords so that harmonic progressions can easily be seen.
The reason Klavarskribo is not more universally known and used, is I think due to the fact that the other method was here first. Music publishers have tooled up for many years to produce the conventional music. Rather like trying to convert the country to drive on the right hand side of the road and converting all the road signs and cars to the opposite mode.
Incidentally, I understand that Klavarscribo is widely used and acclaimed on the continent.
However, in this matter everyone should make up their own minds. Get some Klavarskribo music and the musical text books that are also available and read about it. Then with knowledge of the subject, make your decision.

P. J. Williams
Bridgend, Mid Glam

We are hoping to publish a Klavarskribo piece shortly for our readers to try.

LANDSCAPE EXPLORED

with RICHARD BURGESS and JOHN WALTERS

RICHARD BURGESS: The group's been together for nearly six years — John and I had an idea for an alternative commercial group — something unusual but with a wide appeal and not the bland middle of the road stuff we were used to hearing on the radio. That meant starting fairly left field and then working back to the middle. You can't start in the middle and change a few things here and there — that doesn't work. So we decided we weren't going to have vocals or guitar, looking for personalities rather than instruments, and wound up originally with this very strange line-up of electric trombone, electric soprano sax, bass drum and an extremely unusual Fender Rhodes. Chris made the Rhodes different by sending its output through fuzz, ring modulator, phasers and other effects. Its strong touch dynamics made it an ideal sound source for us.

The original five musicians are still today's Landscape — Peter Thoms on electric trombone, Christopher Heaton plays a range of synthesisers, including the Yamaha CS80 and grand piano. (Chris and I like to 'doctor' the acoustic grand piano to get some strange sounds, probably from our fairly avant-garde background at one stage.) Andy Pask plays bass guitar and bass synthesisers. John Walters now does some of the computer programming, plays the Lyricon and also the Lyricon Wind Synthesiser Driver which interfaces with various other synthesisers. When we started, he used to play flute and saxophone through different pick-ups and effects boxes. (On the new album there's only about 4 bars of saxophone.)

JOHN WALTERS: I'm much more interested in the compositional end of music — instruments are a means to an end and the Lyricon does a lot of things I want to do and the computer does the rest.

Richard used to be just the drummer in the band. At the start we had scrapped two prime targets of attention in a rock band — the lead guitarist and the vocalist. After three or four years, when our image had been established, we were talking to our audience and telling stories based on the bizarre titles of our songs. It became a logical step for us to substitute this dialogue for vocal narrative during the piece, so Richard started singing. In fact, the whole group contributed to the vocals from then on.

RICHARD: That coincided with me getting more and more into electronic drums. Up until then I had solely played acoustic drums whilst doing much of the writing side. I used a large kit — based on the false principle that the more drums you have, the better people think you are!

JOHN: It's also very good visually. Richard used to play a big double kit with two bass drums panned left and right in the stereo field. We always performed in stereo, using Quad 405s on stage with Vitavox horns and bins.

RICHARD: I could never consider not working in stereo except in the smallest locations. It astounds me that so many people still use mono when the spatial effects in stereo are so exciting in performance — as long as you keep the heavy things in the middle, obviously.

JOHN: Looking back to our development, we never had a PA, because we played pubs and small clubs. Each member of the band had his own amplification so we had in fact set up our own spatial sound on stage.

RICHARD: Then we won the bins in the Vitavox Live Sound competition at the end of '76. These were used to extend our sound and, in particular, improve the drums which had not been miked up before. Overall, the sound system was very modest — two 405s amount to only 400 watts but the Vitavox systems were very efficient and made full use of the available power. For our largest venues we would double the whole PA output and it achieved all the power we wanted with good quality as well.

Keeping our cost down on the road, by ignoring such extras as compression and limiting (which we would have liked), enabled us to make a profit on our gigs. We did mix through 32 channels out front which was nice. On the drums we'd use AKG microphones.

Towards Synthesis

I'd always felt the limitations of the miked-up acoustic drum system. It seemed a very inadequate way of interfacing stone-age and 20th Century technologies. So I worked for a long time on an electric drum pick-up that screwed on to the shell. While I was working on that about three or four years ago, I became more involved with electronic synthesis. I'd had an EMS Synthi A for a long time and in our early days I used my own bits and pieces of percussion amplified with a pick-up. I remember us using these cheap Selmer Truvoice pick-ups on the grand piano and regularly blowing them up!

I experimented with electronic drum synthesis on the Synthi A, using its noise generator applied as the first source of the ring modulator, with trapezoid patched as its second source — although the envelope shaping was just not quick enough for good initial attacks. Next I used an SDS3, being unimpressed at the time with Syndrums, although people like Ralph MacDonald used them very well.

"A drum for me is something that kicks you in the stomach and makes your eardrums touch in the middle!"

None of these things did that, but the SDS3 had on it an 'adjustable impact click' which was a step in the right direction. Soon afterwards I met Dave Simmons, the SDS3 designer, at St Albans and showed him my parameters and ideas for a good electronic drum to consider.

My first parameter for a good electronic drum is that the dynamic range should at least equal your physical dynamic range or extend it — in fact the SDS5 does go beyond what you're putting into it.

One of the reasons I began using acoustic drums with pick-ups on them rather than synthesisers was because early instruments were not touch sensitive and therefore hardly suitable for drummers. I'm still amazed that people make systems without touch sensitivity — it's a fundamental requirement for bringing electronic instruments in line with traditional instruments.

If you're playing disco music, bass and snare need to be at a constant level — often done by compressing the dynamic range during recording and thus providing just the one instance where touch sensitive drums may not be necessary. But a simple drum fill (like the Ringo Starr: ♩♪♪♩♪♪) needs different amplitudes on each stroke.

Rhythmic Developments

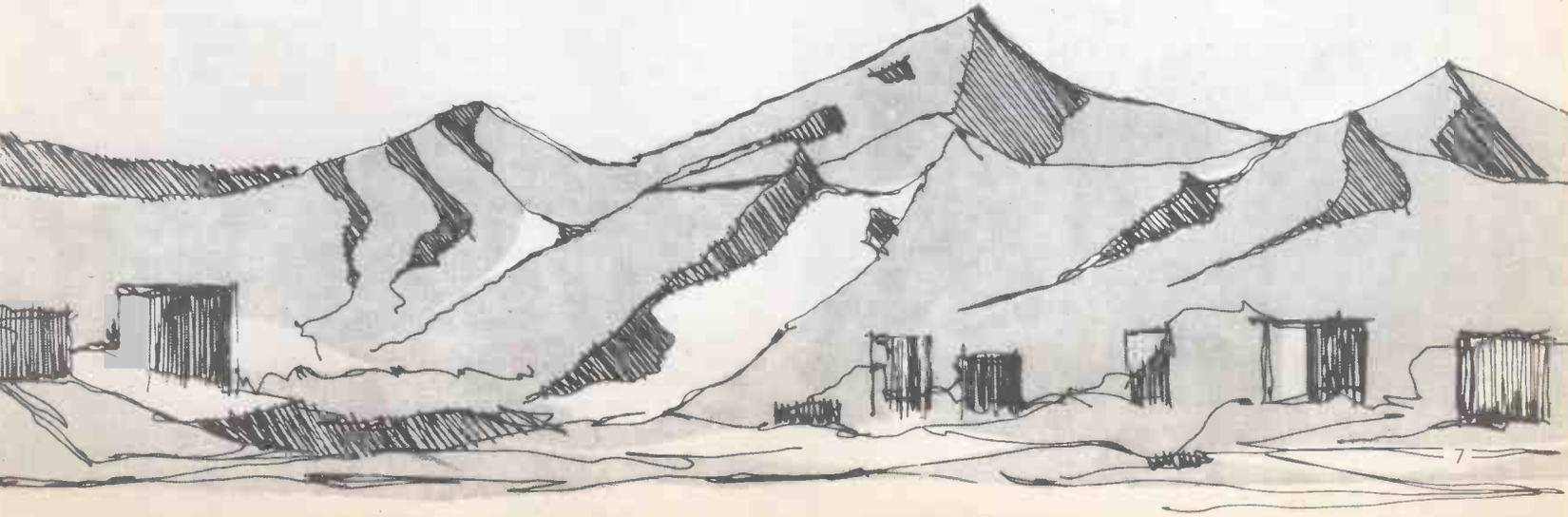
JOHN: Percussion has gone through the biggest change in the group — it's jumped right up to using the latest technology, having lagged behind more than any other instrument. When Richard used a large acoustic kit along with a lot of mics, his roadies would have to set up hours before the rest of us. So he made this lateral jump over to electronics, despite the limitations at the time of available equipment in comparison with acoustics.

RICHARD: Most people probably feel they can't change the way instruments develop. I had this misconception that synthesisers in general were unable to supply fast enough transients for percussion. But we tried the ARP 2600 and found we could create the three fundamental drum parameters — the initial sharp transient using filtered noise, the sound of the head as it pushes a large volume of air forward, and the decaying drum tone as shell and skin vibrate to give a warm rich sound. The latter part is easy to get, that's basically what Syndrums are — a slightly modulated tone with the transients not too obvious at the front.

Once you open the door to electronics, suddenly whole new vistas become possible. Whilst I'd said to Dave Simmons that the fundamental parameter of the electronic drum was touch sensitivity, when we'd done about two months design of the SDS5 (*the original of this remains a mass of wires on Richard's lounge table*), I then realised that we could operate drums by computer with instruments like the MC-8 and the new MC-4 from Roland. They have missed off one basic function for me — the six multiplex pulses which can be routed to control any channel. We don't write rhythms and music sequences in real time, we do it with a series of 'machine-code' style instructions.

I mentioned that I use the Sharp MZ-80K to programme my Roland CR-78 for different bars throughout a piece and Richard agreed that he'd found it possible to do the same sort of thing and that's why he used micro control for the SDS5. I asked him how that fitted in with his playing.

RICHARD: Perfectly, because we'd just about finished our gigs on the road and I wanted to be free of drumming on stage to do the singing. Because we were producing ourselves, it really gave us that incentive to do something new, so instead of trying to get the sound balance right as we did takes in the studio, I could sit in the control room and get the drums right with the MicroComposer.



LANDSCAPE EXPLORED

We never really had complaints about the lack of vocals because most people enjoyed our live performance. Until recently, we hadn't been a hugely successful recording band, although we had our own label and did well with our EPs. Our gigs were often to audiences who had never heard the band before. The music was danceable and yet we began to realise that it had to be verbal to communicate in all the ways we wanted it to.

Our first vocal was 'European Man' and its communication helped us through the existing instrumentals. Generally, we wanted our audiences to walk out of our gigs feeling elated rather than nodding in agreement intellectually about our performance.

Recording

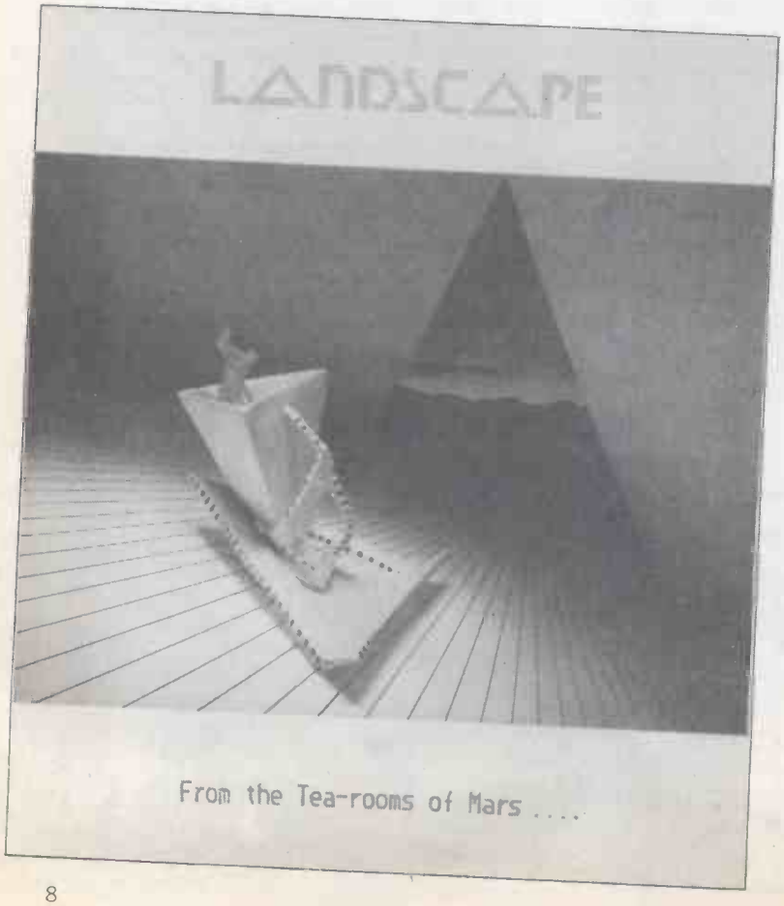
JOHN: Landscape's players come from very mixed backgrounds: Andy went to the Academy for instance, yet all of the group were self-taught in some respects. So we've had to learn by trial and error the best way to record our music. Our first EP was done with two mics over the band during a live gig. On the second EP we went into a church hall for the recording and for its 'B' side we went into an eight-track studio and learnt that way of recording. We also had to learn the ins and outs of pressings, covers and labels. We'd sell records on gigs or persuade local shops to take a few.

When we did our first album for RCA (called 'Landscape'), we made a mistake by recording it in between live shows on the road, so the studio takes were virtually what we played on stage, and the mix wasn't really acceptable for an LP. We'd like to remix the album again sometime.

RICHARD: One of the problems was the lack of the usual introductions done on stage. It also lost some of the 'aggressive' power we put out on a live gig.

We approached our latest album 'From the Tea-Rooms of Mars . . .' to the Hell-holes of Uranus' with a different objective — not to emulate our stage performance, except in quality and intent. You've got to make a record to suit the home environment for the listener who is obviously not as 'high key' as the guy who has travelled a long way to hear us at a live gig.

We finished the Tea-Rooms album in late July/August of last year, and we felt then it was ahead of its time (I'd been producing Spandau Ballet at that stage and Ultravox and Visage hadn't had any hits). So we held it back until March this year, even though a lot of people thought we were mad, but it's been worth the wait — 'Einstein a go-go' has been a tremendous success — particularly from the video we did that was shown on Top of the Pops.



We are very interested in the possibilities of video. It's the perfect medium for expressing the rather bizarre ideas that go with our songs. Our video of 'Norman Bates' has also excited a lot of interest (we've even got Pamela Stephenson doing a nod in the direction of Janet Lee in the film 'Psycho').

Are you becoming more theatrical?

RICHARD: We've always tried to convey the idea of some sort of story, not necessarily with a beginning and an end in traditional style, but simply a visual image that is ideal for video. Here lies a major difficulty — the film visuals must be abstract enough to be as repeatable as the music — most TV programmes would not hold your interest after two or three viewings.

Composing

We put together our music in every way that we can possibly think of. Very often one or two members of the group would contribute the main elements of a piece, but it would still be a 50% group effort. John and myself tend to think up the musical ideas for a piece 'in our heads' and then use the instruments to sort the ideas out in practical terms. Of course, you have to get the technique of being able to hold the music in your mind and then actually write it down.

JOHN: Often composition is to do with spontaneity — capturing an idea or melody before it's forgotten — then you have to do a lot of work to put your inspiration into music.

RICHARD: There were two main reasons I got into electronics. One was because of the sheer impracticality of conveying the sound of acoustic drums to two or three thousand people in live performance. Second, and more important, it increased the dimension of sound textures. As a band of composers we've always been interested in getting a bigger sound from just the five of us.

We orchestrate carefully so that, for example, the bass plays a melody sometimes, whilst the keyboards take over the bass. Obviously, if you're thinking on these lines, synthesisers can be used in many ways to give you a wide variety of colours.

JOHN: I hope that any influence we have on groups who use bass, guitar and drums is towards applying these instruments in other ways. There are unusual things you can do and plenty of bands already use conventional instruments in interesting ways.

RICHARD: But it can be dangerous experimenting on stage in front of 2,000 people! All of our computer programming is done at home, with John and myself finding all the sequences after several weeks' work which we then store on tape.

"The beauty of the computer for us is the way it provides a direct line from your imagination to what you can put down."

JOHN: It also liberates musicians from playing things that aren't very enjoyable. Some of the drum patterns that we use on the album were good to listen to but very repetitive, and this is where the computer can be used. It's the same with some of the very fast lines — in 'Face of the 80's', 'European Man' and quite a few other lines in the album — they're not keyboard or Lyricon, they're computer. It's like having another session musician with you!

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EXPANDABLE POLYPHONIC SYNTHESISER

Cabinet size 31.1" x 19.6" x 7.6" rear 3.4" front

OUR CATALOGUE IS FREE! WRITE OR PHONE NOW!

COMPLETE KIT ONLY

£320.00 + VAT!
(single voice)

Plug in extra Voices — Kit price £52 + VAT (£48 — + VAT if ordered with kit)

TRANSCENDENT POLYSYNTH

By brilliant design work and the use of high technology components the Polysynth brings to the reach of the home constructor a machine whose versatility and range of sounds is matched only by ready built equipment costing thousands of pounds. Designed by synthesiser expert Tim Orr and being featured in Electronics Today International, this latest addition to the famous Transcendent family is a 4 octave (transposable over 7½ octaves) polyphonic synthesiser with internally up to 4 voices making it possible to play simultaneously up to 4 notes. Whereas conventional synthesisers handle only one at a time.

The basic instrument is supplied with 1 voice and up to 3 more may be plugged in. A further 4 voices may be added by connecting to an expander unit, the metalwork and woodwork of which is designed for side by side matching with the main instrument. Each voice is a complete synthesiser in itself with 2 VCOs, 2 ADSRS, a VCA and a VCF (requiring only control voltages and a power supply, the voice boards are also suitable for modular systems). One of these voices is automatically allocated to a key as it is operated. There are separate tuning controls for each VCO of each voice. All other controls are common to all the voices for ease of control and to ensure consistency between the voices.

Although using very advanced electronics the kit is mechanically very simple with minimal wiring, most of which is with ribbon cable connectors. All controls are PCB mounted and the voice boards fit with PCB mounted plugs and sockets. The kit includes fully finished metalwork, solid teak cabinet, professional quality components (resistors 2%, metal oxide or metal film of 0.5% and 0.1%), nuts, bolts, etc.

Kit also available as separate packs

Pack		*Price*
POLY 15	Pots, switches, diodes, Cs for VOICE PCB	£4.80
POLY 16	PCB for plug in voice	£8.20
POLY 17	Rs, Cs, presets, connectors for one voice	£16.30
POLY 18	IC's, IC skts, diodes for one voice	£27.50
POLY 19	Transformer 0-120-240, 17-0-17, 0-7.7	£6.30
POLY 20	Pitch bend control	£3.90
POLY 21	Misc parts e.g. jack sockets, knobs, mains switch etc.	£13.00
POLY 22	Ribbon cable, ribbon cable connectors, mains cable	£8.45
POLY 23	Fully finished metalwork and fixing parts	£25.60
POLY 24	Solid teak cabinet	£25.80
POLY 25	Construction manual	£1.50
Total cost for individually purchased packs for single voice instrument		£355.15
Special kit for 4 voice expander kit including connectors		£295.00

Pack		*Price*
POLY 1	Pair of PCB's for multiplex cct. K.B. contacts	£9.50
POLY 2	IC's IC sockets, Rs, Cs, for multiplex cct.	£8.20
POLY 3	Superior quality keyboard	£32.25
POLY 4	Contacts and bus bars	£12.00
POLY 5	Double sided plated through PCB for digital control and pitch/gate generator cct.	£17.25
POLY 6	Rs, Cs, heat sink for fitting to Pack 5	£10.50
POLY 7	IC's IC sockets, diodes for fitting to Pack 5	£31.30
POLY 8	Double sided mother board (for plug-in voices)	£18.90
POLY 9	Rs, Cs, connectors for mother board	£14.10
POLY 10	IC's IC sockets, Trs, heat sinks for mother board	£13.10
POLY 11	PCB for master controls (left of section marked VOICES)	£18.80
POLY 12	IC's IC sockets, diodes, Trs, Rs, Cs for master control PCB	£9.30
POLY 13	Pots, Switches for master control board	£11.80
POLY 13	Pots, Switches for master control board	£11.80
POLY 14	PCB for VOICE controls	£6.80

ADSR IC CEM 3310 ..... £4.00

VCO IC CEM 3340 ..... £6.00

ICs and details of all packs in our

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The Horizon

RICHARD: The area of new technology that we are functioning in with our music is an expensive one for us — we don't get good deals when buying our instruments because the retail industry is struggling in the recession. Cost is therefore a problem, especially as the instruments often become obsolete in about 18 months, sometimes less!

But it's interesting to work with instruments that don't have clichés yet and maybe we can create some. Computer languages for music composition are also becoming more useful — take the Fairlight CMI. And you can make the computer improvise within certain parameters.

JOHN: The language is getting more 'higher level', so it shouldn't be long before we'll be able to communicate our musical ideas directly, rather than spend hours on the computer entering data. At the moment we're not really involved with real-time computer programming. Of course, if Richard or myself had good keyboard techniques, I doubt whether we would have put so much into the computer side of our music. Instruments like the CMI, Synclavier and PPG Wave 2 all help you to achieve fast playing and multi-layering with the accuracy of the virtuoso player.

RICHARD: I would like to see synthesisers changed in the future, by improving the interface between human beings and the instrument, and by analysing all the instruments of the orchestra to find the fewest number of control functions necessary to simulate them. Then these should be designed into really good touch-sensitive systems. Beyond that, I'd like an analogue/digital hybrid — something like the PPG Wave 2 system, but with more synthesis control than the OBX or Prophet — possibly using analogue synthesis that is totally modular and a digital cross-patching system.

On the single 'Angel Face' that I did for Shock, I played all the instruments myself and that's the way a lot of electro-music is going. In fact, everything was done on the MicroComposer and I only used the SDS5 Drum Synth, the SDS3 and the Roland System 100M with it. The 100M for me is one of the best synthesisers on the market, with so many control functions available independently, whereas most synths only have one or two LFOs to do all the modulating.

We're now working on a 35-minute film of 'Tea-Rooms' and writing music for a new album. We've recently released Spanish and German versions of the new single, plus remixed 12" disco records. We're also negotiating a video that's with other groups as well as Landscape — so perhaps we're becoming video artists of the future as well as electro-musicians!

Mike Beecher **E&MM**

POWERTRAN ELECTRONICS

BUILD THE TRANSCENDENT RANGE

TRANSCENDENT 2000 SINGLE BOARD SYNTHESISER

Cabinet size 24.6" x 15.7" x 4.8" (rear) 3.4" (front)

Designed by consultant Tim Orr (formerly synthesiser designer for EMS Ltd.) and featured as a constructional article in ETI, this live performance synthesiser is a 3 octave instrument transposable 2 octaves up or down giving sweep control, a noise generator and an ADSR envelope shaper. There is also a slow oscillator, a new pitch detector, ADSR repeat, sample and hold, and special circuitry with precision components to ensure tuning stability amongst its many features.

The kit includes fully finished metalwork, fully assembled solid teak cabinet, filter sweep pedal, professional quality components (all resistors either 2% metal oxide or ½% metal film), and it really is complete — right down to the last nut and bolt and last piece of wire! There is even a 13A plug in the kit — you need buy absolutely no more parts before plugging in and making great music! Virtually all the components are on the one professional quality fibreglass PCB printed with component locations. All the controls mount directly on the main board, all connections to the board are made with connector plugs and construction is so simple it ca t be built in a few evenings by almost anyone capable of neat soldering! When finished you will possess a synthesiser comparable in performance and quality with ready-built units selling for many times the price.

Comprehensive handbook supplied with all complete kits! This fully describes construction and tells you how to set up your synthesiser with nothing more elaborate than a multi-meter and a pair of ears!

COMPLETE KIT ONLY £168.50 + VAT!

TRANSCENDENT DPX
MULTI VOICE SYNTHESISER

Cabinet size 36.3" x 5.0" x 5.0" (rear) 3.3" (front)

COMPLETE KIT ONLY £299 + VAT

The Transcendent DPX is a really versatile 5 octave keyboard instrument. These are two audio outputs which can be used simultaneously. On the first there is a beautiful harpsichord or reed sound – fully polyphonic, i.e. you can play chords with as many notes as you like. On the second output there is a wide range of different voices, still fully polyphonic. It can be a straightforward piano as a honky tonk piano or even a mixture of the twol Alternatively you can play strings over the whole range of the keyboard or brass over the whole range of the keyboard or should you prefer – strings on the top of the keyboard and brass as the lower end (the keyboard is electronically split after the first two octaves) or vice-versa or even a combination of strings and brass sounds simultaneously. And on all voices you can switch in circuitry to make the keyboard touch sensitive! The harder you press down a key the louder it sounds – just like an acoustic piano. The digitally controlled multiplexed system makes practical touch sensitivity with the complex dynamics law necessary for a high degree of realism. There is a master volume and tone control control, a separate control for the brass sounds and also a vibrato circuit with variable depth control together with a variable delay control so that the vibrator comes in and only after waiting a short time after the note is struck for even more realistic string sounds.

To add interest to the sounds and make them more natural there is a chorus/ ensemble unit which is a complex phasing system using CCD (charge coupled device) analogue delay lines. The overall effect of this is similar to that of several acoustic instruments playing the same piece of music. The ensemble circuitry can be switched in with either strong or mid effects. As the system is based on digital circuitry data can be easily taken to and from a computer (for storing and playing back accompaniments with or without pitch or key change, computer composing, etc., etc.).

Although the DPX is an advanced design using a very large amount of circuitry, much of it very sophisticated, the kit is mechanically extremely simple with excellent access to all the circuit boards which interconnect with multiway connectors, just four of which are removed to separate the keyboard circuitry and the panel circuitry from the main circuitry in the cabinet.

The kit includes fully finished metalwork, solid teak cabinet, professional quality components (all resistors 2% metal oxide), nuts, bolts, etc., even a 13A plug.

1024 COMPOSER

Programmed from a synthesiser, our latest design to be featured in Electronics Today International, the 1024 COMPOSER controls the synth. with a sequence of up to 1024 notes or a large number of shorter sequences e.g. 64 of 16 notes all with programmable note length. In addition a rest or series of rests can be entered. It is mains powered but an automatically trickle charged Nickel Cadmium battery, supplying the memory preserves the program after switch off.

The kit includes fully finished metalwork, fibreglass PCB, controls, wire etc. — complete down to the last nut and bolt!

COMPLETE KIT ONLY £89.50 + VAT!

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BLACK HOLE CHORALIZER

De Luxe version (dual delay line system) also available for £59.80 + VAT

Cabinet size 10.0" x 8.5" x 2.5" (rear) 1.8" (front)

The BLACK HOLE designed by Tim Orr, is a powerful new musical effects device for processing both natural and electronic instruments, offering genuine VIBRATO (pitch modulation) and a CHORUS mode which gives a "spacey" feel to the sound achieved by delaying the input signal and mixing it back with the original. Notches (HOLES), introduced in the frequency response, move up and down as the time delay is modulated by the chorus sweep generator. An optional double chorus mode allows exciting antiphase effects to be added. The device is floor standing with foot switch controls, LED effect selection indicators, has variable sensitivity, has high signal/noise ratio obtained by an audio compander and is mains powered — no batteries to change! Like all our kits everything is provided including a highly superior, rugged steel, beautifully finished enclosure.

COMPLETE KIT ONLY £49.80 + VAT! (single delay line system)

All projects on this page can be purchased as separate packs, e g PCBs, components sets hardware sets. etc See our free catalogue for full details and prices

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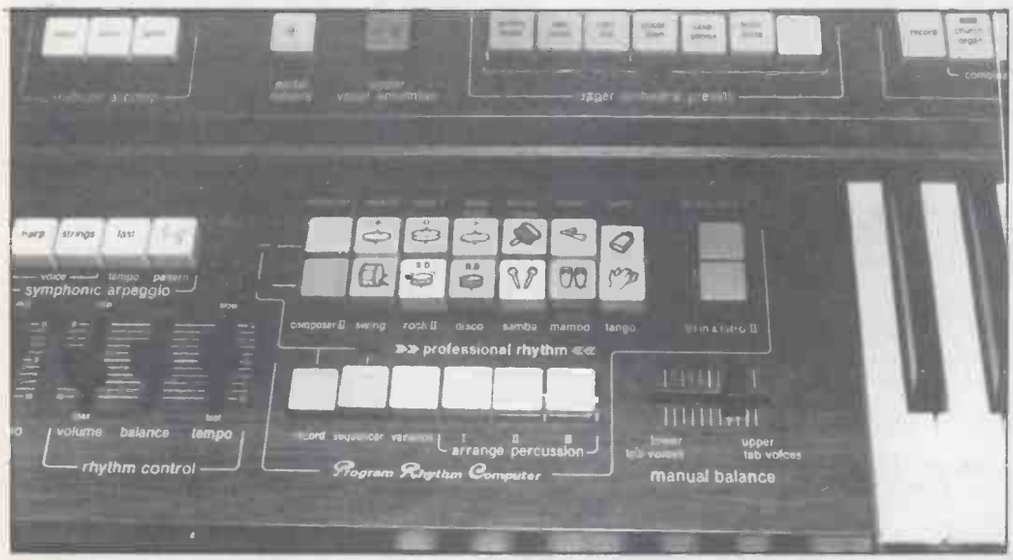
MUSIC MAKER EQUIPMENT SCENE

The Technic SX-U90 organ is a development of the U60 introduced over a year ago from National Panasonic in Japan. The instrument undoubtedly has some exciting features for the creative organist, with a stunning clarity from its 125 watt RMS amplifier system and retails at £3,820.

A new range of effects boxes from T.C. Electronic and distributed by Gigsville which include phasers, dual parametric equaliser, preamplifier, 4-way remote switch and 4 output 9 volt power supply.



Part of the U-90 controls which includes such features as a programmable sequence rhythm computer, auto phase modulation on presets vocal ensemble, solo synths and percussive presets, orchestral conductor and a voice setting computer that remembers every setting on the organ.

New instruments from Elka include the Sidekick 32, a rhythm unit with 16 rhythms with A/B selection, drumbreaks, instrument balance, retailing at £225, and the RM140 speaker/amp system rated at 100w output, with dual inputs each with graphic equaliser, LED output indicators and priced at £495. New keyboards are the X-50 single manual portable organ with 9 drawbars and 7 presets and the Elkatwin 61 which generates two independent polyphonic layers with 14 presets including organ, strings, guitar, piano and brass, plus electronic chorus effects, de-tuning and bass presets.

The Aria Pro II series "Loco Boy" 1½ watt portable amp that is battery powered and ideal for off-stage tuning of guitars. Retail price £16.90.

The Gibson ES335 Pro guitar. This is virtually an exact reproduction of the 58/59 dot inlay 335, regarded by many as a collectors item. It has the old type of 50's knobs and pick-ups with a slightly smaller body than the original, but still retaining the 'Mickey Mouse' ears shape prominent at that time. With the original still selling between £1,250 and £2,000, this new version comes at £875. It features a new 3-position bridge, 3-piece mahogany neck, maple body and aged white binding to give it an authentic finish.

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Available for immediate despatch or for collection at our factory.
Nothing extra required – all kits are complete including a 13A plug.

DJ90 STEREOMIXER

COMPLETE KIT ONLY £97.50 + VAT!

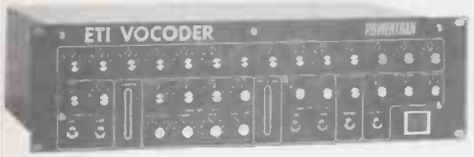
As featured in Electronics Today International — July Issue!

This versatile new mixer, shown here fitted to our console, has 2 stereo inputs for magnetic cartridges, a stereo auxilliary (e.g. cassette or jingle machine) input and a microphone input. The decks can be automatically panned either fast or slow and all 3 music inputs can be mixed with slider controls. There is a 5-section graphics equaliser and a beat-lift control. Also there is a voice-over unit (ducking) and an override button for interrupt announcements. The microphone input can be modulated at a variable rate to produce 'growl' effects and there is monitoring of any music input (pre-fade listen) via the stereo headphone socket and a pair of LED PPMs. The mixer kit includes fully finished metalwork fibreglass, PCBs, controls, wire etc. — complete down to the last nut and bolt!

The console is shown fitted with two 19" panel units

— a Chromatheque 5000 lighting controller
— an SP2-200 stereo 100W/channel power amplifier. For a 200W/channel system two SP2-200s could be fitted.
— Power supply for mixer with screening metal box £90.90 + VAT.
— Console complete with switch panel, lid feet and carrying handles £69.50 + VAT.
— BSR P256 — their latest belt-drive disco turntable £29.50 + VAT each.

ETI VOCODER



Features as a construction article in Electronics Today International this design enables a vocoder of great versatility and high intelligibility to be built for an amazingly low price. 14 channels are used to achieve its high intelligibility, each channel having its own level control. There are two input amplifiers, one for speech either from microphone or a high level source e.g. mixer or cassette deck and one for external excitation (the substitution signal) from either high or low level sources. Each amplifier has its own level control and a rather special type of tone control giving varying degrees of bass boost with treble cut or treble boost with bass cut. The level of the speech and excitation signals are monitored by LED PPM meters with 10 lights – 7 green and 3 red which indicate the level at 3dB steps. There are three internal sources of excitation – a noise generator and two pulse generators of variable frequency and pulse width. Any of the internal sources and the external source can be mixed together. There is a voiced/unvoiced detector which substitutes noise for the excitation signal at the points in speech where the vocal chord derived sounds of the speaker are substituted for by the unvoiced sounds of sibilants, etc. There is a slew rate control which smooths out the changes in spectral balance and amplitude enabling a change of the speech into singing or chanting and other special effects. A foot switch is provided to permit a complete freeze in spectral balance when the freeze is in operation.

An output mixer allows mixing of the speech, external excitation and vocoder output. The majority of the components fit into the large analysis/synthesis board with the rest on 8 much smaller boards with the controls and sockets mounted on them for ease of construction. Connectors are used for the small amount of wiring between the boards.

The kit includes fully finished metalwork, professional quality componentr (all resistors 2% metal oxide), nuts, bolts, etc – even a 13A plug!

COMPLETE KIT ONLY £195 + VAT!

MPA 200 100 WATT (rms into 8 ohm) MIXER/AMPLIFIER

Featured as a constructional article in ETI, the MPA 200 is an exceptionally low priced — but professionally finished — general purpose high power amplifier. It features an adaptable input mixer which accepts a wide range of sources such as a micrphone, guitar, etc. There are wide range tone controls and a master volume control. Mechanically the MPA 200 is simplicity itself with minimal wiring needed making construction very straightforward.

The kit includes fully finished metalwork, fibreglass PCBs, controls, wire, etc. — complete down to the last nut and bolt.

COMPLETE KIT ONLY £49.90 + VAT!

SP2-200 2-CHANNEL 100 WATT AMPLIFIER

The power amplifier section of the MPA 200 has proved not only very economical but very rugged and reliable too. This new design uses 2 of these amplifier sections powered by separate power supplies fed from a common toroidal transformer. Input sensitivity is 775mV. Power output is 100 rms into 8 ohm from both channels simultaneously.

The kit includes fully finished metalwork, fibreglass PCBs, controls, wire etc. – complete down to the last nut and bolt!

COMPLETE KIT ONLY £64.90 + VAT!

CHROMATHEQUE 50005 CHANNEL LIGHTING EFFECTS SYSTEM

This versatile system featured as a constructional article in ELECTRONICS TODAY INTERNATIONAL has 5 frequency channels with individual level controls on each channel. Control of the lights is comprehensive to say the least. You can run the unit as a straightforward sound-to-light or have it strobe all the lights at a speed dependent upon music level or front panel control or use the internal digital circuitry which produces some superb random and sequencing effects. Each channel handles up to 500W and as the kit is a single board design wiring is minimal and construction very straightforward. Kit includes fully finished metalwork, fibreglass PCB controls, wire etc. – Complete right down to the last nut and bolt!

COMPLETE KIT ONLY £49.50 + VAT!

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INDUSTRY PROFILE

Roland (UK) Limited

Part of the large storage areas.

Despatch department.

Roland products began their life in Japan in the early 70's and were first distributed in this country by Brodr Jorgensen over six years ago as part of a European network extending from Copenhagen.

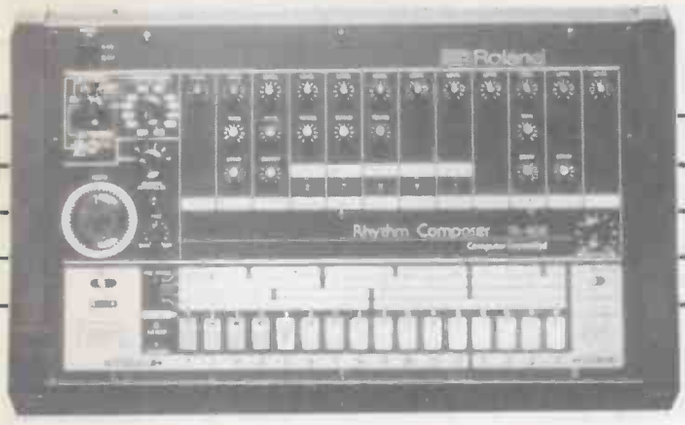
The UK division was started by Brian Nunney working at home with a modest capital of £5,000. Then a small warehouse was acquired with a staff augmented by Fred Mead and Ken Stoddard to a grand total of three! From the outset, their policy was to process orders the same day and the enthusiasm and energy required to maintain this aim is still evident today, along with a bias towards minimum staff and maximum stock of instruments.

After two years of existence, the company made its next big step by moving into a warehouse complex at Brentford, Middlesex with the promise of long term growth ahead.

Then at the end of December, 1980, financial difficulties loomed for the retail side of Brodr Jorgensen in Denmark which prompted Brian Nunney to start negotiations for buying Brodr Jorgensen UK. The Roland corporation in Japan gave the necessary assurance for supporting the proposals with the result that the acquisition proceeded and a new company, Roland (UK) Ltd began as a joint venture with the Japanese manufacturers. So the management stayed the same, with Brian Nunney

The air-conditioned demonstration room.

Inside the demonstration room the full range of Roland products can be examined.



as Managing director, Fred Mead as Sales Director and Ken Stoddard as Financial Director now owning 50% of the company between them.

The warehouse contains offices and a large storage, packing despatch and receipt area in which an impressive air condition demonstration room has been built, as well as separate guitar and equipment workshops. Despatch to retail stores is made daily with delivery within 48 hours.

Roland's product range numbers over 250 items with one new line every month on average introduced. Brian Nunney declares, "Within our field we are the biggest in the country and our policy in terms of products is to keep a broad base -- covering synthesisers, rhythm units, keyboards, amplification and effects". Brian believes their success stems from the innovations introduced in Roland musical products and their research and development team looking very early on at the digital technology available and the subsequent use of computer based designs. He comments, "we've barely scratched the surface!"

"Industry standards are becoming more important as musicians link instruments together and our 1 volt per octave is now the most used standard for voltage control. Similarly, guitar synthesis should focus on the 'electronic guitar' because guitarists in general have kept away from synthesis. In terms of rhythm machines, Roland now have a complete family of instruments from the Dr. Rhythm, the CR5000 (with presets and programmable functions), the CR8000 and at the top of the range, the TR-808 with full composing features. There's also likely to be another machine soon with the TR-808 facilities all in a complete package that's considerably cheaper."

Roland recognise the need for limited 'prestige' lines in order to give the company total professional credibility, such as the System 700 and the MC-8 MicroComposer. From the System 700, the System 100M was derived and from the MC-8 came the TR-808, MC-4 and even the Dr. Rhythm. Very often the same chips and circuit boards can be utilised in more than one product.

Moving on to other products, the Roland Rack has been very successful and comprises a range of specially designed 19" processing, effects and power amp units mounted in a solid flight case for use on stage as well as in transit. This allows the musician to carry the Rack with everything linked and preset for immediate use.

The 100M modular synthesiser is an ideal system for the serious electronic composer although it is also used by many groups and studios, including Landscape and the BBC Radiophonic Workshop. Developed from the large System 700, it offers comprehensive patch-chord interfacing.

Instruments like the Vocoder have introduced new sounds for musicians and will probably become a popular preset on new instruments in the coming years, in the same way that clap boxes are now becoming an integral part of drum machines.

With reasonable cost in mind, the SH series of synthesisers were introduced with a smaller number of keyboard octaves, yet still retaining in/out patch sockets for linking with other instruments.

Although Roland stopped making their portable organs over a year ago, due to economic reasons and the need to look in other directions, it is expected that pro, semi-pro and home organs will be introduced within two years.

Another useful Roland idea is the MS-100 speaker unit, designed for mic stand mounting as a 100W monitor which can be conveniently placed on both sides of the player.

One of the most popular effects boxes is the CE-1 Chorus Ensemble Stereo which is selling well after 4½ years. Roland also introduced FET switching to their effects and made the whole top half of the box as the switch. Digital delay effects pedals are in the pipe-line too.

The new state-of-the-art Jupiter-8 polyphonic synthesiser has the ability to layer user-programmed preset sounds in 8 note playing capability - with 16 oscillators (two on each note with de-tuning possible). It's a variable synthesiser in that you can set up 64 sounds from an 8-switch matrix selection using the digital display.

Following the success of the Cube high quality amplifiers, now extending up to 100W power, Roland have augmented these with the Bolt tube amps and Spirit guitar amplifiers.

The original MC-8 MicroComposer, although expensive, gave a new form of digital/analogue multi-tracking for synthesisers with data keyed in by numbers. The MC-4 has been brought out as a less expensive alternative and, linked with the TR-808, gives a complete harmonic/rhythm backing for compositions. The SQ-100 (and larger memory SQ-600) sequencers provide ideal melodic storage blocks that can synchronise with both the TR-808 and MC-4 to produce music in the style of Tangerine Dream and Logic System.

Another important direction for the company lies in the distribution of guitars and Roland now carry the Washburn range of fretted instruments which include guitars (both electric and acoustic), banjos and mandolins. The addition of this range of products has given the company vital experience over the last two years with fretted instruments alongside the Roland guitar synthesisers. The instruments were made in Japan for Washburn America and are an established and popular range for the professional player.

Roland have always emphasised the importance of training courses for shop sales staff and Alan Townsend regularly holds seminars in the UK. At first it was very hard to persuade retailers to learn about synthesisers - now there is a waiting list, simply because musicians purchasing instruments often knew more about them than the salesman! Jane Yapp, personal assistant to Brian Nunney, plays a large part in the organisation of these seminars as well as the many music exhibitions attended by Roland.

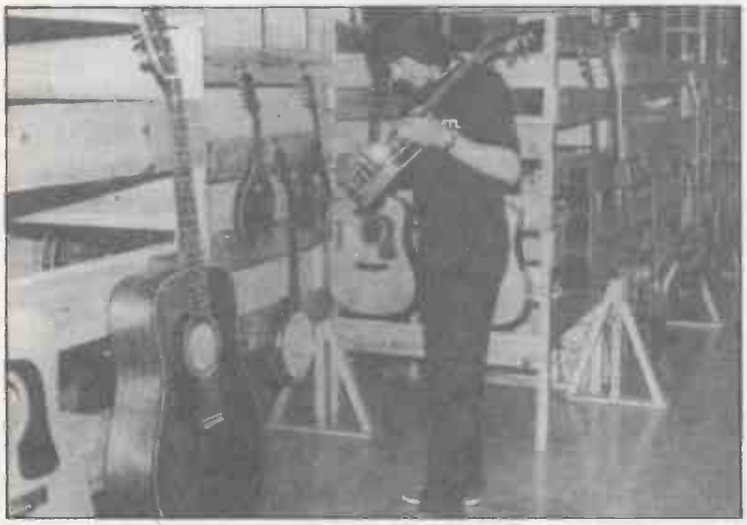
Brian Nunney sees many impor-

A working set-up with MC-4, System 100M, TR-808 and 100 watt monitors.

Mike Baron checks out fretted instruments in the guitar workshop.

Rick Cannell testing a Space Echo unit in the equipment workshop.

Rolands demonstrator in Japan, Ike Ueno, performing his own composition for E&MM cassette no. 4.



Dave Green looks after the range of Washburn guitars, banjos and mandolins.

The Roland Seminar (1) with Adrian Lee.

Some Roland guitar 'foot controllers'!

Jay Stapeley demos the GR-300.

tant areas for consideration in the future, such as tuning standards, interfacing, using electronic instruments for classical music, the continued acceptance of the 'distorted' valve amplifier, linking electro-music with audio visual media (including the use of the TV screen for music notation). He stresses the importance of the specialist musician who paves the way for the future and often is the idol of the younger generation.

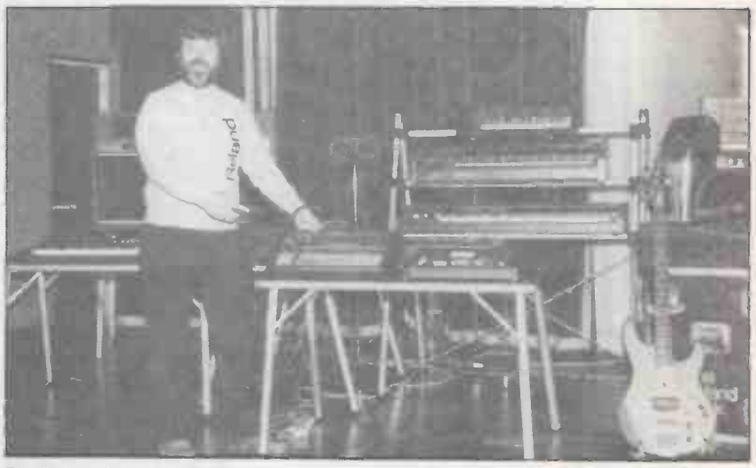
Brian comments, "The music business has limited parameters which so far have not been expanded. What we see in the future, and it's already happening in Japan and the West Coast of America, is the increased use of leisure time in a constructive and creative way, and E&MM is highlighting the direction of the expanding frontier for the music industry."

"You've got to be able to create - we've had a whole decade of being flooded with things that are non-creative but occupy time, e.g. television. People are beginning to want to do something useful with their spare time and electro-music and the silicon chip have made it all the more possible. Combine this music making with studio recording facilities which are much more accessible financially and more acceptable in the home, and you have a whole new extra parameter of music products as well as ways of playing music without being a genius!"

For the future, Roland have their development well planned and will surely continue to provide innovative designs for the amateur and professional musician.

Mike Beecher **E&MM**

On our Demo Cassette No. 4 Alan and Adrian play the Jupiter 8, Jay plays the GR-300 Guitar Synth and Ike plays the MC-4 with other keyboards.



The Roland Seminar (2). Alan Townsend enthusiastically demonstrates new keyboard and rhythm machines.

Brian Nunney, Managing Director of Roland (UK) Ltd.

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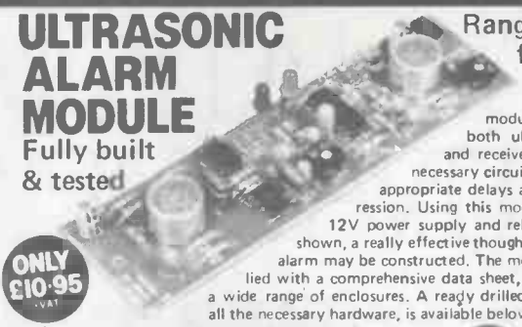

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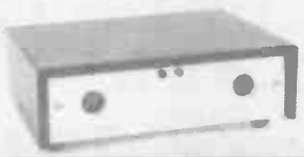

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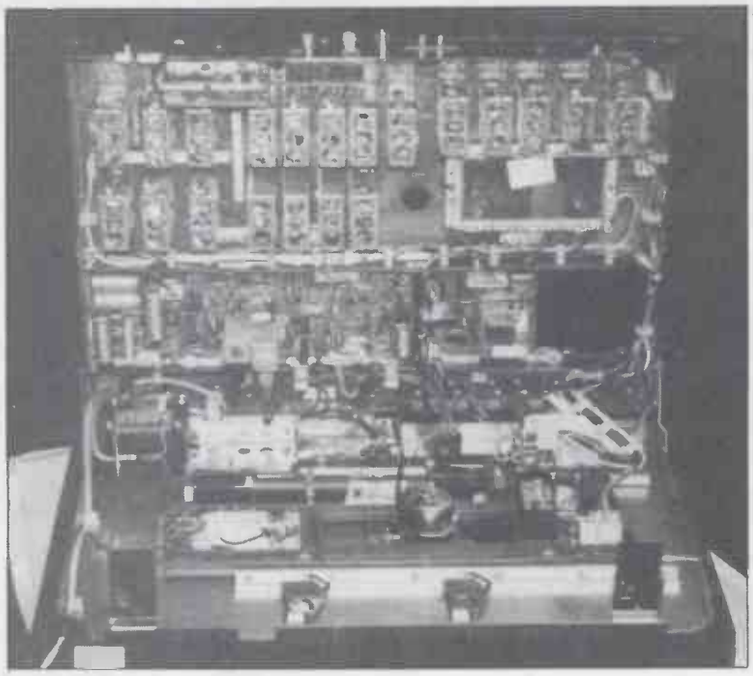
THE 12th HARROGATE INTERNATIONAL FESTIVAL OF SOUND

David Ellis looks and listens to new products at this popular hi-fi exhibition

I have to admit that my last exposure to the hectic concourse of a Hi-Fi show was some five years ago, when, as a grant-conscious student, I went after my first slice of sonic excellence. I still have more-or-less the same system now, which either goes to show that I'm easily satisfied or else that I chose well in the first place! So, having remained blissfully ignorant of discussions about the musicality of turntables or the 'openness' of amplifiers, I think it's true to say that I approached the 12th International Festival of Sound with something approaching an open mind, if not an entirely unbiased ear.

In general, path-breaking innovations were on the scarce side, as also were those demonstrations offering the sort of sonic superlative that roots you to the spot, and the overriding impression was of continuing along well-trodden paths. This year, Japanese manufacturers tended to opt for the pathway of progressive miniaturisation whilst at the same time packing the front panel with yet more LEDs and soft-touch switches. Pioneer and Sony were both parties to this cause and the casual observer could be forgiven for thinking that they were looking at a miniature version of an Underground map complete with station indicator lights. Indeed, Pioneer went so far as to put an enlarged version of the front panel of one of their new cassette decks on the wall of their demonstration area, which tends to prove my point! Maybe next year's offerings will actually use a microprocessor to give a status indication of the functioning of every chip in the circuit.

At the opposite end of the multi-control spectrum, at least when applied to amplifiers, there was the monolithic approach adopted by Mission Electronics with their new 776 pre-amplifier and 777 power amplifier. These looked and sounded mightily impressive, though the starkness of their design, and the egocentric front panel (controls and indentations spelling out the manufacturer's name), will probably tend to restrict its appeal to those that go for 2001-like blocks of granite. Their loudspeakers use a more traditional design, and, with the combination of competitive pricing and high performance standards, deserve the recognition they've received for being uncoloured and excellent negotiators of transients.

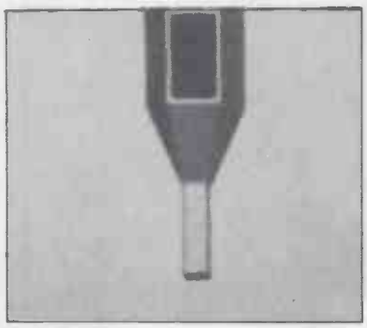


Inside the Phillips LaserVision.

Mission 776 Pre-amplifier and 770 Speaker.

A rather more unorthodox approach to loudspeaker design is adopted by Arnoldi Audio, essentially a one-man British firm, with their extraordinary egg-shaped Egliptic loudspeaker (I've heard of going to work on an egg, but this is ridiculous.) Seriously, though, the design principle is sound, in that a continuously curved surface, such as the inside of an egg, results in waves being reflected in all directions, rather than going off in one massive wavefront that then has to be tamed from its destructive behaviour with the judicious application of Dr. Bailey's long-haired wool. The Egliptic uses a high quality 8" Bextrene-coned woofer/mid-range unit and a Motorola piezo-electric tweeter, a combination which doubtless accounts for the outstanding transient response of the unit. Less impressive is the bass response of the Egliptic, which appears somewhat light to ears attuned to the more resonant sound of conventional loudspeaker boxes. All in all, a unit for baroque or classical music rather than heavy romantic or rock, and very expensive at £440.

Consideration of standing waves was also to be found in a product at the other end of the recording chain, the Crown PZM microphone, being demonstrated by Amcron Ltd. The PZM consists of a small electret capsule mike mounted a fraction of an inch above a 5" square plate. Within a few millimetres of a large surface, sound levels from a pair of equal signals add coherently, thereby eradicating phase cancellation effects between direct and indirect sound waves. As no signals can arrive on axis, but can only enter at the side, so the amplitude response is flat and independent of the position of the sound source. All this adds up to an incredibly sensitive mike that seems to reach the parts that other mikes cannot reach in those situations where sound waves are merrily colliding with each other. The demonstration I heard of the PZM being used for recording a pub rock session really showed how good it is at separating sounds, and it's no wonder that it's being used for sound reinforcement at the Hollywood Bowl. Recording studios seem enthusiastic about the PZM too, but, at £225, it's rather beyond the pocket of most amateur sound engineers.



Crown PZM Microphone.

The Egliptic Loudspeaker.

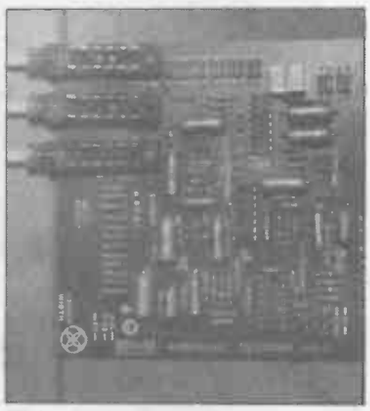
Without wanting to stretch the point, waves, and the ways in which they can be pulled apart for the sake of our aural titillations, came into focus again with two ambisonic systems being exhibited at the show,

The research by Michael Gerzon and his colleagues at Oxford into the nature of ambient sound resulted in the appearance of the Integrex quadrophonic decoder, a unit which is still available in kit or assembled form. The NRDC in fact backed the research and development of the ambisonic system, a strange horse for this normally cautious body to back considering the number of fingers that were burnt on earlier incarnations of quadrophonic techniques. Still, it's fortunate that the NRDC did have the foresight to do this, for the design team seem to have come up with a means of coding and decoding quadrophony that really works.

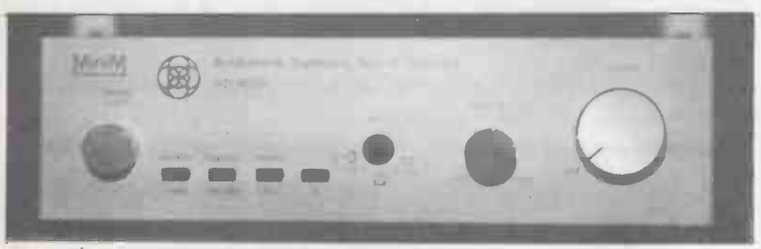
In practice, quadrophonic decoding involves analysing phase relationships between the two stereo channels, and, either, in the case of non-encoded material, 'artificially' extracting ambient signals for feeding to rear speakers, or, in the case of specially encoded material, deciphering the ambient signals placed there as part of the recording process. The crucial factor responsible for successful ambisonic reproduction lies in fooling the ear into hearing a smooth soundfield from just a few speakers. This is easier said than done and involves a pretty intense exploration of psychoacoustics and mathematical relationships between sound waves. Two decoders other than the Integrex unit are now being marketed in this country, and incorporate various improvements made to the system over the past few years. The Minim Audio decoders range in price from £99.95 for the basic AD 1000 model to £199.95 for the top of the range AD 3000. Both of these models accept either of the two current encoding standards (UHJ and B format) as well as allowing the ambisonic decoding of normal stereo signals. Minim have also wisely elected to make available a ready-made module with all the functions of their other units for just £49.45, a figure that seems very reasonable considering it also includes the NRDC licence fee. VAT and postage. E&MM will be looking at this decoder module in the near future and we'll be particularly interested to see what it does as regards the average stereo mix.

IMF Electronics have also produced a ambisonic decoder which appears to offer the same facilities as the Minim units, although the price is somewhat greater. Wharfedale and Shure were also using the IMF decoder in their own demonstrations, and, although the ambience extraction from stereo LPs was impressive, the way in which the unit habitually routed pops and crackles to the rear speaker was rather unnerving. This also seemed to be true of the Minim decoder, and their demonstration also emphasised how important it is to have rear speakers that are compatible with the front set. Like many noise reduction units, successful ambisonic decoding obviously relies on the signal emerging from the pick-up with the same composition as that when the original master was stamped. Similarly, when normal stereo discs are being played, things should be fine, ambience extraction-wise, as long as music is the only thing that's being decoded; otherwise, look out for a shower of rice krispies from the rear!

Very much in evidence at this year's show were the bevy, or, rather, bus-load, of blonde beauties doing their bit for home sun-tans, as well as,



Minim Ambisonic Decoder Module.



Minim Ambisonic Decoder AD 1000.

IMF Ambisonic Decoder.

Koss Sound Partner and Music Box.

somewhat incidentally, the products they were promoting, and spread as generously amongst manufacturers' stands as butter on hot toast. This tribe were well trained in the art of the seductive gaze, but, after the tenth in a row, one started to get the sneaking feeling that the next in line would turn the hapless gaze to stone as snakes sprouted from her hair. Such are the delights awaiting those in 'the trade', and whilst flutter (apart from that of the overladen eyelashes of the above) was nowhere in evidence, cassettes, in all their shapes and forms, were well and truly on the rampage.

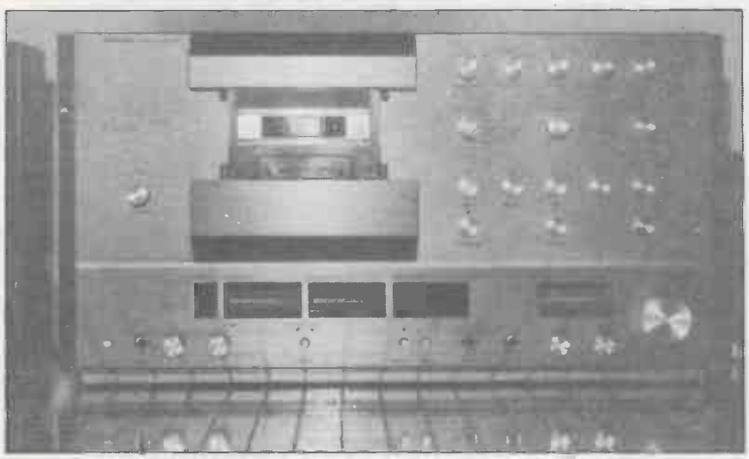
Starting off at the smallest end of the spectrum, the new Sony M1000 stereo micro cassette recorder (RRP £115) seems a pretty remarkable piece of design, and, even though there is at present quite a lot of noise and some tell-tale high frequency compression, the quoted frequency response of 80 to 8,000 Hz on standard ferric tape at 2.4 cm/sec is a real achievement. And it's light on the track suit waistband too! If only these small recorders/players also included noise reduction... What about it Sony?

A variety of manufacturers have been cashing in on Sony's ultra-lightweight headphones, but, as anyone who has been tempted to buy one of the cheap Walkman imitations will know, the similarity is usually only of a cosmetic nature. Koss have now produced their own lightweight (100 g) 'Sound Partner' headphones, which are likely to retail for the same price as the Sony MDR-4 headphones and offer a competitive sound quality. A significant point in their favour is that the design holds them off the ears by means of foam clamps above the drive units. This means that the Sound Partner is less likely to pivot on the ears, and therefore fall off, when you're sprinting or doing some other form of vigorous exercise. Furthermore, the Sound Partner folds up into a compact size suitable for putting in the pocket! Koss were also promoting their Music Box, a 'portable AM/FM stereophone receiver', though the only one to be seen was ensconced under glass rather than heard in the open. I suspect that this was Koss's jewel of the seven seas approach - tempting people with something they can't touch - but it may also have something to do with the poor stereo FM quality that would have been likely to ensue if they'd actually had people trying it out in the middle of the thick-walled Harrogate conference centre. I wonder how well it'd actually work as a stereo receiver in the centre of London - and without a three-foot telescopic aerial? Incidentally, Koss also make an ambience unit, albeit of an 'adding ambience' as opposed to 'extracting ambience' variety. The K/4DS actually uses digital delay to synthesise ambient sounds for a rear set of speakers, but doesn't seem to be available over here.

Sony M1000 Stereo Micro Cassette Recorder.

Moving back to the big boys of the cassette world, we come to the Nakamichi 1000ZXL and Tandberg 3004. Both of these decks use a microprocessor for logic control of the tape

Nakamichi 1000ZXL Cassette Deck.



Tandberg 3004 Cassette Deck.

mechanism, but, in the case of the Nakamichi, there's also an ABLE (Azimuth, Bias, Level and EQ) program which analyses and automatically corrects all the above in a 20 second period before using any new tape type. The 3004 calibration procedure is rather more manually-implemented than with the 1000ZXL but still very straightforward. Certainly, the DYNEQ (Dynamic Equalisation) circuitry, which optimises the record EQ to the source material, produces exceptional recording quality, and the measured frequency response of 19 to 21,000 Hz ±3 dB comes as no surprise.

The 1000ZXL includes a fascinating feature, called 'RAMM' (Random Access Music Memory), which records a 5 Hz coding signal on the blank section of tape between recorded tracks. The code is then used to determine the order in which the recorded sections are to be replayed, to select repeats and to indicate the EQ and noise reduction used during recording. All in all, a remarkable deck with proportions and appearance to match its capabilities. Perhaps £1,500 for a frequency response of 20 to 20,000 Hz ±0.75 dB is almost justified!

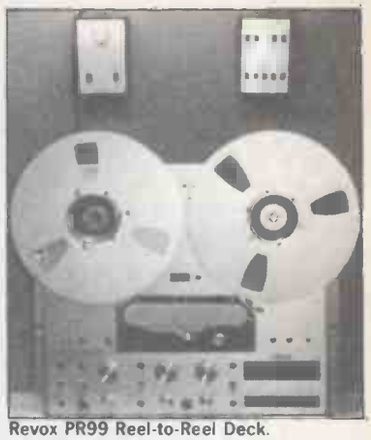
Fortunately, for those with more sense than money, Nakamichi have also brought out three new top-flight decks ranging in price from £450 for the 482Z to £700 for the 682ZX. The latter also includes the RAMM feature of the 1000ZXL, but all these new models also incorporate both Dolby B and C. Nakamichi have also introduced an add-on Dolby B/C noise reduction unit, the NR-200, which offers simultaneous encoding and decoding, and, at £185, seems a somewhat expensive addition more suited to owners of high quality reel-to-reel decks than those already with Dolby B cassette decks.

Rotel and Aurex were also showing add-on units offering one or another of the new generation of noise reduction systems. The Aurex AD-4 uses double ADRES encode/decode circuitry, which they claim achieves 30 dB improvement in s/n ratio and dynamic range expansion to 100 dB, and is likely to sell for around £149. A cheaper (£88) unit, the AD-2, is also available, but this only provides two channels of signal processing, which means that manual switching between encoding and decoding is necessary. However, as cassette deck manufacturers seem to be opting for Dolby C, rather than any of the other alternatives (with the exception of dbx which is now being incorporated in some Technics decks), the ADRES system doesn't seem to stand much chance in the noise reduction stakes.

The two noise reduction units that have emerged from the Rotel stables go for Dolby B/C (RN-560) and High-Com (RN-500) systems. The RN-560 uses switched encoding/decoding and is therefore somewhat cheaper (RRP ca. £100) than the comparable Nakamichi unit. High-Com noise reduction seems to be attracting a good deal of interest, though not all of it is exactly favourable, but, as the RN-500 isn't available in this country, that point is rather academic.

Optonica came up with a rather sharp (!) idea in the shape of their new RT-7070H cassette deck (typical price £239). This model has two independent transport systems - one exclusively for recording and one exclusively for playback - each with its own compartment and electronics. Because of this cunning move towards functional segregation, Optonica have been able to optimise the tape heads for recording and playback. Instead of the usual compromise of a 1.5 micron gap on a combined record/play head, the RT-7070H uses a 3 micron gap for recording and 0.8 micron gap for playback. All this means that the frequency response is superb (30 to 19,000 Hz ±3dB with Fe-Cr tape), and, what's more, tape copying is just a one deck operation!

Revox's new cassette deck, the B710, certainly looks like upholding the tradition of the rest of the 'B' series. Apart from the processor-controlled transport, it seems a no-frills design without the user-programming of EQ and other tape-specific characteristics found in equipvalent top class decks. What Revox do seem to have achieved is a superb transport mechanism with every aspect of tape motion under the same precise control as on their reel-to-reel decks. It's also very nice to see an LED tape counter that's synced via a quartz clock to the motors for really accurate track location. Another new addition to the Revox clan is the PR99. This reel-to-reel unit is really the professional update to the ever-popular



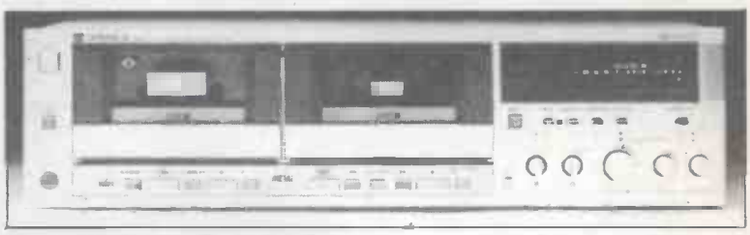
Revox PR99 Reel-to-Reel Deck.

B77, and incorporates such facilities as simul-sync, balanced inputs and outputs with calibrated or uncalibrated or uncalibrated level adjustments, a tape dump facility for immobilising the take-up reel and improved access to the playback head in the edit mode.

A current tendency amongst manufacturers of In Car Entertainment (ICE) is to further miniaturise micro Hi-Fi units and then stack the whole lot in the console in front of the gear lever. With so many knobs, buttons, LEDs, or whatever, there's one thing you can be assured of, and that's driver distraction. Furthermore, however powerful the booster may be that's trying to compete with the 40 to 50 dB of engine noise, there's not much point in emulating small 'Hi-Fi' speakers with a car equivalent, as the average interior of a car just doesn't

Rotel RN-560 Noise Reduction Unit.

Aurex AD-4 Adres Noise Reduction Unit.



Optonica RT 7070 double cassette deck.

Revox B710 Cassette Deck.

Bose Car Stereo System.

bear any acoustic similarity to a fixed listening abode. Of the various ICE systems on show, the one that seemed to make most sense to me was the Bose Car Stereo. Bose seem to have a gift at making small loudspeakers do extraordinary things, as if self-evident with the model 802 speaker, which now seems to be finding favour in just about every audio situation imaginable. Their car stereo uses four drive units, similar to those in the 802, driven from the 1401 Booster/Equalizer. The circuitry in this unit produces a signal for optimal loading of the speakers and incorporates spatial depth and low frequency boost controls to compensate for absorbent upholstery, absorbent passengers, and so on. Combined with the excellent CRC Tuner/Cassette unit, the booster and speakers produce a quality of sound that belies the size of the drive units, and the flexibility of the spatial image control really produces dramatic results. At a complete system price of around £250, the Bose version of ICE isn't cheap, but, if you're after more than rattling door panels, do investigate it.

Turntables are well and truly turned on their head with the Mitsubishi linear-tracking vertical deck used in their MC8000 Music Centre. As a piece of techno-sculpture, it certainly has its merits, but I really wonder how the humble LP can possibly benefit from being strung up like a wheel. Considering that the average standard of record pressings still declines, it becomes more and more difficult to see any future for the conventional LP. This hasn't prevented certain manufacturers from developing remarkably extravagant means of rotating a £5 lump of generally warped and noisy vinyl. Two of these turntables are 'The Oracle', a Canadian turntable priced at £678, and 'The Rock' from the British firm, Elite Townshend. They obviously do their job superbly well, or otherwise the Hi-Fi press wouldn't be making such ecstatic claims for their 'musicality', but I don't think I'd really care to share my house with one of these aggressive hunks of metal, and there's more than a hint of snobbish arrogance in the definitive assertion of their names. Coming rapidly down to the more affordable end of the market, there were some interesting new turntables from Garrard. As a proud owner of a 401, I've always had a soft spot for this firm, and it's good to see that their take-over by a Brazilian company, Gradiente, has resulted in such a rapid resurgence onto the British scene. The turntables in this entirely new range of separates start with the B20 auto-return belt drive at £55 and extend to the D35 direct drive quartz lock unit at £104, and all with Ortofon cartridges fitted as standard. It's encouraging to see such value for money!

Most owners of treasured LPs of some historic performance suffer the inevitable pops and crackles with the martyrdom of a saint, and the thought of coating such priceless objects with a fluid supposed to rejuvenate them would be almost unthinkable. But that does seem to be what LAST (Liquid Archival Sound Treatment) is capable of (within reason, of course), and, with new discs, is claimed to protect a record through 200 plays as well as enhancing the clarity and reducing the surface noise. £14 should purchase enough LAST to treat 50 records; try some and see!

Bose CRC Tuner/Cassette Unit.

The Oracle.

Garrard D35 Direct Drive Deck in see-through version.

Liquid Archival Sound Treatment.

Finally, a silly product for the silly season from Bibi Magnetics Ltd. (and I quote from the Festival Official Guide): 'New Love Dreams Musicassette of Dream Suggestions in counter gravity dispenser with SRP of £1.65'. Perchance to dream without technological intervention... E&MM

Mitsubishi MC8000 Music Centre.

SOUNDBOOSTER

- ★ 15 watts per channel into 4 ohms
- ★ Automatic switch on
- ★ Works from speaker output of a car radio or cassette
- ★ No complicated wiring

PARTS COST GUIDE £22 less case

Few car radios and radio/cassette units offer an output power of more than a few watts and even if fairly efficient speakers are used this often results in inadequate volume in the noisy environment of a vehicle. By using an add-on booster amplifier such as the one described here it is possible to obtain greater output power and sound level with no significant loss of quality.

This booster amplifier simply connects between the speaker output(s) of the radio or radio cassette unit and the loudspeaker(s). The only other wiring to the unit is the supply. Soundbooster gives an output power of about 9 watts into an 8 ohm speaker or 15 watts into a 4 ohm speaker. It is only suitable for use with 12 volt negative earth system cars but virtually all cars have this type of electrical system these days.

A useful feature of the booster is a built-in switching circuit that automatically switches the unit on when an input signal is received, and off again when the signal ceases. It can therefore be forgotten once it has been installed as there are no controls.

The booster is described here as a stereo unit having built-in automatic switching. However, as the circuit is built on two identical printed circuit boards, four permutations are available by including or omitting the switching circuit components.

1. 'Simple mono unit (one board, amplifier components only).
2. Auto switching mono unit (one board, fully assembled).
3. Simple stereo unit (two boards, amplifier components only).
4. Auto switching stereo unit (two boards - one fully assembled, one with amplifier components only).

Amplifier Circuit

An ordinary transformerless output stage can give a peak-to-peak output voltage only as large as the supply voltage used. In any practical circuit the output voltage swing will be somewhat less than this due to unavoidable losses through the output transistors. This limits the output power using a 12 volt car supply to about 2¼ watts into an 8 ohm impedance speaker or 4½ watts into a 4 ohm impedance type.

One way of obtaining a higher output power for a given supply voltage and speaker impedance, and the method employed here, is to use a bridge amplifier circuit. Figure 1 shows the circuit diagram of the amplifier used in this unit and is for one stereo channel only (the amplifier circuit for the other channel is of course identical). A bridge amplifier uses two power amplifiers to drive a single load and in this case, two integrated circuit power amplifiers are used. Under quiescent

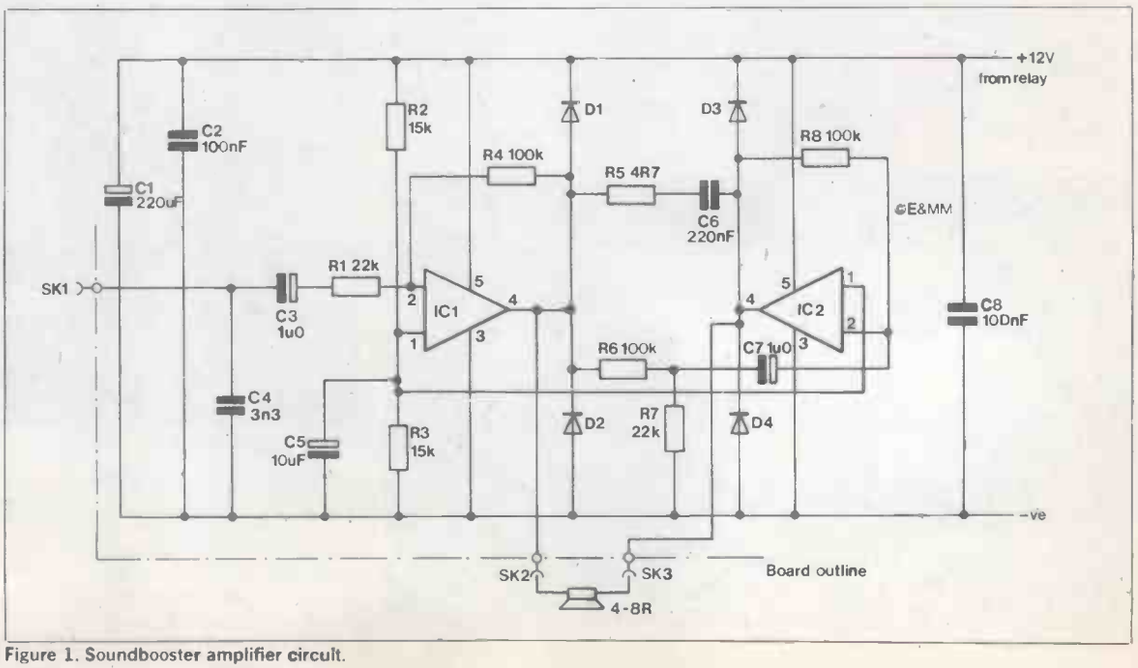


Figure 1. Soundbooster amplifier circuit.

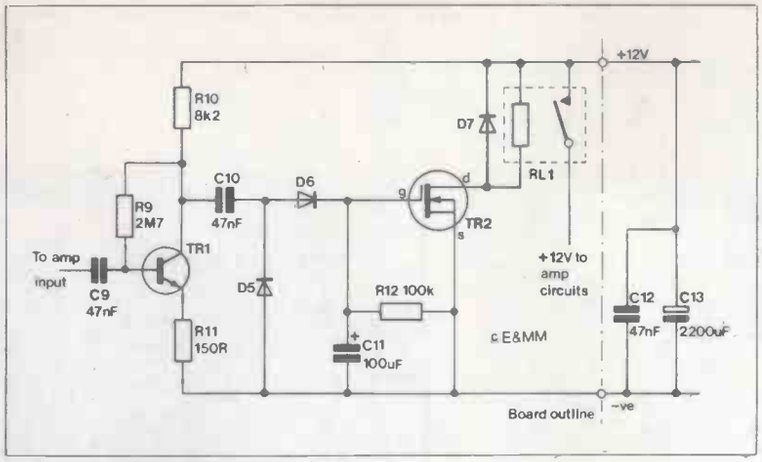


Figure 2. Auto switch circuit.

conditions the output voltage from IC1 is identical to that from IC2, giving zero voltage across the loudspeaker.

If IC1's output swings positive, then IC2's output goes negative by the same amount. If IC1's output goes negative, then IC2's output goes positive by an identical amount. This enables the full supply voltage to be applied to the loudspeaker, and as this signal can have either polarity the peak-to-peak output voltage is double the supply voltage, 24 volts in this instance. Allowing for small losses through the output stages this gives an output power of approximately 9 watts into 8 ohms, or 15 watts into 4 ohms.

IC1 and IC2 are both TDA2030 ICs, a device which in many respects is the same as an operational amplifier. There are inverting and non-inverting inputs (pins 2 and 1 respectively), but the output stage is a high power class B type capable of handling very high currents. Both ICs have their non-inverting input biased to about half the supply voltage by R2 and R3, and C5 is used to decouple any noise that might otherwise find its way to these inputs.

The outputs of the two ICs are biased to half the supply voltage as well since R4 and R8 cause virtually 100% DC negative feedback over the two devices, giving unity voltage gain from each non-inverting input to its respective output. This ensures that the two output voltages are balanced under quiescent conditions, and gives the highest possible peak-to-peak output voltage before clipping is produced.

IC1 is used as a simple inverting amplifier with R4 and R1 acting as a negative feedback network which sets the voltage gain of this stage at only about 4½ times. As the input voltage is going to be at least a few volts peak-to-peak this rather low voltage gain is more than adequate. C3 simply provides DC blocking at the input and C4 prevents the circuit from becoming unstable due to stray pick-up when the input is open circuit.

The voltage gain of IC2 is also set at about 4½ times, with R8 and R7 acting as the negative feedback network in this case. However, R6 couples the output of IC1 to the input of IC2 and also introduces losses which effectively reduce the voltage gain of IC2 to unity. This, plus the fact that IC2 operates in the inverting mode, ensures that the two outputs have the required equal but opposite voltage changes when an input signal is applied.

C1, C2 and C8 are supply decoupling capacitors, and D1 to D4 are protection diodes. R5 and C6 form a Zobel network, and it is quite normal for solid state amplifiers to have a circuit of this type at the output to aid high frequency stability.

Switching Circuit

The automatic switching circuit takes its input from one channel only (the left hand channel in fact) since there will presumably be a signal on both channels or neither channel; ignoring one channel has no disadvantages.

Figure 2 shows the circuit diagram of the auto switch. The original version was designed to have high sensitivity so that it would operate from the background noise of the radio or cassette player, this gave very short attack and decay times so that the unit switched on and off almost in unison with the radio or player. This system was found to be prone to spurious switching due to noise from other parts of the electrical system and has therefore been abandoned in favour of a less sensitive circuit. This has a slight switch-on delay to further reduce the risk of spurious switching, and a long turn-off delay of about 10 seconds to prevent the unit switching off during lulls in the input signal.

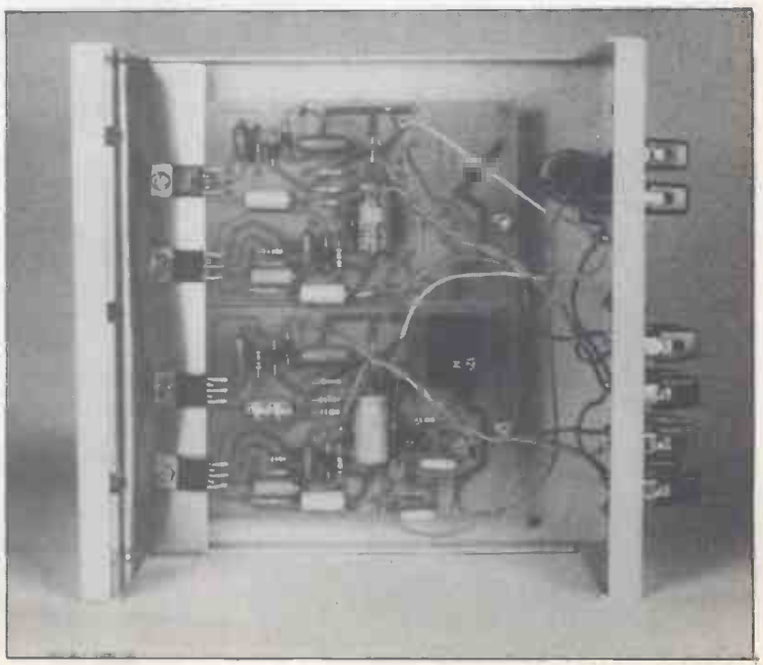
TR1 is used as a common emitter amplifier which is fed with the input signal via DC blocking capacitor C9. R11 introduces a degree of negative feedback which reduces the gain of TR1 slightly but it still provides quite a high level of voltage gain so that the circuit has good sensitivity and will hold-on if the volume is set well back.

C10 couples the output of TR1 to a rectifier and smoothing circuit which uses D5, D6, C11, and R12 in a well known configuration. The values of R10 and C11 set the attack time of the circuit at about one second, while C11 and R12 set the decay time at the figure of 10 seconds quoted earlier.

TR2 is a VMOS transistor which will be biased into conduction when an input signal is present and positive DC bias is produced at its gate but will be cut off when there is no input signal and this bias subsides. A VMOS transistor is used here in preference to a bipolar device because the very high input impedance of the VMOS device prevents loading on the smoothing circuit from affecting the time constants.

TR2 is used to drive a relay which in turn controls the positive supply to the amplifier using a pair of normally open relay contacts. A relay is preferable to a semiconductor switching device as it gives no significant voltage drop and therefore gives no reduction in the output power of the amplifier. The automatic switching circuitry is permanently connected to the car supply of course but as it has a stand-by current consumption of less than 1mA this is of no consequence.

C12 and C13 are suppression components that minimise the inevitable noise spikes on the input supply. An in-line choke can also be used in the positive supply if necessary but the two capacitors should give adequate supply noise suppression on their own.



Internal view of unit.

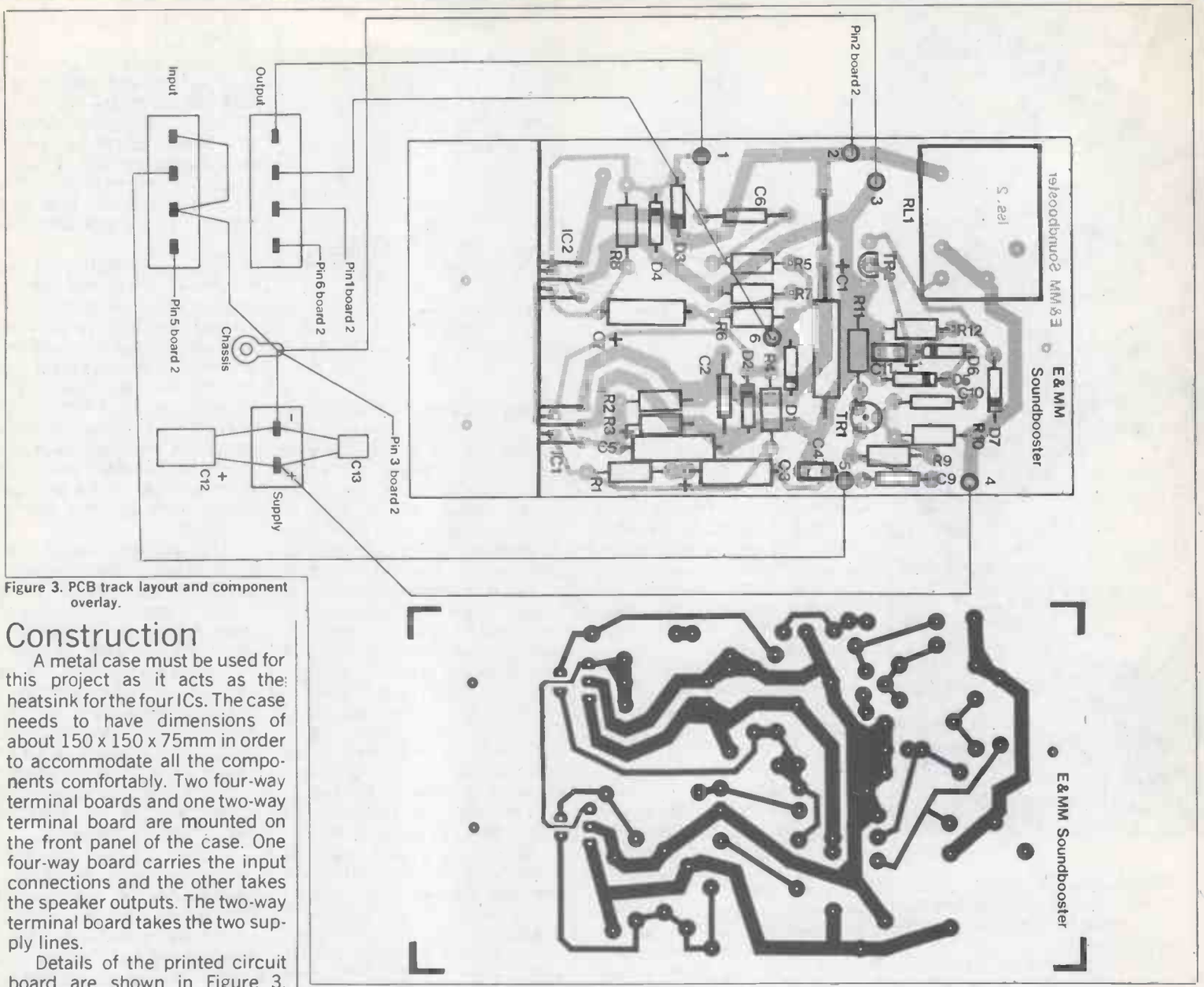


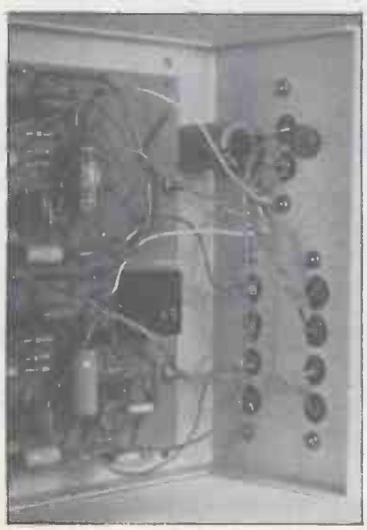
Figure 3. PCB track layout and component overlay.

Construction

A metal case must be used for this project as it acts as the heatsink for the four ICs. The case needs to have dimensions of about 150 x 150 x 75mm in order to accommodate all the components comfortably. Two four-way terminal boards and one two-way terminal board are mounted on the front panel of the case. One four-way board carries the input connections and the other takes the speaker outputs. The two-way terminal board takes the two supply lines.

Details of the printed circuit board are shown in Figure 3. These hold all the components apart from C12 and C13 which are mounted direct across the supply terminal board.

The printed circuits are fitted on the rear panel of the case using an L-shaped mounting bracket.



Internal view showing connector wiring.

This is constructed from 18 swg aluminium and is illustrated in Figure 4. The boards are mounted on the bracket via the four ICs and using 6mm M3 fixings. The rear panel must be drilled to take the three mounting screws for the bracket, and each circuit board requires a mounting hole in the base panel of the case. The positions of all holes can be located using the bracket and boards assembly as a template. Half inch spacers are used on the mounting bolts for the printed circuits so that their undersides are kept clear of the metal case. It is not necessary to use insulating kits to insulate the heat-tabs of the ICs from the bracket and case since the tabs connect internally to the negative supply connections of the ICs, and the case also connects to the negative supply rail.

Before finally fitting the printed circuits into the case complete all the point-to-point wiring, as shown in Figure 5. Much of this wiring carries currents of a few amps and you must use wire of adequate rating.

Installation

As the unit has no controls it can be installed in the boot, under a seat, or in any convenient location. The amplifier does not have an internal fuse and a 5A in-line fuse is used at the positive supply input. In order to minimise ignition noise it is advisable to connect the negative supply terminal to the chassis using a short, thick wire.

It is normal for one loudspeaker lead of a car radio or a cassette player to be at earth potential, and it is therefore essential that each pair of output leads are connected to the input of the amplifier the right way round or the outputs of the radio or player will be short circuited. If necessary, check with a continuity tester to see which leads are the two earth leads, and be careful to connect them to the chassis input terminals of the unit. Alternatively, it is likely that the system will work perfectly well if these two leads are simply omitted as there will be an earth connection between the two units through the car's chassis anyway. It is possible that some radios and cassette players have neither output earthed, and in this case it should be possible to obtain satisfactory results by connecting one output lead of each channel to the non-earthy inputs of the amplifier, the other two output leads being left unconnected.

Remember that none of the output terminals of the amplifier are at earth potential, and they should not be allowed to come into contact with the chassis if this can be avoided. The TDA2030 ICs have output short-circuit and thermal shut-down protection circuitry built-in, and accidental short circuits at the

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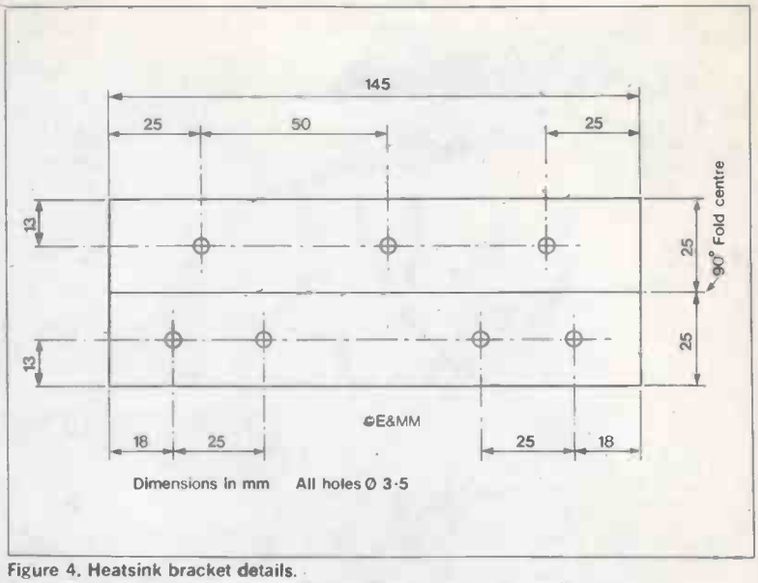

Figure 4. Heatsink bracket details.

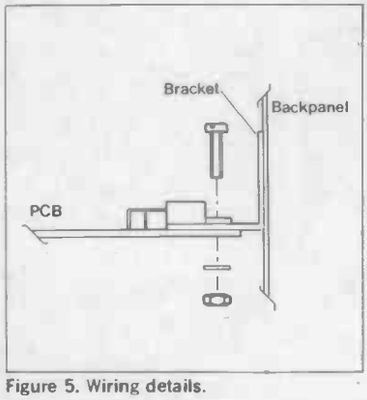

Figure 5. Wiring details.

outputs should not damage the unit. Be careful to use loudspeakers having an adequate power rating.

If the existing speakers are to be retained and the amplifier is to be used to drive an additional pair of speakers it may be found that the amplifier has too much gain, resulting in the existing speakers being driven at far lower volume than the additional pair. Increasing R1 of each amplifier to about 56k in value should eliminate this problem. **E&MM**

PARTS LIST FOR SOUNDBOOSTER

Resistors - all ⅓ watt 5% carbon unless specified

R1,7	22k	4 off	(M22K)
R2,3	15k	4 off	(M15K)
R4,6,8,12	100k	7 off	(M100K)
R5	4 7R	2 off	(M4.7R)
R9	2M7 10%		(M2M7)
R10	8k2		(M8K2)
R11	150R		(M150R)
Capacitors			
C1	220u 25V axial electrolytic	2 off	(FB62S)
C2,8	100n polyester	4 off	(BX76H)
C3,7	1u 63V axial electrolytic	4 off	(FB12N)
C4	3n3 ceramic plate	2 off	(WX74R)
C5	10u 25V axial electrolytic	2 off	(FB22Y)
C6	220n polyester	2 off	(BX78K)
C9,10	47n polyester	2 off	(BX74R)
C11	100u 10V tantalum		(WW79L)
C12	47n ceramic disc		(BX02C)
C13	2200u 16V PC electrolytic		(FF60Q)
Semiconductors			
IC1,2	TDA2030	4 off	(WQ67X)
D1,2,3,4	IN4001	8 off	(QL73Q)
D5,6,7	IN4148	3 off	(QL80B)
TR1	BC108		(QB32K)
TR2	VN10KM		(QQ27E)
Miscellaneous			
RL1	10A Relay, 12V coil		(YX97F)
FS1	5A 1¼in quick blow fuse		(WR15R)
	In line fuseholder		(RX51F)
	Case		(XY44X)
	4-way terminal board	2 off	(BW71N)
	2-way terminal board		(BW72P)
	18 swg aluminium for bracket		(LH12N)
	Bolts 6mm M3	2 pks	(BF51F)
	Nuts M3	2 pks	(BF58N)
	Bolts 25mm M3		(BF53H)
	Spacers 6BA ½in		(FW35Q)
	PCB	2 off	(GA51F)

Note: component quantities are given for the automatic switched stereo version.

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If you have problems with people tampering with your car, electrical and electronic equipment, or if you are just in a habit of forgetting your door keys, we have just the kit for you.

Our ELECTRONIC LOCK KIT includes a 10-way keyboard and a special IC which provides a 750mA output to drive a solenoid or relay (not supplied) when four keys are depressed in the correct sequence. This gives over 5,000 possible combinations! The sequence is pre-wired and may be easily changed by means of a small plug and socket. A "SAVE" function is also available enabling the open code to be stored (especially useful in a car when it is left in a garage for servicing as the open code need not be disclosed). Size: 7 x 6 x 3 cms. Power Consumption is 40uA at 5V to 15V d.c. At only £10.50 C VAT, it will make a smaller hole in your pocket than a bunch of keys!

LOCK I.C.s

LS7220 with SAVE memory	£2.75
Data only	.10
LS7225 with latched and momentary outputs and a tamper output	£2.60

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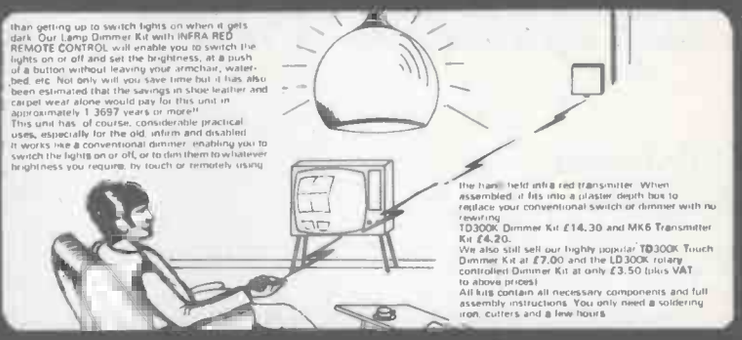

than getting up to switch lights on when it gets dark. Our Lamp Dimmer Kit with INFRA RED REMOTE CONTROL will enable you to switch the lights on or off and set the brightness, at a push of a button without leaving your armchair, water-bed, etc. Not only will you save time but it has also been estimated that the savings in shoe leather and carpet wear alone would pay for this unit in approximately 1.3697 years or more!!
This unit has, of course, considerable practical uses, especially for the old, infirm and disabled. It works like a conventional dimmer, enabling you to switch the lights on or off, or to dim them to whatever brightness you require, by touch or remotely using the hand-held infra red transmitter. When assembled it fits into a plaster depth box to replace your conventional switch or dimmer with no rewiring.
TD300K Dimmer Kit £14.30 and MK6 Transmitter Kit £4.20.
We also still sell our highly popular TD300K Touch Dimmer Kit at £7.00 and the LD300K rotary controlled Dimmer Kit at only £3.50 (plus VAT to above prices).
All kits contain all necessary components and full assembly instructions. You only need a soldering iron, cutters and a few hours.

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These kits form useful subsystems which may be incorporated into larger designs or used alone. Kits include PCB, short instructions and all components.

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Diac	18p

Opto Isolated triac
MOC3020 0.6A/400V

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2716	2.65	8035L	8.00
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LD271 IR Emitting Diode	.36
SFH205 Photodiode detector	.90
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SL490 32-command encoder/transmitter	2.40
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MK6 – Simple Infra Red TRANSMITTER. A pulsed infra red source which comes complete with a hand held plastic box. Requires a 9V battery. £4.20

MK7 – Infra RED RECEIVER. Single channel, range approximately 20ft. Mains powered with a triac output to switch loads up to 500W at 240V a.c. but can be modified for use with 5–15V d.c. supplies and transistor or relay outputs. £9.00

Special Price MK6 & MK7 together. Order as RC500K £12.50

MK8 – Coded Infra Red TRANSMITTER. Based on the SL490, the kit includes 2 IR LEDs, measures only 8x2x1.3 cms. and requires a 9V (PP3) battery. £5.90

MK9 – 4-way KEYBOARD. For use with MK8 Kit. £1.90

MK10 – 16-way KEYBOARD for use with MK8 kit, to generate different codes for decoding by the ML928/926 receiver (MK12 kit). £5.40

MK11 – 10-on/off Channel IR RECEIVER with 3 analogue outputs (0–10V) for controlling such functions as lamp brightness, volume, tone, etc. Other functions include an on/standby output and a toggle output, which may be used for sound muting. Based on ML922 decoder IC, includes its own mains supply. £12.00

MK12 – 16-channel IR RECEIVER. For use with the MK8 kit with 16 on/off outputs which, with further interface circuitry, such as relays, will switch up to 16 items of equipment on or off remotely. Outputs may be latched or momentary, depending on whether the ML926 or ML928 is specified. Includes its own mains supply.

MK13 – 11-way KEYBOARD. For use with MK8 and MK11 kits. Transmits programme step + and –, analogue + and – (3), mute, normalise analogue outputs, and on/standby. £4.35

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DL340M 0.1" 4-digit c.c.	4.50
DL500 0.5"	.75
DL507 0.5" c.a.	.75
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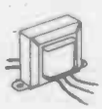
4000	.14	4019	.38	4069	.18
4001	.14	4023	.22	4070	.24
4002	.14	4025	.18	4071	.22
4007	.14	4026	1.05	4077	.24
4011	.15	4027	.40	4081	.22
4012	.17	4028	.50	4093	.45
4013	.35	4040	.68	4501	.24
4015	.70	4049	.30	4511	.85
4016	.30	4050	.30	4514	1.80
4017	.65	4060	.90		

MINI TRANSFORMERS



Standard mains primaries 240V a.c.

100mA secondaries 6-0-6V	80p
9-0-9V	85p
12-0-12V	90p
9-0-9V	210p

LEDs

0.1" Red	9p
0.1" Green	12p
0.1" Yellow	12p
0.2" Red	9p
0.2" Green	12p
0.2" Yellow	12p
0.2" clips	3p
Rectangular Red	16p
Rectangular Green	17p
Rectangular Yellow	17p
Flat Face rectangular, Triangular, Arrow-head or Square Red	17p
Green	20p
Rec Yellow	20p

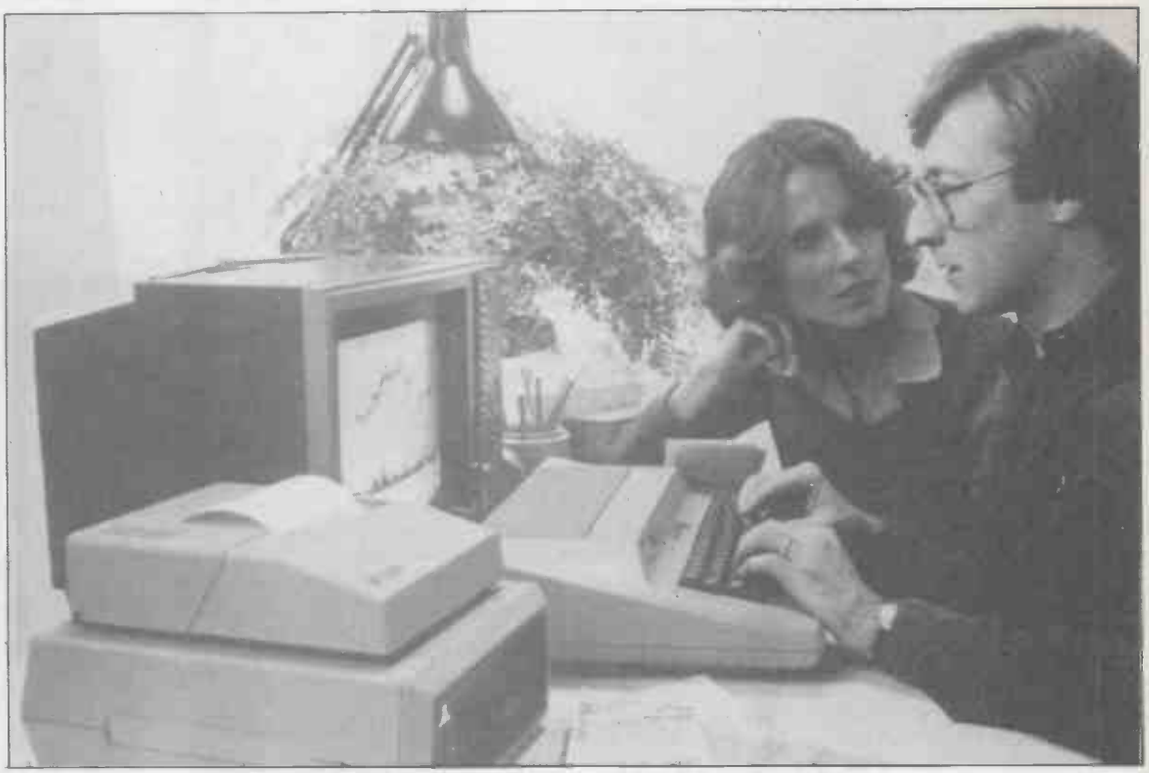
TTL 74LS

LS00	.12	LS38	.16	LS126	.29
LS01	.12	LS40	.14	LS132	.44
LS02	.13	LS42	.40	LS160	.40
LS03	.13	LS47	.42	LS161	.40
LS04	.14	LS51	.15	LS162	.40
LS05	.15	LS54	.15	LS163	.40
LS08	.15	LS55	.15	LS164	.50
LS09	.15	LS73	.20	LS165	1.05
LS10	.14	LS74	.18	LS166	.85
LS11	.15	LS75	.37	LS173	.72
LS12	.15	LS76	.21	LS174	.52
LS13	.27	LS85	.64	LS191	.58
LS14	.58	LS86	.18	LS192	.65
LS15	.15	LS90	.32	LS193	.65
LS20	.14	LS93	.37	LS196	.65
LS22	.15	LS107	.24	LS279	.34
LS26	.18	LS109	.24	LS365	.34
LS27	.15	LS112	.24	LS366	.34
LS30	.14	LS113	.24	LS367	.34
LS32	.15	LS114	.24	LS368	.34
LS37	.17	LS123	.51		

BASICALLY BASIC

Graham Hall, B.Sc

This regular series will attempt to teach BASIC to those who would like to use it for any home, business, scientific or musical application, but have no previous programming experience.



Subscripted Variables

A variable is a symbolic representation of a storage location in the computers memory. The variable names the location and enables the programmer to assign any legal number or string to the location. Also, the result of a calculation can be assigned to a variable and referenced by the variable name throughout the rest of the program.

So far in this series two types of variables have been used: numeric and string. Numeric variables name a single location in memory to store numeric constants. String variables reserve a location for symbolic characters. Now a new type of variable, called a 'subscripted variable' will be introduced. Using subscripted variables the computer's memory can be divided into a series of compartments with each compartment able to store a value. This makes it easier to manipulate large amounts of data in a program without explicitely declaring a large number of variables.

Figure 1 shows three different types of storage location that can be created in BASIC. The simplest is a single numeric variable called X that reserves one storage location in memory.

The second created location is a series of five compartments. Together they comprise a one-dimensional list (also known as a 'vector'), named X. Each compartment of the list X can be referenced by specifying the list name and a subscript within parentheses. For example, the last compartment in the list is referenced as X(4).

(NOTE: BASIC counts location compartments from Ø, so by specifying a subscript of 4, five compartments were created: X(Ø), X(1), X(2), X(3) and X(4))

The third created location, X(3,5), is a two-dimensional table. The subscript is a pair of numbers separated by a comma and defines the dimensions of the table. The first subscript specifies the number of rows in the table and the second subscript specifies the number of columns. So the subscript (3,5) specifies that the table called X has four rows and six columns (since BASIC also counts two-dimensional subscripts from Ø). Therefore the table created by X(3,5) contains twenty-four compartments. Each compartment can be referenced by specifying the appropriate subscript, as shown in Figure 1.

Each of these storage locations is considered as a single entity by the computer. That is, the variable X is one storage space, X(4) is one storage space with five compartments, and X(3,5) is one storage space with twenty-four compartments.

Any storage location that is created by a subscripted variable is called an 'array'.

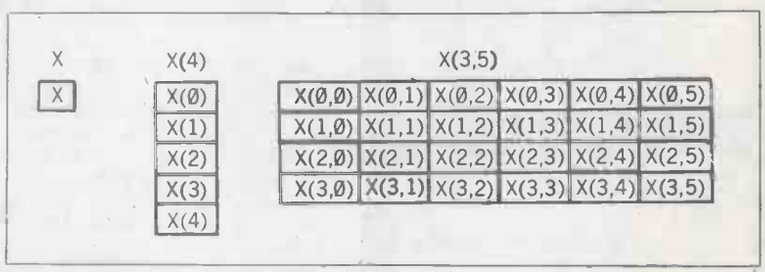


Figure 1. Subscripted Variables.

Arrays

An array can be named by a single letter (A to Z) or a single letter immediately followed by a single digit, followed by a single or double subscript enclosed in parentheses. For example, A1(1Ø), A(1Ø), B(4), F(25) are all legal names for one-dimensional arrays. The specified variable labels or names the array and the specified subscript defines its size. The subscripts that are specified within the parentheses set the limits of the array. The subscript must be a positive integer of Ø or greater.

The DIM Statement

The DIM statement is used to declare the limits of a subscripted variable. Some versions of BASIC automatically allocate enough memory space for a one-dimensional list of eleven items or a two-dimensional table of one hundred and twenty one items. However, if the subscripted variable is to use more space, this must be reserved using the DIM statement. Also actually specifying the size will save memory space if the variable is less than these default limits. The general format of the DIM statement is:

line number DIM variable (subscript)

For example, to allocate enough memory space for a one-dimensional list of twenty-five items the statement

1Ø DIM X(24)

would be included as one of the first lines of the program before the list is declared.

(NOTE: the DIM statement only defines the size, it does not actually create the subscripted variable.)

If it is uncertain how many compartments an array will require then a sensibly large subscript can be specified since it is not necessary to use every location that is reserved by the DIM statement. Some versions of BASIC allow the subscript to be a variable so that the array limit can be specified when the program is run. For example,

```
1Ø INPUT N
2Ø DIM X(N)

999 END
```

Line 1Ø requests a number to be input at the terminal. Line 2Ø uses this number to allocate the required space for the one-dimensional array called X.

Variables and Expressions as Subscripts

The LET statement is used to assign values to variables. The statement

1Ø LET X(5)=1

assigns the numeric value one to the sixth compartment of the one-dimensional list X.

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The subscript of a subscripted variable can also be a variable. Consider the following program:

```
10 DIM X(4)
20 FOR S=0 TO 4
30 LET X(S)=S
40 PRINT X(S);
50 NEXT S
60 END
```

The subscript of the one-dimensional array X, is the variable S. Variable S is also the control variable of the loop which is initialised by line 20. Each time the loop is executed line 30 assigns the value of S to the position in array X specified by S (i.e. X(0)=0, X(1)=1, X(2)=2, X(3)=3 and X(4)=4). Line 40 then outputs to the terminal the contents of the array position specified by S. When the program ends the list X contains the numbers 0 to 4.

Some versions of BASIC allow array subscripts to be formed by expressions. For example:

X(2*S+1) or X(S+1)

The expressions within the parentheses are evaluated according to the rules of operator hierachy previously described in this series.

The subscripts of two-dimensional arrays can be variables. To reference all the compartments of a table each subscript within the array limits must be specified. A nested FOR loop can be used to do this. This is demonstrated by the following program which creates a two-dimensional array and assigns to each compartment of the array a numeric value supplied as data.

```
 10 REM - TABLE HAS 3 ROWS
 20 REM AND 4 COLUMNS
 30 DIM T2(2,3)
 40 FOR I=0 TO 2
 50 FOR J=0 TO 3
 60 READ T2(I,J)
 70 PRINT T2(I,J);
 80 NEXT J
 90 PRINT
100 NEXT I
110 DATA 0,1,2,3
120 DATA 1,1,2,3
130 DATA 2,1,2,3
999 END
RUN
0 1 2 3
1 1 2 3
2 1 2 3
```

When the program is run the output to the terminal is as shown.

The program is composed of the following lines:

Lines 10 and 20 — The characters following the REM statement are ignored by the computer and serve only as a comment.

Line 30 — The DIM statement allocates memory space. The limits specified here reserve enough space for a table of three rows and four columns because BASIC counts the subscripts from 0. For some versions of BASIC it may not be necessary to specify the exact size of the array in this case, since it is smaller than the default value. (The computer automatically allocates space for a one hundred and twenty one item two-dimensional array. However, by specifying the actual size memory space is conserved.)

Line 40 - The FOR loop initialises the variable I to 0 and sets the limit of the loop to 2. Its corresponding NEXT statement is on line 10.

Lines 50 to 80 — Line 50 initialises a loop within a loop. Its range is from 0 to 3 and its corresponding NEXT statement is on line 80. Each time this loop is executed line 60 reads a numeric value from the data and assigns it to the table T2 in the location specified by the subscript. Line 70 prints the value on the terminal.

The loop variables I and J are used as subscripts to the array. During the execution of the program the subscript takes on all possible values within the limits of the array. The first time the loop on line 40 is executed I is set to 0. J takes on each of the values 0 to 3, therefore each compartment of column 0 is referenced ((0,0), (0,1), (0,2) and (0,3)). Now the variable I is incremented to 1 and once again J takes on the values 0 to 3. This specifies the subscripts (1,0), (1,1), (1,2), and (1,3). Finally I is incremented to 2 and the inner loop executed again to assign data to the compartments (2,0), (2,1), (2,2) and (2,3).

Line 90 — This PRINT statement is used to format the output to the terminal. If it was not included the contents of the array would be output on a single line and not as a table (since the PRINT statement on line 70 ends with a semi-colon).

Lines 110-130 — The DATA statements contain the values that the program supplies to the READ statement on line 60.

Line 999 — The END statement signifies that the program is complete.

String Arrays

String arrays are storage locations created by a subscripted variable and can store alphanumeric data. String arrays can be named in the same way as numeric arrays except that the name must be followed by a dollar sign ($). For example, X2$(4,9) defines a two-dimensional string array called X2, which can store fifty strings (five rows and ten columns since the element 0 is included as part of the array). Each compartment of this array can contain a string of varying length.

The default limit of eleven items for a one-dimensional list and one hundred and twenty one items for two-dimensional list also applies to string arrays. To define a specific size for a string array the DIM statement is used in the same manner as for numeric arrays.

The following short program demonstrates the use of a one-dimensional string array. It requests the user to input five strings and then outputs the strings to the terminal.

```
 10 DIM S1$(4)
 20 PRINT "INPUT FIRST STRING"
 30 INPUT S1$(0)
 40 FOR I=0 TO 4
 50 PRINT "INPUT NEXT STRING"
 60 INPUT S1$(I)
 70 NEXT I
 80 REM — NOW OUTPUT THE STRINGS
 90 PRINT
100 FOR I=0 TO 4
110 PRINT S1$(I)
120 NEXT I
130 END
```

E&MM

COMPUTING NEWS

PCW SHOW

The Personal Computer World Show was held on the 10th to 12th September. Computing News this month is a brief report of some of the products at the show with more details of certain items to follow in future issues.

Although most of the well known makes of computers were in attendance only details of relevant new items are described.

The first good news I was given was about the VIC 20. It can now be expanded to an 8, 13 or 21K machine using the 3, 8 or 16K memory cartridges, without the use of the memory expansion board, which costs approximately £100. The problem was the power requirement of the memory cartridges exceeding the capability of the power supply within the VIC 20. However, this has now been reduced sufficiently for direct connection.

Also three new software packages will be available for VIC 20, during October, all of which will cost between £30 and £40 each. These are a Machine Code Monitor, a Programming Aid cartridge which allows the use of additional commands, and a Super Expander. The latter gives a high resolution display, whilst the cartridge features some novel commands for musicians including converting the keyboard to a piano scale.

At the centre of a crowded Acorn Atom stand was the BBC computer. This machine will be available in two versions, Models A and B. Acorn have supplied us with the following dates and prices all of which require confirmation: it will be possible to order either machine from 21st September for delivery to begin at the end of November, the 16K Model A version will be £235 and the 32K Model B £335, (both prices include VAT).

Both versions use the 6502A microprocessor running at 2MHz with 16K ROM BASIC and 16K ROM MOS. Also included is a tone generation system for 3 voice music synthesis with full envelope control, feeding an internal loudspeaker. Colour graphics can also be used, and generally the Model B system is more versatile.

The Sinclair stand was crowded with people purchasing ZX81 kits and had their new printer on show. As with most of Sinclair's products it is small, neat and cheap (£50). It prints 32 characters per line, 9 lines per inch at a rate of 50 characters per second on electrosensitive paper. This paper is available in 65 foot rolls and five rolls cost £11.95.

Personal Computers Ltd were exhibiting the Alpha Syntauri. This is a 61 note keyboard under software control provided by an Apple computer. It has eight polyphonic voices, two oscillators per voice (enabling complex waveforms to be produced) and two 4 stage envelopes per voice. The Apple system required to support the Alpha Syntauri is 48K memory, disc drive, 16K RAM card, monitor and MH oscillator board which totals approximately £1,800. The Alpha costs £750. We'll be reviewing this in the December issue.

Finally, as the name suggests, the Last One. This is a software package which, so they claim, will end all software writing, since it writes programs for you. All that is required from the operator is a definition of the data areas and a program description in the form of a flowchart. The Last One then writes the program in BASIC. At the moment it is available for PET, Apple, Tandy, Sharp and Ohio Scientific computers providing they have two disc drives. The package costs £260 (excl. VAT).

Ian Miller **E&MM**

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74LS14	0.44
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74LS20	0.12
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74LS22	0.14
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74LS27	0.14
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74LS49	0.59
74LS51	0.14
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74LS55	0.15
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74LS74	0.17
74LS75	0.28
74LS76	0.20
74LS78	0.24
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74LS85	0.70
74LS86	0.18
74LS90	0.30
74LS91	0.80
74LS92	0.35
74LS93	0.34
74LS95	0.44
74LS109	0.25
74LS112	0.25
74LS113	0.25
74LS114	0.25
74LS122	0.39
74LS123	0.55
74LS124	1.00
74LS125	0.28
74LS126	0.28
74LS132	0.45
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74LS138	0.34
74LS139	0.37
74LS145	0.75
74LS148	0.90
74LS151	0.34
74LS153	0.35
74LS155	0.39
74LS156	0.38
74LS157	0.34
74LS158	0.36
74LS160	0.39
74LS161	0.39
74LS162	0.39
74LS163	0.39
74LS164	0.47
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74LS166	0.84
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74LS174	0.54
74LS175	0.54
74LS181	1.30
74LS190	0.55
74LS191	0.55
74LS192	0.69
74LS193	0.59
74LS194	0.39
74LS195	0.39
74LS196	0.58
74LS197	0.65
74LS221	0.60
74LS240	0.89
74LS241	0.89
74LS242	0.79
74LS243	0.79
74LS244	0.79
74LS245	0.89
74LS247	1.34
74LS248	1.00
74LS249	0.68
74LS251	0.39
74LS253	0.39
74LS257	0.44
74LS258	0.38
74LS259	1.15
74LS261	1.90
74LS266	0.23
74Ls273	0.90
74LS279	0.34
74LS283	0.44
74LS290	0.56
74LS293	0.45
74LS365	0.34
74LS366	0.34
74LS367	0.34
74LS368	0.34
74LS373	0.74
74LS374	0.74
74LS375	0.47
74LS377	0.89
74LS378	0.69
74LS386	0.28
74LS390	0.59
74LS393	0.59
BUFFERS	
81LS95	0.90
81LS96	0.90
81LS97	0.90
81LS98	0.90
8T26A	1.50
8T28A	1.50
8T95N	1.50
8T97N	1.50
8T98	1.50

MEMORIES

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2732 450ns	1+	5.43
	25+	5.24
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2.4576 MHz	2.50
4 MHz	1.65
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14 pin	0.09
16 pin	0.09
18 pin	0.15
20 pin	0.17
22 pin	0.21
24 pin	0.23
28 pin	0.25
40 pin	0.29
CMOS 4000 'B' SERIES	
4000	0.12
4001	0.13
4002	0.13
4006	0.60
4007	0.17
4008	0.55
4009	0.28
4010	0.28
4011	0.14
4012	0.17
4013	0.33
4014	0.58
4015	0.58
4016	0.28
4017	0.45
4018	0.58
4019	0.29
4020	0.58
4021	0.60
4022	0.62
4023	0.17
4024	0.38
4025	0.16
4026	0.99
4027	0.30
4028	0.55
4031	1.65
4033	1.60
4035	0.72
4040	0.57
4041	0.69
4042	0.54
4043	0.59
4044	0.64
4045	1.65
4046	0.68
4047	0.68
4048	0.54
4049	0.30
4050	0.30
4051	0.59
4052	0.68
4053	0.59
4054	1.20
4055	1.20
4060	0.89
4063	0.95
4066	0.34
4068	0.17
4069	0.17
4070	0.19
4071	0.19
4072	0.19
4073	0.19
4075	0.17
4076	0.60
4077	0.22
4078	0.24
4081	0.14
4082	0.19
4085	0.63
4086	0.69
4093	0.39
4502	0.23
4507	0.39
4508	1.90
4510	0.60
4511	0.49
4512	0.60
4514	1.49
4515	1.49
4516	0.75
4518	0.40
4519	0.28
4520	0.69
4521	1.49
4522	1.20
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Micromusic

Melody Making on the Apple

by Seamus Dunn, Valerie Morgan and Roger Morgan

Unlike the Sharp MZ-80K the Apple computer does not have a specified syntax for making music in its versions of BASIC. However, it does have a speaker so that it is possible physically for it to make music. A program is now described to do this and it is listed in full at the end. It allows you to feed in a piece of music, play it when you wish, save it on disk and so on. It is written in Applesoft BASIC. You can type this in directly and use it immediately since it is self-explanatory. The notes that follow explain some of the techniques used in more detail.

First, it is necessary to describe how each individual note is played. The heart of this is a short mysterious three-line routine, shown in Figure 1.

Line 2Ø15

The numbers represented by B(J), the note's duration, again range from Ø to 255. For most tunes we use 24Ø for a crotchet, 12Ø for a quaver, 6Ø for a semi-quaver, and so on. This means that it is impossible directly to play a dotted crotchet, minim or longer note. It can be done indirectly, however, by playing such a long note as two successive notes with the same pitch.

Line 2Ø2Ø

This line 'CALLs' a machine code subroutine stored in a set of 23 memory units beginning at the unit numbered 77Ø. This subroutine is POKED into these memory units by the lines 1ØØ to 14Ø (see Figure 2).

It is not necessary to know what these numbers in line 1ØØ actually stand for. It is enough that, when stored by lines 11Ø to 14Ø, and called by line 2Ø2Ø, they act very quickly to facilitate or make possible musical sounds.

G#	60	
G	64	
F#	68	
F	72	
E	76	
D#	80	Second
D	85	Octave
C#	90	
C	96	
B	102	
A#	108	
A	114	
G#	121	
G	128	
F#	136	First
F	144	Octave
E	152	
D#	161	
D	171	
C#	181	
C	192	- Middle C
B	200	
A#	214	
A	228	

Table 1

```
2010 POKE 768,A(J) : REM A(J) IS A NOTE PITCH
2015 POKE 769,B(J) : REM B(J) IS A NOTE DURATION
2020 CALL 770 : REM CALLS A MACHINE CODE ROUTINE
```

Figure 1.

```
100 DATA 173,48,192,136,208,5,2
    06,1,3,240,9,202,208,245,174
    ,0,3,76,2,3,96,0,0

110 FOR X=770 TO 792

120 READ Y

130 POKE X,Y

140 NEXT X
```

Figure 2.

```
                WRITING MUSIC

DO YOU WISH TO:
BEGIN A NEW TUNE ---------- B
FINISH FOR NOW ------------ F

LIST NOTES ON SCREEN ------ L
SAVE A TUNE ON DISK ------- S

RECOVER A TUNE FROM DISK -- R
PLAY THE TUNE ------------- P

CHANGE A NOTE ON TUNE ----- C
ADD NEW NOTE TO TUNE ------ A
```

Figure 3.

With these routines typed in, it is necessary to plan a program that will make it possible to input the sequence of notes making up a piece of music, save the tune on disk, recover it from disk, amend it or add to it, and of course play it. This is done using a menu and a modular system of subroutines. When RUN the screen looks like Figure 3.

Line 2Ø1Ø

The number represented by A(J), the note's pitch, can range from Ø to 255 and the numbers corresponding to two octaves, beginning at the A below middle C, are shown in Table 1. Note that the numbers get smaller as the pitch gets higher.

Most of these are fairly normal Applesoft BASIC routines and, since they are listed at the end of this article, are not analysed in detail here. However, the first (BEGIN) routine has a number of complications that need a more careful description.

The user is invited at line 65Ø to put in each note in the form of a 3-symbol combination, for example, 'C2S'. The first symbol, C in this case, represents a note and must be a letter from the set A, B, C, D, E, F, G. The second symbol is a number, either 1 or 2. The 1 stands for the octave which runs from the A below middle C to G. The 2 stands for the octave above this. The third symbol is either N for natural, or S for sharp. The possible combinations are shown in Table 2.

G	G2N OR G2S
F	F2N OR F2S
E	E2N
D	D2N OR D2S
C	C2N OR C2S
B	B2N
A	A2N OR A2S
G	G1N OR G1S
F	F1N OR F1S
E	E1N
D	D1N OR D1S
C	C1N OR C1S MID C
B	B1N
A	A1N OR A1S

Table 2

This three symbol combination is input in line 651 and stored in Z$. So that, for our example, Z$ = "C2S". String functions are then used to separate the three symbols and store them in L$ M$ and R$. So that, in this case:

L$ = "C" : M$ = "2" : R$ = "S"

We now wish to translate any such set of symbols into a number in such a way that the notes are in numerical sequence. That is, if D1N is represented by 6, then E1N is represented by 7, and so on. Table 3 shows the model used to do this. It is read from the left, choose one of A to G: then along the top, choose either octave 1 or octave 2: finally the second line on the top, either N or S. So that D1S is 13. The numbers 15 for octave 2, and 8 for sharp have been chosen to ensure that the numbers are sequential.

	1 OCTAVE 1 = 1		2 OCTAVE 2 = 15	
	N = 1	S = 8	N = 1	S = 8
A = 1	3	10	17	24
B = 2	4	11	18	25
C = 3	5	12	19	26
D = 4	6	13	20	27
E = 5	7	14	21	28
F = 6	8	15	22	29
G = 7	9	16	23	30

(Example: D2S becomes 27 because D becomes 4, 2 becomes 15, and S becomes 8 and 4+15+8=27).

Table 3.

All of this is done on program lines 653 to 680, using the functions ASC and VAL. Line 655 is a test line arising out of a subsequent subroutine and can be ignored here. Finally, on line 700, N is put equal to the note's number which is reduced by 2 so that the numbers run from 1 to 28. Line 710 sends the program to a different routine for each value of N and at each of these, A(Z) is given the proper number appropriate to the actual note, as shown in Table 1.

The subroutines used are as follows:

500-1040	Begin and Input Tune
1500-1550	Save on Disk
1600-1660	Recover from Disk
1700-1720	Change a note
1800-1840	Add notes
2000-2030	Play tune
2500-2530	Print data on screen
3000	End

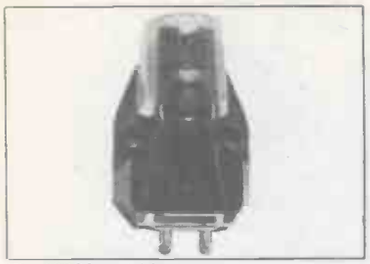
The variables used are as follows:

X	- memory units
Y	- machine code
Z	- counts notes
L	- note numbers
M	- octave numbers
R	- natural or sharp
W	- duration of note
N	- overall note number
J	- counter
X1	- note to be changed
Z1	- temporary value of Z
A(J)	- array to hold note pitch
B(J)	- array to hold note duration
Y$	- menu and casual input
Z$	- note as 3-symbol combination
L$	- left of 3 symbols
M$	- middle of 3 symbols
R$	- right of 3 symbols
D$	- disk control character
N$	- disk file name

E&MM

```
110  FOR X = 770 TO 792
120  READ Y
130  POKE X,Y
140  NEXT X
300  DIM A(80),B(80)
400  HOME : PRINT "       WRITING MUSIC"
405  PRINT : PRINT "DO YOU WISH TO:-"
407  PRINT : PRINT
410  PRINT "       BEGIN A NEW TUNE.........B"
415  PRINT "       FINISH FOR NOW...........F"
420  PRINT : PRINT "       LIST  NOTES ON SCREEN.....L"
425  PRINT "       SAVE A TUNE ON DISK.......S"
430  PRINT : PRINT "       RECOVER A TUNE FROM DISK..R"
432  PRINT "       PLAY THE TUNE.............P"
433  PRINT : PRINT "       CHANGE A NOTE ON TUNE.....C"
434  PRINT "       ADD NEW NOTE TO TUNE......A"
435  INPUT Y$: IF Y$ = "B" THEN 451
437  IF Y$ = "F" THEN 452
438  IF Y$ = "L" THEN 454
440  IF Y$ = "S" THEN 456
442  IF Y$ = "C" THEN 458
444  IF Y$ = "A" THEN 460
445  IF Y$ = "R" THEN 462
447  IF Y$ = "P" THEN 464
450  PRINT : PRINT "   TRY AGAIN": GOTO 400
451  GOSUB 500: GOTO 400
452  GOSUB 3000: GOTO 400
454  GOSUB 2500: GOTO 400
456  GOSUB 1500: GOTO 400
458  GOSUB 1700: GOTO 400
460  GOSUB 1800: GOTO 400
462  GOSUB 1600: GOTO 400
464  GOSUB 2000: GOTO 400
500  HOME : PRINT "       WRITING MUSIC":Z = 0
501  PRINT
502  PRINT "              ************"
505  PRINT "INPUT EACH NOTE AS A 3-SYMBOL"
507  PRINT "COMBINATION AS SHOWN BELOW. N STANDS"
509  PRINT "FOR NATURAL AND S FOR SHARP."
510  PRINT : PRINT "      C       C2N OR C2S"
512  PRINT "   F-------   F2N OR F2S"
515  PRINT "      E       E2N"
517  PRINT "   D-------   D2N OR D2S"
520  PRINT "      C       C2N OR C2S"
522  PRINT "   B-------   B2N"
525  PRINT "      A       A2N OR A2S"
527  PRINT "   G-------   G1N OR G1S"
530  PRINT "      F       F1N OR F2S"
532  PRINT "   E-------   E1N"
535  PRINT "      D       D1N OR D1S"
537  PRINT "   C.......   C1N OR C1S   MIDDLE C"
540  PRINT "      B       B1N"
545  PRINT "   A.......   A1N OR A1S"
550  PRINT : PRINT "         PRESS A KEY"
560  GET Y$
565  PRINT : PRINT "NOTE THAT EACH OCTAVE RUNS FROM A TO G"
570  PRINT : PRINT "WHEN YOU SEE THE QUESTION MARK INPUT"
575  PRINT "THE 3-LETTER COMBINATION FOR THE FIRST"
580  PRINT "NOTE AND PRESS RETURN.  THEN INPUT THE"
585  PRINT "NUMBER, AS REQUESTED, FOR THE DURATION OF"
590  PRINT "THE NOTE.  AT THE END, TYPE IN END."
650  PRINT : PRINT : PRINT "NOW INPUT A NOTE IN THE 3-LETTER FORM:-"
651  PRINT : PRINT : INPUT "REMEMBER TO USE END TO STOP    ";Z$
652  IF Z$ = "END" THEN 1030
653 L$ =  LEFT$ (Z$,1):M$ =  MID$ (Z$,2,1):R$ =  RIGHT$ (Z$,1):Z = Z + 1
655  IF X1 > 0 THEN Z1 = Z:Z = X1
660 L =  ASC (L$) - 64
661  IF L > 7 THEN 680: IF L < 1 THEN 680
665 M =  VAL (M$): IF M = 2 THEN M = 15: GOTO 670
666  IF M = 1 THEN 670
667  GOTO 680
670 R =  ASC (R$)
672  IF R = 78 THEN R = 1: GOTO 685
675  IF R = 83 THEN R = 8: GOTO 685
680  PRINT : PRINT "    TRY AGAIN              ": GOTO 650
685  PRINT : PRINT : PRINT "NOW INPUT LENGTH OF NOTE:-"
687  PRINT : PRINT "240 FOR A MINIM"
690  PRINT : PRINT "120 FOR A CROTCHET"
692  PRINT : PRINT " 60 FOR A QUAVER"
694  PRINT : PRINT " 30 FOR A SEMI-QUAVER"
695  PRINT : PRINT : INPUT "     ";W:B(Z) = W
696  IF  INT (W / 15) = W / 15 THEN 700
698  PRINT : PRINT : PRINT "   TRY AGAIN": GOTO 695
700 N = L + M + R - 2
710  ON N GOTO 750,760,770,780,790,800,810,820,830,840,850,860,870,880,
     890,900,910,920,930,940,950,960,970,980,990,1000,1010,1020
750 A(Z) = 228: GOTO 650
760 A(Z) = 200: GOTO 650
770 A(Z) = 192: GOTO 650
780 A(Z) = 171: GOTO 650
790 A(Z) = 152: GOTO 650
800 A(Z) = 144: GOTO 650
810 A(Z) = 128: GOTO 650
820 A(Z) = 214: GOTO 650
830 A(Z) = 192: GOTO 650
840 A(Z) = 181: GOTO 650
850 A(Z) = 161: GOTO 650
860 A(Z) = 144: GOTO 650
870 A(Z) = 136: GOTO 650
880 A(Z) = 121: GOTO 650
890 A(Z) = 114: GOTO 650
900 A(Z) = 102: GOTO 650
910 A(Z) = 96: GOTO 650
920 A(Z) = 85: GOTO 650
930 A(Z) = 76: GOTO 650
940 A(Z) = 72: GOTO 650
950 A(Z) = 64: GOTO 650
960 A(Z) = 108: GOTO 650
970 A(Z) = 96: GOTO 650
980 A(Z) = 90: GOTO 650
990 A(Z) = 80: GOTO 650
1000 A(Z) = 72: GOTO 650
1010 A(Z) = 68: GOTO 650
1020 A(Z) = 60: GOTO 650
1030  IF X1 > 0 THEN Z = Z1
1040  RETURN
1500 D$ =  CHR$ (4)
1502  PRINT : PRINT : INPUT "  WHAT FILE NAME  ";N$
1505  PRINT D$;"OPEN ";N$
1510  PRINT D$;"WRITE ";N$
1515  FOR J = 1 TO Z
1520  PRINT A(J): PRINT B(J)
1525  NEXT J
1530  PRINT D$;"CLOSE ";N$
1535  PRINT "  NOW SAVED ON DISK.  PRESS ANY KEY"
1540  GET Y$
1550  RETURN
1600  INPUT "HOW MANY NOTES WERE SAVED  ";Z
1605  PRINT : PRINT : INPUT "  WHAT FILE NAME  ";N$
1610 D$ =  CHR$ (4)
1615  PRINT D$;"OPEN ";N$
1620  PRINT D$;"READ ";N$
1625  FOR J = 1 TO Z
1630  INPUT A(J): INPUT B(J)
1635  NEXT J
1640  PRINT D$;"CLOSE ";N$
1645  PRINT "NOW RECOVERED FROM DISK. PRESS ANY KEY"
1650  GET Y$
1660  RETURN
1700  HOME : PRINT "WHAT IS THE NO. OF THE NOTE"
1705  PRINT : INPUT "THAT YOU WANT TO CHANGE ";X1
1710  PRINT : PRINT "REMEMBER TO INPUT END AFTER THIS"
1715  PRINT : PRINT "      PRESS ANY KEY ": GET Y$
1720  GOTO 650
1800  HOME
1810  HOME : PRINT "THE NOTES WILL BE ADDED TO THE"
1820  PRINT : PRINT "END OF THE TUNE.  AS USUAL WHEN"
1830  PRINT : PRINT "YOU WISH TO STOP, TYPE IN END."
1840  GOTO 650
2000  FOR J = 1 TO Z
2010  POKE 768,A(J): REM  A(J) IS A NOTE PITCH
2015  POKE 769,B(J): REM  B(J) IS A NOTE DURATION
2020  CALL 770: REM  CALLS A MACHINE-CODE ROUTINE
2025  NEXT J
2030  RETURN
2500  HOME : FOR J = 1 TO Z
2510  PRINT A(J),B(J)
2515  IF  INT (J / 20) = J / 20 THEN 2517
2516  GOTO 2520
2517  PRINT "   PRESS A KEY": GET Y$
2520  NEXT J
2530  PRINT : PRINT "   PRESS ANYKEY": GET Y$: RETURN
3000  HOME : PRINT "THANK YOU FOR NOW.": END
```

Apple Melody Maker Program listing.



The MC81 cartridge.

HI-FI

Jeff Macaulay

A T100 transformer.

Five years ago the ultimate in pick-up cartridges were high compliance, high output devices. In order to track the groove properly, it was necessary to fit these into low mass arms of low friction in both vertical and horizontal planes.

Although the requirement for low friction is unchanged these arms are not capable of extracting the best performance from today's moving coil cartridges which require high mass arms. Unfortunately, most of the arms available at present are an uneasy design compromise between the requirements of both types of cartridges.

This problem was evident recently when I received an MC81 pickup cartridge to review. The MC81 is an excellent example of a moving coil cartridge and possesses all the features one comes to expect from these. The compliance is low, tracking weight is about 2 grms and the output is well below 1mV.

Naturally a step up device is required to match the cartridge to the normal phono input of the amplifier. For my own listening I used a T100 transformer. Transformers have the advantage of introducing no noise but if badly designed they can influence the final sound quality.

Luckily none of these problems beset the T100 which has a bandwidth of 10Hz to 100kHz.

For an initial listening test the MC81 and T100 were used in a Rega 2 deck. It was noticed at the outset that the cartridge produced previously unheard detail from our favourite discs and we were left in no doubt about the abilities of the combination.

All was not 100% though. When the cartridge was mounted in the Rega arm mistracking could be heard on certain records. I hasten to add though that this mistracking was only apparent on the orchestral peaks of the Telarc digital recordings. As these are cut without any compression they represent the ultimate test for any system, not just the cartridge.

On all normal records tracking is very steady and this combination can be heartily recommended. When I took the cartridge home and mounted into my own reference system the cartridge sailed through the same digital recordings without any mistracking evident.

The reason is not hard to find. The pickup arm fitted to my system is the Acos Lustre GST 1. This arm was introduced in the early seventies and received a lot of criticism at the time for its high mass. When it was introduced the high compliance cartridges that were very popular suffered from a low frequency resonance when mounted in it.

All cartridge/arm combinations have a characteristic low frequency resonance because of the cartridge compliance and the effective arm mass. If the compliance and arm mass is high this resonance occurs below 10Hz and is excited by record warps. As a result the arm oscillates colouring the sound. If the resonance is too high in frequency the lower bass is accentuated also leading to colouration.

With the current crop of MC cartridges the general rule seems to be the higher the arm mass the better. If you are already using such a cartridge it would seem prudent to attach any extra weights that came with the arm, rebalance and try the sound again. Often the addition of a few grammes in the right place works wonders.

Having suffered this rather lengthy preamble the reader will be pleased to know that I am about to get down to the nitty gritty!

The MC81

This cartridge will set you back £49.95. Add a T100 at £24.95 and you have spent £75.

At this kind of price level the value for money aspect must be considered as well as the absolute performance of the device. There are basically two points of view on this. If you are already an enthusiast with a large record collection it makes economic sense to protect your investment by using a high quality cartridge. A good part of my record collection is almost unplayable due to being played on a 'Dansette', back in the early sixties!

The other point of view is that any cartridge that costs more than say £50 must be hewn from solid gold to persuade people to part with their money.

I must admit some sympathy for those who hold the latter view but one tends to find that they have, as a rule not heard what such a cartridge can do for their listening pleasure. The MC81 is a case in point. It performs as well as if not better than most of the (more) expensive cartridges that I've heard. The sound balance is absolutely neutral, instruments and voices are well separated. The image has both depth and stability. What's more impressive though is the way the cartridge never seems to lose control and presents subtle detail even in the presence of more powerful material. In short if you're in the market for a cartridge in this price range give it a listen!

Both the MC81 and the T100 are obtainable from Videotone Ltd.

One of the more interesting aspects of audio is the way the old adage 'There's nothing new under the sun' rings true! Nearly all the 'new' ideas turn out to be rehashes of older designs. An example is the rash of super A amplifiers that have arrived this season from the orient. For those who never read a Hi-Fi mag a word of explanation will be in order. Most power amplifiers operate in class B. This means that under quiescent, idling conditions they draw very little current. Overall feedback ensures that the output acts like a voltage source and provides all the speakers drive current as and when required.

Unfortunately, to do this a pair of complementary transistors are required. One transistor handles the positive going half of the signal whilst the negative going portion is provided by the other. Because it is impossible to find transistors that are perfectly matched some distortion is inevitably created. This distortion is known as crossover distortion. Although the overall feedback reduces this to low levels it can usually be heard and is worse on low level signals.

The obvious way to avoid this distortion is to increase the quiescent current in the output stage and biasing it into class A. When this is done the use of large heatsinks and power supplies become necessary and in simple terms this means a more expensive and inconvenient product.

The Super A amplifiers utilise a different method of eliminating crossover distortion. Essentially the idea is to raise the quiescent current in sympathy with the incoming signal. Thus the output stage will always operate in class A but with an efficiency closer to that of a class B.

Again this idea is far from new. In the late fifties and early sixties Mullard published several simple designs of this type. These circuits were far from Hi-Fi but they show, once again, what purports to be an innovation is in fact just a development.

Whilst on the subject of developments I promised to explain a bit more about active crossover systems. Anyone who reads this column regularly will know most of the advantages by now and it is probably about time to get down to specifics. In all speaker systems the most fundamental decisions are the crossover frequency chosen and the filter slope used. The frequency is chosen in precisely the same manner as a passive system. (See September issue).

The filter slope is more a matter of personal preference although if the ranges of the speakers overlap by an octave or so then the second order type is as good as any.

One thing to ensure is that the Q of the filter is 0.7 since this will ensure that the response will not suffer from 'ripples' in the pass band. That settled the filters can be simple Sallen and Key types built around an op-amp or two. Two matching filters for example are required for a two way system. Figure 1 shows the general layout and formulae for determining the component values. A good choice for 'R' is between 22 and 100k. It will not take long with a calculator to determine the other values.

Finally, a note on the op-amps used. The 741 suffers from slew rate problems. A glance through the Maplin catalogue will reveal several suitable alternatives.

E&MM

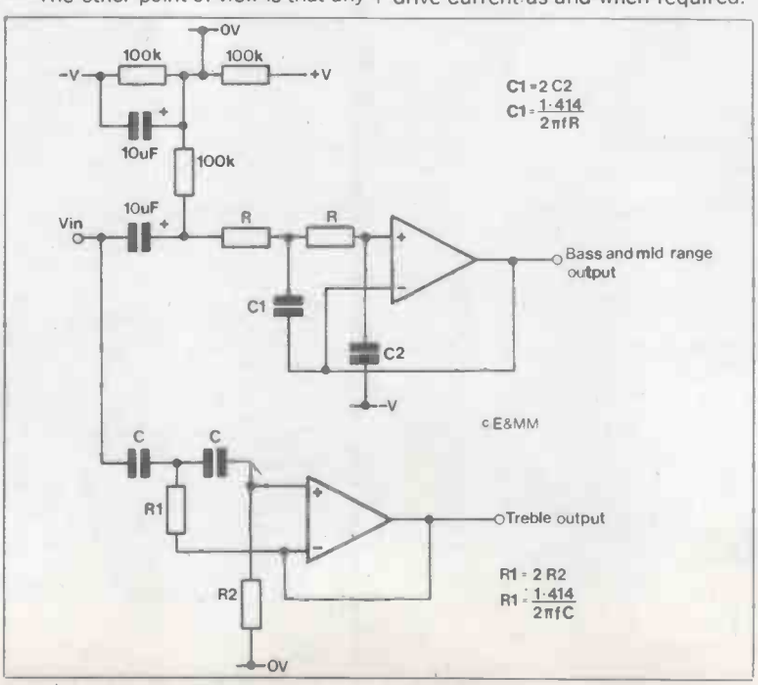


Figure 1. Matching filters for a two way system.

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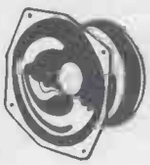

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by Robert Penfold

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Capacitive Reactance

We have covered the charge storage ability of capacitors and the use of this property in timing and decoupling circuits in previous parts of 'Starting Point'. Capacitors have other important uses, probably the most common being for coupling an alternating or varying DC signal from one part of a circuit to another while blocking any steady DC component on this signal.

This property of a capacitor is easily explained with the aid of the simple circuit diagram shown in Figure 1. Assume that R1, R2 and RV1 are all of the same value, and that initially the wiper of RV1 is at the centre of its track. When power is connected to the circuit C1 will be charged by way of R1, the upper section of RV1, and R3. The current that flows gives an initial voltage across R3, but this soon subsides as the charge on C1 builds up to the point where the positive plate is at half the supply voltage and the negative plate is at the negative supply voltage. The charge current then ceases and the voltage across R3 is zero.

If the slider of RV1 is now moved towards R1, the voltage across C1 increases and it therefore charges up through R1, RV1 and R3 once again. This current flow through R3 produces a voltage across this component with the end that connects to C1 being positive of the terminal which connects to the negative supply rail. Of course, when the slider of RV1 reaches the top of its track the charge on C1 soon reaches two thirds of the supply voltage and the charge current ceases. The voltage across R3 therefore returns to zero again.

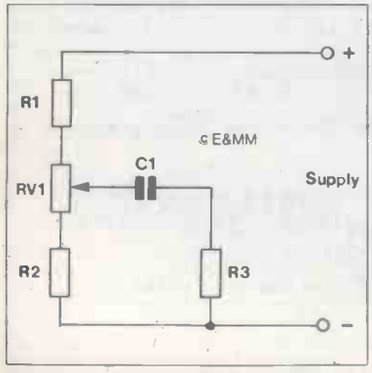


Figure 1. Circuit to demonstrate capacitive coupling.

Moving the wiper of RV1 towards R2 results in a reduction in the voltage fed to C1, and it therefore discharges through the lower section of RV1, R2 and R3. This again produces a voltage across R3, but it is of the opposite polarity this time and the end which connects to C1 goes negative of the negative supply rail. Again, when the wiper of RV1 reaches the end of its track the charge on C1 quickly adjusts to equal the voltage fed to it so that no further charge current flows and the voltage on R3 returns to zero.

Thus it can be seen that C1 blocks a steady DC level from reaching R3, but a varying voltage is effectively allowed to pass through to R3. It is important to realise that the effect is as if C1 was allowing a signal to pass, but no current actually flows through C1. It is simply a matter of a charge being passed backwards and forwards from one plate to the other. Another important point to note is that although a varying DC signal is being generated by moving the wiper of RV1 up and down, the signal developed across R3 is an AC signal which is positive when RV1's slider is positive going, and negative when RV1's slider is negative going.

If R1, R2 and RV1 were to be replaced with an AC signal source the circuit action would be much the same with a charge passing through C1 in one direction during positive half cycles, and a charge passing in the opposite direction during negative half cycles, giving an AC signal across R3.

Reactance

We now come to the question of how well, or otherwise, does a capacitor couple a signal to a load resistance. The factors governing the efficiency with which a capacitor couples a signal from one part of a circuit to another can be explained with the help of Figure 2. The square wave generator produces an output waveform of the type shown in Figure 3(a) and this is coupled to R1 via C1. When the output of the square wave generator changes from 0 volts to being

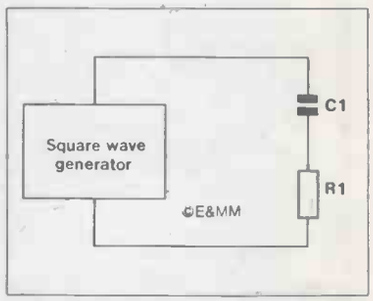


Figure 2. Circuit to demonstrate coupling efficiency.

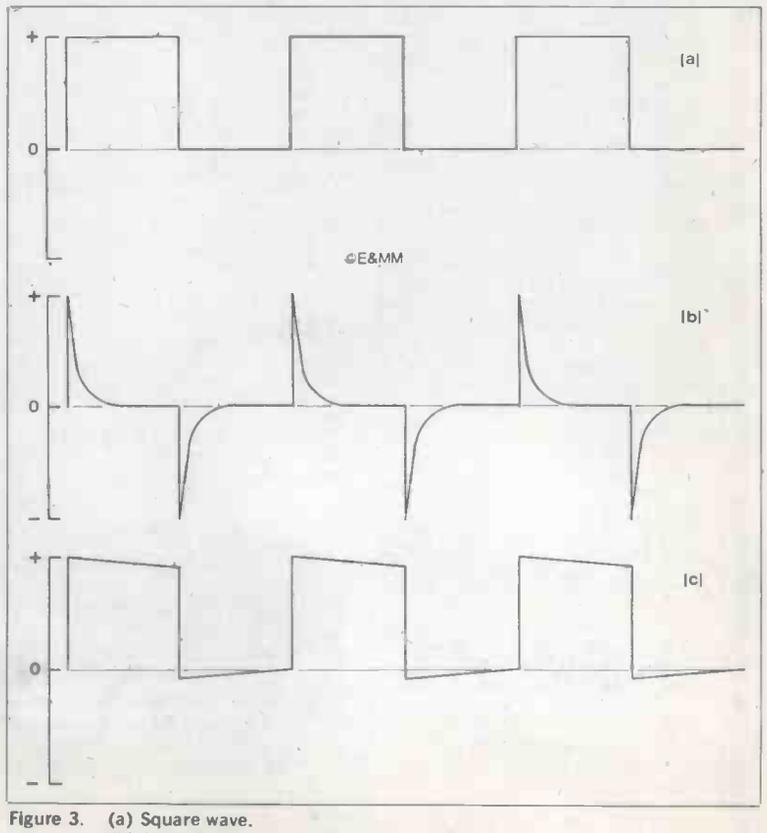
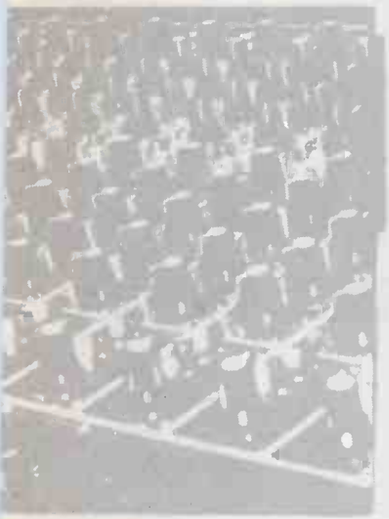
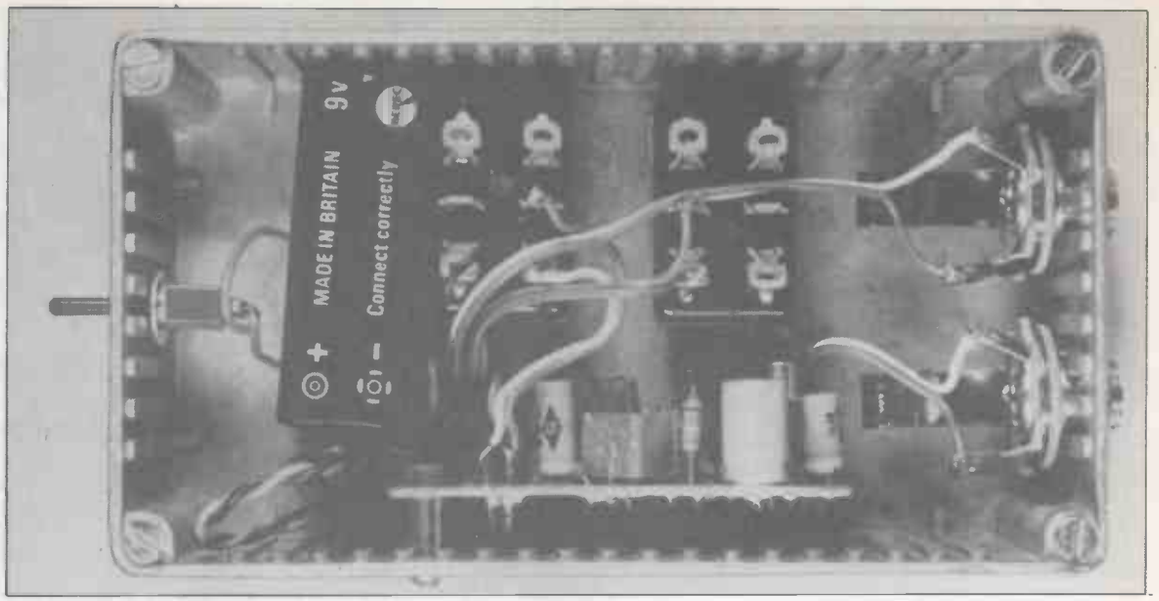


Figure 3. (a) Square wave.
(b) Square wave after inadequate coupling.
(c) Improved coupling waveform.





Internal view of Bass and Treble Booster.

fully positive, C1 charges up by way of R1. If C1 has a relatively low value in comparison to that of R1, C1 will quickly fully charge and the positive voltage across R1 rapidly decays to zero. When the output of the square wave generator switches back to zero volts C1 discharges through R1. With the value of C1 low in comparison to that of R1 it will discharge very rapidly so that the negative voltage produced across R1 quickly drops back to zero again. This gives the wave shape shown in Figure 3(b) across R1.

This obviously gives a rather inefficient coupling, but there are three ways of improving matters. One is to increase the frequency of the input signal so that it returns to zero volts before C1 has started to significantly charge up. There would then be practically no charge on C1 and the negative spikes of Figure 3(b) would be largely attenuated. The waveform across R1 would then resemble that of Figure 3(c). However high the input frequency is made, C1 will always have discharged slightly before the input signal returns from its positive value to zero and there will be some distortion of the wave shape. However, for all practical purposes this distortion of the waveform can be kept down to an insignificant level.

An alternative to increased input frequency is a higher value for C1 as it will then charge up to a lesser degree during the periods when the input signal is positive. The third method is to increase the value of R1, which has exactly the same effect of slowing up the charge rate of C1.

In effect, C1 and R1 form a potential divider, but C1 does not have a fixed resistance. Its resistance is infinite at DC (in theory), and with AC signals its resistance falls as frequency is increased. In fact C1 does not have true resistance at all, and the correct term is reactance. This is measured in ohms, like resistance, but needs to be specified at a particular frequency to be meaningful. There are actually two types of reactance, capacitive reactance and inductive reactance. Capacitive reactance decreases as frequency is increased, whereas inductive reactance increases as frequency is increased.

Sometimes a circuit has a combination of resistance, inductive reactance, and/or capacitive reactance, and the correct term to use is then impedance. Whereas resistance is simply calculated by dividing the applied voltage by the current flow, impedance and reactance are calculated by dividing the peak applied voltage by the peak current flow. This slight modification is necessitated by the fact that with reactance and impedance we are not dealing with static quantities of voltage and current, and peak current flow does not necessarily coincide with peak voltage.

Filters

The circuit of Figure 2 is actually a simple form of frequency selective filter and it is this filtering that causes the changing of the wave shape. At high frequencies C1 has a reactance which is low when compared to the resistance of R1, and the losses through C1 due to a potential divider action are insignificant. At low frequencies the reactance of C1 becomes large in comparison with the resistance of R1, and the losses through C1 are also large. The reactance of a capacitor is inversely proportional to the applied frequency, for example, a doubling of frequency halves the reactance value. In a filter of the type shown in Figure 2 there is only a very gradual and insignificant increase in the attenuation as the input frequency is reduced, except when the reactance of C1 starts to become significant in comparison to the value of R1. Even then, the attenuation rate of the filter can never exceed 6dB per octave (i.e. the signal level at the output can reduce by no more than 50% if the input frequency is halved).

It is the filtering effect of a circuit of the type shown in Figure 2 that gives the waveform distortion shown in Figure 3(a) and 3(b). A square wave consists of a signal at the fundamental frequency plus signals at certain harmonics (multiples) of this frequency. If the capacitor provides inadequate coupling at the fundamental frequency, the fundamental signal becomes relatively weak, and the lower frequency harmonics become weaker in comparison with the higher harmonics. This results in the distortion of the waveform, which only occurs if there are two or more frequency components present at the input. If a pure sinewave (which has just one frequency component) is fed to the filter, the signal at the output can only be changed in amplitude, not waveform.

Frequency selective filtering can also be provided if the positions of the resistor and capacitor are transposed, as shown in Figure 4. However, the filter now provides low losses at low frequencies where the value of R1 is low in relation to the reactance of C1. At high frequencies where the value of C1 becomes less than that of R1 there are large losses through R1. Thus this type of filter permits low frequency signals to pass with minimal losses, but seriously attenuates high frequency signals. The ultimate attenuation rate is again 6dB per octave.

For obvious reasons, a filter of the type shown in Figure 2 is called a high pass filter and one of the type shown in Figure 4 is a low pass filter.

Although these filters only give an ultimate roll off rate of 6dB per octave, as with any filter, a higher attenuation rate can be achieved by using two or more filters in series.

The equation for calculating capacitive reactance is:

$$Xc = \frac{1000000}{2\pi fC}$$

where Xc is the capacitive reactance in ohms, C is the capacitance value in microfarads, and f is the frequency in Hertz. For example a 100nF (0.1uF) capacitor would have a reactance of

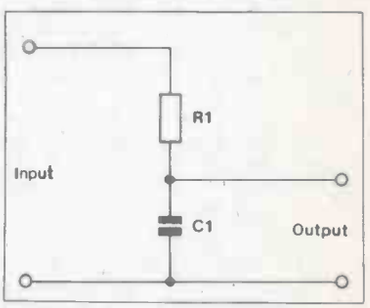


Figure 4. A low pass filter.

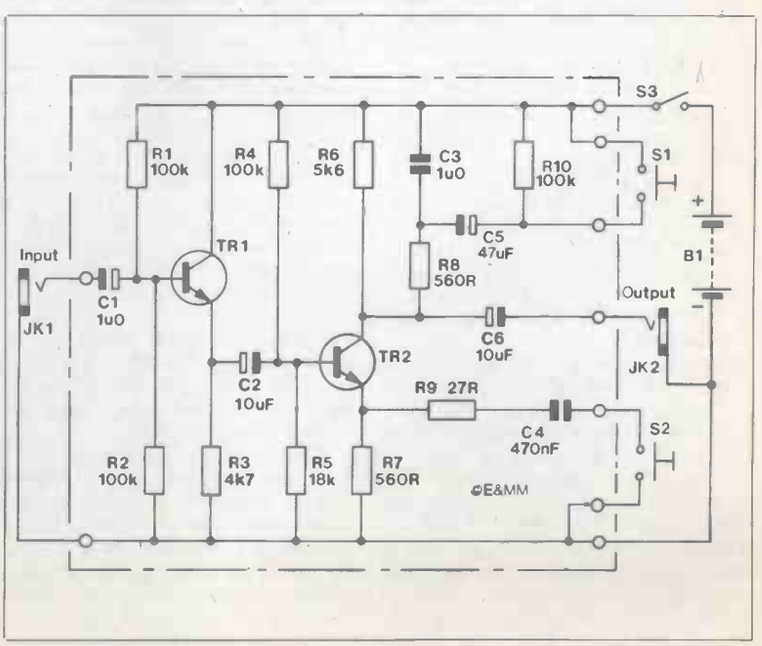


Figure 5. Toneboost circuit diagram.

approximately 159k at 100 Hz, 15.9k at 1kHz, 1.59k at 10kHz, and only 159 ohms at 100kHz.

Toneboost Project

Our constructional project this month is a bass and treble booster for use with an electric guitar. This demonstrates the use of capacitors to provide AC coupling with DC blocking, and tailoring of the frequency response Figure 5 shows the circuit diagram of the Toneboost.

TR1 is used as an emitter follower buffer stage at the input of the unit. This merely ensures that the guitar is fed into a reasonably high impedance so that the pick-up is not so heavily loaded that the output signal level is significantly reduced. R1 and R2 bias the base of TR1 to half the supply voltage, and the emitter of TR1 will be about 0.6 volts lower than this. C1 couples the audio frequency AC signals from the pick-up into the base of TR1, but prevents the fairly low resistance of the pick-up from affecting the biasing of TR1. A capacitor used in this way is usually termed a coupling capacitor or a DC blocking capacitor. The reason for biasing the base of TR1 is to enable the output signal at its emitter to swing up and down in voltage in sympathy with the input voltage. Without this biasing the input signal could take the emitter of TR1 positive of its quiescent level, which would be zero volts. Due to the voltage drop from the base to the emitter of TR1 it would need to reach an amplitude of about 0.6 volts therefore negative input half cycles would have no effect on TR1. Biasing is therefore essential in an audio frequency amplifier.

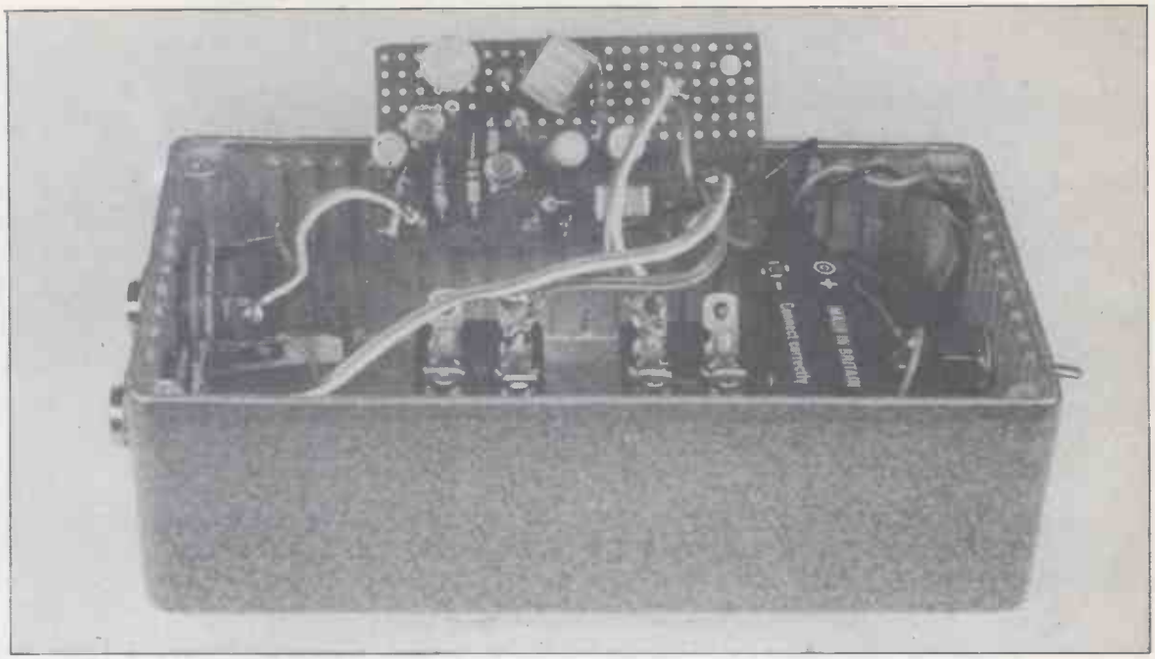
C2 couples the signal at the emitter of TR1 to the input of the next stage, and this is a common emitter amplifier which utilises TR2. We will not consider the operation of a common emitter amplifier in detail here, but it is necessary to know that the voltage gain provided by this stage is approximately equal to the impedance in the collector circuit divided by the impedance in the emitter circuit. It is at this stage that the bass and treble boost are produced.

With S1 closed and S2 open there is roughly unity voltage gain through the circuit. There is obviously 560 ohms in the emitter circuit of TR2, but things are a little less straight forward in the collector circuit. The impedance of R6 is shunted by the parallel impedance of R8. This is coupled across R6 by the parallel capacitance of C3 and C5. These have a very low impedance at all audio frequencies so that the effect is very much the same as if R8 was directly connected across R6. This gives similar emitter and collector circuit impedance values, and the voltage gain of roughly unity through the unit.

The treble boost is switched in by closing S2 so that R7 is shunted by the impedance of R9 and C4. At low and middle audio frequencies C4 has a high reactance (about 6.5k at 50Hz for example) and does not have a large effect on the voltage gain of the circuit. At about 700Hz the impedance through R9 and C4 is comparable to that of R7, and their shunting effect on R7 gives a doubling of the circuits voltage gain. At higher frequencies the impedance of R9 and C4 steadily decreases, and the voltage gain of the circuit rises. The voltage gain is approximately 6 at 5kHz, and reaches approximately 10 at frequencies above 10kHz. The response does not continue to rise significantly above 10kHz due to the inclusion of R9 which limits the shunting effect C4 can have on R7. Although one might expect the value given to R9 to give a higher maximum gain than 10, this is not the case since TR2 has a small innate emitter resistance which is effectively connected in series with the discrete emitter impedance. The circuit therefore gives the required boost of up to about 10 at treble frequencies.

S1 is opened in order to give the bass boost, and this effectively takes C5 out of the circuit. Due to its high value R10 does not have any significant effect on the gain of the circuit, and we can ignore this component for the time being. At high and middle audio frequencies C3 has a low reactance which keeps R8 effectively shunted across R6 and the voltage gain of the circuit at about unity. At approximately 250Hz the reactance of C3 is high enough to reduce the shunting effect of R8 sufficiently to boost the voltage gain to about 2. At lower frequencies the reactance of C3 steadily increases as does the voltage gain of the circuit. The voltage gain reaches about 10 at 30Hz. Thus the required bass boost is produced. As the bass and treble boost circuits operate over different frequency ranges there is little interaction between them, and it is possible to use both at once if desired.

C6 couples the output from TR2 to the guitar amplifier, and it ensures that the amplifier does not affect the DC conditions in the booster circuit if the amplifier should have a DC path across its input. Of course, all three coupling capacitors in the circuit have values which give them a low reactance even at low audio frequencies when compared to the impe-



Veroboard and other parts wired together.

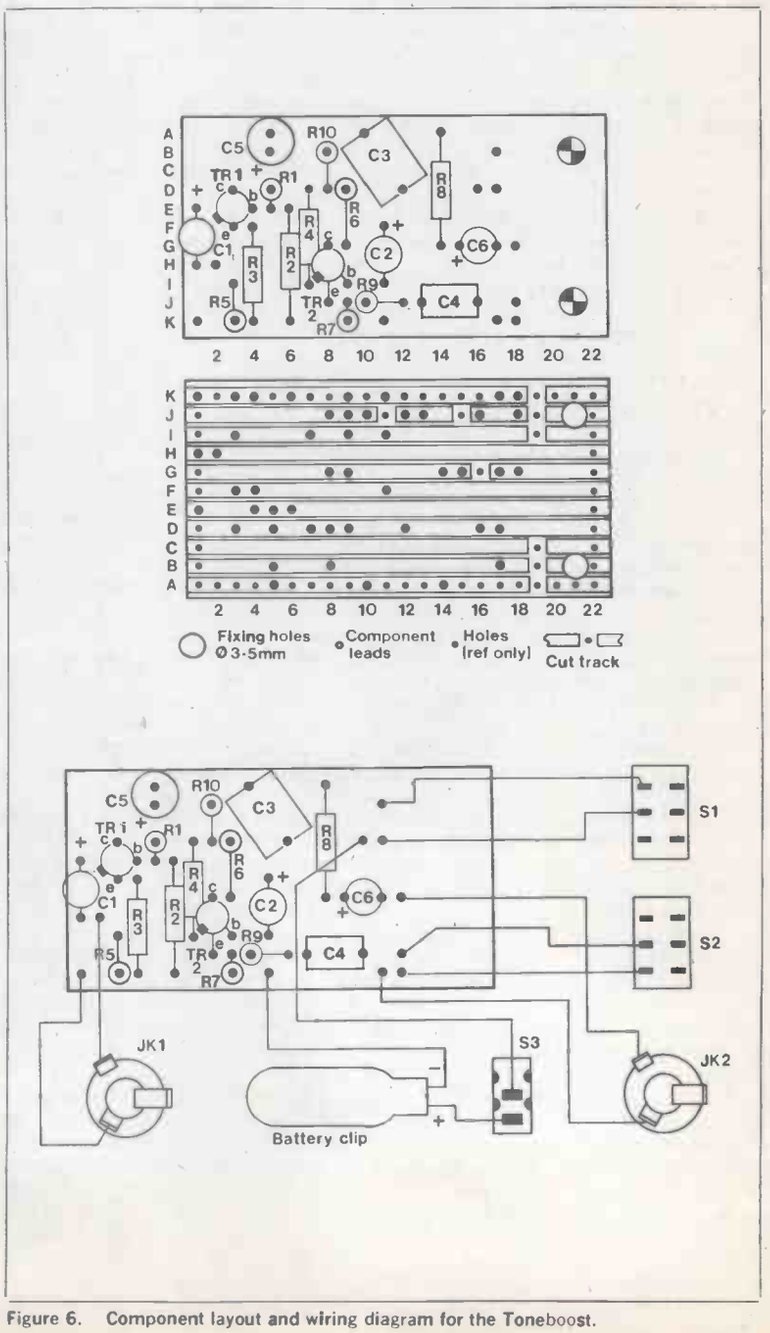


Figure 6. Component layout and wiring diagram for the Toneboost.

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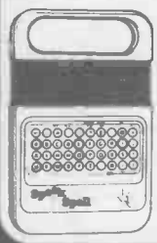

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The most advanced T.V. game in the world. 20 cartridges available. Add-on KEYBOARD coming soon to convert the MATTEL to a home computer with 16K RAM, fully expandable and programmable in Microsoft Basic. Other accessories will be available later in the year.

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HAND HELD GAMES

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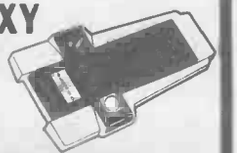
These invaders are a breed of creature hitherto unknown to man. They cannot be killed by traditional methods — they must be buried. The battle is conducted in a maze where squads of aliens chase home troops. The only way of eliminating them is by digging holes and burying them. **£23.95** inc. VAT

HAND HELD GAMES

GALAXY 1000



The 2nd generation Galaxy Invader. The invaders have re-grouped and have a seemingly endless supply of spacecraft whilst the player's arsenal is limited to just 250 missiles to be launched from 3 missile stations. You have to prevent the invaders landing or from destroying your home defences. **£19.95** inc. VAT

THE OLYMPIA — POST OFFICE APPROVED TELEPHONE ANSWERING MACHINE

WITH REMOTE CALL-IN BLEEPER

This telephone answering machine is manufactured by Olympia Business Machines, one of the largest Office Equipment manufacturers in the U.K. It is fully POST OFFICE APPROVED and will answer and record messages for 24 hours a day. With your remote call-in bleeper you can receive these messages by telephone wherever you are in the world. The remote call-in bleeper activates the Answer/Record Unit, which will at your command repeat messages, keep or erase them, and is activated from anywhere in the world, or on your return to your home or office. The machine can also be used for message referral, if you have an urgent appointment, but are expecting an important call, simply record the 'phone number' and location where you can be reached. With optional extra bleepers (£13 each) this facility can be extended to colleagues and members of the family. Using a C90 standard cassette you can record as many as 45 messages. The announcement can be up to 16 seconds long and the incoming message up to 30 seconds long.

The machine is easy to install and comes with full instructions. It is easily wired to your junction box with the spade connectors provided or alternatively a jack plug can be provided to plug into a jack socket. Most important, of course, is the fact that it is fully POST OFFICE APPROVED.
The price of £135 (inc. VAT) includes the machine, an extra-light remote call-in Bleeper, the microphone message tape, A/C mains adaptor. The unit is 9¾"x6"x2½" and is fully guaranteed for 12 months. The telephone can be placed directly on the unit — no additional desk space is required.

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The ACE TELCOM VDX1000 Prestel/Viewdata adaptor simply plugs into the aerial socket of your television and enables you to receive the Prestel/Viewdata service in colour or black & white.

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dance into which there are feeding a signal. This prevents them from significantly reducing the low frequency response of the unit.

The purpose of R10 is to keep C5 charged when S1 is open. If this is not done it is likely that a large pulse would be generated at the output when S1 was closed and C5 rapidly charged up, and this could produce a very loud 'click' from the loudspeaker. The high value of R10 ensures that it does not significantly effect the circuit in other respects.

Construction

The unit is housed in a diecast aluminium box. A case of this type is ideal for a project such as this which needs a tough case that will also screen the circuitry. The case needs to be strong because S1 and S2 are both foot operated. switches, and some cases would be damaged after repeated operations of these.

The general layout of the unit can be seen by referring to the photographs, but the precise layout is not critical and it is acceptable to use any layout that enables all the components to fit into the case and has the controls conveniently placed.

The small components are fitted onto a small 0.1in. matrix Veroboard panel which measures 11 copper strips by 22 holes. This board is constructed using the normal techniques, and Veropins are used at points where off-board connections are to be made. The board can then be bolted in place inside the case before it is wired to the switches, sockets, and battery connector. Use spacers over the mounting bolts so that the connections and copper strips on the underside of the board are kept away from the metal case and are not short circuited through it.

In use the guitar connects to JK1, and a screened lead fitted with a standard jack plug at each end is used to connect the booster to the amplifier. Due to the increase in gain provided by the unit at some frequencies it is necessary to take greater care to avoid significant pick-up of mains hum and stray feedback from the loudspeaker to the guitar pick-up.

E&MM

PARTS LIST FOR TONEBOOST

Resistors - all ¼W 5% carbon unless specified

R1,2,4	100k	3 off	(M100K)
R3	4k7		(M4K7)
R5	18k		(M18K)
R6	5k6		(M5K6)
R7,8	560R	2 off	(M560R)
R9	27R		(M27R)
R10	180k		(M180K)
Capacitors			
C1	1u 50V Min PC electrolytic		(YY31J)
C2,6	10u 16V Min PC electrolytic	2 off	(YY34M)
C3	1u Polycarbonate		(WW53H)
C4	470n Polycarbonate		(WW49D)
C5	47u 16V Min PC electrolytic		(YY37S)
Semiconductors			
TR1,2	BC109C	2 off	(QB33L)
Miscellaneous			
S1,2	Press Toe Switch Type 2	2 off	(FH93B)
S3	Switch miniature S.P.S.T. toggle		(FH97F)
JK1,2	Standard ¼in. Jacks	2 off	(HF91Y)
	Case Type M5004		(LH71N)
	Veroboard		(FL08J)
	PP3 Battery		
	PP3 Connector		(HF28F)
	Wire 10M		(BL00A)
	Veropins		(FL24B)
	Bolts 6BA ½in		(BF06G)
	Nuts 6BA		(BF18U)
	Spacers 6BA ¼in		(FW34M)

EVENTS

Oct. 15th ROCK CONCERT SOUND SYSTEMS - Ben Duncan. Geology Lecture Theatre, Queens Building, Bristol University, University Walk, Bristol. Commences 7.00 p.m. Entry Free.

Oct. 16th-18th VIDEO SHOW, West Centre Hotel, London. 9.00 a.m.-5 p.m. Free Entry.

Oct. 19th-23rd COMPUTER SYSTEMS & APPLICATIONS Exbn. - SYSTEMS, Munich, Germany. For further details phone 01-486-1951, ECL Ltd.

Oct. 21st-24th Int. COMPUTER & TECHNOLOGY Exbn & SEMINAR 'COMPUTA' Singapore. Not for the leaflet collector! For further details phone Bob Hackett — 021-705 707.

Oct. 25th FRETWIRE MUSIC FESTIVAL & TRADE FAIR, New Century Hall, Corporation St., Manchester. Features exhibitions, competitions, workshops, seminars and the Piccadilly Radio/Fretwire band contest. Commences 10.00 a.m. - 10.00 p.m. Further details from Fretwire, 36a Wheelock St., Middlewich, Cheshire.

Oct. 21st-25th HOBBY ELECTRONICS & MINI COMPUTERS Exbn Stuttgart, Germany. Exhibits ranging from electronic games/kits - hi-fi - amateur radio. Special travelling arrangements by Peter Chipperfield Travel Ltd (01) 837 7555. For further details of the fair and other events in Stuttgart, including the annual Hobby Elektronic, phone (01) 236 0911.

Oct. 26th-30th INT. DISCOTHEQUE SHOW - DISCOM, Paris, France. Phone 01-499-2317.

Oct. 27th-29th COMPUTER GRAPHICS, Bloomsbury Centre Hotel, London. 09274 28211.

Nov. 3rd-6th INT. ELECTRONICS TRADE FAIR - ELKOM, Helsinki, Finland. Phone 01-486-1951.

Nov. 5th-8th SOUND & MUSIK '81, Essen Showgrounds, Germany. This exhibition covers musical instruments, accessories and music books. Also featured are special performances by well known musicians. For further information contact: Messe Essen, Sound & Musik '81, Norbertstrasse 56, 4300 Essen 1, West Germany.

Nov. 6th-8th VIDEO, HI-FI - CB RADIO SHOW, Deeside Leisure Centre, Surrey. Exhibits ranging from electric can openers - the latest in Hi-Fi. Open 12.00-6.00 p.m. Entrance 50p. For further details ring Deeside Leisure Centre, 0244-812-311.

Nov. 7th ELECTRONIC MUSIC CONCERT BY IAN BODDY, Spectro Arts Workshop, Bells Court, Newcastle. Ian performs some of his own material using a selection of synths and rhythm units. The concert commences at 8.00 p.m. and costs £1.00.

Nov 11th-15th BREADBOARD, Royal Hort. Halls, London. Home electronics exhibition.

Nov. 17th-20th PROFESSIONAL VIDEO SHOW, Wembley Conference Centre. 01-686 2599.

Nov. 17th-20th COMPEC, Olympia, London. Trade only. Small computers for business and all back-up systems. Opens 10.00 a.m. each day.

Nov. 21st-29th INT. HI-FI SHOW, Brussels, Belgium. For further information write to Brussels International Trade Fair, Parc des Expositions, B-1020, Brussels, Belgium.

Nov. 23rd-25th 1981 SCHOOLS PROM, Royal Albert Hall, London. Including guests, Julian Lloyd Webber, Humphrey Littleton.

Nov. 25th-27th PROFESSIONAL SOUND RECORDING EQUIPMENT EXHIBITION, West Centre Hotel. 01-340 3291.

Nov. 26th-29th MUSIC SHOWCASE, Winter Gardens, Blackpool. Exhibiting everything that is interesting in music. For the professional to the home entertainer. Demonstrations and recitals will also be given by well known musicians. For further information phone 01-855-9201.

Dec. 1st-3rd SOFTWARE INFO INTERNATIONAL EXHIBITION AND CONFERENCE, Wembley Conference Centre.

Dec. 15th-19th GULF COMPUTER EXHIBITION, Dubai. Trade. For further details phone Clive Lowe 01-930 3881.

Courses

TIES COMPUTER COLLEGE. 5 day courses allowing the use of a Sinclair ZX81 computer, manual, mains adaptor and 30 hours of expert practical tuition; teaching you the elements of BASIC (residential or non residential). TIES Computer College, 11 Duke Street, London W1M 5RA. Telephone 01-486-4507/01-486-1186.

COMMODORE TRAINING COURSES, Skyway Hotel, Heathrow Airport. 3 day courses: BASIC for beginners commencing 3rd November. Program Planning commencing 17th November. Assembler commencing 5th December. Disk File Programming commencing 27th October. Cost of each, £210 inc. VAT. This also includes lunches, teas, coffees and documentation. For further information phone Slough 74111. Commodore training dept. 675 Ajax Avenue, Slough, Berks.

SUMLOCK BONDAIN LTD MICRO-COMPUTER TRAINING COURSES. These courses are in four categories: BASIC Programming, Advanced BASIC, Word Processing, introducing Micro-Computers. For further details write to Sumlock Bondain Ltd, 263-269 City Road, London EC1V 1JX. Telephone 01-250-0505.

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Nov 9th, Cologne
Nov 10th, Frankfurt
Nov 11th, Nuernberg
Nov 12th, Munich
Nov 13th, Zurich
Nov 15th, Lyon
Nov 16th, Paris
Nov 18th, Luxembourg
Nov 19th, Heerlen (Holland)
Nov 20th, Brussels
Nov 21st, Nijmegen (Holland)
Nov 22nd, Leiden (Holland)

Tickets and further information from Klaus Muller 010-495143-8003

Don't forget Tangerine Dream at Hammersmith, London, in October!

We shall be pleased to publish news of forthcoming electronic and electro-music exhibitions, clubs - also special electronic music concerts.

ELECTRONICS MUSIC & EFFECTS KITS

128-NOTE SEQUENCER
Enables a voltage controlled synthesiser, such as the P.E. Minisonic, to automatically play pre-programmed tunes of up to 32 pitches and 128 notes long. Programs are initiated from the 4-octave keyboard and note length and rhythmic pattern are externally variable.
Kit plus keyboard & contacts = SET-76 £114.09

16-NOTE SEQUENCER
Sequences of up to 16 notes long may be pre-programmed by the panel controls and fed into most voltage controlled synthesisers. The notes and rhythms may be changed whilst playing making it more versatile than the name would suggest.
Kit order code = SET-86 £60.95

3-CHANNEL STEREO MIXER
Full-level control on left and right of each channel, and with master output control and headphone monitor.
Kit order code = SET-107 £19.42

3-MICROPHONE STEREO MIXER
Enables stereo live recordings to be made without the 'hole in the middle' effect. Independent control of each microphone.
Kit order code = SET-108 £12.54

6-CHANNEL MIXER
A high specification stereo mixer with variable input impedances. Specs given in our lists. The kit excludes some SW's — see lists for selection. The extension gives two extra channels.
Main kit code = SET-90 £89.87
Extension kit = ADN-90 £11.74

AUDIO EFFECTS UNIT
A variable siren generator that can produce British & American police sirens, Star-Trek red alert, heart beat monitor sounds etc.
Kit order code = SET-105 £13.60

AUTOWAH UNIT
Automatically gives wah or swell sounds with each guitar note played.
Kit order code = SET-58 £16.89

CHOROSYNTH
A standard keyboard version of the published Elektor 30-note chorus synthesiser with an amazing variety of sounds ranging from violin to cello and flute to clarinet amongst many others.
Kit plus keyboard & contacts = SET-100 £114.79

COMPRESSOR
Operates as an automatic gain control, with little distortion and a compression range of about 30dB. Has compression level and decay rate controls, and additionally has line and microphone inputs complete with mixing controls.
Kit order code = SET-120 £21.98

DISCOSTROBE
A 4-channel 200-watt light controller giving a choice of sequential, random or full strobe mode of operation.
Kit order code = SET-57 £38.42

DRUM SYNTHESISER
Synthesises conventional and extraordinary drum sounds ranging from bass drum through bongos, woodblocks & snare drums and way on to sea, thunder & jet-plane whooshes. Can be triggered via a microphone (not incl.), by hitting an existing drum, or by handclaps and shouts. Requires a +12V 0V -12V psu at approx 40ma.
Kit order code = SET-119 £45.36

DYNAMIC NOISE LIMITER
Very effective stereo circuit for reducing noise found in most tape recordings.
Kit order code = SET-97 £14.57

EXPOSURE TIMER
Controls up to 750 watts in 0.5sec steps up to 10 minutes, with built-in audio alarm.
Kit order code = SET-93 £38.03

FORMANT SYNTHESISER
For the more advanced constructor who puts performance first, this is a very sophisticated 3-octave synthesiser with a wealth of facilities, including 6 oscillators, 3 waveform converters, voltage controlled filter, 2 envelope shapers and voltage-controlled amplifier. Case and hardware not included — see our lists for further details.
Kit plus keyboard & contacts = SET-66 £330.24

LIST
Send stamped addressed envelope with all U.K. requests for free list giving fuller details of PCBs, kits and other components. Overseas enquiries for list – Europe send 50p, other countries send £1.00

All kits include custom designed printed circuit boards

KIMBER-ALLEN KEYBOARDS
Claimed by the manufacturers to be the finest moulded plastic keyboards available. All octaves are C-C, the keys are plastic, slope fronted, spring loaded, fitted with actuators and mounted on a robust aluminium frame. 3-octave 32.43; 4-oct £40.20; 5-oct £48.53; gold-clad contacts – (GJ = SPCO, GB = DP make-break) GJ 3-oct £14.85; 4-oct £19.40; 5-oct £24.30; GB 3-oct £16.76; 4-oct £21.93; 5-oct £27.45

FUNNY TALKER
Incorporates a ring modulator, chopper & frequency modulator to produce fascinating sounds when used with speech & music.
Kit order code = SET-99 £16.08

GUITAR EFFECTS UNIT
Modulates the attack, decay and filter characteristics of a signal from most audio sources, producing 8 different switchable sounds that can be further modified by manual controls.
Kit order code = SET-42 £14.76

GUITAR FREQUENCY DOUBLER
Produces an output one octave higher than the input. Inputs and outputs may be mixed to give greater depth.
Kit order code = SET-98 £10.62

GUITAR MULTIPROCESSOR
An extremely versatile sound processing unit capable of producing, for example, flanging, vibrato, reverb, fuzz and tremolo as well as other fascinating sounds. May be used with most electronic instruments. Meter & some SW's not included in kit – see list for selection.
Kit order code = SET-85 £74.03

GUITAR OVERDRIVE
Sophisticated versatile fuzz unit incl. variable controls affecting the fuzz quality whilst retaining the attack and decay, and also providing filtering.
Kit order code = SET-56 £19.75

PRICES INCLUDE
UK post & handling, and VAT at 15% where applicable. Overseas customers should consult our current list for export postage rates. Note that Eire, C.I. and most B.F.P.O. addresses classify as export deliveries.

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All payments must be cash-with-order, in sterling by international money order or through an English bank.

GUITAR PRACTISE AMPLIFIER
A 3-watt mains powered amplifier suitable for instrument practise or as a test gear monitor. Drives 8 or 15 ohm speakers (not incl. in kit).
Kit order code = SET-106 £20.56

GUITAR SUSTAIN
Maintains the natural attack whilst extending note duration.
Kit order code = SET-75 £13.30

METRONOME
Has a 'tick' rate that can be varied between approximately 40 & 240 beats per minute.
Kit order code = SET-118 £9.51

P.E. MINISONIC SYNTHESISER
A very versatile 3-octave portable mains operated synthesiser with 2 oscillators, voltage controlled filter, 2 envelope shapers, ring modulator, noise generator, mixer, power supply and sub-min toggle switches to select the functions. A case is excluded, but the text gives comprehensive constructional details.
Kit plus keyboards & contacts SET-38 £169.69

BASIC COMPONENT SETS
Include specially designed drilled & tinned fibreglass printed circuit boards with layout charts, all necessary resistors, capacitors, semiconductors and potentiometers. Most kits include their own power supplies or will operate from 9-volt batteries. They also contain basic hardware such as knobs, sockets, switches, a nominal amount of wire & solder, a photocopy of the original published text, and unless otherwise stated, an aluminium box. Most parts may be bought separately. For fuller kit and component details see our current lists. Kits originate from projects published in Practical Electronics, Everyday Electronics & Elektor.

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PHASER
An automatically controlled 6-stage phasing unit with internal oscillator. Depth can be increased with extension.
Main kit code = SET-88 £18.98
Extension kit = ADN-88 £7.68

PHASING & VIBRATO
Includes manual and automatic control over the rate of phasing & vibrato. Capable of superb full sounds. A separate power supply is included.
Kit order code = SET-70 £42.85

PULSE GENERATOR
Produces controllable pulse widths from 100ns to 2sec. Variable frequency range of 0.1Hz to 100kHz.
Kit order code = SET-115 £22.29

RING MODULATOR
Compatible with the formant and most other synthesisers.
Kit order code = SET-87 £11.98

RHYTHM GENERATORS
Two different kits — the control units are designed around the M252 and M253 rhythm-gen chips which produce pre-programmed switch-selectable rhythms driving 10 effects instrument generators feeding into a mixer.
12-rhythm unit = SET-103-253 £65.65
15-rhythm unit = SET-103-252 £58.37

SIGNAL TRACER & GENERATOR
Allows audio signals to be injected into circuits under test, and for tracing their continuity. Includes frequency & level controls.
Kit order code = SET-109 £16.26

SMOOTH FUZZ
As the name implies! Order code = SET-91 £12.45

SPEECH PROCESSOR
Improves the inteligibility of noisy or fluctuating speech signals, and ideal for inserting into P.A. or C.B. radio systems.
Kit order code = SET-110 £10.58

SPLIT-PHASE TREMOLO
The output of the internal generator is phase-split and modulated by an input signal. Output amplitudes, depth & rate are panel controlled. The effect is similar to a rotary cabinet.
Kit order code = SET-102 £28.87

SWITCHED TONE TREBLE BOOST
Provides switched selection of 4 preset tonal responses.
Kit order code = SET-89 £11.28

TREMOLO UNIT
Suitable for use with most electric guitars, organs and other similar instruments. Includes speed, depth & by-pass controls.
Kit order code = SET-116 £11.91

TUNING FORK
Produces 84 switch-selectable frequency-accurate tones with LED monitor displaying beat-note adjustments.
Kit order code = SET-46 £35.09

VOICE OPERATED FADER
For automatically reducing music volume during disco talk-over.
Kit order code = SET-30 £8.93

VOICE SCRAMBLER
Enables a 'garbled' version of a spoken message to be recorded or transmitted. Decoding of message is achieved using the same unit or an identical second model. Requires a 12V psu at about 30ma.
Kit order code = SET-117 £20.37

WAVEFORM CONVERTER
Converts saw-tooth waveform into sinewave, mark-space sawtooth, regular triangle, or squarewave with variable mark-space. Ideally one should be used with each synthesiser oscillator.
Kit order code = SET-67 £20.34

WAVEFORM GENERATOR
Provides sine, square and triangular wave outputs variable between 1Hz & 100kHz up to 10V P-P.
Kit order code = SET-112 £21.58

WIND & RAIN EFFECTS
As the name says! Order code = SET-28 £10.55

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Valid until end of month on cover of this magazine. Applies to U.K. C.W.O. orders over £25.00 value. Not valid with credit card, export or invoiced orders. This voucher and correct payment must accompany order. (Voucher code MM 1N.)

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More kits and components are in our lists. Prices correct at time of press. E&OE. Subject to availability.

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 projects and reviews.

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

1. The sounds of the Matinée Organ. 2. Musical extracts played on the Yamaha SK20 Synthesiser reviewed last month. 3. Examples of the basic waveforms and effects discussed in 'Guide to Electronic Music Techniques'. 4. Music and sound effects played on the Sharp MZ-80K Microcomputer. 5. Warren Cann demonstrates the Syntom Drum Synthesiser. 6. The PAIA8700 Computer/Controller. 7. Frankfurt Music Fair: the Yamaha GS-1, Electro-Harmonix Clockworks Controller.

Cassette Price: £2.45 inc. VAT and p&p.

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

1. Tim Souster 'feature' examples from his electronic music studio. 2. Electronic Dream Plant: Adrian Wagner plays the Wasp/Spider and some of his music. 3. Lowrey MX 1 Electronic Organ — the essential music complement to the review! 4. Apple Music System — polyphonic computer music. 5. E&MM Word Synthesiser — speech from our friends in Texas. 6. Fairlight Computer Musical Instrument review — because of its price, very few have heard this amazing instrument. 7. Sharp 'Composer' and 'Morse' programs. 8. Yamaha PS20 keyboard — a complete piece on this portable play anywhere instrument. 9. Vero projects: Radio/Metronome/Oscillator 10. Some extraordinary sounds from the creative David Vorhaus.

Cassette Price: £1.99 inc. VAT and p&p.

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INSTRUMENT REVIEW

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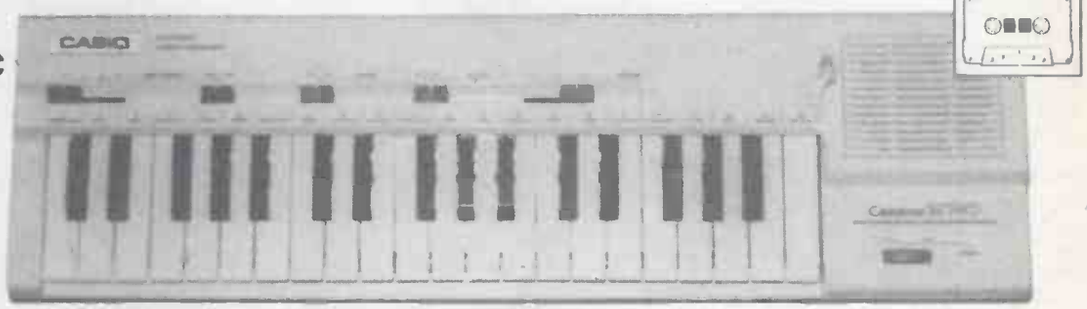
Casio MT-30 Polyphonic Synthesiser



Casio really stirred up the synthesiser industry by releasing the CT-201 and M-10 polyphonic synthesisers just over a year ago. At a price that would previously have only bought a cheap monophonic synthesiser, the CT-201 rapidly established itself as a favourite amongst bands needing a bright, digitally-clean keyboard. What isn't widely known is that both these keyboards used the same VLSI chip, the D773G, and the main difference in circuitry lay in the addition of a programming switch in the more expensive model. A certain amount of criticism was made of the limited keyboard length and small number of presets (4) in the M-10, but, for about £80, this still represented excellent value for money. Whilst Casio have upgraded the CT-201 to the CT-202, they've also replaced the M-10 with the MT-30, and I'm very impressed with what it offers for an average retail price of about £90.

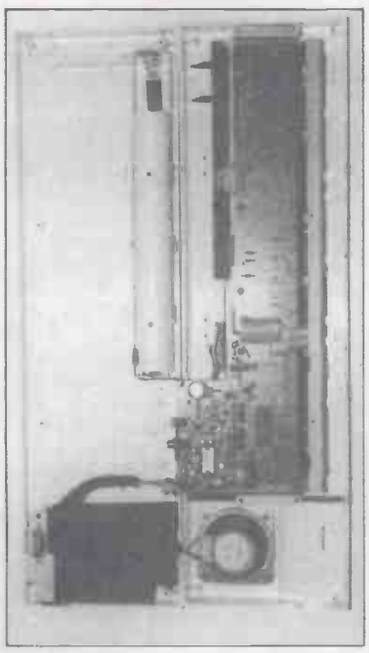
As with the M-10 and CT-201, all sound generation is performed digitally by a 64-pin VLSI chip, but this time it's a D775G, presumably an updated version of the D773G. Each of the 22 instrumental sounds have a note range of 3 octaves, but the starting point varies with the different instruments as follows:

C1-C4: Electric piano, Brass, 'Cello, Synth-Fuzz.
C2-C5: Banjo, Guitar, Harpsichord, Organ, Accordion, Pipe Organ, Violin, Trumpet, Strings, Clarinet.
C3-C6: Xylophone, Celesta, Glockenspiel, Oriental Pipe, Fuzz, Flute, Recorder, Folk flute.

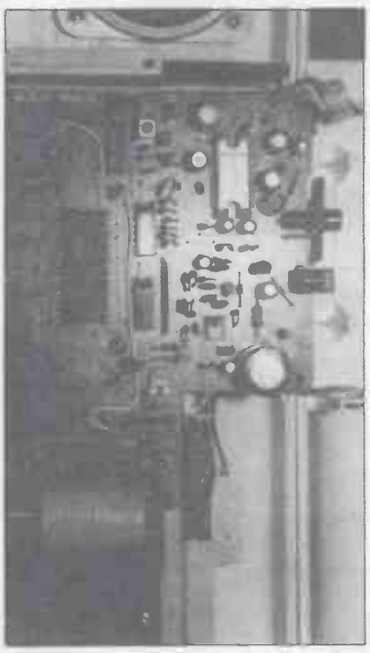
The block diagram in Figure 1 outlines the basic format of the MT-30 circuitry. The keyboard and programme control switches are encoded into the 775 by way of a scanned matrix. This matrix operates in two modes: 'play' and 'set'. The 'play' mode generates up to eight voices as a function of the depressed keys. In the 'set' mode, the last white key depressed determines the instrument sound to be loaded into the tone memory. Four sounds can be loaded at once into the tone memory and are recalled and reproduced at leisure by sliding the selector switch to the required number. The output of the 775 is straight binary, which is converted to analogue by the D to A, filtered, and sent to a power amp and the internal speaker, or to a line output phono socket.

Certain adaptations have to be made to one's playing technique, if not one's anatomy, when using the MT-30. This is basically due to the fact that the inter-octave spacing on the MT-30 is only 5½", in contrast to 6½" on the standard, i.e., non-Japanese, keyboard. I'd normally count myself as being fairly dexterous, but even my ectomorphic fingers found themselves getting wedged into tight corners when playing certain chords with mixtures of white and black notes; the biggest offenders were tetrads of E-flat or B-flat major in the left hand, which necessitated the use of inversions or some very curious changes to pianistic technique to get over such barriers to spontaneous creativity. A plus point of this reduced spacing is that Bach and other contrapuntal extravaganzas immediately become much easier - no more straining to play that tricky tenth chord.

The presets offer a good variety of sounds, but you have every right to expect that from a keyboard offering 22 instrument definitions. What you don't get, though, is 22 different instruments, as many of the instruments in each octave group tend to sound rather similar. So, don't be surprised if you don't hear any difference between xylophone, celesta and glockenspiel, or organ, accordion and pipe organ! What you do get is some sounds which really are rather good - favourites of mine are the recorder preset, which has a superb breathy quality that's really silky, and the synth-fuzz preset, which gives a good rock sound. Examples of these and others can be heard on the 4th E&MM demonstration cassette.



The insides exposed.



The D775 in close-up.

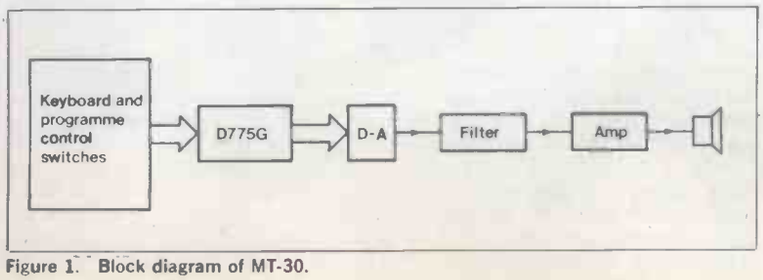


Figure 1. Block diagram of MT-30.

Two other controls allow a certain amount of sustain to be introduced and the addition of vibrato. With some instruments, the sustain isn't enough (notably strings), and, with others, it's too much, which just goes to show that all or nothing switches aren't a good thing. The same criticism could be applied to the vibrato function, but it is at least a pleasant extra and does add warmth and animation to otherwise static sounds.

A more serious gripe is that, like the M-10 and CT-201 predecessors, the MT-30 has no pitch control. This is a really strange omission when you consider that even the VL-Tone has one, but I'm pleased to report that the MT-30 was spot-on with A-440. To be fair to Casio, it should be pointed out that the MT-30 was never intended as anything other than a 'leisure instrument', and therefore a pitch control wasn't deemed necessary. For the supply of power, the MT-30 uses either 5 x HP2-type batteries (which it consumes with greed) or the inevitable AC adapter.

The quality of sound from the internal loudspeaker is adequate, in the sense that it doesn't rattle or squeak, but line connection to an external amp can be made, either by a phono socket, which annoyingly doesn't disconnect the internal speaker, or by a headphone socket, which produces a low impedance, high level signal that tended to distort with my mixer.

The deviant keyboard on the MT-30 won't win it much favour with pudgy-fingered players, but, as a 'carry anywhere' source of some very acceptable polyphonic sounds, there's no reason why it shouldn't find a lot of popularity in small studios, bedrooms, bathrooms, or anywhere else that might inspire you to grab a fistful of small but tasty notes in the middle of the night!

Dr David Ellis **E&MM**

INSTRUMENT REVIEW

Roland GR-300 Guitar Synthesiser

The word 'synthesiser' by itself is usually taken to mean one which is controlled by a keyboard; synthesisers meant to be played by musicians who are used to other instruments always have a qualifying word in their description, such as 'wind synthesiser' or 'guitar synthesiser'.

There are quite a few such devices about nowadays, and with good reason: musicians do not want to give up the techniques they have learned and swap to keyboards in order to become synthesiser players.

In addition, there are effects easily available from a guitar (for example) which simply are not possible on a keyboard without extra 'performance controls' as they are called.

The main reason for the supremacy of the keyboard as a synthesiser controller is its simplicity — each note is selected, and simultaneously played, by the pressing of one key only. A contact can then be arranged under each key to route a voltage to a voltage controlled oscillator (VCO) and to make the appropriate pitch sound.

On a wind synth, on the other hand, the notes are defined by one or more keys in combination, and sounded by blowing, so that some complexity is needed just to work out what the note ought to be. In addition, a breath operated switch is necessary to detect whether or not the player is blowing.

The Lyricon works on the above principle, and works very well, but the problems are multiplied for an instrument like the guitar. It is possible, for instance, to detect which strings are being pressed on to which frets by a simple electrical scanning, and some guitar synths employ this principle; but there are several guitar techniques which will not be picked up this way. Harmonics, for instance, where the note sounded is an octave or more above that actually fretted; and bending and finger vibrato, where once again the string stays fretted at the same place, but is stretched so as to increase its pitch.

An alternative approach is to employ a device called a pitch to voltage converter, or P to V, which works a little like a VCO in reverse. The instrument's actual sound is fed into the P to V, which sorts out which note is being played and passes this information in the form of a voltage to the VCO.

Guitars are quite difficult to trigger from in fact; as a note decays the second harmonic becomes louder than the fundamental, and primitive P to Vs have a distressing habit of leaping up an octave as the sound decays. A chord, of course, will give any pitch detector a fit of the vapours straight away: which note out of the six does it lock on to?

Early guitar synthesisers employed a six channel (hexaphonic) pickup with a separate output for each string — then the loudest string was detected and passed on to the P to V; you could still only synthesise one note at a time, of course, six oscillators and six pitch to voltage convertors being needed to produce a truly polyphonic instrument, and this is where Roland step in and the instrument in question actually gets reviewed.

Roland GR-300 guitar synthesiser.

The Guitar

Instead of giving you a hexaphonic pickup to screw to your own guitar, Roland make you buy a whole guitar with the pickup built in. The main disadvantage is that you cannot use the GR-300 with your favourite '58 Les Paul which you picked up for $30 in an Alabama pawnshop. The advantages are several — the most used synthesiser controls may be mounted on the guitar, where they are easy to alter during a performance, and the critical pickup is already adjusted and mounted for you in the best place (near the bridge, where many guitars do not have room).

One man's guitar is another man's firewood as we all know, so Roland offer four different guitars, all with normal guitar pickups in addition to the synthesiser pickup so they can be used as straightforward electric guitars via a standard jack socket.

The G-303, the one I tried, is a fairly standard Japanese style twin cutaway design with two twangy Japanese style humbuckers. The G-808 is basically the same but has its neck laminated through the body: the G-505 is Stratocaster inspired and has three single coil pickups and a vibrato arm, whilst the G-202 is also Strat shaped but has two humbucking pickups.

This is supposed to be a synthesiser review, so I will not attempt to assess the guitar except to say that it was well-made (as it should be for the price) and would not disgrace any player not afflicted with Gibson/Fender mania. In fact, the sample I played had been well used in the Roland roadshow prior to me getting my greasy fingers on it, and the strings were rather neglected; it is a credit to Roland's pitch converter circuitry that the synthesiser triggered impeccably off such a horrible signal.

Controls

The straight guitar controls are quite sparse — just a pickup selector, overall tone control and master volume which also controls the synthesiser volume. The rest of the knobs belong to the synth section: a balance control which mixes synthesised and straight guitar sound in any proportion; cut off frequency and resonance for the filter; vibrato depth, and a 'voice' switch. This enables you to feed the filter either with oscillator signal, or with the output of six independent distortion circuits, one for each string so there is no intermodulation; a very nice effect by itself. Finally, there are two touch plates, one on either side of the bridge pickup which switch vibrato on and off, or alternatively enable you to just dab a bit in here and there whilst playing. All this lot is fed via a decent (five metres) length of 24 way cable and two sturdy connectors into the GR-300 which goes on the floor like any other effects pedal.

The Synthesiser

Mere effects pedal it is not, of course, but the GR-300 does not have the same facilities as a keyboard synthesiser. For example, there is no envelope shaper at all; the synth follows the guitar's envelope, and the harder you hit it, the louder it plays. Slow fade-in 'violin bow' effects have to be done manually with the volume control, which is conveniently placed on the guitar so that you can turn it with your little finger whilst playing. Secondly, there is only one overall filter instead of one for each string, so that more harmonics are cut off the top strings than from the bass ones.

There are five foot switches along the front, with an indicator LED for each so you can see how they are set. Two of these are for pitch transposition; in addition to a master tuning control, there are two preset pitch knobs, A and B, each with a range of one octave up or down from the fundamental guitar pitch. The associated foot switches A and B can be made to work in two modes — latching, where the transposition is permanent until you tread on the switch again, or unlatched where the

transposition is only effective for as long as you hold the switch down. Pitches A and B cannot both be selected together, but the Duet footswitch brings in the guitar's fundamental pitch in addition to the transposed sound for instant single handed harmony playing; or if no transposition is selected, a slight detuning can be performed to make a richer sound.

Portamento, or glide between notes, may be added; unusually, with separate control over rise time and fall time. Six slide switches enable the player to disable each oscillator, so that the synthesiser triggers only on a limited number of strings: for example, it is possible to have a bass line derived from the low E string accompanying a straight guitar part, or a melody can be picked out from the middle of a suitable chord sequence.

Two foot switches and two knobs control modulation of the filter. The filter is sensitive to your playing, i.e. the harder you pick, the more harmonics that are let through, and the 'Sens' control determines the extent of this effect. 'Attack Time' slows down the onset of the filter sweep. One footswitch turns the modulation on and off, the other inverts the effect so that the filter sweeps down in frequency instead of up. Finally, there is a compressor which prolongs notes in the usual fashion when turned on. It is actually possible to turn the knobs with your foot provided you have not been hitting the bottle during the sound check, but in case there still are not enough controls for you there are sockets for more on the back of the unit. A pedal can be connected to the filter for wah-wah type effects, and there is provision for three extra foot switches. One switches the compressor in and out, the second cancels the glide effect if there is one set up, and the third brings in all six oscillators regardless of the string selector switches.

The G-808 guitar.

Alternatives

It is not necessary to buy the synthesiser straight away, of course; you could just play one of the guitars by itself until you have saved up for the rest of the gear. If the synth is still too much, then Roland also make the GR-100; although it plugs into the same range of guitars, it is not a synthesiser at all. Instead of oscillators, it has just the six channel distortion which is filtered in the same way as on the GR-300. There is no transposition or glide, but all the controls on the guitar except the voice switch work in the same way; so there is vibrato, rather cleverly done with a delay line which can also provide a chorus effect. I did not try out the GR-100 for myself, but at £350 the price saving does not seem worth the loss of flexibility.

Although the GR-300 is short on synthesiser features compared to a keyboard instrument, the controls provided are those that are likely to be of the most use, and have obviously been carefully thought out with live playing and the reasonably non-technical guitarist in mind. The outstanding feature of the device is its responsiveness to the player's technique; you can play it just like any other guitar without having to alter your style at all. There are a wide range of sounds available ranging from the beautiful to the grotesque, and you can be as subtle or unsubtle as you like; bend the strings, use vibrato, play it with your nose (as I once saw John Williams do on a classical guitar) and it will follow where you lead.

If you want convincing, try the GR-300 out with only the sixth string oscillator on, tuned an octave below your guitar; then calculate how much you can save by firing your bassist! Bass unemployment is not Roland's intention, of course, because they also make the G-33B bass synthesiser with a choice of two bass guitars to go with it, but it is a tempting thought; in fact, with a decent drum machine and the GR-300 you could sack your whole band . . .

Peter Maydew **E&MM**

The GR-300 is £515; the cheapest guitar (the G-202) is £299 whilst the G-303, G-505 and G-808 are £399, £425 and £499 respectively. These prices are inclusive of VAT.

Steve Howell.

THE HOME ELECTRO-MUSICIAN

With so much electronic music making taking place, E&MM looks with interest at musicians' home studio set-ups and invites possible contributions from readers

Setting up a studio is a difficult job at the best of times but if you don't possess the required qualifications or experience to join an already established organisation the only way to pursue one's musical aspirations is to go it alone. 'But I couldn't afford to get my own studio together,' I hear you say. 'Couldn't you?' I retort. I managed it and I don't class myself as rich. It's not a cheap venture but then it needn't be that expensive especially nowadays when every electronic device comes served with chips.

It all depends on your attitude. What constitutes a studio? Is it a 48-track computer mixed system with banks of gleaming microprocessed polysynths raring to go at the touch of an alpha-numeric keyboard or is it a small room in your house equipped with a few 'domestic' tape recorders, a home-made mixer and a couple of inexpensive but versatile synthesisers? Nice though the first idea may be (there's not many of us who haven't drooled over the equipment listing on the back of Tomita's albums) if you have the creativity to produce good results with your smaller set-up then think how good they will be when you unleash that creativity in the studio of your dreams.

My studio is quite a modest affair by some peoples standards, but using it I have written and recorded the music for some twelve plays (including the first ever stage production of 'The Hitch-Hikers Guide To The Galaxy' which was toured around England and Wales) and two documentary/information type films. I've also appeared on BBC radio in connection with my musical activities and have appeared in a BBC2 documentary about electronic music with Tim Souster. I've used the computer controlled electronic music studio at Cardiff University and have given lectures on synthesisers and their use. I've had the good fortune to be involved in a whole host of other activities in this field too numerous to mention, so it just shows what can be done with a small set-up.

The way I record is very straightforward. I record a backing track on one machine and then transfer that to the other machine whilst adding another synthesiser part, mixing and balancing levels etc. as I go. This may not seem a very good system but by recording at as high a level as possible and by judicious use of EQ the results can be surprisingly good. By doing this I find I can 'bounce' between the two tape recorders quite a few times. I normally do about four overdubs but I have done as many as nine and the results were fine (honest!). The one facility I do miss by not having true multi-track facilities is the ability to 'drop-in', but by careful planning of overdubs (i.e. laying down as many parts as possible in one take), it's as good as 4-track recording and by the time I've spliced the tape up a bit the results can be very good indeed.

Another trick I use to broaden my sound is to use echo and flanging. I feel that these two effects are as important a link in the synthesiser chain as the filter or the envelope generator. Synthesisers, when plugged in directly to a mixer, are very flat and have no spatial placement at all. A miked up instrument always has a break in the process — that is, the distance between the instrument and the mic however near or far that may be. A synthesiser does not have this break and so requires spatial enhancement more than any other instrument. If you use echoes at different speeds within one piece of music you can create even more depth — just listen to Larry Fast or Tomita to see what I mean. You can also use repeat echo to create some startling rhythmic effects, especially if you split the straight and echoed signal left and right in the stereo image.

But before all this, of course, I consider it important to have a good basic sound. Effects such as those I have mentioned can beef up a poor sounding synthesiser but this is not the same as starting with a good sound which can be further highlighted by using effects. I have chosen my instruments very carefully for their sound and their versatility. The ARP Axxe, although a one-oscillator device, is capable of producing a wide range of tones, partly because it has the unique ability to connect every parameter to each other simultaneously and so is as good as a small modular synthesiser. The Wasp has a strong Moog-like quality and for the price is 'fat' sounding and, when used with the Spider digital sequencer, is capable of generating rhythmic patterns. The Boss programmable rhythm unit I have is an ideal partner for the Electronic Dream Plant set-up as you can drive the Spider off the Boss's clock output. The snare drum is crisp and the bass drum is tight and punchy and, of course, the fact that it is totally programmable means that you can create the rhythm you want instead of having to rely on those awful 'mambas' and 'sambas' offered by preset rhythm machines. The Boss also has a programmable accent with which you can programme a certain amount of 'feel' into your drum pattern which gives even more scope. My polyphonic keyboards were also chosen for their versatility. My newly acquired Yamaha PS20 (reviewed in E&MM's June issue) has a wide range of polyphonic sounds which are ideal for some of the music I write. It also has an arpeggiator which flies up and down the keyboard picking out the notes you are depressing *a la* Jupiter 4. When used in conjunction with the sequencer (you can trigger the Spider off it) it really is a remarkable effect. The Crumar Performer has a silky string sound which can be modified by its own three-band graphic equaliser to produce a vast range of orchestral sounds (including a beautiful Tomita-like choir effect) and it also has a very versatile brass sound which, when used with the instrument's delay vibrato, can give some great polysynth sounds. It also has an output for the straight sawtooth oscillator signal which I put through the ARP (I've modified the Crumar's gate output so that it can trigger the ARP) for even greater versatility. All the instruments go into the Prokit mixer kit where they can be individually echoed or flanged (I use the mixer's foldback send as an effects send to the flanger).

As you can see, I have a simple but effective system which works well for me. You don't have to go to such lengths for your studio; there are a lot of really excellent synthesisers on the market which are very versatile and which would be a good investment. Nearly all of them are fitted with control voltage and gate in/out sockets and so would form the basis of your studio, allowing you to expand when you needed to or could afford to. There are devices like the Teac Portastudio (although I feel a second-hand reel-to-reel 4-track would be a better buy if you could get one) which bring real multi-track facilities within the reach of most people who have the mind and the inclination to get on with creating electronic music.

But despite the vast array of electronic gubbins, you may or may not possess the most important factor - creativity. Most people can twiddle knobs, make noises and record them . . . there is little musical skill in that! A good electro-musician, however, can make good electronic music with just one fuzz box and a three-head tape recorder, which brings me back to my first point: you don't need banks of the latest technology to produce good, creative music. With a bit of ingenuity, amazing results can be achieved with next to nothing. In fact, minimum resources can often improve one's creativity. I can't deny that I want a modular system with a computer controller and an 8-track, but I must be realistic and realise that, for the present time at least, these are beyond my means but I will happily continue to make the best of what I have and exploit each device to its full.

Steve Howell **E&MM**

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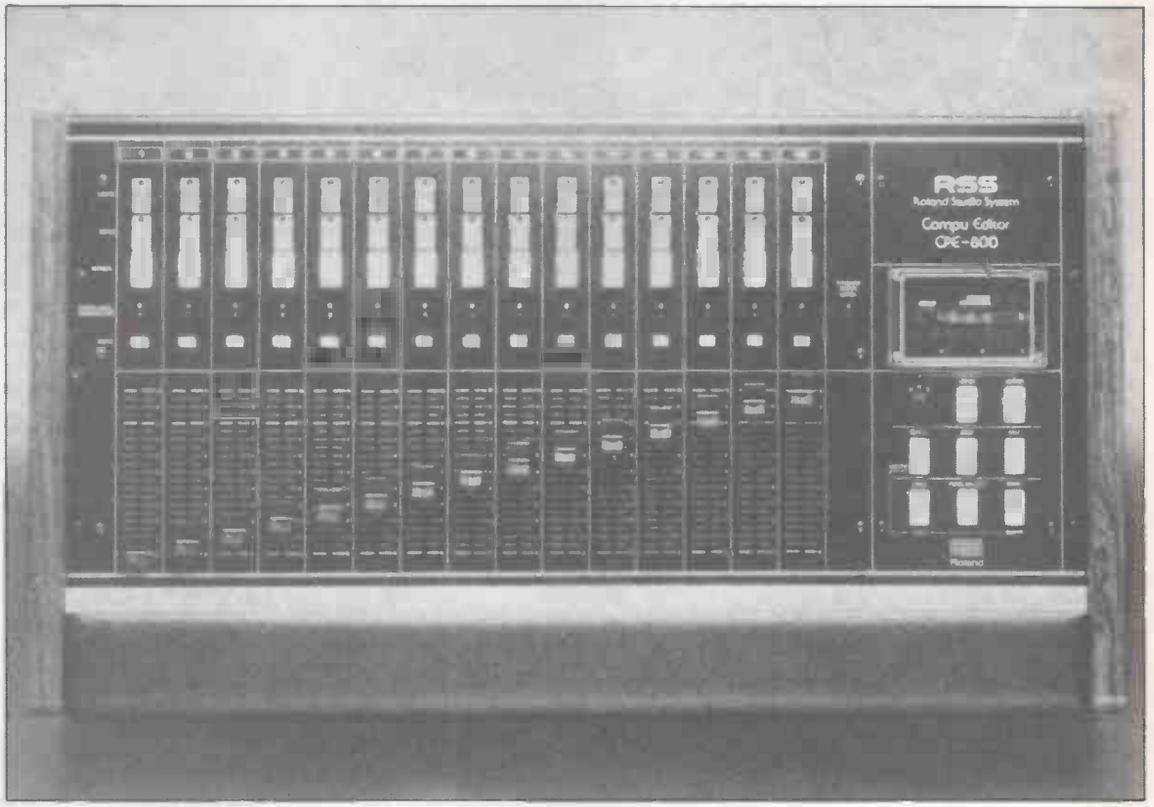
INSTRUMENT REVIEW

Roland CPE-800 Compu-Editor

When working in studios with an automated mixing desk, it's easy to be mesmerised by the sight of faders moving up and down without any human intervention, almost like some Great Producer in the Sky trying to taunt us to do better with some celestial dance of the faders. That impression shouldn't detract from the fact that an automix facility is one of the most important developments in studio technology since the multi-track tape recorder. This is particularly true in the case of much recent electro-music, where a complex interplay of sounds and textures can only be achieved with non real-time techniques of sound manipulation. However, the cost of a typical automix facility has generally put it in the realms of fantasy for all but the top-flight 24-track plus studios who can afford the £100,000 or so for a Neve computer-mix console. That's until now, for the CPE-800 Compu-Editor really provides an economic alternative.



The CPE-800 control unit.

A Break With The Past

Roland's studio equipment is a recent addition to their range, but hitherto has been confined to 'effects' (the Roland Rack) or microprocessor control of analogue synthesisers (the MC-8 Micro-Composer), rather than units directly concerned with the recording and playback chain itself. So, the Compu-Editor is something of a break with the past, and its existence reflects initiative on the part of Roland in America rather than Roland in Japan. In fact, the original American design was conceived for computer-controlled mixing of a multi-keyboard set-up, but the gestation period resulted in a much more generally applicable unit. A valuable aspect of the Compu-Editor is that it is designed as an update for any existing studio. With a RSD 16 into 4 desk and a TEAC 8-track machine, the Compu-Editor instantly adds the sophistication of computer-mixing.

The unit has been out for about 9 months, but it has only been available in this country for the past few months. At the moment, the Compu-Editor is being sold by only Roland themselves and Turnkey. Whilst it normally retails for around £3,500, Turnkey are offering it at a considerably reduced 'special price', and will also set it up in the studio of an interested customer, in order to give them an in situ demonstration of its capabilities.

Design

The Compu-Editor is split into two units: firstly, the CPE-800 control unit which houses the 15 faders, the microprocessor, 32K of RAM, function controls, time and memory displays and controls, and a SMPTE time code generating program with read and write capabilities; secondly, there's the VCA-800 unit which consists of 15 VCAs receiving control voltages from the control unit and, typically, interfaces with a mixing desk via individual channel outputs and monitor returns. The faders operate by changing the DC voltage fed to opto-isolators. The light-variable resistance in turn adjusts the gain of a subsequent amplifier. Each resultant voltage is fed to a de-multiplexing A/D converter which translates the 0-10 V fader setting into binary code, representing 128 steps from +9 dB (10V DC) to -36 dB (1V DC). 110 steps of 0.39 dB provide more resolution in the working area of the faders.

Since brightness changes in an opto-isolator are not instantaneous (off/on takes 10 msec, on/off takes 100 msec), control of the amplifier passes from the opto-solator to a FET circuit for instantaneous gain switching. The fader position code is stored in the onboard RAM and this can be read, edited, or saved onto tape as the situation dictates.

The CPE-800 generates the SMPTE time code used world-wide and this enables the control unit to lock onto and synchronise fader movements. The data resulting from addressing pages of RAM relevant to a particular mix is a multiplexed after D/A conversion and the 15 control voltages outputted via multi-core to the VCA-800 unit. The VCAs in this unit also work around opto-isolators, and, unlike many other VCAs that demonstrate audible level clipping, these modules are really quiet. The excellent specifications for the VCA-800 attest to this: -95 dBm for noise, 80 dB (10 kHz) for crosstalk, and 15 Hz to 30 kHz - 1 dB for frequency response.

Use

To start the automix, it's necessary to transfer the SMPTE code from the Compu-Editor to a spare track on the multi-track machine that you're using. The timing track is then fed back to the Compu-Editor, and, if the two machines are started at about the same time, the Compu-Editor locks onto the SMPTE code ensuring sync with the audio tracks on the multi-track. On selecting 'start', the time display shows the time read from the tape track in hours, minutes and seconds.

In addition, there's a memory percentage display that registers the amount of available memory left for mix storage. In order to program a mix, the 'write' mode is selected on whatever channels you wish to work with. Engaging the 'start' button results in the SMPTE code clocking the display upwards and puts the operator in the real-time mix record mode. As the faders are brought up, so the memory display starts to count down. The rate at which the memory is used up is totally dependent on the number of channels that you're using and the activity of the faders. Thus, if you were doing a manic mix-down for a piece of post-Stockhausen electronic music, you'd probably find yourself (or, rather, the Compu-Editor) running out of mix time pretty rapidly. On the other hand, if you elected just to have a simple fade-in and fade-out, and very little else moving during the course of a mix, then you could theoretically go on for about 100 hours!

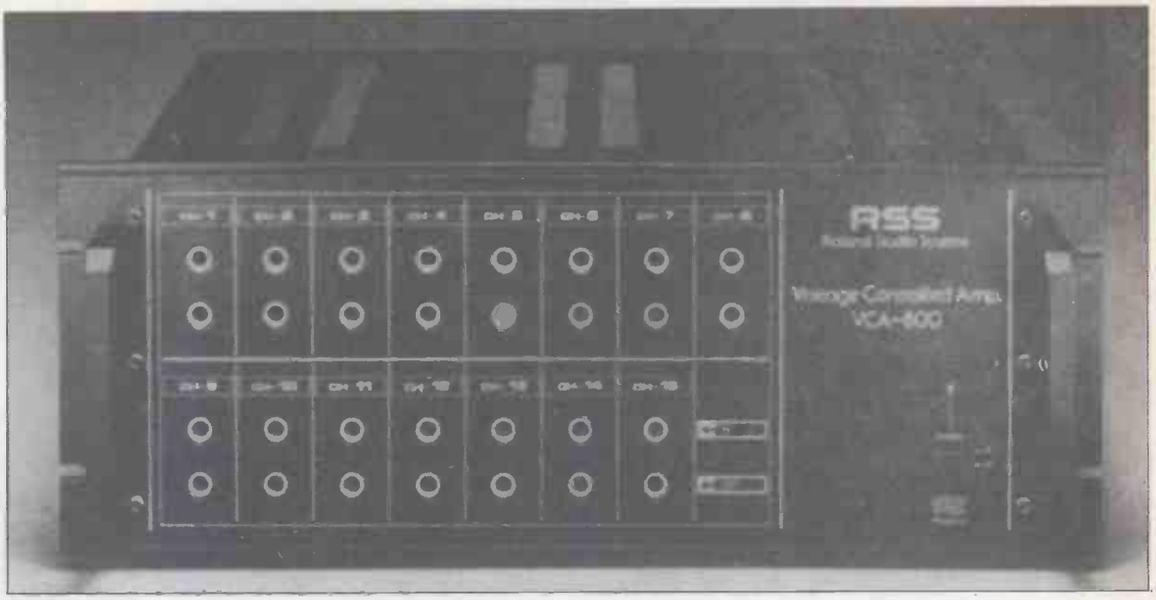
The mix can either be done in one sitting (true real-time mixing) or as a number of mixes spread over the 15 channels (overdub mixing). In the latter case, the tape motion is halted after working with an initial set of faders, 'stop' engaged to process data and reset the CPE-800, and the tape rewound. The next group of faders is then selected with 'write', and the tape recorder and Compu-Editor started again. In addition to fader data, the 'write' mode will also allow a 'mute' instruction selected on particular channels to be sent to RAM. The 'mute' function switches off the channel FET and the resultant 0V DC

is converted to the lowest fader code.

Having finished a mix, the unit is readied for playback by engaging 'read' on all channels. Pressing 'start' results in data being read from RAM and relevant control voltages being outputted to the VCA-800. Since the faders don't actually move when a stored mix is read, a couple of level comparators are built into each channel for LED indication of whether the fader position is higher or lower than the setting being recalled from memory. This facility also enables the operator to rewrite mix data by using the comparator LEDs to match levels with a particular point on the previous mix and then 'punch in' a new fader movement.

The contents of onboard RAM can be saved onto cassette and loaded back, though, with a normal mix, it's possible to get about 4 different mixes in the internal memory without having to dump onto tape.

By connecting an oscilloscope to X and Y gain output sockets on the back of the CPE-800, it's possible to see a fader position display that graphically shows the setting of all 15 control voltages at once. Although not required in the 'manual' or 'write' modes, this facility is fairly essential when reading a mix from memory, especially if one wants some idea of whether an increase in dynamic level is due to an increase in performer dynamics or the action of a fader. During playback, it may often be necessary to override a particular fader, i.e., returning to real-time control, and a 'manual' key results in the position of a particular fader setting the gain signal to the VCA-800, regardless of the computer mode.



The VCA-800.

As well as the SMPTE mode, there are also two other modes of timing: firstly, the 'internal clock' mode, which results in the timing sync being derived from the Compu-Editor itself, rather than from a timing code on the multi-track, and also allows the use of a 'halt' function for event recording of a complex mix; secondly, there's a 'scene' mode, which allows scenes or patches to be set up and recalled in sequence. The three modes, 'SMPTE', 'internal clock' and 'scene', are selected by a timing mode select switch, which, for some curious reason, is situated on the back panel of the CPE-800.

Aside from the automation update application of the Compu-Editor in budget studios, there's also no reason why it shouldn't find favour with larger studios wishing to expand computer-mixing facilities. Furthermore, the fact that the CPE-800 provides control voltage outputs means that it is equally suitable for, say, providing a computerised lighting board in theatres.

Thanks to Andrew Stirling of Turnkey for demonstrating the Compu-Editor. Anyone interested in knowing more about this excellent unit, or seeing it in action, should contact him on 01-440-9221.

Dr. David Ellis **E&MM**

JABBERWOCKY! ...

. . . or is there more to this than meets the ear?

by Alan Davies

In this article we take a look at some methods of electronic speech production and manipulation and investigate some applications of this technology in the recording industry and the rapidly expanding market for the 'talking chip'.

'Twas brillig, and the slithy toves
Did gyre and gimble in the wabe;
All mimsy were the borogoves,
And the mome raths outgrabe.

'Beware the Jabberwock, my son!
The jaws that bite, the claws that catch!
Beware the Jubjub bird, and shun
The frumious Bandersnatch!'

From 'Jabberwocky' - Lewis Carroll Reproduced by kind permission of Frederick Warne Publishers.

Undeniably some of the most interesting and frequently employed special effects in recent popular music have been various treatments and subtle uses of the human voice and the qualities which it possesses. A very good example of the use of the untreated voice is David Bowie's 'Ashes to Ashes'. A close examination of this reveals an extremely compelling use of background voices which seem to half chant, half whisper the words of the song. This has the effect of drawing the listener's interest to it just in the same way as two people whispering across the room arouses a curiosity as to what is being said. This ploy commands attention and is certainly a powerful musical 'hook'.

Another common effect which trades upon vocal qualities is the ubiquitous Wah-Wah pedal - creatively used in the film music 'Theme from Shaft'. Related to this are the 'Mouth Tube' and the much more sophisticated 'Vocoder'. One of the earliest examples of the use of the latter's sound in popular music was 'Sparky's Magic Piano'. More recently ELO's 'Mister Blue Sky' and television's talking robot 'Metal Mickey' have both used this equipment.

But why this fascination with vocal effects? To explain this it is important to appreciate the way in which the human ear responds to sounds. Recent research has shown that the hearing system is not only sensitive to the frequency and amplitude of an incoming signal but also to the way in which both these parameters vary temporally. For example, if a pure sine wave (no harmonics) of constant pitch and amplitude is played to a listener then he soon tires of this - the ear becomes fatigued by the stimulus. If however the signal is mildly frequency modulated (i.e. a slight vibrato introduced) at a rate of say 8-10 Hz then the ear is able to sustain a greater exposure to this before fatigue sets in. The same principle applies to the introduction of amplitude modulation (tremolo): in both cases the incoming signal is more interesting to the ear. If the principles of frequency and amplitude modulation are now extended to waveforms having much higher harmonic contents (such as a ramp wave) then this is even more interesting as modulations of the fundamental then produce more complex modulations of the harmonic structure resulting in an extremely 'active' sound. This discussion tends to suggest that there are receptors within the auditory system which are 'tuned' to detect both frequency and amplitude variations in an incoming signal. Indeed it has been shown that they are even capable of determining the shape of the modulating waveforms! Thus it is transients within a sound which are important to maintain interest and also very important when it comes to the recognition of, for example, musical instruments or speech.

This may be easily seen when you try to simulate the sounds of conventional musical instruments on a synthesiser. The problem arises from the fact that it is very difficult to introduce sufficient variation of both frequency and amplitude into the waveforms produced. With sounds of short duration then it is just about possible to deceive the ear but with any sustained sound such as the imitation of a held violin or oboe note then the ear is able to detect the too regular nature of the waveform and labels it as electronically generated. With the advent of the new generation of computer synthesisers (such as the Fairlight CMI) then the real-time control of frequency and amplitude parameters is possible to a very fine degree but it is still difficult to produce a really convincing 'held sound' - the waveforms are still too 'perfect' and do not possess the unpredictable irregularities common to all natural sounds.

So, the human ear is highly sensitive to *changes* in an incoming signal and this is a clue as to the power of the human voice as a communicator and also its magnetic attraction when used for special effects. There is no more flexible sound generator known to man than the human voice. It is capable of extremely precise amplitude, frequency and harmonic control over a relatively wide range resulting in a vast repertoire of expression.

How is the human voice able to achieve all this? Let's take a closer look at the way in which speech is produced and the reasons why certain sounds are described as possessing a 'vocal character'.

Speech is composed of two main component sounds:

(1) VOICED SOUNDS. These are produced when air from the lungs is forced between the vocal chords, which are situated in the windpipe, causing these membranes to vibrate and a pulsating column of air to enter the mouth and nasal cavities. The fundamental pitch of the resultant note is determined by the length, thickness and tension of the vocal chords.

(2) UNVOICED SOUNDS. If the air from the lungs is not forced through the vocal chords but simply expelled through the mouth then unvoiced sounds such as 'f' or 'h' are produced. These are very similar in nature to the sounds which may be produced by the filtering of a 'white noise' source.

The shape of the mouth and the nasal cavities determines the character of both the above types of sound - they act as complex filters, the response of which is variable by altering the shape of the mouth. (Try vocalising the sound 'ah' and then slowly altering the shape of the mouth and listen carefully for the changes in the harmonic structure which results from this. All the vowel sounds can be produced in this manner). Precise variations are obtained by movements of the tongue and lips which alter the resonant features of the filter system, creating areas in which certain frequencies are boosted and others cut. The ranges in which frequencies are boosted are known as formant bands (which are also present in the resonant structures of musical instruments and largely account for their different sounds - each instrument can be said to have its own formant 'fingerprint'). The lips play a particularly important role in the production of sounds which may be distinguished by their dynamic amplitude characteristics such as the percussive attack transients in sounds such as 'p'.

Overall then, the voice may be regarded as a complex sound generating instrument consisting of an amplitude and frequency controlled oscillator (vocal chords and lungs), noise generator (lungs) and a set of formant filters (mouth and nasal cavities). Viewed in this light it would seem that the basic ingredients required for voice production are available on a conventional music synthesiser and it poses the question as to the feasibility of producing vocal sounds using conventional synthesis techniques. These would involve using a voltage controlled oscillator to simulate the vocal chords (ensuring that the waveform produced is sufficiently rich in harmonic content, e.g. a pulse wave) and a noise generator for the unvoiced sounds. Circuitry would be required to switch back and forth between these two sound sources depending on whether voiced or unvoiced sounds were desired. For the filtering section, a bank of voltage controlled bandpass filters could be used each tuned to a quarter or third of an octave apart, covering the area of the audio band in which speech components are most prominent (approx. 150-8000 Hz). The array of filters would be similar to those employed in a graphic equaliser except that those of course are not voltage controlled. If you possess a graphic equaliser with sufficient frequency discrimination between its bands - preferably a 20 channel unit - then you can have a go at simulating various vowel shapes on it by using a pulse wave as a signal source and adjusting the slider controls to approximate the outlines of the frequency spectra of the vowel shapes shown in Figure 1. Interesting backing sounds for songs may be produced in this way especially if the output from the equaliser be passed through a chorus unit producing not just one vowel sound but a multiple effect.

Thus far the possibility of speech production using conventional synthesis techniques seems on the cards. However, it is when considering the extremely complicated control voltages which would be required to manipulate the filter bank that we come up against the main snag with this system.

How can we overcome this problem? One possibility is to store the control voltages digitally resulting in a hybrid analogue - digital speech synthesiser. Control voltages would be stored in ROM (Read Only Memory) and a microprocessor could read these out and convert them via a D/A

(Digital to Analogue) converter into analogue voltages for the filter bank. This would enable a limited vocabulary of words to be produced governed by the storage capacity of the ROM.

A slightly different approach to speech synthesis and one which is now becoming more commonplace is the entirely digital system. This in some ways is an extension of the one described above, in that the components of words are stored in ROM. Now the data stored is such that when read out and fed through a D/A converter, the analogue voltage produced is no longer just a control voltage to be applied to a filter bank but may be immediately fed to an amplifier and will produce the desired sound of say a vowel or consonant. The beauty of this system is that instead of having to store lots of control voltages - up to 22 for each sound in a large hybrid system consisting of 22 bandpass filter channels - it is now possible to store less values for the same resultant sound. A further extension of this principle leads to even more compact storage of words.

Consider the following:

better; batter; matter; match; fetch; mud

It is possible to divide these up into component sounds:

better	-	(1)beh	(2)tur
batter	-	(3)bah	(2)tur
matter	-	(4)mah	(2)tur
match	-	(4)mah	(5)ch
fetch	-	(6)feh	(5)ch
mud	-	(7)muh	(8)d

From these individual components it is now possible to make new words such as:

fetter	-	(6)feh	(2)tur
batch	-	(3)bah	(5)ch
bed	-	(1)beh	(8)d
bad	-	(3)bah	(8)d
mad	-	(4)mah	(8)d
much	-	(7)muh	(5)ch
fed	-	(6)feh	(8)d

etc.

As may be seen, an extension of this system will result in a large vocabulary being available from relatively few component parts. This is the method which is used in various devices such as the talking calculator or spelling game or in anything which uses a 'talking chip'.

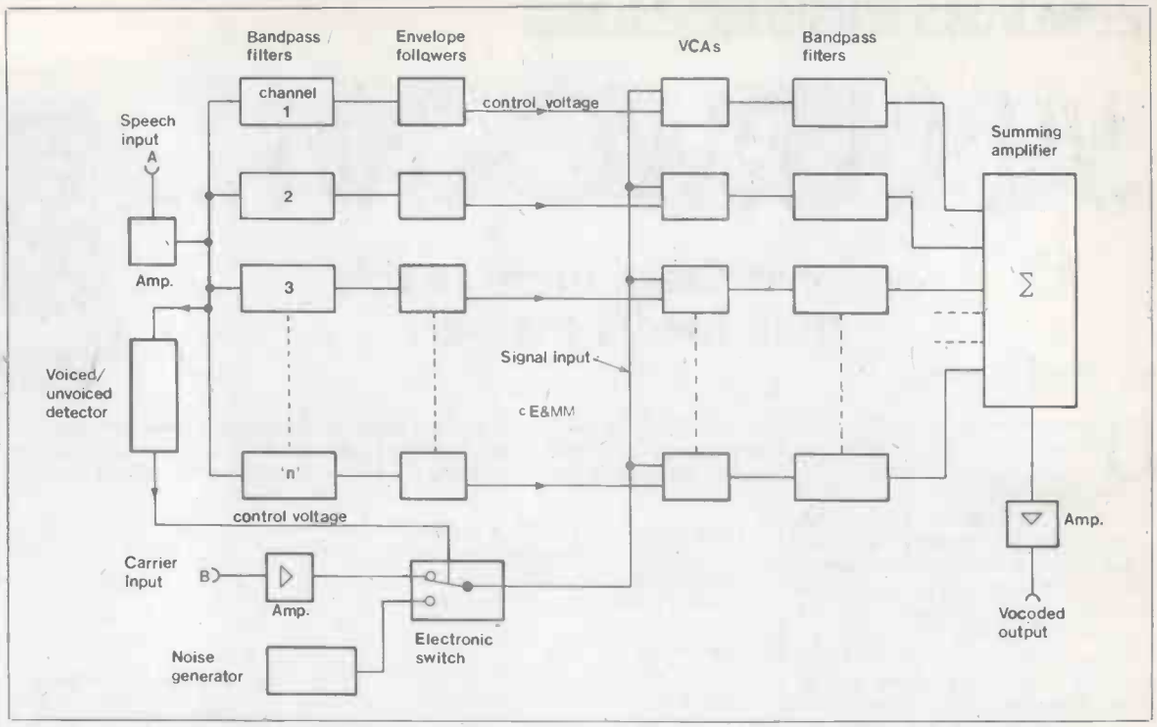


Figure 2. Block diagram of a typical vocoder.

So much for methods of producing speech 'from scratch'. Let's return to the topic of vocal special effects. These make use of an existing human voice and subject it to different forms of electronic processing. One of the most obvious of these is of course the addition of either reverberation or echo. Another is the use of a frequency-shifter to generate the effect of two voices singing together a fixed interval apart. But perhaps one of the most popular vocal effects units is the vocoder.

Vocoding or VOice-CODING is not a new concept. Indeed the original idea was conceived before the Second World War. There was interest in Germany in the thirties due to the military potential of the unit for encoding secret messages. The first person to use the term vocoder to describe a commercial unit was an American called Homer Dudley who in 1936 devised a machine for the compression of the bandwidth of speech for transmission purposes. The modern vocoder still operates on the same principles, namely that of the real-time superimposition of speech onto a 'carrier signal' -nowadays this usually means a musical instrument.

Utilising this system it is possible to make almost anything speak from a guitar to a full symphony orchestra.

The way in which the unit works may be seen by refering to the block diagram of the circuitry of a typical vocoder (Figure 2). This is somewhat simplified but gives an overall view of the processes involved. Speech is input at point 'A' and is then split up into discrete frequency bands by a series of bandpass filters. At the output of each of these there is an envelope follower which produces a DC voltage proportional to the amplitude of the signal present in that particular frequency band. The bank of bandpass filters thus produces a series of control voltages which precisely follow the frequency spectrum of the incoming speech signal. These control voltages are used to control a bank of VCAs (Voltage Controlled Amplifiers) as shown. Connected to the signal input of each one of these is the 'carrier signal' (e.g. guitar sound) which enters the vocoder at point 'B'. This carrier is used for the production of the 'voiced' portions of the speech and a noise generator for the 'unvoiced'. The circuit which selects either 'carrier' or 'noise' is the 'voiced/unvoiced detector'. This compares the relative levels of high and low frequencies in the incoming speech signal. When there is a higher proportion of frequencies above 4000 Hz than below, the noise generator is switched in as the component of speech being input at that moment will be 'unvoiced'. The outputs of the VCAs go to an identical bank of bandpass filters to those used for the analysis of the incoming speech signal. Therefore, the control voltages derived from the speech input now determine the amplitude of each frequency band in the carrier signal allowed through to the output summing amplifier. The speech has therefore imposed its frequency spectrum on the musical carrier. Result - talking music!

The combination of the transient nature of both speech and music which this unit affords provides a formidable tool for the making of aurally arresting sound effects which if used sparingly will always demand the listener's interest.

So, we have now considered some methods of speech production and processing but what of this Jabberwocky? Perhaps, when it comes to effects, it's not so much what is said but the way it sounds which is important!

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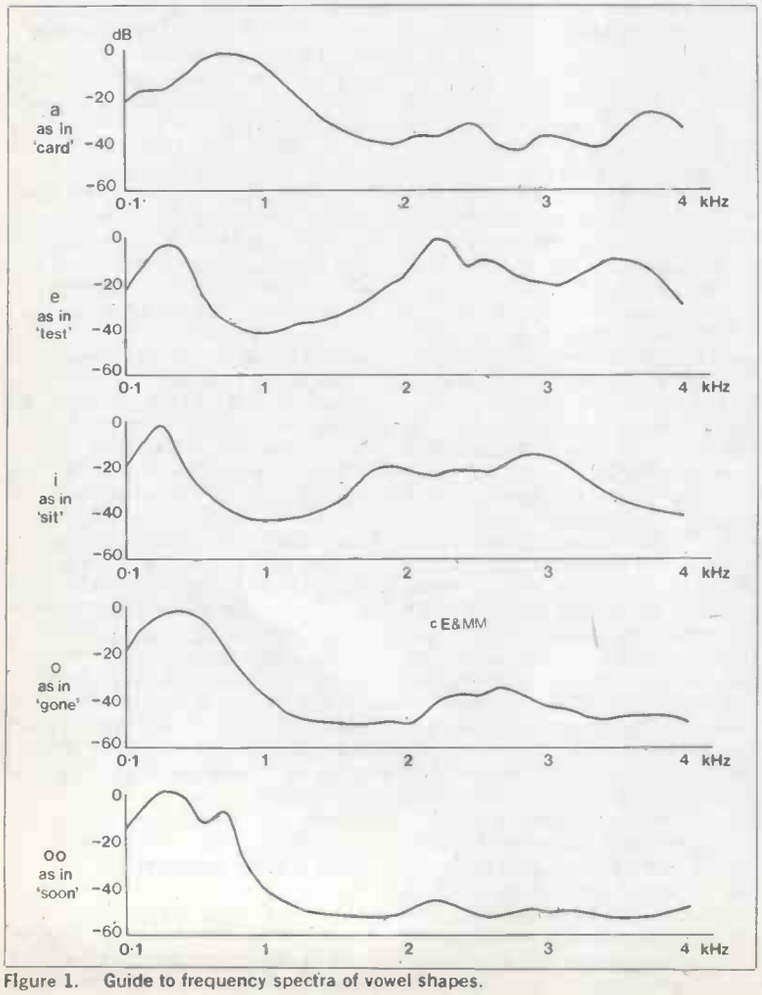


Figure 1. Guide to frequency spectra of vowel shapes.

Hot Wiring your GUITAR

Adrian Legg

The FTPA41's big brother and its possibilities have to wait a little longer, as amidst the mail I found a couple of requests for information. Firstly, to Mr. Moore in Yorkshire, my apologies for the delay - life is currently hectic. I have tried a passive mid-range idea for bass or guitar, and so far it's useless. My brainy colleague, Dave Petersen, hopes to get to an active unit design that might suit as soon as he gets out from underneath a pile of work, and I think I can suggest some useful alternatives in a future article where I shall look specifically at bass wirings.

Meanwhile, a brave beginner in Tyne & Wear is about to buy his first soldering iron and get stuck into his guitar. Courage brother, if you can spell reasonably, and can thread a needle, then you have sufficient wit and dexterity to wire your guitar any way you like.

A couple of thoughts on the iron. When I first started wiring guitars and melting my first capacitors, I used a little 15 watt Antex. As it wasn't very hot, I damaged fewer components than my fumblings deserved. On the other hand, the iron wasn't hot enough to solder to pot casings. A 17 watt alternative to this is available and while a beginner will find this useful as technique develops, more heat will be needed for proper shielding; like soldering on to copper foil, pot casings, string earths and so on.

My regular iron in my home workshop is an industrial type solder station with a transformer and interchangeable elements. I use a 370°C for general work on guitars, a 430°C occasionally for heavier stuff-earthing and so on, and a 315°C for light work like trying out different capacitor values on taps or pots. It's a fairly expensive set-up, and would be hard to justify for occasional work or a one-off job.

Antex make a 25 watt iron which they say has a heat capacity equivalent to that of a 40 or 60 watt conventional iron. I would advise a beginner to use a well known make such as this rather than to take pot luck in a bubble-pack D.I.Y. store or spend the earth on a professional set-up which could collect more dust than wear. This 25 watt iron is also available as a kit with a stand and some general advice on soldering. I think a stand, and the accompanying bit of sponge for cleaning the tip, is an absolute essential.

Desolder braid will also prove useful to the beginner, as in the early days of soldering, much excess solder may be splashed about. Desolder braid can be used to clean up mistakes simply by placing the braid against the solder you wish to remove, and heating it with the iron so that the solder soaks into it. I have found clamping action surgical forceps extremely useful for work in and on guitars, both from the point of view of poking a bit of wire and iron into a confined space, and from the point of view of heatsinking components and thin pick-up conductors. A good medical supplies house will usually stock a cheap line that will be suitable. Alternatively, smooth grip pliers will do. Personally, I prefer the clamping forceps because you can let go and leave them attached to the work.

The specific query from our friend in Tyne & Wear concerns the possibilities offered by a pair of Lawrence L 500's and a couple of push-pull pots.

The L 500's first. I first came into contact with these pick-ups a while ago when I was asked to look at them for another, sadly defunct, publication, and I enjoyed them very much, but found them a little too limited tonally for my own purposes. They are covered, along with Schecter three conductors, in my forthcoming book "Customising Your Electric Guitar". The L 500 is a rich, bar type high power

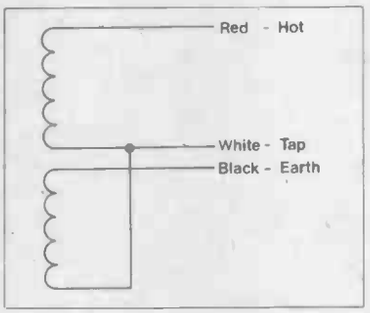


Figure 1. Lawrence L 500 wiring.

humbucker which, set up right, will deliver the sort of full sound favoured by heavy metal freaks all the time, and most of us (not ashamed to admit it) now and again. The unit is wired three conductor and shield for overall pick-up phase reverse and coil tap. The ones I saw were sealed in epoxy, so it was not possible to add another conductor, nor did I find it possible to check out if the coils were wound in opposite directions or simply linked out of phase. I shall assume, for the sake of the diagrams here, that the coils run in the same direction and link out of phase - the effect using these colours will be the same either way. In Figure 1, you can see that it would be logical to take red as hot, black as earth, and white as the tap wire. Lawrence recommend tapping to earth via a capacitor, and if memory serves me right, the value is .02uF. It is (or was!) claimed in the accompanying wiring information sheet that this retained the humbucking character of the pick-up when tapped. I have said before, and must repeat, that this is not wholly correct. The .02 uF earth tap shaves off the treble frequencies from one coil, and thus as far down as the capacitor threshold at this impedance, the pick-up is effectively single coil, and thus normal single coil noise will be present from the highs down to this level. Below that level, some hum cancelling will occur. Thus, if you were to use .05 uF as tap capacitor, the background noise would extend to a lower frequency than if you used, say, .01 uF. Obviously, there could be quite con-

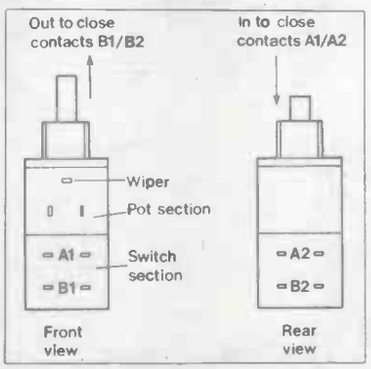


Figure 2. Push-pull switched pot connections.

siderable tonal variation. The value of a partial earth type tap via a capacitor is undoubted in terms of avoiding volume drop on switching from series coils to tapped mode, and it is possible to achieve some nice tonal variation and still retain enough power to distort an amplifier fairly healthily.

It is well worthwhile experimenting with different value tap capacitors as tonal results can vary quite considerably. During the prototype work for the circuit in the Vox Custom 25, I found that I could achieve a very passable "out of phase Strat" tone on a rear humbucker by tapping the coil nearest the bridge via one value capacitor on a 24¾" scale, siting the pick-up very specifically, but needed a wildly different value to achieve the same result on the same pick-up in the same place on a 25½" scale. I also

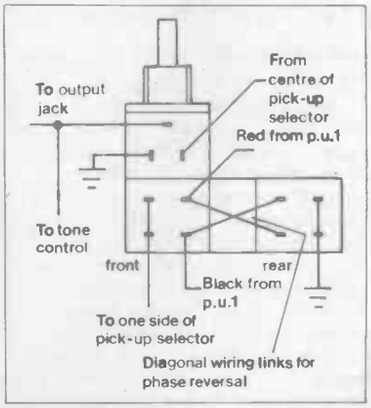


Figure 3. Pull switch used as phase reverse (on volume control).

found that slight variations in capacitor value could have the effect of moving the peak point of this tone from one string to another, and eventually settled on a value that landed it smack on the third, which is where the classic back and centre mix on the Strat shows to its best advantage anyway. Whether or not you can achieve this with a Lawrence I cannot say, much depends on your guitar's physical characteristics, and I do not feel that the Lawrence is as versatile as the Dimarzio X2N's which I invariably favour. However, experiment will certainly lead you through some interesting tones. Putting a couple of different values at a time into the circuit via a temporarily mounted (break out the P.V.C. tape) SPDT will give you a helpful A-B test facility. If you really get interested, mount up all the values you want to try on a double tag board, get yourself a couple of wires with hooded crocodile clips at each end, and try different values at different points in the guitar circuit. It used to be said that guitarists couldn't hear the difference between different value tone control capacitors - don't believe it.

Meanwhile, back at the specific query, Figure 2 shows the back and front view of an Allen-Bradley push-pull pot. The top section is the normal rotary variable resistor, values available that I know of are 250k ohms and 500k ohms. The pot has attracted criticism in that the rotary motion can feel too loose for some tastes, and that having a nylon track, it can develop a static crackle. I have used one on an experimental base for some time now and have had no problems, but I do not like them for guitar as I suspect that they are linear (I have no confirmation or otherwise of this) as I cannot achieve the sudden sharpening up with a 1nF bypass capacitor that I can with, say, the Dimarzio 1M ohm or 500k ohm pots. I could argue the value of audio pots in other situations; but I have had excellent results with a 250k ohms linear pot for tone.

Whatever, the bottom half of this useful little beastie houses two pairs of contacts. Pull the pot shaft out and the lower pairs make, and the top pairs break, push it in and the reverse happens. Which reminds me of the time Fender first brought out a pull-out top boost on the Twin - for months people were wandering around hopefully pulling the knobs off amps! A similar thing happened to guitars briefly when the Schecter custom guitars made their debut.

Figure 3 shows how to wire it up with a Lawrence for pick-up phase reverse and volume in a one volume, one tone and three-way selector guitar, with the pot as volume.

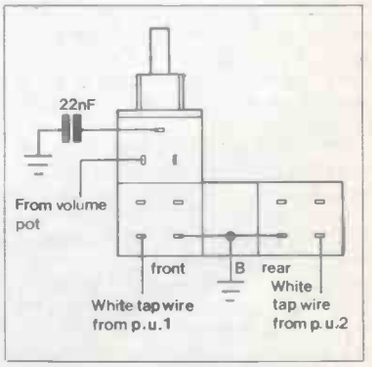


Figure 4. Pull switch used as double coiltap (on tone control).

Figure 4 shows how to wire another in the same guitar for simultaneous complete earth type tap on both pick-ups and as tone control. Wire B to earth would be replaced by a capacitor for a simultaneous partial tap.

E&MM

The Allen Bradley push-pull pots are available in Britain from Chandler guitars.

WORKING WITH VIDEO

by Andy Emmerson

VHS and Beta video cassettes under test in the quality control laboratory at 3M.

How do you choose which brand of tape to use? Do you buy one particular brand or do you take whatever's going cheap this week?

In fact you cannot go far wrong whichever brand you buy, as long as you stay away from totally unknown names. There are some apparent bargains in really nasty tape made in back rooms somewhere in the Taiwan or Hong Kong area, though not all of the "pirate" brands are bad. However, you can be fairly certain that a tape with a well-known name like Scotch, TDK, Maxwell or Fuji will be all right, as is a tape bearing the name of a VCR manufacturer.

From time to time there are shortages of blank tape and wholesalers are then forced to import tapes originally destined for the USA or domestic Japanese market. Imported VHS tapes are prefixed "T" instead of "E" (e.g. T-120) and play for almost a third longer (so the T-120 plays for approximately two hours forty minutes). These tapes are all right to use despite what you may have read elsewhere — if you check out some of the pre-recorded film tapes you'll find that a number are on T-127 blanks and the professional duplicators would not use them if they might harm your (or their) machines.

One little known fact is that you often get more tape than you pay for! A nominal three hour tape usually has a little extra which is useful if the programme you are recording overruns. Experience shows that Scotch tapes give one minute to spare while JVC and Thorn give up to five minutes extra. The RCA VK-250 tapes are the most generous, with about 10 minutes to spare.

This is not to say that everyone uses the whole length of the tape. A recent survey revealed that 55 per cent of users did not use all the time available for recording on a cassette. A large number wasted 15 or even 30 minutes recording time per cassette. This is probably true; I know I do this myself and usually you can't help it. The programmes do not always run to schedule and also, if a programme lasts 100 minutes you have little option but to use a two hour tape.

The same survey, which was directed at VHS users, showed that 65 per cent of them purchased only the E-180 length, just 20 per cent bought the E-120 size and the remaining 15 per cent purchased selectively according to their specific requirements. It's a safe bet that most E-30's are sold to businesses for demonstrating and advertising films.

If you believe surveys you'll be interested to know that the majority of video users are within the age group 30 to 45 years and their main use of video is to record movies on the television they are unable to watch when transmitted. The fact that you are reading this article probably indicates you don't fit this mould — among younger people there is a growing interest in the new dimension which video gives to music. Currently they are not worried by the lack of stereo or hi-fi sound but there will come a time when consumers will demand better sound, which will generate the need for a new breed of video.

Of course, you may be more concerned with the price of video cassettes. I must admit I am an addict with some 70 tapes — in fact I have resorted to buying secondhand films from duplicating houses to re-use in order to satisfy my voracious appetite. But if you're forced to buy new and feel like being patriotic you might pause to think there is only one brand of video tape manufactured in Great Britain, and that's Scotch. The manufacturing plant is located near Swansea in south Wales and produces video cassettes in all the popular formats (VHS, Beta and VCR). VCC will be added this autumn and for Philips 1500 and 1700 users the news is that the VCR tape production line will be maintained for at least a year. Longer lengths of VHS are promised (probably E-240) and not before time, the cardboard sleeve (which let the product down) will be replaced by a plastic one.

The Welsh factory currently exports to 41 countries in Europe and the Middle East and plans to quadruple production during the next two years, such is the demand. Scotch recently celebrated their silver anniversary in video tape manufacturing, though until recently this was all for the professional and broadcast market. Still, if it's good enough for the broadcasters it's probably good enough for you and me.

Changing the subject; do you remember all that fuss last autumn about the mini video recorder announced by Technicolor? The news is that a European (PAL system) version will be available in time for Christmas this year. Using quarter inch tape, the unit is smaller than other VCRs and is a portable machine, weighing just over 3 kilograms. A matching colour camera is also available.

Because of the machine's small size the length of tape in the cassette is limited to a maximum of 45 minutes. To record TV programmes you will be able to buy a combined portable colour TV set and VCR weighing 9 kg. Somehow I cannot see any real advantage in this unique system — the tapes aren't long enough to record films or most TV programmes and the size/weight advantage is not sufficiently great over a Beta or VHS portable. But I'll probably be proved wrong — I still say video discs will not catch on with the British public though I grudgingly concede they might be better than tape for commercial and business training and instructional purposes.

By the way, have you noticed how film industry companies are getting into video? I have just mentioned Technicolor, and Eumig, the movie camera people, are about to market a VHS portable system here. Pentax are doing the same thing in Japan. Watch this space for further developments!

E&MM

Guide to Electronic Music Techniques

PHASING

Paul Conway

Many terms used in electronic music are surrounded by mystery. The musician is blinded by the technical jargon of the engineer and the engineer is often perplexed by the terms used in music. This month and in future issues we will be taking one or more of these terms and describing them with the aim of removing some of this mystique. Phasing is a technique very popular today, but was first used many years ago as far back as the Beatles era at the Abbey Road Studio. In simple terms, phasing as it is meant in the musical effects sense, involves delaying a signal for a small amount of time (by storing it) and then mixing the delayed signal with the undelayed.

Now, because any complex sound (and music of course is a very good example) consists of many frequencies, each component of the signal when delayed by a fixed amount and then added to the original will produce a new signal, whose individual frequency component levels will have changed according to the frequency of the component being considered and the length of the delay introduced. In simple terms, due to the wavelength of the individual frequency components, some frequencies will be completely cancelled, some will increase in amplitude and some will not change very much at all. It all depends upon the phase relationship of the signal that comes out of the delay unit with respect to the undelayed signal. For example, if a 1kHz signal is delayed by one half period (0.5 mS), then the output of the delay device will be exactly 180° out of phase with the original signal and therefore cancellation will occur at this frequency.

In fact, cancellation will occur at all frequencies at which the delay time is an odd number of half periods. This produces what is known as a comb filter because of the shape of its frequency response, as shown in Figure 1.

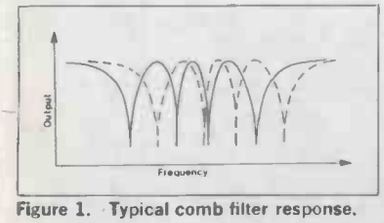
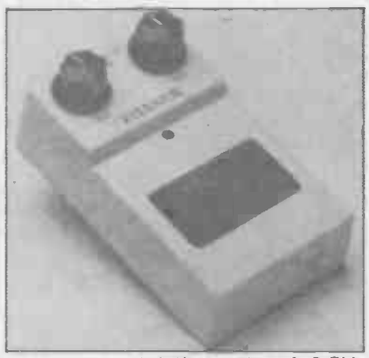


Figure 1. Typical comb filter response.

However, the story does not end here because the time delay introduced must be slowly changed from shorter to longer, longer to shorter and so on. The rate at which the delay is changed is made to be about 0.5Hz. As the delay time changes, the frequencies at which the notches and peaks occur in the comb filter response also change and this 'modulation' of the delay time has the effect of shifting the frequency response in Figure 1 from side to side.



At a modulation rate of 0.5Hz therefore, different frequencies will add and cancel in any two second period when added to the original signal, producing the characteristic phasing effect used so often today.

In simple terms then, the basic requirements for a Phaser are:

1. A variable delay system for audio frequencies.
2. A low frequency oscillator.
3. An audio mixer (adder).

Any phasing effects unit can be defined by the general system block diagram shown in Figure 2.

When phasing was first used many years ago it was achieved by recording the material twice on two tape recorders and then replaying the two recordings together; but with the speed of one of the machines being constantly increased and decreased at a rate of about 0.5Hz.

When the outputs of the two machines were added together they produced the same effect as that produced by modern systems. The 'delay line' in this case being a tape recorder.

It should be becoming clear now that a vital part of the phaser system is the delay line. Modern systems need not use tape and as 'electronic delay' is vital to many audio effects, some modern methods of realising this in practice will be described.

Let us first remember that the process of delaying a signal is achieved by storing it for a period of time. Furthermore, if it is required to achieve cancellation as with the phaser, then the delay line must be able to store a signal for half of one cycle, i.e. 180°. The longest storage time must therefore be defined by the lowest frequency at which a 'notch' is required in our comb filter. So, the maximum delay time will define the lowest frequency of operation. For example, if it is required to produce phasing effects down to Middle C which is around 256Hz, then:

1 Period = 3.9mS

½ Period = 1.95mS

It can be seen then that our delay line must be able to store an audio signal for about 2mS.

There are several methods of producing 'live' delay (sometimes referred to as delay in 'Real Time'). Almost every electronic component introduces some delay, even a piece of wire. Some methods are of course impractical, for example taking the speed of signal propagation as 300000 metres per second in wire would require a length of approximately 363 miles for a 2mS delay! Electro-mechanical delay lines can be used (the spring line being a very common type) but they suffer from the disadvantage of poor frequency response, fixed delay and large physical size. Electronic phase shift networks can be used but it is difficult to produce large time delays over a wide range of frequencies.

More recently analogue shift registers have become available and these provide a much more attractive solution. The difference between this type of delay and all the others is that the signal is sampled at a certain frequency. Each sample (i.e. the instantaneous amplitude) is stored in a small capacitor. It can be shown that as long as this sampling process occurs at at least twice the highest input frequency, the original signal can be recovered. The individual samples are then shifted down the line using an electronic clock, the input signal finally appearing at the output N clock pulses later. For example, if the highest frequency to be used is 10kHz, the clock rate would have to be at 20kHz, i.e. a sample being taken every 50uS. Therefore if it were required to store the signal for 2mS, there would have to be 2mS/50uS = 40 sample stores.

Analogue shift registers are often referred to as 'Bucket Brigade' delay lines because the method of storing the signal and shifting it is analogous to a line of men passing buckets of water to each other, the amount of water in each 'bucket' representing the instantaneous amplitude of the signal when sampled. The detailed operation of these devices is of course more complex but this simplification illustrates the principles involved. The 'delay modulation' is now achieved simply by changing the clock frequency as it is this that determines how long it takes for a signal to get from input to output.

As a final comment, it is possible to convert the signal into digital numbers using an analogue to digital converter. If this is done, the signal is now in digital form and can be delayed using a digital shift register. These are much cheaper than their analogue counterparts but the cost is offset by the expensive input analogue to digital converter and digital to analogue converter required at the output in order to convert the digital signals back into analogue form. This is known as digital delay and, as the cost of the converters comes down, offers a very attractive alternative to the analogue system. A block diagram of a digital phaser is shown in Figure 3. The digital system has the advantage that it does not degrade the original signal, whereas analogue methods introduce noise and distortion which increase as more delay is used.

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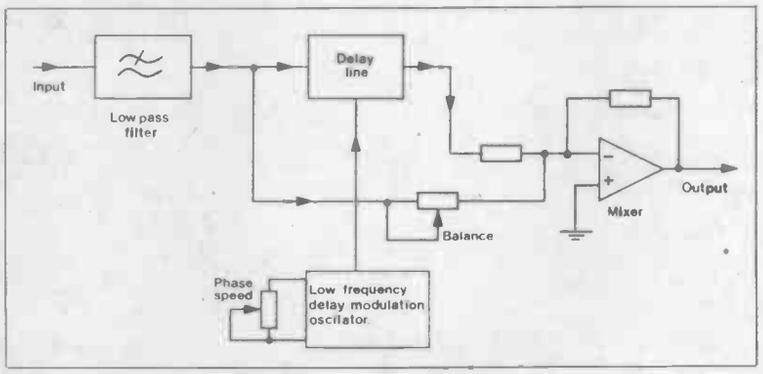

Figure 2. Block diagram of a modern phaser.

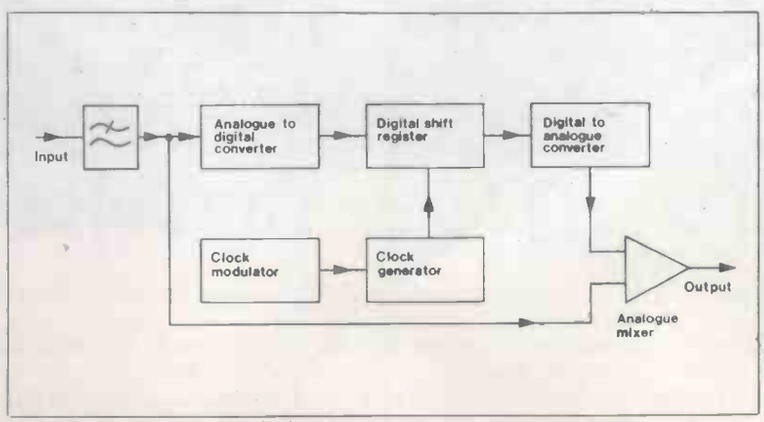

Figure 3. Digital phaser block diagram.

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Organ Talk

Ken Lenton-Smith

RE-ARRANGING SHEET MUSIC

Organ scores for classical music have always been available, those for popular music having become more numerous with the rise in popularity of the electronic organ over the last few decades. Even so, in the popular field it will often be found that an organ arrangement of a given composition simply does not exist. Therefore the only course open is to arrive at a self-arrangement for the three staves. This does not necessarily imply the use of manuscript paper (though not a bad idea at that), but rather getting used to employing a method of instant re-arrangement of the musical data.

This could be termed extemporisation and, although it is possible to extemporise with any musical instrument, none is better suited to this than the organ. Some knowledge of music is necessary before any degree of success is achieved here but the goal will be well worth any amount of time and thought expended in the process.

In a recent article in this series, the question of the type of music notation was discussed, the matter having been raised by a reader. We suggested that *standard* methods were the only way of learning to understand what was happening musically. At the same time, 'Rudiments of Music' was mentioned as good bedtime reading: this type of book sets the beginner on the right track - learning to sight read. The first hurdle will have been cleared when certain rudiments have been mastered - the staves, positions of notes and their durations, time signatures and accidentals.

By now our player will be able to read a single note melody with accuracy and will be encouraged until faced with reading several notes simultaneously, especially playing chords. Noticing that chord symbols are indicated on the music, why not use the automatic chords, he reasons? After all, this facility was part of the cost of the organ, was it not? He manages some quite pleasing results and tends to continue to use this method of playing but probably makes no musical progress beyond this stage.

However good an automatic chord system, the choice of chords is severely limited: the effect begins to pall after a while, his music sounding increasingly mechanical. No doubt he will admire the player who can sit down and play sheet music (even three staves) at sight, realising that that this ability is not necessarily a 'gift' but something attained through past hard work. In some cases, however, sight-readers play the score perfectly but somewhat woodenly - rather in the style of a player-piano being fed a paper roll. Without his music he may be completely stumped: although an excellent reader, his knowledge of the mechanics of music may be so limited that he cannot improvise and the best he can do is attempt to bring a photographic memory into play. So perfect sight-reading may not be as enviable as would at first appear.

At this point it should be explained why piano scores are unsuitable for an organ and require considerable modification. The (acoustic) piano is a percussive instrument and, once the hammers have struck their strings, the sound dies away fairly rapidly - even if the keys are continually held down. The Harpsichord and Piano stops on an organ have circuitry designed to follow the same characteristics as their acoustic counterparts, but organ tones of the conventional type will sound as long as the keys are depressed. The organ is a sustained note instrument in contrast to the percussive piano so that piano music can sound totally wrong when played on an organ, especially where the left hand part is concerned.

The type of extemporisation called for when using piano music involves taking the music apart mentally and putting it together again in suitable form for two manuals and pedals. The piano's treble clef part can often be played as written on the solo manual but the bass clef has to be re-organised between the accompaniment manual and pedal. If the original score has chord symbols indicated it will be easier to re-arrange. 'Buskers Albums' are the easiest to work from as the musical information is reduced to the bare essentials - a single note melody line and chord symbols.

Not being limited to someone else's written instructions, the organist's own arrangement can be as simple - or as complex - as he likes. The Solo manual and Pedal parts present no difficulties but the Accompaniment requires a good deal of patience at first: rather like learning to ride a bicycle, once you have the knack it is not too difficult. Let us look at a few guidelines, leaving the Accompaniment as the last aspect to consider.

Right Hand

Until completely familiar with re-arranging, it is best to play a simple melody line on the Solo manual. This single note line is taken straight off the piano music. 'Buskers Albums' score in this respect in that the melody line is all you are presented with whereas it may be somewhat buried in the treble clef of a piano score.

Naturally, you have to find your own registration as none will be shown. An instrument which offers instant changes by means of presets is a great advantage but the main idea should be to get the melody over clearly and with gentle incisiveness. Remember that it is effective to take the vibrato *off* as a registration change, perhaps using Chorale instead. An interesting effect is obtained with vibrato on one manual but not on the other if the controls allow this.

When some proficiency has been obtained, the melody can be reinforced by using block chords which follow the general sequence to be mentioned when dealing with the Accompaniment manual. If 16' pitch is used for anything but a single note melody line it is best to transpose the right hand part up one octave to prevent chords sounding dull and muddy. Even if the player is capable of chords in both hands, a single note melody line is quite often the most effective.

Provided that some degree of music reading has been attained, the right hand part poses no real problems, except possibly remembering to make changes in registration and finding the right moment to do so. A 'Buskers Album' style of score is shown in Figure 1, which contains all the information required.

Chord symbols are always shown in these albums but not always on piano scores. For a start, at least, it is best to avoid piano music without those symbols.

Pedal Part

This need be no more than the root note of the indicated chord, played on the appropriate beat(s) of the bar. In 3/4 time the pedal will fall on the first beat whilst in 4/4 time on the first and third beats. Much will depend on the player's taste and the tempo concerned. Latin-American rhythms, for example, offer plenty of scope for pedal patterns. Even so, the actual note played will always be the root in a simple arrangement.

Repeating the same pedal note twice, or even four times, in each bar can become a little monotonous, so an alternating pattern can be used instead. In this case, the alternating note is usually the fifth of the chord. Indeed, any other note of the chord can be used for alternating with the root. Eventually, when familiar with the various notes that make up chords, a walking bass pattern can be employed. Some instruments are fitted with controls for walking bass but it will often be found that patterns are only available over major chords: this is another reason for not using beginners aids once some progress has been made musically.

Occasionally, the chord indicated takes the form 'X/Y' where X is the chord concerned and Y is the sug-

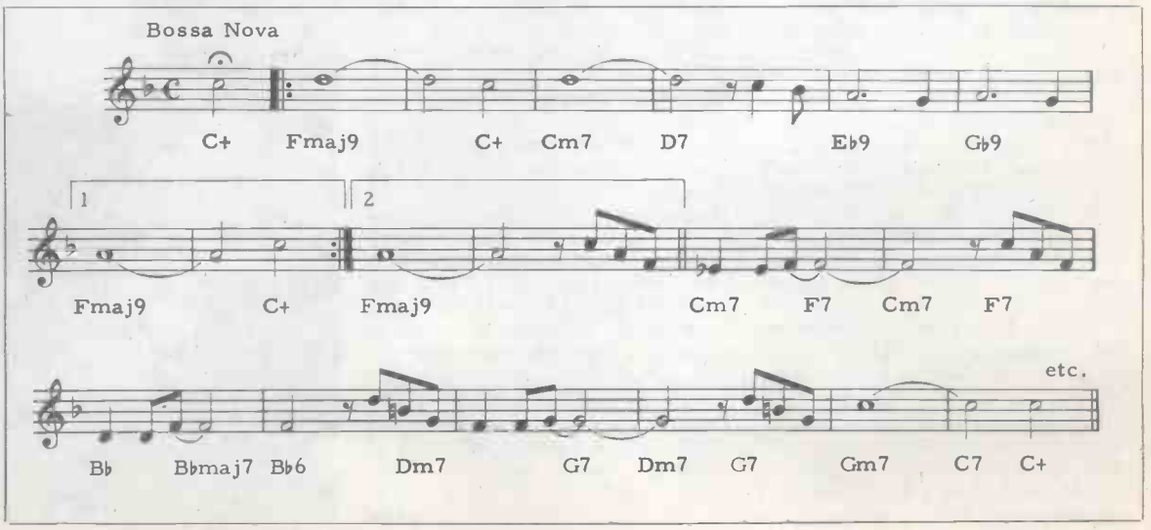

Figure 1. A 'Buskers Album' type of score.

gested pedal note to be used with it. For example Cm7/F guides the player to the C minor seventh chord with F as the pedal note. Obeying this type of suggestion is usually effective.

Pedal registration must be chosen to accord with the other voices in use, particularly the Solo manual. If it is available, pedal Sustain is best reserved for slower numbers - especially those in 3/4 time. Little else needs to be mentioned regarding the pedal part at this stage as, like the right hand part, it is simple to select from printed music. However, the pedal line is the foundation of the harmony and so it is important to feel for the correct pedal: practising in stockinged feet often helps in this respect.

Left Hand

This aspect has been left until last as it calls for rather more concentration and an idea of chord formation. Even if harmony is a familiar subject, the way the chord information is used makes a great deal of difference to the final result. In fact, the left hand part is often the making of a good light entertainment organist: to verify this, listen to a skilled player performing. There is no doubt that the all-important left hand sorts out the men from the boys.

Chord books are published from which it will be seen that there are hundreds of different chords to choose from. Most of these are variations on four themes - major, minor, seventh and diminished chords. The 120-bass accordion is an example of the basic requirements which, after eliminating bass notes, counter-basses and duplicated chord buttons, has just 48 chords available: these are the four chords previously mentioned as applied to the twelve chromatic notes. Some of these chords are used frequently and others only occasionally because popular music tends to be written in a limited number of key signatures to suit transposing instruments such as trumpet, saxophone and clarinet. In practice, the task of forming and memorising chords is not therefore all that formidable.

Another encouraging aspect is that chord *sequences* soon start to become known as they are often similar in totally different tunes. In next month's issue we will examine a method of arriving at given chords once the key signatures of the major scales are known and also the chord 'shorthand' used in sheet music.

E&MM

National Home Electronic Organ Festival

Brenda Hayward.

A theory class in progress.

Over 2,000 residential organ enthusiasts have just spent a whole week at the first National Home Electronic Organ Festival held in Pontin's Tower Beach Holiday Camp at Prestatyn, North Wales, and already plans are under way for another festival next year.

Bob Chapple, the festival organiser and Cled Griffin, the festival producer gathered together at Prestatyn many of the top concert and recording electronic organists, several of the largest organ companies and many of the finest teachers.

This made it possible to produce a festival which catered for every need of the residents, with a continuous daily programme of demonstrations, teaching sessions and concerts.

To readers of this magazine the Wersi display would have been of considerable interest. All their organ, synthesiser and keyboard models were on display for anyone to sit down and play. Wersi also had the use of a chalet where interested constructors were shown the basics of assembling their kits and the principles of soldering.

On the Thomas stand every model was available and behind the scenes they had a small group teaching studio with six organists at a time under the expert instruction of Tony Bayliss. None of these people had ever played any kind of musical instrument before, yet by the end of the week they were able to play simple tunes using both manuals and pedals.

Trevor Daniels of Crumar Organs and David Shepherd of Rogers/Gulbransen Organs provided regular teaching sessions on many aspects of organ playing. Other organ companies represented included Conn, Lowrey, Cavendish, Kawai, National, Yamaha, Marlborough and Gem.

Special teaching groups were regularly held by Roy Neal, Alec Leader, Brian Hazelby and Brenda Hayward, who is the authoress of The Organ Master books featured recently as a special offer (August 1981 issue of E&MM). Brenda used an overhead projector to give a visual impact to her teaching of left-hand chord formation and creating introductions, middle fill-ins and endings, modulation and transposition; subjects which most home organists are never taught.

The evening concerts were the great attraction with Brian Sharp, Tony Back, Bryan Rodwell, George Blackmore, Trevor Daniels, Mark Shakespeare, Keith Evans, Jerry Allen, Dave Smith, Tony Peglar and many other artists providing a rich variety of talent and entertainment.

Whether your interest was in choosing a new organ, learning how to play better or in just being entertained The National Home Electronic Organ Festival provided every opportunity, with the added attraction of enjoying a week with like-minded 'Organ-Nuts!'

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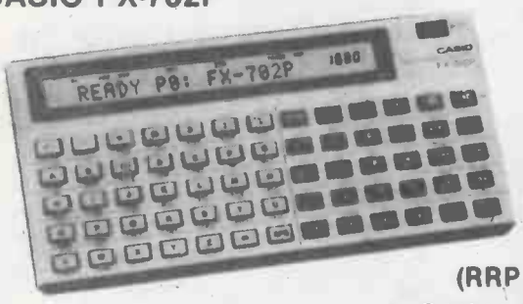

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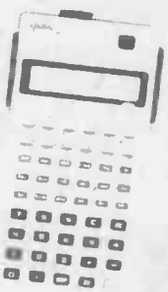

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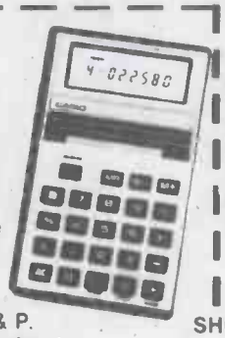

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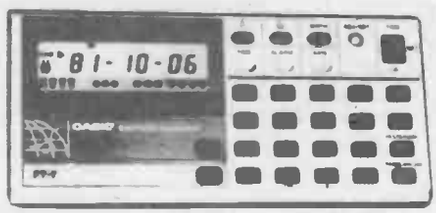

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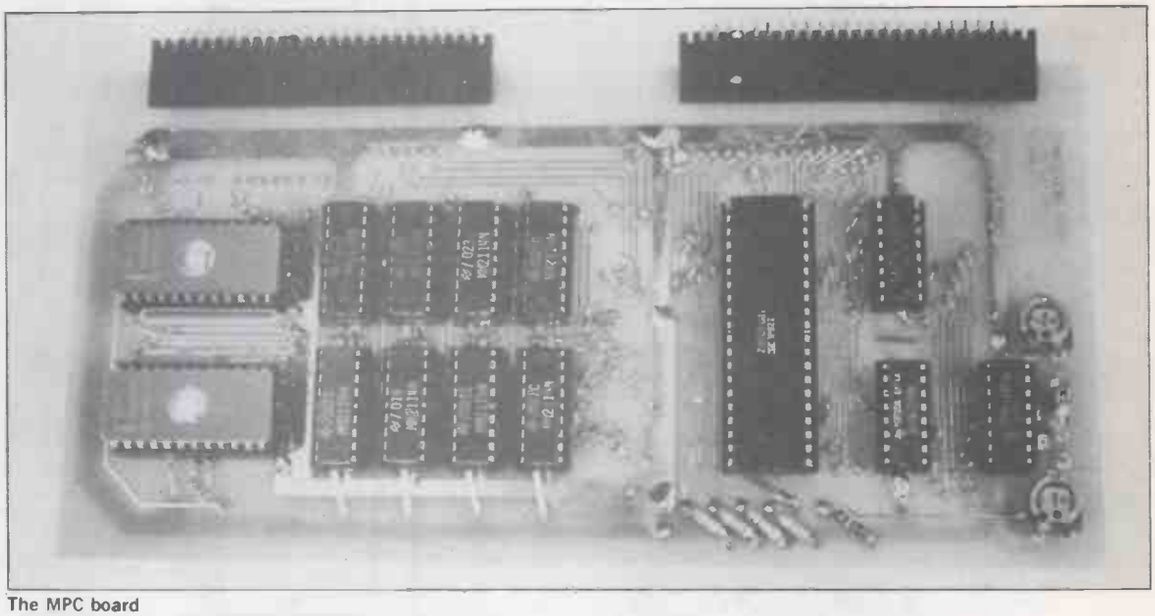

The MPC board

This month we present a complete general-purpose Z80 microprocessor board, called the MPC (Memory-Processor-Clock). The purpose of the MPC is to take the hard work out of building microprocessor-based projects. The board contains a Z80 cpu, clock, memory and I/O decoding logic, up to 4K of static RAM and 8K of EPROM. This makes it suitable for most small-to-medium sized applications.

Whereas most processor boards are intended to be used as part of a system in a card rack or with cards plugged into them, the MPC is designed to function as a 'programmable component'. Its first application is the 'Electric Drummer' project following this article.

Circuit

The circuit diagram of the MPC board is shown in Figure 1. Memory address decoding is provided for the following ranges:

$\overline{MEM0}$ — 0000 — 0FFF
$\overline{MEM1}$ — 1000 — 1FFF
$\overline{MEM2}$ — 2000 — 2FFF
$\overline{MEM3}$ — 3000 — 3FFF
$\overline{MEM4}$ — 4000 — 4FFF
$\overline{MEM5}$ — 5000 — 5FFF
$\overline{MEM6}$ — 6000 — 6FFF
$\overline{MEM7}$ — 7000 — 7FFF

$\overline{MEM0}$ addresses ROM1(IC 12), $\overline{MEM1}$ addresses ROM2(IC 13) and $\overline{MEM2}$ is decoded to address the four pairs of 2114 RAM's as follows:

IC4-5 : 2000 — 23FF
IC6-7 : 2400 — 27FF
IC8-9 : 2800 — 2BFF
IC10-11 : 2C00 — 2FFF

$\overline{MEM3}$, $\overline{MEM4}$ and $\overline{MEM5}$ are taken to edge connector P2 for external memory expansion if required. I/O decoding is also done on the board and all the decoded select lines (I/O 0 to I/O 3) are taken to the edge connectors.

The on-board clock, (IC17) is configured so that any combination of crystal and capacitors may be used. Also, potentiometers may be inserted for adjustment of frequency and range. These should be linked to ground if a crystal is used. Manufacturers of the 74LS124 recommend that V_{cc} should be less than 5V and provision is made on the board for the insertion of one or two diodes to give the required voltage drop.

Links are provided on the board for the selection of:

(1) Main or auxiliary +5V supplies for the RAMs: the auxiliary supply may be used to drive low-power CMOS RAMs.
(2) 2716/2732: each ROM socket may be individually selected for a 2K or 4K EPROM.

The edge connector details are shown in Table 1. P1 supplies all the signals required to drive up to four Z80 I/O devices (including interrupt vectoring) or other I/O. All other signals are taken to connector P2. Thus, for most small applications only connector P1 is needed. In most cases, if external devices are kept close to the connector the busses do not need to be buffered. Thus the cost of adding 'intelligence' to a system is kept to a minimum.

Pin	P1	P2
1	Ov	$\overline{MEM3}$
2	$\overline{RD}$	$\overline{MREQ}$
3	$\overline{M1}$	$\overline{MEM4}$
4	Ø clock	$\overline{RFSH}$
5	$\overline{INT}$	MEM5
6	$\overline{IORQ}$	A_{15}
7	$\overline{Wk}$	A_{14}
8	$\overline{I/O\ 3}$	A_{13}
9	$\overline{I/O\ 2}$	A_{12}
10	$\overline{I/O\ 1}$	A_{11}
11	$\overline{I/O\ 0}$	A_{10}
12	D_0	A_9
13	D_1	A_8
14	D_2	A_7
15	D_3	A_6
16	D_4	A_5
17	D_5	A_4
18	D_6	A_3
19	D_7	$\overline{BUSRQ}$
20	A_0	$\overline{BUSAK}$
21	A_1	$\overline{WAIT}$
22	A_2	$\overline{HALT}$
23	$+5V_{aux}$	$\overline{NMI}$
24	$+5V_{main}$	$\overline{RESET}$

Table 1. The MPC board edge connectors.

Construction

The PCB is double-sided and its size has been kept to 3¾" x 7½". This means that if the board is plugged into another PCB the height of the box required is still reasonable. Initial versions of the board are not through-plated and some 200 through pins must be inserted in the board and soldered both sides. However, if time is available this should present no problem in construction.

Maplin's part number for the PCB is GA56L. No specific construction details are given, since the circuit configuration may be changed to suit the application. Part 2 of the 'Electric Drummer' project will contain details for using the MPC board with this unit. **E&MM**

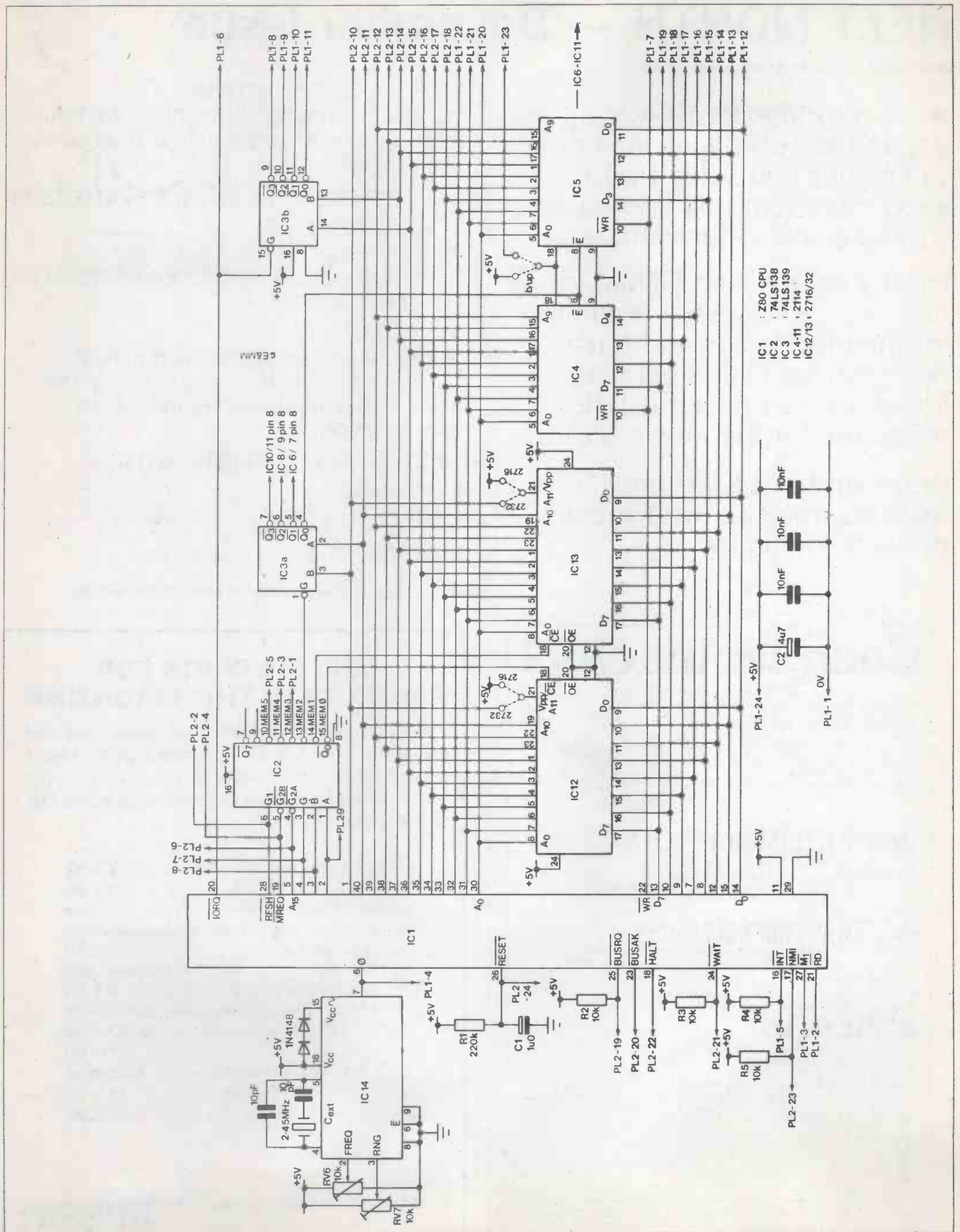

Figure 1. Circuit of the MPC board.

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ELECTRIC DRUMMER

Part 1

by Peter Kershaw B.Sc

A versatile programmable drum computer, featuring:

- ★ Programming in real time, or step by step
- ★ Comprehensive editing facilities including 'spread' and 'condense' for best use of memory
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- ★ Battery back-up option for memory

Most people are familiar with the electronic 'rhythm boxes' which have been available for over a decade and are now included in even the cheapest home organs. The most significant limitation of these is that only a small number of preset rhythms is available. However, with low-cost microprocessor control several sophisticated programmable drum synthesisers have come onto the market (see Warren Cann's review of the Linn drum computer, September E&MM).

The controller presented in this article allows the user to program rhythms in 'real time' or step-by-step, to edit them, string them together and to store rhythms on tape if required. The unit generates standard +15V trigger pulses for 14 instruments plus an accent output (to accentuate selected beats) and a special 'hi-hat open' output. LEDs show the status of each trigger and the position of the downbeat while four 7-segment displays show beat number, rhythm number and other variables.

Hardware Features

A block diagram of the drum controller is shown in Figure 1. The heart of the system is the MPC board, which is described in 'Using Microprocessors' in this issue. All the logic devices operate from the standard +5V supply. Also, ±15V supplies are used for trigger outputs and for driving analogue sound generators (if these are not to be used the -15V supply may be omitted).

The front panel layout is shown in the photograph. Note that the instruments specified are arbitrary and apply to the sound generator board to be described.

Operation

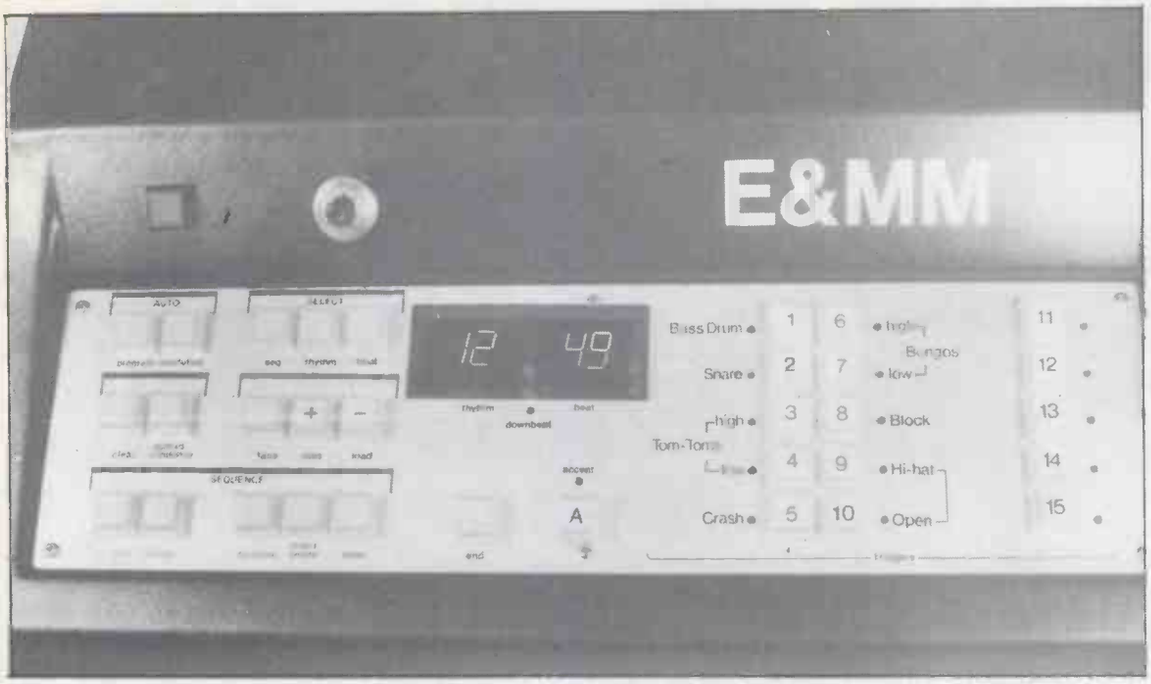
In order to illustrate the operation of the system a programming and editing sequence will be described. Let us assume that the memory of the device is empty. This will be the case at power-up unless battery back-up of the RAM is employed. This option will be considered in Part 2.

First we have to allocate a rhythm number. This is done by pressing and holding RHYTHM SELECT then + or -. The rhythm number shown on the left-hand display will be incremented or decremented. When the desired rhythm number has been selected, + or - is released.

In auto program mode the system is programmed in real time in sync with a tempo output. The timing of a key depression will be resolved to the nearest half-note, quarter-note, eighth-note, etc. or triplets of these. To select the desired resolution, RESOLUTION and + or - are pressed. If, for example, 16th note triplets are required, stop when the display shows 16.

Now we are ready to program the rhythm. Press PROGRAM AUTO. The beat number will increment from 1 to 96 then reset to 1 and repeat continuously at a rate determined by the tempo control. At the same time a trigger is sent to the 'block' output every quarter-note so that the player can synchronise to the system clock. If you do not want the 'block' to be the sync pulse (you may want to program the 'block' first) press BLOCK then, for example, HIGH BONGO and that becomes the sync output. Whenever the beat number resets to 1 the downbeat lamp flashes.

To set the rhythm length press END at the moment when you want the beat number to reset to 1. If you do this at about the end of beat 16 you will have a 16-beat sequence. Now you can program any combination of instruments one or more at a time as the rhythm cycles. If you find you do not like the snare drum rhythm,



Front panel layout.

for instance, you can press CLEAR and SNARE DRUM and all the snare drum beats will be removed. If your drumming is a little inaccurate it will be corrected to the pre-selected resolution. This applies to all the instruments and additional triggers as well as to the ACCENT key.

Whereas most triggers give a short +15V pulse output, the 'hi-hat open' output remains high for the whole beat length. When a trigger channel is active its associated lamp is turned on. When there are enough instruments programmed to make the sync output unnecessary, pressing the sync instrument button twice will cancel sync and allow that instrument to be programmed normally.

Programming is terminated by pressing RUN/STOP.

The rhythm may now be edited. Step through the rhythm one beat at a time by pressing BEAT SELECT and + or -. The LEDs will light to show which triggers are selected and they will be turned alternately on and off when the trigger keys are pressed, modifying the rhythm in memory. Of course, a whole rhythm can be built from scratch using this editing mode and it is an alternative and possibly preferable way of setting the bar length.

Two other rhythm editing functions are provided. The CLEAR key may be pressed with BEAT SELECT or RHYTHM SELECT to clear a beat or rhythm. The other editing function is rhythm spreading and condensing. To spread, press SPREAD/CONDENSE and +. As you press + the spread factor in the right-hand display will increment. To make the system foolproof you must release + and press END to execute the spread function. If the spread factor was 2 the number of beats will be doubled. If 3, it will be tripled, thus allowing triplets to be inserted.

The condense function is initiated as above but you should press - instead of +. If the condensing factor is 2, every other beat is removed (even-numbered beats). If it is 3, two out of three beats are removed, thus eradicating triplets. This function is useful in making the most of memory space.

Sequences

A sequence consists of several rhythms strung together to make a complete tune or song backing. To program a sequence first press SEQUENCE SELECT and + or - to select a free sequence number. Then press INSERT and + to set the insert mode. If we wish to start with three repeats of rhythm 2 we press RHYTHM SELECT and + or - alone until three repeats are indicated on the right-hand display. When both the number of repeats and the rhythm number are as desired, press ENTER to fix the data in the sequence memory. When the sequence is complete press END.

To remove data from the sequence press INSERT/DELETE and -. Then step to the entry to be deleted and press ENTER to remove it. You may also press INSERT and + at any point in the sequence to insert rhythms after the currently displayed entry without destroying those which follow.

As an alternative to programming in a number of repeats of a rhythm you may program the repeat number to zero. This will cause the rhythm to be repeated indefinitely until the operator presses the CHANGE key. The sequence will then step onto the next entry at the end of the rhythm. When in the continuous repeat mode the decimal points of the display flash to show that operator intervention is required. This mode is particularly useful for 'jamming' where the length of a piece will vary.

In Part 2 we will give the circuit diagrams and board layout of the controller as well as suggested sound generation and processing circuits to use with the controller.

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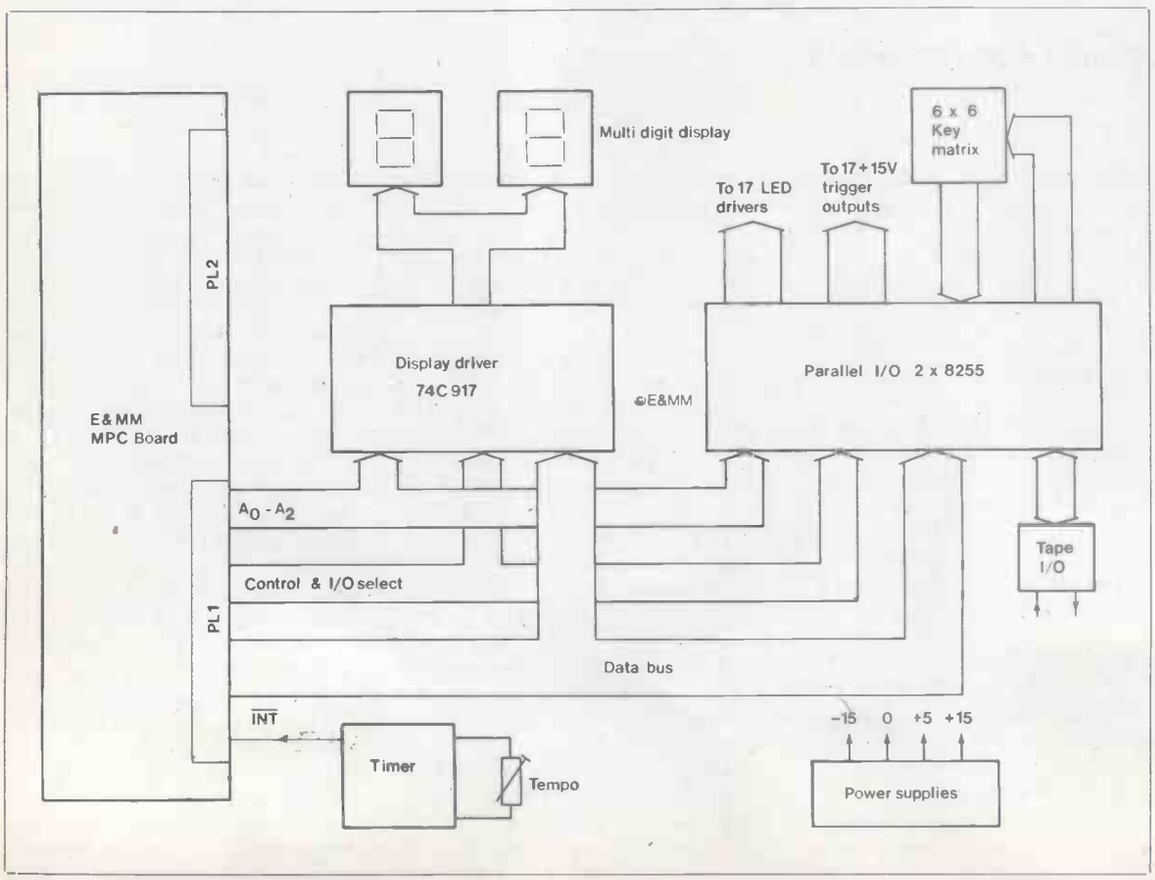

Figure 1. Block diagram of the Electric Drummer.

What to do with your hands on Friday the Thirteenth

Try out the latest in creative music recording at the 'Hands on Show', a unique two day event of live demos, new products, Workshops, in fact everything multitrack, right from the basics. You'll get hands on experience of equipment from leading manufacturers and a chance to talk to their experts.

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There's a new generation of Personal Multitrack equipment by **Fostex.** The ultimate suitcase studio and affordable eight tracks

on quarter inch. And of course **Tascam**, check out their full range, right up to sixteen track. Mix and compare the results with mastering studio equipment by **Soundcraft**. Hear their latest twenty four track system, and find out how they are cutting the cost of studio ownership. And don't miss the opportunity of doing your own balance of Sergeant Pepper on the original **Studer** four track,

which was used to record this classic Beatles album.

Computers Galore

It's not just where creative recording started, but also how microchips are invading music. There's the **Movement** real drum rhythm computer and **Roland's** latest Micro Composer. Even if you have never played, **Casio's** revolutionary VL-Tone won't fail to amaze you. And a few keystrokes on our **Pet** computer will assemble an equipment package at your command.

Ear Delights

Don't expect silent demos. **JBL, Tannoy** and **Auratone** are there to let you hear why their systems are chosen for monitoring. All the way from budget compacts to multi driver monsters. **AKG**

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It's a unique opportunity for direct comparison of the latest studio effects, from harmonisers to aural exciters. Stretch and squeeze levels, frequencies and time with signal processing by **MXR, EXR, Ashly, Rebis, Accessit** and others. Bring along a tape or use the keyboards and guitars at hand for a personal demo. Product experts will answer every query.

Creative Workshop

If you make it through to Friday night, stay on and hear guest speakers talk multitrack. The basic equipment, effects and acoustics. Slides will be shown and problems discussed. Attendance is free, but **please** apply for tickets **now**, last time we ran out of chairs.

The 'Hands on Show' is being held at the Clive Hotel in Primrose Hill. On Friday November 13th

doors open at ten till the Workshop at seven. For the superstitious, same time Saturday, but open till eight. We look forward to seeing you there. Don't miss it.

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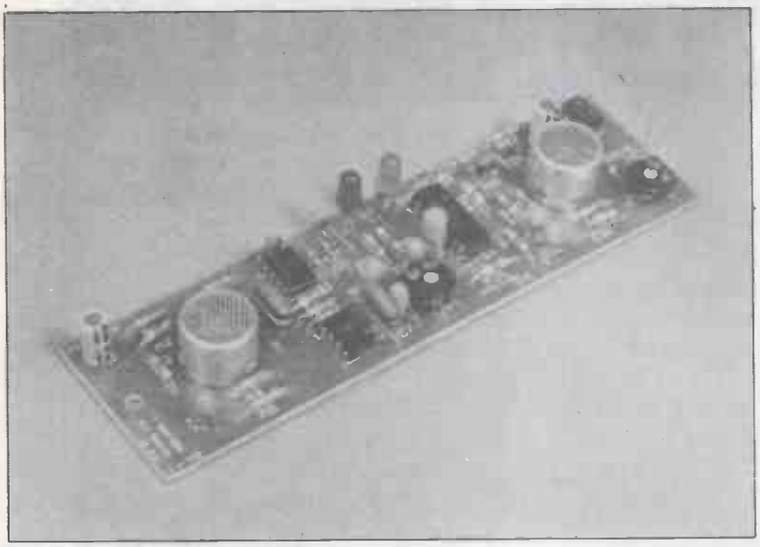


ULTRASONIC ALARM

Riscomp have just introduced a new Ultrasonic Alarm Module, the US4012, which operates at 40kHz, giving a 5-25ft adjustable range.

The unit can be mounted in a wide range of enclosures due to both transducers being mounted on the module.

Features include a 40-second 'switch-on' delay, a fixed alarm time and an inhibit period after an alarm to avoid positive feedback caused by slow siren decay.

Two LED indicators allow visual set-up and a low stand-by consumption of 15mA at 12V allows battery back-up facilities.

The module, with full instructions, is £10.95 + VAT, and a range of accessories are also available.

For further information contact: Riscomp Ltd., 21 Duke Street, Princes Risborough, Bucks HP17 0AT.

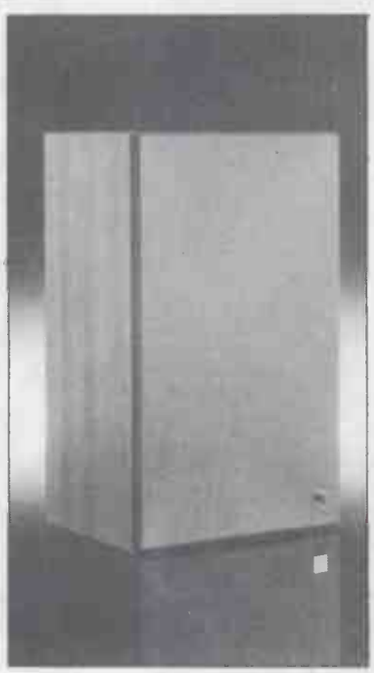
NEW KEF LOUDSPEAKERS

KEF have just introduced four new models in their 'C' series of loudspeakers, which are intended for use in living rooms of 'average' size. These are the Coda II (see photograph), Cantor II, Caprice II and Carlton II. All four are the result of computer-aided design and engineering techniques.

Coda II, retailing at around £80 per pair (including VAT) is a two-way bookshelf loudspeaker. Programme rating is 50W; nominal impedance is 8 ohms. The design incorporates computer-optimised crossover networks to aid performance and reliability. Efficiency is rated at 87dB per watt at 1 metre. Peak sound pressure levels (PSPLs) of 104dB are comfortably achieved under normal listening conditions.

Cantor II is based upon the successful Celeste IV. Efficiency, programme rating and PSPL specifications are as for the Coda II above. It is housed in a traditionally styled enclosure and is priced at around £100 per pair.

Caprice II is a two-way system employing the latest developments in Bextrene - cone drive units, and Carlton II is a quality floor-standing system. Both have programme ratings of 100 Watts into nominal impedance of 8 ohms. Both have efficiencies in the medium range - 86 dB/W measured at 1m, and both will give PSPLs of up to 106dB in 'typical' listening rooms.



Caprice II is available in simulated walnut veneer with contrasting brown textile grille (as are Coda II and Cantor II) and costs around £150 per pair. Carlton II also comes with a natural walnut veneer finish and removable textile grille. Retail price is about £230 per pair.

More information from: KEF Electronics Ltd., Tovil, Maidstone, Kent, ME15 6QP.

DIGITAL THERMOMETER

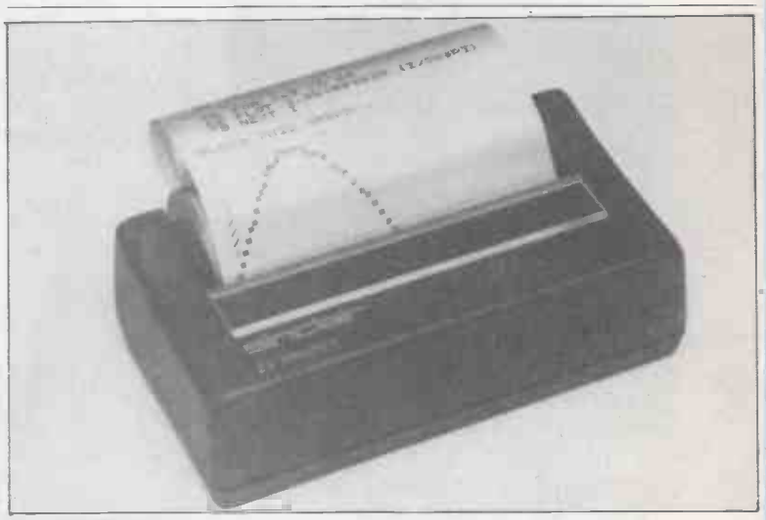
Thandor have now added a Hand Held Digital Thermometer to their range of test equipment, namely the TH301.

It has a temperature range of -50 to 750°C with 1°C resolution. The readout is in the form of a large LCD. It is housed in a tough, stylish plastic case and is supplied with a battery (giving up to 1000 hours operation) and a fast response bead thermocouple.

Thandor offer a range of thermocouples as optional accessories, covering the widest choice of applications, including mineral filled, hypodermic, right angle and surface thermocouples.

The retail price of the TH301 is £59.50 + VAT.

More information from: Sinclair Electronics Ltd., London Road, St Ives, Huntingdon, Cambridgeshire PE17 4HJ.



ZX PRINTER

The new printer from Sinclair Research, to complement the ZX range of personal computers and software, is now available. The printer features full alphanumerics with 32 characters to the line, 9 lines to the vertical inch at a speed of 50 c.p.s. and high resolution graphics.

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The printer is supplied with a 65 foot roll of special aluminised paper. The ZX printer is only available from Sinclair, mail order, at £49.95 inc. VAT, and a pack of five additional rolls of paper are also available for £11.95.

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For further information contact: Black Star Ltd., 9a Crown Street, St Ives, Cambridgeshire PE17 4EB.

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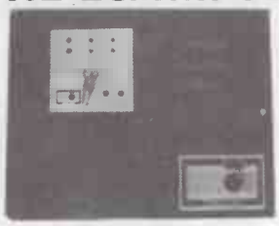

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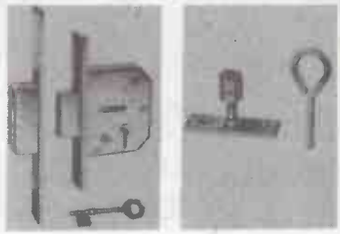

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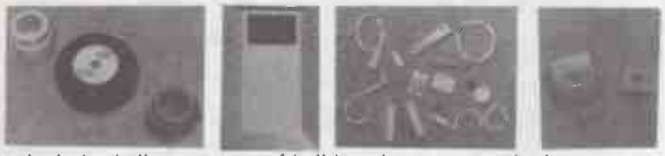

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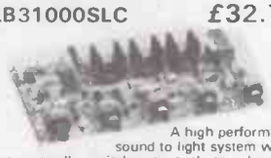

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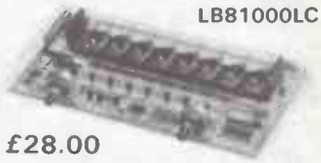

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0.07% THD	0.1% THD	0.1% THD	0.1% THD
96DB S/N	110DB S/N	110DB S/N	110DB S/N
LB25	LB100	LB150	LB250
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AUTO SWELL

by Clive Button

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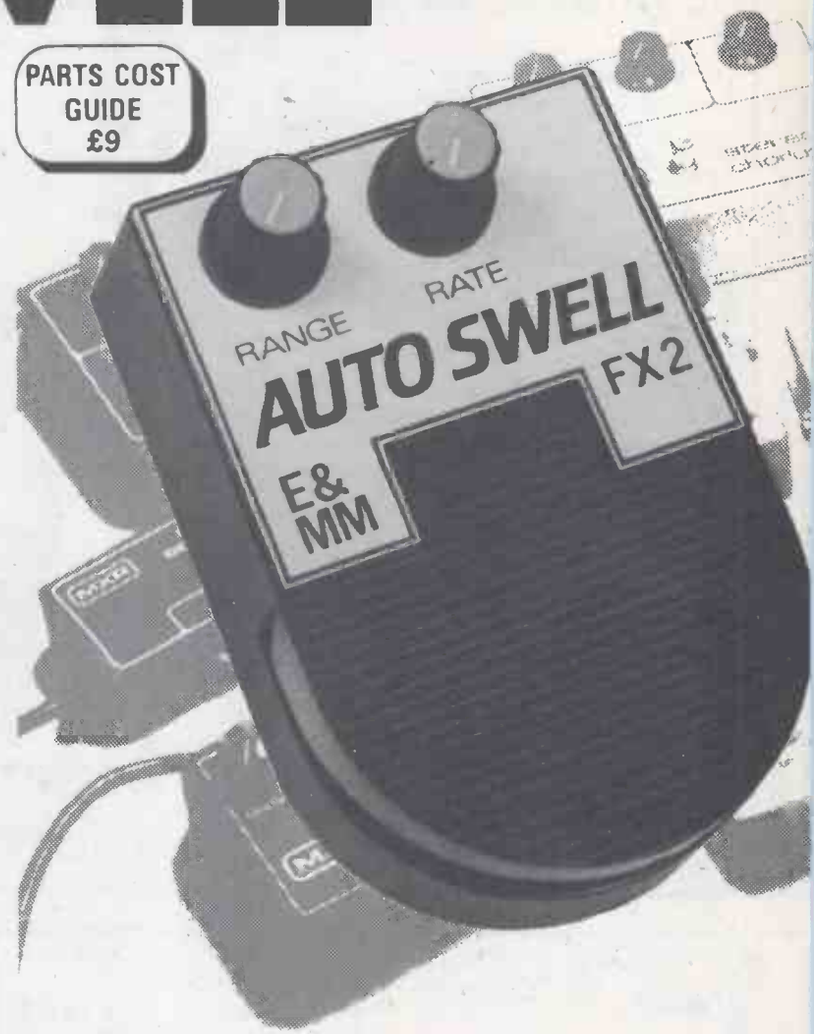


A foot operated volume control, or swell pedal, is one of simplest effects pedals there is - it is also one of the most useful. The most common application is for reducing an instrument's volume during accompaniment playing, allowing it to be increased for a solo. Whilst it is easy to set a pedal at either end, i.e. minimum or maximum, a half-way setting can be difficult to duplicate accurately. The auto swell enables the player to set a consistent accompaniment level, and increase the volume (at a preset rate) by pressing a pedal. When the pedal is released, the volume reverts immediately to the lower level. Noise and wear problems associated with the pedal operated pot type of mechanism are also eliminated.

The unit can be put to a variety of uses and some of these will be suggested in the section on applications.

The circuit is essentially a voltage controlled amplifier, the gain of which is controlled by a variable rate ramp which is initiated by a foot switch. The advantages of this method over such devices as a conventional swell pedal or compressor unit will only really become apparent when you start to experiment with the possible uses it can be put to on guitar or keyboards.

The Circuit

The input is passed to IC1a inverting input via C1 and R1; this first op-amp increases the signal by a factor of four; its output passes the signal to the circuit comprising R3, C2, RV1 and TR3 (TR3 being the FET). This circuit is in effect a variable potential divider, the top half being R3, the bottom half being the series combination of RV1 and TR3 whose resistive value can be altered by adjustment of RV1 or control of the gate voltage on the FET. C2 is for DC blocking only. The output of this potential divider is passed on to the second op-amp IC1b via R4 and C3 and finally via C4 to the output. So what we have is an amplifier whose gain is variable and can be controlled by a DC voltage on the gate of the FET. R9 and R10 provide a mid-point voltage for op-amp biasing, decoupled by C6.

The circuit around TR1 and TR2 gives us our control voltage, by providing a variable speed ramp voltage; this is achieved in the following way: With S1 (a

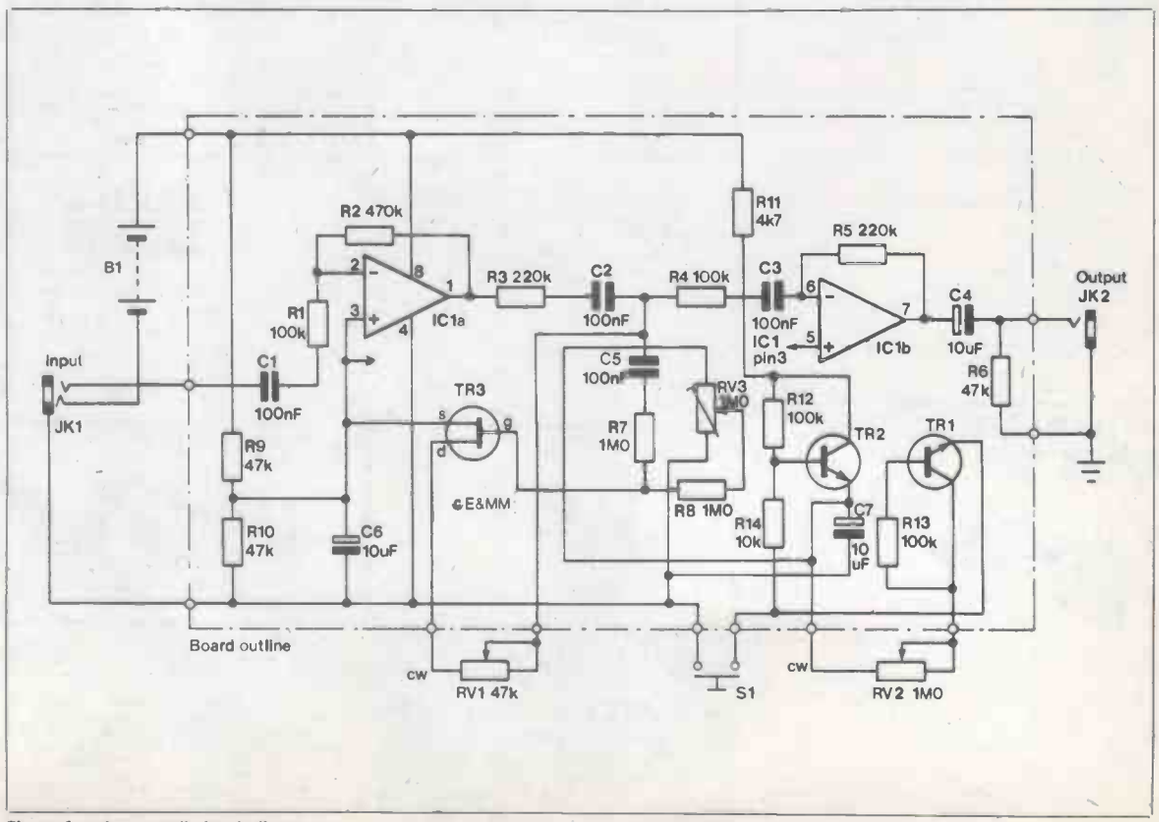
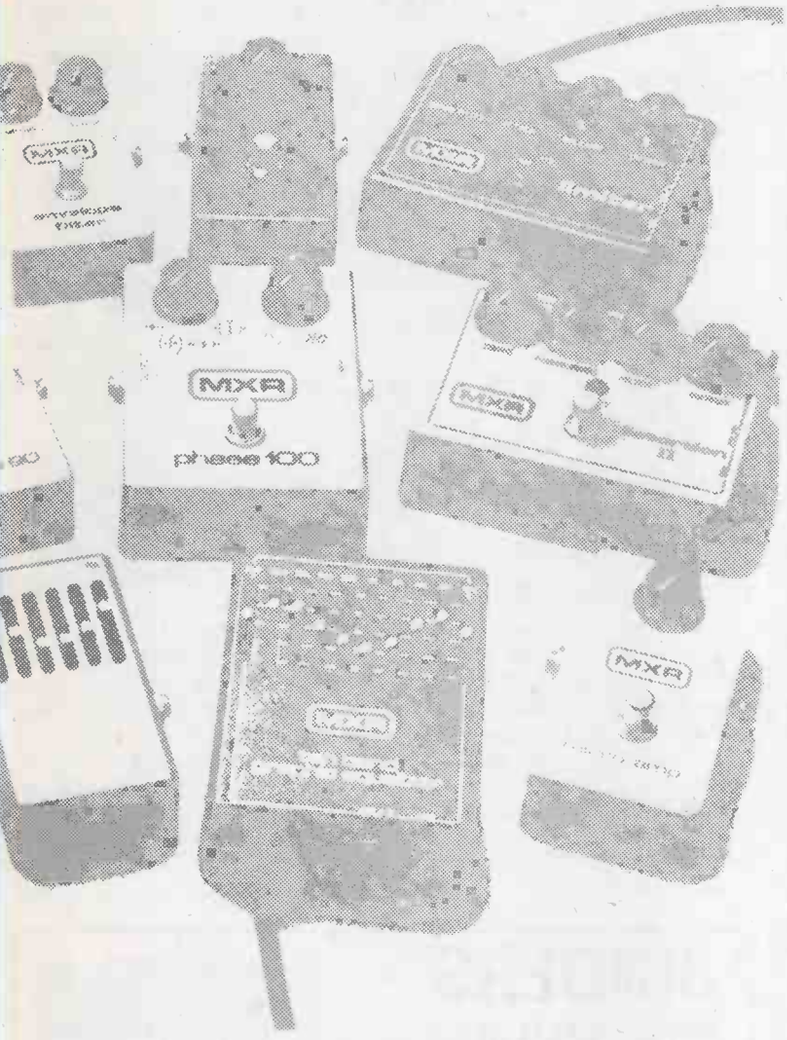
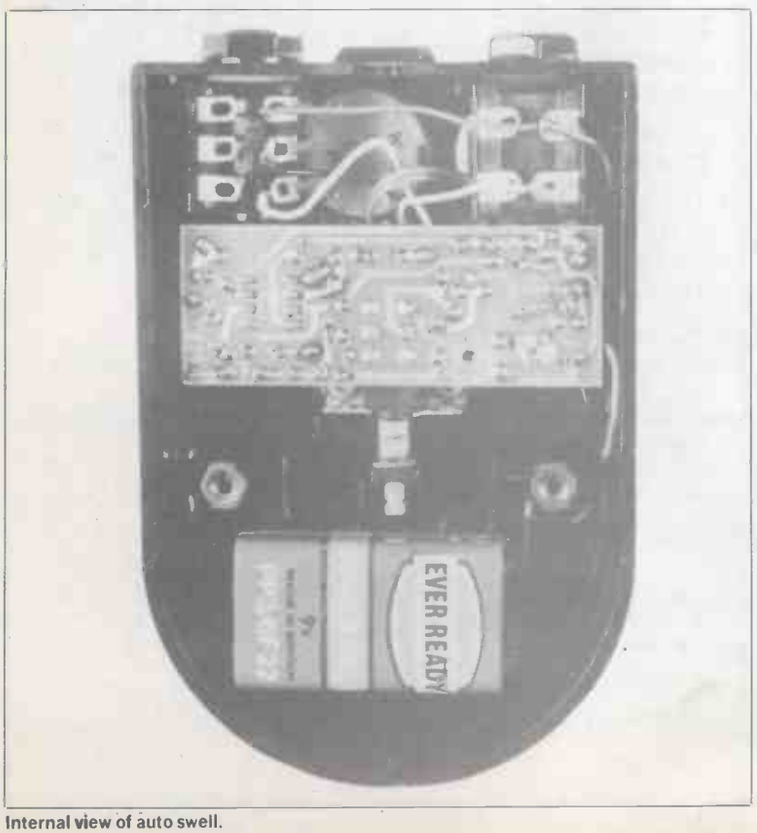


Figure 1. Auto-swell circuit diagram.





Internal view of auto swell.

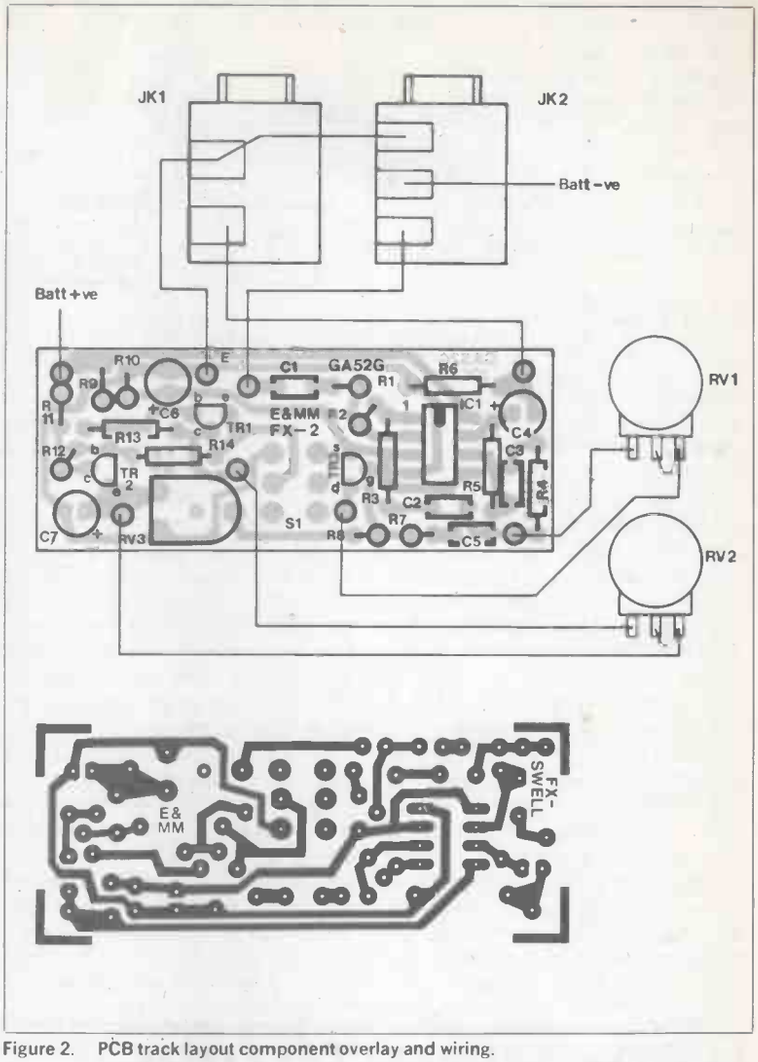


Figure 2. PCB track layout component overlay and wiring.

single contact push-to-make momentary action switch) in its normally open position TR2 will be forward biased via R12 and will charge up C7 to positive supply voltage. When S1 is closed TR2 will be cut off via R14 and no longer supply a charging current to C7, however the circuit containing TR1 will be completed giving a linear discharge path to the voltage on C7, the rate of which can be controlled by RV2. This discharge ramp is passed on to the gate of TR3 via RV3 which is set for the gate voltage of the particular FET used. The circuit is powered by a PP3 9-volt battery that is switched on when the input jack is inserted.

Construction

Assemble the PCB in the usual way, following Figure 2. Also fit wires of the appropriate length to connect to the controls and jack sockets. The board is designed to fit in a Cliff CFS-1 pedal box which comes with a switch similar to Maplin's two pole latchswitch; this needs to be modified as follows. First, bend back the four tabs holding the switch in the frame, remove the switch and disconnect the wire that comes with the unit. Now is a good time to drill the pedal box to take the pots and jacks, whilst the fragile parts are out of the box. Next, the switch needs to be converted to non-latching operation: push the spring back and carefully remove the action lever (see Figure 3). Now solder the switch on to the board, and mount the whole assembly in the pedal. Note that the switch is now upside down in the bracket; because of the PCB you will only be able to bend two of the tabs over, but this should be sufficient to hold everything securely. Finally, wire up the sockets and controls: don't forget the battery negative lead, which connects to the centre tag on the stereo jack socket.

Setting Up

After the unit has been constructed RV3 will have to be set to suit the gate voltage of the FET. First of all plug the unit into an amplifier and check that with an input present, the output can be varied in level by the range control. If this is the case then set RV3 to its mid-point, set the rate control to fast and the range control to x2, adjust RV3 such that by pressing the switch you just get a doubling in gain at the output. The best way to do this is to adjust RV3 to the end that gives

no alteration in gain at all when operating the switch, and gradually advance it until a doubling in level is achieved on operation of the switch, leaving it set at this point. This should ensure that the FET is working over its correct range and the range control is correctly calibrated. The unit is then ready for use.

Applications

The idea of this design was to produce a simple effects pedal that would give a gradual increase in gain to a guitar or keyboard signal at the touch of a foot operated control, the rate of the increase to be variable from almost instantaneous to around 3 seconds and the amount of increase variable from times two to times 10. The original requirement being to give guitarists the facility to apply sustain to individual notes within a solo by having a slow increase in gain that could be applied as and when required to counteract the natural decay in volume of the string. At this point I hear you all shout, "Why not use a compressor"? Well, the reason is that it cannot be applied to just odd notes here and there within a solo piece, and you also have to alter your technique to overcome the clipping effect to notes where you don't want it.

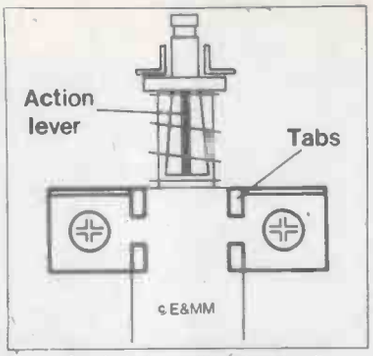


Figure 3. Switch modification details.

Although this was the main reason for designing the unit, it was soon found that it could be used to provide a vast number of other effects, and not only on guitar. I will mention a few of these and leave it to the constructor to discover the full potential of the unit. On guitar or keyboard it can be used with a fairly fast rate to produce violining or bowing effects by applying it at the start of each note played, or with a slightly slower rate the sound of a steel guitar can be imitated (very effective on chords). It can be used as a straight swell pedal with the range set to mid-way, or with the range set to x10 and the rate on slow a very intense crescendo effect can be obtained by playing a chord, applying the effect and letting it build in volume. With a range of x2 and instantaneous rate it can be used as a straight boost for guitars and with the range midway and the rate fairly fast you can make it sound as if you're playing backwards by applying it on each note and cutting it off sharply before playing the next note. (Like the guitar part on the Beatles' "Tomorrow never knows.")

Because the unit is in circuit all the time your instrument and amplifier settings will have to be adjusted to suit the way in which the effect is to be used, but as a guide you will find with the range control set to its mid-position you have a gain of unity, i.e. input signal equals output signal (that is with the switch in its normally open position). **E&MM**

PARTS LIST FOR AUTO SWELL

Resistors - all 5% ⅓W carbon unless specified			
R1,4,12.13	100k	4 off	(M100K)
R2	470k		(M470K)
R3,5	220k	2 off	(M220K)
R6,9,10	47k	3 off	(M47K)
R7,8	1M	2 off	(M1M)
R11	4k7		(M4K7)
R14	10k		(M10K)
RV1	47k log pot		(FW24B)
RV2	1M log pot		(FW28F)
RV3	1M hor. preset		(WR64U)
Capacitors			
C1,2,3,5	100n disc ceramic	4 off	(YR75S)
C4,6,7	10uF 35V PC electrolytic	3 off	(FF04E)
Semiconductors			
TR1,2	BC182L	2 off	(QB55K)
TR3	BF244		(QF16S)
IC1	LF353		(WQ31J)
Miscellaneous			
JK1	Stereo jack socket		(HF92A)
JK2	Mono jack socket		(HF90X)
	Knob	2 off	(YG40T)
	Knob cap (blue)	2 off	(QY01B)
	PP3 clip		(HF28F)
	PCB		(GA52G)
	Pedal switch box		(YK26D)
B1	PP3 battery		

RECORD REVIEW

Sequences
by Didier Bocquet
Pulse 004

Bocquet is one of the most promising of the fine young synthesiser players emerging from France. Previously overshadowed by the Germans, and penalised by bad management and insular record companies, they are now finding a receptive market elsewhere.

As one would anticipate, they play with a great deal more obvious passion, and very often with the romanticism, that we would expect from the land of Debussy and Messaien.

I'm normally frightened off by the mention of a Vocoder on an album cover but I found that he uses the Roland VP330 with string control quite brilliantly. Bocquet 'vocodes' sparingly and in such a way that the strong emotion he produces instrumentally is heightened further still. In fact, he is quite an advert for Roland hardware. He uses the System 100 and the SH-7 Polysynth with digital sequencer in addition to the VP330. Also featured are a couple of Mini-Moogs; a Crumar and a Yamaha grand piano.

The track "Short Winding" shows off what has become one of Bocquet's trade marks ... namely some crackling percussive sounds. As befits an ex-rock drummer, the underpinning of his themes by strong varied rhythms is felt on much of the album. It's interesting to note that one of the most successful German synthesiser records of the last year "Synthesist" (Sky 043) is also the work of somebody better known as a drummer.

Harald Grosskopf used to wave the sticks for Ash Ra Tempel. Though the Bocquet and the Grosskopf LPs are very different, both artists show tremendous skill in weaving strong melodies into ear catching textures.

At the moment, my favourite track is "Without Apparent Limits" (part 2), the last track on the album. A continuous throbbing ocean of sound engulfing some carefully crafted and logically developed themes. Music to play loudly! If you do you'll probably find it better to close your eyes. That way you don't feel so silly dancing about!

Bocquet has neither the fame of Jean Michel Jarre or the startlingly charismatic presence of Richard Pinhas, yet one feels that with this album he deserves to join the Pantheon of European electro-musicians. "Sequences" is a mature and satisfying work whose emotional energy makes the offerings of many established artists sound sterile and bland in comparison.

The album is also produced in real time cassette format.

Matthew Gavin

Dig It
by Klaus Schulze
Brain 60.353 (Import)

Dig It is the 13th solo album from Klaus Schulze and his last on the Brain label. All his new solo albums will be on his own I.C. label. The title may sound a bit dated but it is a play on words, Dig It - Digit, as this is a digital recording.

Technically speaking, the sound reproduction is superb, the digital process being far superior to the conventional analogue mode we have become accustomed to over the years. All the music comes via Schulze's new toy, the GDS computer. The first track is called 'Death Of An Analogue.' It takes the form of a dirge, with Schulze singing through a vocoder, mainly about the superiority of the digital process over the analogue, with such computer terms as 'one bit for you, one byte for me'. By contrast, track two, 'Wierd Caravan', is very up-tempo, played mainly with short, sharp notes sounding something like an electronic xylophone. The drumming on 'Wierd Caravan' is a loop by the band 'Ideal' who are currently recording on the I.C. label.

Track three, 'The Looper isn't a Hooker' is also up-tempo, it is far more interesting than the previous one and finishes more climatically.

Side two has just the one track, 'Synthasy', which lasts twenty-three minutes. It starts off very 'spacily' indeed with the odd electronic sound thrown in for good measure before settling down to a beautifl melodic passage reminiscent of one of his previous albums 'Moondawn'. Then we encounter some very aggressive chords halfway through the side, leading to a much faster tempo, the basic rhythm of which continues to the end with some speed changes and the addition of Schulze's voice, once again treated through a vocoder.

One aspect that stands out on the album as a whole is the percussion (with the possible exception of Wierd Caravan). More prominent than is usual, the percussion is very effective, having been put right up front.

For those unfamiliar with Schulze's work, this album would be a good starting point. The 'A' side is his most commercial so far, perhaps accessible would be a better word, commercial seems to imply a compromise purely for the sake of sales and this is not the case. The 'B' side however is more of the classic Schulze style.

All round, the album makes a good introduction for the newcomer, yet still satisfies the growing number of hard-core fans.

Dennis Emsley

Synthesist
by Harold Grosskopf
SKY 043

Synthesist' is definitely an album for those that like their synthesiser music in tasteful pastel shades - more like Monet than Mondrian - with hardly an angular line or threatening stab of black or white to upset the image. I also feel that the title suggests a degree of egotism which is rather suspect on a debut album, especially as the synthesiser techniques that he uses are of the 'pianist moving to synthesisers school' rather than those of a true electro-musician. The album is very much the product of somebody going into a multi-track studio with a handful of ideas and a good engineer. That said, Grosskopf at least uses the stock in trade device of multiple layering of sequences effectively, and his lead lines do convey some emotional response to the music that he's producing, though, once he has succeeded in building up tension, he doesn't really seem to know what direction to

take, apart from the inevitable fade

Harold Grosskopf is definitely not a functional harmonist, whatever else he may like to call himself, and composition has a pretty lean time on this album. While a number of the tracks are firmly stuck in a one-key musical niche (usually F major), with what momentum there is being derived from a real drum kit (a saving grace on many a keyboard-based album), others show marginally more tonal exploration. The opening track, 'So Weit, So Gut' (so far, so good - wishful thinking and a bit presumptious, I think!) belongs to the latter, and a quick analysis may help to illustrate the Grosskopf approach.

For the first 40 bars, the track moves along in F major, ably assisted by the kit and a 4-beat sequencer pattern (D/F/G/A\G\F\D). A second sequence (F/Bb\A\F) enters on top of the first, but in a higher octave, and continues for the next 18 bars. The music notches up to G major for the next 24 bars and then falls back for another 32 bars of F major, at which point the lead line enters. A brief foray into A minor results from another modulation via G major and then the track retreats back to the home key. And so things continue in that vein. Of course, it's very easy to be snooty about such musical limitations, and many 'minimalists' like Steve Reich and Philip Glass make a positive virtue out of them.

It's to Grosskopf's credit, then, that such a track achieves a certain degree of fascination for the listener.

Side 2 of 'Synthesist' contains considerably more interesting material, mainly resulting from the inclusion of 'space sounds' (to quote from the record sleeve) courtesy of Udo Hanten rather than Grosskopf himself. Actually, 'space sounds' seems a misnomer, as most of these effects are of the Middle Earth subterranean grunting variety, but no less impressive for that. Invariably, though, Grosskopf uses them as a non-tonal backcloth over which to drape his own repetitive meanderings. In fact, the first track on this side, '1847 - Earth', sounds remarkably like a certain Tangerine Dream track, with a bouncy sequenced bass line and a rapidly repeated ADSR applied to the lead line.

In sum, a curious album, musically uninspired, but well produced, strangely anachronistic in these days of 'socially realistic' rock - it certainly takes some courage (or naïvety) to call a track 'Transcendental Overdrive' in 1981!

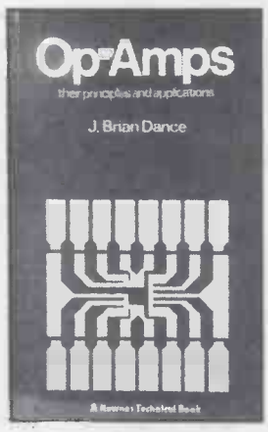
David Ellis

BOOK REVIEWS

Op-Amps - Their Principles and Applications
by J. Brian Dance
Published by Butterworths.
Price £3.45

The operational amplifier is so much a part of life in electronics and technology today, being widely used in every field from measurement to high fidelity, that any text on the subject is worthy of serious consideration. This is all the more so when the author of the work is one well-known in the world of technical publishing for his fruitful production of practical material directed at both the amateur and the professional reader.

This book offers a well set-out introduction to the sometimes confusing world of operational amplifiers, with a sensible glossary of the terminology used and a comprehensive index to guide the reader to areas of particular interest.



Brian Dance has managed to cram into some 88 pages a wealth of useful and, on the whole, well-ordered facts concerning both the various forms of operational amplifier and the ways in which these can and should be used. He has given practical circuits and leads the reader past many of the pitfalls that can beset the user of these devices.

Whilst he quite intentionally avoids the original area of application for these devices, that of computation in analogue computing machines, he provides comprehensive coverage of other areas including both AC and DC use in measurement, power supply applications and audio uses including low-noise circuitry.

He has gone to some lengths to avoid becoming bogged down in any abstruse mathematics, at the same time providing simple descriptions of the more complex parameters of an operational amplifier. This alone makes the book worth having - particularly as an introductory guide to these devices.

It is perhaps in this area alone that the text falls a little short of its aim to instruct since, in the reviewer's opinion, a few of the simpler formulae could well have been included to great advantage without adding confusion, and in one or two locations the odd photograph or somewhat more detailed drawing would have added greatly to the clarity and general value of the book.

Notwithstanding this, Brian Dance has produced a book which has undoubted value, particularly to the uninitiated in the field of op-amps.
Dick Railton

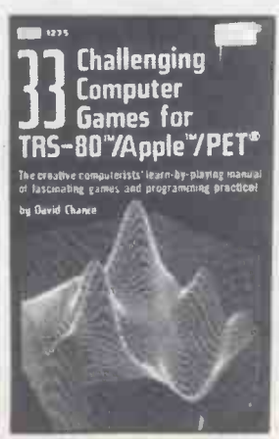
---

33 Challenging Computer Games for TRS-80/Apple II/Pet
by David Chance
Published by Tab Books Inc. and distributed by W. Foulsham & Co Ltd
Price £4.75

The author of this book claims that the TV is a modern relic, at least in those households where the computer has gained entry. His aim in writing this book is to speed up the latter's domination of the living room. Whether one agrees with his point of view is another matter. Nonetheless, he has put together an imaginative range of programs which are presented in a manner that is both clear and instructive.

Chapter One introduces the book and the remaining seven chapters are devoted to games which range from Games of War through such diverse topics as Learning; Self-improvement; Adventure and Disaster; Calculation; Speed and Order, to Games Using Graphics. Being an aviation buff myself I especially liked 'Bombardier' though the phrase 'Bombay doors open' reads more like the freedom of the city than the operation of part of an aeroplane (bomb-bay)!

The first 29 games can be run on any of the three computers stated; directly on TRS-80 Level II and on Apple II and Pet by exchanging appropriate statements from TRS-80 Basic to the relevant Basic form. Obviously TRS-80 owners have the best of it; Apple and Pet owners will have a little extra work to do, but not too much. However, the final four games which employ graphics are written for TRS-80 graphics and will, therefore, run only on this machine.



Each game is wittily introduced by a simple pen sketch and is presented in the form of a sample run (where applicable), a flow-chart and the program listing in TRS-80 Basic. It is this format that is one of the strengths of the book since it encourages the development of one's ability to program in Basic rather than mere slavish copying.

The book concludes with three appendices, giving a run-down on the three varieties of Basic used by the computers of the title. Also included is a brief index.

Summing up, the author has presented, clearly and inexpensively, the dedicated games player with enough mental stimulation to while away even our long winters. Certainly he has justified the use of the word 'challenging' in the title.
Graham Dixey

The GIANT Handbook of Electronic Circuits
Edited by Raymond A. Collins
Published by Foulsham-Tab
Price £10.25

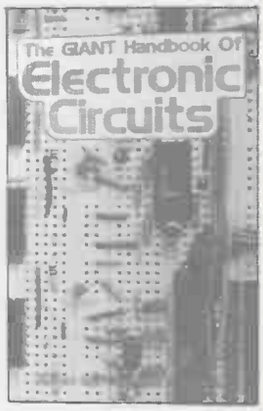
Although expensive for a paper back the title really does live up to expectations; the book is thick (5 cm actually) and contains enough circuits to keep the Circuit Maker pages in print for over 15 years. A more apt title would possibly be 'Dictionary of Electronic Circuits' for that is what it certainly is.

The book is divided into 60 chapters, each containing circuits within a certain classification be they waveform generators or battery chargers. The necessity for a good index is obvious and for once it is possible to report that an extensive index is included, which, with the chapter titles, means that the chances of finding the required circuit are very high.

The material for the book is drawn mainly from manufacturers data sheets and application notes. Some of the contributing companies are well known (Motorola, National Semiconductor), others are less well known, particularly in the amateur field (Analog Devices, Precision Monolithics). The circuits themselves vary in presentation considerably indicating that they have been reproduced directly from the data/application note and some are much more legible than others. Some circuits do not identify the pins used on the integrated circuit, and in one or two cases the IC itself is not identified. These offenders were obviously reproduced from a data sheet dealing with one particular IC where the cryptic pin labels were explained elsewhere. Certainly no excuses can be made for one circuit which uses a resistor of value Rx together with a note: "See text", when the text is not reproduced. Better editing in these areas would undoubtedly improve the book.

Having said this however, it is often easy to guess what IC is being used, and pin connections should not cause too much of a problem.

It is important to stress that the title '... of circuits' means just that - no construction or test procedures are included. This will give problems with several of the circuits, particularly those using integrated power amplifier circuits since decoupling is critical if the 20MHz power oscillator syndrome is to be avoided. A further problem with this approach is that no circuit description is included and while most of the circuits are self-evident one or two have defied all attempts made to understand their operation. In fairness to the book however, it never claims to be anything except a collection of circuits.



It is in the actual construction that problems might occur since this is an American publication. A brief guide is included with the book, but this guide is very general and is limited to pointing out differences in standard wire gauges, battery labels, mains voltage and TV standards. Not much use if you wish to build a circuit using a HEPR0080 (1N4002) or a HEPS011 (?????).

Do the circuits work? Several tried at random did without any trouble but the chance of all 1100 working first time must be fairly small. Apart from obvious substitution problems, some manufacturers are not always totally honest when preparing data and several classic examples of 'never' circuits exist. It is only reasonable to assume that some of these may have slipped through.

Some gaps are noticeable, LSI and VMOS does not receive a mention. Siliconex, for example, produce a very good VMOS application manual worthy of a chapter in its' own right.

These points aside the book is a veritable collection of useful circuits, and most particularly well indexed circuits. No one person could hope to collect all the data that the book is drawn from and so it must be considered worthwhile. The book is not much use to those people who have acquired an XY Z145 chip and want to use it, nor is it much use to the less experienced person who will run into difficulties because of the sparse nature of the information. The more experienced person will find the book a good buy because it will provide the raw circuit upon which to work; the more experienced will also know that the HEPS011 can be replaced in most of the circuits by a humble BC184.
Chris Lare

America

Tim Schneckloth

Last month, you may recall, we were in Chicago, taking a brisk stroll through the NAMM International Music and Sound Expo, the largest American musical instrument trade fair. Well, through the underrated magic of printed media, we're back there again to see what we missed last time.

It's no secret that Peavey Electronics has lately had a greater impact on the worldwide electro-music scene than most American manufacturers. Company president Hartley Peavey places great emphasis on innovation; he constantly tries to keep ahead of his competition from the U.S. and elsewhere in providing maximum quality for the money.

At this year's NAMM show, Peavey's big news had to do with guitars. The company is shipping the T-15 guitar which, according to Peavey, is the only American-made guitar retailing for less than $200 (including a hard shell case). As something of a guitar snob, I tested the T-15 as critically as I could and had to concede that it's an excellent instrument for the money. It features a 23½-inch scale maple neck with Peavey's patented bi-laminated construction and full adjustment capabilities. The body is made of contoured hardwood and is fitted with two high performance pickups with selector switch and an adjustable bridge.

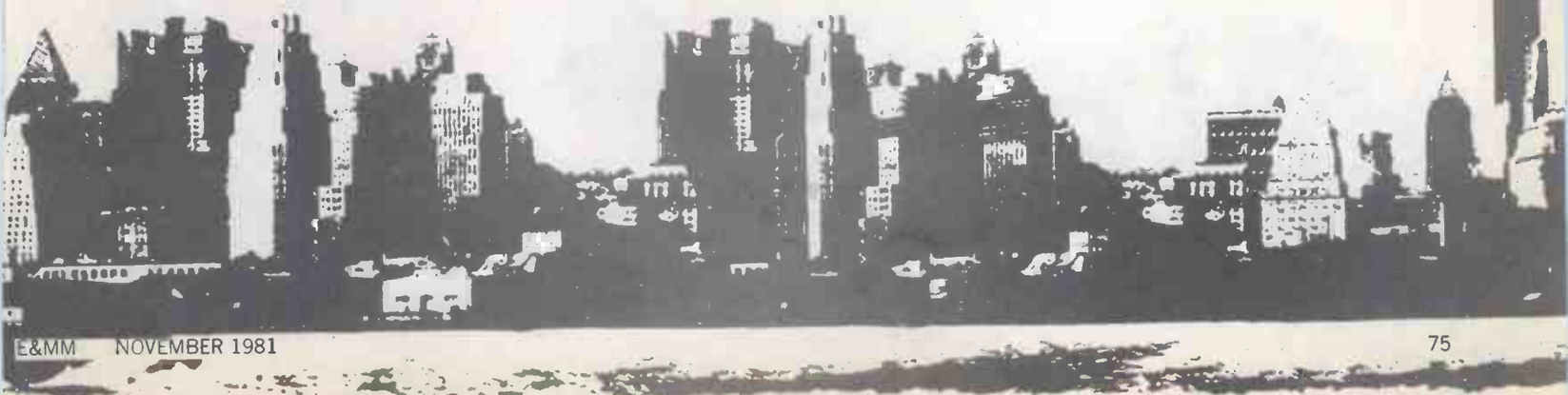
Another new axe from Peavey is the T-JR, a miniature electric guitar that seems to be surprisingly playable. Aside from the novelty aspects, the instrument should open up new possibilities in performance locations. I can hardly wait to try one out in the front seat of a sports car, a cramped water closet, underground trains. The mind boggles!

For those in the market for sound reinforcement equipment, two of the leading American microphone manufacturers had new wares on display. Shure Brothers, that well-known concern from the banks of Lake Michigan, was touting the SM85, a handheld condenser microphone designed for professional entertainers. It has an integral multi-stage pop filter, a mid-range presence peak, extended high frequency response, a controlled low frequency roll-off, and an effective internal shock mount for reduced handling noise. The microphone's electronics section is protected by a lightweight but rugged aluminium case and a tough steel grille. Both the case and the grille feature a scratch resistant, ebony polymer finish. As if that weren't enough, it also boasts "a high-level signal handling capability and a smooth and consistent cardioid pattern at all frequencies for exceptional off-axis rejection of unwanted sound for improved separation and isolation," say the Shure people.

The PL88 microphone from Electro-Voice is no slouch either. It's a dynamic cardioid vocal mic that features voice-tailored frequency response characteristics and resis-

Peavey demonstrator with T-JR guitar.

Shure SM85 microphone.



tance to the nasty noise that occurs when you're throwing it around on stage. It's finished in a non-reflecting snow grey with a contrasting charcoal grille. It has an on/off switch and is available in both high and low impedance models. It can be had for less than $70, too.

Now that we have these wonderful microphones, we need a mixer, right? Well, as luck would have it, the people at Edcor have a new automatic unit called the AM400. With this mixer, up to seven units can be "daisy chained" together, providing control for 28 inputs; the first unit becomes master and the other six become slaves. It has variable depth of attenuation controls for each input - instead of completely turning each channel on or off, the unit allows the user to turn off each channel by degree. Logic outputs let the user mute certain speakers by activating relays when channels are opened or closed.

According to Edcor, the AM400 is "a hybrid of digital control and analog circuitry." The company also maintains that the attack time for each channel is too quick to be noticed in the form of "clipped" consonants. Its suggested retail price is $500.

New at the show from Morley were two new miniaturised effects: the Sync-Attack and the Sync-A-Wah. How would you like to have the job of thinking up names for sound modification boxes? Anyway, both units are pocket-sized; they were designed to be small and light enough to clip to a guitar strap.

The Sync-Attack enables the musician to control the speed and character of his attack. It also lets him simulate string, woodwind and keyboard sounds. The Sync-A-Wah, on the other hand, provides a 'Wah' effect for each note attack and eliminates sound level sensitivity problems and the need for special settings. According to Morley, very soft, subtle, wahs or strong wahs can be played without altering playing technique.

From Imaginearing Audio, a small, entrepreneurial company in Oregon, we have the Echo/Digital Recorder, a digital storage unit with an easy-to-operate computer control key-pad programming section. This enables the user to echo, delay, reverse echo, record and play back forward and reverse, all in segments of .001 seconds to 16.777 seconds. The product uses no tape and has no moving parts. It's available in two models: one with a 16-second memory, the other with an eight-second memory. Each can be purchased for under $2,000.

Another entreprenuerial type,

Morley Sync-Attack and Sync-A-Wah,

Dennis Craswell of California's Poly Keyboard Interface, spent the NAMM Expo busily demonstrating two keyboard instruments. One was a quite substantial polyphonic synthesiser; the other was a tiny, wireless combination microphone and keyboard. According to Craswell, the instrument was built especially for Elton John, but somehow Elton neglected to come around and pick up the instrument. Such is show biz!

On the subject of portable synths designed for stage use, Performance Music Systems once again displayed their Syntar, a hybrid electric guitar/synthesiser. It weighs only 14 pounds and contains a three-octave keyboard on the main body. The neck is a nine-key, left hand keyboard/multiple controller. The instrument also has five interface jacks within the power supply. It comes with a 30-foot cable, owners manual and various accessories. Suggested list price is $1695.

Octave-Plateau Electronics, Inc. showed its newly developed line of synthesisers: Voyager 1, Voyager 8, VPK-3 and VPK-5. Both the Voyager modules share a 32-program memory with tape load/dump and a 32-page program stepper allowing any sequence of programs to be accessed with a footswitch in either forward or reverse direction. Both feature paral-

Octave-Plateau Electronics display at NAMM Expo.

Guitar design from Charvel.

Edcor AM400 Mixer

Dennis Craswell demonstrates Poly Keyboard Interface products.

Hartley Peavey and wife Melia with Peavey T-15 guitar.

leled memory bank control between modules and computer interface for expansion. Each has a standard 19-inch rack mount chassis for uniform arrangement of module arrays. The Voyager 8 has eight voices, a split layer or whole eight-voice keyboard module and arpeggiator. It can drive slave synthesisers with left and right hand sections. Stereo/mono outputs are also featured.

The VPK 3 (mono) and VPK 5 (poly) keyboards both have velocity and pressure sensitivity and an XY spring-loaded joystick controller that can connect to the Voyager 8 with a common mic cable, and can control several Voyager system modules simultaneously.

And for guitarists, Charvel Manufacturing had some interesting designs for various solid body guitar types. So, if you should ever have an overwhelming urge to play chess on a Gibson Explorer, Charvel are the people to see.

Companies and manufacturers mentioned:

Peavey Electronics, 711 A Street, Meridian, MS 39301
Shure Brothers, Inc., 222 Hartrey Ave., Evanston, IL 60204
Electro-Voice, Inc., 600 Cecil Street, Buchanan, MI 49107
Edcor, 16782 Hale Ave., Irvine, CA 92714
Morley, 6855 Vineland Ave., North Hollywood, CA 91605
Imagineering Audio, 5558 S.E. International Way, Milwaukie, OR 97222
Poly Keyboard Interface, 437 Marsh Street, San Luis Obispo, CA 93401
Performance Music Systems, P.O. Box 6028, Bend, OR 97701
Octave Plateau Electronics, Inc., 928 Broadway, New York, NY 10010
Charvel Manufacturing, P.O. Box 245, San Dimas, CA 91773

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To fit the maximum information on a line please use the codes listed: Inst. categories (except M&C) imply the use of electronics with inst. specified.

NAME
TOWN
COUNTY
TELEPHONE

INSTRUMENT
K=KEYBOARDS
O=ORGAN
G=GUITAR
E=ELECTRIC BASS
M=SOUND ENGINEER
D=DRUMS
V=VOCALS
S=STRINGS
W=WOOD
B=BRASS
C=COMPOSER

LEVEL
B=BEGINNER
M=AVERAGE
A=ADVANCED

TYPE OF MUSIC
C=CLASSICAL
J=JAZZ
P=PROGRESSIVE
R=ROCK
E=EXPERIMENTAL
B=BEAT
G=REGGAE
O=ORGAN
V=VARIOUS

ELECTRONICS
D=DESIGNER
C=CONSTRUCTOR
N=NEITHER

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COUNTY	**TELEPHONE**
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INSTRUMENT	**LEVEL**
K	M
MUSIC	**ELECTRONICS**
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Kevin Lark, Sutton, Surrey, 01-643-3141, KG, BA, PRE, -.
Paul Walker, Birkenhead, Merseyside, 051-644-9915, G, M, PRE, -.
D. A. Parvaz, Henley, Oxfordshire, 073522-3766, KDS, MMB, V, -.
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Andrew Cox, Launceston, Cornwall, 0566-3782, KG, M, E, -.
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Derek Tallent, Langport, Somerset, 0458-250-985, M, -, V, -.
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Clive Allen, Llandudno, Gwynedd, 0492-82930, G, M, B, -.
Martin Davies, Bridgwater, Somerset, 0278-55060, D, M, V, -.
Mark Woodham, Northampton, Northants, 0604-45622, KOC, A, E, N.
Chris Askwith, Leeds, West Yorks, 0532-682816, G, M, R, -.
Steve Gould, Halesowne, Westmidlands, 021-5594602, K, B, E, -.
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Andrew Walden, Capel St. Mary, Suffolk, 310439, K, B, E, C.
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Andrew Hammond, Maidstone, Kent, 0622-677776, GV, M, EV, C.
Allan Bula, Bexhill, E. Sussex, 0424-210410, K, B, V, N.
Philip Hammond, Maidstone, Kent, 0622-677776, E, M, EV, C.
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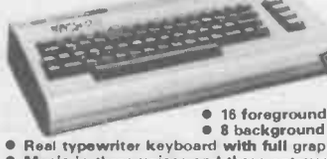

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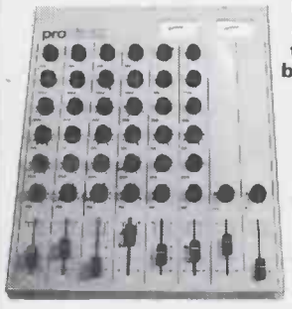

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