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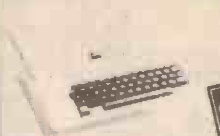

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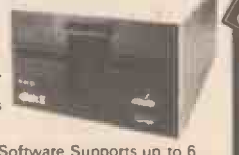

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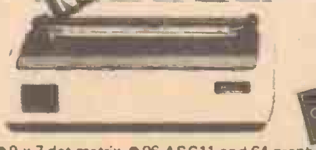

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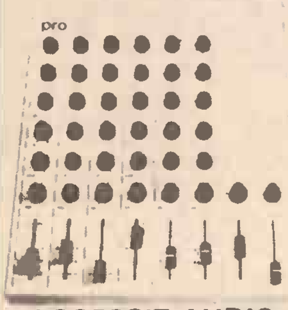

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ELECTRONICS & MUSIC MAKER

Rick Wakeman joins E&MM

by Mike Beecher, Editor
Electronics & Music Maker.

I have been looking for some time for a well known musician who specialises in keyboards to join our consultants.

With Warren Cann already making his first important contribution in last month's issue about the developments in electronic drums, there is no doubt that musicians young and old, beginner or advanced can learn from others who have a dedicated interest in their playing.

There are many respected musicians in this country and abroad who read E&MM and I recently met Rick Wakeman who had no hesitation in offering to be the first of our consultants on keyboards.

Rick studied classical music and composition at the Royal College of Music and over the years has developed his own style of playing multi-keyboards from grand pianos to synthesisers that thousands admire. Besides preparing the musical scores for his own rock band along with large orchestras, and choirs, he will be putting pen to paper for E&MM from time to time. I feel sure his own opinions on the world of electro-music will be of interest to us.

Over the next few months we shall be looking at ways of helping readers who have little or no training in music. Our feature this month tells about music education at the City University and we shall continue to examine the opportunities for learning about making music through the use of electronic instruments and computers.

Micromusic has prompted us to look closely at Pascal as an alternative to BASIC, simply because real time interfacing between instruments and computers using the latter is just not quick enough for serious composition. For those unfamiliar with machine code here's a possible alternative that looks promising.

Interfacing instruments is of tremendous importance for the electro-musician and it's a subject that can be learnt by reading and experimenting for yourself. Using your computers with synthesisers can be a challenging step forward as a compositional aid and we take a look at micro interfacing to put you in the picture.

Finally, our younger readers who enjoy experimenting with sounds will have plenty of fun from the kit reviewed in our Education pages.

Mike Beecher

Readers Letters

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

Dear Sir,
Thanks for the magazine, highly informative as it always is. It's good to see someone at last catering for electro-musicians with a practical periodical. That said, I must admit that despite having bought all the editions of E&MM since it started, I don't have an incredible amount of interest in assembling your constructional projects; I leave my soldering iron in storage most of the time unless it's to make up patch boards or leads.
My main interest is in the music section of your magazine, which I find quite informative; in particular the 'Sound on Stage' items and the 'Guide to Electronic Music Techniques'.
Unfortunately I am left with the overall impression that music is taking a back seat to the electronic processes of producing it, and that it is perfectly acceptable to have huge racks of equipment when one's playing skill and general musical ability would be laughed at by a Grade Two piano student.
I am not alone in my opinion that what some electro-musicians regard as music is in reality a simple melodic figure that would fail to impress an O-level examiner, enhanced by bangings and swishings of white noise and all manner of special effects. We speak of electronics being the future of music, but it can never be so until we have mastered the playing techniques of the synthesiser and learned to apply the proper harmonic content of conventional music to it.
So many students of music choose the concrete format because they consider that the final mix is not critical as regards tuning or rhythm. In other words, when improvising several layers of the mix separately one cannot feel the same emotions evoked by the music. The resulting mish-mash is given a name and played to other devotees of electronic music, who will accept it purely on the basis of the sound and the associated knobs, flashing lights and mountains of black plastic that one normally visualises when thinking of synthesisers.
None of us can successfully make music by purely messing around with a synthesiser. There must be something controlling the hand on the keyboard which can turn a technological innovation in sound into a meaningful piece of music. So I suggest that when we switch on our keyboards we do not waste time making strange noises which have no meaning: the most effective method of playing is to practice conventional keywork. Develop the level of skill before sorting out the different sounds.
So, E&MM readers! If you want to make your mark as an electro-musician, let the music come first. Try and make up a few decent tunes with interesting harmonies, then worry about the sound effects. You'll only know true success when you can play what you want to play live. And that takes practice and originality. That's what makes you an electro-musician.

R. H. Ward
Gainsborough, Lincs.

Dear Sir,
I am the first reader in Pulau Pinang to write to you in the hope that you can help me and the world enthusiasts to build an electronic Hawaiian Guitar (eight or six strings). You are the only magazine I can really depend on to create something new for people to see in Pulau Pinang, the younger generation do not even know what a Hawaiian Guitar looks like.
Please send me just the scale with the actual measurement so that I can complete the guitar in three days. Another magazine helped me once to make a Hawaiian Guitar but I could not trace the scale drawing of the construction.
The Mosfet Amplifier constructional project impresses me very much and I hope to build it upon finding MOSFETS 2SK133 and 2SJ48.

Khoo Seng Hwa
Pulau Pinang,
Malaysia

It is quite simple to calculate the fret positions for any fretted instrument once you know the scale length, i.e. the length of the string between nut and bridge. Hawaiian guitars generally have the same dimensions as a normal guitar; say 25 inches or 63cm scale length. The distance of the first fret from the nut is obtained by dividing the scale length by 17.817; then the distance between first and second frets is calculated by doing the same division on the measurement between first fret and bridge, and so on down the neck. As a check on your calculations, the 12th fret should be exactly half way along the string. If the guitar is to be used solely for Hawaiian playing, you probably will not bother with frets, but simply mark the fingerboard at the appropriate positions.
If you have access to a standard guitar, it may be easier to take your dimensions from that.

Dear Sir,
Please would you give me some advice on the Mosfet Amplifier. I have built one channel using two 2SK134 Mosfets and two 2SJ49 Mosfets in parallel. I would like to know if RV1 still remains set at 50mv when 4 transistors are used?
Secondly, I have built a good quality preamp with the power amp and will use it to play an Ovation acoustic guitar, though I have used the Maplin toroidal transformer 35-0-35 rated at 300VA and would like to make the second power amp but instead of stereo power amps would parallel both outputs together to give more power into one 15 ohm speaker.
The speaker is the 'Peavey Black Widow' rated at over 200 watts, impedance 4 ohms. I'm not happy with the power supply, there is too much hum. I thought of putting another 2 4,700 uf 63v can elect in parallel with the two already installed. Perhaps you could suggest something better to reduce the hum.

S. D. Howe
Tynemouth

Firstly, the quiescent current should be increased to around 75mA (not mV). Secondly, connecting two MOSFET AMP outputs to one speaker is called bridging and one amp input must be fed with a signal 180° out of phase to the other amp input. No provision is made on the PCB for bridging.
Using a 35-0-35 VAC transformer and driving into a 4 ohm speaker, approximately 150WRMS will be developed. 2 amplifiers, 2 speakers and an uprated power supply (4/6A transformer) will produce a 300-watt RMS sound wall, and acoustic feed-

Readers Letters

back may become a serious problem! The PSU should produce an extremely low hum level in the speaker (not audible) with the Amp inputs short circuit to 0V. You may have an earth loop between pre-amp and and power-amp. Connect the amp input screened cable to 0V at either Power Amp or Pre-amp only.

Dave Goodman

Dear Editor,

My son and his friends have formed a pop group, 3 guitars, drums and a singer. They have played in pubs and discos and they are now listening more closely at the sounds which they produce.

One of them is a reader of your magazine and the May issue with the signal mixer project set him thinking, although his electrical knowledge is limited like mine.

He feels that one person should sit with the group and balance the individual signals through a control unit, the singer and drums having microphones. The circuits are to be controlled individually (he thinks that mixing them can cause cross distortion). The individual signals would be preamplified and then passed through volume controls so that the sounds can be balanced, a meter in each circuit would enable notes to be made for future reference. It seems logical at this stage to incorporate a bass/treble control for each circuit. The signals would then pass to the main amplifiers. It occurred to me that the person sitting with the group may not judge individual sounds easily, so can he be hooked in with headphones with their own volume control?

I trust you will forgive me if this letter seems pedantic. I am not conversant with this type of equipment but would like to help them produce a unit which is not over-expensive.

A. Jones, Purton, Wilts

On the contrary, the train of thought in your letter is that which has led to the development of some of the more sophisticated consoles in use today. What you have arrived at, is a fairly accurate description of a typical mono mixer, in general use with today's music makers. The signal mixer described in the May issue is the most basic. For optimum performance, the microphone input signals should be individually preamplified to a level which is not likely to cause noise level degradation.

Individual tone controls are particularly useful, to make up for differing acoustics and microphone qualities. At the end of each of these input 'channels' is a level control, normally of the slide rather than the rotary type for convenience of use.

These signals are now combined and fed to a master level control and final amplifier.

As you rightly say, it is necessary to 'monitor' the signal so that the mixing man is aware of the signal level that is being put out over the PA amplifier or into a tape recorder, and also to make sure that the mixer electronics are not being overloaded.

A 'VU' type scale level meter is normally used for this as it presents an actual voltage reading of what the mixer is putting out to the system. The input level control on the following amplifier or recorder is set to follow this level for best performance. Headphones are reserved for a signal quality and balance check rather than accurate voltage monitoring, as engineers listening level settings tend to vary greatly, and so preferences cannot be deemed as accurate.

In terms of monitoring the individual input channels, this is most economically accomplished by featuring a switch which can momentarily switch the input signal to the 'VU' meter to check that the levels are correct. In practice, making note of individual level readings is not really practical as levels from different microphones tend to vary according to the performer, location, type of music and so on.

So far I have simply expanded on your thoughts, two further features are also commonly found in this kind of sound mixer.

Firstly, most mixers have channel 'pan' controls and an overall stereo output. The former enables any of the input signals to be positioned between the left and right outputs of the mixer. Whilst the use of stereo is often disputed for sound reinforcement, it is most certainly a useful facility if the mixer is ever to be used for recording work. A stereo output simply implies duplication of the master level control, amplifiers, metering and monitoring.

Secondly, some form of effects system is also incorporated. This takes the form of an extra rotary level control on each channel, which forms part of a separate mixing circuit, feeding a proportion of the chosen input signal to an effects unit. The output of the effects unit is recombined with the main signals via a spare input.

That just about covers the anatomy of a modern mixer in a nutshell. Bigger mixers have fancier tone controls, more inputs and outputs and greater sophistication in electronics and construction. Some mixers have become so complex, that the engineer needs a computer's help to operate them. Essentially though, they all do the same thing, combine and process musical sounds.

You will find several mixer kits advertised in this magazine which have the features you are looking for. It may be an idea to request an assembly manual before you start building to make sure of what you are letting yourself in for!

Mark Andrews

Dear Sir,

I am still very interested in your excellent magazine (although earlier issues were quite difficult to obtain).

I have recently bought a Hammond E100 Organ and to extend the performance, I would like to include the 'Leslie' effect. Do you have an electronics circuit which I could use? For instance, would the 'Matinée' rotor sound be suitable?

Robin Clarke
Melton Mowbray

The Matinée's rotor sound compares favourably with other electronic circuits used in lower priced organs for this essential effect.

Wersi also produce a complete kit for making a sophisticated 'Leslie' and string phased sound that is used by many professional musicians for recording studio sessions, to eliminate the background noise and clicks found on mechanical units.

Dear Sir,

With reference to the PA Signal Processor project in E&MM August '81, I would be obliged for any comments regarding part of this project.

I would like to use the PPM section of this article and would like to know if part of the limiter circuit could therefore be omitted so that the audio input (from loudspeakers) could drive the display chip.

R. E. Golding
Ashford, Kent

One of the design briefs during the development of the PA Signal Processor was that each module should be able to be used independently if required and because of this it is very easy to employ the PPM section in other equipment.

The PPM circuit may be used on its own as drawn in Figure 6. Naturally if speaker level input is required some form of input attenuator should be employed to feed the PPM input with 30mVolts. In these circumstances it would also be wise to connect a diode between each supply rail and the input after the attenuator to prevent nasty accidents to the 311 if the level is too high. This scheme works because the PPM circuit does actually rectify the incoming signal, however it only acts as a half wave rectifier on the positive peaks, the negative peaks being ignored. Since in speech particularly the positive and negative peaks may differ by up to 10dB this is a limitation. It is for this reason the precision rectified output of the limiter system was used; this output is a fully rectified version of the input signal thus positive and negative peaks are fed to the PPM which rectifies them again (with no effect obviously). If a PPM with full wave rectification is required, part of the limiter section as suggested must be included. Obviously a speaker output is of low impedance and so it would be in order to connect the speaker signal directly to the precision rectifier section via a suitable attenuator into C105, using the output of the rectifier as indicated for the Signal Processor.

Chris Lare

Dear Sir,

I must congratulate you on your magazine E&MM — quite the most informative and useful electronics/music mag. around despite the distressing disappearance of the Spectrum Synth articles from your pages (a temporary omission I hope — it looked very promising).

However, this month's plethora of computer based Composer Cartridges, Micromusic/Alphadac programmer etc takes the average electronics/music reader well into the hostile and sterile hinterland of a grotesquely computerised future with not a dotted semiquaver or single op. amp. to reassure him. How one is expected to be creative in such a technology and jargon entwined undergrowth beats me.

The reason for this slightly unsympathetic and unreasonable moan is that for years I have felt the need for a particular piece of electronic/musical hardware and without the exception of the original Pianola roll cutters I have yet to hear of it. Yet the field of computer based wonders proliferates and still the concept I have has not emerged and I wonder why.

As a composer many of my musical ideas are arrived at by the process of improvisation at the keyboard — usually at the piano and whilst one can use a recording as an aide memoire it is often not enough. Unfortunately the flow of creative thought is constantly being interrupted and sometimes destroyed by the mechanical necessity of having to stop and write the music down using conventional musical notation. What with this stop/start progression and my notation getting more and more undecipherable I hope you will bear with my growing impatience with the proliferation of computer based musical gadgets which totally ignore the true composer or indeed his temperamental inability to cope or even understand the differences between a RAM, ROM, floppy disc or Space invader.

Clearly what is needed is some form of instant print out and with a bit of R & D I'm sure your boffins could come up with some solution not using the computer route (too expensive, sophisticated and hide bound with jargon, menus and mystique) but using a print-out type terminal giving dots and streaks on a paper record which in some way can be easily read or converted to standard musical notation.

What would seem to be needed is as follows:

1. Keyboard contacts fitted to the piano keyboard — one contact per key.
2. A current or voltage sensitive paper i.e. metalised paper capable of retaining a burnt record of its passage beneath a row of contacts (one per note) and a transport mechanism capable of transporting the paper tape past the electrode contacts. Bar lines i.e. passage of time could be added later.
3. A pulsed 'burning' current — pulse frequency being at least twice the fastest playing rate i.e. about 50 Hz.
4. Current pulse demand being equal to all fingers depressing keys simultaneously e.g. 10 keys pressed (rare but not unheard of).
5. A special printer head with one electrode contact per keyboard note (it may be advisable to restrict the number to 72 or there abouts in the interest of cost).
6. Perhaps some form of keyboard/keying control to prevent overheating on sustained notes.
7. Finally a form of decoding cursor for converting the dots and streaks into conventional musical notation.

There may well be problems which have prevented this fairly obvious application being put into action i.e. having to key the burning current at the keyboard and some form of keying circuit may well be required. As I have indicated I can have the ideas, the need etc. but do not have the development skills — all I can do is the electronic knitting.

Perhaps the idea could be made to work and maybe produce a think/play/write machine — its value to all walks of composers could be immense.

R. Stapleton
Hounslow

Dear Sir,

I have read with interest your article in the May '81 issue of E&MM about the 'Compander'.

The next statements are fairly obvious, but I would still like them answered purely for clarification.

(1) There is no compatability with Dolbyised pre-recorded tapes?
(2) There is no 19kHz filter for recording from FM broadcasts (stereo).
(3) No means of controlling the level into the 'compressor' or the input and output of the 'expander'.

As I said fairly obvious statements, but the reason for asking is that I wish to incorporate two channels of the 'Compander' into a domestic cassette recorder (Maplins Cassette kit XYP36) - without using any external circuitry - like mixers, etc., also a better level indication - etc.

Are the above mentioned points feasible and could you give me some quick guidance on how they may be accomplished without degrading the 'compander' response. One final point, can the 'expander' be modified in any way to act as a Dolby DNR (switchable)?

M. Davies
Biggin Hill, Kent

Unfortunately, just as we seem to live in a world doomed to incompatibility, so the Noise Reduction Unit is also incompatible with any type of Dolby. The reason for this (but not the state of the world) is due (a) to the restricted bandwidths of signal analysis and noise reduction in Dolby systems, and (b) different degrees of compression and expansion.

The 19 KHz filter incorporated into commercial decks prevents the subcarrier from causing phantom modulation when the signal emerges without it off the tape. As there's already a high-pass filter at the input of the compressor, you need to add a simple low-pass filter to give the unit a bandpass filtering facility.

Because of the unity gain of the compressor and expander, and because most mixers and tape decks have O/P level controls, it wasn't considered important to provide level matching controls on the unit itself (in fact, the level-adaptive circuit in the unit takes care of it to a considerable extent). However, there's no reason why you shouldn't add some presets to attenuate signal levels if it's necessary.

With a domestic cassette deck, you have to watch out for a tailing-off of the deck's frequency response affecting the accuracy of the compansion process. Also, be warned that tape drop-outs and phase anomalies (commonplace with cassettes) can wreak havoc with noise reduction systems using 1:2 expansion!

Dynamic noise reduction (DNR) is a whole different ball game to compansion, and uses a VCF controlled by the input level to chop bits off the top end of the spectrum when there isn't much signal around. So, if you're interested in adding DNR to your cassette, I'd recommend that you add it on as an extra, and there are a number of good designs around.

Dr David Ellis

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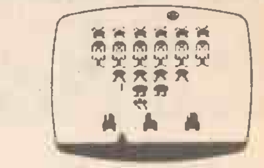

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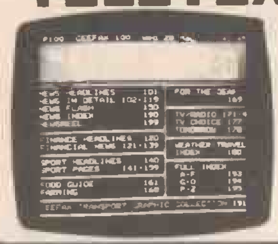

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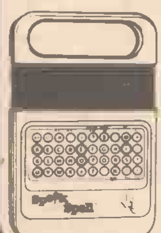

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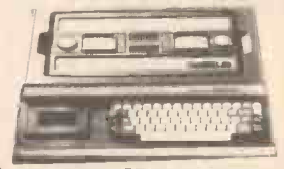

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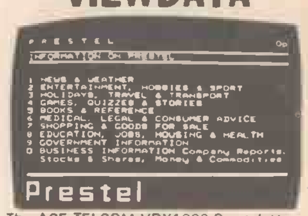

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by Paul Williams

PARTS COST GUIDE £19

Harmonisers are beginning to attract much attention from musicians, particularly for use in live performances where they can 'thicken up' the sound tremendously. Most musicians, however, cannot savour the delights of the harmoniser due to its very high cost. The only pitch change device within the price range of the average musician is the octave divider type of accessory used by guitarists. Between these two devices there appears to be a void.

The E&MM Harmony Generator is intended to fill this void, being a compromise between the simplicity of the octave divider and the versatility of the harmoniser. The Harmony Generator can give up to three octaves of pitch shift, up or down, including individually selectable intervals of '3rd' and '5th' harmonics. The pitch shifts are digitally derived and are thus very stable, obviating the need for precise setting-up and pitch shift adjustments during a performance. The Harmony Generator can, however, only accept monophonic signals from a source such as a mono synthesiser. Indeed this is an ideal device for use with a single VCO synthesiser, greatly extending its versatility.

The Harmony Generator will not only follow the pitch of the instrument, but also the amplitude, applying the same amplitude envelope to the harmony signal as that of the instrument. A mixer is provided so that the contrast between the instrument and harmony signals can be optimised.

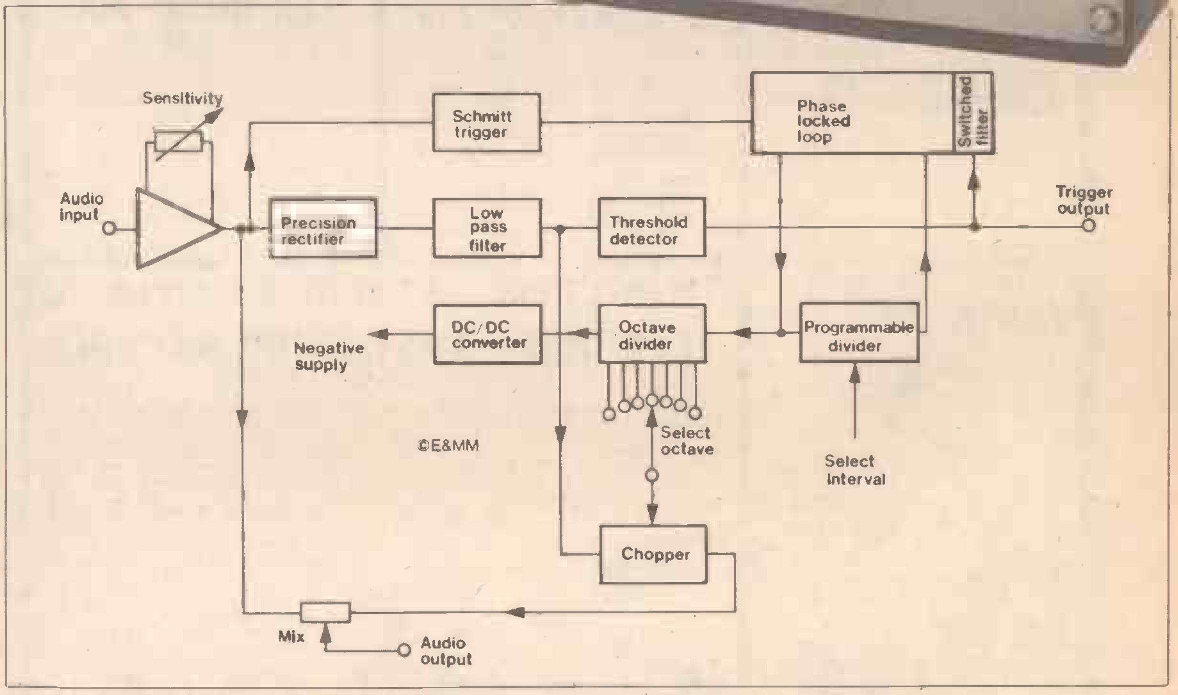


Figure 1. Harmony Generator block diagram.

Design Principles

The block diagram, Figure 1 shows the basic functional circuit elements. The heart of the unit is the phase-locked loop (PLL), which allows frequency multiplication to be performed. The PLL effectively compares the input frequency with that fed back from the output of its internal voltage controlled oscillator (VCO). It will adjust the voltage applied to the control input of the VCO, and hence alter its frequency until the two frequencies are the same. Since the programmable divider is in the feedback path of the PLL, the VCO output frequency will be a multiple of the input frequency. The ratio between them being the same as the division ratio of the programmable divider, which is selectable. The octave divider successively divides the frequency from the VCO output providing several outputs at one octave intervals below the VCO output frequency.

The nominal division ratio of both the programmable divider and octave divider is 64, thus for unison harmony, the VCO will operate at 64 times the input frequency. To achieve the interval '3rd', the pitch must be shifted up by 4 semitones, which is an increase in frequency of $(\sqrt[12]{2})^4=1.26$, close to $^{81}/_{64}$. Thus for the interval '3rd', the programmable divider must be set to ÷ 81. Similarly for the interval '5th', a 7 semitone shift is needed, or $(\sqrt[12]{2})^7=1.5$, or $^{96}/_{64}$. Thus the programmable divider must be set to ÷ 96.

The precision rectifier provides a DC voltage which follows the amplitude envelope of the input signal. The threshold detector senses when the signal is of sufficient amplitude to reliably operate the Schmitt trigger in the PLL input line. Also at this signal level the trigger output is activated for the operation of external envelope generators, synthesisers etc. Below this threshold level, the PLL filter is switched in such a way as to 'freeze' the operating frequency, enabling the note to decay normally, even when the input signal level falls below the Schmitt trigger threshold.

Another DC output is taken from the precision rectifier which

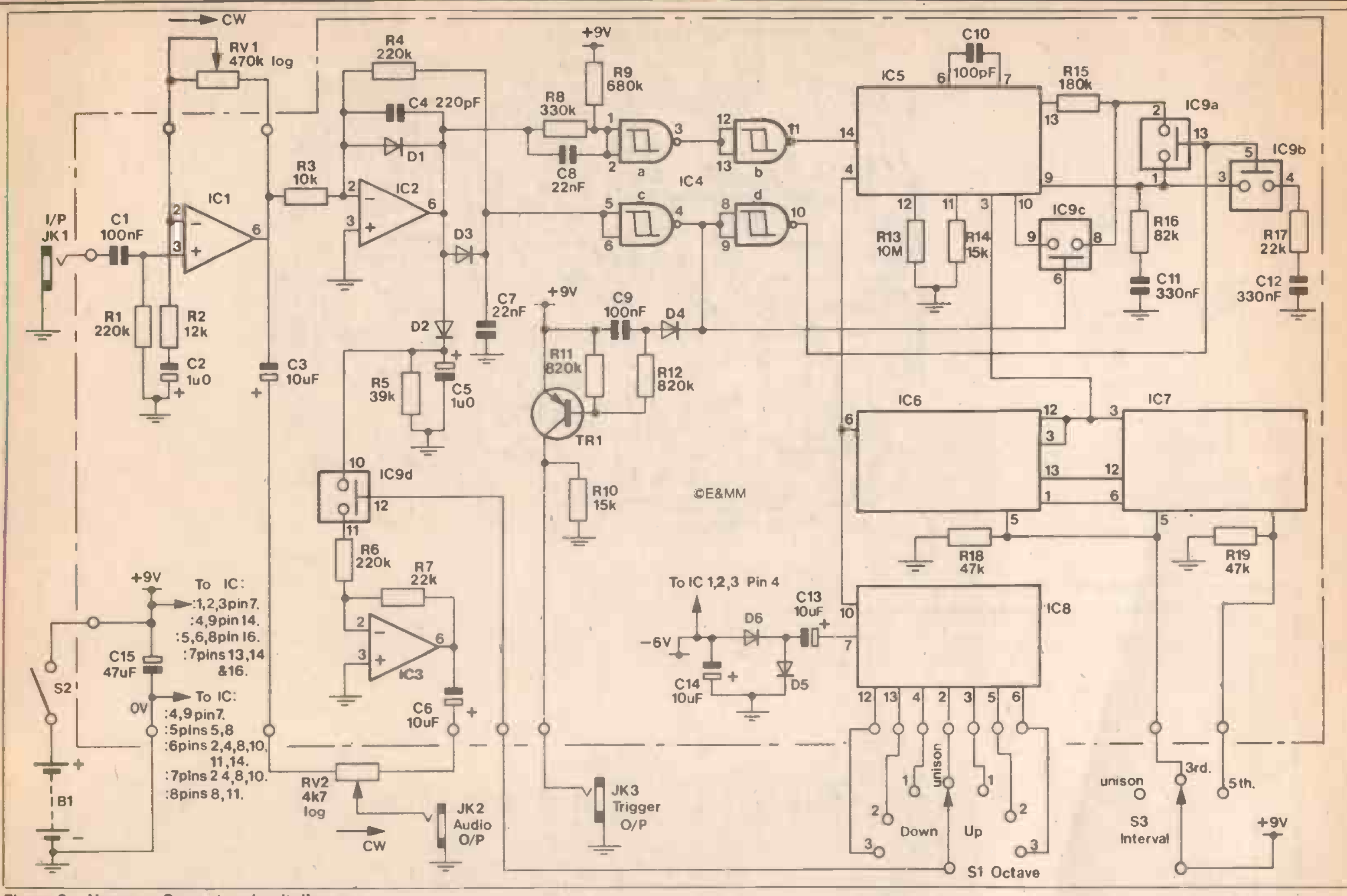


Figure 2. Harmony Generator circuit diagram.

is chopped at the frequency selected from the octave divider. This AC signal which has the amplitude of the input signal and the frequency of the octave divider output selected, is the harmony signal. It takes the form of a square wave and is mixed with the input signal to become the combined output.

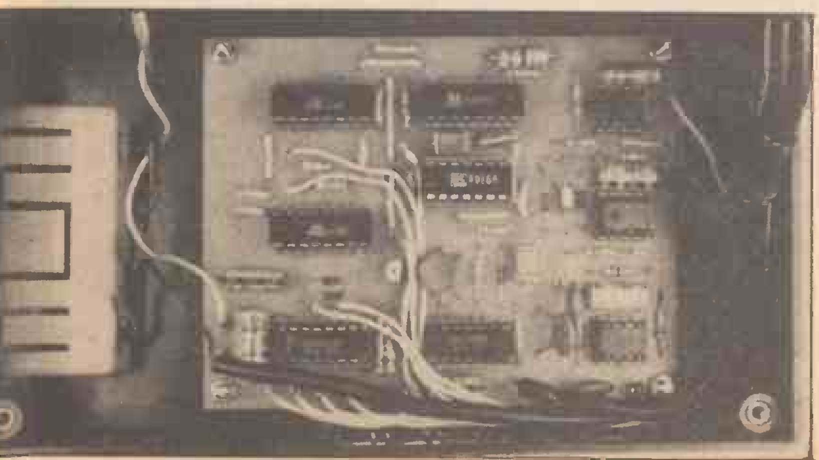
Circuit

IC1 forms a conventional non-inverting AC amplifier, its gain being adjusted by RV1, allowing an input signal range of 5mV to 200mV RMS to be accepted. IC4a, b form the Schmitt trigger which 'cleans up' the signal from the precision rectifier, IC2, to the PLL, IC5. C4 provides some attenuation of the higher frequency harmonics of the input signal.

The threshold detector IC4c, d controls the switches IC9a, c, which cause the PLL to freeze by disconnecting the voltage control source, pin 13, from the VCO input, pin 9. IC9b helps to keep the VCO frequency constant during a decaying note by disconnecting the short time constant filter R17, C12, leaving the longer time constant R16, C11 in circuit when the input signal amplitude becomes low. At higher signal levels, IC4 pin 4 will go low, causing TR1 to switch on to provide a positive-going trigger output.

IC6 & 7 comprise the programmable divider. Its division ratio is determined by the conditions on the programming inputs, selected by S3. A binary divider IC8 forms the octave divider, which again provides a division ratio of 64, with other outputs of divide by 8, 16, 32, 128, 256 or 512 selectable via S1. The selected signal controls the chopper IC9d, IC3. RV2 then mixes the chopped DC voltage from the precision rectifier with the untreated instrument signal from the output of IC1. The combined output signal at the wiper of RV2 has a typical RMS amplitude of 200mV.

An output from IC8 is used in conjunction with C13, 14, D5 and 6 to form a DC/DC converter, providing a negative supply voltage for the operational amplifiers. R13 ensures that the PLL VCO free-running frequency, and hence the frequency at pin 7 of IC8, is sufficiently high to allow the DC/DC converter to operate correctly. Since the circuit is CMOS based, the complete unit takes very little power; approximately 4mA from a PP3 battery.



Internal view of Harmony Generator.

Construction

All the components are contained on a single PCB, the track and component layout of which is shown in Figure 3. Assembly should commence with the resistors, diodes and capacitors, taking care with the polarisation of diodes and electrolytic capacitors, according to the component layout shown. Next solder in the IC sockets for all the CMOS ICs (IC4-9), but do not insert the ICs at this stage. The operational amplifiers IC1, 2 and 3 can be soldered directly into the PCB, along with the transistor TR1, again taking care with orientation. When assembly of the PCB is complete, the CMOS ICs may be inserted into their appropriate sockets, exercising the usual anti-static precautions.

Before mounting the jack-sockets, pots and switches on the front panel, adjust the rotary switch end-stops by inserting the tab of the washer into the appropriate end-stop hole; 7 for S1 and 3 for S3. Wire the sockets, pots, switches and the battery holder to the PCB according to the wiring diagram Figure 3. Use screened cable for the connections to the input socket, JK1, and sensitivity control, RV1. The screen of the cable to RV1 does not go to 0V but is used as the through connection from IC1 pin 6 to RV1.

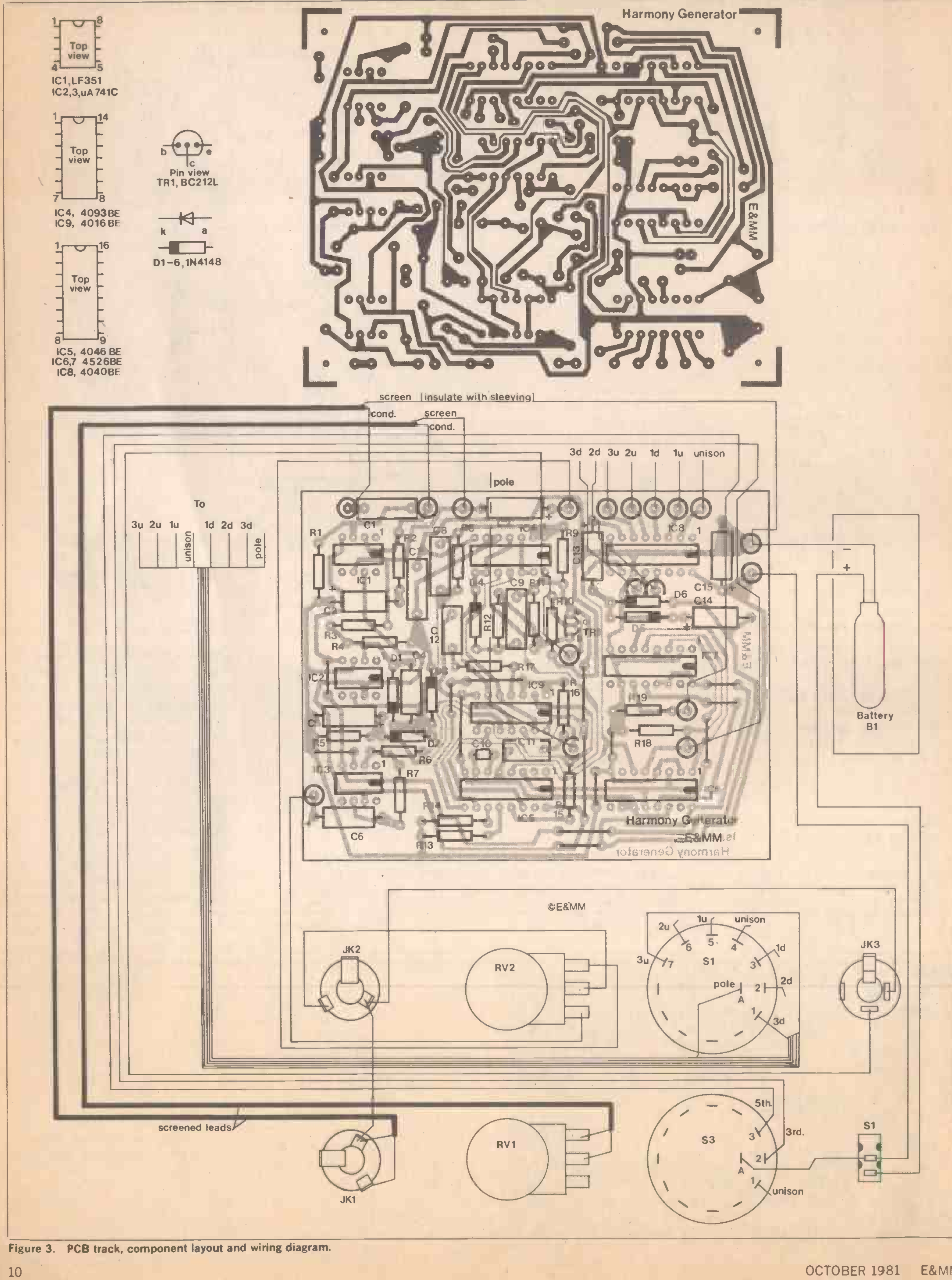


Figure 3. PCB track, component layout and wiring diagram.

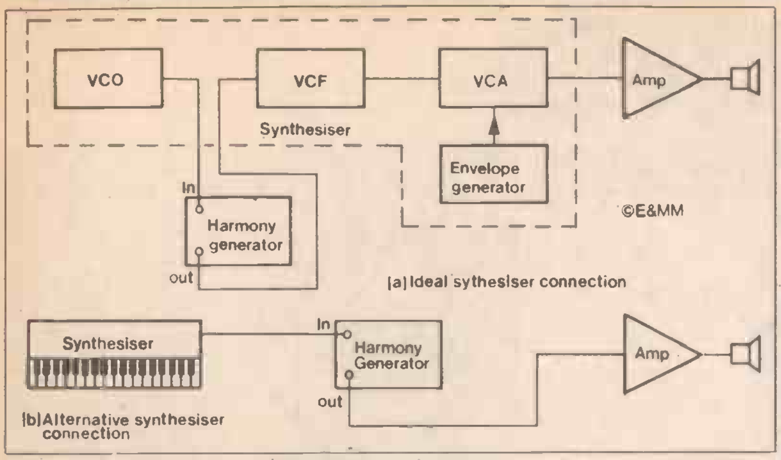


Figure 4. Harmony Generator/synthesiser connections.

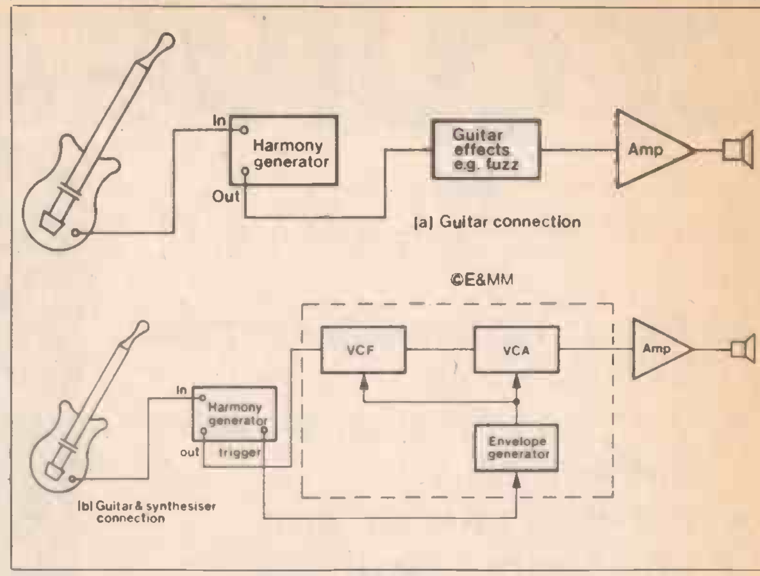


Figure 5. Harmony Generator/guitar connections.

Operation

There are no presets to adjust in this project; just connect the Harmony Generator's input to your synthesiser and the output to your monitor amplifier. Switch the unit on and set the controls initially as follows: sensitivity anticlockwise; mix clockwise; interval and octave as required. Play some notes on the synthesiser and advance the sensitivity control until the Harmony Generator just starts to lock on to and follow the frequency of the synthesiser. The mix control can then be adjusted to give the desired contrast between instrument and harmony signals. The Harmony Generator is now ready for use.

It is as well to understand the few limitations of this device so that the best use can be made of it. Only a single note at a time can be handled; it is not capable of dealing with polyphonic signals. Since high amplitude harmonics can also cause instability, high VCF Q values should be avoided. This applies also to the use of audio frequency FM, although the unit can cope with vibrato type FM. AM does not present quite such a serious problem, as long as the modulation depth is not too great. If a slow attack is used, then a pitch jump might be noticed as the amplitude passes through the threshold level. This effect can be reduced by advancing the sensitivity control.

The fact that the harmony signal is a square wave does not seem to be too much of a disadvantage since the mixed instrument signal gives the overall sound sufficient character. This can be further improved by putting all treatments such as phaser, flanger, reverb, echo etc, after the Harmony Generator.

Most of the above problems can be avoided altogether by using the ideal synthesiser connection scheme shown in Figure 4a. Here, the Harmony Generator is fed directly from the synthesiser VCO. The VCF Q setting will then make no difference to the stability. Also, the VCF will filter the Harmony Generator square wave, giving it extra character. The slow attack pitch jump problem also disappears since the amplitude envelope is applied after the Harmony Generator. If, however, you do not have access to these connections on your synthesiser, then you will have to settle for the connection scheme shown in Figure 5b.

Although this project was designed primarily for use with a synthesiser, there is no reason why the circuit should not be used, or adapted for use with other instruments such as guitars (Figure 5), brass and reed instruments or even vocals. The main criterion to be satisfied is to attenuate any high amplitude harmonics. This might be achieved by altering the value of C4, or more ideally by preceding the Harmony Generator by a sharp cut-off low-pass filter. With the circuit in its present form, bass instruments cannot be used since the response to pitch change becomes very slow at low frequencies. This could be improved somewhat by increasing the value of C7.

Once the synthesist has become familiar with this unit, he will find it an invaluable addition to his accessory collection.

E&MM

Rear view of front panel.

PARTS LIST FOR HARMONY GENERATOR

Resistors - all 5% ⅓W carbon unless specified			
R1,4,6	220k	3 off	(M220K)
R2	12k		(M12K)
R3	10k		(M10K)
R5	39k		(M39K)
R7,17	22k	2 off	(M22K)
R8	330k		(M330K)
R9	680k		(M680K)
R10,14	15k	2 off	(M15K)
R11,12	820k	2 off	(M820K)
R13	10M		(M10M)
R15	180k		(M180K)
R16	82k		(M82K)
R18,19	47k	2 off	(M47K)
RV1	470k log pot		(FW27E)
RV2	4k7 lin pot		(FW01B)
Capacitors			
C1,9	100n ceramic	2 off	(BX03D)
C2,5	1u 63V axial electrolytic	2 off	(FB12N)
C3,6,13,14	10u 25V axial electrolytic	4 off	(FB22Y)
C4	220p polystyrene		(BX30H)
C7,8	22n ceramic	2 off	(BX01B)
C10	100p metalised ceramic		(WX56L)
C11,12	330n polycarbonate	2 off	(WW47B)
C15	47u 10V axial electrolytic		(FB38R)
Semiconductors			
D1-6	1N4148	6 off	(QL80B)
TR1	BC212L		(QB60Q)
IC1	LF351		(WQ30H)
IC2,3	uA741C	2 off	(QL22Y)
IC4	4093BE		(QW53H)
IC5	4046BE		(QW32K)
IC6,7	4526BE	2 off	(QQ44X)
IC8	4040BE		(QW27E)
IC9	4016BE		(QX08J)
Miscellaneous			
JK1,2	Jack socket	2 off	(HF91Y)
JK3	3.5mm socket		(HF82D)
S1,3	12-way rotary switch	2 off	(FF73Q)
S2	Ultra min toggle switch		(FH97F)
	14-pin DIL socket	2 off	(BL18U)
	16-pin DIL socket	4 off	(BL19V)
	Box M4005		(WY02C)
	PCB		(GA48C)
	Knob KB4	4 off	(RW87U)
	PP3 battery holder		(XX33L)
	PP3 battery		

SECURIGARD

by Steve Manning, B.Sc (Eng.), MISM

★ **Two instantaneous operation, four-wire zones**
★ **Delayed operation for entry and exit zone**
★ **Personal attack alarm**
★ **Anti-tamper alarm**
★ **Bell shut-off facility**
★ **Mains/rechargeable battery operation**
★ **Powers either standard and/or self activating bell**

PARTS COST GUIDE £60 (kit) excluding battery

In recent months a variety of journals have published articles emphasising the importance of general home security. It is an unfortunate and sad comment on our society that intruder detection systems are no longer considered the status symbols they once most definitely were, but are becoming more and more necessary items of equipment for all homes. We make no apology for following the current trend — E&MM readers have as much, if not more to protect than readers of any other magazine.

In addition to presenting the E&MM Securigard in our usual project format, advice is also given on installing a complete alarm system in your home. Information on the various signalling devices is supplied and three examples of alarm systems illustrate the different methods available.

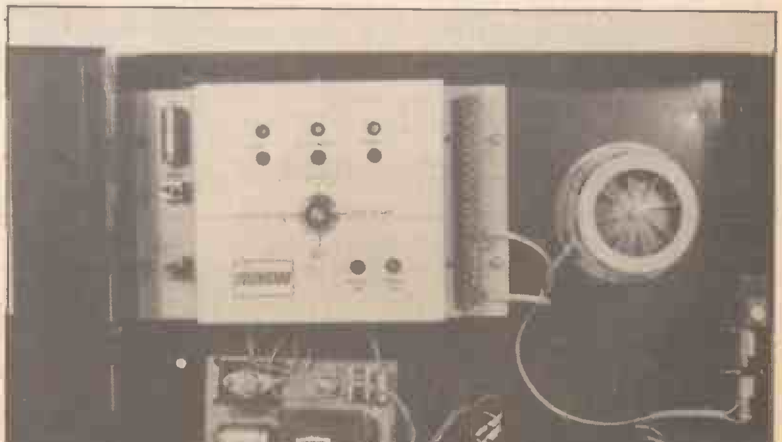
The E&MM Securigard has been designed as a high reliability, high security unit, with particular emphasis on ease of construction. A multi-option concept has been employed so that an essentially tailor-made installation can be completed at minimum cost. Of particular note is the 'four wire' positive and negative loop contact wiring circuitry. The majority of burglar alarm control units designed for the home use only 'two wire' or single loop wiring. Whilst being slightly easier to install, a two wire system is very simple to defeat — just short the two wires together and it is done! A four wire system is a little more difficult — short the wrong wires and an alarm condition is the result. Definitely off-putting to the would-be burglar!

There are four separate alarm zone circuits available for use in the E&MM Securigard:
a) Zones 1 and 2 — these are identical and give an instantaneous alarm condition when the loops of the four wire system are either broken or shorted together.
b) Zone T — this is the timed entry/exit zone which is of the same basic configuration as zones 1 and 2 except that it includes an arming delay. This enables the key-holder to exit from the premises after arming the system without triggering the alarm and to render the control panel inoperative before the alarm sounds after entry of the building. The delay time is set by a three-way switch (ENTEX) which is approximately calibrated in seconds: 30, 60 and 90. An internal buzzer sounds during the time-out period.
c) Zone 24 hour/Tamper — this is identical to zones 1 and 2 except that there are no indicators on the front panel of the unit to show whether the alarm has been triggered. Part of the zone is used to protect the control unit from unauthorised entry. The remainder is used for such purposes as attack push-buttons and anti-tamper devices.

The delay zone T and zones 1 and 2 each have indicators on the front panel which show whether the circuit is armed or if it has been triggered. There is also a mains-on indication and, if a rechargeable battery is installed and being used, a mains-failure indicator.

Operation of the unit is by use of a 2000 combination keyswitch. This has four positions, the key only being removable in the two 'armed' positions.
Attack alarm - Only the 24 hour/tamper zone is armed.
Reset - All zones are reset and inoperative. The bell circuit is also reset and inoperative. All indicators should be showing green.
Full alarm - All zones armed.
Bell test - Sounds the alarm by triggering the system. The key must be turned to 'reset' to silence the alarm.

The unit also contains a bell shut-off facility which gives the


Internal view of E&MM SECURIGARD.

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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 PC8 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

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POLY 16	PC8 for plug in voice	£8.20
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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 PC8's for multiplex cct. K.8. contacts	£9.50
POLY 2	IC's IC sockets, Rs, Cs, for multiplex cct. ...	£8.20
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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
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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
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option of having the alarm shut off after sounding for 15 or 30 minutes or sounding continuously. This is a facility often required by the police. The time setting is controlled by a three-way switch.

Circuit

One glance at the circuit diagram shown in Figure 1 reveals the first important decision made when the project was still a twinkle in the designers eye — reed relays interface with the outside world as far as the alarm zones are concerned. Do not be fooled by the myopic 'C-MOS is best' pressure group. It is amazing just how much interference can be picked up by wires which run for long distances around the inside of a building, often as far as one hundred metres in an intruder detection system! Reed relays are inherently much less prone to interference problems than many of the apparently more attractive devices available. Let's face it, reliability is the key word here. Apart from the obvious advantage of not being woken in the middle of the night because a freezer thermostat arced a little, the effectiveness of an alarm system which false triggers frequently is on a par with the little boy who cried wolf once too often!

In both the 'instantaneous' and 'delayed' action zones, the alarm loops are taken from both ends of a reed relay coil. In normal circumstances these loops are closed, and the relay holds in. If either loop should be broken, or if the loops are shorted together the relay will drop out, and will then latch out since there is no way of re-applying power to the coil until the zone is reset. For the 'instantaneous' zones, reset is manual, whereas the 'delay' zone is reset automatically after a predetermined period if certain conditions are fulfilled. Resistors R20, 21, 22 and 23 are protection components to prevent the supply rail dipping, however momentarily, and to protect the reed relay contacts in the event of two loops being shorted together.

Trigger

The trigger, output and delay circuits are all based on the ubiquitous 555 timer integrated circuit. The trigger circuit is 'armed' by setting the flip flop in the 555 timer, IC5. This is achieved by momentarily connecting pin 6 to the supply rail through R12. The pin is normally held low by R7. In this state pin 2 of IC5 must always be served by a voltage of not less than 1/3rd of the supply rail voltage. If this voltage is not maintained an alarm condition will result. It should be noted that the output relay (RL6) is energised whilst the trigger circuit is armed, and hence fails 'safe' when triggered.

An alarm condition will be generated by one or more of the following actions:

a) When the potential divider created by R16, 18, 19 and 14 is upset by an instantaneous zone having been triggered.

b) When the voltage on C2 drops below predetermined limits for a short period as initiated by the delayed entry/exit zone.

c) When the voltage on pin 2 of IC5 is pulled low by TR1 as part of the bell test procedure.

Entry/exit delay

The 'delay' circuit is centred around IC1, and is initiated whenever RL2 latches open. This action allows the buzzer trigger input to rise to the supply rail voltage, since contact RL2/1 opens; the buzzer sounds, the green 'zone armed' LED is extinguished, and C1 charges via the resistors around S2, which sets the entry/exit delay time. When the voltage on C1 reaches 2/3 of the supply rail voltage RL1 is energised and C1 is discharged through R9. Contact RL1 also resets RL2 when this is possible (if a loop fault does not exist). When RL2 is reset the buzzer stops sounding and the green 'zone armed' LED lights once more. The outputs of IC1 are energised during the time that C1 discharges from 2/3 to 1/3 of the supply rail voltage. During this time C2 is also being discharged via R5. The values of R5 and C2 are such that with C2 initially fully charged the first operation of IC1 (i.e. on exit) will not cause the voltage on C2 to drop below 1/3 of the supply rail voltage, but will cause it to drop below that value on subsequent operations of the device (i.e. re-entry). Such a voltage drop will initiate an alarm condition at the trigger circuit around IC5.

Bell shut off

The output of the trigger circuit is passed to the bell shut-off circuit. The output relay RL6 is connected between the totem pole outputs of IC5 and IC4. To achieve the cut-off time the output of the second 555, IC4, 'times out' after a pre-set period. IC4 is arranged as an oscillator, the time

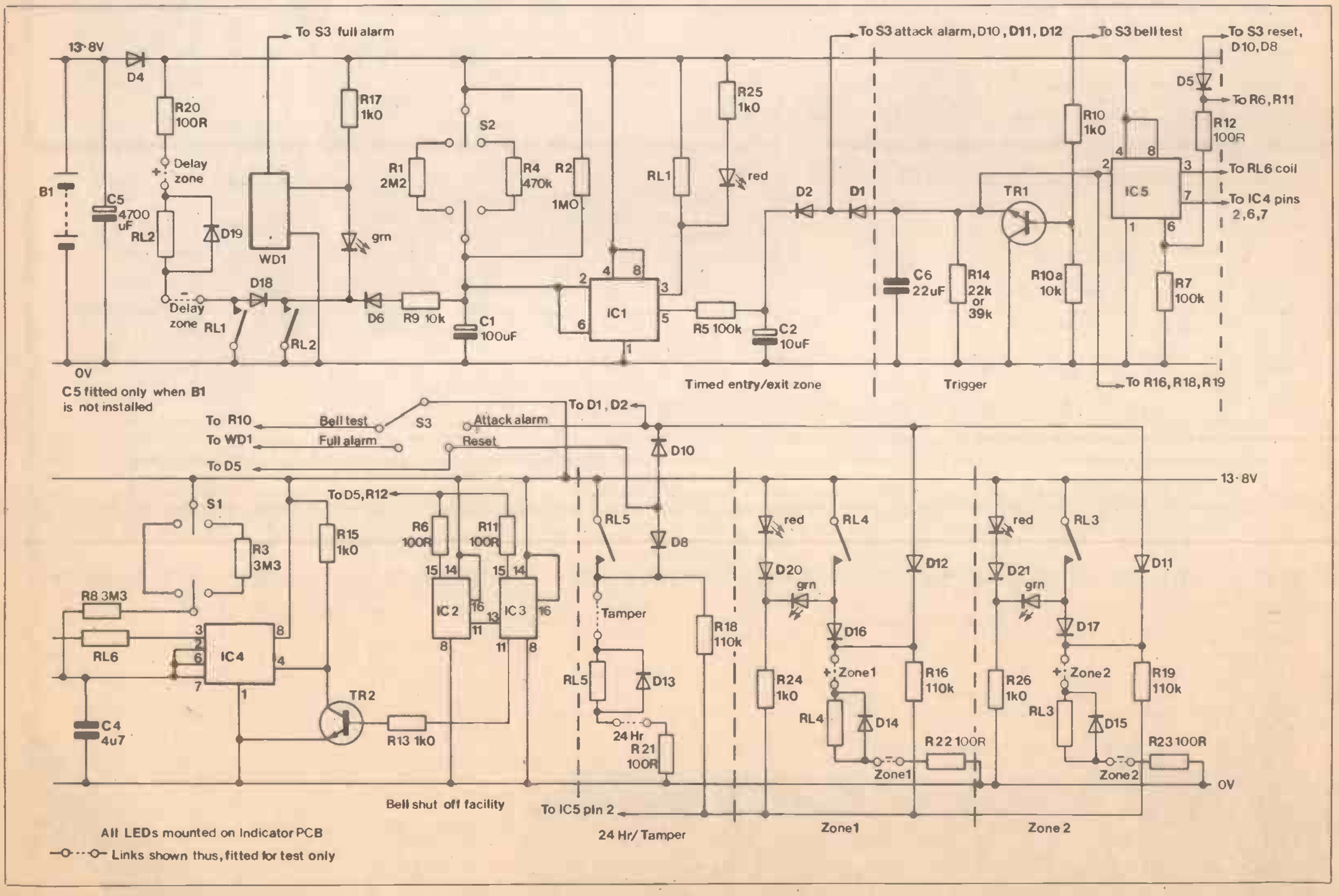

Figure 1. Main control module circuit.

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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.

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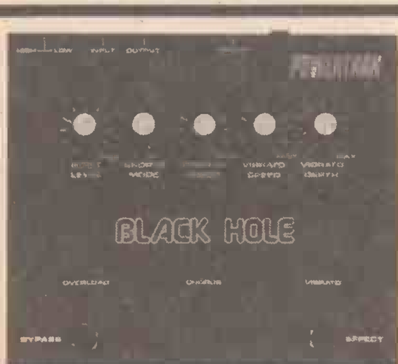
BLACK HOLE CHORALIZER



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period governed by C4 and a resistor value determined by S1. When IC5 is triggered the voltage on C4 is allowed to rise, and as IC4 oscillates the output is fed into the input of two C-MOS 4017 divide by ten counters, IC2 and IC3. Since the recovery time of the oscillator is so short RL6 is unaffected by the action of the additional circuitry until pin 4 of IC4, the reset pin, is pulled low by the counter circuits activating TR2. At this point the output of IC4 goes high, and so sources power for the relay.

Outputs

The outputs of the unit are fused as shown in Figure 2. There are conflicting points of view about the advisability of such action, since it is easy to silence a fused bell by simply shorting the feed wires together. It is the considered view of the author that there should always be a minimum of two alarm sounders in any one installation. If a non-fused output is used in this case, shorting the supply leads to one bell could render the whole system inoperative. Conversely, if each output is fused then in the event of tampering or a sounder failure, a fuse will fail, and the warning still goes into operation.

Components

Before passing on to the subject of the power supply, just a few comments on components. Capacitors C1 and C2 are not a standard electrolytic capacitor type, but should be either a solid aluminium type, or solid tantalum. Unfortunately the time variable leakage characteristics of wet electrolyte capacitors cannot be tolerated in this application from either a circuit reliability or delay repeatability point of view.

The reed relays used have a coil resistance of 1k0. Whilst there are no technical problems from a construction and testing angle to restrict the usage of reed relays with a lower resistance, it should be remembered that the alarm installation as a whole may not be able to tolerate a substantially lower loop resistance in the feeder circuits.

Power supply unit

The power supply unit is conventional, based on the 723 voltage regulator IC1, as shown on Figure 3. The output voltage is set by means of the preset resistor to 13.8 volts, which is the float charge voltage of a 12V (nominal), sealed, lead-acid, rechargeable battery. The output voltage of the unit slowly collapses as the current drawn exceeds ½ amp. At 12 volts about 1 amp is available. If necessary this will be supplemented by a rechargeable battery if installed. In addition to the power take-off leads from the power supply card, a connection is taken from the collector of TR1. This voltage is used to provide mains-fail and mains-on indication on the front panel of the unit.

It should be noted that if the power supply unit is used without a rechargeable battery being connected, an additional smoothing capacitor of 4700uF is required at the output terminals.

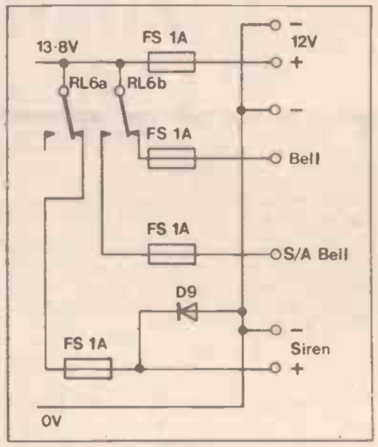

Figure 2. Alarm sounder outputs.

Construction

There are three printed circuit boards within the unit:

a) The main control module which contains the trigger, delay, bell shut off, instantaneous zones and output circuits.

b) The power supply unit.

c) The indicator board containing all the LEDs.

Assembly of the power supply module should be attempted first. Figure 4 shows the PCB track and layout. Apart from the usual precautions and assembly procedures the only important point to watch is that the transformer should be soldered to the PCB after the fuse holder. Apart from it being good constructional practice to add the largest and heaviest component last, it will be found impossible to perform the task in the opposite order! Note that if the required PCB-mounting push connector spades are not used then the negative power take-off point needs a shorting link between the two pads which would otherwise be joined by the termination.


'U' bracket mounted on main control board.

The power supply card is tested by applying mains voltage to the unit by means of the terminal block and checking the output voltage on a suitable voltmeter. If a sealed lead-acid battery is to be used with the system the voltage output should be set to 13.8 volts ± 0.3 volt by adjusting RV1. Do not be tempted to exceed this voltage limit as gassing would result and sealed batteries do not have vents . . .! RV1 should then be locked in position by a dab of adhesive.

Assembly of the main control module is a little more involved than that of the power supply, but is none-the-less straightforward if a systematic procedure is adopted. Figure 5 shows the PCB track and layout.

Mount all the diodes on the main board first. There are two reasons for this — firstly, from experience, diode polarity problems cause the largest number of initial testing headaches when faulting alarm systems, so its a good idea to put them on to an uncluttered board, and secondly the 1N4000 series diode provides an excellent source of soft copper wire for the PCB links, which should be installed immediately after the diodes.

The components should now be added in size order (smallest to largest). Bear in mind that the reed relays are not tolerant of overheated leads, and that switch bodies are surprisingly brittle when their pins are being manipulated. Two four-inch lengths of wire with ¼ inch spade receptacles crimped to the opposite end should be soldered into the PCB next to the power input spade terminations. These wires connect to the power supply board which is mounted directly below the control module. (The spade terminals on the control board are for connection to the

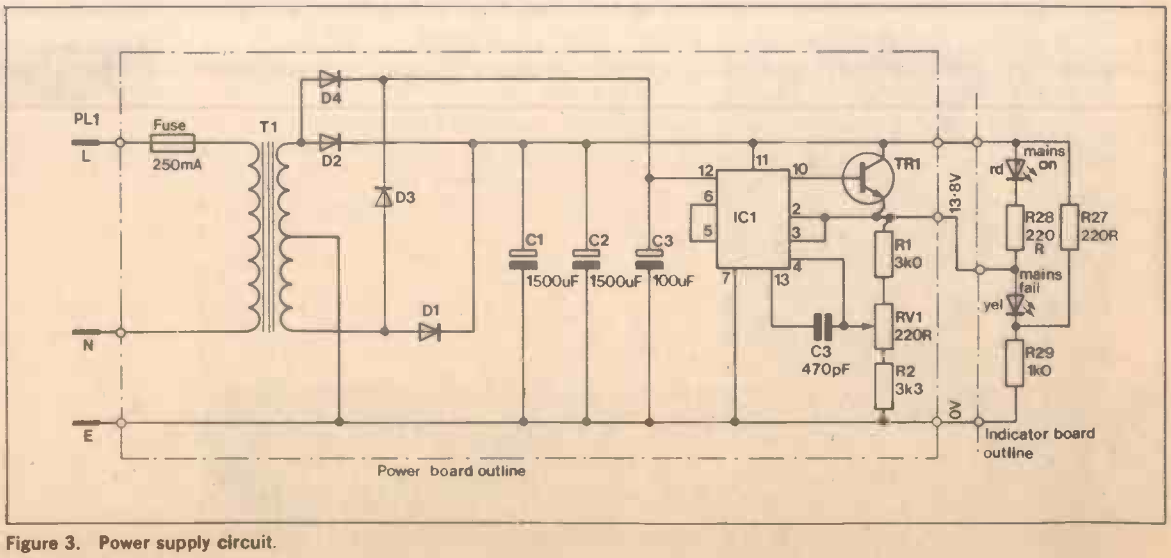

Figure 3. Power supply circuit.

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DJ90 STEREOMIXER

as being featured in Electronics Today International - July Issue!

This versatile new mixer, shown 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 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 and an SP2-200 stereo 100W/channel power amplifier. For a 200W/channel system two SP2-200s could be fitted.

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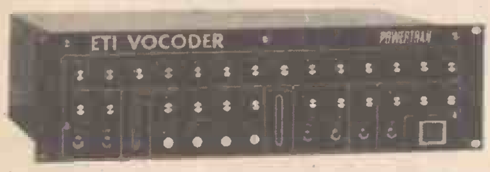
ETI VOCODER



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!

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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.

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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.

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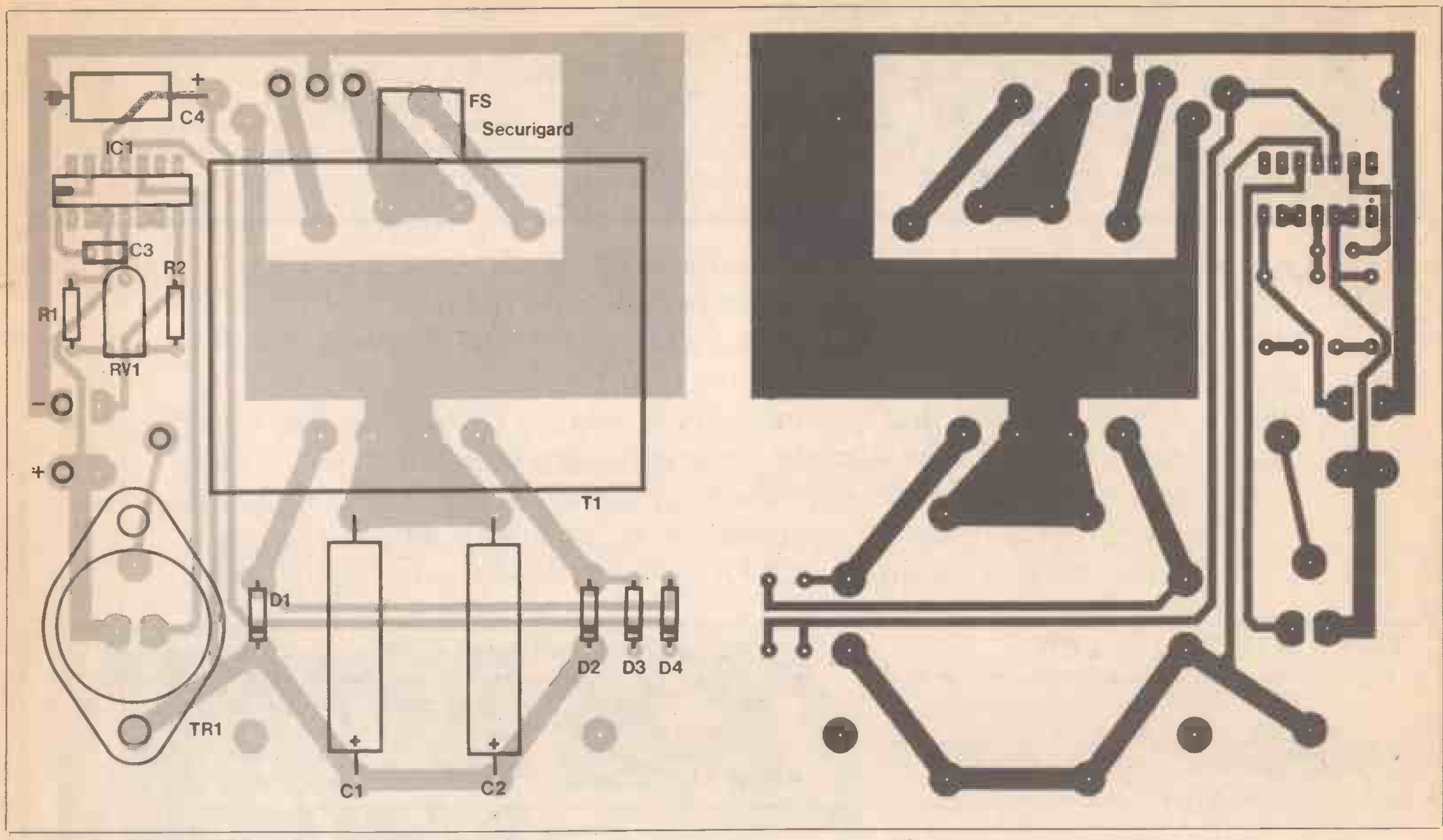


Figure 4. Power supply PCB track layout and component overlay.

rechargeable battery, or auxiliary smoothing capacitor if the battery is not used.) A three and a half inch length of seven way ribbon cable should be soldered in position at the set of holes indicated by the legend 'indicator board'. Finally, link out in pairs the alarm zone input terminals at the right-hand side of the board, working from the top of the terminal block as shown in Figure 6. Do not link out any of the lower seven terminals as this action will cause fuses to blow later!

The PCB upon which the light emitting diodes are mounted is assembled last. The track and layout are shown on Figure 7. Take care to mount the LEDs vertically on the board, and also take care not to overheat them during the mounting operation — LEDs are more heat sensitive than many other components and in this application the leads need to be kept short. Note that the flat side of the otherwise round component indicates the cathode of the device. A six-inch length of wire with a solder tag attached to its opposite end is soldered to point M/O on the PCB. The tag must be connected to the heat sink of TR1 on the power supply board at final assembly. Terminate the ribbon cable from the main control board on to the indicator board. The set of holes on both PCBs correspond exactly, so there is no need for concern here — just wire to the component side of both boards, with them both in the same orientation.

Testing

Initial testing of the control module can now be carried out. (Ensure that the rear of the indicator PCB does not short out to the main board, especially on the fuse holders.) Set the 'ENTEX' switch to 30 seconds, and the 'BELL SHUT OFF' switch to 15 minutes. The metal barrel of the keyswitch assembly, as yet unmounted, can be used to set the rotary switch in the centre of the board (S3) so that the tell-tale triangle symbol on the central rotating section points vertically up the board.

Apply power to the board. The green LEDs for zone indication should glow (except for the delay zone one) as should the mains fail LED. The main relay RL6 should be heard to pull in. After 30 seconds (nominal) the green LED for the delay zone should also light, the corresponding red LED having flashed momentarily. Rotate the switch S3 until the triangle points to the left (rotate anticlockwise one quarter turn). Short each of the two loops in each zone together momentarily one by one and observe the result. For the delay zone the green LED should immediately extinguish, but return again in thirty seconds as previously observed. If the loops are permanently shorted together the red LED will stay on, and the green one will not show again until the short is removed, after the usual delay. When zones 1 and 2 are shorted out the red zone LED will light but will revert to green when the short is removed. In the event of the '24 hour' and 'tamper' loops being shorted together the main relay RL6 will drop out.

Now turn S3 clockwise until the triangle shape points to the right. As the switch passes through the vertical position RL6 should pull in again. Immediately the switch is in its final position the buzzer should sound — with a low hum if the delay zone green LED is on, otherwise quite loudly. Short each zone loop together as before resetting the unit between each zone test. The first momentary shorting out of the delay zone loops should have no effect on the unit other than to extinguish the green LED as previously observed and to sound the time out buzzer. The second shorting action will eventually cause RL6 to drop out. Shorting out zones 1, 2 and the 24 hour/tamper zone should cause RL6 to drop out immediately with a corresponding showing of the red zone LED where appropriate.

Once again reset the unit. Turn the switch S3 until the triangle shape points downward. RL6 should immediately drop out. If the bell shut-off facility is fitted, a fifteen minute wait will be rewarded by RL6 pulling in again. If you do not want to wait that long at this stage bridge R8 with a 100K resistor and the whole process will be speeded up to completion in a few seconds. Return S3 to the position where the triangle points to the left. Finally, disconnect the positive supply to the module and connect the solder-tagged end of the M/O wire to the supply instead. The 'mains on' LED should glow.

Final assembly

Assuming that the module has passed all the above test procedures its final assembly can be completed. (If it did not, now is the time to do the rectification work!) Take the 'U' bracket and self adhesive printed label. After having removed the protective backing position the label on the front of the bracket by viewing the bracket through the label with the help of a strong light source. This is not as difficult as it sounds. Take care not to touch the two components together until positioning is correct.

Cut holes in the label with a scalpel or other sharp knife corresponding to the LEDs on the indicator board already assembled, and also for the barrel of the keyswitch unit. Since the holes are already present in the bracket there should be no problem with this operation. Take the keyswitch barrel and with the key

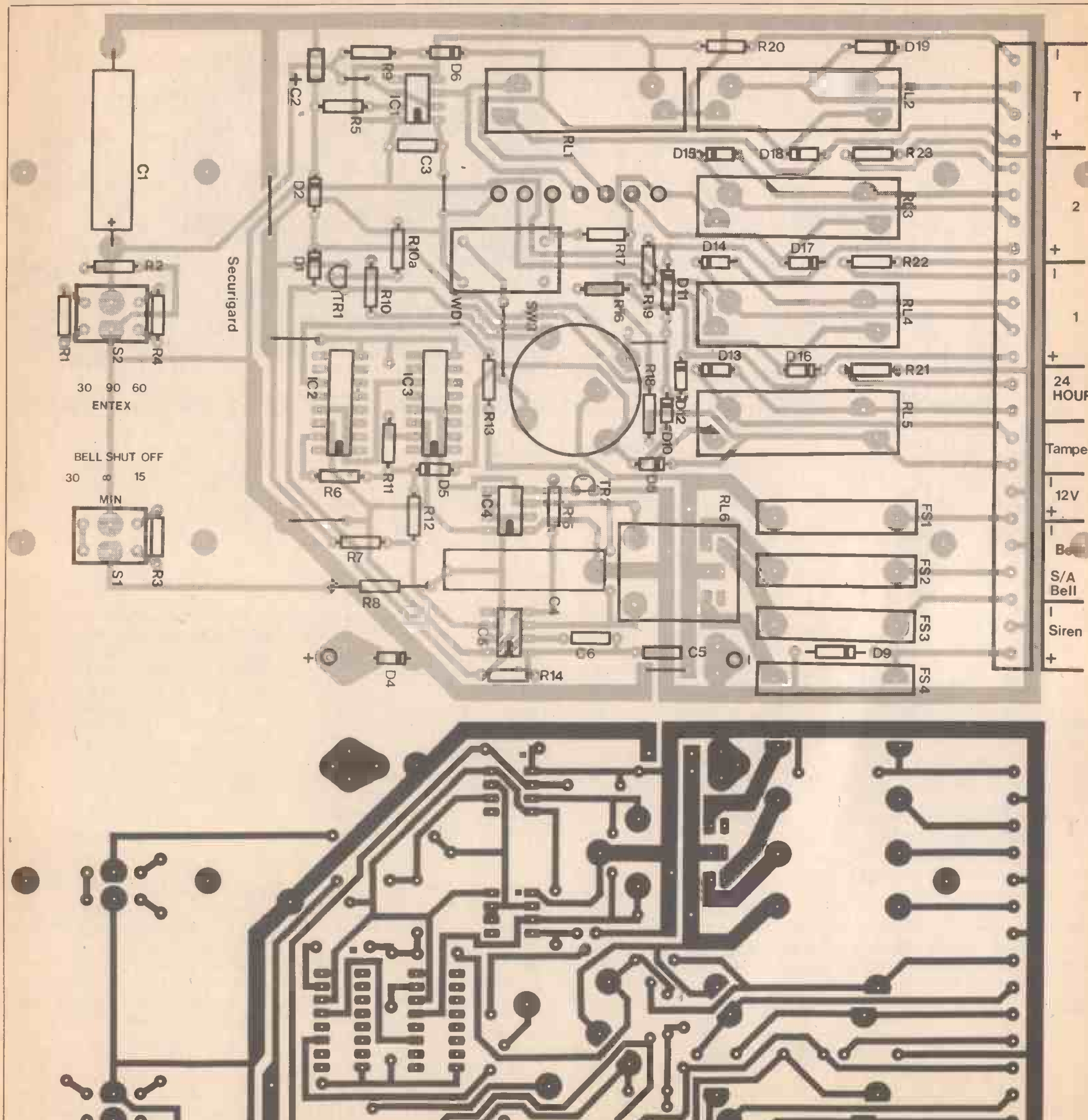


Figure 5. Main control module PCB track layout and component overlay.

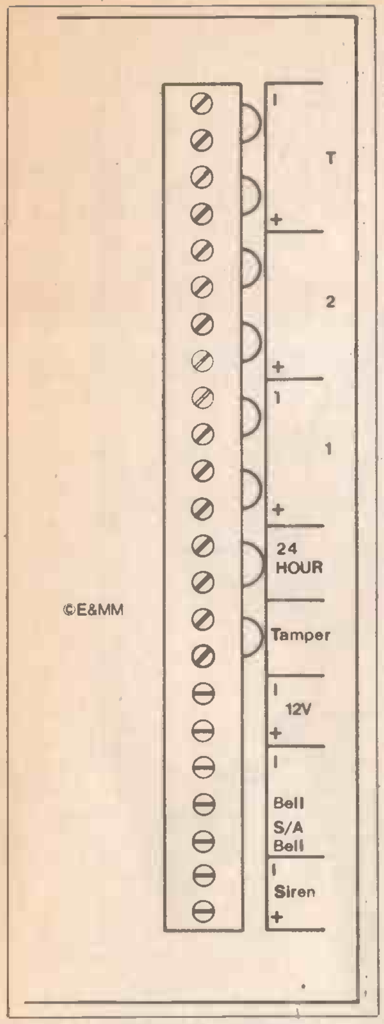
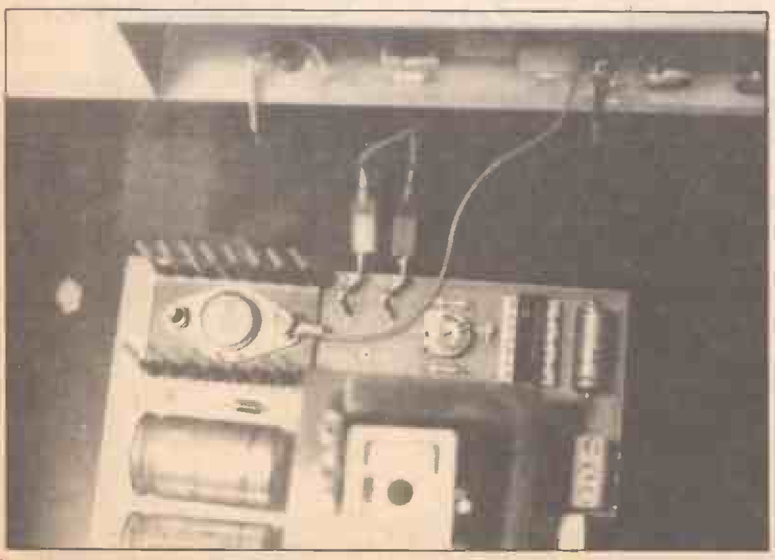


Figure 6. Terminal block links.

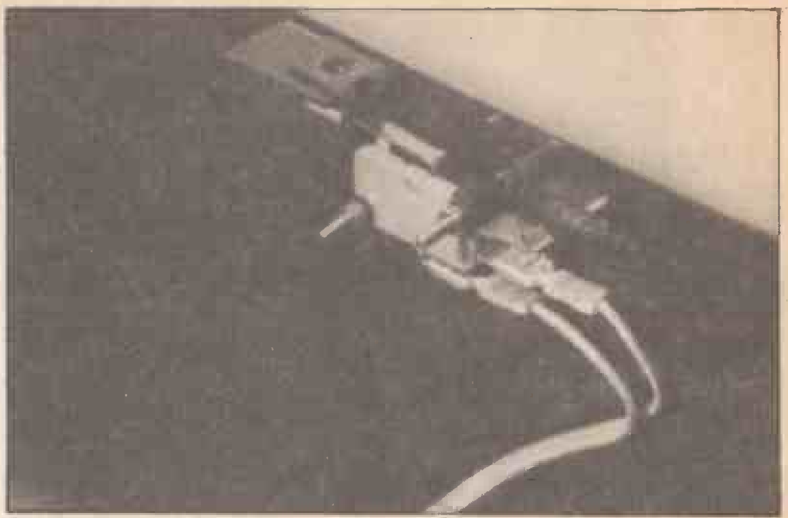
rotated fully clockwise in it, push it through the large hole in the centre of the bracket. Viewed from the rear the stop on the barrel should be positioned to the right, and the flats should be horizontal. Replace the nut on the barrel and tighten. Turn the key to the anticlockwise position and remove it.

Push LED clips through the smaller holes in the bracket. Carefully present the indicator board to the rear of the bracket assembly and push home firmly but without undue pressure. Locate the bracket on the main PCB and screw self-tapping screws through the board into the bracket from the rear. Take care to ensure that the screw heads do not short out down to the PCB track.

The control module can now be mounted in the main housing on the integral brackets beneath the large rectangular hole in the front panel. Self-tapping screws are used once again in this situation. The power supply module is mounted on pillars below this position. The nylon stand-off pillars are attached to the housing by self-tapping screws, the PCB clipping on to the pillars. The flying leads from the control module should be terminated on the power supply board as shown in the photograph. An anti-tamper microswitch fits under the speed-nut bracket on the main housing and is operated by the screw which holds the front panel shut. Since the microswitch lever is quite narrow it is suggested that a ¼-inch spade receptable is is pushed on to the end of it providing a larger area for the screw tip to locate. The normally open contacts (normally closed in use) are connected to the tamper position on the control module. The internal siren is mounted behind the louvres in the housing, next to the control module. The leads are taken to the siren position on the control module. Some sirens are polarity conscious so this may need to be taken account of during installation. It may also be necessary to use a larger fuse rating in the siren fuseholder than the 1 amp recommended for general use, due to the heavy start up current of small electric motors. Up to 2.5 amps may be drawn through the output circuits for limited periods without damage. Remember, however, the limitations of the power supply unit. With the rechargeable battery in position the internal view of the complete unit should be similar to that shown in the photograph.



Power supply leads.



The anti-tamper microswitch.

The completed E&MM Securigard should now be given a full function test similar to that described earlier, but without cutting any corners. Since it is likely that this test will be performed with the front panel open do not forget that the anti-tamper switch is now operative, and will require holding in if the unit is to be reset satisfactorily.

Installing four wire loops

It is suggested that when installing a four-wire loop system the method of wiring shown in Figure 8 is adopted. Run all four cores together as this gives extra protection from attempted tampering. Use one loop (say positive) for the main type of detection device used in that zone and the second loop (negative) for the remaining devices. This method will aid fault finding at a later date. Always use one colour core for the output and another colour for the return lead for the same reason.

Note if pressure mats are used they should be connected between the terminals marked 'M' as shown in Figure 8. This causes the two loops to be shorted together when activated.

How to protect your home

The first point to bear in mind when protecting your home from burglars, vandals and thugs is that you are in a better position than they are to know where your home's weak points are . . . but do not assume that they will not find them very quickly. A burglar alarm system will only indicate when your premises have been, or are about to be violated. It will not keep burglars out, although its presence will often deter the casual thief. There is no simpler solution to door security than the fitting of five lever mortice deadlocks if these are not already present. Window locks should also be fitted . . . but whatever security devices are fitted to your home they are only effective when they are in use. As a matter of preference a burglar will always walk into a house through an unlocked or even open door at the rear, especially if he has an indication that the occupier will be away for a predetermined length of time even if that only extends to two or three minutes. In most households such an opportunity for the prospective intruder occurs many times a week.

Next to an unlocked door a burglar's preference is for open windows. Once again those which are not in a position to be observed by neighbours are particularly attractive. Do not leave tools for the thief to work with. Ladders are an obvious item but an open garage or toolshed could provide just the article a thief needs to complete his anti-social assignment.

Once inside your home, whatever his point of entry, a burglar suffers from one major disadvantage — he must move around to complete his task, more than that, he must move around in a manner predetermined by the layout of the building. It can be seen that there are two major opportunities to detect the thief at work; first, when he actually enters the building, and second at specific points as he moves around your home searching for goods and valuables.

In addition to the main control unit, the brain of a burglar alarm system, every installation contains detection devices and signalling facilities. Let us consider the components available:

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Contacts

Contacts are specially designed switches which are constructed so as to maintain current flow in the detection circuits when doors, windows, shutters etc., are correctly closed. The vast majority are magnetically operated, but some employ a mechanical action. Many types are available (see photograph). Contacts are relatively inexpensive to purchase, and are generally very reliable in operation. Their main drawback concerns the amount of wiring and hole drilling required to complete their installation.

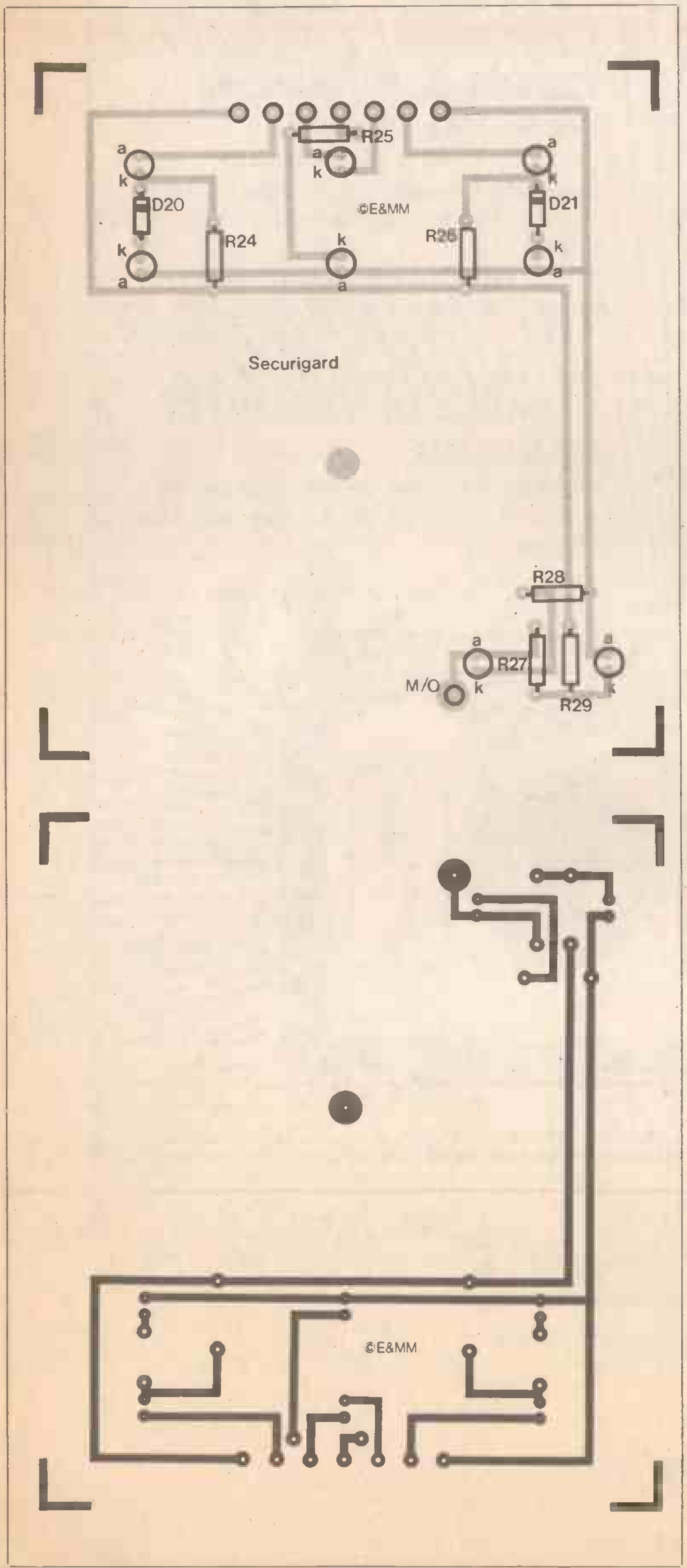
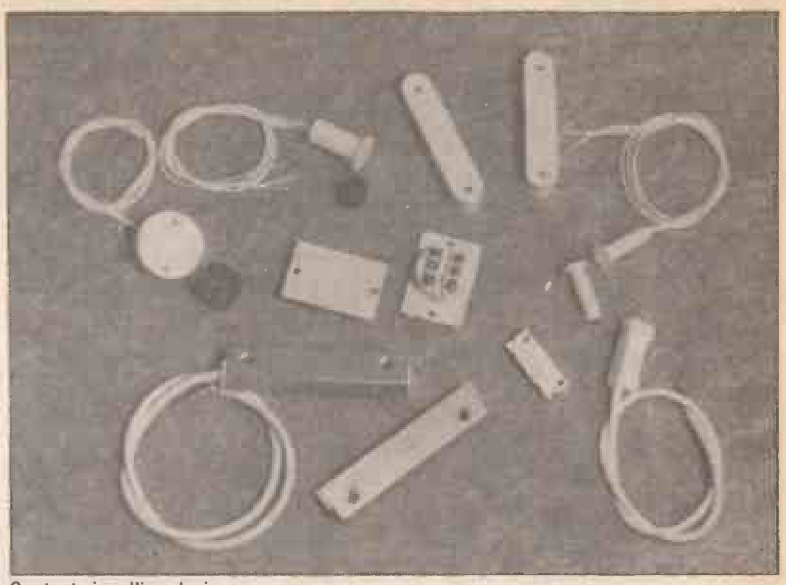


Figure 7. Indicator PCB track layout and component overlay.



Contact signalling devices.

Pressure sensitive mats

Pressure sensitive mats are a special form of multi-contact device manufactured as a very thin mat. They can be used under most types of floor coverings, and will close a contact when an intruder steps upon one of them, see photograph.

Another low cost item, the pressure sensitive mat is an excellent 'spot' defence device. Its main drawback concerns its sensitivity as it can quite easily be set off by cats and dogs.

Window foil

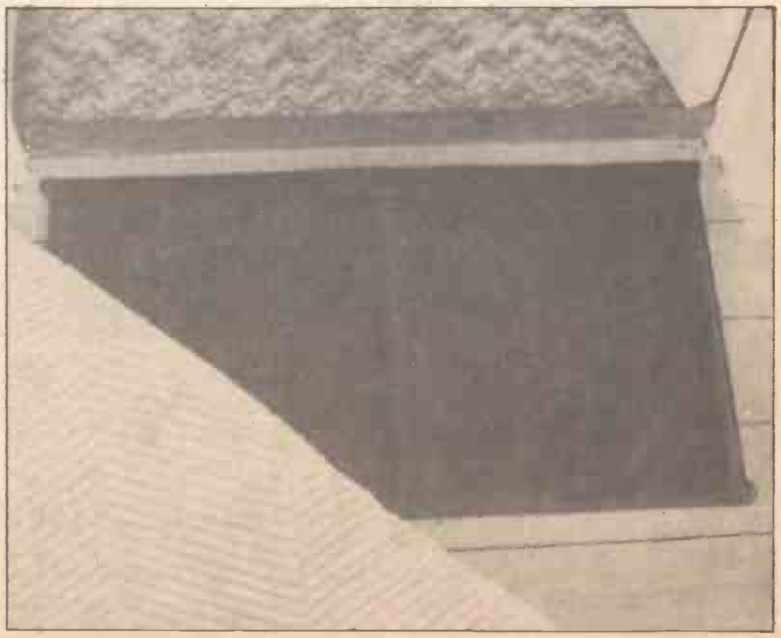
Self-adhesive metallic foil is available in both lead and aluminium. Lead foil is more expensive, but perhaps a little more tolerant of inexpert handling as it can be repaired. However, repairs are never encouraged as the repair will be much stronger than the virgin foil. For this reason it would be better to avoid the temptation altogether and use only aluminium foil.

Connection to the alarm system from the foil is made via a terminal block which is cemented to the glass. Generally the foil is run around the perimeter of the glass a little from the edge, but any format can be used which will cause a fracture in the foil when the glass upon which it is mounted is broken. Figure 9 gives application information.

Personal attack contacts

Personal attack contacts are alarm push-buttons strategically placed in areas where a victim is likely to be assaulted. They are normally hand operated, but foot activated types are also available. Examples of the types available are shown.

The push-button itself is normally recessed, to reduce the likelihood of unintentional activation, and is generally self-locking (key release), so that the source of the alarm is readily identifiable. Hand operated types are available in both flush and surface mounting options.



A pressure sensitive mat.

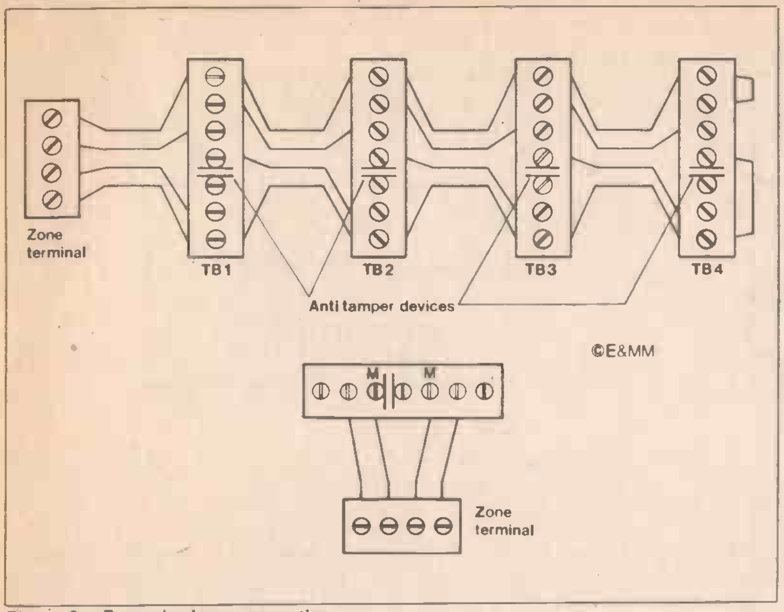
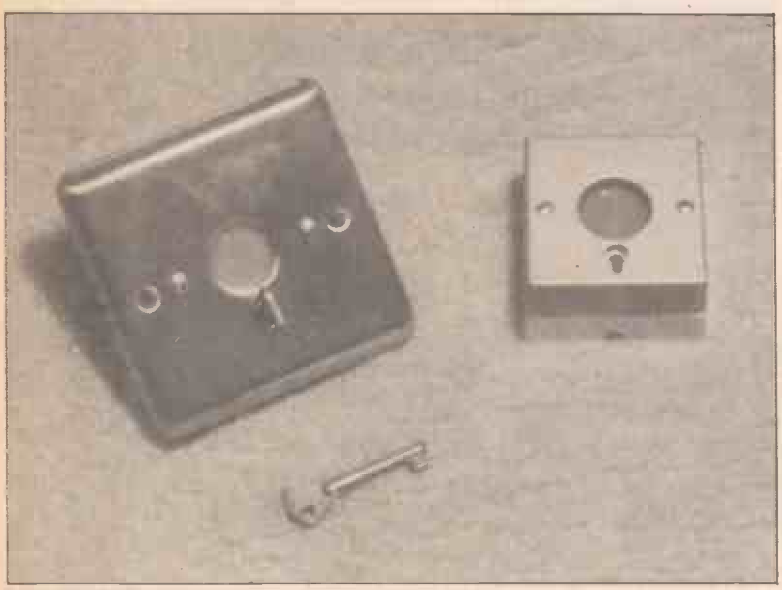


Figure 8. Four wire loop connections.


Personal attack push buttons.

Space detectors

Up to this point we have only reviewed devices which give very localised protection at a specific point. Space detectors, as the name suggests, cover a large area. There are a number of types available, but the following general comments apply to all:

1. Space detection devices are very much more expensive than localised protection devices on a unit cost basis. In fairness though this should be balanced by considering the number of devices, and the amount of effort required to produce the same degree of protection by another means.

2. Generally speaking, the more sophisticated a detection device is the more prone it becomes to generating false alarms, although some units and detection methods are better than others in this respect. Conversely, a space detector by virtue of its design philosophy is much more difficult to tamper with since it is to a very great extent self-protecting in operation.

Space detectors for home use utilise three basic detection methods — microwave radar, ultrasonic radar and passive infra-red heat detection. In the author's opinion the latter method, passive infra-red, is the most suitable for home installations, but all have merits which should not be discounted. Unfortunately there is too little space available in a general article to discuss the merits and demerits of each.

Signalling systems

Since we are essentially concerned with home protection, 'local' or 'site' alarms will only be considered in this section. Remote alarms such as those provided by autodialling machines are expensive and are of little use in that thieves do not normally stay for an extended period of time in domestic premises.

Site warning usually consists of bells. Sometimes sirens and even lighting controls are used. The primary function of the equipment employed is to scare off intruders.

The first line of defence is the external bell, or siren. It is usually fitted in a tamper-proof enclosure which provides protection from both the weather and from persons who would interfere with its operation. The photograph shows a typical bell and sirens. A six inch underdome bell is normally considered adequate for a domestic installation. Alternatively eight inch bells are available. Although it should be mounted as high as possible the bell housing should not be hidden from view — it is one of the best signalling equipments available. (One common procedure followed by installers is to fit dummy housings to buildings, along with real ones, if the working units cannot be seen from all approach angles.) The sight of a bell housing is to an intended thief a major deterrent, and it may put him off his intentions completely.

Designing an installation

In the preceding pages of this article we have designed and built a burglar alarm system, considered how the thief operates, and examined many of the devices which can assist us in our quest for greater home security. So that you may be aided in the planning of your own home intruder alarm system we will now consider three typical installations using the same floor plan as a starting point. Only the ground floor will be considered in the examples given. The diagrams referred to are shown in Figure 10.

Case 'A'

The owner of this home has an attractive wife, a young family and a dog — three factors which are very important to consider when planning an intruder alarm system. Unfortunately it is almost impossible to keep young children and animals confined to one area of a home, so to minimise the possibility of false alarms the owner has essentially opted for a perimeter defence scheme. It can be seen that all the external windows and doors have been protected (no foil has been used) but that very little protection has been provided internally. The exception here is the lounge which can be isolated by means of small bolts on the doors. Since with small children there is a possibility of contacts being disturbed, and things being left on pressure sensitive mats, an infra-red space detector has been installed at one end of the room — so covering the whole area with a minimum of fuss.

So that his attractive young wife may feel more secure her husband has installed personal attack push-buttons, not only at the front and rear doors, but also at other strategic points around the home — not forgetting the master bedroom.

Case 'B'

The owner of this home is single and not really a handyman. He also does not have a great deal of money to spend, but does want to protect his property. Using his understanding of the way a thief operates he has placed pressure sensitive mats at strategic points under the floor-coverings. Although a thief will not be detected at the point at which he enters the building, he should be detected as he goes about his illegal duties. Since the owner is not at all concerned about being assaulted no personal attack push-buttons have been installed.

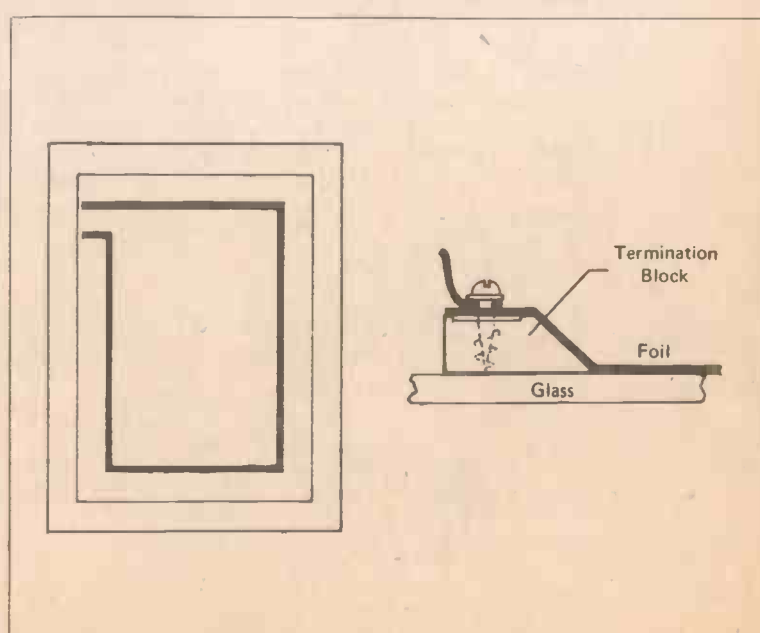


Figure 9. The application of window foil.

Case 'C'

The occupants of this home are a middle aged couple with one teenaged daughter still at home. They have an attractive dwelling filled with a large number of 'treasures' gathered over a long period of time. In view of the intrinsic worth, and the personal importance, of their possessions the couple have decided to protect their property as best they can on a limited budget.

A perimeter detection system has been installed as a first line of defence. For 'advertising' purposes dummy window foil has been added in some areas, as well as a dummy bell housing at the rear of the property. Internally, contacts have been fitted to all connecting doors, and pressure sensitive pads placed under the stair carpet. Since the owners are concerned about certain particularly valuable items, pressure pads have been positioned in front of the television and hi-fi units and an expensive wall clock has had a contact unit fitted to it so that in the event of an intruder showing more than a passing interest in them he will initiate an alarm. Personal attack push-buttons have been fitted near the front and rear doors of the house.

Hints and Tips

1. Draw a floor plan of your home.
2. Put yourself in the role of a thief. Consider how you would burgle your own home.
3. Consider the occupants — are there young children or animals around?
4. Decide on the quantity and positioning of the detection devices. (Do not plan for more than ten devices per alarm zone — it makes fault finding difficult.)
5. Position the control unit.
6. If a pass switch or time delay is to be used, which devices are to be disenabled by it?
7. Plan the wiring layout to determine the amount of wire required. Plan to conceal the wiring as far as possible.
8. Don't forget the shed or garage — it needs protecting too!

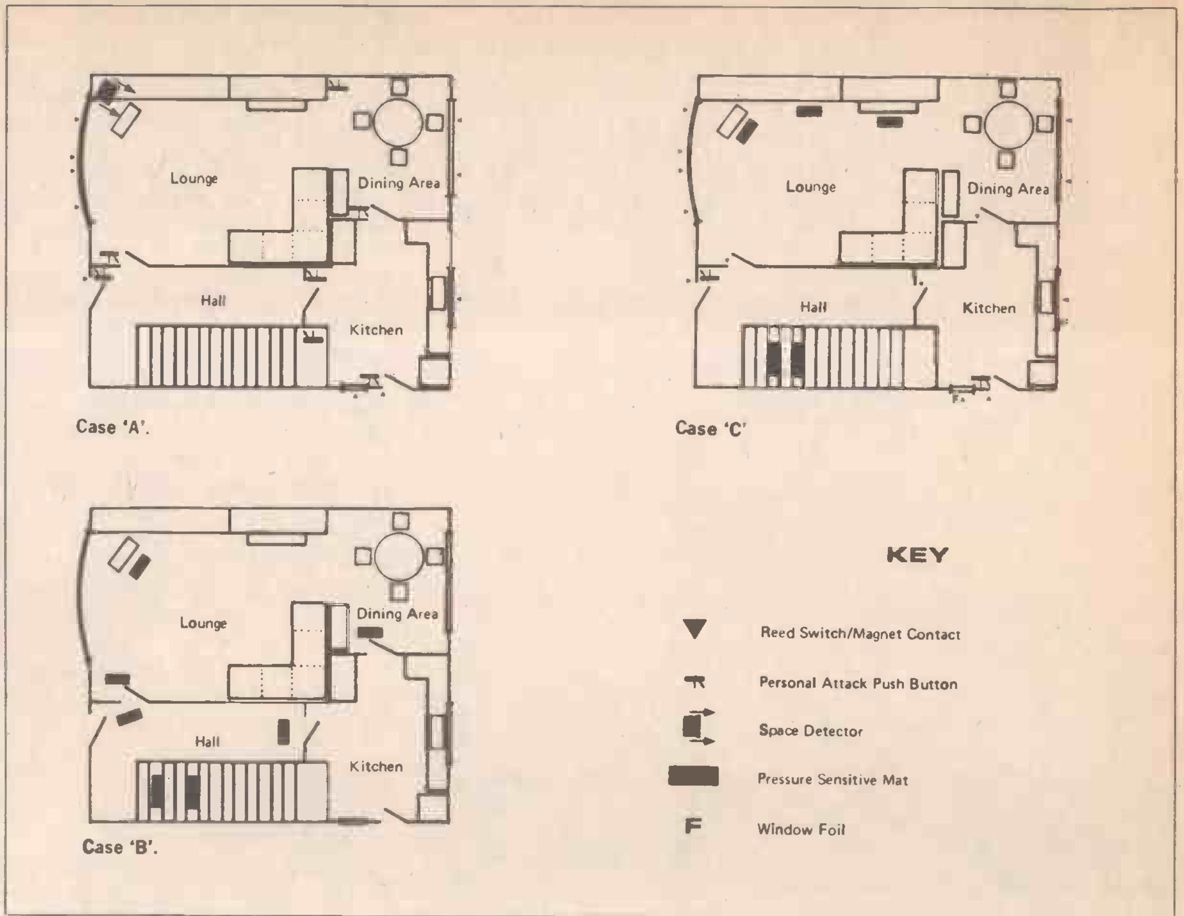


Figure 10. Installation examples.

And finally

Linton Electronics, who produced the design of the E&MM Securigard, have undertaken to supply all the 'hard to get' parts for the project on an individual basis, or to supply the complete unit in kit form for those who prefer to obtain all their parts from one source. They are also prepared to assist with technical problems and, in fact, have a free booklet available which gives more details on how to go about installing your own burglar alarm system than is possible in a short article. They have asked, however, that an A5-size stamped addressed envelope be included with all information and data requests. Their address is given in the parts list.

E&MM

Typical bell and sirens.

PARTS LIST FOR MAIN CONTROL MODULE

Resistors - all 5% ⅓W carbon unless specified			
R1	2M2 10%		(M2M2)
R2	1M0		(M1M0)
R3,8	3M3 10%	2 off	(M3M3)
R4	470k		(M470K)
R5,7	100k	2 off	(M100K)
R6,11,12 20-23	100R	7 off	(M100R)
R9,10A	10k	2 off	(M10K)
R10,13,15,17	1k0	4 off	(M1K0)
R14	22k		(M22K)
R16,18,19	110k	3 off	
Capacitors			
C1	100u 25V axial electrolytic		(FB49D)
C2	10u 35V tantalum		(WW70M)
C3,5	100n polyester	2 off	(BX76H)
C4	4u7 polyester		
C6	220n polyester		(BX78K)
Semiconductors			
D1,2,5-19	1N4002	16 off	(QL74R)
D4	1N5402		(QL83E)
TR1,2	BC548	2 off	(QB73Q)
IC1,4,5	NE555N timer	3 off	(QH66W)
IC2,3	HEF4017BP counter	2 off	(QX09K)
Note: There are no D3 and D7			
Miscellaneous			
WD1	Buzzer CMB 12 type		
FS1.4	Fuse 1A 20mm quick blow	4 off	(WR03D)
	Fuse holder open PCB mounting PCB 'RBSO'	4 off	
RL1-5	Reed relay CPR1/C type	5 off	
	Contact relay DPCO 12V PCB mounting		
	8-pin DIL socket	3 off	(BL17T)
	16-pin DIL socket	2 off	(BL19V)
	Terminal ¼in. spade PCB mounting	2 off	
	Terminal block 23-way PCB mounting		
S1,2	DPDT centre off min. switch PCB mounting	2 off	(FH05F)
S3	Keyswitch RPT type		

PARTS LIST FOR POWER SUPPLY BOARD

Resistors - all 5% ⅓W carbon unless specified			
R1	3k0		
R2	3k3		
RV1	220R min. Hor. preset		(WR53H)
Capacitors			
C1,2	1500u 16V axial electrolytic	2 off	(FB87U)
C3	470p ceramic		(WX64U)
C4	100u 25V axial electrolytic		(FB49D)
Semiconductors			
D1,2,3,4	1N4002	4 off	(QL74R)
TR1	2N3054		(QR24B)
IC1	uA723C regulator		(QL21X)
Miscellaneous			
	Fuse 250mA 20mm quick blow		(WR01B)
	Fuse holder 20mm PCB mounting		
	PCB 'RS1'		
	PCB stand offs	4 off	
	Heat sink T066 vaned type		
	14-pin DIL socket		(BL18U)
	Terminal ¼in. spade PCB mounting	2 off	
	Terminal block 3-way PCB mounting		
T1	20VA 12½/0/12½ transformer PCB mounting		
	Transistor mounting kit T066 type		(WR25C)
	Nut 3mm	3 off	(BF58N)
	Screw 3mm 12mm long	2 off	(BF52G)
	Spring washers 3mm	3 off	

PARTS LIST FOR INDICATOR BOARD

Resistors - all 5% ¼W unless specified			
R24-26, 29	1k0	4 off	(M1K0)
R27,28	220R	2 off	(M220R)
Semiconductors			
D20,21	1N4002	2 off	(QL74R)
	LED green 0.2in.	4 off	(WL28F)
	LED red 0.2in.	3 off	(WL27E)
	LED yellow 0.2in.		(WL30H)
	LED clip	8 off	(YY40T)
Miscellaneous			
	PCB indicator board		

PARTS LIST FOR FINAL ASSEMBLY

Capacitors			
*C5	4700u 25V can electrolytic		(FF26D)
Miscellaneous			
	*Battery 12V 2.6AH rechargeable lead acid		
	Label		
	Microswitch V3 lever act. type		
	Control unit housing		
	Motor driven siren		
	'U' bracket		
	¼in. spade receptacle	8 off	(HF10L)
	¼in. space receptacle cover	8 off	(HF12N)
	Solder tag		(LR64U)
	No. 6 ⅜in. self-tapping screws	12 off	(LR67X)
	6BA screw 1in.	2 off	(BF07H)
	6BA nut	4 off	(BF18U)
	6BA spring washer		
	3½in. of 7-way ribbon cable		(XR06G)
	Plus wire to suit		

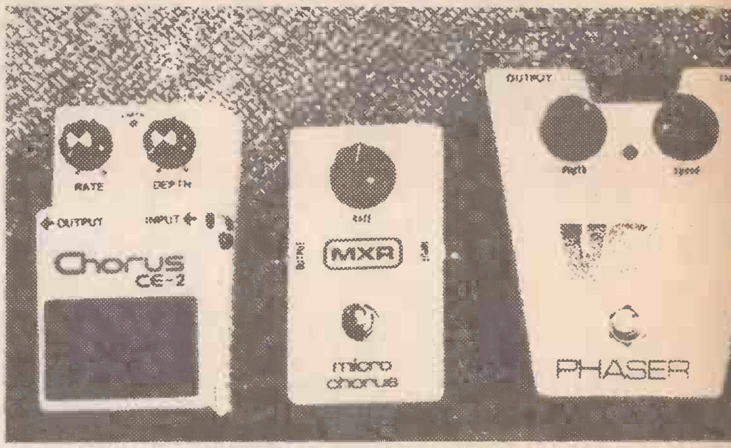
NOTES
*If the rechargeable battery is not used the capacitor C5 must be installed.
All parts quoted that are not available from Maplin Electronic Supplies can be purchased from:

LINTON ELECTRONICS,
4 HELSTON CLOSE,
BURTON-ON-TRENT,
STAFFS DE12 6PN.

Alternatively a complete kit or ready-built version can be purchased from Linton Electronics. For prices write to the above address or telephone: Burton (0283) 761877.

EFFECTS LINK FX-1

by Glenn Rogers



- ★ **Unique design allows multi-selection of effects pedals**
- ★ **One touch continuous route selection**
- ★ **CMOS switching for noiseless change-over**
- ★ **Eight different route possibilities**

The effects link FX-1 is designed with the guitarist and keyboard player in mind. It provides a facility for selecting one of a number of effects pedals or units but it has application in the studio or on stage wherever multi-routing is likely to be necessary.

With the huge range of effects pedals now available as ready made items, it is perhaps a little surprising that few manufacturers until recently have considered the problems of routing more than one of these devices together.

The first effects pedals were primarily for the guitarist and therefore required a high impedance input (to avoid loss of control and upper response from the guitar) and the ability to handle low level signals. This immediately caused problems for the keyboard player who might well use a pedal (e.g. phase or wah wah) that needed some component change internally to correctly match the 'line' level output of a synth, organ or electric piano to the unit.

Several companies have produced designs that use a common power supply and through-linking, so that the player can switch in or out one or more effects at any time without the need for re-routing cables from units. This generally works well but does not present the most versatile solution. Another point to remember is that the order of connecting several effects can be important to the final multi-processed sound. Many professional musicians use custom designed patch boxes to solve their routing problems and there are only a few switch link boxes currently available (e.g. from MXR and Electro-

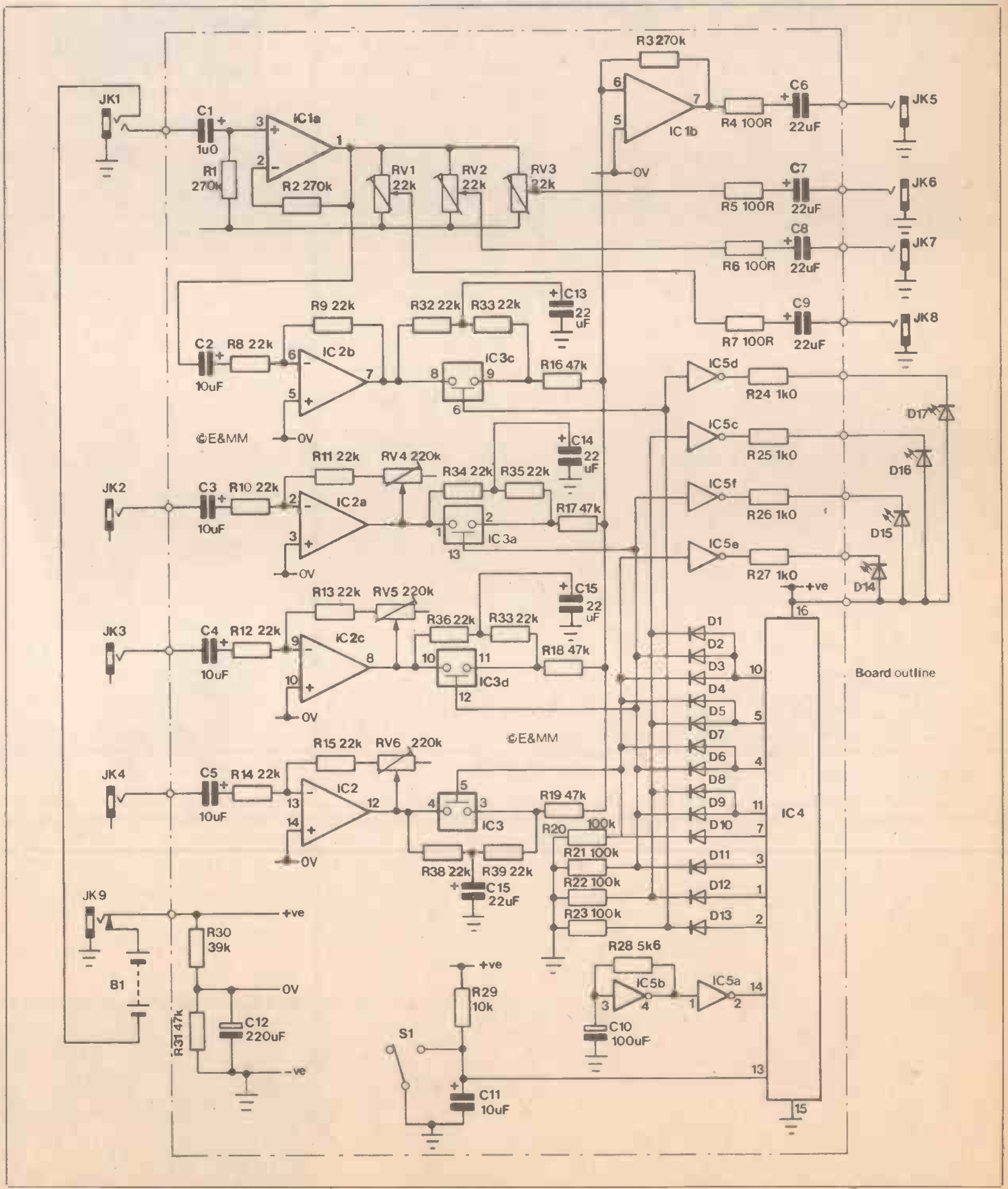
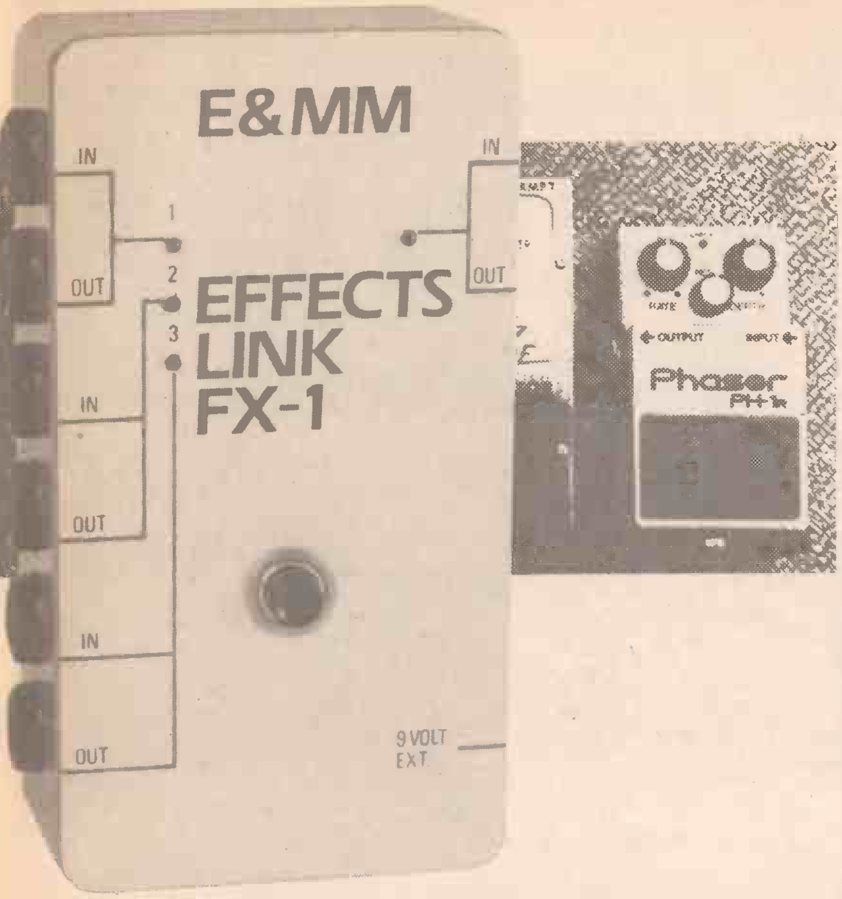


Figure 1. Circuit diagram of Effects Link.



Harmonix) that simply switch between two or more effects.

The Effects Link should provide the variety and compatability required by the most discerning musician and will cope easily with guitar and all electronic keyboard levels. The electronic switching makes easy selection of the effects from one place, either on the floor (using your feet) or on a console top (using your hands). The circuit uses CMOS analogue switches to eliminate the noise generated by mechanical switches. LED indicators give an instant instrument check on the effect in use (invaluable for effects units without this facility), and the strong die-cast box recommended will minimise hum pick-up and withstand knocks and handling. Level adjustment is provided on both send and return signal lines to enable each route to be set up so that there is no change in level between routes.

Circuit

Figure 1 shows the circuit diagram of the Effects Link which can be divided into two sections, the audio section and the control section. Let us first consider the audio circuits. IC1a acts as a buffer for the signal input (which can range from 50mV to several volts), and as a driver for the three effect sends. The presets RV1-RV3 can be used to set the send level. R1 sets the input impedance of the buffer to approximately 300k and, with R2 sets the gain of the buffer to unity. Each of the return signals and the straight signal are fed through buffers (IC2) and into the CMOS switches. Each of the buffers for the return inputs has a gain variable between unity and times ten, controlled by presets RV4-RV6. The outputs from the switches are fed to a four-input, unity gain mixer formed by IC1b. The return paths are switched in preference to the send signals so that the outputs of noisy effect pedals do not cause a deterioration of the signal-to-noise ratio. The unit has zero phase shift between input and output, input and send, and return and output.

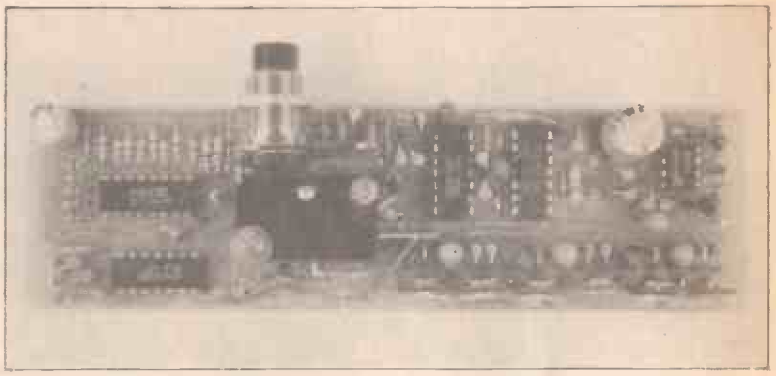
The selection of the route patterns is carried out by a one-of-eight decoded counter (IC4) and a diode matrix. The diode matrix along with resistors R20-23 form four diode 'OR' gates which control the CMOS switches. IC4 is controlled by the footswitch and the clock (IC5a and b). When the footswitch is depressed the decoder is enabled and the unit steps through the eight possible combinations continuously. When the footswitch is released the clock input is disabled and the last combination remains set. The route pattern is displayed on the top of the box by four LEDs driven by IC5c, d, e, f from the switch control lines. If less than eight combinations of routes are required this can be achieved by connecting the reset pin of IC4 to one of the decoded outputs, i.e. if only four routes are required then the fifth decoded output should be connected to the reset pin.

The unit is powered from a single 9V supply and R30, R31 and C12 provide half the supply voltage to correctly bias the op-amps. The power is switched on and off by the signal input jack socket, JK1.

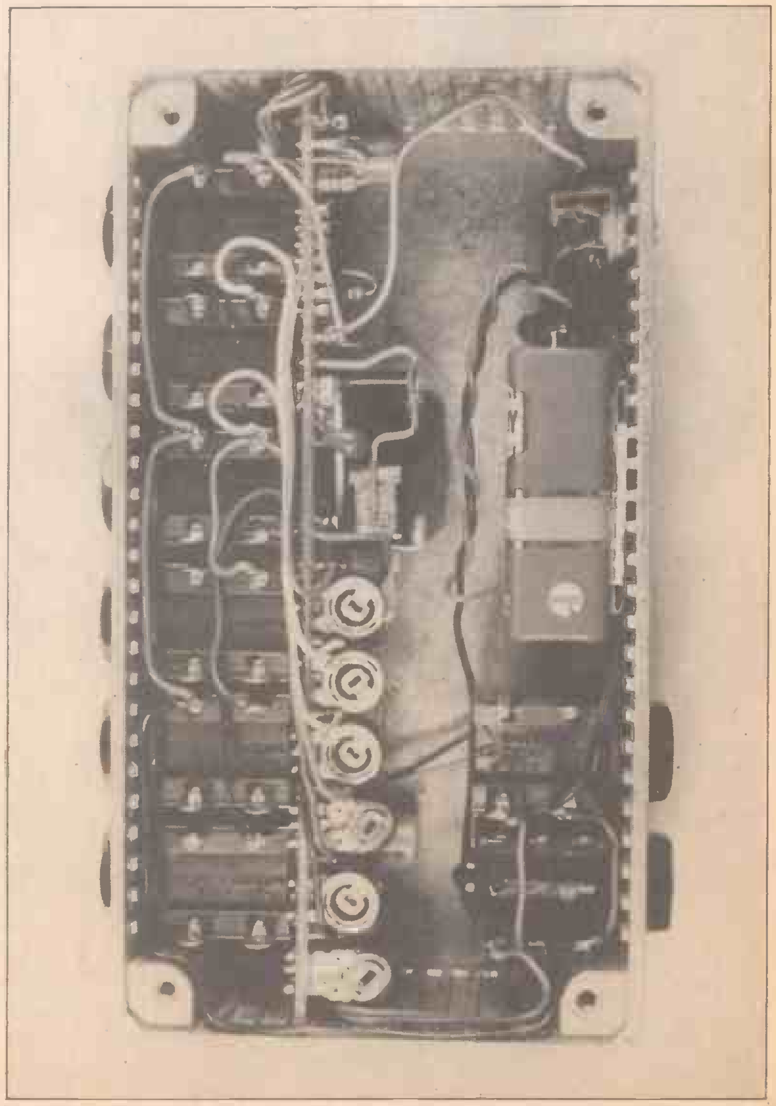
An additional jack plug (JK9) allows connection of an external power source if the unit is to be in regular use. The Synpac project (see September 1981 issue) is an ideal power source for this purpose.

Construction

All the components except the LEDs and the sockets are mounted on the PCB (shown in Figure 2). In the prototype unit the ICs were not fitted into sockets but there is space to do so if preferred. PCB assembly should start with the links. Next the resistors, capacitors, presets and diodes can be soldered into place and the microswitch mounted on the board. Assembly of the PCB can then be completed with the insertion of the ICs. Note that



Component side view of PCB.



Internal view of case.

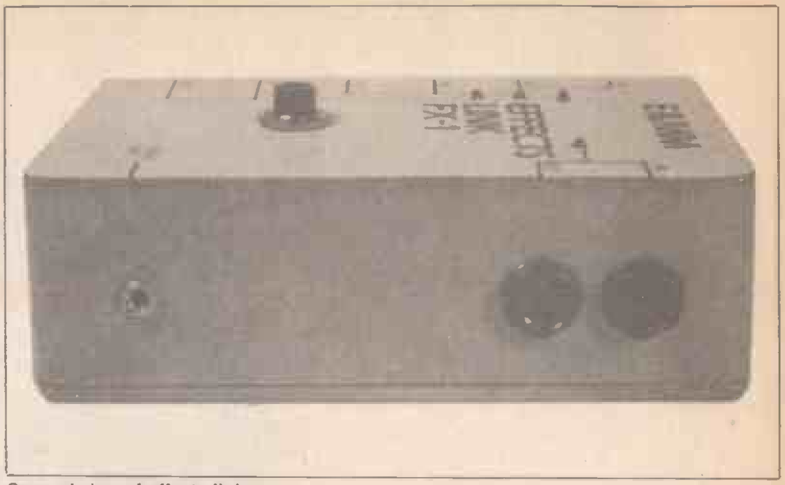
some of the resistors are mounted underneath the microswitch assembly.

The case should be drilled to the dimensions given in Figure 3. The LEDs are glued into their mounting holes with a suitable adhesive. Connect the anodes of the LEDs together and connect a wire to them. Also connect a lead to each of the four LED cathodes. Next fit all the jack sockets and wire them as shown in the wiring diagram. When all the connections to the PCB have been made it can be slotted into position and secured with the nut on the microswitch assembly.

Testing

Having completed the assembly of the unit, the next step is to fit a battery and switch on by inserting a jack plug into the signal input socket. The unit should then display a random route on the LEDs. If this does not happen, switch off and check the circuit again. If all is well, depress the footswitch and watch the Effects Link step through the eight combinations. The sequence should be as follows: Straight, FX1, FX2, FX3, FX1 and FX2, FX2 and FX3, FX1 and FX3, and FX1, FX2 and FX3.

Having checked that the con-



General view of effects link.

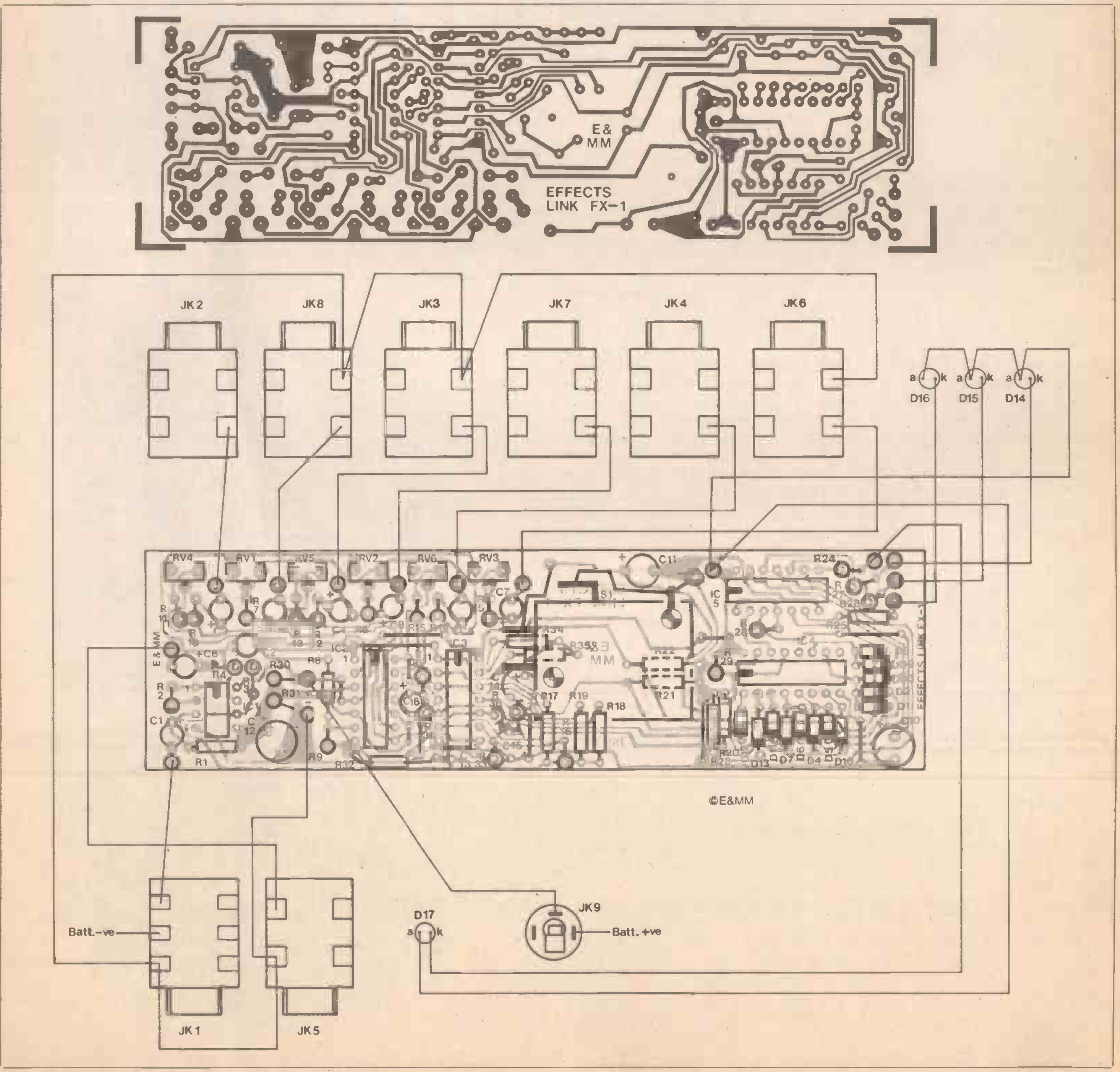


Figure 2. PCB track layout, component overlay and wiring details.

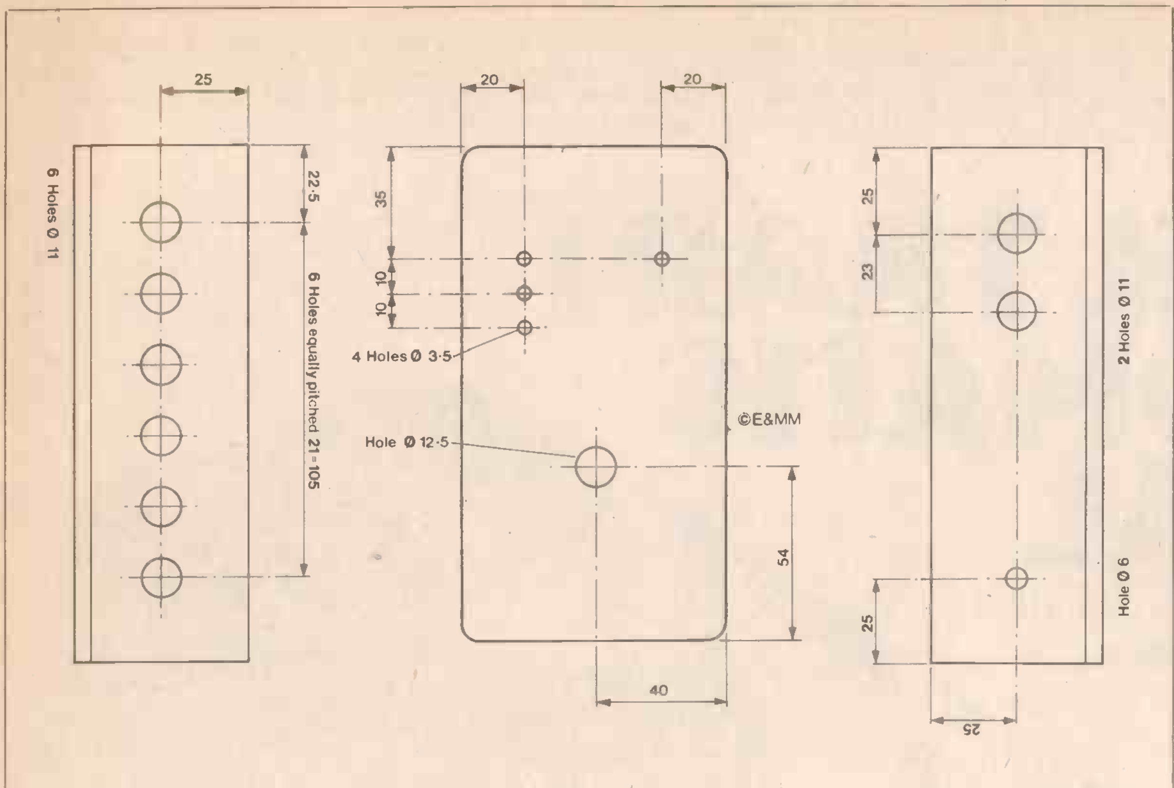


Figure 3. Case drilling details.

trol section is operational you can now test the audio section. Connect a signal source to the input and connect the output to an amplifier. Set the Effects Link to the straight route and the signal should be audible. Check that the signal output is clean and undistorted. Next, connect jack to jack leads between the send and return sockets and set the presets for unity gain. Now depress the footswitch and check each route is operational and that there is no change in signal level except when more than one route is selected. Finally, before fitting the bottom of the box, adjust the presets to give the required levels for your effects pedals and ensure that there is unity gain on all routes.

Using the Effects Link

The first thing to do is decide on how you wish to use the selector. Its main use is to select one or a combination of single effects pedals or, to select different chains of effects pedals. Figure 4 shows a few connection possibilities.

The wiring diagram shows only the send jack-sockets connect with an earth. This has been done to eliminate the possibility of earth loops when using standard effects pedals, but in some situations this may cause problems with interference and it may become necessary to earth the return jack as well.

The unit can also be used as a switched input mixer for the three return lines and the straight signal or, as a signal splitter with a straight output and three sends. This gives endless possibilities of use in the studio for route selection to tape recorders and effects and for splitting signals for different effects as well as for dedicated use with an instrument and effects pedals. **E&MM**

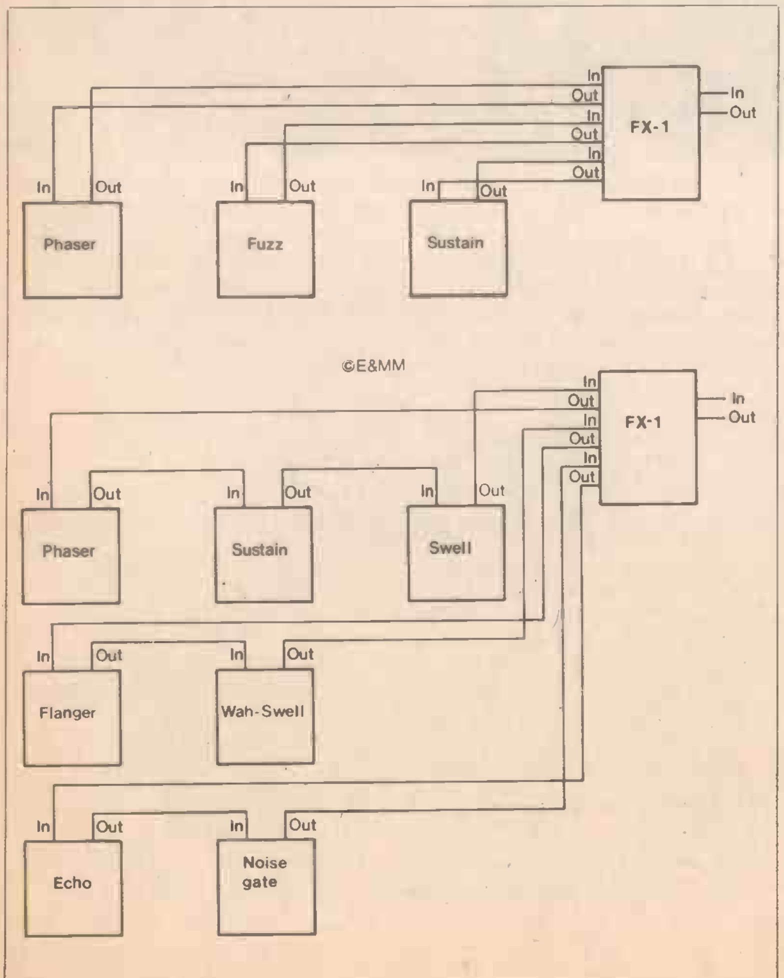


Figure 4. Using the Effects Link.

PARTS LIST FOR EFFECTS LINK

Resistors - all 5% ⅓W carbon unless specified			
R1,2	270k	2 off	(M270K)
R3,16,17,18,19,31	47k	6 off	(M47K)
R4,5,6,7	100R	4 off	(M100R)
R8,9,10,11,12,13, 14,15,32,33,34, 35,36,37,38,39	22k	16 off	(M22K)
R20,21,22,23	100k	4 off	(M100K)
R24,25,26,27	1k0	4 off	(M1K0)
R28	5k6		(M5K6)
R29	10k		(M10K)
R30	39k		(M39K)
RV1,2,3	22k vert S-min preset	3 off	(WR72P)
RV4,5,6	220k vert S-min preset	3 off	(WR75S)
Capacitors			
C1	1u 35V Tantalum		(WW60Q)
C2,3,4,5,11	10u 16V Tantalum	5 off	(WW68Y)
C6,7,8,9,13,14, 15,16	22u 16V Tantalum	8 off	(WW72P)
C10	100u 10V PC Electrolytic		(FF10L)
C12	220u 16V PC Electrolytic		(FF13P)
Semiconductors			
IC1	1458c		(QH46A)
IC2	3403		(QH51F)
IC3	4066BE		(QX23A)
IC4	4022BE		(QW19V)
IC5	40106BE		(QW64U)
D1-D13	1N4148	13 off	(QL80B)
D14-D17	LED min red	4 off	(WL32K)
Miscellaneous			
JK1	Jack socket stereo		(HF92A)
JK2,3,4,5,6,7,8	Jack socket mono	7 off	(HF90X)
JK9	Jack socket 3.5mm		(HF82D)
S1	Microswitch and bracket		(HQ83E)
	PCB		(GA50E)
	Diecast box type DCM5005		(LH73Q)
	Battery clip		(HF28F)
	PP3 battery		

Young Ideas

This series will present a variety of projects designed to appeal to the younger reader but not necessarily suitable for the complete beginner. We shall be pleased to receive articles or project ideas for possible use in this feature.

MODEL TRAIN AUTOMATIC SIGNAL

PARTS COST GUIDE £7

- ★ Completely automatic operation
- ★ Reacts exactly as British Rail system
- ★ No reed switches needed

This simple model railway accessory is a signal which automatically switches to 'red' when a train passes, and back to 'green' again when the train has gone a certain distance along the track. The signalling system used by British Rail is semi-automatic, and in many ways the system used here is a similar version of this system.

Designs of this type are not new but the circuit described here is a little unusual in that it uses Hall effect switches to sense the train as it passes the signal and as it passes a point further along the track where the signal is reset to 'green'. The more common method of sensing the train is to use reed switches. In either case the magnet in the electric motor of the train may produce a strong enough magnetic field to operate the sensors; if not, a small magnet can be added to the train.

Hall Effect

As many readers may not be familiar with the Hall effect or Hall effect switches, we will briefly consider these before proceeding further. Figure 1 shows the basic arrangement used in a Hall effect sensor. As can be seen from this illustration, the sensor consists of a thin bar of silicon having electrodes placed on opposite sides and an equal distance down the bar. A current is passed down the bar, but there is no potential across the electrodes as they are the same distance down the bar and are therefore at points which are at an identical voltage.

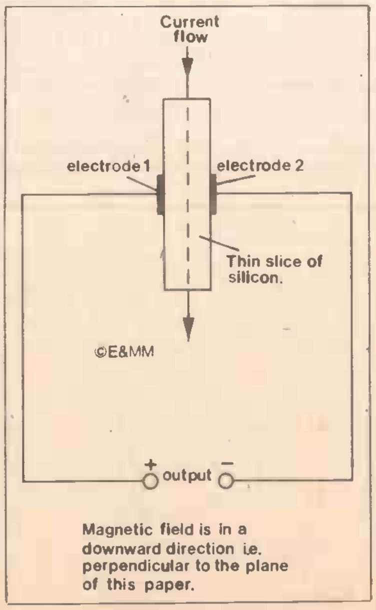
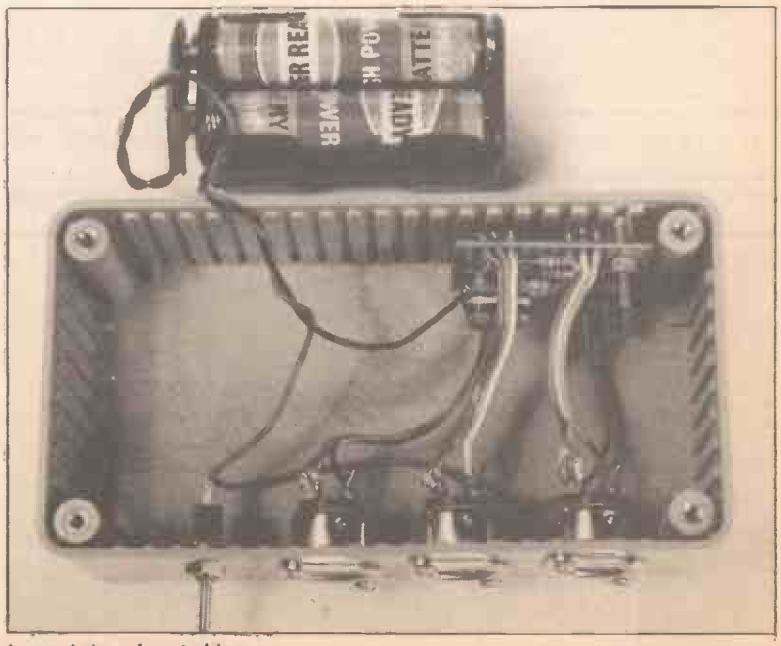


Figure 1. A basic Hall effect sensor.

If a magnetic field is applied to the device in the direction shown in Figure 1, this deflects the current carriers in the silicon bar in the same way as a magnetic field deflects the electron beam in a cathode ray tube. This distortion of the normal current flow through the bar results in a small



Internal view of control box.

potential being produced across the electrodes and this potential is proportional to the strength of the magnetic field. Using an opposite magnetic field has the opposite effect on the silicon bar, giving an output voltage of opposite polarity. A magnetic field at right angles to this direction has no significant effect on the sensor as the effect at each electrode will be the same, and no output potential will be developed.

The simplest type of Hall effect switch has three terminals: positive supply, negative supply, and output terminal. The output terminal connects to the collector of the output transistor; there are no other internal connections to this terminal. If a magnetic field of suitable direction and strength is applied to the device, the output transistor is biased to saturation. If the magnetic field is removed or reduced somewhat in strength the device switches off. The TL172C is an example of a Hall effect switch of this type.

The automatic signal circuit uses a slightly more complex type of switch which latches in the 'on' state once it has been triggered and remains switched on when the magnetic field is removed. It can be switched off by applying a magnetic field of opposite polarity to the one originally used to switch it on (using the same magnetic field and turning the device through 180 degrees gives the same effect). Momentarily interrupting the power supply also switches the device off provided there is no magnetic field to immediately retrigger it.

The Circuit

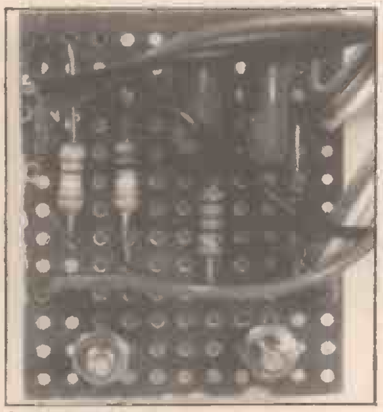
The signal uses few components, as can be seen from the circuit diagram which appears in Figure 2.

IC1 is the sensor placed under the track beside the signal, and this will be switched on when the train first passes the signal. The output transistor of IC1 then connects the supply to the red LED (D1) via current limiting resistor R2. D1 and D2 are used as the lights in the signal, and the unit is therefore set to 'red' in the required manner.

IC2 is the sensor positioned further along the track, and when this is activated it switches on the green LED (D2). It simultaneously sends a brief but strong negative pulse to the positive supply terminal of IC1 via C1 so that the supply to the latter is momentarily interrupted and IC1 is reset to the 'off' state. The signal thus changes from 'red' to 'green'.

When IC1 is next operated it switches D1 on again, and sends a negative pulse to the supply terminal of IC2 via C2 so that IC2 and D2 are switched off. This cycle of events continues as the train moves around the track.

The circuit has a fairly high current consumption (about 15 to 20mA) but this can be provided economically by four HP7 size batteries. The unit only has one control and this is the on/off switch S1.



Assembled board.

Construction

Obviously the two sensors and the two LEDs are not fitted in the case with the other components. Instead these connect to the main unit via thin three-way leads, one lead each for IC1 and IC2, the third being used for D1 and D2. These leads are terminated in three-pin DIN plugs which mate with sockets fitted on the case of the main unit.

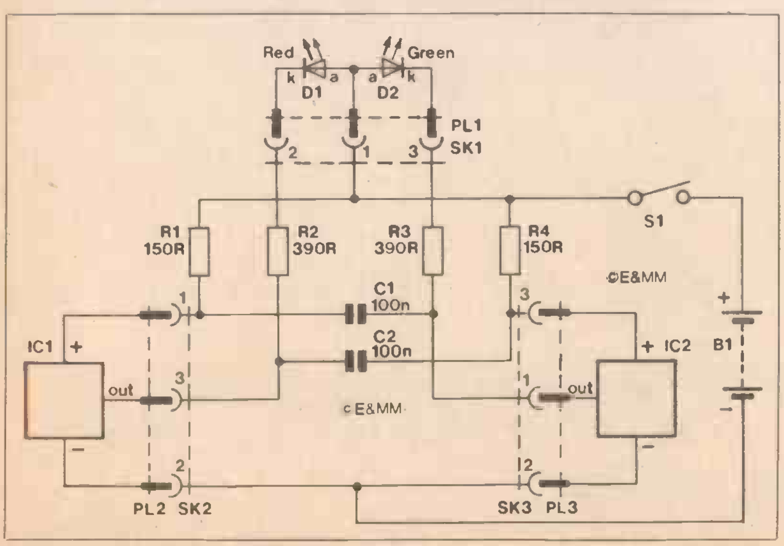


Figure 2. Automatic train signal circuit diagram.

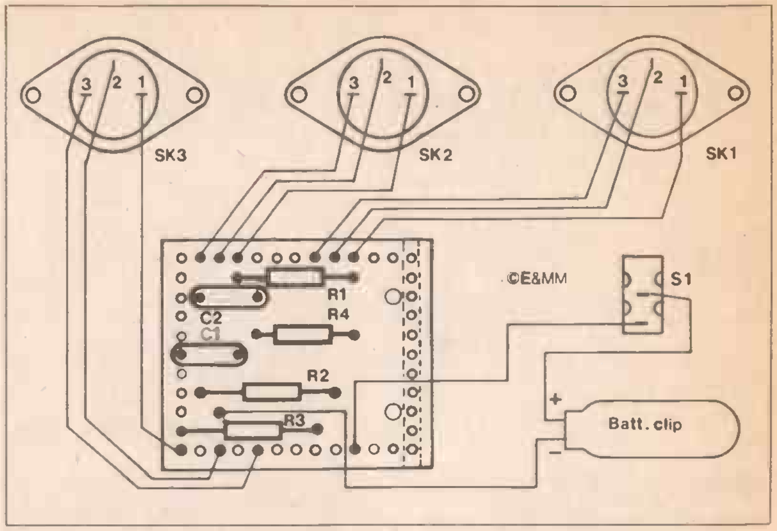


Figure 3. Component layout and wiring.

A small plastic box (type ABS 2004 or similar) is used to house the component panel, battery, on/off switch, and sockets. The three sockets and the on/off switch are mounted along one of the long edges of the case which leaves room for the battery and component panel to be located behind them.

The component panel uses a piece of 0.1in. matrix Veroboard measuring 11 holes by 13 strips and the layout of this is illustrated in Figure 3. This diagram also shows the other wiring details of the unit. There are no breaks in any of the copper strips and the two mounting holes in the board are 3.2mm in diameter and accept 6BA fixings. The three leads connecting the sockets to the component panel can be three-way leads taken from 10-way ribbon cable, as can the external leads which connect to the sockets.

As mentioned earlier, the four HP7 size batteries used to power the unit fit in a plastic battery holder. This must be a short holder and not the type which has the batteries fitted end-to-end, otherwise the batteries will not fit inside the case. The battery holder is fitted with PP3 type press-studs, and the holder is connected to the unit via a PP3 type battery connector.

When all the wiring has been completed the component board is bolted to one side of the rear panel of the case (opposite the sockets and switch), allowing sufficient space for the batteries to fit in beside the board as shown in the photograph.

Signal Construction

The signal must obviously be constructed to look reasonably like the real thing and no doubt many constructors will have their own ideas about how to tackle this. Figure 4 shows the approach used in the prototype, and this is based on a piece of plastic or wood about 4 or 5mm in diameter. This could be taken from a plastic trimming tool or knitting needle, or could simply be a piece of dowel.

The two LEDs are fitted on a very small aluminium panel which measures about 20mm by 9mm. The two holes should be drilled for the LED holders before it is cut from the piece of aluminium sheet, as it would be very difficult to make these holes once the panel had been cut to size. The rod is drilled with holes about 0.8 to 1mm in diameter which enable the leadout wires of the LEDs to be threaded through it and bent flat against the other

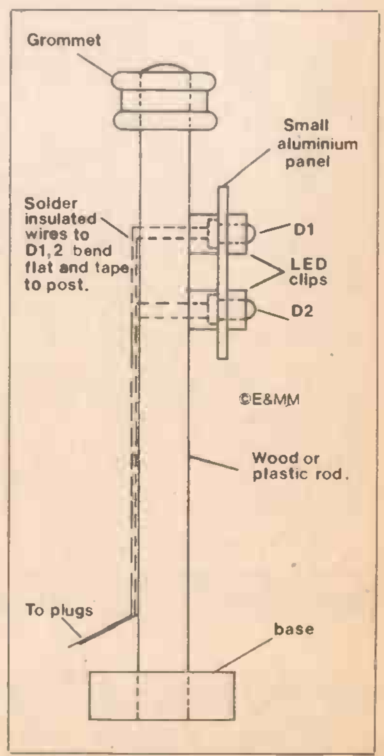
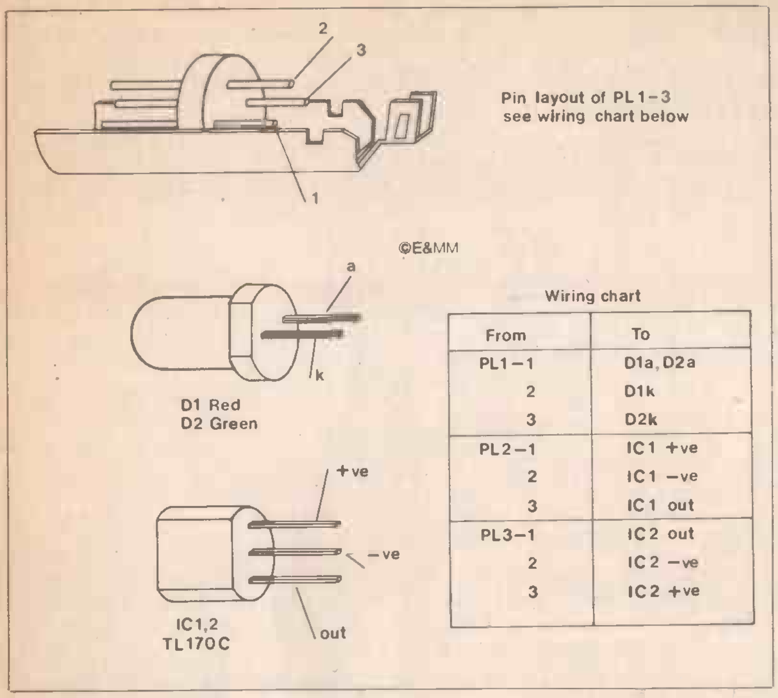


Figure 4. Signal construction.



Wiring chart

From	To
PL1-1	D1a, D2a
2	D1k
3	D2k
PL2-1	IC1 +ve
2	IC1 -ve
3	IC1 out
PL3-1	IC2 out
2	IC2 -ve
3	IC2 +ve

Figure 5. Signal and sensor plug wiring.

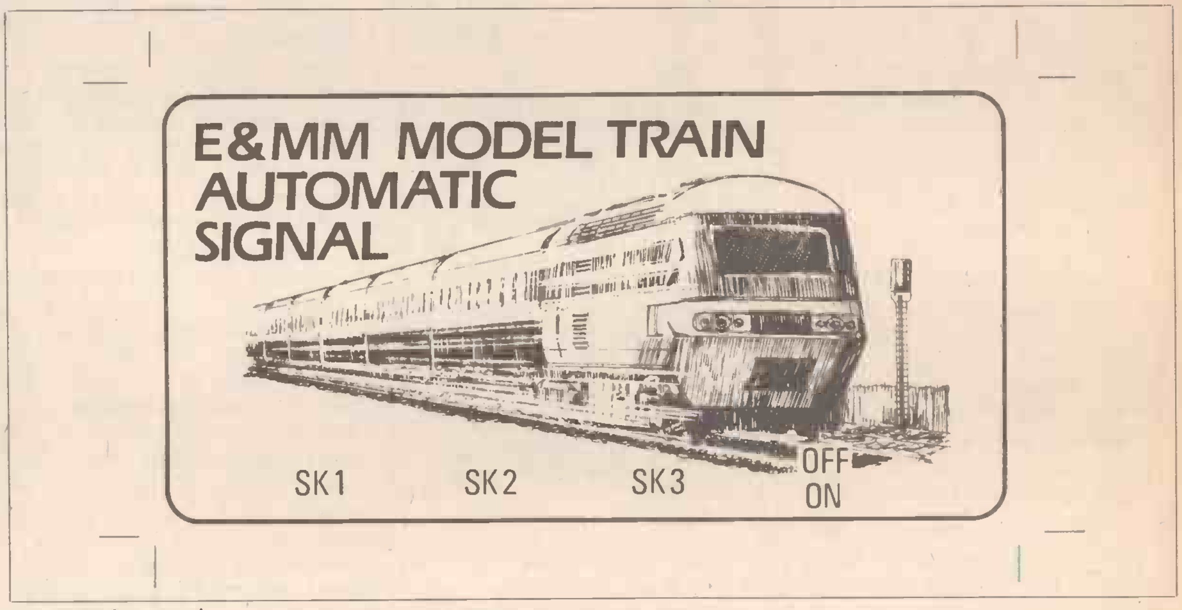
PARTS LIST FOR AUTOMATIC TRAIN SIGNAL

Resistors - all 5% ⅓W carbon unless specified			
R1,4	150R	2 off	(M150R)
R2,3	390R	2 off	(M390R)
Capacitors			
C1,2	100n polyester (C280)	2 off	(BX76H)
Semiconductors			
IC1,2	TL170C	2 off	(WQ75S)
D1	LED 3mm Red		(WL32K)
D2	LED 3mm Green		(WL33L)
Miscellaneous			
	Case type ABS 2004		(LH60Q)
S1	SPST Miniature toggle		(FH97F)
PL1,2,3	3-Pin DIN plug	3 off	(HH25C)
SK1,2,3	3-pin DIN socket	3 off	(HH32K)
	Battery holder for 4 x HP7s		(HF29G)
	0.1in. matrix Veroboard		(FL08J)
	Battery HP7	4 off	
	Ribbon cable 10-way		(XR06G)
	Battery connector PP3 type		(HF28F)
	LED clip	2 off	(YY39N)
	Magnet		(FX72P)
	Bolts 6BA ½in.		(BF06G)
	Nuts 6BA		(BF18U)
	Screws No. 2 3/16in. self-tapping		(BF64U)

side so that the LEDs are held in place.

Thin insulated leads are soldered to the leadout wires; only three are needed as the two anode leadouts are wired together. A piece of PVC insulation tape is placed over the leadout wires and connections, to give a neat finish, and bands of this tape are then used to bind the three thin leads to the rod. These three leads can be attached to the connecting cable using a three-way terminal block. This can also be used as a base for the signal if the lower end of the rod is filed down to fit into one of the holes in the terminal block. Some modelling clay could be used to cover the terminal block and give a neater finish to the base part. The signal is then painted to give a better overall finish.

The signal lead must be connected to the three-pin DIN plug correctly, as must the leads from IC1 and IC2. Figure 5 shows the correct method of connection for all three plugs.

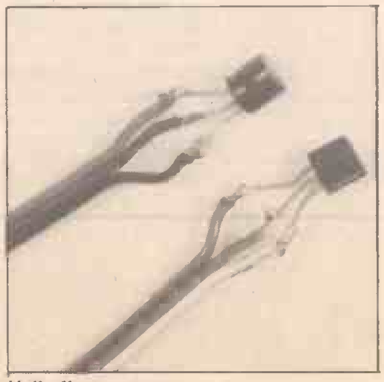


Artwork for front panel.

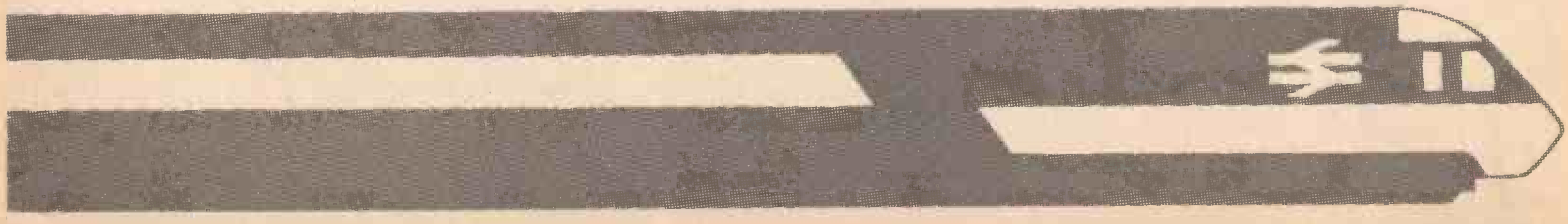
Using the Signal

Fit the sensors on or under the track with the flat face or the encapsulation uppermost. When using the signal with an 00 gauge layout it was found that the sensors could be fitted on top of the sleepers without derailing the train, and the magnetic field produced by the motor in the locomotive operated the signal reliably. In some cases though, it will probably be necessary to fit a bar magnet into the train to trigger the signal, and it is essential to fit this magnet with the correct pole facing down towards the sensors, or both LEDs will simply switch off. The correct way up for the magnet is found by trial and error.

With smaller gauge layouts it will probably be necessary for the sensors to be fitted beneath the track, but a Maplin large bar magnet will operate the unit at a range of about 12.5mm (½in.) and there should be no problem in getting the system to work properly. The magnet can be mounted at an angle if it is necessary to fit it in a confined space but this will result in some reduction in operating range. It is unlikely that satisfactory results will be obtained with the magnet mounted horizontally. **E&MM**



Hall effect sensors.



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THE KEY TO YOUR SECURITY

IS IN OUR LOCK

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 Ç 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

YOU MUST HAVE BETTER THINGS TO DO

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.

MINI KITS

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

MK1 TEMPERATURE CONTROLLER/ THERMOSTAT
Uses LM3911 IC to sense temperature (80°C max) and triac to switch heater 1KW £4

MK2 SOLID STATE RELAY
Ideal for switching motors, lights, heaters, etc. from logic. Opto-isolated with zero voltage switching. Supplied without triac. Select the required triac from our range. £2.60

MK3 BAR/DOT DISPLAY
Displays an analogue voltage on a linear 10-element LED display as a bar or single dot. Ideal for thermometer's, level indicators, etc. May be stacked to obtain 20 to 100 element displays. Requires 5-20V supply £4.75

MK4 PROPORTIONAL TEMPERATURE CONTROLLER
Based on a new zero voltage switch IC, this kit may be wired to form a 'burst fire' power controller, enabling the temperature of an enclosure to be maintained within 0.5°C. Thermistor failure causes output to switch off. Temperature range ambient to 90°C 3KW. £5.55

MK5 MAINS TIMER
Based on the ZN1034E Timer IC this kit will switch a mains load on (or off) for a preset time from 20 minutes to 35 hours. Longer or shorter periods may be realised by minor component changes. Maximum load 1KW £4.50

NEW!

NOT JUST ANOTHER CLOCK

but a PROGRAMMABLE TIMER KIT which can run your central heating, burglar alarm, lighting, tape recorder/radio and lots more. Designed to control four mains outputs independently, switching these on and off on selected days and times in a seven day cycle.

Features include:
* 0.5" LED 12 hr. display.
* Day of week, am/pm and output status indicators.
* Zero Voltage Switching Outputs.
* 50/60Hz mains operation.
* Battery backup saves stored programmes and continues time keeping during power failures. (Battery not supplied).
* Display blanking during power failure to conserve battery power.
* 18 programme time sets.
* Powerful "Everyday" function enabling output to switch every day but use only one time set.
* Useful "sleep" function – turns on output for one hour.
* Direct switch control enabling output to be turned on immediately or after a specified time interval.
* 20 function keypad for programme entry.
* Programme verification at the touch of a button.

To control your central heating, for example (including different switching times at weekends), just connect it to your system, programme it, set it and forget it. The clock will do the rest. There has never been a clock capable of so much at this price.

CT5000K Timer Kit (includes all components, assembly and programming instructions, and an attractive black case) **£45.00**

INTEGRATED CIRCUITS

555 Timer	.21
556 Dual 555 Timer	.40
741 Op Amp	.19
AD590 Constant current Temperature Sensor	2.75
AY-5-1224 Clock	2.60
AY-5-1230 Clock Timer	4.50
AY-3-1270 Thermometer	8 20
CA3080 Transconductance OpAmp	.72
CA3130 CMOS Op Amp	.75
CA3140 CMOS Op Amp	.43
ICL7106 DVM (LCD drive)	7.00
ICM7555 CMOS 555 Timer	.79
LM377 Dual 2W Amp	1.45
LM379S Dual 6W Amp	3.50
LM380 2W Audio Amp	.80
LM382 Dual low noise pre-amp	1.00
LM386 250mW low voltage amp	.75
LM1830 Fluid Level Detector	1.50
LM2917 F-V converter (14-pin)	1.60
LM3909 LED Flasher oscillator	.60
LM3911 Thermometer	1.20
LM3914 Dot ^Bar driver (linear)	2.10
LM3915 Dot Bar driver (log)	2 20
LS7220 Electronic Combination Lock with "Save" feature	2.75
LS7225 Electronic Combination Lock with tamper output	2.60
MM74C911 4-digit display controller	6.50
MM74C915 7 segment BCD converter	.96
MM74C926 Counter 7 seg output	4.50
S566B Touchdimmer	2.50
SL440 AC Power Control	1.75
SL441 Burst Fire Controller	1.35
SN76447 Complex Sound Generator	1.75
TBA800 5W Audio Amp	.68
TBA810AS 7W Audio Amp	1.00
TMS1121 Clock, 7 day Timer	8.50
Data for TMS1121	.50
TDA1024 Zero Voltage Switch	1.20
TDA2020 20W Audio Amp.	2.85
TDA4290 DC controlled, Base, Treble & Volume Pre-Amp	1.98
TL081 J-FET Op Amp	.37
TL082 Dual J-FET Op Amp	.60
TL084 Quad J-Fet Op. Amp	1.00
ZN414 AM Radio	.98
ZN1034E Timer	1.80
Most ICs supplied with Data Sheet	
Data Sheets only per device	.10

TRIACS

400V Plastic Case (Texas)

3A TIC206D	49p
8A TIC226D	58p
12A TIC236D	85p
16A TIC246D	96p
25A TIC263D	190p
6A with trigger Q4006LT	80p
8A isolated tab TXAL2268	65p
Diac	18p
Opto Isolated triac MOC3020 0.6A/400V	

MEMORIES & MICROS

2114	1.35	Z80A CPU	5.00
2708	2.25	M6802P	5.50
2716	2.65	8035L	8.00
2732	7.60	Z80A CTC	4.00
4116	1.40	Z80AP10	4.00
6810	1.40	6850P	1.85
6821P	1.85	6852P	3.00

REMOTE CONTROL COMPONENTS AND KITS

LD271 IR Emitting Diode	.36
SFH205 Photodiode detector	.90
SL480 IC Pulse Amp	1.70
SL490 32-command encoder/transmitter	2.40
ML922 10-channel receiver + 3 analogue outputs	4.20
ML926 16-channel receiver 4 momentary binary outputs	1.40
ML927 16-channel receiver 4 momentary binary outputs	1.40
ML928 16-channel receiver 4 latched binary outputs	1.40
ML929 16-channel receiver 4 latched binary outputs	1.40
Clip-on Plastic reflector for IR LEDs, increases range	.20

ML925 – A decoder designed for model/toy control, providing a 2-speed driver motor and three position latched steering system or a vehicle with momentary action steering and a third motor, e.g. gun, turret, winch, etc. Outputs also available for other facilities such as horn, turn indicators, headlights, etc. 2.10

KITS ++++ KITS ++++ KITS ++++ KITS

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

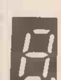
MK10 - 16-way KEYBOARD for use with MK8 kit, to generate different codes for decoding by the ML928/926 receiver (MK12 kit). £5.40

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

DISPLAYS

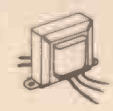


CQX87A 0.5' dual, c.a. red	1.80
DL340M 0.1" 4-digit c.c.	4.50
DL500 0.5"	.75
DL507 0.5" c.a.	.75
MP463 4-digit 0.5" multiplexed c.c. LED Clock Display	2.20
RG81000 10-element Bar/Graph display, 25 x 9 mm.	1.30
Liquid Crystal Display, 3½ digit, 0.5" digits, d.i.l. package.	6.00

CMOS

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		

CIRCUIT MAKER

Readers contributions can be an original feature or constructional article describing electronic or electro-musical equipment which is ideally a complete building block that will aid the circuitmaker. All ideas and circuits presented for publication should have been proved before submission and should include a circuit diagram and explanatory text.

Low cost stereo LED meter

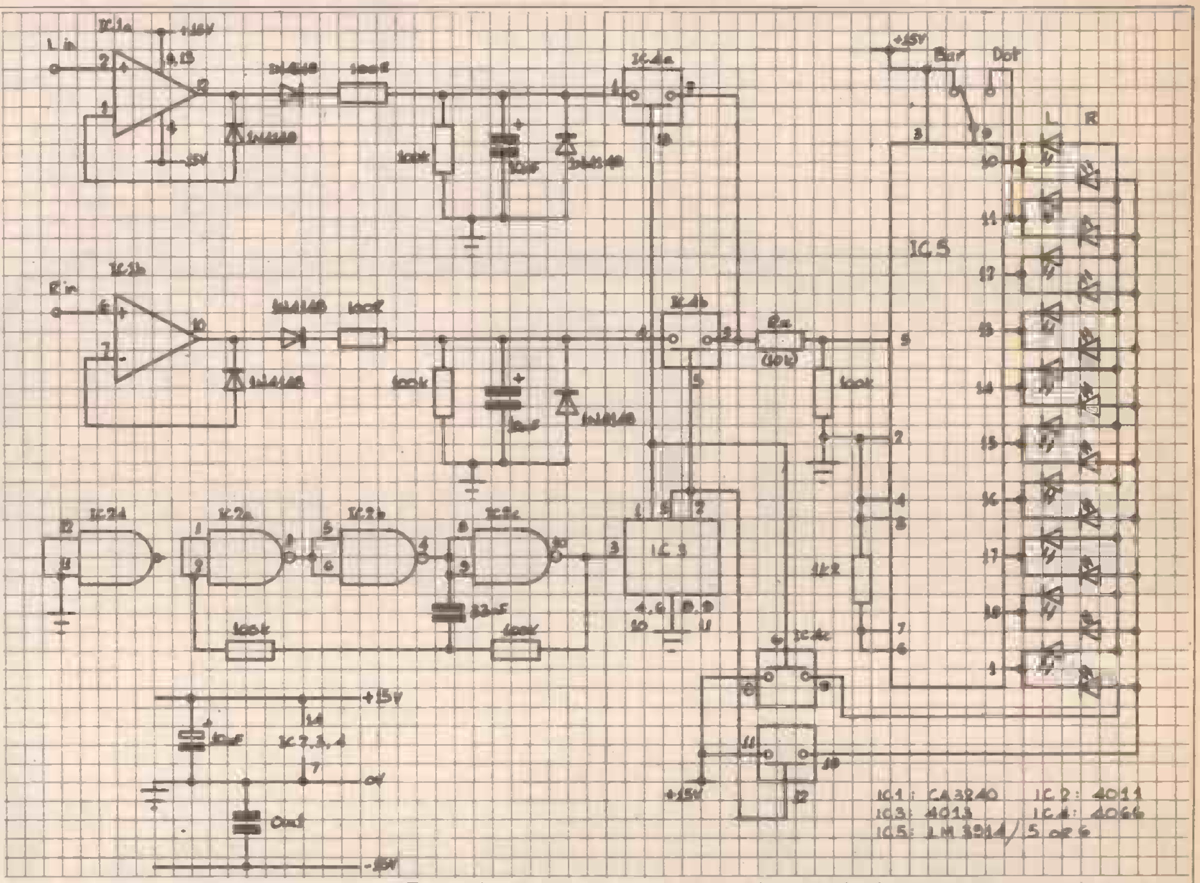
G. Durant, Brayton, N. Yorks

This design for a stereo LED meter differs from most current designs in that only one LED driver chip is used; this is multiplexed between the two stereo channels.

Each input is connected to a rectifier, followed by an RC network. This will act as a peak detector with a PPM type response. The 100R series resistor ensures that the tantalum (for low leakage) capacitor charges quickly, and hence catches short musical transients, and the 100k resistors allow this charge to leak away slowly thus giving the desired response.

The output from each capacitor is fed to a CMOS switch, and then to the LED driver. The CMOS switches are controlled by a D-type flip flop, one switch being connected to each output of the flip flop, thus ensuring that both switches cannot be 'on' together. The clock input of the D-type is fed from a 200Hz clock built around a traditional CMOS oscillator. It is obvious that each of the two inputs are connected to the LED driver in turn.

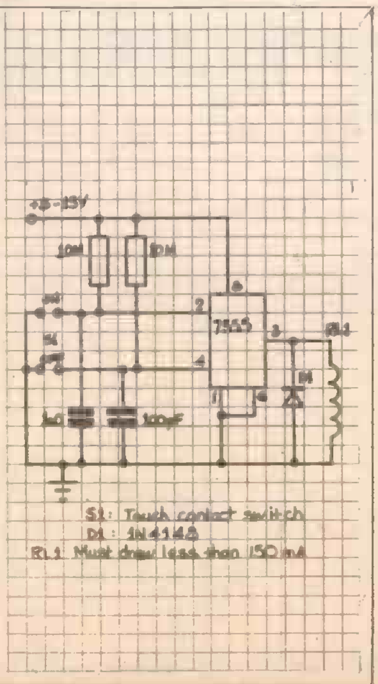
The LED driver may be any one of the three National drivers, LM3914/5/6 depending on the required response. Each output of the driver is connected to two LEDs; the common line of each row of LEDs being connected to the +ve rail via two more CMOS switches operated together with the input selector switches. Thus the right-hand column of LEDs lights when the right input is selected, and vice versa. Since this happens at 100Hz the eye perceives both lines to be on at the same time, the resultant saving of which is not merely a display driver but a considerable lessening in the number of wires required to connect the display and the driver. There is also no reason why this approach cannot be expanded to have four or even eight audio input lines, where the cost and complexity saving will be considerable. If the design is to be used with high-power amplifiers some form of attenuation at the input will be required to avoid damaging the input amplifier with the high voltages. For lower power amplifiers or high signal levels the circuit may be used directly, the resistor Rx in the circuit being varied to obtain the correct calibration.



Easy touch switch

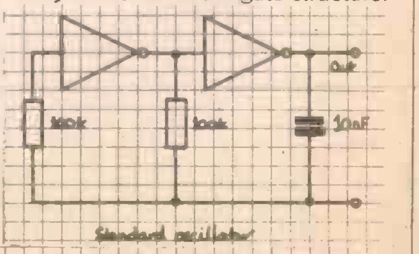
The CMOS version of the 555 timer can be used to make a very small latching touch-switch. The trigger and reset inputs are held high by the 10M resistors but may be pulled low by joining the touch plates together with a finger (typical resistance 200K - 1M0). Two capacitors are included to prevent RF pickup and at the same time apply a power-up reset by making the 'off' capacitor bigger than the 'on' one thus holding the reset low as power is applied.

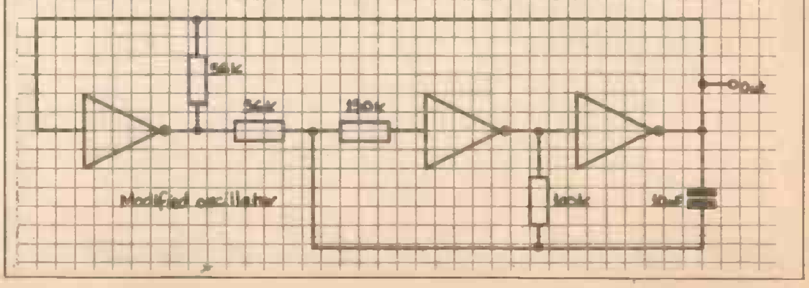
The output can be used to drive a LED or a relay as shown. The relay should not draw more than 150mA and the diode, to catch any back EMF, must be included. If a sink type drive is required, the switch plates should be relabelled to be the other way round. The power supply voltage is not critical and the switch has been found to work well with any supply between 5 and 15 volts DC.



True square wave oscillator

The standard CMOS oscillator shown suffers from the problem that the mark-space ratio is not necessarily balanced. This is simply due to differences in the input stages of the gate, resulting in slightly different switching points. This problem is usually of little consequence because most oscillators of this sort are used to drive edge-triggered circuits, the timing not being critical. However, in some multiplex designs, an equal mark-space ratio is required. This can be produced by adding another gate to the simple oscillator to provide feedback which drives the first of the oscillator gates hard, thus swamping any variations in the gate structure.





Guitar Tuner Mod

Michael Scott. Selby, N. Yorks

After seeing the Guitar Tuner project in E&MM (June 1981) I decided that it would be even more useful if it could be used for bass as well as lead guitars. The following modifications to the published design will achieve this quite cheaply with little modification to the PCB.

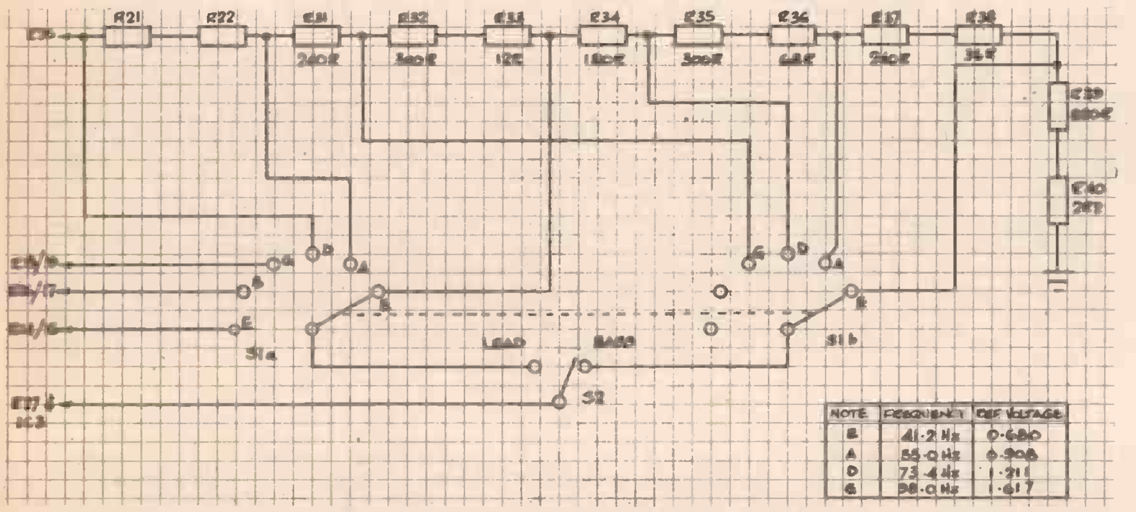
To accommodate the lower frequencies the cut-off of the input high-pass filter is lowered to 33Hz by changing C1 to 100nF. On the reference chain, R23-26 are removed, and replaced as follows:

R23,24 replaced by R31-33 with the junction of R31, 32 connected to the spare tag on S1 corresponding to G.
R25, 26 replaced by R39, 40 then R34-38 are soldered across the relevant spare tags on S1 (see diagram).

The PCB track connecting the pole of S1a and R27 is broken and connected to a new double pole switch, S2, together with a connection to the pole of S1b.

With S2 in 'lead' position the tuning is as before, but when 'Bass' is selected, it works as a bass guitar tuner using the voltages as listed in the table. The calibration is the same.

All the resistors added should be 1% metal oxide types.



NOTE	FREQUENCY	REF VOLTAGE
E	41·2 Hz	0·680
A	55·0 Hz	0·908
D	73·4 Hz	1·211
G	98·0 Hz	1·617

Hexadrum Improvements

Lt. A. E. Wride, R.N., Portland, Dorset

The range of sounds produced by the Hexadrum (August 1981 issue of E&MM and various corrections) whilst being good on the high drums, lacks a certain something on the low drums. The case also produces mutual interference if the pads are struck just a little too hard and the pad layout can be improved for stage use.

To produce better resonance on drum 6 R64, R65 and C63, previously omitted, should be added to the circuit (R64 + R65 are 82k — C63 is 100nF). This involves soldering the three components together and then linking them to the appropriate place on the PCB, either by drilling holes or more simply by soldering them to existing components.

A better span on the drums can be produced by changing the values of C52 and C62 to 47nF and 33nF respectively as well as changing C42 to 22nF as detailed in Corrigenda September 1981 issue.

To produce a more even volume for each drum R18, R28, R38, R47, R57 and R67 can be adjusted to suit personal taste.

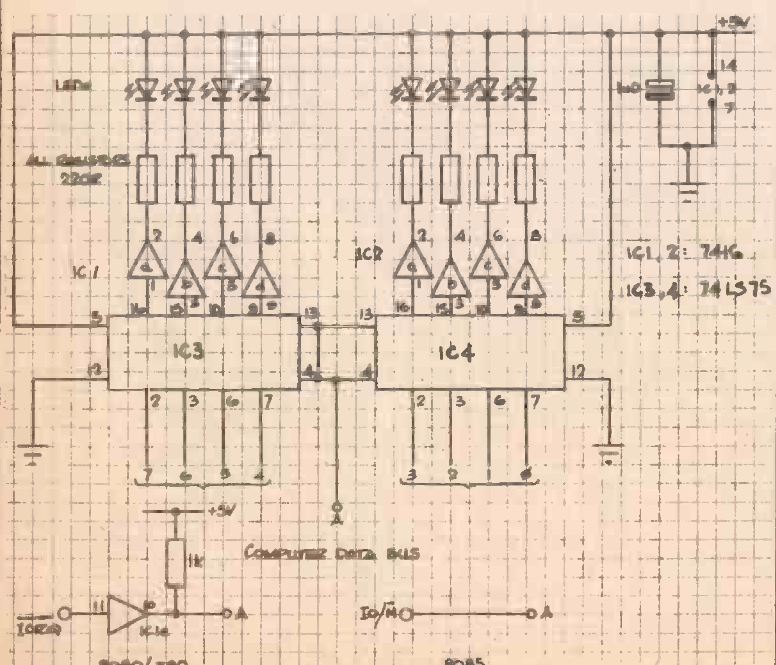
For stage use and to prevent mutual interference the pick-ups can be mounted on a piece of veneered chipboard. The box can be secured underneath using short wood screws having first recessed the chipboard for the pick-up wires.

The whole assembly can now be attached to a suitable stand or rested on an available speaker!

I/O Port Monitor

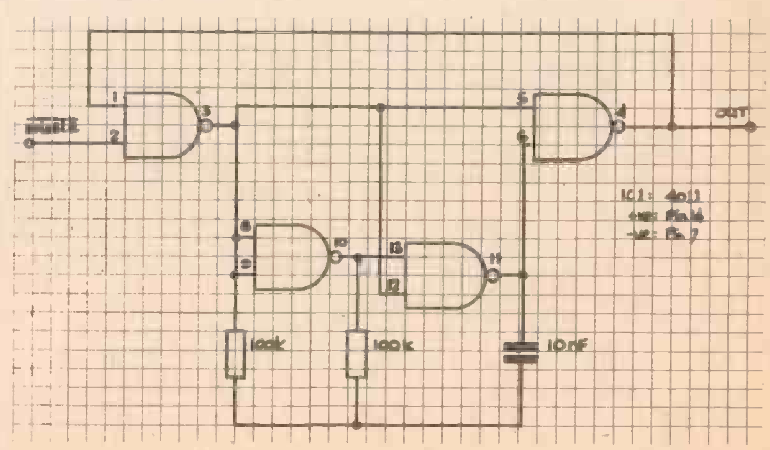
Glenn Rogers, Wickford, Essex

Have you ever wished that you could see what was on the data bus of your microcomputer when you are addressing an input/output port? This simple and cheap circuit allows you to observe the data on the bus when ANY I/O port is addressed. The data on the bus is latched and lights a set of LEDs when IORQ (input/output request) becomes active. The LEDs are driven by 7416 open collector buffers. The circuit has been used to great effect on my Z80 based system but it will work equally well with any system using ports for I/O rather than memory mapping. It is worth noting that an 8085 based system can dispense with the inverter in the IORQ line, using the IO/M line directly.



Clean Gated Oscillator

It is necessary on many occasions in counters or similar equipment using pulse-trains, to ensure that the last pulse of a gated signal is not truncated. The circuit shown prevents such truncation in a very simple way - by adding a couple of gates around a standard oscillator. It works as follows: When the enable signal is low (active) the oscillator runs and the output is present. When the enable input is taken high, the output of the enable gate does not go low until the other input to the enable gate also goes high; since this input is connected to the oscillator output it is obvious that the oscillator will not stop until this occurs. When the oscillator stops, the outputs of both gates in the oscillator go high and this would result in a spurious pulse appearing on the output so an additional gate is used to combine the actual oscillator signals and the enable gate output such that the system output remains in its high state after the completion of the current low cycle once the enable is taken high.



USING MICROPROCESSORS

Peter S. Kershaw B.Sc (Eng.)

Part 7 — Peripheral Devices

This month we look at some peripheral devices designed to interface directly to microprocessors. Whilst most of these devices are part of a general processor family (Z80, 6800, 8085, etc) most can be configured to work with almost any processor. This gives us a wide selection of devices to use for any application. For example, for serial data interfacing, we might choose the 8251 (Intel, NEC, AMD, NS), the 6850 (Motorola, AMI), the Z80-SIØ (Zilog, Mostek, SGS), the AY-5-1Ø13A (GI), the 64Ø2 (Intersil, Harris) or any one of a dozen others. Some offer more facilities than others. Cost and ease of interfacing also vary accordingly. It is always advisable to consult the manufacturer's data sheets for interfacing compatability.

We will examine the types of peripheral available by reference to specific devices. They will be shown interfaced to the Z80-CPU.

Parallel Input/Output (PIO)

A wide range of such devices (also called Peripheral Interface Adaptors or Parallel Peripheral Interfaces) is available. Figure 1 shows the Z8Ø-PIO connected to a CPU and being used to control a stage light. The PIO has two 8-bit I/O ports (A and B). These may be mixed I/O or dedicated to either input or output. Each port has handshake lines, $\overline{STB}$ and RDY (strobe and ready) to control the transfer of data between the PIO and the peripheral. In addition, there is some logic for the generation of interrupts to the CPU. The interrupt logic is specifically designed to work with the Z80-CPU and so is not compatible with other processors. Other devices (such as the Intel 8255) do not have this interrupt logic and are therefore unable to take advantage of the advanced interrupt facilities of the Z8Ø-CPU.

Each port of the PIO contains the following registers which may be modified by the CPU and external data:

Mode Control Register — this 2-bit register determines the mode of operation:

Mode Ø — Output
Mode 1 — Input
Mode 2 — Bidirectional
Mode 3 — Bit Control — any line may be input or output

Mode 2 is available only on Port A as all four handshaking lines are used.

Data Output Register — stores 8-bit output data.

Data Input Register — holds 8-bit input data (strobed in by $\overline{STB}$).

I/O Select Register — in Bit Control Mode gives the direction of each of the 8 port lines (1 = input, Ø = output).

Interrupt Mask Register — in the Bit-Control Mode an interrupt can be generated automatically when the unmasked bits go to a specified state. The 2-bit mask control register determines the specified state (1 or Ø) and whether one or all unmasked bits are required for an interrupt. This may be useful, for example, in an alarm system.

The control registers must be programmed in order to create the required configuration. Control is selected when the 'Control/Data Select' pin is low and address bit A_1 has been used for this function in the example. Bit A_0 has been used to select Port A or B. The device is selected when A_2 is low. Thus the I/O address map for the device is as follows:

Port ØØ — Port A Data
Port Ø1 — Port B Data
Port Ø2 — Port A Control
Port Ø3 — Port B Control

The control register which is written to is determined by the format of the data. For example, if D_0 to D_3 are set to 1111 then D_4 and D_5 are ignored and D_6 and D_7 are written to the Mode Control Register. Thus if 11001111 is written to Port Ø2, Port A is put into Mode 3. As this is the Bit Control Mode, the following byte to Port Ø2 is read into the I/O Select Register.

The device supports the Z8Ø vectored interrupt mode. As described in the June article, in vectored mode the interrupting device places the least significant byte of the interrupt routine address on to the data bus and the most significant byte is supplied by the processor's I Register. The PIO senses when to supply its byte by monitoring the $\overline{M1}$ and $\overline{IORQ}$ lines. The interrupt request is dropped (i.e. $\overline{INT}$ is raised) when the CPU executes a return from interrupt (RETI) instruction (decoded internally by the PIO). In addition, interrupts may be 'daisychained' using the IEI and IEO pins so that a low priority interrupt service routine may be suspended to service one of a higher priority. This allows urgent conditions to be dealt with immediately whilst temporarily holding up normal operation.

In the example of Figure 1, Port A is used to drive a digital-to-analog converter. Thus Port A must be set to Mode Ø (output). Port B has to read logic level inputs and drive binary outputs. Thus it must be used in Mode 3 (control). This also enables us to generate an interrupt when a current overload occurs so that immediate action can be taken.

Note that the handshake lines have not been used for either port. In other applications they will be used to strobe data into the device and signify acceptance of data.

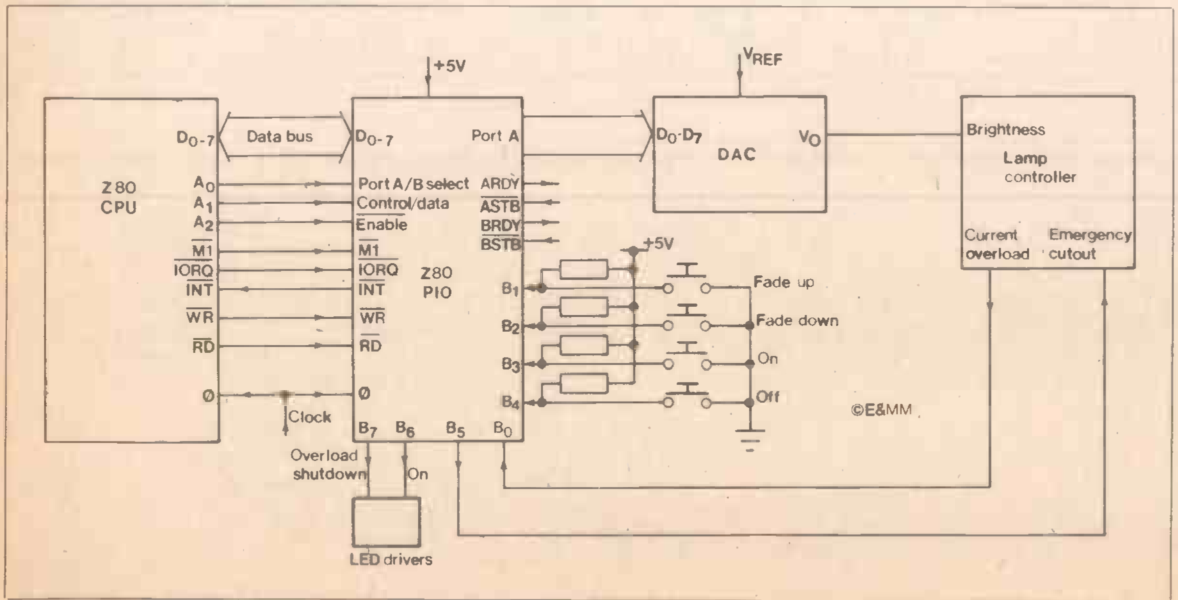


Figure 1. Parallel input/output used in a simple lighting controller.

Typical initialisation software for this application is given in Table 1. Because the interrupt mask is set to Ø1, bit Ø of Port B (emergency cut-out) will be monitored. If it goes high an interrupt wil be generated. Then Register I (12H) and the vector from the PIO (34H) will be combined and the program will jump to the interrupt handler at 1234H.

Serial Input/Output

For serial data transmission the data is sent along a single screened cable one bit at a time. This is the most practical method for communication over distances of a few metres or more. In particular, serial communication is used between computers and terminals.

There are two kinds of serial communication: synchronous and asynchronous. Synchronous transmission is controlled by a Universal

Synchronous Receiver/Transmitter (USRT). The receiver clock is locked to the transmitter clock by the regular transmission of synchronisation characters when no data is being transmitted. Asynchronous transmission is controlled by a Universal Asynchronous Receiver/Transmitter (UART) or Asynchronous Communications Interface Adaptor (ACIA). An asynchronous protocol is most often used with small systems. A typical asynchronous data format is shown in Figure 2a. Most devices allow programming of various word lengths, parity and number of stop bits. As with the PIO, the format is set by writing to control registers. In addition, there is usually a status register which may be read by the processor. This gives information concerning the status of input and output buffers and various errors in incoming data (parity error, etc).

The UART receive section operates by looking for a falling edge on its input pin signalling the possible beginning of a start bit. The start bit is checked by looking for a 'low' at its centre. If this is found, it is considered valid and the UART reads the levels at the centres of the data, parity and stop bits.

Figure 2b shows two 8251 USART's (part of the 8080 microprocessor family) being used for communication between two processor systems. A USART (combined UART and USRT) may be programmed for either synchronous or asynchronous operation.

Line interfacing is usually required. For long-distance communications a current loop (e.g. 20 mA loop) is often used, with opto-couplers at either end of the line (Figure 2c). This gives good noise immunity and isolates the processors from the line.

The Baud rate of a signal is the rate of transmission in bits-per-second. This rate may be from 110 Baud for low-speed teletypes to 9600 Baud for high-speed printer interfacing. The USART may be programmed to divide the Baud rate clock by 1, 16 or 64.

In the configuration shown, when data is received by one USART it will interrupt its processor. The processor reads the data and then the status to ensure that there are no errors.

It is, of course, possible for the processor to perform the serial transmission without a USART. In fact the 8085 processor has serial I/O pins. However, this is very time-consuming, delaying other processing.

Most serial interface devices also provide special control signals for peripherals, modems, etc.

Counters/Timers

For real-time and counting applications it is often useful to employ a counter/timer circuit (CTC). A block diagram of one of the four channels of the Z80-CTC is shown in Figure 3.

Each channel can be programmed independently. In timer mode an 8-bit time constant is loaded into the time constant register (TCR). This is loaded into the down counter register (DCR) which is decremented every 16 or 256 clock pulses. When the DCR goes to Ø a time-out pulse occurs, an interrupt may be generated, the TCR is loaded into the DCR and the count starts again. In addition, the contents of the down counter can be read at any time. The count down may be initiated by an external signal or under program control.

In counter mode, the TCR is loaded and the contents transferred to the DCR as before. This time, however, the DCR is decremented every time an external clock/trigger pulse occurs. As with the Z8Ø-PIO, vectored interrupts are supported.

Typical uses for the CTC might be to provide regular timing pulses for computer-generated music or to count items on a production line.

Data Converters

In order to interface analogue signals to microprocessors, digital-to-analogue and analogue-to-digital converters (DAC's and ADC's) are used. The choice is bewildering; different types varying in accuracy, resolution, speed and

```
          ORG Ø
          ;Initialise PIO
START     LD   A,ØFH
          OUT  (2),A        ;Port A = Mode Ø
          LD   A,34H
          OUT  (3),A        ;Port B Interrupt Vector
          LD   A,ØCFH
          OUT  (3),A        ;Port B = Mode 3
          LD   A,1FH
          OUT  (3),A        ;I/O direction (ØØØ1 1111)
          LD   A,ØB7H
          OUT  (3),A        ;Interrupt Control
          LD   A,Ø1H
          OUT  (3),A        ;Interrupt Mask

          ;Initialise CPU
          LD   SP,2ØØØH     ;Initialise stack
          IM   2            ;Vectored interrupt mode
          LD   A,12H
          LD   I,A          ;Load Interrupt Vector
          EI                ;and enable interrupts
          :
          :
          :
```

Table 1. Initialisation of the parallel input/output lighting controller.

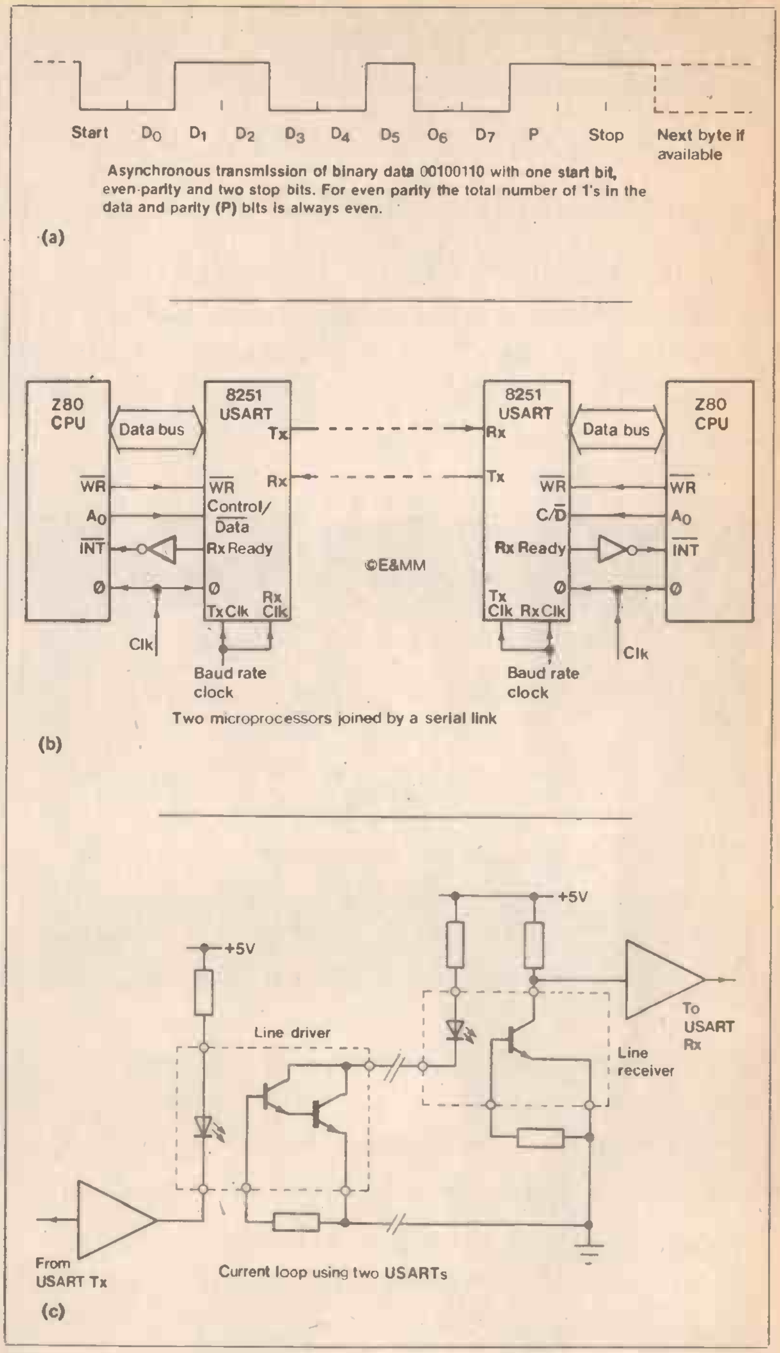


Figure 2. Serial input/output.

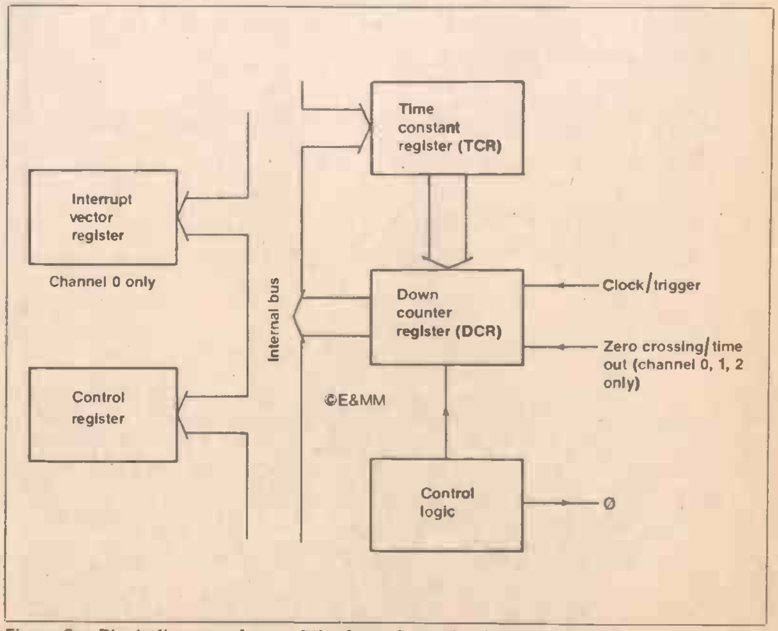


Figure 3. Block diagram of one of the four channels of the counter/timer circuit.

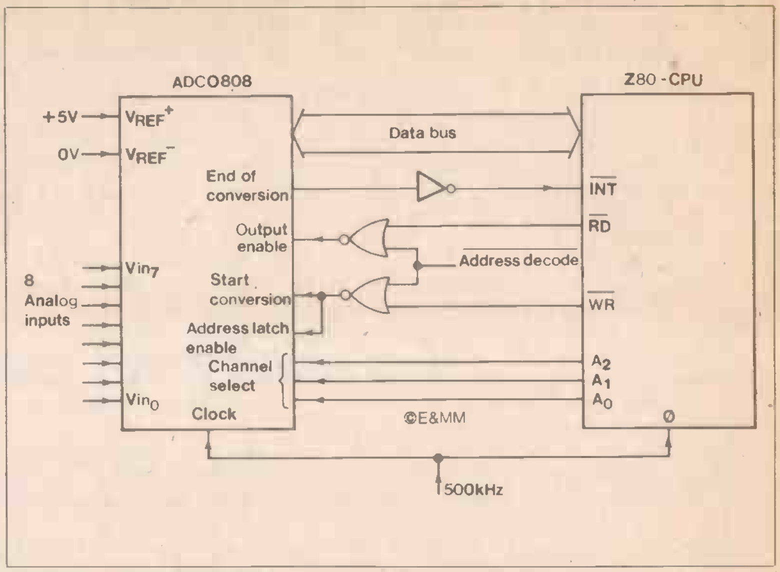


Figure 4. An 8-channel, 8-bit data acquisition system.

cost. One example, the microprocessor-compatible ADC 0808 (National Semiconductor) is shown in Figure 4. This is an 8-bit analogue-to-digital converter with an 8-input analogue multiplexer and a conversion time of 100us.

Writing to the required channel (selected by $A_{0\text{-}2}$) initiates conversion of the analogue voltage on the selected input. When the conversion is complete the processor is interrupted and the digital representation of the analogue input may be read.

A great deal of literature is available in textbooks and from manufacturers about the different methods of data conversion available and their relative merits.

Many other special purpose microprocessor peripheral devices are available and we do not have the space to go into them all in detail. However, the most important are summarised below.

Interrupt Controllers

These expand the number of interrupts into a system, assigning them an order of priority. This may, for instance, be necessary when a computer has more terminals than the processor has interrupt inputs.

DMA Controllers

Direct Memory Access (DMA) is a technique whereby large quantities of information may be transferred directly to the processor's memory without passing through the processor. Two techniques are used:

Halting the processor — the Z80-DMA controller uses the Z80-CPU's $\overline{BUSRQ}$ input to stop the processor and to take control of the data and address buses. Processing is resumed when the data transfer is complete.

Cycle stealing — the DMA controller uses the cycles of the processor in which the memory is not accessed (e.g. during accumulator manipulations) to transfer one byte at a time. This is slower than the method above but the data source may not make data available any faster than this anyway.

One use for DMA is when reading or writing hard disc stores. Although the access time may be relatively long, when the data is reached it becomes available at a very high speed.

Video Controllers

A wide range of devices is available for generating the synchronisation and video signals for data and graphic displays. Some of the most sophisticated unfortunately work only with the US 60 Hz, 525-line standard. Many, however, are programmable and the rate of development in this area is currently very rapid due to the growth of TV games, etc. Video generation will be dealt with in detail in a later article.

Arithmetic Processors

Floating-point arithmetic is time consuming and a processor can spend long periods performing this work (especially where scientific calculations are being carried out). Much of this burden may be relieved by the use of an arithmetic processor. For example, the National Semiconductor MM57109 Number Oriented Processor can carry out most of the functions normally associated with an 8-digit scientific calculator, but under the control of a host microprocessor. This frees the processor from time consuming computation and greatly reduces the system designer's software overheads.

It has not been possible to describe all the peripheral devices available (e.g. keyboard/display controllers, disc controllers, programmable sound generators, etc.) but any list of devices would soon become out of date as more and more functions are combined in a single 'chip'. **E&MM**

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.

The FOR NEXT Statements

One of the most frequently used constructs within computer programs is the 'loop'. A program loop is a process where one or more statements are executed for a given number of 'iterations' or repetitions. So far loops have been realised using an IF THEN statement together with GOTO statements and a control variable. The following short program demonstrates how a loop can be implemented by this method:

```
10 LET C=1 : REM - C IS THE CONTROL VARIABLE
20 PRINT "C=";C
30 IF C=5 THEN GOTO 50
40 LET C =C+1 : GOTO 20
50 PRINT "THE LOOP HAS FINISHED AFTER ";C;" ITERATIONS"
60 END
```

The number of times that the contents of variable C are printed is determined by the test on line 30. In this case when C has been incremented to the value five the comparison with the constant five is 'true' and program execution is directed to line 50 by the GOTO statement.

BASIC provides a more convenient and concise method of implementing a loop using the FOR and NEXT statements. The general format of the FOR statement is: FOR variable = num exp 1 TO num exp 2 [STEP num exp 3] where

- variable —is a numeric variable known as the 'loop index'.
- num exp 1—is the first numeric expressionist — the initial value of the index. This is usually a constant.
- num exp 2—is the second numeric expression — the maximum value of the index.

The contents of the square brackets are an optional part of the FOR statement. They can be included to specify the incremental value of the index. If the step is not specified the default value is +1. (A default value is a quantity which is automatically assumed by the BASIC interpreter or compiler. When the actual value is specified, the default value is superceded).

The FOR statement must be used with a NEXT statement. The FOR statement defines the beginning of a loop; the NEXT statement defines the end. The NEXT statement has the following format: NEXT numeric variable,

where:

numeric variable — must be the same variable named in the corresponding FOR Statement.

The statements which are to be repeatedly executed are placed between the FOR and the NEXT statements.

Now the previous program can be re-written using a FOR NEXT statement combination:

```
10 FOR C=1 TO 5
20 PRINT "C=";C
30 NEXT C
40 PRINT "THE LOOP HAS FINISHED AFTER ";C;" ITERATIONS"
50 END
```

The resulting program is concise and easier to visualise. The loop index is the variable C which is initialised to one by the FOR statement in line 10. The NEXT statement on line 30 increments the loop index by one. The loop is terminated when the value of the loop index is five. Program execution then continues with the statement immediately after the NEXT statement. An increment value was not specified using the STEP statement so an increment of one is assumed by the BASIC interpreter or compiler by default. If line 10 is replaced with a FOR statement which includes a step, other than one, the output will be changed. For example, replace line 10 with the new line:

```
10 FOR C=1 TO 5 STEP 0.5
```

The output will be a list of 9 numbers starting at one and increasing in steps of 0.5 until five. Any whole or decimal number except 0, can be used for a step. However, if negative numbers are used the range of the loop index must be adaptable to a backward step. For example, the line:

```
10 FOR C=1 TO 5 STEP -1
```

is incorrect because the program cannot go from +1 to +5 in a backward direction. The line must be modified to operate correctly:

```
10 FOR C=5 TO 1 STEP -1
```

Great care must be taken when index values of a loop (initial, final and step size) are decimal values. All numbers in a computer are represented by binary numbers. When the values are integer, they can be represented exactly in binary; however, it is not always possible to represent decimal values exactly in binary when they contain a fractional part. This is because of the size restriction imposed by the hardware of the computer and is known as 'rounding error'.

In some computers the following example may demonstrate this (depending on the system of internal representation of decimal numbers):

```
20 FOR X=0 TO 10 STEP 0.1
30 PRINT X;
40 NEXT X
50 END
```

When the program is run the loop executes 100 times instead of 101 times. This is because the rounding error inherent in the conversion of 0.1 to binary, although very small, becomes significant after repeated additions to X. After the 100th iteration, X is not exactly equal to 10 — it is slightly larger so the loop stops. To ensure the loop is executed the correct number of times it is advisable to use indices that have integer values. If the above example was modified thus:

```
20 FOR X=0 TO 100 STEP 1
30 PRINT X;
40 NEXT X
50 END
```

it would perform the loop the correct number of times.

So far the range and step have been specified by a constant. From the general format of the FOR statement it can be seen that variables or expressions can also be used to define the range.

The following program requests input from the terminal and uses it as the loop parameters:

```
 10 REM — LOOP VALUES INPUT FROM THE TERMINAL
 20 PRINT "INPUT INITIAL LOOP INDEX VALUE" : INPUT I
 30 PRINT "INPUT FINAL LOOP INDEX VALUE" : INPUT F
 40 PRINT "INPUT STEP VALUE" : INPUT S
 50 REM — CHECK THAT SPECIFIED RANGE IS CORRECT
 60 IF S=0 THEN PRINT "INVALID STEP" : GOTO 20
 70 IF S > 0 and F< I THEN PRINT "INCORRECT LOOP RANGE" : GOTO 20
 80 IF S < 0 AND F >  I THEN PRINT "INCORRECT LOOP RANGE" : GOTO 20
 90 REM — ASSIGN VARIABLES TO LOOP INDEX (C)
100 FOR C=I TO F STEP S
110 PRINT C,C*C
120 NEXT C
130 END
```

The output to the terminal is a list of numbers and their corresponding squares. The length of the list depends on the parameters which are initially input to the program.

Note lines 70 and 80 use the AND boolean operator which will be explained later in this series. In this program it is used to compare the result of two conditions: the IF statement will only succeed if both conditions give a 'true' result. For example line 70, the error message "INCORRECT LOOP RANGE" will only be printed if S>0 *and* F<I.

If one or more of the loop variables are to be assigned to the result of a numeric expression, BASIC first evaluates the numeric expressions in the FOR statement before assigning a value to the loop variable.

For example:

```
10 LET J=10
20 FOR K=2*J+1 TO 6*J STEP 2
30 PRINT K
40 NEXT K
50 END
```

K is given the initial value of 21 (2*10+1), and BASIC tests to determine if K is less than or equal to the terminating value of 60 (6*10). When the NEXT statement is encountered, the value of K is incremented by two.

Again K is tested to see if it is greater than or equal to the terminating value. When the value of K is greater than 60, program execution continues from the line immediately following the NEXT statement.

There are certain restrictions which have to be observed in a program that is to contain FOR, NEXT and GOTO statements. It is permissible, although generally bad programming practice, to use a GOTO statement between a FOR and a NEXT statement. However, if a GOTO statement transfers control into a loop that has not been initialised with a FOR statement the results will be unpredictable and may cause the computer to stop program execution and to output a 'run time error' message.

Nested FOR loops

A 'nested' FOR loop is a loop which is used between the FOR and NEXT statements of another FOR loop. Using FOR loops in this way is called 'nesting'. Each loop within a nest must contain its own FOR and NEXT statements, and the inner loop must terminate before the outer loop. Also, the variables used in each FOR statement must be unique for that loop. The following examples show legal and illegal forms of nested loop:

LEGAL:

```
10 FOR X=1 TO 6
20 FOR Y=1 TO 6
30 PRINT X*Y,
40 NEXT Y
50 PRINT
60 NEXT X
70 END
```

ILLEGAL:

```
10 FOR X=1 TO 6
20 FOR Y=1 TO 6
30 PRINT X*Y,
40 NEXT X
50 PRINT
60 NEXT Y
70 END
```

If the 'legal' program were run the output to the terminal would be a simple multiplication table. Initially the loop indices X and Y are set to one by their respective FOR statements. Line 30 prints the product formed by multiplying X and Y. Line 40 is the NEXT statement which corresponds to the FOR statement on line 20. When line 40 is reached it increments Y by one and the program loops back to line 20. The value of Y has not yet reached six so the result of multiplying the new value of Y with X is printed on the same line (the comma at the end of line 30 directs the PRINT statement to place its output on the same line with separating spaces). This is repeated for values of Y up to and including six. Loop Y has now finished so the next statement line to be executed is line 50. This simply closes the PRINT statement of line 30 so that the next output will start on a new line.

Line 60 increments the loop index X by one and program execution loops back to line 10. Now loop Y is executed again to produce the next line of output (i.e. the products 2*1, 2*2. . .2*6), by the same process as described above. The third, fourth, fifth and sixth lines of output are then produced in the same way using the values of X as 3, 4, 5 and 6. After loop X terminates the program ends.

Finally this month, a program which uses a nested loop to print a triangle of numbers will be considered:

```
10 REM - TRIANGLE PROGRAM
20 FOR R=1 TO 10
30 FOR C=1 TO R
40 PRINT C;
50 NEXT C
60 PRINT
70 NEXT R
80 END
```

The upper limit of the index of the inner loop, initialised on line 30, is set to the value of the index of the outer loop (R). As R is incremented the number of times that the inner loop is executed increases. When the program is run the output to the terminal is:

```
1
1 2
1 2 3
1 2 3 4
1 2 3 4 5
1 2 3 4 5 6
1 2 3 4 5 6 7
1 2 3 4 5 6 7 8
1 2 3 4 5 6 7 8 9
1 2 3 4 5 6 7 8 9 10
```

E&MM

COMPUTING NEWS

VIC 20

As promised, further news of the VIC 20 from Commodore. It is now available at a price of £200, although there are plenty of retailers advertising it at £190. Two items on the machine's specification which are immediately impressive are the colour graphics and sound generators. A total of 24 colours are available, eight border and sixteen screen. There are 3 sound generators plus a white noise generator for sound effects. As usual these are available through a UHF television. The display consists of 22 characters by 23 lines. Not very large, but each program line can, if necessary, occupy 4 screen lines. Therefore a program line can have a maximum of 88 characters.

The basic machine has 5K of memory, however, only 3½K (approx) is available to the user. The memory can be expanded to a maximum of 32K using 3K, 8K and 16K RAM cartridges. These seem reasonably priced at £25, £35 and £45 respectively, but to use the 8K and 16K cartridges a memory expansion board is required, which costs £100 (approx). So the total cost for a 32K system is approximately £405.

VIC has essentially the same internal software as PET and uses BASIC 2.0 (PETBASIC as used on the 3000 series PETs). Consequently it will accept the standard software which is already available, the only problem being memory size.

It has a full QWERTY keyboard plus colour keys, graphic symbols and eight programmable function keys. The 64 graphic symbols are again the same as those used on the PET. The programmable function keys are operator definable and are usually used for the common programming commands to reduce typing time.

One of the drawbacks with the system (at the moment) is the lack of a machine language monitor. It is not capable of handling machine code. However, I am sure that this will be changed and a monitor added to the impressive list of peripherals and accessories: tape cassette (£50), dot matrix printer (£200), single drive floppy disc (£300), RS 232 interface cartridge, IEEE interface, game controllers (joysticks, paddles and light pen), game control expansion board (allows multiple game controllers), plus the usual ready-made software cartridges.

In conclusion I think the many features fitted as standard, despite the cost of expansion, will make VIC 20 very competitive.

TI 99/4

Texas Instruments TI 99/4 has been available for some time in the USA. Texas have now modified it to interface to the PAL television system and it is being released in this country. The basic machine is available for £300, although (as with VIC 20) some retailers are advertising it at a slightly reduced price.

It has 16K of RAM and a 26K ROM operating system which contains the BASIC, floating point, sound and colour graphics software. Because of the size of the ROM there are some outstanding software features; dynamic string variables up to 255 characters, three dimensional arrays of numbers and strings, in-line editing with automatic program line re-numbering, variable names up to 15 characters in length and debugging features. The latter allows the introduction of breakpoints in the program and a trace facility which lists all the line numbers that are executed, in sequence. It is also able to interface to either one or two tape cassettes.

The display is high resolution comprising 24 lines of 28 characters, with 4 screen lines available for one program line, i.e. 112 characters. The screen can be made up of 16 different colours. There are 128 characters available and any of these may be redefined to any graphic character which is formed by turning any of the 64 dots, which make up a character 'on' or 'off'. There is also a facility to insert graphics or text anywhere on the display without having to scroll the other lines.

Up to three notes and one noise can be independently generated, so three note chords can be played. These notes are available over five octaves (110Hz to 4kHz).

Another interesting feature is an equation calculator which allows the keyboard to be used directly as a calculator.

The memory can be expanded to a maximum of 72K which comprises 16K RAM, 26K ROM plus the add on extra 32K RAM (£300) or 30K ROM. The latter being in the form of Solid State Software Command Modules.

Other peripherals available are a disc memory system comprising a controller with a capability of three disc drives (£200) and a disc drive (£400) providing 92K storage, an RS232 peripheral adaptor for modems (£150) and a speech synthesiser (£99). The speech synthesiser is similar to the one featured in 'WORDMAKER' which appeared in the June issue of E&MM, with a vocabulary of almost 400 words.

TI 99/4 will interface to a standard domestic tape cassette provided TI's cassette cable is used (£10). Joystick controllers are available plus over 400 ready written programs in 58 software packages. Most of these packages presently available are on TI's Solid State Software Modules, some are on cassette and ten are on disc only.

A machine with the backing of TI and boasting these specifications for £300 should be popular. **E&MM**

Micromusic

Music programming on the Sharp MZ-80K in Pascal and FORTH

Graham Knight

Pascal Music

Earlier issues of Electronics and Music Maker have detailed the programming techniques which enable the Sharp MZ-80K micro to play tunes written in BASIC or machine code. Two further languages are now available for the Sharp - Pascal and FORTH. Both support music statements, and programming sounds presents an interesting challenge and greatly assists in learning the new languages.

Pascal was originally developed as a teaching aid and in that respect it is excellent as it encourages programmers to adopt a systematic and logical approach towards writing structured software. Sharp have released a Pascal interpreter for the MZ-80K which occupies 17K of RAM leaving 31K for programming on the 48K Sharp. Sharp's interpreter has many of the features as defined by Niklaus Wirth, the inventor of Pascal, with the addition of TEMPO and MUSIC.

```
 0.VAR A:INTEGER;
 1.BEGIN
 2.TEMPO(3);
 3.A:=4;
 4.WRITE("■■■■■■■■■■■■■■■■■■■■CLEMENTINE OPENING BARS");
 5.WHILE A<>0 DO
 6.    BEGIN
 7.    MUSIC("D3","D1","D4_A4");
 8.    MUSIC("#F3","#F1","#F4D4");
 9.    MUSIC("D3","#F1","A4","A4");
10.    MUSIC("G3","#F1","E6R1");
11.    A:=A-1;
12.    END;
13.END.
14.
```

Figure 1. A Pascal Program.

An example of a music program written in Sharp Pascal appears in Figure 1. The first thing to notice about a Pascal program is that there are no line numbers - those that appear on the left hand side of the listing are merely used by the text editor to make preparation of a program easier. These numbers have been left in the listing to make the explanations somewhat easier. A semi-colon is used to denote the end of a statement line. The indentation of the listing is not essential but is advisable in order to make the programs readable and lucid.

All variables in a Pascal program must be declared before use along with their type, which may be real, integer, character (car), or boolean. Line Ø declares a variable A which is used to store an integer. BEGIN in line 1 signifies the end of all declarations of variables and denotes the start of the main program block, which is terminated by the word END. (note the full stop). Line 2 sets the tempo for the music calls and can be in the range 1 to 7. Line 3 initialises variable A with the value 6 and it is worth noting that a variable is of indeterminate value between declaration and initialisation. Line 4 is the equivalent of a BASIC PRINT statement as Sharp Pascal accepts the usual print formatting characters.

Lines 5 to 12 demonstrate one of Pascal's best features, the WHILE - DO loop. If the test at the start of the loop is true, the loop is repeated until such a time as the condition finally becomes false. With a REPEAT - UNTIL loop it is possible to place the test at the bottom of the loop. The music statements in lines 7 to 10 are very similar to the BASIC music commands. The use of a comma as in line 8 programs a small rest to produce the distinctive dotted quaver - semi-quaver rhythm. Each time the loop is executed the value of A is decreased by 1 until finally the test registers false and the program ends.

Obviously there is far more to Pascal than can be shown in this small example but it gives an indication why Pascal is being hotly tipped to become the successor to BASIC in the world of personal microcomputing.

```
REG 1 + CONST AREG REG 2 +
CONST BC REG 4 + CONST DE REG
6 + CONST HL
```

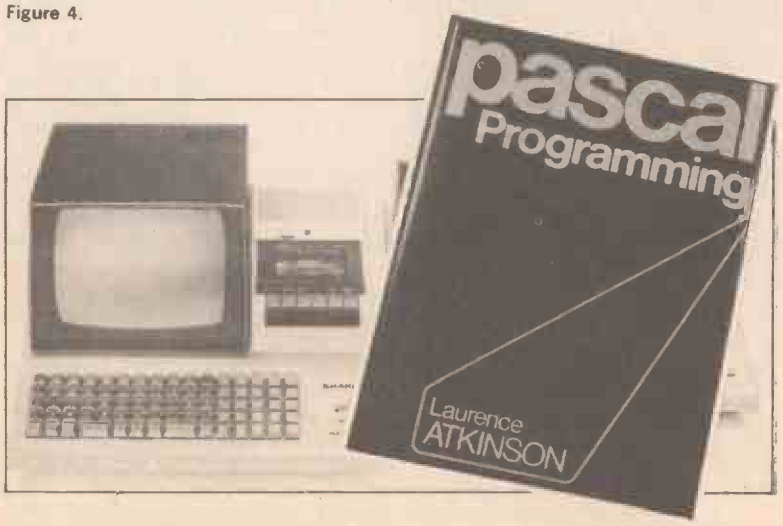
Figure 2.

```
[ MUSIC DE ! $30 USR DROP ]
```

Figure 3.

```
#CDEFGAB‾C‾D‾E‾F‾G‾A‾E■ MUSIC
```

Figure 4.



FORTH

Another language which is now available on tape for the Sharp MZ-80K is FORTH and again the implementation supports the Sharp music facility. Originally developed by a radio astronomer, FORTH is a compiled stack-based language utilising Reverse Polish Notation. FORTH is capable of a very high speed of execution as it is kept as simple as possible - indeed the programmer is left to define any extra commands required, apart from those previously defined by the language. In other words FORTH allows the programmer to strip the language down to the bare minimum of commands thus allowing programs to run at over ten times the speed of BASIC programs.

To access music in FORTH on the Sharp MZ-80K it is necessary to start by defining the Z80 CPU registers for use under program control. An example is given in Figure 2. Next it is necessary to define the MUSIC command (see Figure 3). Programming music in FORTH is then as easy as programming in BASIC (see Figure 4), but it must be remembered that the string to be played must end with a (shifted C) followed by a space and the command MUSIC.

Those users new to Pascal and FORTH may wish to start learning by using the music commands first. Errors in ordinary programs are sometimes difficult to spot and often take a long time to appear on the screen. Errors in programming music in Pascal and FORTH will be heard instantly and provide an excellent introduction to these powerful languages. **E&MM**

Further details of these languages from: Knights Computers, 108 Rosemount Place, Aberdeen.

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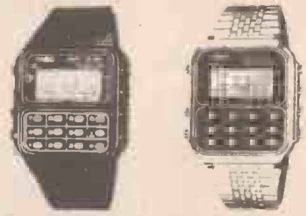

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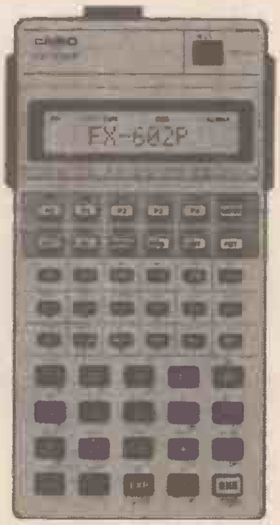

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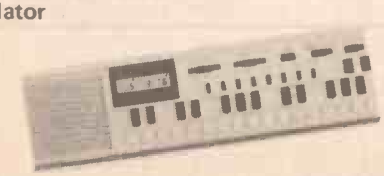

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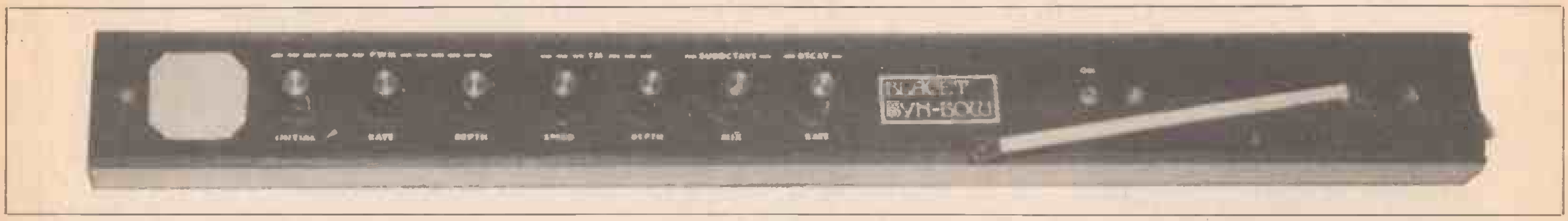
INSTRUMENT REVIEW

Each month we review the latest Electro-Music Equipment — from synthesisers to sound reproduction and effects!

E&MM's special in-depth reviews look at what's new in the world of commercial music — a vital updating for both electronics designers and musicians.

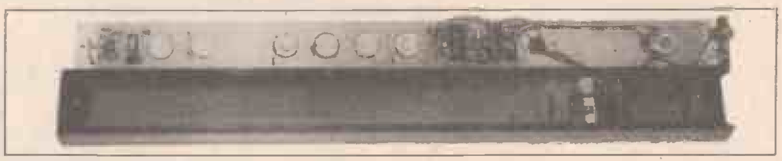


The Blacet Syn-Bow

I have to admit at the outset that I totally approve of any manufacturer who has the courage to develop an interface between human and synthesiser that doesn't involve keyboards, joysticks or modulation wheels. The one quality that's usually missing from keyboards (apart from the acoustic piano) is the ability to really sense an actual mechanical connection between the muscular action that causes your fingers to strike the keys and the sound that is produced so many microseconds later. Velocity-sensitive keyboards go some way towards alleviating the frustration caused by this physical deprivation, but what I really need is touch feedback, or 'feel'. In this respect, the development of synthesisers has been retrogressive, as the first electronic keyboard instrument, the ondes Martenot, invented in 1928 by Maurice Martenot, provides this touch control in a way that no synthesiser manufacturer has ever bothered following-up. An article on this instrument, together with a constructional project for a unique touch control system applicable to any synthesiser, will hopefully appear in a later issue of E&MM. For the time being, though, I'd like to recommend anyone interested in hearing the power of the ondes Martenot's touch control to listen to either the Chant d'amour section of Messiaen's Turangalila Symphony or the Concerto for ondes Martenot and orchestra by André Jolivet.

The Blacet Syn-Bow questions the over-mechanical nature of operating a synthesiser, and returns, though I don't think that Blacet are aware of this, to modes of control used in the 50-year-old ondes Martenot. As you can see from the photographs, the Syn-Bow totally does away with conventional input of pitch. Instead, Blacet use the simple device of a 7¾" plastic rod, or what they call a 'frequency bow', attached to a potentiometer. Since the potentiometer slider travels through an angle of 300° this means that the end of the frequency bow describes ⅚th of a circumference of 48", i.e., 40", which is a lot of resolution from something as simple as a plastic rod and a pot! At the other end of the instrument there's a touch sensor consisting of the sort of piezoceramic device used for 'beeping' and a foam pad to cover it. Pressing down on the sensor pad

Playing the Syn-Bow.



Interior view of Syn-Bow.

with one or two fingers of the left hand (see photo for my inimitable playing technique) strains the piezoceramic crystal and produces a voltage output that is proportional to the pressure applied. After buffering, the sensor then provides a control voltage for controlling the various sections of the Syn-Bow. The rest of the Syn-Bow centres around the Texas Instruments SN76477N, the sound generator chip usually dedicated to blasting things out of space and sky rather than such sophisticated activities as making real music. This chip includes three sound generators: a SLFO, VCO and noise generator. However, in the Syn-Bow only the first two are used. The frequency range of the VCO is set to give three octaves over the 40" resolution of the frequency bow. The basic output of the VCO is a square wave, which, as it stands, isn't particularly interesting. Some variations on the basic waveform are introduced by frequency modulation applied to an external VCO control input on the chip, and by using the SLFO triangle output to provide pulse-width modulation.

These modulatory activities certainly help to animate the sound of the Syn-Bow, but pulse waveforms are pulse waveforms and the lack of other waveshapes is a considerable sonic limitation.

There are actually three VCAs in the Syn-Bow. One, on-board the SN76477N, operates connected to an envelope generator providing a simple attack and decay cycle. The attack time is controlled by a fixed resistor connected to the relevant pin on the chip, the decay by the front panel decay control. The second is a diode VCA connected to the audio output of the SN76477N and controlled by the voltage from the touch sensor. The third VCA is a CA3080 transconductance op-amp actually used as a non-linear transformation block, which means that the waveshape passing through it alters according to the amplitude of the input signal. Since this amplitude depends on the voltage from the touch sensor, it follows that the touch sensor also affects the waveform transformation. Blacet call this third VCA their "natural filter patch", the idea being that it should enable the Syn-Bow to mimic the behaviour of natural instruments and louden, brighten and increase the sustain of a waveform the harder the pressure applied to the touch sensor.

This is a pretty clever idea, but the amount of touch variation of waveshape isn't that great and doesn't disguise the square wave pedigree of the original SN76477N output. It's curious that Blacet haven't also added a proper VCF to provide some rather more extensive timbral transformation.

The weakest link in the system is the fact that the attack and decay parameters are preset; what's really needed in an instrument like this, especially if one's taking touch control to its logical conclusion (and this is where the ondes Martenot steps in), is to make attack and decay time totally dependent on how the touch sensor is initially hit and how long the fingers stay on the sensor. Instead, if a short decay time is set with the front panel control, one is forced to retrigger every note played, which gives a very unnatural choppiness to the sound, or, if a long delay time is selected, notes played include all the intervening slides of the frequency bow.

The use of the frequency bow is no easy matter, as it's probably more akin to plucking notes out of thin air than any other fretless or keyless instrument (with the exception of the Thérémin). However difficult conventional fretless instruments may be to learn initially, at least the notes are available on the basis of linear spatial coordinates, i.e., notes stretch in a line in front of or away from you. With the Syn-Bow it's necessary to choose your notes out of a circular distribution and that really is incredibly difficult, especially when you're at the top end of the instrument.

The Blacet Syn-Bow is available from Blacet Music Research, 18405 Old Monte Rio Road, Guerneville, CA 95446 U.S.A. The current price of the kit is $124 and UK residents should add a further $10 for shipping. Customs duty and VAT will add a further $30 on top of that. So, at an exchange rate of $1.85 to the pound, a Syn-Bow will cost you about £88. Is it worth it? Well, considering that it's a kit, and that the components could be conservatively bought for about £25, it does seem over-priced, but, for anyone interested in exploring alternative methods of synthesiser control, it does offer much food for thought.

Dr. David Ellis **E&MM**

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INSTRUMENT REVIEW

dbx RECORDING TECHNOLOGY SERIES NOISE REDUCTION

Dbx has been around for a good few years now, and, in its time, has attracted its fair share of brickbats from dedicated audiophiles and Hi-Fi journals. There's a paradox in this, for dbx has established itself as one of the rock-steady favourites of professional recording studios, alongside or in place of Dolby A.

However, faced with the public's insatiable appetite for greater degrees of noise reduction in consumer cassette decks, and the rapid growth of the 'alternative' noise reduction industry, I suspect that dbx were practically given an ultimatum to improve on their act, or, at least, make their products more acceptable to well-tuned ears. Their Recording Technology Series of noise reduction units represents one solution to these requirements, and a press reception at the Savoy Hotel in June saw the first British airing of the refurbished dbx.

Design

There's much mystique attached to noise reduction systems, when really all they're doing is coding the signal in a form that on decoding will resurrect the music exactly as it was originally. The coding can be as simple as 2:1 compression, so that a 12 dB increase in dynamic level is reduced to just 6 dB, or as complex as A/D conversion, so that the signal is actually subjected to the ultimate form of coding, i.e., transformed into binary code. Whatever coding is used, tape hiss and machine noise will be pushed down in dynamic level when the off-tape signal is decoded.

In the case of compansion systems using 1:2 expansion, the noise generated during the recording stage will also be expanded, but, since it wasn't part of the coded signal (hopefully), the noise components will be pushed below the limits of audibility. With digital decoding, i.e., D/A conversion, only the binary code corresponding to the signal is transformed back to its original analogue state, and, as a consequence, noise just gets ignored. Neither coding/decoding technique is exactly easy to implement. With digital techniques it's necessary to use a sampling rate that's at least double the top end of the frequency response and use at least 12-bit conversion to reduce quantisation error. However, once the digital modus operandi has been worked out, there aren't many things that can go wrong with the operation of the system, as the heart of the process - A/D and D/A conversion - goes on transforming information regardless of the dynamic or spectral content of the music. With compansion systems, this is where the problems really start.

Dolby B has enabled good cassette decks to achieve signal-to-noise ratios in excess of 60 dB, a figure totally beyond the expectations of Philips when they first introduced the compact cassette in the late 1960s. However, Dolby B's 10 dB of tape hiss reduction is a compromise between what can be achieved with compansion systems (30 to 35 dB improvement of S/N ratio) and the problems encountered in the use of such comparatively extreme signal processing. It is generally conceded that the more compression/expansion there is applied to an audio signal, the more likely it is that modulation of the noise accompanying the signal by the compander will become audible. It's this modulation that produces the notorious 'breathing' or 'pumping' often considered as being the biggest drawback of compansion systems. However, there are a number of ways of getting around this.

The complex expedient adopted by Dolby in their professional system, Dolby A, was to split the audio spectrum into four separate bands, less than 80 Hz, 80 Hz to 3 kHz, 3 kHz to 9 kHz, and greater than 9 kHz, derive control voltages from each band, and then compress each band separately. During playback, the signal is again divided into bands and each is expanded back to its original level. The end product is 10 to 12 dB of noise reduction, which is fine for recording studios using professional tape equipment already capable of S/N ratios of 75 dB or thereabouts, but hardly a 'quantity' improvement on the noise reduction offered by Dolby B, and, more to the point, rather temperamental with regard to setting-up. Unlike a broad band or linear compander that is insensitive to the frequency characteristics and level setting of the recording chain, Dolby A treats the different bands separately, and therefore level setting can drastically affect the frequency response.


The dbx press reception - note the large TV screens being used to give a frequency profile of music being played.

The dbx noise reduction system is an example of a linear compander, and, compared with the complexities of Dolby A, it really is very straightforward, as you can see from the block diagram in Figure 1. On entering the compressor section, the signal is band-pass filtered between 30 Hz and 100 kHz. The low cut-off removes sub-sonic signals from record warps, basso profundo grunts, and so on, that, lying on the edge of recordability, may well cause ghost modulation of the expanded signal when it emerges off-tape without these deep bass components. The signal then passes through a pre-emphasis circuit that boosts frequencies by 12 dB/octave up to 60 dB. This simple device, in combination with a corresponding de-emphasis circuit in the expander, helps to eliminate modulation noise at high frequencies.

The VCA following the pre-emphasis has a remarkable 120 dB of dynamic range (better even than the Aphex 1537 VCA chip) and may provide the clue to why dbx works as well as it does. This VCA reduces the dynamic range of the input signal by half, subjecting it to 2:1 compression uniformly over the entire audio spectrum. The control voltage for the VCA is derived from a level sensing circuit comprising three further circuits. The first filters the signal emerging from the VCA to encompass a range of frequencies that can be expected to pass fairly flatly through the recording chain. This makes good sense, as there's no point in trying to derive control voltages from frequencies that somehow got left behind! After this, there's a further pre-emphasis stage (this time, 20 dB/octave above 200 Hz for 60 dB) prior to an RMS detector and full-wave rectifier that converts the audio signal into a control voltage for the VCA.

One problem associated with the use of pre-emphasis to limit modulation noise is that it also has the side-effect of causing high frequency saturation of the tape. The additional pre-emphasis circuit prior to the RMS detector circumvents this, so that with high frequencies the RMS detector is put into overdrive and therefore decreases the gain of the VCA to ensure constant amplitude output over the audio spectrum.

When the off-tape signal enters the expander side of the dbx system it first passes through a low-pass filter with a cut-off of 100 kHz to prevent supersonic frequencies generated by bias oscillators and so on from confusing the expansion process. The control voltage is generated by the chain of the same band-pass filter used in the compressor, a de-emphasis circuit to increase the gain of the VCA at high frequencies, and, finally, the RMS detector that delivers the goods to the VCA. This time, of course, the VCA is doubling the dynamic range of the input signal by subjecting it to 1:2 expansion over the audio spectrum, or, at least, that which has successfully emerged from its mauling at the hands (heads) of the tape machine. Finally, there's a de-emphasis circuit on the output of the VCA that restores the highs to their rightful place in the sonic hierarchy.

Impressions

So, what do we get after putting our precious music through this Krypton factor-like obstacle course of filters? Well, in noise reduction terms, an improvement of 30 to 35 dB in the S/N ratio, which is the practical limit for 2:1/1:2 compansion systems, and, if we're reasonably careful in using the system, a remarkably clean sound that doesn't show too many of the side-effects encountered with the previous generation of dbx. This sounds too good to be true, and, when you consider the reasonable pricing of the Recording Technology Series of dbx noise reduction (£120 for the switchable record/play model 222, £150 for the simultaneous encode/decode model 224), one wonders what sort of reaction the audiophile community will give to it.

Inevitably, the less than enthusiastic press response to the previous incarnation of dbx will cloud the issue, and there's always the nagging suspicion that a compansion system offering so much noise reduction trades something off for giving so much. In practice, everything is fine if (a) the original signal is noise-free, and therefore doesn't contain noise that can be modulated, (b) the heads on the tape machine are accurately aligned and the tape itself is free from dropouts, and (c) the frequency response of the compansion process matches the frequency response of the recording process.

In a studio, all three requirements are routinely met, courtesy of the engineer lining up a multi-track before use and setting levels on- and off-tape, and musicians playing noise-free instruments, or, alternatively, making sure that noise-prone ones are passed through a noise gate.

In a domestic environment, though, it is incredibly difficult to meet these requirements. One of the main bugbears of consumer cassette decks is the remarkable laxity with which manufacturers appear to treat head alignment. Furthermore, the vast range of cassette types available have an equally vast range of frequency responses which makes it impossible to rely upon the off-tape signal having the same frequency spectrum as that coming out of the compressor onto the tape. Add to this quality control problems, in the form of tape dropouts, and you get some idea of the hazards facing the implementation of dbx noise reduction in the average cassette deck-based Hi-Fi system.

With a bit of care, though, dbx, like any compansion system, can be made to acquit itself favourably in a domestic situation, though obviously there are fewer spectral barriers in the way if a reel-to-reel is used rather than a cassette deck. At the recent dbx press launch, various musical excerpts were played to demonstrate how the system performs with both cassette and reel-to-reel machines. The reel-to-reel (a Technics 4-track deck running at 7½ ips) produced some impressive results with no audible squashing of transients or breathing. The cassette machine (a new Sony model), on the other hand, seemed to fare rather less well, and, apart from the fact that the sound just seemed uncomfortable, there was some audible breathing going on. In fact, there's a good chance that this less than impressive performance was due to a mis-aligned deck, but the choice of KEF 105.2s as the speakers for the demonstration didn't help either, as the bass just seemed to roll around on the floor without any real definition.

Quite frankly, I was itching to hear an A/B comparison of the dbx system just switched in and out of a signal's path, but, even though frequency analysis was displayed on the large TV screens (see photo) either side of Jerome E. Ruzicka, the enthusiastic Vice-President of dbx Inc., no attempt was made to use this facility to show the 'before' and 'after' spectral image of music passing through a dbx unit. To quote Mr Ruzicka: 'Nothing is perfect in life, and certainly no companding system is perfect, but, from my view though, any trade-offs involved are very much in favour of hearing this kind of reproduction in the home, with the virtual absence of any background noise'.

So, what it all boils down to is intelligent use. If the user is prepared to take some care in using dbx, then he should be assured of the best that it can offer, and this can be very, very good.

dbx Discs

One side of dbx's endeavours that really is 'very, very good', and something that's reproducible without any additional effort on the part of the listener, is their dbx-encoded discs. Given that digitally-encoded discs are still some years away, and that record manufacturers seem increasingly unable to control the quality of pressings, companded discs seem to offer the only solution to the frustrations of pops and crackles. Apart from the absence of surface noise, these discs also deliver an extraordinary 75 dB of dynamic range when the encoded music is from a conventional analogue master tape; with digital masters, that figure actually comes close to 90 dB on dbx-decoding!

It's very easy to get more excited by such technical specifications than the music itself, and my first reaction to dbx's claim that such encoded discs represent 'the full dynamic range of a live performance' was that they were getting carried away with their own superlatives. I think there is a degree of truth in that pre-judgement, but only with regard to the quality of the discs; the process itself seems in the clear.

I tried a particularly nasty test on the efficiency of the disc decoding by recording some un-decoded music onto a TDK SA cassette with a mid-priced cassette deck (but with heads properly aligned and cleaned!) and then decoding the cassette playback with dbx's disc decoder. Applying this treatment to some digitally-recorded discs of the Tchaikovsky 'Romeo and Juliet Fantasy Overture' and a compilation album of 'Digital Space' (sic) featuring the LSO (yet again) in full flight, the results were truly stunning, with no trace of compansion side-effects, even after being transferred to cassette. The Tchaikovsky was musically the most satisfying of the records I tried out; 'Digital Space' seemed paradoxically earthbound with some uninspired arrangements and a feeling that dynamics were being milked for all their worth just to satisfy dbx.

To play any of the 130 or so dbx-encoded discs currently available (ranging in price from £6 to £12), a disc decoder is needed. The good news is that this is really cheap. BSR Ltd. (the British owners of dbx Inc.) now offer the Model 21 Disc Decoder for around £65. Carping apart, dbx-encoded discs offer some remarkable sonic experiences, and, for rock music, must be near to listening in the JBL-equipped control room of a recording studio.

Computerised EQ

Dbx's range of products encompasses just about every audio application that can be made of compressors and expanders, and includes dynamic range expanders, dynamic range enhancers, their professional series of noise reduction and compressor/limiters, together with the extraordinary subharmonic synthesiser, or 'boom box', that generates gut-crunching infransonics.

A recent addition to their range, the 20/20 Computerized Equalizer/Analyzer, looks particularly interesting. This unit combines a microprocessor-controlled 10-band graphic equaliser, real-time analyser, pink noise generator, sound pressure level meter and a calibrated microphone. By setting the mic at a desired listening position, starting up the pink noise, and pressing the AUTO EQ button, the 20/20 performs a spectral analysis of the sound reaching that location from the speakers of your Hi-Fi system and automatically establishes the EQ curve for a flat response.

In addition, to quote dbx: 'Because the 20/20 has ten memory locations, you can equalise each of your favourite listening positions, then store them for recalling later at the touch of a button'. At a price getting on for four figures, the 20/20 is definitely a rich man's toy, but, with this addition to the dbx range, I'm beginning to wonder how much further this quest for perfection will go. Perhaps dbx's next step will be to standardise the process of composition itself!

As long as society (with some glaring exceptions) allows Man to perform and experience different types of music, and as long as there's no standardised accuracy of auditory perception in a given individual, then people will continue to argue on the merits and demerits of heavy turntable platters, digital recording, and noise reduction systems like dbx. Perhaps, now, we could get back to the task of helping musicians and composers create the music without which dbx would be out of a job!

Dr David Ellis **E&MM**

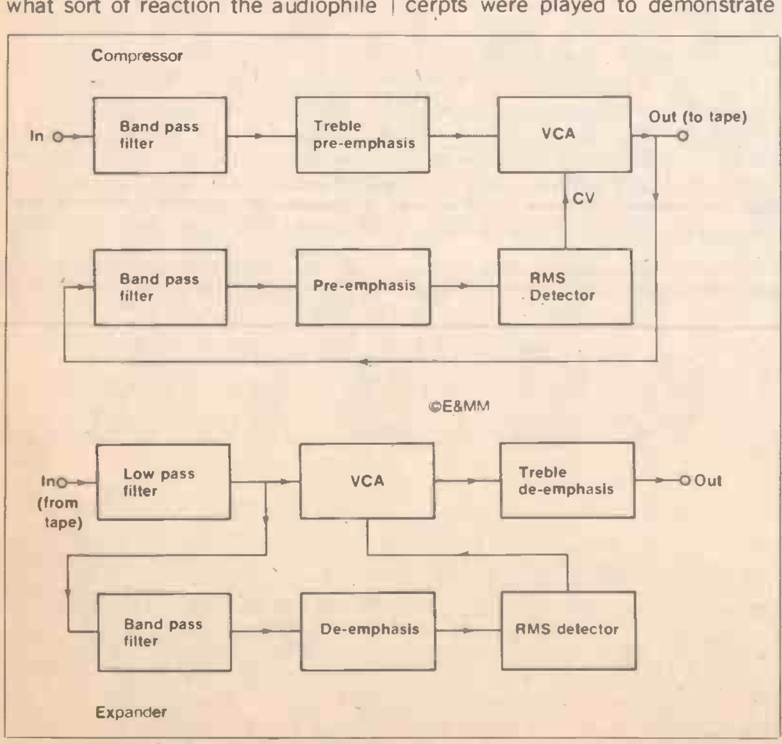

Figure 1. Block diagram of the dbx system.

NEW

GNAT SYNTHESISER

ONLY £125.00 Inc. VAT

An advanced digital synthesiser, totally portable, based on the world famous British 'Wasp' synthesiser.

The Gnat gives you more facilities (some unique) than other synthesisers that are three times the price.

1978 saw a genuine breakthrough in synthesiser technology. The world's first synthesiser for under £200. The 'Wasp' offers a quality and performance which has remained unchallenged. Many well known recording artists and personalities perform with this instrument. Now at last the 'Gnat', with the following facilities, is available.

*Easy to play, one finger, touch sensitive two octave keyboard incorporating a new digital breakthrough which holds the oscillator constantly in tune. The oscillator has sawtooth, squarewave and enhance positions. The enhance 'feels' like two oscillators.

*Digital white noise.

*A five position wave form control oscillator incorporating the famous random sample and hold.

*A powerful 'low pass' filter with 'Q' resonance and a control oscillator and control envelope to the filter for those rich synthesiser sounds.

*A unique control envelope which on one knob gives you many shapes for the filter.

*Envelope with attack and decay/release.

*Preset sustain and volume.

*A full digital coding interface link for connection to any of the products (Wasps, Spiders, Caterpillars, Fleas) and Micro Computers.
Plus line output for amplification, and a 9 volt power input adaptor socket.

*Housed in a durable, light weight (1 KILO) plastic case with battery compartment for six HP11 type batteries.

*Internal practice speaker.

*Every Gnat comes with a comprehensive specially written manual–a complete course in synthesiser technique, from the first principles to advanced performance.

The Wasp

(£199 inc. VAT) Incorporating everything in the Gnat plus the following features–2 oscillators with pulse and width control and variable pitch. Separate digital white noise and control. Filter A three band filter consisting of low pass, band pass and high pass. Separate positive and negative controls from the low frequency oscillator and the second envelope shaper. Both envelope shapers have individual sustain, repeat and delay functions. Two link outputs and headphone outputs.

The Spider

(£199 inc. VAT) A digital micro computer based sequencer designed for use with the Gnat and the Wasp synthesisers. Two modes of operation–

1. Pulse Time with 252 note storage capacity.
2. Real Time with 84 note storage capacity.

Variable speed playback in both modes. Note editing facilities, tape synchronising facilities (sync/pulse input) Digital to anologue voltage converter which produces trigger and control voltage for other makes of synthesiser. Memory is retained when power is turned off.

The Caterpillar

(£149 inc. VAT) A three octave four voice digital moving keyboard controller designed for use with Gnat and Wasp synthesisers. Up to four synthesisers can be connected and played polyphonically. Three modes of key assignment unison, normal polyphonic, and cycle polyphonic.

Completely portable–Long life from a PP3 internal battery. The caterpillar allows the Gnats and Wasps to be built up polyphonically as required, simply by adding more together. Thus making a very cheap and versatile four voice synthesiser at a fifth of the cost of other makes.

Coming Soon

The Flea Sequencer
(£125.00 inc. VAT).
A smaller version of the Spider Sequencer.

Special Offer

Available for every unit purchased. A free holder bag for your instrument. Specially custom designed to protect against dust.

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To: Quasar, P.O. Box 233, London SW3 3DQ

Qty	Item	Code	Item Price £	Total £
	Gnat	G	125	
	Wasp	W	199	
	Spider	S	199	
	Caterpillar	C	149	
			Total	£

Please tick if you require a VAT receipt ☐
*I enclose a cheque/postal order to Quasar for £
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Quasar

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Equalisation

Discotheque equalisation ('EQ') falls into two discrete categories. Microphone EQ can be used to project your voice with clarity or imbue it with *character* - such as presence or breathiness. EQ can also make loud vocals a reality without risk of feedback whereas for general music, reproduction is usually of a totally different nature. For a purist, creative EQ isn't an inherent requirement here, because if a record is worth playing, it will 'come across' of its own accord; Black Sabbath live and music that is often 'out of balance' thrive without EQ provided your audience are attuned. In this instance, music EQ is as philistine as touching up an impressionist painting because 'it looks untidy!'

An alternative and holistic viewpoint is that it's valid for the DJ to interpret the records he plays by EQ'ing them and even by adding sound effects. But this approach demands a sensitive appraisal of the nature of the record and your audience; a souped-up version of 'Foxy Lady' would not endear you to those who hold Hendrix in reverence. From a different angle, EQ is required to repair the unwholesome sound of many records. Limitations of equipment often conspire to ensure that electro-music is rarely heard with fidelity - either recorded or live, whilst, ironically, the public's awareness of sound quality goes from strength to strength. This problem is most acute in the realms of Heavy Metal discs, which frequently emulate the ear-ripping characteristics of certain Rock PA systems, rather than the sweet (if cacophonous) sound of the unadulterated music. Conversely, clarity on record frequently goes hand-in-hand with a good live sound. Even though Reggae and Funk are often excellently recorded, the startling clarity and vitality of recordings by Aswad, Level 42 and Earth, Wind and Fire violently underline the paucity of microphone technique, mixing and cutting skills, and pressing quality in a lot of vinyl.

Equalisation is also a means of correcting deficiencies in the system, particularly those occurring in the loudspeakers, and it can compensate for bad acoustics to an extent. For the time being, however, we'll concentrate on *creative* EQ - which isn't really *equal*isation at all, of course!

The Tools

The ubiquitous Baxandall tone control (first described by Peter Baxandall in 1952), owes its popularity to its ability to provide fair compensation for the deficiencies at the extremes of the audio spectrum commonly encountered in low-cost audio equipment. But as a creative equaliser, it's not especially useful in the classic 'bass and treble' configuration, your control over the nature of the sound being limited by the most arbitary dichotomy. And the regular circuit is inherently limited to providing shallow response curves which peak only at the extremes of the audio spectrum. Nonetheless, the standard configuration can be usefully tailored, notably to home in on the two key regions in vocal applications. The fundamentals of male vocals lie between 70Hz and 150Hz, whilst the upper harmonics for both male and female lie in the 5kHz to 12kHz region. The component values in Figure 1 are attuned to providing maximum effect about these frequency bands as opposed to circa 30Hz and 18kHz, as in Baxandall circuits a la domestic 'Hi-Fi'. Apart from making the standard Baxandall tone control circuit better suited to adding character to your vocals, it's also possible to enhance its ability to add 'sparkle' and 'Tsst' to the music viz, boosting the high treble (10-18kHz) region. The usual problem here is that reasonable accentuation of these frequencies incurs a degree of overkill in the 2-7kHz region (where the ear is extremely sensitive, the pain threshold being a mere 108-114dB hereabouts) which creates a 'bitey', harsh, fatiguing sound, quite apart from being cruel to bats and dogs! In Figure 1, this problem has been overcome by adding a switched shelving control. When the control is in position 'A', the treble boost grows with increasing frequency starting around 1kHz, in the normal fashion, only flattening out (or *shelving*) at the uppermost end of the spectrum. In positions B and C however, the boost curve begins at higher frequencies. Thus painful 3kHz won't predominate as a consequence of gaining an audible effect at 16kHz for instance.

One major shortcoming of the original Baxandall control is its inability to provide any useful control over the midrange frequencies. Whilst a midrange section can readily be added to yield useful results, it suffers from interaction. This is an inevitable consequence of placing three passive networks in parallel, with close seated frequency ranges. Indeed, it's quite common to find interaction in the *two-band* version - the high treble frequently evaporates when maximum bass boost is applied. Apart from this

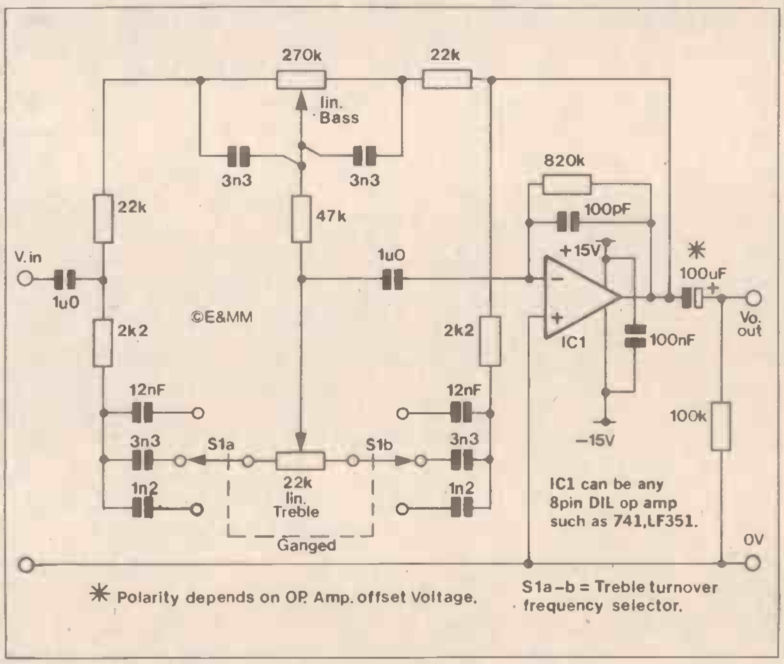


Figure 1. Baxandall tone control with shelving control.

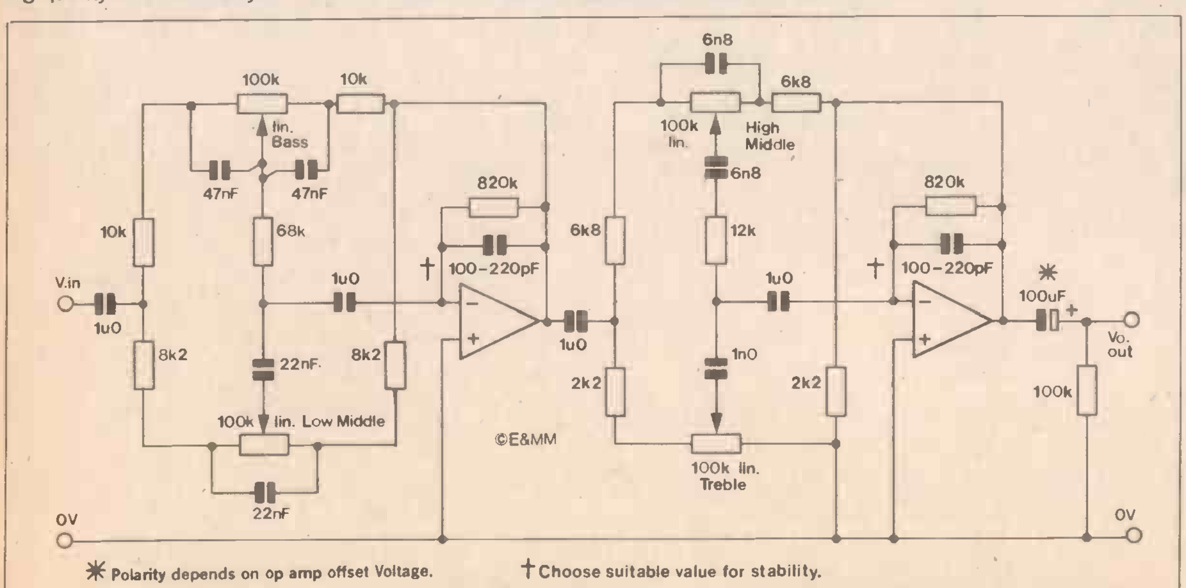


Figure 2. A four-band equaliser.

inexpedience, a three band equaliser is still one elusive step from providing useful control over the four essential elements of music. In other words, equalisation which provides control over the bass (the *soft*, physical sounds), the low midrange (the warm, muddy sounds), the high midrange (the hard, delicate sounds) and the treble (the cold and transparent sounds) is the pre-requisite for creativity in sound. Like the north and south poles of a magnetised material, all music can be split into a series of alternately soft/warm/hard/cold sounds.

Figure 2 shows a practical four-band equaliser. In this circuit, the problem of interaction has been elegantly sidestepped by using a pair of two-band networks in series.

If you use an active crossover, an unusual brand of EQ can be achieved by tweaking the attenuators in each band. This yields a flat, broadband adjustment that is quite unique, although not necessarily useful. However, if you only sport bass and treble controls on your *desk*, the midrange attenuator(s) on the crossover can be useful for restraining the brash midrange sound on certain records, or, alternatively, the bass and treble attenuators can be adjusted in conjunction with the desk's tone controls to yield a balance between overall bass boost and bass boost centered in the high or low regions. For instance, by cutting the bass on the Baxandall circuit, and boosting it on the crossover attenuator, the high bass (circa 200Hz) can be boosted at the expense of the low bass - a reversal of the normal state of affairs! The key disadvantage of using the crossover in your equalisation schemes is the impossibility of differentiating between microphone and music EQ; if the crossover is over-enthusiastically adjusted in pursuit of the latter, protestations a la feedback invariably occur from the microphone . . .

The success of four-band EQ depends greatly upon a judicious choice of centre frequencies - the point about which the equalisation in each band has most effect. The SWEEP EQUALISER overcomes any compromises in this respect, as the centre frequencies are continuously variable over a range of several octaves. This gives great flexibility, but its versatility can overawe, and considerable experience is necessary before one can instinctively 'feel' a 4-band sweep equaliser and adjust it successfully whilst concentrating on your audience. Much the same goes for the PARAMETRIC EQUALISER in which the bandwidth (or 'Q') of the equaliser's effect can be either sharpened up or spread out - together with a continuously variable centre frequency. It's worth noting that some sweep equalisers on the market are sold as 'parametric' - naughty and deceptive! The true parametric is particularly valuable for microphone EQ; its selectivity allows you to accentuate the interesting harmonics in your vocals. The graphic or multiband equaliser is an extension of the four-band equaliser, but it's not necessarily advantageous, because after spending a lot of money, you're stuck with a finite number of centre frequencies. An attempt to save

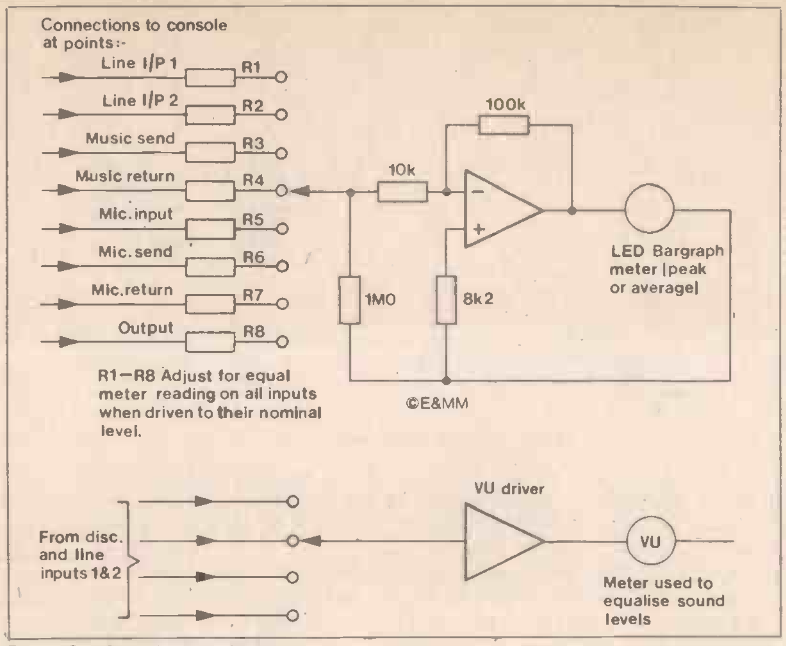


Figure 3. Console metering.

money can lead you to problems of interaction once again. In general, for creative applications, choosing a top-notch 5 to 10 band unit (such as the Klark Teknik DN22) is preferable to skimping (willy-nilly) for the sake of more bands.

Although their creative applications are legion, these instruments can yield rather vulgar sounds that forbid their trial and error adjustment mid-performance, though of the three, the sweep equaliser is the easiest to 'throw-in' surreptitiously. Instead, useful settings for vocals and/or certain records are best noted before the performance; the equaliser is then switched deftly in and out between records or announcements. Multiband and parametric equalisers will be of greater practical use to the DJ when enterprise ties them to a microprocessor to provide a library of instantly accessible preset equalisation settings.

Metering

Meters can help you to equalise (literally this time!) the level of the forthcoming disc or tape, prior to crossfading. Although it's often not possible to pre-adjust the level of disc sources, a meter will at least forewarn you of impending changes in the modulation. On the line inputs (e.g. tape sources) a gain control is usually present, and the meter can be used before the gig to roughly match tape and disc levels.

Metering can also provide you with an objective reference as regards sound levels; a clean sound system can 'feel' deceptively quiet, and whilst it's tempting to raise the level (good music is never loud enough!), restraint is often called for, to appease either your client or a nasty sound level meter/cutout. Metering of this nature is best placed across the output lines, immediately prior to the power amplifiers; but for the metering to be meaningful, it's necessary to abstain from adjusting the amplifier's gain controls - which lie beyond the meters - during the performance. These meters can also serve as an invaluable guide to the vulnerability of your speakers when you have to push

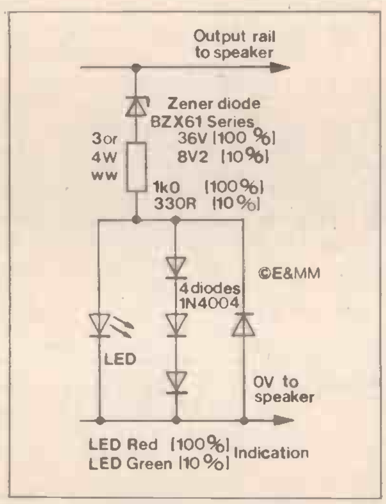


Figure 4. Amplifier output power indicator.

the sound system to its limits, provided they are accurate, and the input sensitivity and output power of each amplifier is sensibly aligned.

It's quite common to place the output metering in the desk - or across the line level outputs - if the console features internal power amplifiers. However, unless it's guaranteed to *always* drive amplifiers with identical sensitivities, which match the 0dBu/0VU reading on the meters, this arrangement is fraught with error. However, these meters can be of use in large rigs as a guide to the output level of the desk, as opposed to other line levels, as the signal passes through equalisers and crossovers *en route* to the power amplifiers. They're also a reassurance when nothing works five minutes before the performance that an output signal is present, and that the desk isn't being grossly overdriven, though no competently designed desk should approach clipping under normal conditions. Metering of this kind is also useful across the inputs, and whilst it needn't be precise, it *must* indicate over a wide dynamic range. Given this, it's a godsend and a source of sobriety when leads fail, or connections and switches are attacked in a wild and frantic effort to find the missing signal! As you won't usually want to know if all inputs and outputs on the desk are working simultaneously, a switched metering arrangement is adequate (Figure 3). Another vexing question, 'Is this *?*!*??* power amplifier working?' cannot reasonably be answered with switched metering, and short of going to the expense of providing a full range meter for each amplifier, a useful indication of an amplifier's utility can be provided with two LEDs, indicating outputs of approximately 10% and 100% of full power respectively (Figure 4).

The VU and its shortcomings

Affordable meters come in two varieties. The VU meter, dating from 1939, is cheap but has numerous shortcomings. Its VU (or 'Volume unit') scale (which corresponds to dBm, albeit with a zero error of +4dBm) only applies if the meter is connected across a 600 ohm line, which today is largely obsolete in Europe. Because the VU standard specifies a meter impedance of 3k9, which causes significant loading and even distortion in a 600 ohm system, a series resistor has to be added, conventionally to make the impedance up to 7k5. With this attenuation, 0VU becomes equal to +4dBm (0dBm is 775mV on a 600 ohm line) with a sinusoidal or musical waveform - but only if you're measuring across a 600 ohm line!

This pedantry is completely out of step with modern UK equipment practice, where low impedance (<100 ohm lines) are standard. This, coupled with the zero error makes the VU an unhelpful standard, to say the least. The problem is compounded by the widespread use of nondescript oriental meters, which are calibrated in 'VUs', but conform to no recognisable standard. These scruples can be transcended by driving the meter actively (Figure 5) rather than just dunking it across the output, and by regarding it as a guide rather than as the ultimate arbiter. This attitude is important, because the VU meter movement is sluggish; it takes time to respond. Thus it can only indicate the average (or *long term*) levels in a signal. When instruments giving a substantially continuous tone e.g. woodwind, brass and strings predominate in the signal, the meter will read fairly accurately. But signals bearing percussive sounds, viz: vocals, drums and keyboard instruments will under-read by some 8 to 14dB; hardly a small error!

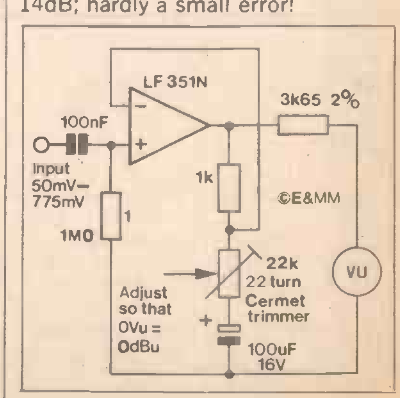


Figure 5. Active VU meter.

As Rock, Funk and Reggae abound with - indeed, are *built* out of percussive sounds, VU meters are largely useless for assessing the peak level of the signals in a discotheque system and the onset of overload in power amplifiers. Now because it's often *clipped* waveforms, rather than a small excess of sinusoidal power, that blows speakers, a lone VU meter *isn't a reliable guide* to driving your system to its limits without damage. However, it's still quite valid as a guide to *perceived loudness*. Thus the VU is acceptable as a means of equalising levels, and indicating the presence of a signal, but there its usefulness ends.

A further problem with the VU meter is its *linear* scale; this is fine for judging modulation levels percentage-wise but as a 'dB' meter, around two-thirds of the scale length is taken up with the 6dB's centred around 0VU. Hence the meter needle either registers vaguely at the bottom and or flickers confusingly all over the top end of the scale.

Peak programme metering

Whilst transient overloads are unforgiveable if they occur on a master tape costing £10,000 to produce - or if they blow up a broadcasting transmitter, they're apparently harmless in a live performance, in that they are quickly forgotten. To an extent, this viewpoint is reasonable.

However, the crux of the problem is the knife-edge between dirty, clipped sound and clarity in conventional transistor amplifiers. Occasional clipping - say half a dozen mildly clipped cycles every few minutes is harmless, but minute changes in the voltage of the mains supply, or a tweak of the gain or EQ controls can send the system into prolonged clipping; the difference between live speakers and dead ones can be traced back to an excess of a mere 2 or 3dB's over several hours. . . Apart from the immediate upsurge in speaker voice coil temperatures and the precipitous cone accelerations called for by the substantially square shape of clipped waveforms, there's ample evidence that it's clipped percussive sounds rather than loud music *per se* that is primarily responsible for hearing loss. In other words, accurate metering which will enable you to steer clear of long term clipping will not only save you the cost of damaged speakers but will also prevent you alienating and offending your clientele, through the nausea and ringing ears that come hand-in-hand with distorted sound.

So, the second variety of meter is the PPM (or *peak programme meter*). Originally spawned by the BBC, the PPM features an agile meter movement with a log scale, and a driver circuit. It remains the Rolls Royce of audio metering on account of its rigorous specification and thoughtful design. But true (i.e. BBC spec.) PPMs are expensive enough to be restricted to broadcasting and recording studios. With the benefits of LEDs, however, we can synthesise the most useful aspects of the BBC PPM - and even improve on them. The prime requirement for indicating peak levels is not only for the meter to respond quickly, but also to present the message 'Oi, you're overloading me!' for a reasonable length of time. To this end, the BBC PPM provides full deflection in 2.5ms (although not exceptionally fast, the ear is unlikely to hear distortion occurring over such a short duration). The needle then takes *one second* to approach zero level again. Any well designed LED PPM should iterate this decay characteristic (approx 8dB/second); unfortunately, the LED meters built into many consoles fail in this respect, having a 'liquid' response that makes the peak readings hard to see, let alone attention-grabbing. In the latter respect, the LED meter has the advantage that green, yellow and red can be used to shout 'OK', 'You are approaching the limits' and 'Ouch!' In this case, you only have to glance at the meter to know roughly what's going on. The BBC PPM has a 1-7 numerical scale, but a discotheque version using LEDs is more useful if it's calibrated in dBU or watts (Figure 6). Finally, by adjusting the time constants of the attack and decay characteristics an LED peak meter can also yield average characteristics - in other words, an LED 'VU' meter! A single LED meter with a 'peak/average' switch can then meet all the metering requirements in a console. The scale needn't be regular, it's useful to provide 1 or 2dB steps around the overload point, with 3 to 6dB steps at the lower end of the spectrum. E&MM

12 LED meter (dBm)	9 LED meter (Watts)
O +4	O Clipping
O +3	O 500
O +2	O 250
O +1	O 125
O 0	O 62
O −3	O 31
O −6	O 15
O −9	O 8
O −12	O 3
O −15	
O −18	
O −20	

12 LED peak meter, calibrated in dBm with scale extended around 0dB and −20dB

9 LED peak meter with power scale in Watts

	VU	PPM
Attack	300mS	2·5mS
Decay	300mS	8·7dB/Sec

Time constants for peak and average metering. To BBC specification.

©E&MM

Figure 6. LED PPM scales and time constants.

WORKING WITH VIDEO

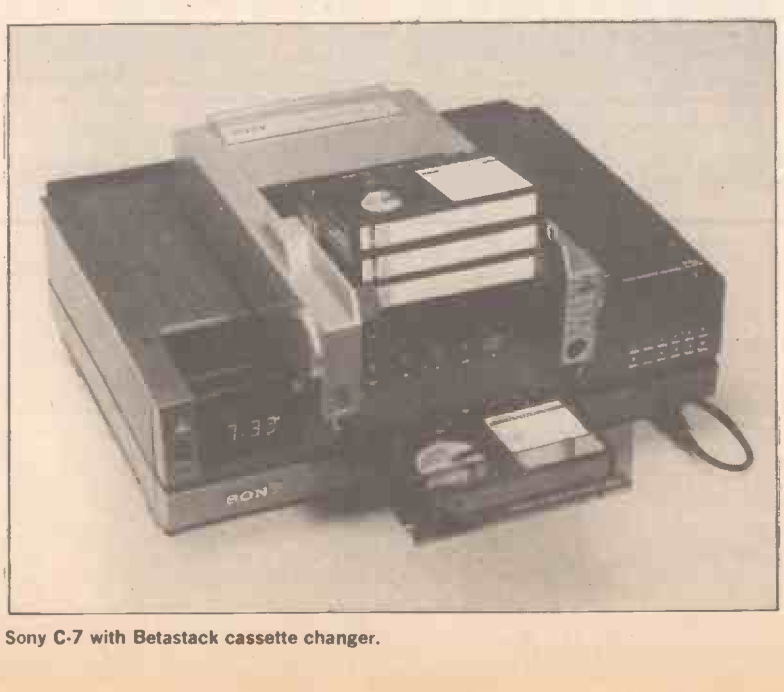
Andy Emmerson

In the past I may have been guilty of treating the Beta system as the poor relation, and even though its market share is only a fraction of that enjoyed by VHS one should not make the mistake of treating it as dead. Quite the opposite, as we shall see this month, with four significant Beta-only developments to investigate. In many ways it is only a historical accident that Beta format did not make it to number one in the popularity stakes, and in some markets, notably South America, it *is* numero uno. Technically, there is little to choose between Beta and VHS, and your final choice depends more on the availability of tapes and machines to your taste. Up to recently in this country there was not much of a choice in the latter area; on the one hand you had the impressive but expensive C-7 from those awfully nice Sony people and on the other you had Sanyo's bargain basement machine which was making it so difficult for VHS to get into the real budget video area. Very recently Sanyo have restyled their low cost machine and Sony have brought a new mid-price recorder, the C-5, on to the market. No doubt both of these machines will find their way into homes and increase the popularity of the Beta format.

At the premium end of the market Sony's C-7 was the only machine to look at, so it's good to know there is now another one to consider. It's the V-8600B from Toshiba and as the photograph shows, it's an impressive beast. Like Sony's C-7 it differs from other machines on the market. It also has the same type of touch switches as the C-7 on the top front edge of the cabinet. In fact this coincidence led my evil mind to wonder if Toshiba's new baby was just the Sony chassis in another housing but this is not the case. I suppose they may be buying in some of the Sony mechanical assemblies but the features are significantly different and in fact, the controls are not the same. Benefitting from experience gained in the USA market, the new Toshiba machine uses four, not two, heads: the additional two heads are reserved for achieving faultless freeze-frame and "super slow motion" pictures. Without the extra heads it is far less easy to get rid of the "noise bars" on the trick functions and certainly on the Sony T-7 (and possibly C-7) this had not been perfected. The new V-8600B also offers picture search at seven to twenty-five times normal speed, in both forward and reverse directions. I must say, of all the "trick" features I have seen, this is the only really useful one I have come across. It's ideal for skipping adverts and finding the start of programmes when you have recorded several programmes on one tape. Slow motion I never use and freeze-frame very occasionally. There is a remote control unit, with an optional infra-red (wireless) one as well. The recorder also features BNR — Beta Noise Reduction — to improve sound quality, but I have not yet been able to evaluate this against the more commonly used Dolby system. The retail price, including VAT, is quoted as £685.50 and my verdict is: well worth considering, particularly if you can find it below this price.

Toshiba's new V-8600B video recorder.

Development three is a Sony exclusive, the Betastack cassette changer. This is a highly ingenious device which sits atop your VCR and holds three additional tapes. It covers the machine's tape handling controls and operates them automatically. Using the longest length of tape cassette, with one in the VCR and three in the Autostack you can work out for yourself how many programmes you could record while you were away for a holiday . . . the mind boggles how many episodes of "Crossroads" you could get in! Obviously it will only fit Sony machines and certain models at that, so you had better ask your friendly dealer whether it would work with yours. Ask him his price at the same time, since manufacturers' recommended prices are a bit of a nonsense. I have been reading an American test report on this device and they said both installation and operation were simple, although if you didn't want a programme to be split between two tapes you had to figure in dummy programmes so that changes took place during these. Performance is said to be superb: actual changeover of tapes takes only 15 seconds and the device handled them very gently. The hardest handling is a quiet two and a half inch drop into a tray for the completed cassettes. Wonder if the VHS camp will come out with a me-too product?


Sony C-7 with Betastack cassette changer.

Our fourth development is also from Sony, the SLO-383 Betamax Videocassette Editor. It is the world's first editing deck for domestic video tapes and will probably set a trend for a new era of low cost consumer and industrial units. Its unique four-head design uses two "flying" erase heads to ensure perfectly clean edits without any "glitches" visible. Segments can be assembled one at a time in order, or a new sequence can be inserted in the middle of an existing one. High-speed searching is possible, as is slow backward motion to back up to an edit point. Direct FM dub in/dub out jacks enable you to bypass the normal video jacks, resulting in a little less smearing and colour noise. Price in the States is $3750, which puts it out of the home user's budget, but for the small college, industrial or fledgling commercial studio it is a bargain. We shall have to see how quickly Sony bring out a European version; it should not be long.

To round off our little chat this month, a couple of things to look out for if you're a VHS enthusiast. Sony now are in the enviable position of having a manufacturing licence for VHS tapes, but it remains to be seen (a) whether they use it, and (b) whether their tapes come out under their own name. Interesting though... The other point is a novel idea from the USA — where else — in which you have a snap-together tape cassette in which you insert the spools of tape. The spools are stored, however, in separate boxes and you need only one tape cassette as such. It is claimed that this method saves a lot of money! What next?! Back to sanity next month — see you there! **E&MM**

HI-FI

Jeff Macaulay

Last month I promised to look at the fundamentals of active crossover design. First, though, a look at a new product which I'm sure will be of interest to most of you.

To begin at the beginning. For the last few years the cartridge market has been split between the proponents of moving coil and moving magnet systems. Certainly in the last couple of years the former type has gained an enviable reputation for sound quality. However, there is a new breed of moving coil cartridges that have an output voltage comparable to that of the moving magnets. Naturally I was interested to see if the sound quality of the old moving coils could be maintained and so I obtained a review sample of the new Coral MC-88E which is to be distributed by Videotone Ltd.

As with the previous R100 cartridge review the reference system used consisted of a Planar 2 deck feeding through a custom-built active speaker system. My own reference system with a BD1 turntable, Acos Lustre arm was also used. Unfortunately the Lustre is now obsolete but the Rega arm, the R200, was developed from it although the latter has considerably less mass.

The MC-88E is a heavy cartridge and requires a tracking weight of 2 grams to eliminate mistracking. Not that this proved to be a problem in use since the cartridge sailed through the most heavily modulated Telarc digital discs without problems.

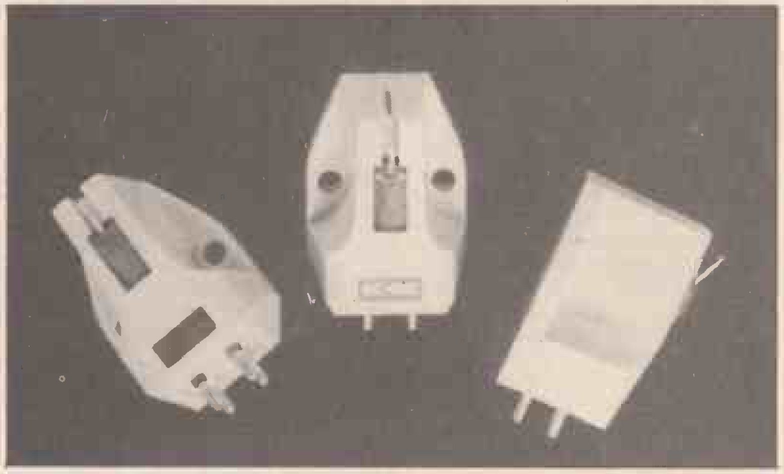
One inconvenience from the consumer's point of view is that the stylus is not user replaceable. Those readers who already possess moving coils will be aware that the cartridge must be sent back to the makers for a replacement to be fitted. Another, albeit minor, problem was that the plastic stylus guard repeatedly fell off while the cartridge was being fitted to the headshell.

Enough of the preamble — how did it sound? In short I was pleasantly surprised. On first hearing, the sound was reminiscent of the VMS20E2 with which it was compared, with good detail transmission, neutrality and a feeling of immediacy.

It soon became apparent though that the '88' was delivering information that the '20' had completely missed. Subtle details, especially on cymbals, became noticeable without having to concentrate one's hearing. Bass also had a different character being better extended and more firmly controlled.

Playing my collection of direct cuts and digital records produced further revelations. It became possible not only to hear the musical notes but also the way in which the musician was playing them.

By now you will have gathered that



The new Coral MC-88E moving coil cartridge.

I am enthusiastic about this particular newcomer to the audio scene. The output from the cartridge is 0.5mV/cm/s, about half that generated by the majority of moving magnet designs. As such the cartridge can simply be fed straight into a standard moving magnet amplifier input without problems.

The introduction of this type of cartridge raises some interesting implications for the preamplifier into which it is fed.

Moving magnet types have a large inductance and so the source impedance rises with frequency. So much so that the output impedance of the cartridge becomes comparable with the input impedance of the RIAA stage. Moving coil devices, including the MC-88E, have a much lower inductance and hence do not require special matching. Now the S/N ratio of any cartridge input stage is limited by the noise generated by the cartridge. This in turn is dependent upon its internal resistance. The larger the resistance the more noise is generated.

The MC-88E has an internal impedance some twenty times less than that of a moving magnet which means that with careful design a S/N ratio at least 10dB better than that normally achieved with moving magnets should be obtainable.

Another interesting point is the automatic extra 3dB of headroom obtained with this cartridge. This is quite noticeable when playing highly modulated passages. Often what was thought to be mistracking or poor pressing is revealed as unsuspected front end clipping.

All in all then highly recommended. The cartridge can be obtained from Videotone for £39.95.

Now I have some further comments on active crossovers. Potentially this technique promises a revolution in the perceived sound quality of speaker systems. However, in order for the technique to be fully exploited a change will be necessary in the general philosophy behind Hi-Fi.

Up to now most Hi-Fi systems that merit the name have been collections of separate amps, tuners, speakers and decks. The actual sound quality provided by these systems depends as much on their compatability as their individual excellence. The reasoning behind this philosophy is not difficult to find. It does not follow that because a manufacturer makes a superb amplifier that their speakers are going to be as good.

Active speaker systems require a marriage between amplification and speaker systems to an unprecedented degree. Naturally this will not happen without a struggle between the various vested interests involved.

With the advent of transistor amplifiers, speakers systems started to get smaller. This pleased the housewife if nothing else since speakers became less of an eyesore in the lounge. However, in order to maintain good bass extension, efficiency had to be sacrificed. This in turn led to higher power amplifiers to maintain sound levels.

A cosy cartel of interests has thus arisen in which speaker manufacturers make low efficiency (expensive) speakers that are driven by equally high powered (expensive) amplifiers. One of the major contributors to this inefficiency is the passive crossover network. The more parts in this the more the insertion loss. A 6dB drop is normal.

Now 6dB is a ratio of 4:1. This means that a nominal 25W rated drive unit will require 100W when fed from that particular crossover. An active crossover has no insertion loss so only 25W would be required to reach the same sound levels!

Consider the situation from the viewpoint of the speaker manufacturer. Reputable manufacturers spend large amounts of money on developing high quality speaker systems. A lot of this design effort is directed towards the crossover. Indeed one of the arguments used to discourage the experimenter from building his own is that crossover design will be beyond his abilities. Apart from the obvious economic desirability of propagating such a belief it is, unfortunately, partially true.

It is not so much that crossover design is generally difficult, more that the information required is hard to find.

Another point — the checking of a speaker system's sound is done in an anechoic chamber. As such it is rarely found that the speaker's frequency response is flat in the average lounge.

Active speakers on the other hand require relatively little design work. A set of basic formulae and a calculator are all that is required for the job.

So far this situation has led to the inevitable tri-amped systems employing conventional amplifiers and have, in consequence cost the earth. The alternative self-contained models, Meridian M2's for example, offer higher levels of performance because the design effort can be directed towards fully integrating the individual parts rather than trying to manipulate existing designs. **E&MM**

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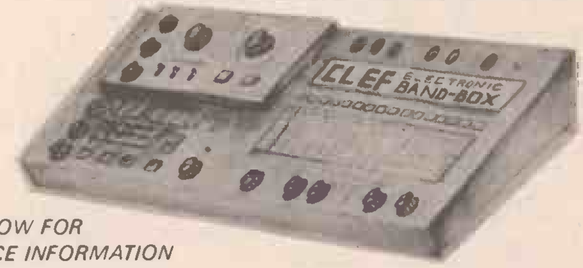

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Organ Talk

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Ken Lenton-Smith

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3.	Flute Chorus	8' Ensemble	40 6806 004	5555 3333
4.	8' Clarinet	8' Open Flute	00 8383 640	5522 0000
5.	8' English Horn	8' Concert Flute	00 3577 540	5321 0000
6.	16' Oboe Horn	8' Viol Celeste	47 5430 000	2323 2110

Table 1.

There are so many facets of organ playing that it is only too easy to lose sight of some of them. As the instrument is possibly the most versatile of all, the player can become an individualist and distinctive in style due to the wide choice of tone colours and methods of using them.

Pianists, on the other hand, playing the same score, will be difficult to differentiate between unless one happens to be an expert in that field. To a large degree the tonal quality of a piano is fixed in its manufacture, although some variation can be achieved by the *piano* and *forte* pedals and by the player's touch.

Organists tend to be recognised not only by their arrangement of the music but by their choice of registration - disregarding for a moment classical pieces scored on three staves.

Registration

Even the most modest of two manual instruments will offer a fair range of tonal variation. Synthesised voices aside, the individual stops are of three families - FLUTES, STRINGS and REEDS - with their hybrids and mutations. At this point we are interested in the *permutations* of these between the upper (solo) and lower (accompaniment) manuals.

Classical players will know the upper manual as the SWELL and the lower as the GREAT. Whether playing light or classical music there is, of course, no reason to adhere rigidly to one particular manual for the solo part, provided that a suitable accompaniment stop can be found on the other.

The best guideline that I can offer is to attempt to choose contrasting voices for the two hands. If the solo voice chosen has a stringy quality, the accompaniment best suited may well be something with very little upper harmonic content - such as a flute. Bearing in mind that instruments vary in their character and facilities, the examples in Table 1 may help to illustrate this principle. Drawbar registrations have been added for Hammond, Kawai and other owners of organs with this feature, especially as they help to illustrate harmonic content and differences (see Organ Talk, June 1981).

This list could be endless and never match the specification of any particular instrument, of course. However, it will pay to sit down and experiment with the voices available, noting down on paper the best accompaniment found for a given solo voice. It is worth reversing the roles of the two manuals from time to time as the lower manual can often incorporate useful and distinctive voices for solo work.

Balance

Where the strength (or loudness) of individual stops is fixed - as it is on most instruments - suitable combinations across the two manuals should also obey another simple rule: in addition to the tonal contrasts, the solo stop should be somewhat louder than its chosen accompaniment. Nothing sounds worse than the melody being lost in a welter of heavy left hand chords.

One manufacturer's idea of the loudness of a given voice (of the same name) will differ from another's; even instruments of the same make and model can vary according to how presets were positioned in the factory. Any self designed organ ought to provide presets to control individual stop levels for this very reason, but there is no doubt that considerations of balance will rule out some of the possibilities found in comparing the quality of voices for tonal contrast. In this respect, drawbar instruments score heavily as it is necessary only to push each drawbar in by one notch to obtain a quieter version of the same registration - at least, in theory!

Summarising registration and balance, the melody should be heard clearly against its accompaniment. Reed and String solo registrations, simple or in chorus, will have more incisiveness. A solo stop which is mainly fundamental in nature will require a quiet backing richer in upper harmonics. The Yamaha Tone levers and drawbars found on some other organs are useful for arriving at correct balance, although left hand chords played *staccato* can disguise the fact that they are too heavy for the melody. 'Accent' tabs, if provided, help in solving problems of balance.

Pedals

So far, the pedal department has not been mentioned. Given the average 13-note clavier, differences in tonal quality at 16' and 8' are less detectable than they are on the manuals. A full 32-note pedalboard is rather a different matter, but using the 13-note board will mainly involve finding stops of suitable volume. On the whole, flute tones tend to sound better than complex waveforms if there is a choice; an 'accent' tab may allow the same stop to be strengthened, if necessary. Attack, Decay and Percussion will help in ringing the changes but do try to avoid an overbearing pedal as it tends to be most objectionable. This point may be less obvious to the player than the listener - who is in the direct line of fire, whereas the organist often sits well above the sound source!

This column's readers will no doubt have a collection of discs and tapes of well-known organists. Whilst even the worst pop groups can be made to sound acceptable given all the trappings of a modern recording studio, the solo organist is very much out on a limb. Basically, you hear just what he plays - with very little embellishment.

May I suggest that, at the next hearing of those recordings, the registrations used are guessed and written down on paper so that an attempt to re-create them can be made later on. Knowing one's own instrument intimately also helps because it is quite often found that the stops indicated (and they are simply indications) on organ sheet music are rather unbalanced. Unavoidable possibly, in view of the plethora of instruments, but there should be no excuse for this if drawbar registrations are shown alongside. So, it will pay to experiment at length, even if it does seem like playing with Rubik's cube!

Bad Habits

An objectionally loud pedal line has already been mentioned. Here are a few more points concerning things to avoid when playing.

Rhythmic piano players keep their right foot beating time on the *forte* pedal, which is really a sustain pedal. The organists right foot does control *forte* and the dynamic range of that pedal is often quite considerable. Beating time is hard going for the listener: it is better to develop the habit of using the swell pedal purely for expression - as it was intended - or for occasional accent. Another good reason for avoiding 'piano player's foot' is that a good tape recording will be made that much more difficult!

Be prepared if someone asks you to play for them. I don't mean cavilling at the very idea but simply avoiding playing a few notes to 'find' the registration, then running through all the permutations of the rhythm unit before actually getting on with the job. Be warned that this is a serious crime: I once heard a Colonel warn an army dance band after the trumpeter had gone through a few 'twiddles' between numbers. When the trumpet player forgot himself for the second time, the whole band was put on a charge! Those days have long passed, but a little musical discipline does no harm.

Take a good look at the registration if playing chords. Whilst 16' pitch is ideal for strengthening a melody line, chords played too far down the manual sound confused and muddy. The answer here is to play 8va (up one octave) as the addition of 16' pitch will effectively have shifted everything down by one octave. Similarly, chords played when mutation stops are in operation - or on drawbar organs when the odd harmonic drawbars are prominent - will indeed sound odd.

Turning to the physical aspects of playing, the most suitable playing position is *not* crouched over the keyboards. Playing like this for any length of time will result in backache of the first order. Sit upright with a straight back as in any case the music will be nearer to eye level. With a short pedal board it will be found better to sit towards the left hand end of the bench whose legs should be positioned so that the heel does not touch them when playing bottom C.

Quite a number of enthusiasts buy an organ at the same time as they first acquire bifocal spectacles. This can cause difficulty as the keys are in sharp focus and the music out of range. Either it is a case of reading glasses or preferably looking only at the music (with nose in the air) and playing by touch. It does not pay to have more than two manuals because the music gets progressively higher!

Someone reading this page might be considering a self-designed organ. The points made earlier would suggest preset level controls for every voice and unless a drawbar design, accent tabs for each department.

Finally, in connection with my notes in the May 1981 edition, I hear with regret that G.I.M. have decided to discontinue manufacture of the AY-1-0212A Top Octave Synthesiser. The AY-1-0212, which accepts a lower master oscillator frequency, will still be available. E&MM

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Hot Wiring your GUITAR

Adrian Legg

You may remember a while ago Ibanez produced a guitar featuring 'Tri-Sound', and Elektra produced a guitar with a similar switching capability — though how widely the latter got round the UK I'm not sure, I saw a sample. Both guitars utilised humbuckers, and provided switchable normal humbucker/single/in-phase coils for one or both pick-ups. The switch that I saw on the Ibanez was one which I use quite extensively, an FTPA41, made by the New Ohto Co. Ltd, yet another bunch of cunning Orientals. The 4 in the number refers to the toggle shape, in this instance a triangulated paddle. The F refers to the series, a quite inspired range if you're a switch freak like me, and the rest denotes an on/on/on DPDT (yes, double-throw, the centre on is incomplete — more later) similar to the JBT on/on/on, used in the Elektra.

You may have a little trouble getting hold of this item. JBT used to be run in the Schecter catalogue but have now been superceded — I imagine there must be an equivalent but at the time of writing don't know it.* The FTPA41 may be available via Ibanez dealers and I believe there may also be a similar function Alco. Personally, I have only used a couple of Alco on/on DPDTs, and I broke both of them. I've used quite a few JBTs and FTPA41s for quite a while, and had no problems so far. If you do have trouble getting hold of a suitable switch, get in touch with me, I may be able to help. The switch must make contacts as shown by the dotted lines in Figure 1. Note that the diagonal opposites in the centre position may be either way round, and they should be checked with a simple circuit tester before wiring up. It doesn't actually matter at all which way round they are for the purposes of normal/single/in phase switching, but this switch has applications for series/single/parallel coils, as a stereo selector switch, for power off/standby/power on switching and more.

Wiring is as in Figure 2 for the 'Tri-Sound' type of wiring, and while I fully appreciate Ibanez's interest in the matter, it is not unique and I make no apology for using DiMarzio colour coding as it is the most commonly known up and down the country.

You can see fairly clearly from Figure 2 what is happening. In the toggle down position, that is, centre terminals in contact with top terminals, signal is taken from the red conductor of coil 1, and black and white are linked to give the normal out-of-phase series coils of the humbucker. In the toggle up position, that is, centre contacts linking with lower terminals, the phase of coil 1 will be reversed to normal, and signal will now be taken from coil 1 black via the diagonal link wire, and red will now link with white to give coils in series but in-phase. In the toggle centre position, whichever way the diagonally opposite contacts are made, there will be an incomplete circuit on coil 1, and signal will be taken zig-zag fashion from white and coil 2 only. Pick-up mounting is the only way of deciding which coil to tap off in relation to other pick-ups. Overall phase reverse on top of this is perfectly feasible, would operate on all settings, and would be achieved simply by running the output from the switch and the green to a normal diagonally wired on/on phase DPDT as in Figure 3.

Well, it's an interesting wiring; so it's a pity that on its own, a pick-up with coils in phase sounds terrible, hums excessively, and has a hefty relative power drop. But does your average golf club secretary or Admiral swig away at just angostura? No, he sloshes gin and tonic all over it first, and this is exactly what this wiring is, a mixer. It mixes best of all when used on a neck end pick-up in conjunction with a tapped centre pick-up, and in spite of possible heavy-ish connotations, is very much a picker's mix. Get the overall phase right (on my guitar, pick-ups out) and it will give a brittle sweetness that emerges from the hurly-burly of a band mix with Dobro stamped all over it. Back it off via a treble bypass capacitor and strum it, and you have the apparent equivalent of the top end of a well recorded acoustic rhythm, or the pièce de resistance, open tune it, shove it through a chorus, and chord harmonics played rasgueado will give a very convincing auto-harp sound. It positively reeks of greenery and Mother Maybelle (begging her pardon) and used properly, gives the sort of feel that you will not get out of a guitar synth in a month of Sundays.

E&MM

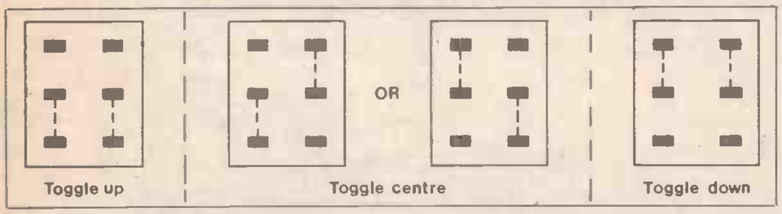


Figure 1. Switch contact sequence.

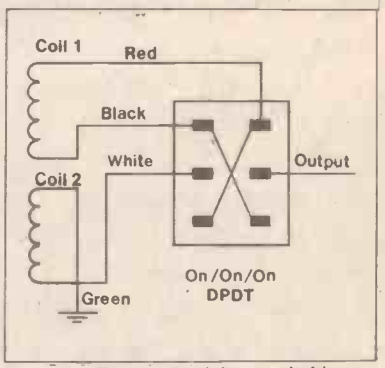


Figure 2. Three way pick-up switching.

**Maplin's sub-miniature toggle L (FF72P) can be used for this circuit, and matches the switches currently supplied with DiMarzio pick-ups. The same three-way switching is a feature of the Shergold Masquerader guitar.*

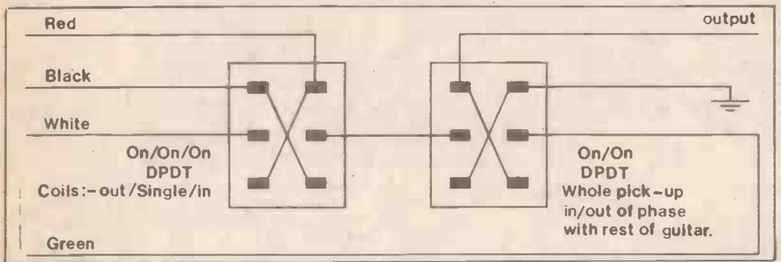
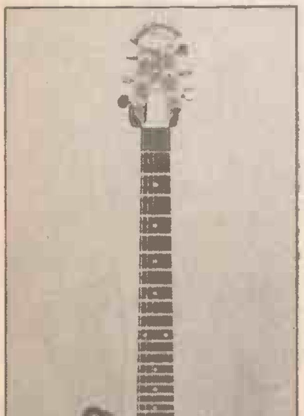


Figure 3. With overall phase switch.



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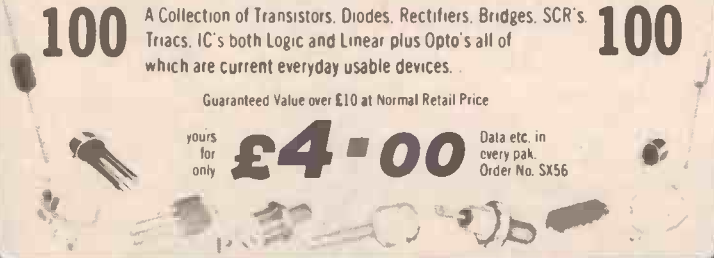

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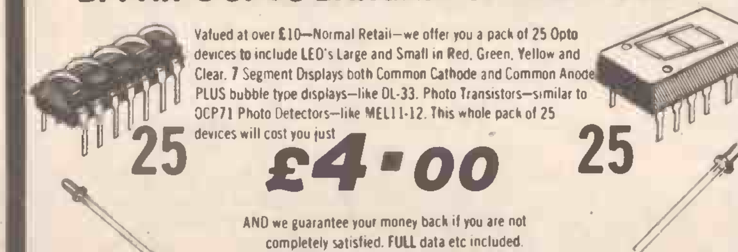

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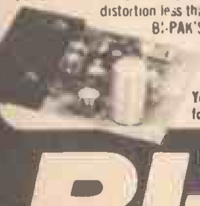

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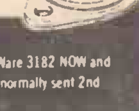

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MUSIC AT CITY UNIVERSITY

RECORDED ON CASSETTE NO. 4

David Ellis delves into computer music and electro-acoustic education in London

At the same time as one's greedily fingering the latest digital music wizardry, it's salutary to remember that such objects don't appear out of thin air and reflect the consequences of intensive R&D, as well as years of research into the nature of sound and synthesis techniques. It's also arguable that any musician using such products of high technology should be aware of the ingredients that went into their design as well as the ways in which the sounds are actually produced.

The Music Department at City University, London adopts the technologically-intelligent musician as its basic educational standard in a way that's wholly refreshing in comparison to the archaic musicological approach of many other Music Faculties. The two sides to the activities at City could come under the headings of 'analogue' and 'digital', but this would do a disservice to the very careful and non-pigeonholed course structure that Simon Emmerson has built up over the past five years. I'll be talking to him later on about the studio and the course itself, but, firstly, I started off my day at City by talking to Dr Kevin Jones, a research student working on computer music.

MUSIC 5

The pioneering work in the field of digital synthesis was done by Max V Mathews at the Bell Telephone Laboratories in the States. He wrote a series of programs, MUSIC 1 through 5, that configured the computer as an infinitely complex synthesiser. The original MUSIC 5 was written in FORTRAN, which is notoriously slow, but a former member of the department, Stanley Haynes, now working at IRCAM in Paris, re-wrote part of the program in assembler to speed up the rate of sound generation.

Kevin Jones explained where MUSIC 5 came into his own work. 'The version of MUSIC 5 that Stanley was using was quite old and just capable of setting up basic oscillators and using them to control each other. I developed a special version of the program with pre-programmed instruments so that beginners could sit down and write simple instrument files and define instruments just in terms of frequency, waveform and envelope. This enabled them to build up waveforms and experiment with simple frequency modulation, but they didn't actually have to program the oscillators together.'

Obviously, MUSIC 5 was pretty tough on the composer warily treading digital synthesis ground for the first time, and, in the first version, this wasn't helped by the necessity of entering logarithmic pitch data related in some way to the sampling rate. 'With my version, you could at least enter pitches as Hz, but Stanley actually wrote a conversion routine which meant that you could enter more conventional musical parameters. The main way I used the program was to generate note lists via recursive procedures which call themselves in order to generate comparatively dense structures.' Whatever neatness lay in these programs was subject to the frustrations of inadequate processing facilities to generate tapes that could be played back via the department's D/A converter.

'It took us about 9 hours on the University mainframe, an ICL 1905E, to generate about 60 seconds, which gave a processor time/music time ratio of something like 100:1! The 7-track playback unit here in the studio was used to play the tapes from the ICL, but, since the University has changed over to a Honeywell which operates on a 9-track format, it's now incompatible. The only way we can get the thing to work is by having our tapes converted from one format to another at the UCCL computing centre. So, we decided it just wasn't worth carrying on with mainframe work.'

The cynic would argue that high-level music languages are fairly detached from reality, and the cost of mainframe processing time must be incredibly uneconomic, so I wondered how Kevin felt this work was justified.

'Well, the development of digital synthesisers as commercial products must owe a lot to the work of Max Mathews and others in the States, and I think that MUSIC 4 and 5 must have been a necessary link in the chain. In general, the sort of research done in Universities or other technological institutions often filters its way down, but, with the MUSIC series, Max Mathews's original research started off in connection with speech synthesis and acoustic research, and then musical applications developed out of it.'

It's curious that whereas in the States it's de rigeur for large synthesis set-ups to be connected with big companies like Bell Telephone Labs, over here there's just nothing of the sort; I mean, can you imagine British Telecom supporting digital music synthesis? Though this seminal research could be said to have reached a full-stop in this country, it's very alive and kicking elsewhere.

'MUSIC 5 has now spawned MUSIC 10 which is being used at IRCAM and also at Stanford. MUSIC 10 is modelled more on ALGOL, in that you assemble your instruments using procedural calls, and then you put logical expressions, tests, and so on, into your instrument definitions, which makes it much more sophisticated and gives you "intelligent" instruments. Note calls are also built into procedural definitions and the whole thing is much easier to work with.'

Dr. Kevin Jones at the Apple.

Even so, these high-level languages take a lot of assimilation, and it's only too easy for a composer to be distracted from the business of actually getting down to producing music. Really, composers need an interpreter interface which will allow them to enter music in the most painless way possible.

'Well, I think that's what people in big computer music installations are just starting to realise, but there was a time when people like John Chowning, at Stanford's Artificial Intelligence Laboratory, said that if a composer wants to use a digital synthesis system then he's got to learn how to use it. Now, at IRCAM, they've changed a lot of that and a composer often works with an assistant. But, to do anything that's more than fairly basic, I think a composer does need to get to grips with programming languages.'

I wondered what Kevin thought of computer music in this country as compared with, say, France.

'Well, I'm afraid that there isn't any. It's a great shame, because the foundation was laid with Peter Zinovieff's EMS studio to do amazing things, but everything just fell apart. I know of no one else who's really seriously involved in computer music, apart from myself. Jonathan Harvey has worked at IRCAM and Tim Souster at Stanford, but apart from them there's nothing happening here. That's why I feel it's so important that we extend the music course here at City. Really, I feel the amount of computing should be much greater — at the moment computer studies is a core subject for every other department apart from music.'

Knowing only too well the conservatism of University administrators, I foresee some difficulty in getting the marriage between computers and music accepted.

'Yes, I suppose so, but having the Apple here means that people can work with computer techniques and get a good idea of applications in music.'

Kevin has been extensively working with the Alf music synthesiser cards in conjunction with the Apple, both in his personal work and for teaching purposes. The latter include some aural training programs that enable a student to test himself alone without the embarrassment of appearing tone deaf in front of a class! Kevin's PhD was basically in algorithms and compositional techniques applied to computer music. A section of this is on generative grammars which are used to create stochastic webs, or, in other terms, producing structures with elements of chance.

'I'm trying to surprise myself by generating structures rather than sounds, and, because the structures are interesting, I'm pretty convinced that I'll get an interesting sound. It's all down to the idea of cybernetic serendipity! Even though you're stuck in a square wave cage with the Alf modules, calling the subroutine at different places enables you to develop nice sophisticated canonic structures.'

Two examples of this technique

can be heard on the E&MM demonstration cassette No. 4. This also includes an example realised on the ICL1900 computer using the MUSIC 5 program to create a digital tape, which was replayed through the department's D/A converter.

Electro-Acoustics

Practically the first thing learnt in the Music Department is that the term used to describe a technological-based form of music-making is 'electro-acoustics' rather than 'electronic music'. Simon Emmerson explained: 'We're unashamedly French-orientated, in that we deal with the 'sound object'. So, how you record and treat the individual sound is, for us, the ultimate sound synthesis. In the first year of the course, the studio activities of the students are geared towards recording individual sounds and splicing them together. The thing about the French approach is that emphasis is put on the sounds themselves speaking to a greater or lesser extent.'

This seems perfectly reasonable to me, as it's incredibly easy for a student to use the sounds of a commercial synthesiser in a way that's dictated more by the way in which commercial music uses such pre-patched instruments than from the intuition of the composer's mind. I asked Simon about the origin of the course at City: 'The course was planned in the early seventies and some money was given by the Worshipful Company of Musicians to establish two studentships in electronic music. The first was mine, from '74 to '76, and the second was Kevin's, from '76 to '78. Meanwhile, the degree course started in '75, and all along it was intended to bridge science, technology, art, music and ethnomusicology. So, the course consists of three pillars: scientific aspects (sound in nature), cultural aspects (sound in culture), and performance.

'The obvious influence on the course has been that of York University because statistically the number of members of staff that have been to York is rather large. If anything, we're more technologically-based than them, but we also have a very strong performance link with the Guildhall School of Music and Drama. The scientific aspects of music have always been very important, and, for certain modules of the course, students are sent across the road to the Physics department.'

Simon then outlined the ways in which people can enter courses in music at City University: 'The BSc in Music is a normal degree course entered via the UCCA scheme. We interview people before they've taken their 'A' levels and also give them an audition and a short written paper. A Grade 8 pass on an instrument is formally required, but we don't trust it — that's why we include an audition as well. Usually, 5 points at 'A' level — 2 Ds and an E, for instance — are sufficient to enter the course, and these need not include music. We also have some postgraduates and adult education classes. The latter take the form of two hour blocks on a Monday evening, and there's a basic and advanced course on electro-acoustic techniques. Also, the studio is available for hire by composers and others at rates dependent on the project.'

It's encouraging to hear that a University studio is prepared to open its doors to outsiders, especially so when one of the facilities likely to be included in this offer is the Fairlight CMI. The addition of this piece of equipment has been purposely limited to the ever-popular VCS3s. The Fairlight will obviously tie in well with the electro-acoustic philosophy of the Music Department, as its voice cards specifically hold 'sound objects' in the form of waveform memory. The Fairlight has been given a special studio all to itself, not surprisingly, but mainly so there's some degree of control on the number of grubby paws running over its keys. The main studio at City University includes two 4-track machines and one 8-track machine plus the fairly obligatory Dolby A noise reduction. There's also an EMT echo-plate (several thousand pounds-worth!) waiting to be installed that City were very fortunate to pick up at a knock-down price from the recent Abbey Road auction. The studio is obviously only as good as the people using it, and City University seem to be very fortunate in having Alejandro Vinao, a composition research student, as one of their main musical ambassadors. Two of his pieces, 'Other Fictions: GO' and 'Una Orquestra Imaginaria', won first and second prizes, respectively, at the '79 and '81 Bourges International Competitions for Electro-Acoustic Music. Alejandro has very kindly prepared some excerpts of these exciting pieces, and they can also be heard on the demonstration cassette.

Multi-track facilities.

While studio-based electro-acoustic work appears to be in a fairly healthy state in this country, judging by the success of composers like Alejandro Vinao, Dennis Smalley, and others, and the fact that the Electro-acoustic Music Association includes something like twelve University installations, the same can't be said for the live performance applications of electronics in 'serious' music.

'I think that's correct, in the sense that the use of electronics in music isn't very pluralised in this country, but EMAS has an equipment pool which is being hired out on an average of once a week, and there are a number of small groups like Lontano, Singcircle and Electric Phoenix that are very involved with the use of electro-acoustics.'

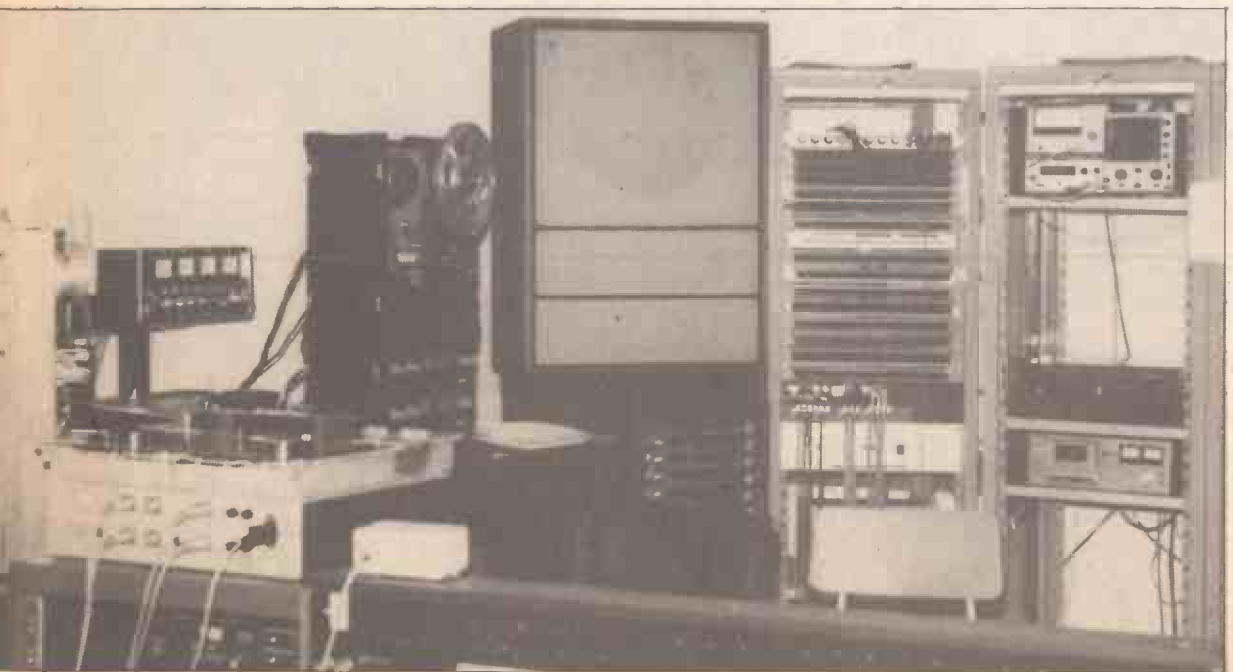
However, in many cases, the 'electronics' are used in a very passive way — switch on the tape and play along with it — and it would be really refreshing to see another group like Intermodulation where the members actually interacted with the electronics.

'Yes, that's true. In the 60s there were a lot of composer-performer groups and there doesn't seem to be that sort of experimentation now. I mean, there are very few composers actually writing live electronic pieces. I think this must just be part and parcel of the much more conservative attitude to experimentation in music as compared with ten or so years ago. I don't actually think that Britain is really in a worse position with regard to contemporary music than anywhere else. After all, the neo-romanticism (not to be confused with the "new romantics"!) of the 70s is prevalent all over the world. The one area that is forging ahead is technology, but this seems pretty likely to outstrip any creative development, considering the innate conservatism of the British public, and this makes it very important to introduce the technology at an early stage into Music Academies and Universities, which, so far, seem to be making very little effort to come to terms with the new technology.'

Finally, I asked Simon about how he saw the Music Department developing in the future. 'We'd really like to move into yet more interdisciplinary areas, like the psychology of music. Ideally, I'd like a totally free creative ethos wedged between various disciplines of science, so that the whole lot could interact in a really creative way. My ideal would be a team consisting of a psychologist, a computer programmer and a technologist, and then we'd have the start of a feedback loop for the people involved in producing music so that machines could be developed to suit their needs.'

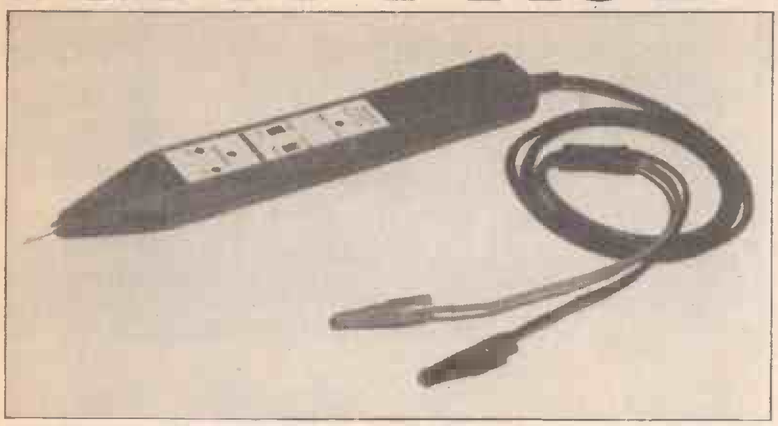
Anybody interested in knowing more about the courses offered by The City University's Music Department, the possibility of using the studio, or the activities of EMAS, is invited to contact Simon Emmerson at the Music Department, The City University, St John Street, London EC1, telephone 01-253 4399 x400, and I'd like to thank Simon Emmerson and Kevin Jones for being such good hosts.

E&MM



A general view of the main studio.

NEW PRODUCTS



LEADER LOGIC PROBE

Sinclair Electronics Ltd. have launched a new low cost logic probe from Leader, known as the LDP-076. It has a frequency response from DC to 50 MHz (and so can be used with high clocking-rate digital circuits) and a high input impedance of 10M .

The probe may be used with TTL/DTL as well as with CMOS logic. Readout is from three LEDs indicating 'high', 'low' or open circuit/poor level states, and there is switchable pulse/memory mode facility.

If TTL operation is selected, then the probe responds to a minimum pulse width of 10ns; values above the (2.2+0.3) volts threshold are determined as 'high', while levels below (0.6+0.3) volts are indicated as 'low'; intermediate levels are assumed 'bad'. The probe operates using power from the device to be measured and under CMOS operation the threshold levels are (70+10)% and (30+10)% of the operating voltage (V_{DD}) for 'high' and 'low' respectively. Minimum detectable pulse width is 20ns for CMOS.

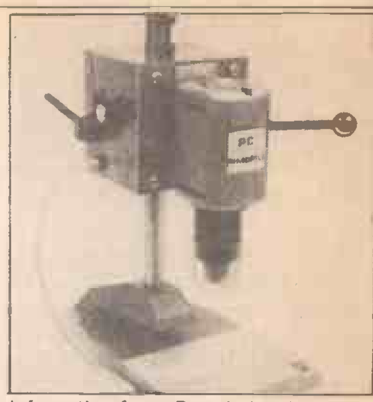
In the 'memory' mode the instrument can detect single or very low repetition pulses; the signal is latched for 250ms to light the pulse LED. In 'pulse' mode the probe responds to the first incoming transient, and the pulse LED flickers at 3Hz to indicate continuous high-speed pulses.

LDP-076 is protected against input overload of +120V AC/DC; maximum power input protection is +100V AC/DC. There is an audible alarm which sounds if input signal level exceeds operating level, when power voltage exceeds 30V DC or a reverse polarity is applied, and when AC power is connected to the input. The LDP-076 logic probe is on sale for £49.50 plus VAT.

Further information may be obtained from Sinclair Electronics Ltd., London Road, St. Ives, Huntingdon, Cambs. PE17 4HJ.

BOSS PC BIMDRILL

Boss Industrial Mouldings Ltd. are now marketing their PC BIMDRILL - a new high accuracy, variable-speed, auto-start drill, primarily designed for PCB applications. Its deep throat enables drilling up to 150mm from the PCB's edge. The locking screw head stop is used for repeatable depth drilling; drill speed is controllable up to 4000 r.p.m. The LPA chuck accepts drills up to ¼" diameter, and has a free-fall plastic safety guard. Price is £96 plus VAT.



Information from: Boss Industrial Mouldings Ltd., 2, Herne Hill Road, London, SE24 0AU.

SM85 PRO TECH MICROPHONE

The SM85 is the latest condenser microphone from Shure Electronics Ltd. It is a hand-held, vocal microphone designed for broadcast, recording or on-stage use.

The frequency response is between 50 and 15000Hz, and Shure claim that it has low distortion, low RF susceptibility, and low total harmonic and intermodulation distortion. They also say it has good high-level signal handling and a smooth, consistent cardioid pattern at all frequencies. The supply voltage can be between 11 and 52V DC, covering both DIN 45596 voltages (12 and 48V) and the proposed 24V standard.

The microphone has a rugged construction with a lightweight aluminium case and a steel grille. These are in a scratch-resistant, ebony, polymer finish. Its weight is 180grams and it is 192mm in length.

Each SM85 is supplied with a foam windshield and a swivel adaptor but without a cable. However, the SM85-CN does have a 7.6m triple flex cable with connector. Nominal price of the SM85 is £129.20 plus VAT.

For further information contact: Shure Electronics Ltd., Eccleston Road, Tovil, Maidstone, Kent.

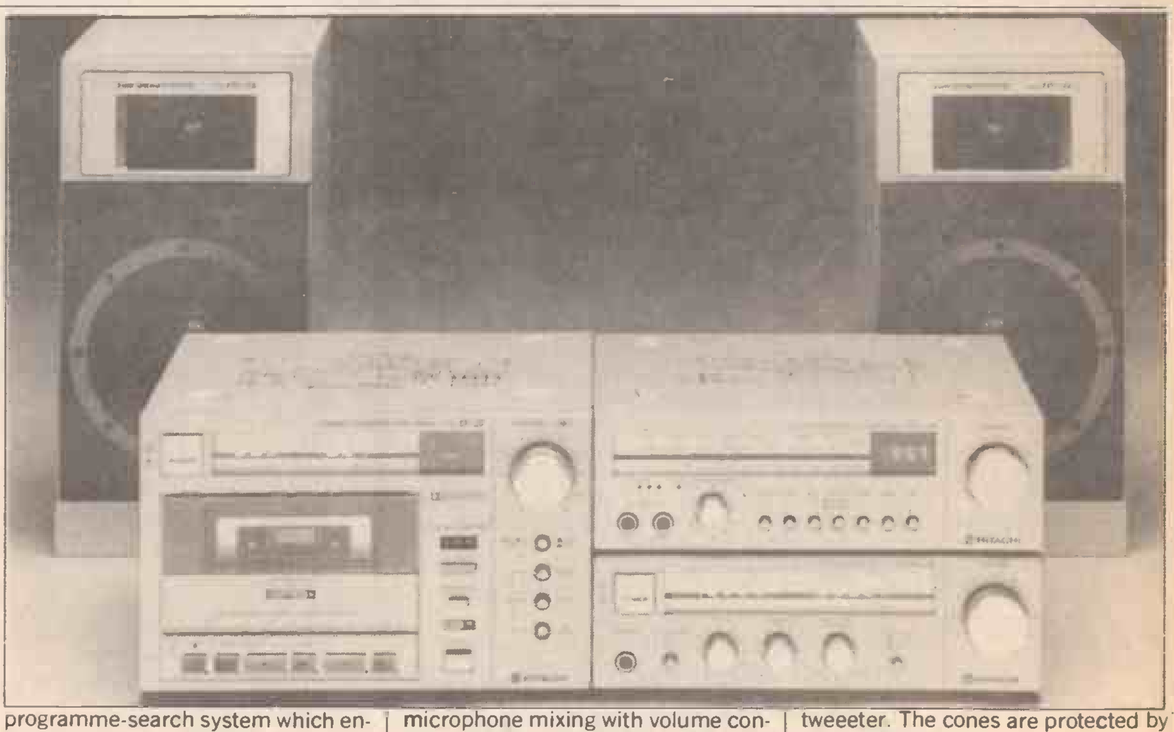
BOOKCASE ACT

The Act 02 is a new bookcase Hi-Fi system from Hitachi. It is a follow-up to the earlier ACT 01 and utilises some of the latest advanced circuitry for sound reproduction.

All four units comprising the system (amplifier, tuner, cassette deck and speakers) are 'miniaturised'. The amplifier and tuner are only 230 mm wide by 74 mm high; if placed one on top of the other they are the same height as the cassette deck, so forming a neat and compact system (see photograph).

The amplifier gives an output of 25 watts (RMS) per channel, with no more than 0.3% total harmonic distortion. There are 5 LED power output level indicators per channel, A or B speaker selection, loudness switch and rotary controls for volume, bass, treble and balance.

The tuner can receive FM stereo, medium and long wave transmissions, and tuning is by a flywheel-coupled knob. There are LED tuning indicators, and a special feature is the digital frequency readout accompanying the analogue frequency scale. The front-end of the tuner incorporates a dual-gate MOSFET for clear FM reception.



The cassette deck will accept metal, CrO_2 and normal tapes. One useful feature is the Hitachi self-programme-search system which enables the listener to jump one selection ahead or back. A record mute facility is used to create blank intervals between selections, for correct operation of the search system. It also allows editing when recording. The deck has Dolby noise reduction, microphone mixing with volume control and a timer recording facility. The eject mechanism is air-damped and button controls are activated by a 'light touch'.

Act 02 has a two-way stereo speaker system, each enclosure containing a 12cm woofer and a 5cm tweeeter. The cones are protected by a meshed net.

The complete ACT 02 system retails at £349.

Further information from IDP (Public Relations) Ltd., Tavistock House South, Tavistock Square, London WC1H 9PJ. Tel. 01-388 7394.

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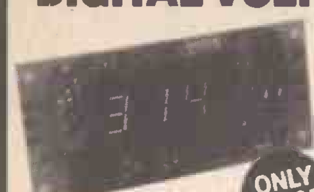

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INDUSTRY PROFILE

Antex Soldering Irons

One of the most essential tools for the electronics hobbyist is the soldering iron and the name of Antex has long been associated with a fine range of these products.

The Antex company was founded by Edward Klein, a Dutchman living in the UK, who set out to manufacture a miniature soldering iron devised by Sidney Brewster. From this small beginning the export of low voltage irons to many countries started.

A mains 115 volts model was then designed for USA export and this was soon followed by a 220/240 volt iron, opening home and European markets still further.

In 1962, Antex moved to Tavistock, Devon and eventually became two separately financed companies — Antex (Electronics) Ltd, handling the marketing under the management of Edward Klein, and Antex Manufacturing Co. Ltd now managed by Tom Tucker, to produce a range of soldering irons for their sister company.

With a staff numbering up to 100 employed at the manufacturing plant, the company produced over 10,000 soldering irons and bits each week. During the recession, staff numbers were reduced to around 60 and an automated soldering iron 'bit' machine was purchased to eliminate six separate stages of bit production — quite a risky investment at the time but has since undoubtedly helped to maintain normal output.

The design of a new product is the senior management's responsibility and all the parts for their soldering irons are made from the basic materials at the Antex factory, except for the mains cable and element pins.

Antex now export to all the major industrialised countries including Japan, but excluding Canada and Australia where legislation is too restrictive.

Making a Soldering Iron

The Antex iron has undergone several modifications recently and the new range of soldering irons are put together in the assembly, machine, test and packing sections of the factory.

A stainless steel hollow shaft has a heat-resisting phenolic plastic material moulded at one end for insertion in the handle. Three pins are glued with Araldite to the moulding and the two element wires are soldered to these along with the third earth contact which is spot welded to the element. A ceramic shaft is used for high insulation and has a bead melted on to its tip. A ceramic former is then wound with copper wire of the correct thickness and number of turns required for the appropriate voltage and wattage rating. The prepared wire-wound element is tested and then inserted inside the stainless steel shaft. The assembly is then continuity tested.

The plastic handle is light and virtually unbreakable (actually made of Macralon polycarbonate used for crash helmets). The yellow colour is chosen for its suitability on the workbench.

Inside the handle, a plastic core is


Element assembly shop.


Bead insert melted on end of element ceramic tube.


Cement insertion into stainless steel shafts.


Fitting pins to mould on shaft.


An element.


Element first stage testing.


Inserting the element into the stainless steel shaft.

Spot welding MKII stainless steel shaft with an earth wire.

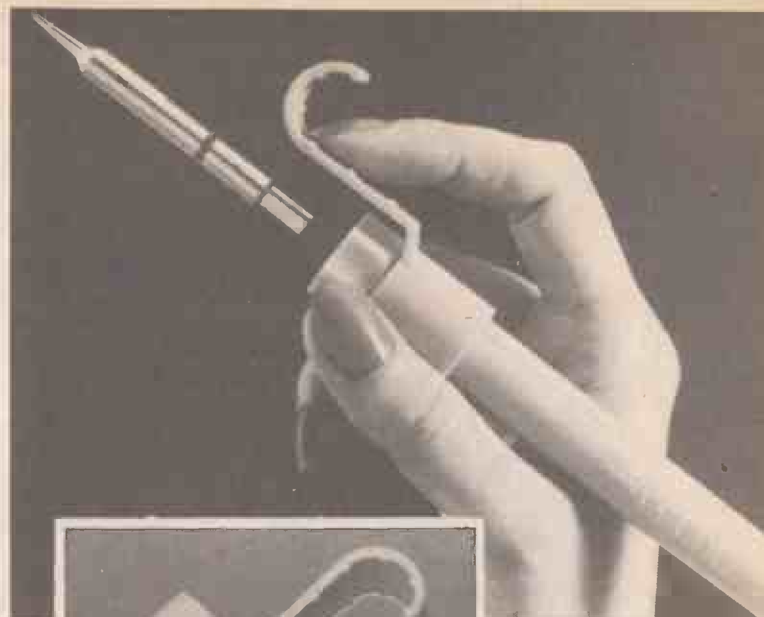
Completed temperature controlled element section.

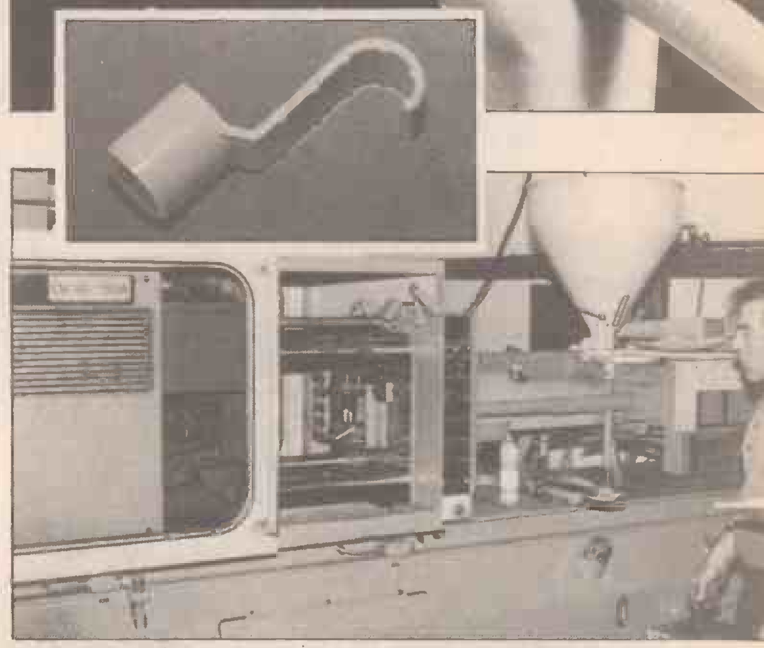
A new machine that automatically winds element wires on to pins.

Assembling TCSU1 circuit boards.

Testing correct operating temperatures of irons.

Handle moulding on Herbert machine.





New type XS and CS hook (insert) moulded on this Krauss Maffia machine.

Part of the large machine shop for manufacturing bits.

now fitted to separate the 3-core mains wires and this eliminates the chance of shorting should an internal break occur. The mains lead enters the rear of the handle and is screw-fastened in place. An appropriate moulded plug is also fitted as standard. A new snap-on hook is added which can be used as a finger protector, temporary stand or means of hanging the iron. Finally, a suitable bit that has been heavily iron plated and nickel finished to stop corrosion is inserted over the stainless steel shaft. A spring clip is fitted on to the bit to ensure that it stays in position.

Incidentally, 40% of the copper used in making the bit is in fact wasted and sold as scrap.

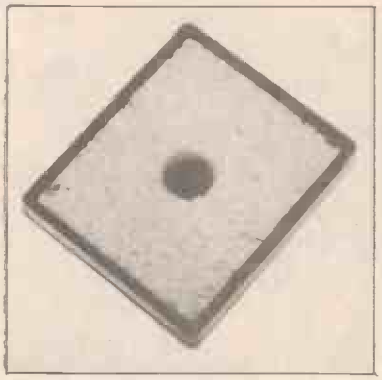
The completed iron is then tested for current consumption and leakage at the specified voltage. A 25 watt iron will, for example, consume 200 mA at 240V whilst a 12V iron will be much more efficient and pass up to 2A.

The 17 watt iron is a much smaller iron than the 15 watt version and yet is designed to produce the same bit temperature (about 390°C). Thus, different size bits are needed to dissipate the heat produced or the element would burn out. The XTC iron used in the temperature controlled model can vary its bit temperature from 65-420°C.

New Accuratool machine for making a complete bit, designed by production manager Derek Allen.

General assembly area.

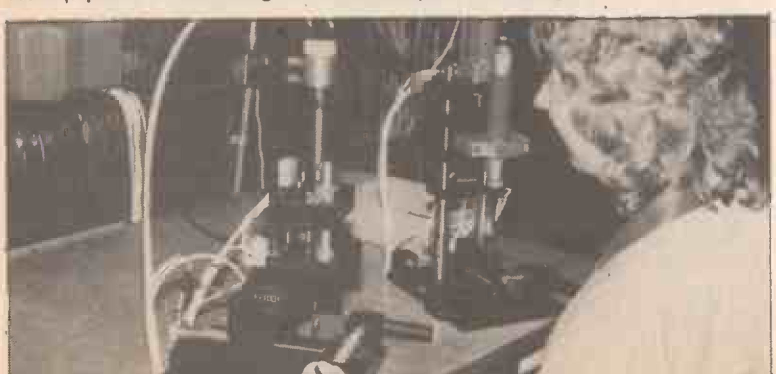
Packing finished and tested irons.



New stand with large foam pad for cleaning soldering iron bits.

Managing director Tom Tucker and deputy general manager Richard Bushell of Antex Manufacturing.

Test equipment for measuring current consumption and leakage.



New machine for tapping and inserting grub screw in handle.

Product Range

Antex have always specialised in soldering irons with accessories limited to a wide range of bits, stands but not solder. Having established the mains voltage type of soldering iron as the X25 240 volt and the CX230 volts at up to 25 and 17 watt ratings respectively, two further standard irons were produced: the model C miniature iron rated at 15 watts which is the most popular for the constructor (with 7 different bit sizes available), and the MLX 12-volt model for car and boat repairs. Antex then make variations in the models to suit different parts of the world.

At the top of the range comes the TCSU1 soldering station, with its own special electronic circuitry for maintaining precise temperature settings and anti-static earth connection for protecting MOS devices. Various kit packs are also sold containing an iron, spare bits, solder and 'how to solder' booklet. Two new models have recently been launched that are quicker to assemble and easier to replace the element.

Looking Ahead

Several improvements have already been implemented in Antex products and plans for extra features are currently in progress.

The new phenolic stand has been designed to accommodate a much larger foam pad (to retain moisture longer) with a central hole for wiping the solder off the bit. Drill-bit holes and bench screw holes are omitted and rubber pads are fitted on the underside.

An LED indicator in a transparent handle of the iron is also being considered as another improvement. An indicator is already fitted to the TC soldering station as a flashing LED light to verify correct operating temperature and power connections. A digital display is also planned for TC unit production shortly. Instead of the slider pot, there will be numbered miniature sliders for setting the exact temperature required.

For the future, Antex have their sights on an instant heat iron that still retains their established shape — an attractive yet functional soldering iron for the professional home constructor.

Mike Beecher **E&MM**

America

Tim Schneckloth

Over here across the brine, the big annual trade fair for electro-music products is the NAMM International Music and Sound Expo. In case you don't know what NAMM is (and there's no particular reason why you should), it stands for National Association of Music Merchants. Americans are crazy about acronyms.

Anyway, this extravagant event occurs every summer, usually in Chicago, a city known for its disgusting weather and great blues bands. Most of the business types that show up for the NAMM Expo, however, couldn't care less about scouring Chicago's South Side for blues clubs. They seem to prefer the cavernous confines of McCormick Place, the huge exhibition hall that houses the Expo.

As usual, hundreds of U.S. electro-music manufacturers - large and small, old and young, rich and poor, thick and thin (stop this!) - came to Chicago to introduce their newest wares. And, as he does every year, your intrepid reporter set out, notebook in hand, to wander the innumerable aisles of exhibits seeking the latest in electro-musical gear.

As my feet felt the first twinges of pain, I happened upon the Moog Music exhibit, where the company was proudly demonstrating a microprocessor-controlled, programmable monophonic synthesiser called The Source. Actually, the Moog people have good reason to be proud - it's a very nice instrument.

The analog section of The Source is a two-oscillator lead synth with LFO, noise generator, full modulation effects, single/multiple triggering, and Moog's exclusive 24 dB/octave filter. There are two digitally-generated four-part contours and a digital sample/hold circuit. The keyboard spans a full three octaves and there is an additional switch for extending its range down one octave.

Other good things about The Source include 16 programmable voices and two digital sequencers, each of which is capable of storing up to 88 notes in real time.

Another new feature stores any sequence of voice program changes to automatically change programmed "voices" during the playback. The Source also boasts a new kind of arpeggiator which permits the player to change arpeggio patterns in the middle of a performance. All programs, note sequences, program sequences and arpeggios can be saved on tape with a standard cassette recorder.

The Oberheim people had some things to be excited about, too, namely their new DSX Digital Polyphonic Sequencer and DMX Programmable Digital Drum Machine. The DSX has powerful storage capabilities - it can record up to 3,000 notes polyphonically and in real time (expandable up to 6,000 notes). It also includes eight independently controllable CV and GATE outputs with both Oberheim and Moog triggers, not to mention complete editing and overdubbing capabilities.

The DMX Programmable Digital Drum Machine is, according to Oberheim, "ideal for composers, recording and live performance". It allows the user to create complete drum arrangements with realistic feel and sound. Song structure, time signature, sequence length, dynamics and tempo are all programmable. When putting together your drum arrangement, you have 24 sounds to choose from, including bass drum (soft, medium, loud), snare (soft, medium, loud), hi-hat (closed, accent, open), six tom toms, three cymbals, handclaps, rim shot, tambourine, shaker, etc.

Oberheim DSX sequencer.

For smaller companies, the NAMM Expo is an important marketing event. Since such manufacturers have severely limited advertising budgets, the trade fair provides a rare opportunity for catching retail merchants by the sleeve and making them buy something. And it is often the smaller concerns that have the most interesting new products.

Sequential Circuits employee shows the Model 500 PRO FX.

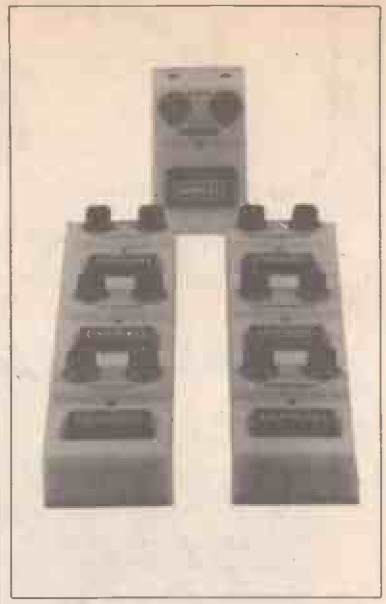
One example is a new company on the U.S. East Coast called ElectroSonics. Their pride and joy is something called the Mojo Bone, an audio interface device that provides nine separate functions. One of its uses is as a portable practice amp in conjunction with two standard high fidelity speakers or headphones. If the user wishes to play along with records or tapes, his lines will be mixed in. The Mojo Bone is also useful as a program source amplifier, recording mixer/monitor, in-line power booster, PA monitor driver and effects device. It runs on a nine volt battery and costs $130.

Getting back to the synthesiser companies: Sequential Circuits used the NAMM Expo to unveil the Model 500 PRO-FX, an integrated signal processing system that "offers the convenience of a modular rack mount design with the flexibility and control of full programmability", according to the manufacturer.

The system mainframe is a standard 19 by 5¼ inch rack mount chassis with a system controller and space for six modules. All operating modes of the system are directed by the system controller. The desired program is entered on the eight Program Select switches and appears on the LED display. The mode switches initiate record or preset, and the Edit LED indicates that a preset has been modified by the adjustment of a control or change of a switch. The memory switches load the non-volatile program memory to or from a tape deck. The allocation controls are used

Brisk activity at the Casio exhibit.

Gleeman Pentaphonic Synthesizer.



MXR Commande Series.

An array of Fender/Rogers/Rhodes equipment.

to configure the program memory to the system's current module arrangement.

The first 500 series modules available include: 510 Phase Shifter, 512 Distortion/Sustainer, 514 Mixer, 516 Parametric Equalizer and 518 Reverb. All modules utilize low-noise "state-of-the-art" op-amps, noiseless FET switching, and multiplying DAC's for maximum performance and reliability.

Another rack mounting signal processing system was being shown by Audio Envelope Systems. They call their system the "axerac" and offer such modules as the ar100 studio preamp, the ar250 sweep equalizer, the ar300 noise gate, the ar320 complimenter, the ar500 auxiliary insert module, the ar640 output amplifier and others. Audio Envelope Systems are also offering the "tubecube" TC-101 Active Direct Box. It is, of course, yet another device designed to make a new, state-of-the-art guitar amplifier sound like your old, kicked-in, 1959 Fender tube amp. Someday, somebody's going to have to explain it all to me.

Although Casio is not an American company, they deserve attention here because they attracted so much interest at the NAMM Expo. The reason? Well, it's simply that the company seems to be taking the lead in bridging the gap between electro-music and what is called "consumer electronics" in the U.S. With aggressive, innovative marketing strategies (like selling keyboard instruments in stores that would normally never think of stocking a musical instrument), Casio is hoping that instruments like the MT-30 keyboard will have considerable Stateside success. It seems to be a pretty safe bet.

The intense competition in the U.S. synthesiser business didn't intimidate NAMM Expo exhibitor Robert J. Gleeman. Not by a long shot. The California-based Gleeman Instrument Co. leaped right into the market by launching the Gleeman Pentäphonic Synthesiser, a 37-note, five-voice polyphonics unit with a built-in sequencer, a unique oscillator bank and a self-contained audio amp and speaker.

The sequencer can store up to 300 notes in either mono or poly mode while preserving the original timing. The oscillator bank consists of three identical waveform generators which independently generate any of eight waveforms. Each generator has its own gain and octave select controls, and a single fine-tune control allows accompaniment with any instrument while maintaining the chorusing effect of the multiple oscillators. According to the company, the instrument should retail for under $3300.

As always, MXR Innovations enlivened the NAMM Expo with some new sonic aids for the exploratory musician. This time, the company showed their Commande Series, including a new preamp, sustain, overdrive and phaser. The new effects pedals are enclosed in a durable polycarbonate case with newly-developed circuitry designed for clean, quiet performance and long battery life. The Commande Series also features a universal 'mini-plug' power jack with special filtering circuitry that reduces hum.

And, for those musicians who'd like to "customize" their Rhodes pianos, San Francisco's Dyno My Piano was showing a Tri Stereo Tremolo Kit - a stereo pan incorporating left and right stereo outputs in conjunction with the already existing mono output of the Rhodes. The unit is effective in mono, stereo and multiple channel keyboard systems and features intensity, pulse rate and pan controls. By using separate effects on each piano output, the player can create various choral arrangements of three distinct rotating keyboard sounds. The kit comes complete with the unit, an external power transformer, a name plate, solder, instructions and templates.

Next month we'll continue our tour of the NAMM Expo. I'm going to go soak my feet. E&MM

Roland demonstrator shows GR system.

Expo visitor tries a Synare drum synthesizer from Star Instruments.

EDUCATION

The EX-System

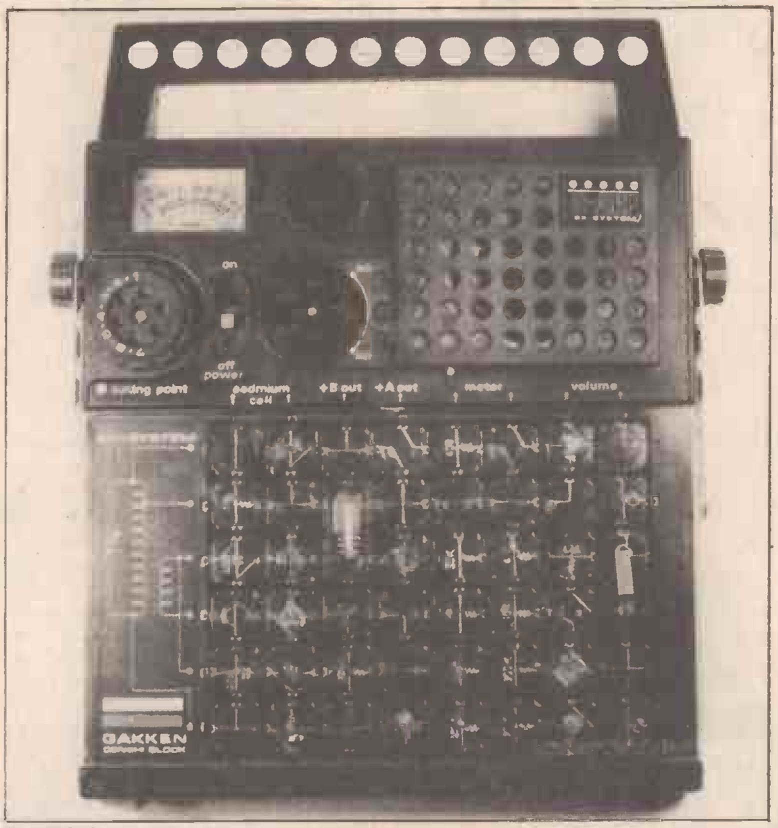
The EX-150 'Electronic Experimenter's Kit' is top-of-the-range of the Gakken EX-system of electronic kits. The EX-150 kit comes complete and enables the user to build 150 different electronic circuits. Alternatively, you may begin with the EX-15 kit (giving 15 circuits) and this may be built up progressively by adding additional sets from the EX range, to give finally the same capability as the EX-150.

The building blocks of the system are small plastic cubes each of which contains an electronic component and has a symbol hot-stamped on its upper surface, showing the type and value of the component inside. The cubes are arranged within a grid so that connections are made between components via spring-metal bands on the sides of each cube. This means that no soldering or wiring is necessary - an obvious advantage to any beginner in electronics construction.

The grid forms part of a frame made of shock-resistant ABS resin, which also contains other built-in components. In the EX-150 kit, these inaccessible components are: on/off switch, tuning dial, 'volume control knob', a CdS photosensitive cell, an IC amplifier incorporating 12 transistors and 6 diodes, a loudspeaker and a moving coil meter. These features allow a wide variety of circuits to be built; the meter is especially useful for making a number of different measurements. Connecting points to these internal components are clearly marked on the frame, at the edge of the grid.

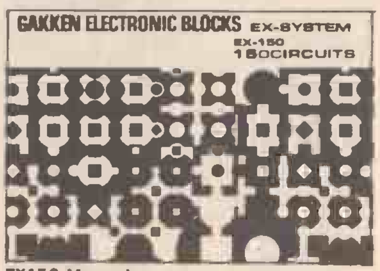
The major advantage of the EX-system is the simplicity with which circuits can be constructed from the building blocks and built-in components in combination.

Supplied with the kit is a 158 page instruction booklet. This begins with a description of the kit itself, followed by a simplified description of each type of electronic device, and a chart showing the different symbols used to represent these devices in circuit diagrams and on the Gakken building blocks. Perhaps the explanations at this stage could be a little more informative. For instance, a resistor is described as "performing the function of determining the quantity of the electric current delivered from the battery." Fair enough, but a slightly roundabout way of saying that a resistor offers a 'resistance' to the flow of current! It is also assumed that the reader knows what "operating point of a transistor" means. This part of the book, then, could stand to give a little more information and explanation; though to be fair, this situation is remedied to a certain extent further on in the book, where instructions are given on how to build circuits in order to illustrate particular electronic principles.



The EX150.

EX150 Accessories.



EX150 Manual.

The best way to learn electronics is through practical experience, and this is another plus-point for the EX-system. 150 pages of the instruction book are devoted to different circuits - one on each page - and are a well-balanced mixture.

Some of the circuits illustrate the principles of operation of a particular device. The various functions of a transistor, for instance, are investigated quite well in various circuits. One of the simplest examples in the book illustrates rectification, using a diode and a bulb.

Other circuits show the operation of common simple component configurations - e.g. circuit no. 66 is a monostable circuit; circuits 94-98 show how logic gates operate, using switches and a transistor. The moving coil meter is used in many of the circuits to demonstrate measurement of different quantities. Voltmeters, Ammeters and Ohmmeters can be made, covering different ranges. The DC voltmeter, for instance, can be made with either 4V or 40V full-scale deflection. Something I disliked here was that these were shown as two different circuits on two different pages of the book, when, to convert one to the other required only the swopping of a resistor cube. Worse still, there was no explanation as to why this changed the magnitude of the full scale deflection.

Then there are the circuits which do something useful - and there are quite a few of these, including a number that make use of the CdS cell. This photosensitive device is used to switch something on or off when light falls upon it. Circuit 104, for example, causes a buzzer to sound when light falls on the cell; circuit 108 turns on a radio.

There are quite a number of circuits for different types of radio. I built circuit no. 45, the one-transistor plus IC amplifier reflex radio, and this really does work quite well - it is the kind of thing a beginner would be quite excited about - there is nothing more encouraging than building something like this that actually works!

Using the kit is simplicity itself. Educationally though, this is a mixed blessing! It means that it is possible to build up all the circuits without thinking, and learn very little. (Obviously this need not be so!). On the other hand, to the complete beginner it is very satisfying.

A conventional circuit diagram is given for each experiment. Unfortunately, due to the limitations that using the grid and blocks impose, it is impossible to set the circuits out logically with the blocks, so it can be difficult to appreciate what is going on. This means that although it is undoubtedly possible to design your own circuits using the kit, it would be quite difficult to do so. Sometimes, in order to minimise the number of cubes required, blocks containing a component are used merely as connecting leads (with the component by-passed). Although this makes sense price-wise, it does cause confusion when you are looking at an assembled circuit.

The EX-synthesiser part in situ in the EX-150.

The EX-synthesiser

The EX-synthesiser part may be bought separately for use in conjunction with the EX-150 kit. An instruction book is included. This gives 31 new circuits using the synthesiser accessory, each of which 'synthesises' a different sound.

The synthesiser unit is fitted into the grid of the EX-system frame, and takes up the space of 4x5 cubes. The various EX-system component blocks are used with the synthesiser as required; an extra PP3 battery (9V) is needed, and this is mounted in a compartment in the synthesiser part.

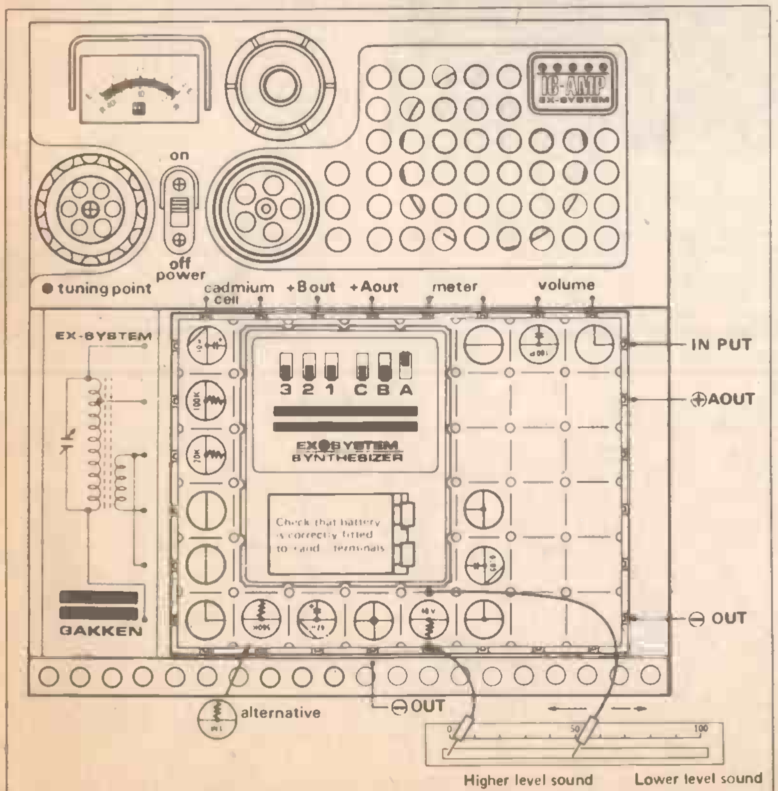
The main device in the synthesiser is an integrated circuit type SN 76477 which is inaccessible; a number of resistors and capacitors are also inside the unit. Six select switches make and break internal connections. A separate carbon resistor plate is also provided with the kit. By moving a contact along its length, the sounds produced by the synthesiser circuit can be varied.

Sounds which can be synthesised using the different circuits given include: a 'foghorn' - this is recognisable as such, though a little 'tinny'; an 'explosive' noise - basically decaying noise; a 'blacksmith's hammer' (metallic clanging repeated); a 'helicopter' - quite a lifelike revolving rotor blade sound, and an American patrol car siren - which is very lifelike, and just as annoying as the real thing!

On the whole the EX-synthesiser is quite a nice adddition to the EX-system, and will appeal to anyone who enjoys making curious noises! It illustrates very well the fact that natural sounds can be synthesised electronically. Unfortunately, there are no explanations of circuit action at all.

Summarising, I don't think the EX-system would be a particularly good choice as a serious educational aid, for example in schools, due to the shortcomings already mentioned. The instruction booklets do explain *what* the circuits do reasonably well, but say hardly anything about *why* they work. Of course, a conventional textbook could be used to supplement the kit in this respect. Having said this, the EX-system is exceptionally easy to use and allows a wide variety of interesting circuits to be built. For the complete beginner, especially the youngster, I think the kit is an ideal introduction to electronics, and could easily spark off a lifelong interest in the subject.

Robin Cooper **E&MM**



RECORD REVIEW

Chariots of Fire
by Vangelis
POLS 1026

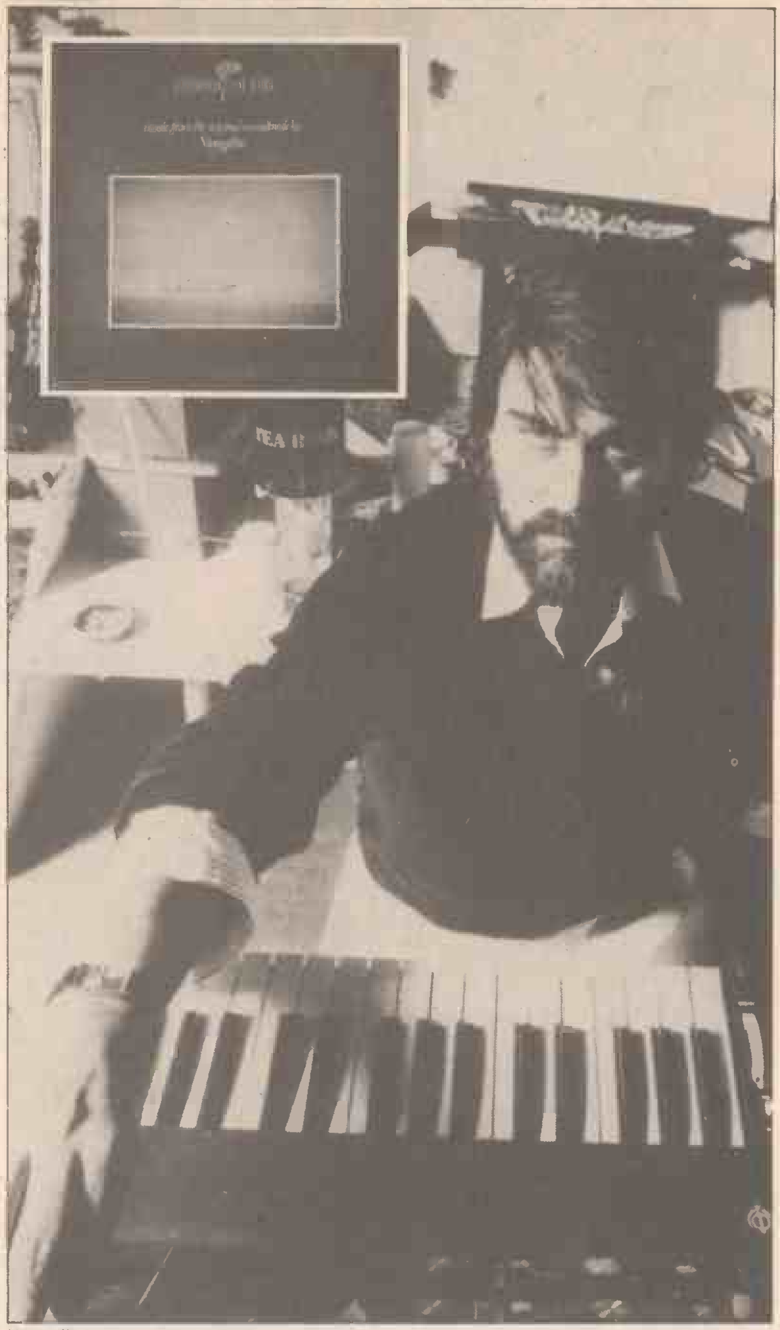
This is an album of music taken from the soundtrack of the film Chariots of Fire and, as such, can be regarded in two ways. Firstly, as a reminder of the scenes in the film and secondly as an album of music in its own right.

Considering the first aspect; film scores are written to be atmospheric, to enhance the thoughts, feelings, actions and emotions of the characters on screen at the time. Many films have exciting themes which have a strong musical appeal long afterwards, but very few people remember the incidental music, the parts 'in the middle'. Very little incidental music in fact is written to be remembered, rather it is written to accent and reinforce the action and it can be soft and gentle or noisy and rhythmic without being in the least way memorable. Indeed, it is often reckoned better to write incidental music which will *not* distract the viewers' attention.

An album of music from a soundtrack, therefore, takes on a different character to a straight LP. If people enjoyed the film, they are quite likely to buy the LP. If they have not seen the film then they are unlikely to buy it unless the theme is particularly memorable or unless the music is by a known musician. In either case, they will be judging the album from a purely musical point of view.

Which brings us to the second aspect - the music - and from here we will bring the two sides together.

Everyone will have heard the theme by now (even if they don't know what it's called): the hi-hat-like 16ths fading in and out, the simple theme on piano taken up by brass, the tinkling arpeggios: Vangelis excells at this type of arrangement. He can take a very simple chord progression - sometimes only one chord - and weave a very exciting melody over it. This, the main title, is the theme everyone will remember.



Vangelis

The second track, 5 Circles, begins with a slow brass fanfare and develops into a very simple hymn-like tune. The next two tracks, Abraham's Theme and Eric's Theme are slow, wandering pieces with electronic brass and strings in evidence.

Apart from a few areas which are clearly electronic, most of the music sounds as if it could have been performed by conventional instruments. The electronics effects are certainly less apparent than is usual with Vangelis.

The fifth track, 100 metres, is a short collection of electronic wails, triangle tinkles and tympani booms and these merge into the sound of a great organ and a choir starts to sing Jerusalem (by Parry, not Vangelis), an incredibly stirring and rousing piece of music whatever album it happens to be on.

Side two is simply called Chariots of Fire. It begins with bursts of white noise, a few tinkles and a few piano notes scattered about. A brass and piano introduction leads into the Chariots of Fire theme on piano without the 16ths. The music tends to meander this way and that, playing snatches of the various themes on side one and giving the impression of working within the original Chariots of Fire theme harmonic framework. It sounds like a very loose set of variations.

No information about the production or instrumentation is given on the sleeve which is a shame as it would be interesting to compare the score-writing Vangelis with the album-maker. As a musical album, Chariots of Fire does not have the excitement and imagination of most of his other work (although it seems to be taking a different direction judging by his latest releases) but as this is not necessarily called for in a film score such criticism may be unjust. I would suggest seeing the film and then making your mind up about the album. He has certainly written better.

Ian Waugh

Ecstasy
by Georg Deuter
Kuckuck 044

Georg Deuter represents an intriguing school of largely Munich based musicians. Whilst employing electronic instruments, Deuter also uses a wide variety of acoustic instruments to create some of the most beautiful music this writer has ever heard. By the time this review appears Kuckuck will have released a new double album by Deuter, somewhat self-defeatingly called "Silence Is The Answer"! In fact this title embodies the philosophy behind the Munich school. Music or organised sound vibration is believed to help the spiritual development of the hearer; it is preparation for plumbing the poignancy of silence.

However pompous all that sounds, "Ecstasy" has been thrust on to the turn-tables and into the Sony Walk-

men of over fifty thousand Germans and Americans. I wouldn't be surprised if the new LP set sells double that number by the end of 1981.

The cover notes of "Ecstasy" are not concerned with such "trifles" as naming the instruments used. I would guess that nothing very fancy is used. Deuter knows how to get the very best from his instruments and his recording equipment. Apparently only an eight track mobile was used to record this album in India; though I believe it was mixed in Germany.

The title track, which is nearly eleven and a half minutes long, builds with the flowing quality of a Westernised raga — though it shows a great deal more variation in volume, instrumentation and melody. It's very noticeable how many musicians working in the synthesiser/new music field are finding inspiration from non-European sources. E&MM readers have already had their attention drawn to Terry Riley. Peter Michael Hamel; Steve Reich; Eberhard Schoener; Holger Czukay and Irmin Schmidt have all acknowledged their indebtedness to Indian, African and Asian musics. Brian Eno and his New York cohorts are equally influenced by those ethnic sources; though the fact that they have first been filtered through the ears of the German musicians has not always received due recognition.

From an electronics point of view the outstanding cuts are "Ecstasy", "Blue Waves Gold" and "Back To A Planet". The excellence of his fusion of synth and an acoustic instrument, in this case concert flute, is exemplified by "La Ilaha Il Allah".

In the early seventies this music would have been called cosmic. In the late seventies the same word would have been applied as a total put-down. That backlash to anything that seemingly smacked of hippies and the 'cosmic trip' has now nearly disappeared, and music like that of Deuter and the previously mentioned artists is seen for what it is . . . an attempt at beauty in a not too pretty and often joyless world.

Matthew Gavin

BOOK REVIEWS

How To Build Your Own Working Microcomputer
by Charles K. Adams
Published by TAB Books Inc.
Price £5.95

There is a vast number of books available on the subject of microcomputers and their uses. However, I believe that this one has something different to offer. The unusual quality of this publication is its practical approach. It really does explain how to build a working microcomputer. Details of all the components required, circuit diagrams, board layouts and wiring schedules are presented in a project type format. Suggestions for the power supply design and components are also given.

The microprocessor used is INTEL's 8080A and the associated circuitry makes available 3K of ROM and 1K of RAM. The input and output

devices are a 20-position keyboard, LEDs and seven segment displays (so do not pay too much attention to the picture on the front cover). An EPROM programmer is included in the project so the constructor controls the system from the lowest level. A single step facility is also included, this being almost essential in debugging the system and programs.

The book has three main parts. The first gives information on computers in general, and goes on to microcomputer terminology and structure. The basics are also explained in this section: digital logic circuits and numbering systems. These subjects are not detailed in great depth but there is sufficient information for the beginner.

The second part describes the design and assembly of the microcomputer and also how to get the system working. The construction details are presented as a series of modules. Each module circuit is described with assembly instructions and parts list. The last stage in the assembly is wiring the modules together.

The third part deals mainly with programming. Basic information is given on programming and flowcharting methods. The instruction set for the 8080A is explained and guidance given on programming the microcomputer built with the use of the book.

The final chapter is devoted to expanding the system and its capabilities, this now being essential with any home computer system as they are quickly outgrown.

The book is written for the novice who wishes to learn about and build a micromputer. The assembly instructions are organised in a logical manner and should be clearly understood. I could see no reason why the finished project should not eventually function properly.

The main aim of the book is to build and operate the microcomputer. However, as each stage or subject is encountered the background information is given. Because of this the constructor also obtains a sound knowledge of how these devices function and their operation. There is sufficient information given for the book to be useful without actually building the computer. I was also impressed by the large glossary and appendices which contain useful information for quick reference.

Like so many publications on this subject the book is American. However, I did not notice many occasions where the difference in terminology might cause problems, the glossary explaining most of the unfamiliar terms.

The only real drawbacks with the book is that a quick calculation of the parts cost revealed that to build the complete microcomputer would be in excess of £100. High for a machine of this specification. However, for the beginner of limited resources the purchase of parts could be spread over a period of time. Considering the knowledge gained I think the money would be well spent.

Ian Miller

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110 Electronic Alarm Projects
by R. M. Marston
Published by Newnes Technical Books
Price £4.65

Although many of the circuits in this book are simply variations on some of the other circuits, a wide range of alarm circuits are covered in the seven chapters. The topics covered include burglar alarms, light, temperature, and contact activated alarms, plus alarms for use in cars.

The circuits are all tried and tested modern designs with accompanying circuit descriptions that are clear and concise. Apart from the 'standard' light and water activated circuits there are more unusual and equally useful types such as proximity alarms, a power failure alarm, smoke alarms using optical detection, temperature deviation alarms, and resistance activated alarms, which considerably add to the interest of the book. The only obvious omission is infra-red alarm circuits, all the light activated circuits employ devices which operate in the visible light spectrum only.

One slight drawback for would-be contructors of limited experience is that only circuit diagrams are pro-

vided, there are no printed circuit or stripboard layouts for the designs. As virtually all the circuits are quite simple this is not a major shortcoming and all but complete beginners at electronics should be able to build the majority of the projects with little difficulty. Any unusual aspects of mechanical construction are explained in the text and these explanations are supported by drawings in many cases. Another useful feature is the inclusion of semiconductor leadout and pinout diagrams in an appendix, which could save much searching through data books. It is a British book, and the components used in the circuits are all readily available in the UK.

All in all a very interesting and worthwhile book which is easy to read and understand. Well up to the usual standard of this popular series of books by an author of considerable experience, and well worth having on the bookshelf for anyone interested specifically in projects of this type, or electronics in general.

Robert Penfold

Electronic Music Synthesisers
by Delton T. Horn
Distributed in the UK by
W. Foulsham & Co. Ltd.
Price £4.20

This book is subtitled 'How to build or buy – and use – your own electronic music synthesiser!" and crams quite a lot of information into its 168 pages. There are two sections, the first starts with a clear summary of the parts of a synthesiser, basic principles of synthesis, and goes on to examine commercial models in detail; the second deals with construction and presents many circuits. Finally, there is an appendix giving patch diagrams and connections for some of the ICs used in the circuits.

Chapter 2 is, in fact, one of the most useful parts of the book, especially to a beginner. It describes all the facilities normally found on a synthesiser, what effect they have on the sound, the various ways of interconnection and control, and also the external bits such as amplification and recording.

The remaining chapters in this section deal one by one with Moog modular systems, the Minimoog and Polymoog, ARP, PAIA, Oberheim, the EML Synkey and the RMI keyboard computer.

The final chapter is headed Accessories but in fact deals only with the ARP sequencer and the EML Poly-Box, and this brevity is carried through the other chapters. Considering the book was published only last year, there are some remarkable omissions: no Prophet, no Wasp (to take an example from each end of the scale) and no mention of any Japanese instruments, so ignoring a list of worthy instruments which is probably so long that it won't fit in this review. (Yamaha, Korg, Roland – need I go on?)

The circuits are all simple enough to be tackled by a near-beginner, mostly using 741 op amps, TTL gates and sometimes the 555 timer. Voltage control is only touched on, using lamps shining on to LDRs; there is nothing very critical or difficult to

construct. There are also a couple of basic 'organ' designs – one monophonic, using a stylus type keyboard and a polyphonic circuit using twelve master oscillators.

All in all, then, a handy book for the newcomer to synthesis – those who want guidance on how to spend their hard-earned cash and those who just want to "frighten dogs and small children with grotesque noises" are both catered for here. For the more advanced among us, the second section is a timely reminder that electronic music doesn't have to be made with vastly complicated circuitry.

Peter Maydew

E&MM

MAPLIN ROADSHOW

Maplin are on the move to Birmingham, Edinburgh, Manchester, Newcastle-upon-Tyne and Norwich.

At the end of September '81 Maplin are taking the Atari personal computers and their new Matinée Organ to five cities in the UK. This is a golden opportunity for mail order customers or anyone for that matter to actually handle these popular products and meet some of the friendly Maplin staff.

A warm welcome awaits anyone wishing to enjoy a pleasant, informal evening that is completely free, so make a note in your diary now. Take your family and friends along anytime between 6 p.m. and 10 p.m. to hear the fabulous sounds of the Matinée played by a professional organist and see how easy it is to build. See also what can be done with the versatile Atari computers and associated peripherals and software.

All the venues are located in city centres and have been chosen for their ease of access and parking.

FRIDAY, 25th SEPTEMBER — NEWCASTLE-UPON-TYNE
Grainger Room, Newcastle Centre Hotel, New Bridge Street, Newcastle-upon-Tyne. (5 minutes from Newcastle Central Station).

SATURDAY, 26th SEPTEMBER — EDINBURGH
Rosebery Room, Grosvenor Centre Hotel, Grosvenor Street, Edinburgh. (Close to Princes Street and 3 minutes from Haymarket Station).

SUNDAY, 27th SEPTEMBER — MANCHESTER
Ullswater Room, Portland Hotel, 3 Portland Street, Piccadilly Gardens, Manchester. (3 minutes from Piccadilly Station).

MONDAY, 28th SEPTEMBER — BIRMINGHAM
Malvern Suite, Birmingham Centre Hotel, New Street, Birmingham. (2 minutes from New Street Station).

TUESDAY, 29th SEPTEMBER — NORWICH
Riverside Suite, Hotel Nelson, Prince of Wales Road, Norwich. (Thorpe Station across the road).

Both the organ and the computers will be available for sale. Should you need any further information, please contact Maplin Electronic Supplies direct (Tel. 0702 554155).

EVENTS

Sept. 15th-17th WEST OF ENGLAND ELECTRONICS SHOW. Bristol Exhibition Centre. Ring: 09274 28211.
Sept. 10th-12th PERSONAL COMPUTER WORLD SHOW, Cunard Hotel, Shortlands, Hammersmith, W6 8DR. Something for everyone! 10/11th commences 10 a.m.-7 p.m. 12th commences 10 a.m.-6 p.m.
Sept. 13th-16th BADEM DISCOTEK '81 Bloomsbury Centre Hotel, Coram St., London WC1. Complete range of disco equipment: lights, amps, decks etc. Open to trade Sunday 13th. Tickets at door.
Sept. 23rd-25th ELECTRONIC DISPLAYS Exhibition & Conference, Kensington Exbn. Centre, London. For further information phone Network (02802) 5226.
Sept. 28th-Oct. 4th IMAGE, SOUND & ELECTRONICS Exbn. 'SONIMAG' Barcelona. Ferial Oficial de Barcelona, Av. Maria Critina, Palacio No 1, Parque de Montjuich, Barcelona, Spain.
Oct. 1st-3rd 5th LONDON EXHIBITION OF MUSICAL INSTRUMENTS, New Horticultural Hall, London SW1.
Oct. 14th-20th ELECTRONICS SHOW - KES - Seoul, Korea. Write to Electronic Industries Assocn. of Korea, CPO Box 5650, Seoul 134.
Oct. 16th-18th VIDEO SHOW, West Centre Hotel, London. 9.00 a.m.-5 p.m. Free Entry.
Oct. 16th-22nd ELECTRONICS SHOW, Taipei, Taiwan. Write to China External Trade Development Council, Taipei World Trade Centre, Sungshan Airport, Taipei.
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. DISCOTEQUE 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, music introduction. 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 demonstrated 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

Sept. 1981 'O' LEVEL ELECTRONICS, St. Vincent Centre, Gosport, is offering a one year 'O' Level Electronics course beginning in September 1981 and leading to the A.E.B. examination in June 1982. The course, which is on Wednesday evenings 7-9 p.m., is suitable both for those who are interested in electronics as a hobby, and wish to pursue their interest and share their enthusiasm, and those who wish to gain a qualification. The course fee is £20.75 (£10.38 for under 18's and O.A.P.'s). Leaflets with full details are available from Mrs Thorpe, St. Vincent Centre, Mill Lane, Gosport.
THEATRE SOUND ENGINEERS COURSE, Paddington College, London W2. This is a one year full time course in association with ABTT, leading to a college diploma, and with a general aim of producing a competent sound technician. Further information from The Secretary, Department of Engineering Technology, Paddington College, Paddington Green, London W2 1NB. Tel: 01-402 6221 ext. 52 or 54.
THANET ELECTRONICS CLUB is for young people to gain a feeling of membership of an on-going group that they run themselves. Based on electronics, a wide range of awareness of technology, sometimes critical, becomes part of the experience. 1981/82 session a GCE Electricity/Electronics examination is arranged. Contact the club direct for more information: Quarter Deck, Zion Place, Margate, Kent.

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

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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.
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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, –.
R. Pearson, Whitechapel, E. London, 01-986-7407, K, B, E, –.
Colin Potter, York, N. Yorks, 0347-810188, KGEV, M, PE, –.
Andrew Walden, Capel St. Mary, Suffolk, 310439, K, B, E, C.
Bob Coleman, Ipswich, Suffolk, 0473-211425, KM, B, CPE, DC.
Gareth Prosser, Ipswich, Suffolk, 0473-58647, G, A, PRE, DC.
Kevin Bantoft, Ipswich, Suffolk, 0473-213632, E, B, R, N.
Nigel Langford, Ipswich, Suffolk, 0473-75118, EG, B, RE, N.
Jim Black, Newcastle, Tyne & Wear, 0632-329418, G, A, RPB, DC.
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.
Neil Cox, Preston, Lanc, 0772-35350, K, B, EV, N.

NEW! ELECTRO-MUSICIANS DIRECTORY NEW!

We have had many requests from readers to run a column that enables musicians interested in making electronic music to contact each other. E&MM invites you to submit your contact information in a way that should allow us to insert a large number of musicians names each month. £1.00 for 3 insertions.

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

INSTRUMENT		LEVEL	TYPE OF MUSIC		ELECTRONICS
K=KEYBOARDS	D=DRUMS	B=BEGINNER	C=CLASSICAL	E=EXPERIMENTAL	D=DESIGNER
O=ORGAN	V=VOCALS	M=AVERAGE	J=JAZZ	B=BEAT	C=CONSTRUCTOR
G=GUITAR	S=STRINGS	A=ADVANCED	P=PROGRESSIVE	G=REGGAE	N=NEITHER
E=ELECTRIC BASS	W=WOOD		R=ROCK	O=ORGAN	
M=SOUND ENGINEER	B=BRASS			V=VARIOUS	
	C=COMPOSER				

Send your information in this format for your directory ad next month (closing date 20th September). Cheques made payable to Maplin Publications. £1.00 for 3 insertions.

(Fictitious example)

NAME	TOWN	COUNTY	TELEPHONE	INSTRUMENT	LEVEL	TYPE OF MUSIC	ELECTRONICS
BILL JONES	SOUTHEND	ESSEX	0524-61232	K	M	E	C

Offer subject to available space. STD Code + no.

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THIS MONTH'S SPECIAL OFFER

Each month, Electronics & Music Maker gives special offers to its readers that represent a substantial saving on normal retail prices.

ANTEX SOLDERING IRON

Antex have made available their new miniature CS soldering iron for a limited period only.
This is an ideal and essential tool for the electronics constructor featuring easy-change bit, strong plastic handle that is lightweight with new detachable hook and a mains lead with moulded fused plug.

Normally at least £6.50
Offer Price £5.55 (inc. VAT, P&P)

Please complete the Order form below. Closing date 30th November 1981. Normal conditions apply. Please allow 28 days for delivery. Overseas (Europe only) please add 20p extra. State whether British square pin or European plug.

Overseas payments including Republic of Eire should be covered by Bankers draft in pounds sterling.

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282 London Road, Westcliff-on-Sea, Essex SS0 7JG.

Please send me:

Quantity	Item	Item Price £	Total £
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State whether British or European Plug

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Electronics & Music Maker for: £.......................................
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Address ....
.... E&MM10/81

All prices shown include VAT, postage and packing

ADVERTISERS INDEX

CORRIGENDA

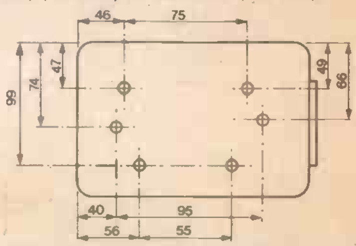
The following errors and omissions have been noted in previous issues of E&MM and are brought to your attention:

APRIL ISSUE
SYNTOM DRUM SYNTHESISER. Page 4, Figure 1, IC1 pin 1 should read pin 6.

MAY ISSUE
NOISE REDUCTION UNIT. Page 7, Figure 2, SK3 (top left of diagram) should read SK1, C7 1p0 should read 10pF, C5 wrong orientation, C23 1M0 should read 1uF, RV2, 100K (top middle of diagram) should read RV1 100K. Page 10, Parts List, R22 4K7 should read R22 3K9.

JULY ISSUE
BOOK REVIEWS. Page 84, Musical Applications of Microprocessors and The Joy of Minis and Micros published by Hayden Book Company Inc. are distributed by John Wiley & Sons Limited of Baffins Lane, Chichester, Sussex.

AUGUST ISSUE
HEXADRUM. Page 23, Component layout, transpose positions of R22 and R23. Page 24, Figure 3(c), measurements for preset holes incorrect, see diagram below. Parts List, (WW36S) should read (WW37S).



CIRCUIT MAKER. Page 43, Workshop – Capacitor Bridge, diagram, transpose pins 1 and 2 of IC1.

SEPTEMBER ISSUE
PARTYLITE. Page 8, construction, IN5004 should read IN5404, 6A should read 10A (1¼ inch type).

The editorial staff apologise for any inconvenience that may have been caused to our readers.

E&MM

NEXT MONTH — November Issue

on sale at your newsagent from October 12th

LANDSCAPE EXPLORED
Richard Burgess and John Walters of Landscape discuss their successful contribution to the popular electro-music scene on stage and video.

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For the first time we offer the musician a constructional project that utilises state-of-the-art micro control of electronic drums.

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If you've ever had difficulty in setting solo and accompanying levels on keyboards or guitar, here's the answer at the touch of a switch.

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THE HOME ELECTRO-MUSICIAN
We start a new column that features an amateur musician experimenting with electro-music in the home studio.

Plus our regular articles bringing you up-to-date in the exciting world of Electro-Music.


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