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Australia $1.10 New Zealand $1.20 Malaysia $4.50

PRACTICAL ELECTRONICS

MARCH 1981

65p

LISTEN IN WITH OUR 27/28MHz Converter

FREE! INSIDE DIODE IDENTICHART

Also Simple Microphone Mixer

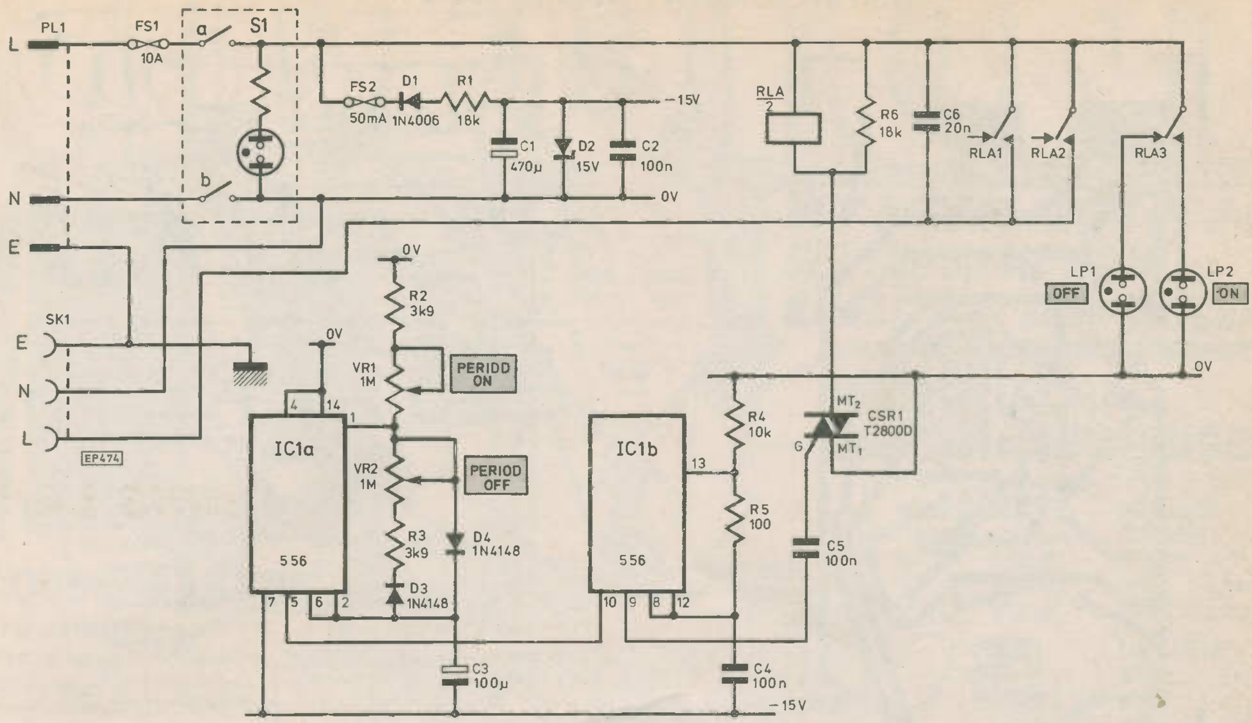


Fig. 1. Circuit of Tester

COMPONENTS . . .

Resistors

R1, R6	18k 2W (2 off)
R2, R3	3k9 (2 off)
R4	10k
R5	100

All $\frac{1}{4}$W carbon unless otherwise stated

Capacitors

C1	470µ 25V elect
C2	100n polyester Mullard C280
C3	100µ 25V elect
C4,C5	100n (2 off)
C6	20n

Potentiometers

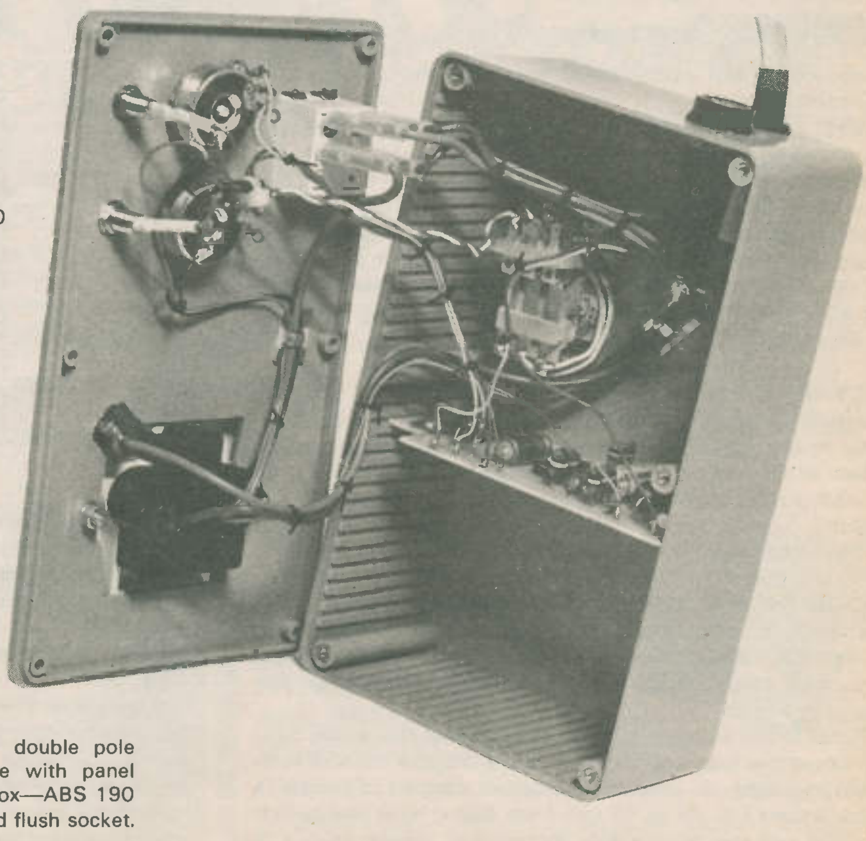
VR1, VR2 1M linear (plastic shafts)

Semiconductors

D1	1N4006
D2	15V 400mW Zener
D3, D4	1N4148 (2 off)
IC1	ICM 7556
CSR1	T2800D triac

Relay

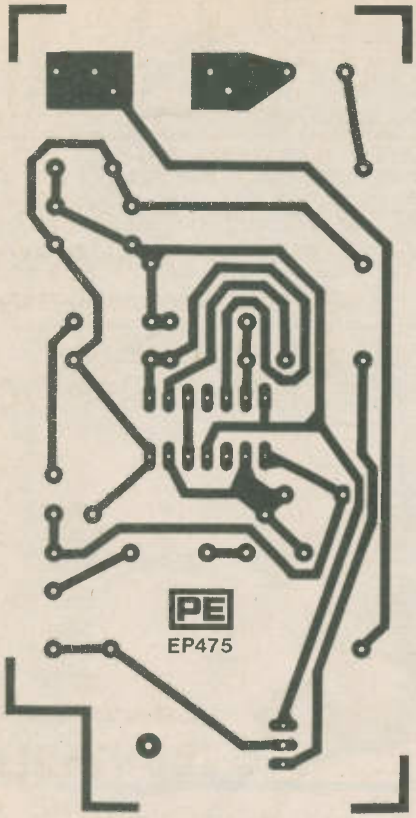
RLA 240V coil with 10A contacts (RS 349-563)

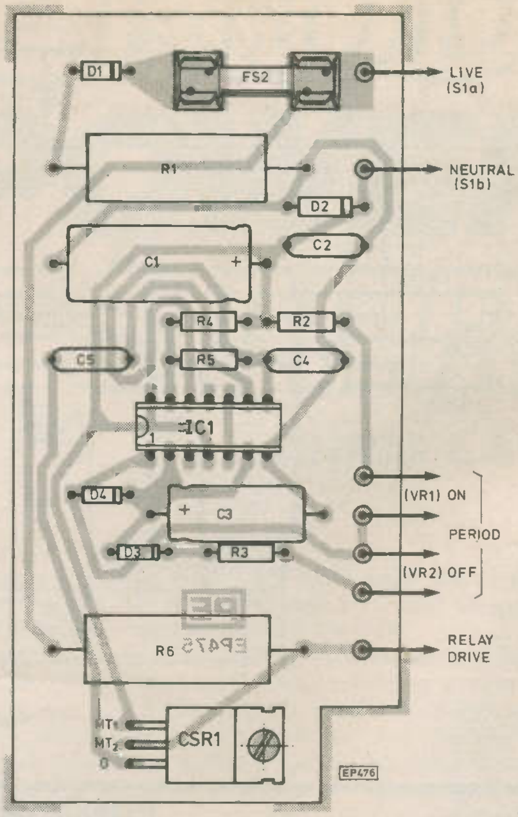


Miscellaneous

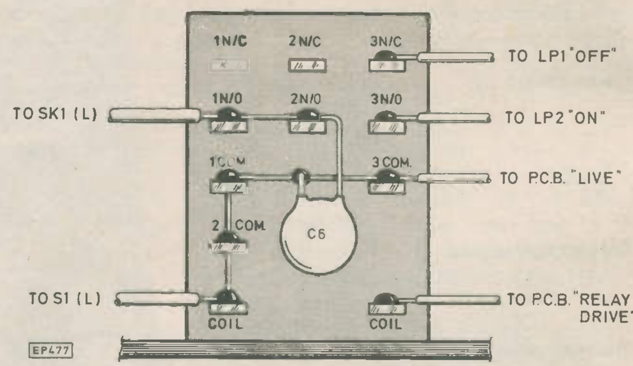
LP1, LP2 mains neons, S1—illuminated double pole mains, FS1-10A $1\frac{1}{4}$ in quick blow fuse with panel fuseholder, cable grommet, cable, knobs, box—ABS 190 × 110 × 60 mm PL1, SK1—13A plug and flush socket. FS2-50mA with p.c.b. mounting.

PRINTED CIRCUIT BOARD AND . . .





. . . RELAY WIRING



CONSTRUCTION

The prototype board is of the printed circuit variety. Veroboard is not recommended due to the presence of live mains.

Wire up the board and relay as shown, except for the mains connections. The front panel must be earthed if metal, as must the potentiometer cases. The latter should have plastic shafts.

Ensure the unit is well fused; the prototype has a $1\frac{1}{4}$ in fuseholder loaded with a 10 amp fuse in circuit as well as the 50 milliamp p.c.b. fuse. The whole was built into an ABS box with p.c.b. mounting slots and so no mounting holes are available on the board design.

TESTING

Before commencing testing remember that this unit employs mains electricity directly, and as such is potentially lethal. Initial testing should be completed with an external 12 volt power supply connected across C1, observing the polarity.

Do not use a 15 volt supply because the Zener diode will fail.

Check that the output of the first 555 oscillates slowly, and if an oscilloscope is available check the pulse output of the second. If no scope is available measure the voltage output with a meter set to a sensitive range; some deflection should be noted.

Remove the external supply, and connect the mains supply. Cover the fuse and live end of the dropper resistor with insulating tape to prevent accidental contact. Connect a meter across C1, set to 15 volt f.s.d. Stand back and switch on. The voltage across C1 should rise slowly (about 5 seconds) to 15 volts. If it continues past 15 volts switch off quickly and check the state of the Zener diode. On no account let the supply exceed 18 volts, at which point the i.c. will fail. If all seems well complete the assembly, and test properly, paying particular attention to earth continuity to the socket.

IN USE

Remember that this unit presents a very severe test to any equipment and it would be short sighted to expect an average amplifier to stand up to a 15 second cycle time while running at full power. Remember, if the equipment does fail a reason exists, so changing the faulty component will not always effect a cure if the cause is still present.

★

Readout...

A selection from our Postbag

Readers requiring a reply to any letter must include a stamped addressed envelope. Opinions expressed in Readout are not necessarily endorsed by the publishers of Practical Electronics.

CB and the Law

The following correspondence should help to clarify certain aspects of the law about which readers may be unsure.

To Press and PR Office,
Home Office.
Dear Sirs, We are investigating some of the legal aspects of 27MHz CB which is being operated in this country. Would you please supply the following information as soon as possible?

1. *Is it illegal to listen to 27MHz CB transmissions?*
2. *Is it illegal to purchase or to supply a* receiver *capable of receiving 27MHz CB?*
3. *I understand that it is illegal to import 27MHz CB transceivers, is it illegal to import a 27MHz receiver?*
4. *Are CB converters capable of being purchased and used legally in this country?*

Finally, are the Home Office proposing any new laws that may affect the answers to the above questions?

Mike Kenward,
Practical Electronics.

Dear Mr. Kenward—Thank you for your letter regarding the law and CB radio. The answers to your questions are as follows:

1. Under the Wireless Telegraphy Act 1949 it is an offence to listen to CB transmissions without a licence. Penalty for contravention is £200 maximum fine.
2. It is not an offence to purchase a receiver but it could be a common law offence to supply.
3. It is not illegal to import a receiver if it does not possess the capability to transmit. The importation of transmitters is controlled by the Radio Telephonic Transmitters (Control of Manufacture and Importation) Order 1968. Penalties under the Customs and Management Act 1979 attract on summary conviction, a fine three times the value of the goods or £1,000, whichever is the greater, or 6 months. On indictment, an unlimited fine or 2 years maximum.
4. CB converters are capable of purchase, but their use is illegal.

During the first nine months of this year (1980), 325 persons were convicted for unlicensed installation and/or use of 27MHz citizens band radios.

You may be interested to know that the Home Office will be seeking powers to prohibit the sale, hire or advertising for sale or hire of 27MHz band equipment as soon as Parliamentary time permits.

I hope this information is of some assistance.

M. J. Palau (Miss),
Public Relations Branch,
Home Office.

It is also interesting to note that the CBA recently sent the following letter to all MPs.

Sir—The Citizens' Band Association has just sent the Home Office a response to the Discussion Document "Open Channel". This response was, I am afraid, critical of their proposals. The CBA is well aware of the amount of paper an MP receives, so we have not sent you a copy of our response—if you would like one, however, do please let us know and we shall send you one at once.

We should also like to offer you the loan of a Citizens' Band receiver. You may not appreciate just how commonplace the use of CB radio has become in the UK, even though such use is still illegal. If you would like to listen to CB transmissions for yourself we should be happy to lend you a receiver so that you may do so. We cannot lend you a transmitter, however, as their possession is illegal.

James M. Bryant,
President, CBA.

Counter Proposals

The following is an extract from the rather lengthy CBA response to the discussion document. The following is part of the CBA counter proposals.

The Citizens' Band Association therefore calls on the Home Office to announce a VHF FM system of Citizens' Band Radio during December 1980. The system should come into operation no later than February 1st 1981, and preferably on New Year's Day. Suitable frequencies are 41 or 230 MHz and a power output of at least 2 watts and preferably 5 watts should be permitted.

If this proves impossible the Home Office should reverse its former position and legalise 27MHz CB AT ONCE. The present disregard of the law cannot be allowed to continue but it would be wrong to mount a draconian campaign against an activity which is shortly to be made legal. The CBA has fought for VHF CB and against 27MHz for five years but continued procrastination by the Home Office has brought the UK to a position where within weeks it will be impossible to do anything but legalise a "*fait accompli*". It may, indeed, be too late already.

If 27MHz is legalised the American 40 channel a.m. system should be adopted unchanged. The vast majority of sets in this country and the world are to this standard and the European CB Federation has called for its adoption as a common pan-European standard. Although there is a European CEPT specification for 27MHz CB the equipment is more expensive than equipment to the FCC specification, even though the performance is poorer. As a result the majority of European CB users buy and use the cheaper, but higher performance, American sets, even though their use is not legal. If we adopt 27MHz CB we should avoid the problem by allowing the equipment which the majority of people will actually use.

The CBA feels that in the, hopefully brief, period between the end of the discussion period and an announcement, the Home Office should meet with the CBA and other interested parties to discuss the proposed announcement in time for the Home Office to modify its proposals in the light of any valid comments from these parties.

CB: Social Uses

Sir—The Yorkshire Ripper is just another example in which CB (Citizens' Band) radio could help society. The continuing unwillingness of the GPO to license 27MHz amateur radio and the efforts applied by the police to detection and prosecution of users is astonishing. It is evidence of some Establishment fear about free use of this medium. This is in spite of overwhelming evidence from overseas that in case of fire, flood or natural disaster of any kind, road accidents or merely traffic congestion, CB can be used to warn, avert further disaster, summon help and keep all relevant authorities informed. The important point is that with CB, it all happens simultaneously: no need to find a 'phone box (probably vandalised anyway): no need to know the number to dial: no need to dial a series of numbers and repeat the same message: just press a button and say "help" or tell what's happened. Watered-down proposals using UHF will never be effective: sets will simply be too dear. Arguments that CB on 27MHz is already overcrowded are not substantiated by US experience; limit transmitter power to 100mW and effective radius is very small. Join a Euro 27MHz union and curb the power of Italian sets. Manhattan Island, with free 27MHz CB, is an extreme example of a densely-populated area, yet CB is a tremendous social asset. Approaching Manhatten from New Jersey by road, ask into any of 40 CB channels "Which bridge is free of traffic?" and within seconds several helpful strangers will all tell you traffic conditions on the different bridges. Your day is made easier by strangers: CB is an antidote to big-city ills; you help, others help you, but there is no threat to your privacy; you can always switch off!

An immediately relevant application is in combating rapists, muggers, wage snatchers etc. A simple 27MHz bleeper which when pressed shouted a radio "Mayday" would alert and enable rapid location by police or others willing to help. In the early seventies, the only effective safeguard against child-snatching was based on radio: it was not used because of the official veto on the free use of radio by ordinary people. Please let us sweep aside this bureaucratic nonsense to allow the use of radio by citizens, not just by the government.

Alan Vincent,
Dorset.

P.E. INVENTORS COMPETITION RESULTS

RESULTS of a competition from June '78? We did announce the prizewinners of our Inventors Competition in December '78 but one proposal which did not receive a prize, because no prototype was available, was considered by one of the organisers to merit further investigation. The results of that investigation and of nearly two years intensive development and field testing is a flue-gas analysis test unit that sets a new standard for the modern combustion engineer. The unit is called the Anagas and is now being produced by Colwick Instruments Ltd.

THE INNOVATION

When setting up the combustion in boilers, heaters, etc., to the optimum, it is necessary to carry out analysis of flue gas remarking, in the case of oil fired equipment, percentage oxygen or carbon dioxide, flue gas temperature and smoke density, and in the case of gas fired equipment, carbon dioxide, flue gas temperature, and an indication of the presence of toxic, and combustible gases (ie carbon monoxide). From the above information, the correctness of the combustion, and the overall efficiency of the heating equipment may be calculated.

Until now, test equipment has taken the form of chemical analysis apparatus produced by several companies, the best known of which is named "Fyrite". The kit used comprises a set of separate instruments to analyse respectively, carbon dioxide, smoke density, flue gas temperature and carbon monoxide, using reagents to absorb or change colour. The reagents are short lived and somewhat messy, and in the case of the tests for carbon monoxide involve the use of a glass phial containing crystals (after the manner of the breathalyser). The glass phial is non-reusable and costs around £1 per test!

Some four years ago, being aware that all the gas characterists required could be measured electrically or electronically, Mr. B. Drake decided to attempt to design a portable test apparatus which would automatically measure CO_2 and flue gas temperature, and give an indication of the presence of carbon monoxide and smoke. At that time, it was not envisaged that the instrument would be manufactured in quantity, but was merely entered into as a project which may have practical applications within Mr. Drake's own boiler servicing company.

After a considerable amount of spare time research, the means to carry out each measurement, together with a block scheme of the instrument was produced; it was then found that the time involved in development would be more than could be worthwhile unless a marketable product could result from this work. The opportunity for further work on the project came in May 1978 with the announcement of the Inventors Competition in *P.E.* An entry was made up and submitted by Mr. Drake with a note to the effect that the project was as yet undeveloped, but was based on tried and tested technology.

Mr. Derek Buckley, one of the organisers, contacted Mr. Drake and further development took place with the aid of Mr. Drake's associate Mr. Cameron. The analyser was completed and bench tested in early June 1979 and has since been on trial in the field by Mr. Drake's employees. Frequent reports as to its behaviour have been received since that time and the general performance in measurement of CO_2, flue gas temperature and carbon monoxide is as good or better than anticipated. More important, verbal reports from the field indicate that the service engineers actually like to use the instrument, and find a considerable time saving in its operation.

THE UNIT

As mentioned above, the Anagas unit is an instrument for analysing flue gases from a boiler or heater, and measuring the temperature within the flue. It uses one sampling probe for its three functions, which in order are: measurement of net flue gas temperature (temperature within the flue minus ambient temperature), measurement of the percentage of carbon dioxide in the sample, and detection of any combustible gases such as carbon monoxide which would be indicative of incomplete combustion.

The analyser consists of an executive case accommodating all the electronic components including a charging circuit to enable the built-in rechargeable batteries to be kept powered. Samples of flue gas are drawn, by means of an electrically operated pump, into the analyser. From the probe they pass first into a condensation trap and into the gas analysing cells, one of which responds to carbon dioxide and the other to carbon monoxide. Signals from the gas cells are amplified and diverted via a three position switch on the front panel of the analyser, to the meter. Zero adjustments are provided on the front panel to enable the user accurately to set the CO_2 and temperature range.

Although all these three measurements are continuously available within the instrument, the switch enables the quantity to be measured to be selected individually by the user. The use of a single probe enables the user to monitor all three indications while at the same time making adjustments to the combustion equipment. This is to be compared with the present method which involves the use of each of three separate measuring instruments each time an adjustment is carried out, ie. chemical equipment.

The system offered has several other clear advantages over conventional equipment, one of which is the ability to measure nett flue gas temperature (Δt) directly, whereas conventional equipment needs to have ambient temperature deducted from the thermometer reading. Another advantage is its lighter weight and inherent portability. The Anagas costs less than £450 inclusive and is available from Colwick Instruments Ltd., 9 New Vale Road, Colwick, Nottingham. Tel 0602 249947.

We believe that the Anagas has a bright future and that this application of electronics will be of great assistance to combustion engineers everywhere. We are pleased that *P.E.* has been able to play a small part in the development of this unusual product.

Strictly Instrumental

by K. Lenton-Smith

WHEN does an electronic organ cease to be an organ? Judging by the range of organs currently available, the answer to this question is any time now.

Musically, the organ's character is changing rapidly. Its voice is no longer simply a handful of flute pitches modulated by a doppler speaker—a most pleasant sound, whose source is instantly identifiable—or conventional organ tone colours. The modern instrument will also incorporate a very convincing string chorus and synthesised solo voices which are already close to perfection.

The oboe, jazz flute, piano and accordion sound much like their orchestral counterparts and synthesised brass is now better than ever. Thus a skilled player is able to make an appropriate organ sound like an orchestra: the listener may be deceived until the use of 'organ sound' (as we used to know it) gives the game away.

ORCHESTRA

Practically all of the manufacturers are following this trend towards the orchestral organ. A good example is the *Riha* 'Orchestra', played by Brian Sharp on cassette tape VCA049 (VFM Records and Tapes), where the instrument certainly lives up to its name. Indeed, synthesised voices are so similar between one make of organ and another that one could be forgiven for thinking that they all used the same circuitry!

Less expensive instruments still tend to be based on a simple divider generator system with top octave synthesiser, conventional waveform filters and a modest rhythm unit. Bearing inflation in mind, the majority of organs still represent very good value for money. Despite advances in circuitry and the addition of new features in recent years, much of the hand-wiring has been eliminated and modern p.c.b.s. require less labour-intensive treatment.

Paying upwards of £1000 will see the instrument fitted with orchestral features. These will include a string synthesiser and either or both monophonic and polyphonic synthesiser sections. An 'ensemble' tab is not unusual, which gives the effect of a chorus of voices from a single stop: based on string synthesiser techniques. Other uses for 'bucket brigade' devices include reverberation and 'electronic Doppler' effects.

Not so very long ago the synthesiser was a separate, bulky instrument and the polyphonic type uncommon. Circuit condensation by means of LSI has allowed the manufacturer to fit all these extras into a small console and still leave room for more.

COMPUTER

The *Allen* computer organ has been in existence for several years now and the microprocessor is being used increasingly in organs of all makes. Its applications include advanced rhythm units which are often programmable and far less monotonous than their predecessors. It can also be used to provide memory facilities and the easy-play features which help to inspire raw beginners at the keyboards.

Classical organs are, of course, exceptions where automation is concerned. It is interesting to note that the fine classical range from *Johannus* still uses diode keying and a special form of divider generators to obtain chorus effect. This company's Model 130, a large 3-manual instrument with drawstops, sounds impressive and is a good recommendation for established methods of keying and tone generation.

Free phase generators are unusual in commercial organs today, although *Conn* still use this method. In this case, an individual, tuneable oscillator is employed for each note of the compass: the tiny tuning discrepancies and lack of any phase relationship provide results akin to a pipe organ.

The majority of commercial instruments use a single master oscillator which operates at about 2MHz. This feeds a TOS (Top Octave Synthesiser) which provides the 12 chromatic frequencies of the top octave. Each of these top notes has its own divider string and these may incorporate divider-keyer i.c.s similar in principle to the TDA 1008 described in the *September 1978* edition. Some organs use clock-keying and multiplexing methods to eliminate key-click. Even so, a number of instruments are fitted with a 'Key-Click' tab—to restore the very feature that was probably responsible for making the pre-war *Hammond* organ so popular with rhythmic players of the day. Digital systems of generation are also becoming common as in the new 'D' series of organs from *Wurlitzer*.

CONTROLS

Touch switches are a feature of the 'Equinox' organs from *Gulbransen*, providing a clinical appearance to the consoles. From the player's point of view, however, there is often not enough time to touch precisely the correct part of the control panel: I think I would rather have a tab or button to manipulate. These and other organs are capable of automatic introductions and breaks, where harmony is dependent solely on the pedal part.

Arpeggiators are more or less standard on all new organs. This facility gives automatic runs of notes up and down the keyboard, their harmony being controlled by the accompaniment chord being played and their speed by the rhythm pattern in use. There are options on how the arpeggios are played—down, up and up, down, for example—and the effect can be overlaid on the lower manual part in a quite different registration.

Easy-play features are what sell organs to the customer, so these are fitted to even the most expensive models. To many prospective purchasers, 'one-finger chords' is an essential facility. With the appropriate tab in operation, touching a single note on the lower manual will give a major chord—gated according to the rhythm pattern in use. By pressing another single note, major chords can be turned into minor chords: in some cases, conversion is by means of a switch on the swell pedal and there may be methods of producing dominant and diminished chords automatically.

The number of different chords encountered in sheet music is well beyond the scope of the 'one-finger chord' facility, but it may well help to get the beginner off the ground with the conviction that progress is being made. When more experienced or when reading from a three stave score, this feature can be switched off.

The *Elka 30* ranks high on my list for the best easy-play organ on the market. This organ's music stand is provided with several rows of l.e.d.s over which specially punched music is placed. A cartridge containing programmes of several tunes is placed in a slot in the console, then the organ will do everything except play the single line melody. The player has the music to guide him and an l.e.d. lights at the beginning of each bar to help him to keep in step with his automatic instrument.

National/Technics have been back to the drawing board and produced their new 'U' series of organs, all but one of which have a programmable chord computer. A sequence of chords is captured by playing each singly, followed by a capture key: the sequence can then be played back in chosen tempo and rhythm pattern, leaving the player to use both hands for the melody and its block chords.

The 'Vocalist' synthesiser from *Logan* sings in four voices, or a choir of these, electronically and without recourse to microphones. Playing a single note produces the Soprano, whilst playing chords adds the Alto, Tenor and Bass voices. The player can alter the timbre of the voices to suit his taste.

ULTIMATE

The last word in automation is the *Lowrey* MX1. In a rather different price bracket, it is described by the manufacturer as 'the ultimate in micro-electronic computer logic'. Having heard this extraordinary instrument, I can believe the claim! The automatic accompaniment is fully orchestrated and the mode—Big Band or Blue Grass, for example—can be selected. Other *Lowrey* features such as Magic Genie and A.O.C. (Automatic Organ Computer) are also present. In 'Big Band' mode, the brass and soli saxophone section sounds very much like the real thing: once set in motion, the automatic accompaniment will find its own harmonies and instrumental sections long after the organist has walked off to lunch! It is good to know that the organist is still in full control—and not vice versa—and can even play the MX1 as a 'straight' organ if he wishes.

The new flagship of the *Hammond* range is the Elegante, a development of the Colannade. This has all the refinements the enthusiast could wish for. There are two 5-octave manuals with reverse colour preset keys and 25-note pedalboard. Its Auto-Vari 64 rhythm unit uses 16 rhythms, each with four programmable variations, and is very effective. The usual cluster of easy-play features have not been forgotten.

It would certainly seem that organs are becoming strictly instrumental. Possibly the choice of title for this series, made almost ten years ago, was far seeing?

Countdown

Microsystems (exhibition and conference) March 11–13. Wembley Conf. Centre, London. **ZI**
INSPEX March 16–20. NEC, Birmingham. **ZI**
Seminex (seminars only) March 23–27. Imperial College, London. **HI**
BEX (Business Equipment) March 25–26. Metropole, Brighton. **K**
The Northern Electronic Test & Measurement Exhibition March 31–April 2. Wythenshawe Forum, Manchester. **T**
Laboratory April 1–2. Glasgow. **I**
BEX April 8–9. Centre Hotel, Liverpool. **K**
Laboratory April 8–9. Manchester. **I**
All Electronics Show April 22–24. Grosvenor House, Park Lane, London. **FI**
Computer Graphics April 28–30. The Barbican Centre, London. **O**
BEX April 29–30. Dragonara Hotel, Leeds. **K**
Entertainment May 9–17 (weekday mornings trade only). NEC, Birmingham. **B2**
The European Consumer Electronics Show May 10–13. Nuremberg, West Germany. **I**
The European Consumer Electronics Show May 10–13. Nuremberg Fair Centre, W. Germany. (Trade) **I**
BEX Train May 11–22. Calling at: Cambridge, Norwich, Leicester, Sheffield, Newcastle, Middlesbrough, Hull, Nottingham, Reading and Portsmouth. **K**
Defence Components Expo May 12–14. Brighton Metropole. **I**
East Suffolk Wireless Revival May 24. Sports ground of Ipswich Civil Service Sports Association, Straight Road, Ipswich. **VI**
Scotelex June 2–4. Royal Highland Exhibition Hall, Ingliston, Edinburgh. **AI**
Semlab June 2–5, Grand Hall, Olympia, London. The international scientific, educational, medical and industrial laboratory equipment exhibition. (Trade). **I**
Transducer Tempcon June 9–11. Wembley Conf. Centre, London. **T**
Components (Electronics Components Industry Fair) June 9–12. Earls Court, London. **I**
International Word Processing Exhibition & Conf. June 23–26. Wembley Conf. Centre, London. **Z**
Solar Energy Exhibition Aug. 23–28, Brighton. **M**
Laboratory Sept 8–10. Grosvenor House, Park Lane, London. **I**

I Industrial Trade Fairs. ✆ 021-705 6707
K Douglas Temple Studios, 1046 Old Christchurch Road, Bournemouth
M Montbuild. ✆ 01-486 1951
O Online Conference. ✆ 0895 39262
T Trident International Exhibitions. ✆ 0822 4671
AI Institute of Electronics. ✆ 0706 43661
VI Jack Tootill, Ipswich. ✆ 0473 44047
ZI IPC Exhibitions Ltd., 40 Bowling Green Lane, London EC1R 0NE. ✆ 01-837 3636
B2 Brintex Exhibitions Ltd., 178–202 Great Portland Street, London W1N 6NH. ✆ 01-637 2400

News Briefs

FUEL CELL BREATHROUGH

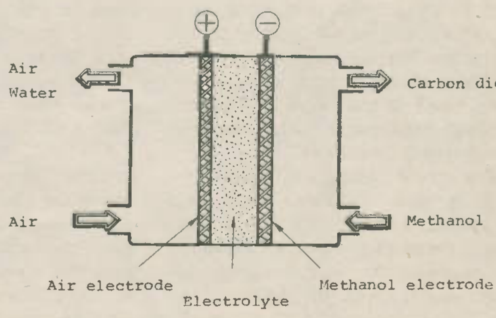
A NEW compact fuel cell with a generating capacity of 12 Volts at 4 Amperes has been developed by Hitachi. Described as the world's first compact portable methanol fuel cell, it is intended for use in home appliances, and agricultural and engineering equipment.

The new fuel cell weighs only half that of an automobile type lead-acid battery of the same size, and has been made possible by the development of a new type of electrode, yielding a three-fold increase in power output compared to the conventional methanol fuel cell. Hitachi's platinum ruthenium catalyst, in place of the platinum single catalyst, overcomes the low electric current density and low electrode voltage problems which have retarded the fuel cell's exploitation in industry.

Furthermore, a development of a new battery structure using ion exchange film as an electrolyte has made the 12V 4A fuel cell an eventual reality.

The day may yet arrive when such things as methanol powered electric lawn mowers appear on the market!

Hitachi's experimental model portable methanol fuel cell



Fuel cells directly convert fuel (in this case Methyl alcohol) into electricity through the reaction of an oxidising agent

MICROPHONE MIXER

R. A. PENFOLD

A POPULAR method of making simple "live" stereo recordings is to use two microphones; one being positioned each side of the sound stage. However, even if the microphones are of the correct type and are positioned properly, this method does not always give very good results because it is prone to the so called "hole in the middle" effect where the centre of the sound stage is lacking when the recording is played back.

This problem is easily overcome by using three microphones, these being positioned at the left, right, and centre of the sound stage. Signals from the centre microphone are mixed equally into the left and right channels, and are reproduced at equal volume by both speakers during playback. Provided the two channels have the proper in-phase relationship which is necessary for good stereo imaging, a very vivid centre sound stage should then be produced.

The simple mixer which forms the subject of this article is designed to give the necessary form of mixing for this recording method, and in practice seems to give excellent results for such a simple arrangement. The unit is primarily designed for use with high impedance (50k) microphones, but seems to work satisfactorily with 600 ohm types.

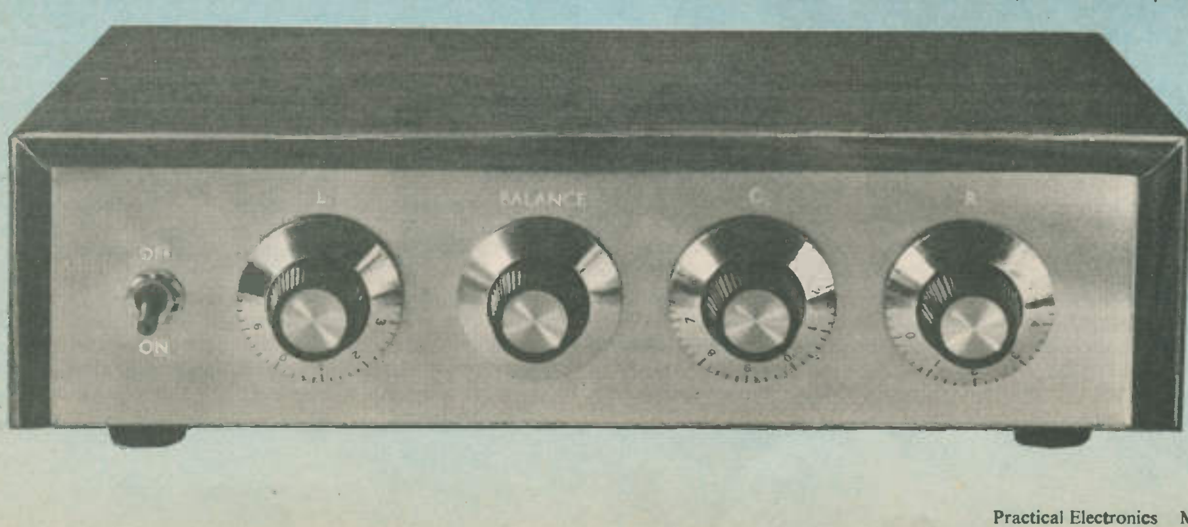
CIRCUIT DESCRIPTION

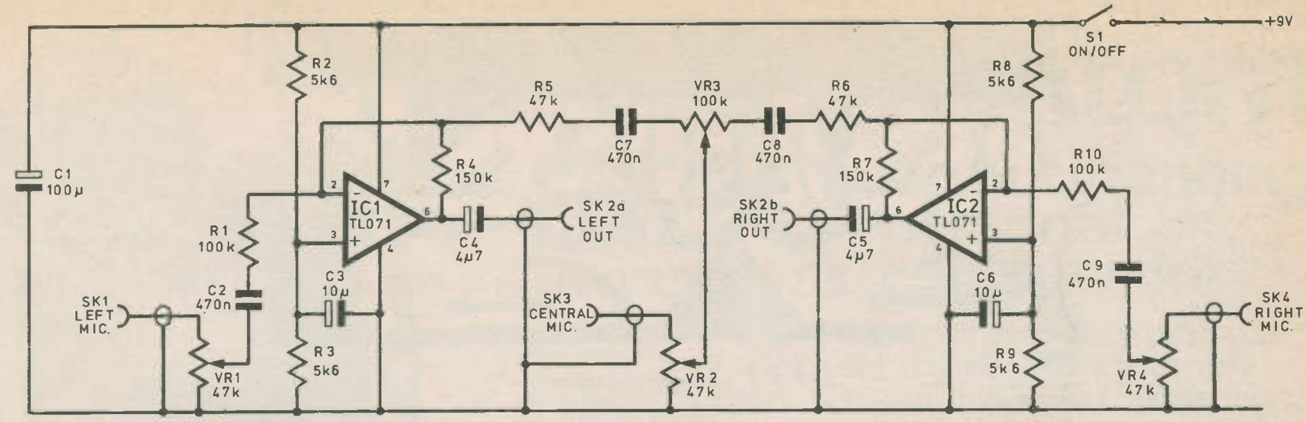
The circuit is based on two low noise operational amplifier i.c.s, and these are both used in the standard operational amplifier style mixer configuration. The circuit actually consists of two identical sections; one to mix the centre and left hand channels, and the other to mix the centre and right hand channels, with one i.c. being utilized in each section.

As can be seen from the circuit diagram in Fig. 1, the two mixer stages are basically standard inverting amplifier circuits. If we consider IC1, the non-inverting input is biased to about half the supply potential by R2 and R3. At d.c. there is 100 per cent negative feedback through R4, and so under quiescent conditions the output and inverting input also assume half the supply voltage.

The input from the left hand channel microphone is coupled to the inverting input of IC1 via d.c. blocking capacitor C2, and series resistor R1. If there is an input potential of (say) 1mV positive, then this will unbalance the input potentials of IC1, and the polarity of the signal across the inputs is such that the output is sent negative. Although a voltage difference of less than a millivolt at the inputs of an operational amplifier is sufficient to send the output fully positive or negative due to the high innate ("open loop") voltage gain, the output will in fact only go 1·5mV negative. This is due to the feedback through R4, and the fact that with the output 1·5mV negative and the input 1mV positive, the potential divider action across R1 and R4 balances the input potentials and prevents the output from going further negative. The voltage gain of the amplifier (known as the "closed loop" gain) is controlled by the ratio of R1 to R4, and is equal to R4 divided by R1, or 1·5 times in this case.

The signal from the central microphone is coupled to the





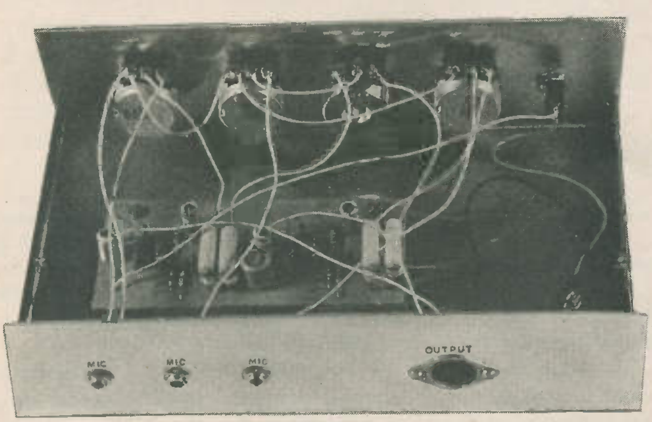
EG502

Fig. 1. Circuit diagram of the Mixer.

inverting input of IC1 by way of a part of VR3's track, d.c. blocking capacitor C7, and R5. If the slider of VR3 is at the centre of its track, VR3 and R5 combine to effectively form a 97k input resistor. This gives a voltage gain from the central input to the output of approximately 1·5 times, as was the case for the left hand channel. With input signals applied at both these inputs, the output will obviously be 1·5 times the sum of the two inputs, and the required mixing action is obtained. Moving the slider of VR3 to the left increases the gain from the central input to the left hand output, but reduces the gain from the central input to the right hand output (where it provides increased rather than decreased input resistor value). Moving the slider of VR3 to the right has the opposite effect. Thus it is possible to balance the level of the central signal in the two stereo channels by adjusting VR3.

VR1, VR2, and VR4 are the level controls for the left, central, and right hand channels respectively, and enable a correct overall signal balance to be achieved. On/off switching is provided by S1, and the circuit has a current consumption of approximately 4mA. Capacitors C3 and C6 are used to decouple any stray pick up that might otherwise occur at the non-inverting inputs of IC1 and IC2.

Although there might appear to be a signal path through R5, C7, VR3, C8 and R6 that could severely degrade the channel separation of the unit, no significant cross coupling occurs here. This is because the negative feedback action of the circuit maintains the inverting inputs at a virtually constant voltage (producing what is termed a "virtual earth"), and this effectively isolates the left and right channel inputs.



Internal view of the Microphone Mixer

NOISE

It is obviously essential for the circuit to have an extremely low noise level as it will be processing signals that are likely to have maximum amplitudes of only a few millivolts r.m.s. at most. A suitably low noise level is obtained by the use of Texas bifet operational amplifiers which are designed for optimum noise peformance, and give good results in practice. The use of substitute devices is not recommended.

Although the circuit has good supply ripple rejection, the unit would need to be powered from a well smoothed mains power supply in order to obtain a low enough hum level at the output. Great care would also need to be taken to avoid introducing hum due to stray pick up. The prototype is powered from a 9 volt (PP3 size) battery, and this is probably the most practical power source.

COMPONENTS . . .

Resistors

R1, R10	100k (2 off)
R2, R3, R8, R9	5k6 (4 off)
R4, R7	150k (2 off)
R5, R6	47k (2 off)

All resistors ⅓W 5% carbon

Potentiometers

VR1, VR2, VR4	47k log. carbon (3 off)
VR3	100k lin. carbon

Capacitors

C1	100µ 10V electrolytic
C2, C7, C8, C9	470n type C280 (4 off)
C3, C6	10µ 10V electrolytic (2 off)
C4, C5	4µ7 10V electrolytic (2 off)

Semiconductors

IC1, IC2	TL071CP (2 off)

Switch

S1	Sub-miniature toggle type s.p.s.t.

Miscellaneous

Printed circuit board.
Input and output sockets (see text).
Metal case about 200×130×50mm.
Four control knobs.
PP3 battery and connector to suit.
Wire, solder, i.c. sockets.

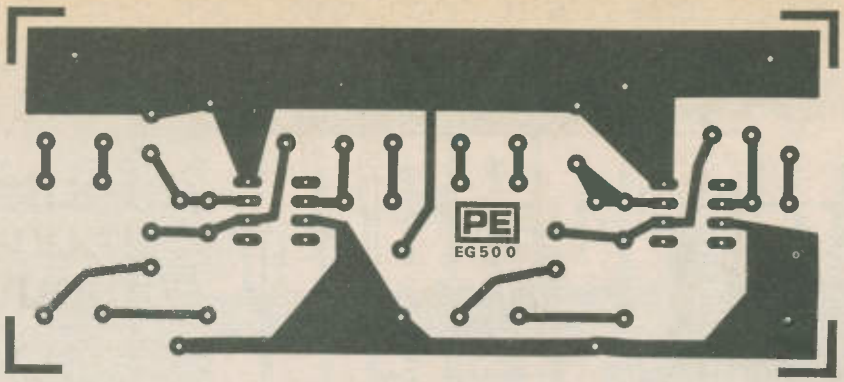


Fig. 2. Design for the p.c.b.

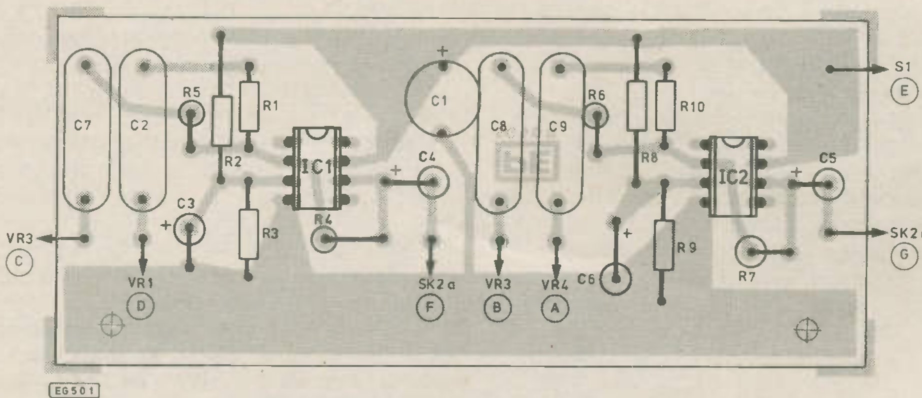


Fig. 3. Component layout for the p.c.b.

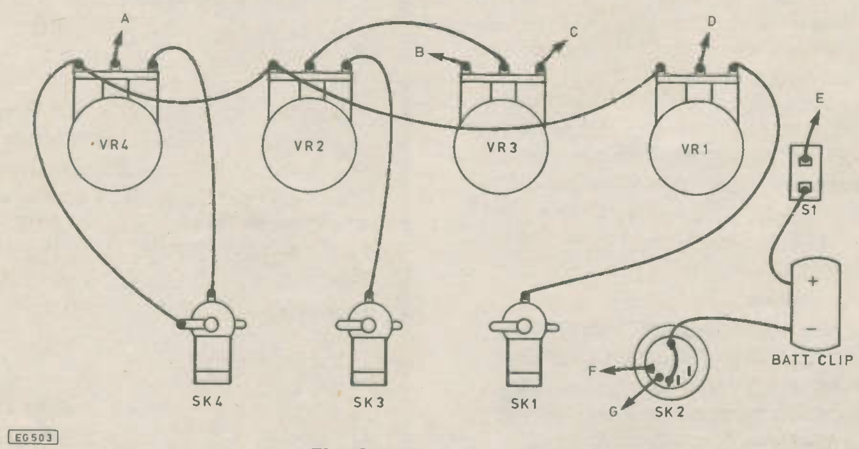


Fig. 4. Wiring diagram.

CONSTRUCTION

It is advisable to house the unit in a case of all-metal construction that will screen the circuitry from sources of electrical interference. The prototype was built into a metal instrument case measuring about 200×130×50mm, and the four potentiometers used were all rotary types. The input and output sockets are mounted on the rear of the case. 3·5mm jacks were used for the microphone sockets and a 5 way DIN type socket for the output, but these should be types that suit the equipment with which the mixer will be employed.

The printed circuit design for the circuit is shown in Fig. 2, with the component layout shown in Fig. 3. Note that the two i.c.s are JFET types and not MOSFET devices, and therefore they do not require any special handling precautions to protect them from static charges.

A wiring diagram for the unit is shown in Fig. 4. Screened cable should be used to couple the output of the mixer to the microphone inputs of the recorder so that there is no significant noise or r.f. pick up. The output is at a fairly low impedance, and so a long connecting cable can be used without causing any significant loss of performance. ★

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*The picture shown demonstrates mixed graphics and characters in three shades of grey provided by the Standard Atom.

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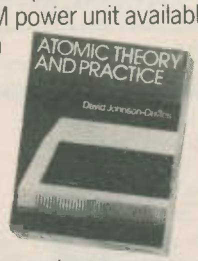

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● Memory from 2K to 12K RAM on board (up to 35K in case) ● 8K to 16K ROM (two 4K additions) ● 6502 processor ● Video Display allows high resolution (256 x 192) graphics and red, green and blue output ● Cassette Interface – CUTS 300 baud ● Loudspeaker allows tone generation of any frequency ● Channel 36 UHF Modulator Output ● Bus output includes internal connections for Acorn Eurocard.

The ATOM software includes:
● 32-bit arithmetic (±2,000,000,000) ● High speed execution ● 43 standard/extended BASIC commands ● Variable length strings (up to 256 characters) ● String manipulation functions ● 27 32-bit integer variables ● 27 additional arrays ● random number function ● PUT and GET byte ● WAIT command for timing ● DO-UNTIL construction ● Logical operators (AND, OR, EX-OR) ● LINK to machine-code routines ● PLOT DRAW and MOVE.

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AFTER THE PASS

Voyager 1 has now passed to its future which lies outside the Solar system. Once again all those directly or indirectly involved with the project have the same breathless words on their lips, 'We have learned more about Saturn and the Saturn system in a week than in the whole span of recorded History!' This statement and the statements made previously about other missions seem to have an increasing excitement. It must be hoped that the new knowledge will be used well.

Some of the more significant highlights will be covered in this issue of Spacewatch and then space must be given to other matters. There will of course be frequent updating as details become available and perhaps old theories shaken, discarded or modified. Some things have been confirmed, some things are entirely new but much of the early astronomers' thinking has proved right. One particular item stands out and that is the varied nature of the rings. A few years ago there was an intense radar observation carried out to determine exactly what were the differences in size of the particles. Part of this survey led to the conclusion that there were boulders up to a metre in diameter or perhaps more exactly, size. When the first pictures were returned from the spacecraft it appeared to indicate that there were no large particles. However it has now been established that in fact rocks up to a metre are present.

On December 19 the cameras were shut down concluding the pass of Saturn. Up to that time the spacecraft had returned some 18,000 photographs and recorded 560 preprogrammed images, flew within 2,500 miles of Titan to pass downward through the rings. At the time of the closest encounter with the planet the speed was 56,000 miles per hour. The spacecraft emerged finally through the slit in the ring structure caused by the satellite Dione. One of the advantages of seeing both sides of the ring system structure was that the forward and back scattering of the sunlight could be observed. The advantages that accrued were threefold. The extent of the ring, designated G, was determined at a radius of 93,000 miles. Estimates place this ring just inside the orbits of the co-orbital satellites S-10 and S-11.

A second benefit was that it was clear that the range of particle size was from fine dust to boulders of metre extent. Highly detailed structure of the rings was observed and it may be that up to a thousand ringlets will finally be known at the end of the count.

Thirdly it enabled the faint D-ring inside the C-ring. Speculation is that this ring is from material that has leaked past the C-ring where the edge seems to form a barrier.

The thin braided ring designated the F-ring may be intertwined with a third ring element, which initially was seen as a diffuse ring component outside the braided structure. Perhaps the fact that the F-ring, which is outside the primary ring structure, has greater contrast when the spacecraft imaging system observes the forward scattering of sunlight from the ring and indicates that there are a large number of particles involved.

Still another discovery was that the satellite Titan, thought to be the largest moon in the solar system, was found to be smaller than the satellite of Jupiter called Ganymede. Titan's atmosphere has an abundance of nitrogen and it is possible that there are lakes of liquid nitrogen.

The atmosphere of Saturn has winds which flow at 900 miles per hour and in contrast to those of Jupiter seem to be continuously in one direction at the equator. There is a very high magnetic field on the planet possibly one hundred times that of the Earth. This would indicate a field of the order of 50 gauss. Nothing like this had been expected. With such a high level it is expected that there could be considerable electrostatic effects. This might suggest a solution to the problem of the rings. The small particles would respond to static charging rather than to gravity and could account for the behaviour of the scattering effects. Some of these problems may be solved when Voyager 2 reaches the area next August. It may well be that the main attention then is concentrated on the rings.

Titan's atmosphere has been subject to a good measure of analysis though there is much yet to be done. Some of the findings are very surprising. At a point in the satellite's atmosphere the pressure is about 1·5 times that of the Earth. This suggests that the pressure at Titan's surface is three times that of the Earth. Also at the point of measurement this indicates that the satellite is less than 3,200 miles in diameter. The preliminary findings show that the satellite may be warmer at the surface than was supposed. The temperature at 1·5 atmospheres was −294°F. The theoretical model of the atmosphere postulated that the main constitutent would be methane rich. This was not found to be the case. There is about 1 per cent methane. The atmosphere is dense, with nitrogen the abundant ingredient. It is certainly an alien body. According to the imaging member of the team, Tobias Owen, who said 'It is not like Mars, the Moon or even Venus. If you landed on Titan, you won't be looking at rocks or impact craters; all such features will be hidden under aerosols. If the layer of aerosols is as deep as it seems, liquid ammonia rather than liquid water will be flowing across the surface. The poles might well be liquid nitrogen.' Earth observations have already shown the presence of acetylene and ethane. Titan is the most accessible object in the solar system which because of its temperature and environment accumulated these important ices, in particular the ammonia and methane. A step toward discovering the early history of this moon would be to put a lander on the surface to more accurately determine the abundance of complex organic molecules.

Despite the haze that lay over the cloud tops of Saturn the pictures after enhancement were able to indicate meteorological conditions. There were major differences between Jupiter and Saturn. Long lived jet streams flow on Saturn at 400 metres per second, compared with 100 metres per second on Jupiter. During the next months the temperature gradient between the equator and the poles will be intensely studied to determine how they will be affected. The northern hemisphere of the planet seems to be darker markings suggesting warmer temperature and the wider and lighter areas were colder.

Radioastronomy measurements showed very large bursts of radio emmission from the vicinity of the planet. These covered a very wide spectrum. Some may have emanted from the rings.

The haze layers seem to be in three levels. One is at about 150km above the clouds, another at 300km above and a third at 500km. The haze is made of polymers and other hydrocarbon chemicals formed by the action of the Sun on methane. The temperature of the haze varies from 175°K at the top to 65°K at the cloud tops.

Other items of particular interest are:

The side of Titan facing Saturn radiates noise in the radio spectrum.

The rings of Saturn emit radio noise caused by electric fields and collisions between particles.

Radio emmisions come only from the northern hemisphere, possibly due to an anomaly in the magnetic field.

THE SECRET OF VENUS

The rapid rotation of the atmosphere of Venus has been a puzzle for some time. Now the Ames Research Centre at Moffet field have an answer to the problem. They have found that the ratio of Argon to Krypton in the atmosphere of Venus is higher than in the Earth's atmosphere. They have also found that the greenhouse effect derives from three sets of chemicals.

The team monitored the movement of the atmosphere by tracing the dark markings. Analysis of two years photography shows that the atmosphere rotates at the same speed for all latitudes. It rotates from East to West. The rate is very high, something of the order of 100 metres a second. This is a complete circulation of the planet in four days. This rotation seems to be due to the pressure differences in the cloud layers. The differences in temperature between day and night is as much as 20°C in the daytime and −173°C at night. Differences in day and night temperatures below the cloud layers is not more than 5°C.

Interfacing COMPUKIT

Part 3 D.E.Graham

THIS month we shall be looking at the output of data from Compukit in digital form through the 6821 PIA and through sets of latches, to control devices from relays to 7-segment displays; and will cover applications such as a 7400 series i.c. tester, and full interfacing for the *P.E. Speech Synthesis Unit.*

DIGITAL OUTPUT

The Decoding Module described in parts 1 and 2 of the series allows the Compukit to output up to 16 parallel bits of data through the MC6821 PIA. The Module also provides a number of address-decoded Write Enable lines which may be used to activate sets of latches, to provide an alternative data output. These may be connected to Compukit's data bus via SK5 or 6 of the Decoding Module; and when enabled will store data appearing instantaneously on the bus, and make it available for use at the latch outputs. This output will be maintained until the latch Enable is retriggered by the appropriate address-decoded Write line from the Module.

From the range of t.t.l. latches available for this purpose, we have selected the commonly used 74LS75 quad latch. It is somewhat less convenient to use than more complex devices such as the 74116, which provides reset facilities and allows for active-low Enable, but has the advantage of relatively low cost, and is readily available in LS. Fig. 3.1 shows a pair of 74LS75s wired to provide an 8-bit port that connects directly to the Decoding Module. Note that only the Module's active-high Enable lines are suitable for connection to this latch, such as for example, W12, 13, 14 or 15 at pins 19, 9, 18 or 10 of SK5.

Note also, that if latches etc. are to be powered as well as enabled by the Decoding Module, then more than one earth connection should be made to it.

SEVEN-SEGMENT L.E.D.S

Either port of the PIA, or a 74LS75 port may be used to control 7-segment l.e.d.s using an intermediary as decoder-driver such as the 7447.

The circuit of Fig. 3.2 is for a two-digit Display Unit that plugs directly into SK5 of the Decoding Module to provide Compukit with digital readout, whilst leaving the PIA completely free for other uses.

The circuit uses a pair of 74LS75s to drive a pair of 74LS47 decoders which in turn drive a pair of FND 507 low cost common anode displays. These plug into a single 24-pin d.i.l. socket mounted on the board. The 7475s are both connected to the lowest four bits of the data bus, and are activated by two *separate* Enable lines from the Module. This procedure makes software control easier than it would have been had both l.e.d.s been run from the full 8-bits at a single address.

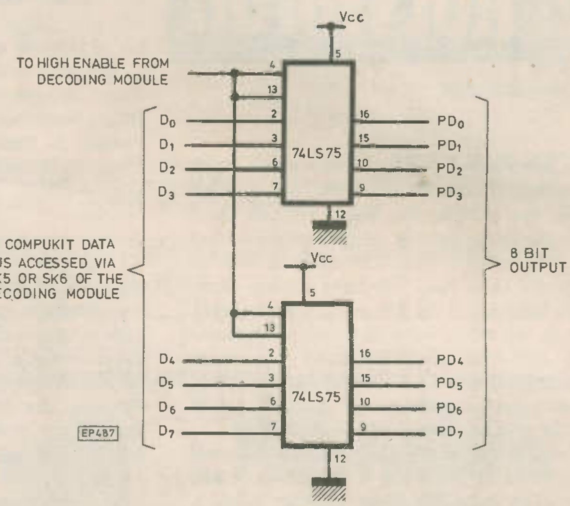


Fig. 3.1. 74LS75 8-bit Port

Figs. 3.3 and 3.4 give p.c.b. artwork and component overlay for the Display Unit. All connections to the board are via a single 16 pin d.i.l. socket which connects to SK5 on the Decoding Module, providing data bus, Write Enables and 5 volt supply. See Table 3.1 for pin connections.

The unit should not draw much more than 200mA when displaying "88" so that it should be possible to run a pair of these boards from the Decoding Module power supply, to give a four digit readout (in which case pins 15 and 14 of SK1 on the second display board should be connected to pins 18 and 10 of SK5 on the Decoding Module). If two Display Units are used however, the Decoding Module power supply will not be able to support the next add-on board of the series, to be introduced next month.

Using the Display Board is extremely simple. The command POKE 61324, X: POKE 61325, Y will display the number YX on the display (where Y and X are integers between 0 and 9).

Table 3.2 gives a program that will count seconds from 0 to 99 in decimal on the l.e.d. display located at 61324 and 5. Note how the two count digits are separated out in lines 130 and 140, and POKEd to the two separate addresses. It should be possible to achieve timing accuracies of up to about 0·1 per cent with this program by adjusting the length of the waiting loop on line 160.

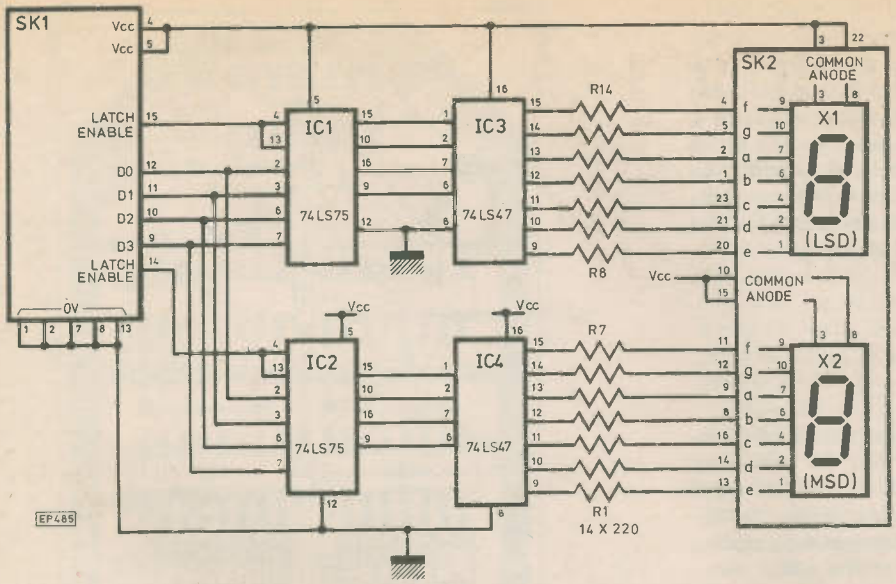


Fig. 3.2. 7-segment display circuit

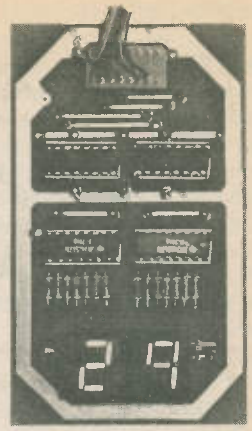
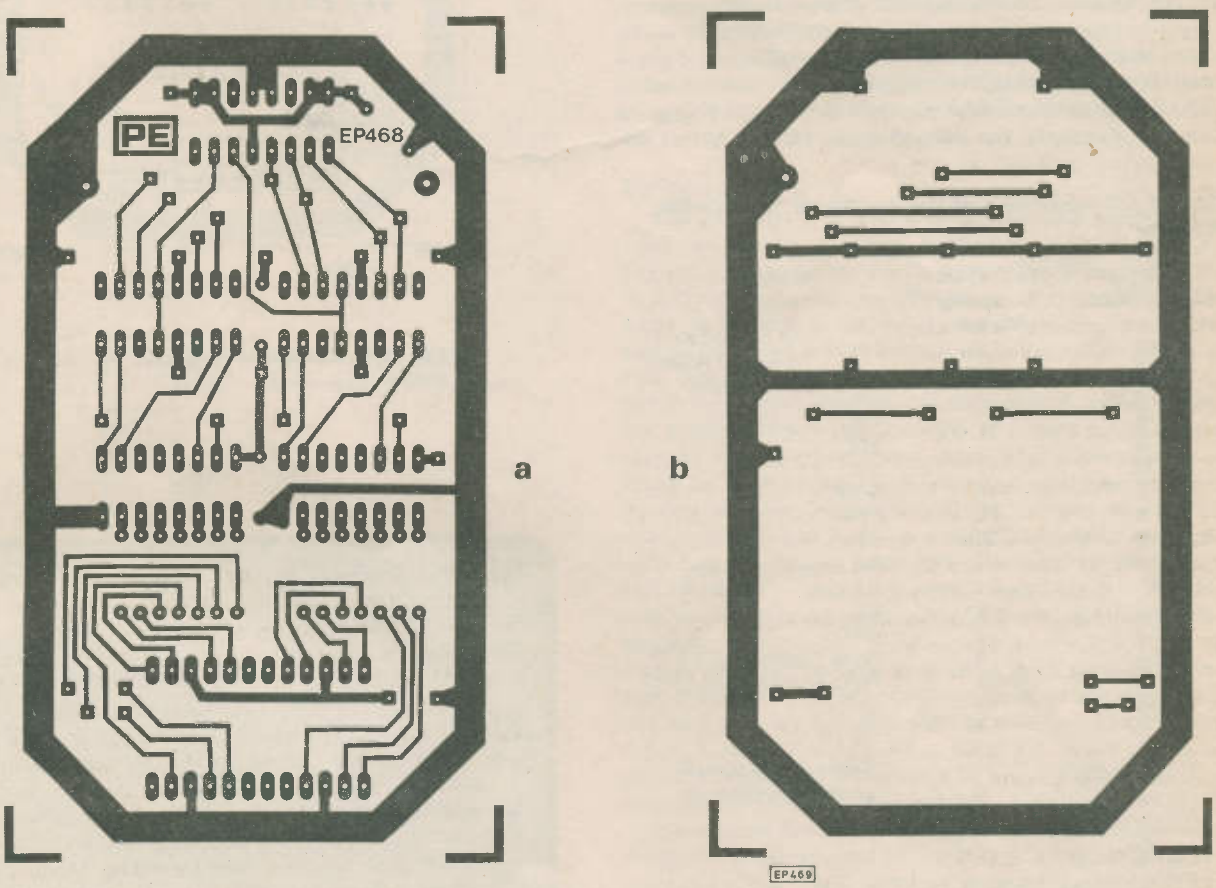


Fig. 3.3. (Below), p.c.b. for Display Unit (actual size). (a) Copper side (b) Component side



Incidentally, although the count is only taken up to 9 on each digit in this program, the 7447 will in fact decode for the hex values A-F using the symbols shown in Table 3.3, so that it would be possible to display values up to FF hex (or 255) with the Display Board, albeit at some loss in ease of readout.

By employing similar techniques, it is possible to add a routine to the joystick screen writing program given last month so as to provide a digital readout of the screen address of the cursor. This is a useful facility in setting up graphics work, and the use of l.e.d.s for outputting the data is particularly convenient in that it leaves the full screen clear for graphics development. The full program is given in Table 3.4. As may be seen, the bulk of the work is carried out in a routine starting at line 400. This causes the two-digit display to show a sequence consisting of the first, second and third pairs of digits of the 6-digit screen address currently occupied by the cursor. The display then goes blank before repeating the sequence.

AUDIO OUTPUT

There are many ways in which Compukit can be interfaced for the production of sound. About the simplest is to connect a single bit of an output port directly to an audio amplifier, and then generate a series of pulses in software. Fig. 3.5 gives a circuit that can be connected to one bit of either port of the 6821 or to a 74LS75 latch. When used with the following program it will produce a square wave output at about 140Hz with a mark to space ratio of about 1:3 on all bits of Part A on the PIA.

```
100 P=61340
110 POKE P+1,0 : POKE P,255
120 POKE P+1,255
130 POKE P,255
140 POKE P,0
150 GOTO 130
```

The output frequency is limited by the speed of Compukit's BASIC interpreter, though this may be enhanced somewhat by using variables (eg X and Y) in place of the 0 and 255 of lines 130 and 140, and giving these the appropriate values at the start of the program; and by adding the contents of lines 140 and 150 to that of line 130.

If higher frequencies are required, it is necessary to resort to programming in 6502 machine code, which can then be accessed from BASIC using the USR(X) call. Table 3.5 gives an assembler listing of such a program. It was assembled on the UK101 Assembler/Editor. Column 1 of the listing gives dummy line numbers; the second gives the actual hex ad-

Table 3.1 Connections of Display Board to Decoding Module

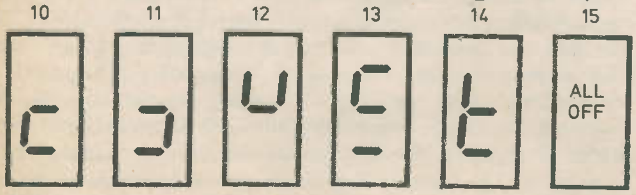
SK1 on Display Board	To SK5 on Decoding Module	Function
1	1	GND } Not connected if 10-strand ribbon cable is used
2	2	GND }
3	/	n/c
4	11	Vcc
5	12	Vcc
6	/	n/c
7	15	GND
8	16	GND
9	2Ø	D3
1/ 0	7	D2
11	21	D1
12	6	DØ
13	/	GND
14	9	Write Enable (MSD)
15	19	Write Enable (LSD)
16	/	n/c

```
80 REM INTERFACING UK101 PROGRAM 4
90 REM 0-99 COUNTER ON61324/5
100 P=61324
120 FORA=0TO99
130 A1=INT(A/10)
140 A2=A-10*A1
150 POKEP,A2
155 POKEP+1,A1
160 FORT=1TO1100:NEXT
170 NEXT
180 GOTO120
```

Table 3.2. Seconds counting program

Table 3.3. 7447 symbols

A	B	C	D	E	F
10	11	12	13	14	15



EP486 HEX. DECIMAL 7447

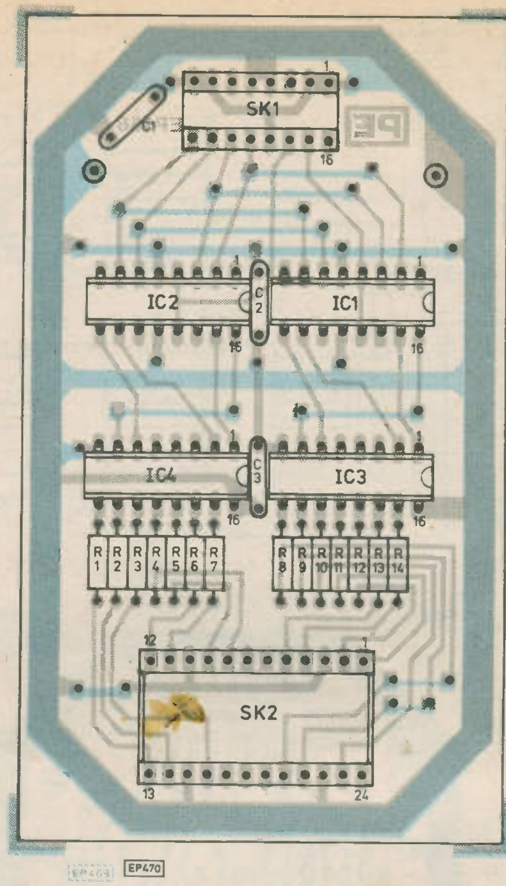


Fig. 3.4. Component layout for Display Unit

COMPONENTS . . .

DISPLAY MODULE

Resistors

R1–R14	220 $\frac{1}{4}$W (14 off)

Capacitors

C1–C3	100n low voltage disc. cer. decoupling (3 off)

Semiconductors

IC1, IC2	74LS75 (2 off)
IC3, IC4	74LS47 (2 off)
X1, X2	FND 507 (2 off)

Miscellaneous

SK1	16 pin d.i.l.
SK2	24 pin d.i.l. (for displays)

16 pin d.i.l. sockets (4 off)
Printed circuit board
16-pin d.i.l. header
10-strand ribbon cable

Constructors' Note

A complete kit of parts is available from **Technomatic Ltd., 17 Burnley Rd., London NW10.**

```
80 PEM INTERFACING UK101 PROGRAM 5
90 REM JOYSTICK DRAWING ROUTINE
95 REM WITH LED SCREEN POSN READOUT
96 REM POKED TO 61324/5
100 FORI=0TO15:PRINT:NEXT
110 V=53260
120 X=23:Y=8
125 VP=V+X+64*Y
126 VE=VP:V1=0:V2=0
130 P=61340
140 C=161
145 J=5
150 POKEP+1,0:POKEP,0
160 POKEP+1,255
165 R=61324:REM LED ADDRESS *******
170 Q=PEEK(P)
180 IF(QAND64)=0THEN200
184 C=C+1:IFC=191THENC=128
186 POKEVP,C
188 FORI=0TO300:NEXT
210 IF(QAND2)>0ANDY>0THENY=Y-1
220 IF(QAND4)>0ANDX>0THENX=X-1
230 IF(QAND8)>0ANDX<47THENX=X+1
240 IF(QAND128)>0THEN100
250 VP=V+X+64*Y
260 C1=PEEK(VP)
265 POKEVP,35
270 B=B+1:IFB=5THENB=0:GOTO400
275 FORT=0TO100:NEXT
277 POKEVP,C
280 IF(QAND16)>0THEN170
290 IF(QAND32)>0THENPOKEVP,32:GOTO170
300 POKEVP,C1
310 GOTO170
400 IFJ<1THENPOKER,255:POKER+1,255:J=5:VE=VP:V2=0:GOTO500
410 VE=VE-V2*10↑(J+1)
420 V1=INT(VE/(10↑J))
430 VE=VE-V1*10↑J
440 V2=INT(VE/(10↑(J-1)))
450 POKER,V2:POKER+1,V1
460 J=J-2
500 GOTO277
```

Table 3.4. Screen Writer program with readout

```
  5 0000          ;ASSEMBLY LISTING OF SQUARE WAVE GEN
  6 0000          ;AUDIO OUTPUT ON PORT A OF PIA AT 61340
  7 0000          ;RELOCATABLE PROGRAM BASED AT 0230 HEX
 10 0000          START=$0230
 20 0230         *=START
 30 0230         ME1=START-3
 40 0230         ME2=START-2
 50 0230         ME3=START-1
 60 0230 A900     LDA #00
 70 0232 8D9DEF  STA 61341
 80 0235 A9FF    LDA #255
 90 0237 8D9CEF  STA 61340
100 023A 8D9DEF  STA 61341
110 023D AC2E02  STT LDY ME2
120 0240 AE2D02  STU LDX ME1
130 0243 CA      A1 DEX
140 0244 D0FD    BNE A1
150 0246 88      DEY
160 0247 D0F7    BNE STU
170 0249 8D9CEF  STA 61340
180 024C E901    SBC #1
190 024E D0ED    BNE STT
200 0250 CE2F02  DEC ME3
210 0253 D0E8    BNE STT
220 0255 60      RTS
```

Table 3.5. Assembler Listing for Audio output

```
60 REM INTERFACING UK101 PROGRAM 6
70 REM SQUARE WAVE GENERATOR
75 REM USES USR ROUTINE TO PIA AT 61340
77 REM REQUIRES ACCOMPANYING 6502 CODE PROGRAM
80 PRINT:PRINT:PRINT:PRINT
90 PRINT,"SQUARE WAVE GENERATOR"
95 PRINT:PRINT
100 POKE11,48
110 POKE12,2
120 PRINT"  FREQ 1-255 (255 = LF)"
130 INPUTA
135 POKE557,A:POKE558,A
137 PRINT"  DURATION 1-255 (0 OR 255 = LONG)"
140 INPUTB
145 POKE559,B
200 X=USR(X)
210 GOTO80
```

Table 3.6. Basic control program for above

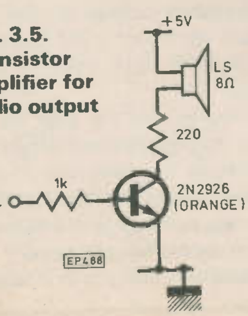


Fig. 3.5. Transistor amplifier for audio output

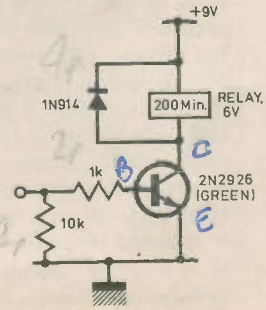


Fig. 3.6. Relay operation

dress in memory; the third, the instruction sequence in 6502 code; and the right hand column gives the assembly language listing, with standard 6502 nemonics. STT, STU and A1 are dummy labels used during assembly.

The program uses data stored in 022D and 022E hex to determine the time period of its output, and the contents of 022F to determine the duration of sound output. It then outputs a square wave on all 8 bits of port A of the PIA, each bit differing by one octave from the next.

To enter the program, column 3 of the listing could be input manually via Compukit's monitor, placing A9 at 0230 hex, and so on, up to 60 at 0255 hex. Alternatively this string of data could be POKEd into the appropriate addresses using a program in BASIC, though addresses and data would first have to be decimalised.

Once the values are in, the short BASIC program in Table 3.6 may be run to access the machine code program via the USR(X) call. Using this set-up the output frequency as measured at bit 0 of the PIA may be controlled from about 2Hz to 20KHz. At bit 7 it is 1/128 of this.

Because the machine code program is located at an unused space before 0300 hex (the start of Compukit's BASIC file space), it is safe from any attempts to erase it (except by switching off). Even a Cold Start will not shift it.

There is of course one obvious limitation to this method of sound production: it ties up the CPU for the whole duration of sound output. We shall examine more economical means of sound production next month.

OTHER OUTPUTS

The PIA and any 7475 port may also conveniently be used for control purposes, with each of the eight bits controlling a separate device. Power handling is easily achieved in such applications through the use of relays. Fig. 3.6 gives a circuit for relay operation from a single bit of such a port. It should be noted that if this circuit is used with port A of the PIA, the relay contacts will be closed even when the PIA is set to input (as it is on Reset), since port A output buffers are not tristate; this is not the case with port B. An alternative way of driving relays from either of the ports is to use a driver i.c. such as the 7416 hex inverting driver, or the 7417, its non-inverting equivalent. These devices will sink up to 40mA per bit, and their open collector outputs may be used with supply voltages up to 15V; although the chip supply on pin 14 must not exceed 5 volts. These i.c.s are also ideal for driving l.e.d. indicators (see Fig. 3.7) and opto-isolators from the PIA.

Software for this type of application is easily written even if all 8 bits of a port are simultaneously in use. One approach to this is to use a function such as A1×1 + A2×2 + A3×4 + A4×8 + A5×32 + A6× 64 + A7×128, where A1 to A8 are variables which take the value of zero for low output on the appropriate bit (relay off), and 1 for high output (relay on)—or the reverse if a non-inverting driver is used as in Fig. 3.7. All that is then required of the control program is to allocate ones or zeros to the 8 variables as desired, and then to POKE this function to the appropriate port.

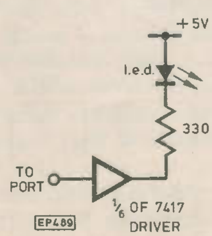


Fig. 3.7. L.e.d. indicator

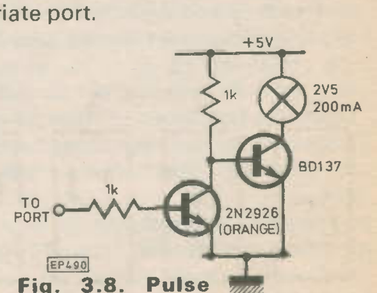
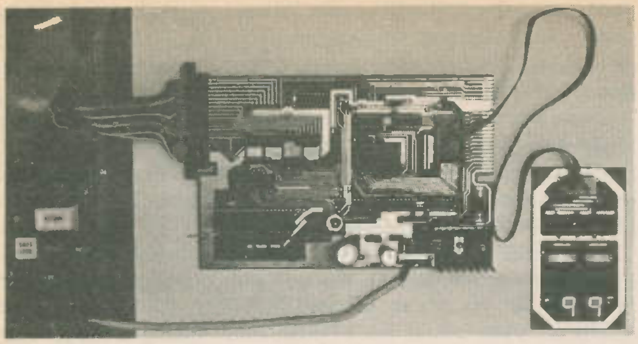


Fig. 3.8. Pulse controller



It is also possible to use each bit of a port to achieve a degree of analogue control by using pulse techniques. This involves generating variable duty cycle pulses in software, and POKEing these to a given bit of an output port which is connected to a current amplifier. In order to illustrate this method Fig. 3.8 gives a circuit for controlling the brightness of a 2·5 volt 200mA torch bulb. A short test program to drive this from any bit of port A of the PIA is given below:

```
50 REM DUTY CYCLE LAMP CONTROL
90 P=61340
100 POKE P+1,0: POKE P,255
110 POKE P+1,255
120 INPUT "BRIGHTNESS 0 (BRIGHT) TO 10 (OFF); X
130 POKE P,0
140 FOR A=1 TO 10 : NEXT
150 POKE P,255: FOR A=1 TO 10*X: NEXT
160 GOTO 130
```

The program requests a number from 0 to 10, and controls the brightness of the lamp accordingly; decimal numbers in the range 0 to 1 giving greatest illumination. This means of control suffers somewhat from the relatively low pulse frequency obtainable in interpreted BASIC, and from the fact that it monopolises the CPU during power output. In many respects a more satisfactory means of achieving analogue power control is to use D/A conversion techniques, details of which will be given next month.

7400 SERIES IC TESTER

The ability of the PIA to configure any of its 16 bits for either input or output allows it to be used as the basis for a t.t.l. i.c. tester. To show how this may be achieved, we give details of a tester suitable for most 14 pin i.c.s of the 7400 series. It will in fact work with all those using pins 7 and 14 for power supply connection, and whose gates are configured symmetrically across the middle, as are those of the 7400 and 7420, for example, but not the 7415, whose third gate has 2 inputs on the LH side and one input and its output on the RH side. The principles used may be extended to cover most 7400 devices with 14, 16 or 18 pins, though removing the symmetry condition will increase data and software complexity.

For the 14 pin tester, a 14 pin d.i.l. socket is wired to a pair of 16 pin headers as shown in Fig. 3.9 which plug directly into SK3 and 4 of the Decoding Module. Pins 7 and 14 of the test socket are taken to ground and Vcc respectively, and the remaining 12 go to the lowest 6 bits of ports A and B. The six 4·7k resistors act as pull-up resistors on the port B inputs, so that when confronted with a high impedance state (as would be the case when testing a 74125 tristate buffer for example), the tester consistently detects a high logic state.

To perform a test, the i.c. is plugged into the socket, and the program listed in Table 3.7 is run on Compukit. This first requests the user for the i.c. number, and checks program lines 5000 onwards to see if it has data on the device. If it does, it sets up the ports for input and output on the appropriate pins and then performs a series of logic tests on the device, checking responses against data held for that device. It then prints out the results.

If the number of the i.c. is not known by the user (or he lacks the energy to enter it), a zero may be entered when the chip number is requested. This causes the program to perform its complete repertoire of tests in sequence until the i.c. is recognised; whereupon the device number is printed out. Successful recognition can of course only be achieved if the i.c is fully operational, and if it is one whose data is included in the program.

Fig. 3.9. I.c. tester connections

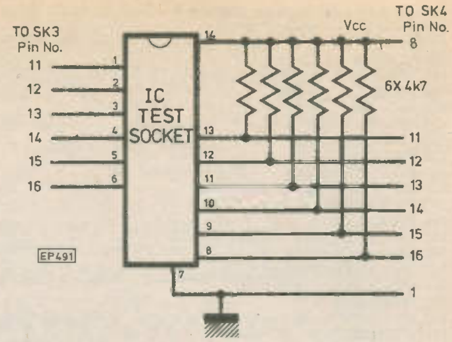


Table 3.7. I.c. tester program

```
2 REM INTERFACING UK101 PROGRAM 7
5 REM UK 101  IC TESTER
10 FORI=1TO16:PRINT:NEXT
15 PRINT,"UK101 7400 SERIES IC TESTER"
20 RESTORE
70 P=61340
80 F=0
90 PRINT:PRINT:PRINT
100 PRINT"    ENTER NUMBER OF DEVICE"
110 PRINT"    OR ZERO, IF NOT KNOWN"
120 INPUTD
130 IFD=0THEN280
140 IFD<7400 OR D>74999THEN170
150 IFD>7499 AND D<74000THEN170
160 GOTO200
170 PRINT:PRINT
180 PRINT"    ONLY 7400 SERIES PLEASE"
190 GOTO20
200 READ D1
210 IFD1>-1THEN240
220 PRINT:PRINT"    NO DATA AVAILABLE ON  THIS DEVICE"
230 GOTO20
240 IFD1<>DTHEN200
250 PRINT:PRINT:PRINT"    DATA AVAILABLE ON  ";D1
260 PRINT
270 GOTO300
280 READD1
285 IFD1<0THEN950
290 IFD1<7400THEN280
300 REM
320 READR
340 POKEP+1,0
350 POKEP,63-R
360 POKEP+1,255
370 POKEP+3,0
380 POKEP+2,63-R
390 POKEP+3,255
400 READS
410 IFS>255 OR S<0THEN770
420 READT
430 F=F+1
440 POKEP,S
450 POKEP+2,S
460 IF(PEEK(P) AND R)<>TTHEN870
470 IF(PEEK(P+2) AND R)<>TTHEN870
480 GOTO400
770 IFD<>0THEN800
780 PRINT:PRINT"    DEVICE RECOGNISED AS  ";D1
790 GOTO830
800 PRINT
810 PRINT"    ";F"TESTS COMPLETED ON";D1
820 PRINT"    DEVICE OK"
830 FORI=1TO5000:NEXT
840 GOTO20
870 IFD=0THEN280
900 PRINT"     **************************"
910 PRINT"    ";D1;"FAILS ON TEST   ";F
920 GOTO20
950 PRINT:PRINT"    **********************"
960 PRINT"    DEVICE NOT RECOGNISED"
970 COTO20
5000 DATA7400,9,54,0,36,9,18,9;0,9
5010 DATA7402,36,0,36,18,0,9,0,27,0
5020 DATA7404,21,42,0,0,21
5030 DATA7408,9,54,9,36,0,18,0,0,0
5040 DATA7420,1,62,0,60,1,58,1,46,1,30,1,0,1
5060 DATA7432,9,54,9,36,9,18,9,0,0
5070 DATA74125,9,54,9,36,9,18,9,0,0
10000 DATA-1
```

As the program stands it will test the i.c.s 7400, 02, 04, 08, 20, 32 and 125; though since data for each device is handled in a single data line, it is a relatively easy matter to add data for further similar devices. When using the i.c. identification routine, it should be remembered that a number of devices in the 7400 series are logically similar (such as the 7404, 5, 6 and 16 for example). In such cases the program will simply print out the type number of the first device that it comes across whose data correctly matches the i.c. under test.

In order to facilitate additions to the program enabling it to test further devices, we will examine the derivation of the data used for testing the 7400. All the relevant data for this is stored in line 5000 of the program:

5000 DATA 7400, 9, 54, 0, 36, 9, 18, 9, 0, 9

The first number after the device code is used for setting up the PIA so as to input data from those pins of the i.c. which carry output, and to output data to those which carry input. The program is also so arranged that one only has to consider the LH side of the i.c. in setting up the data—ie pins 1–6: the RH side is automatically catered for providing that the i.c has the required symmetry.

Fig. 3.10 gives a pinout of the 7400, with the port connections made by the test socket. From this it may be seen that pins 1, 2, 4 and 5 are inputs, and 3 and 6 are outputs. From the way in which the PIA ports are configured, ones are used to denote PIA outputs, and zeros input. The code used for configuring the ports in this program follows this, so that for the 7400 this is 9 (ie (0×32) + (0×16) + (1×8) + (0×4) + (0×2) + (1×1)).

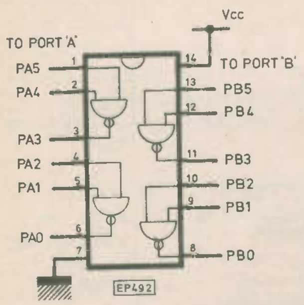


Fig. 3.10. 7400 pin-out for tester

Table 3.8 Truth Table for 7400 IC Tests

PIA Bit	=	PA5	PA4	PA3	PA2	PA1	PAØ	Code
Decimal Bit Value	=	32	16	8	4	2	1	
First Test	input output	1 X	1 X	X Ø	1 X	1 X	X Ø	54 Ø
Second Test	input output	1 X	Ø X	X 1	1 X	Ø X	X 1	36 9
Third Test	input output	Ø X	1 X	X 1	Ø X	1 X	X 1	18 9
Fourth Test	input output	Ø X	Ø X	X 1	Ø X	Ø X	X 1	Ø 9
Key:	1 = High Ø = Low X = Ignored							

The numbers which follow the port code in the data line are arranged in pairs; two for each test. The first of each specifies the test parameters, and the second the required result. Four sets of tests are used on the 7400 (see Table 3.8). The first test takes each input high, and looks for a low output. Since ones are used to denote high PIA output on any given bit, the code for the first test is 54 (ie (1×32) + (1×16) + (1×4) + (1×2)). The result of the test should be zeros on bits 8 and 1. The code for this is (0×8) + (0×1), or zero. Had the required result been high outputs from the i.c. on these two pins, as it is in the remaining tests, the result code would have been (1×8) + (1×1), or 9.

The remaining test codes are constructed in a similar way, as may be seen from Table 3.8, and the program stops testing a device when, as it looks for the next test code it confronts a new device number. When performing the whole repertoire of tests, or when searching for a particular device number, it uses the −1 in line 10000 as an end indicator.

USING THE PIA TO CONTROL SPEECH OUTPUT

In the *December 1980* issue of *P.E.* Dr Berk described a Speech Synthesis Unit which can be used to provide a microcomputer system with a vocabulary of 24 or 64 spoken words. This unit cannot be easily interfaced to Compukit because Compukit possesses no user port; and even when the unit is interfaced via the 2114 memory sockets, word timing problems are encountered because such an arrangement provides no way of monitoring the Busy signal from the Speech Unit.

The PIA on the Decoding Module provides a simple way of fully interfacing the Speech Synthesis Unit to Compukit, and at the same time gives us an opportunity to examine the use of the peripheral control facilities provided by the 6821. These will be used in the present instance to monitor the state of the Synthesis Unit, and inform Compukit when the unit is busy outputting a word, and when it is ready for the next. But first we will look at the simpler question of how to interface the Speech Unit to the PIA without monitoring the Busy signal.

PIA INTERFACE

The Speech Unit requires six parallel data lines to specify the word to be output. These may be connected to the lowest six bits of either port of the PIA. Apart from the Busy line, which we shall ignore for the moment, there are two other lines to consider: Latch and Start. The former requires a positive-going edge to cause the 74174 data latches on the Speech Interface Board to capture data on its bus. The requirement for the Start line is that it be taken low to trigger the output of a word, and left in that state until the word is completed.

These requirements may be met using the remaining two bits of the chosen port of the PIA. Bit 6 of the port should be connected directly to the Latch Enable, and bit 7 to the Start line. Software can then be used to control their status.

To output the word "four" for example, the following commands would be executed after initialising the PIA for output on all 8 bits of a port:

POKE A, 128+ 4
POKE A, 64 + 4

A is 61340 for port A of the PIA (or 61342 for port B). The first command takes the Start line high, the Latch low, and places the number 4 on the bottom 6 data lines. The second command triggers the latch by taking bit 6 high, and initiates speech output by taking bit 7 low, while maintaining the data on the lowest 6 lines. Technically the Start signal should come marginally later than the Latch, but the above arrangement appears to work well at both ports of the PIA.

The program below will output the full 24 word vocabulary of the Speech Unit using the techniques described above:

100 A=61340
110 POKE A+1,0
120 POKE A,255
130 POKE A+1,255
140 FOR B=0 TO 23
150 POKE A,128+B
160 POKE A,64+B
170 FOR C=1 TO 1500: NEXT
180 NEXT

As Dr Berk has suggested, if the Busy line cannot be monitored, a timing loop, such as that given in program line 170, must be used to allow one word to finish before the next begins. One difficulty with this approach is that since the words are of differing length, spaces between them will also be variable. In the present program there are considerable pauses after the 10 digits in order that much longer expressions such as "times minus" may be spoken without interruption. This problem may be overcome by using one of the PIA's peripheral control lines.

PERIPHERAL CONTROL WITH THE PIA

Each port of the 6821 PIA has two so-called peripheral control lines: CA1 and CA2 on port A, and CB1 and CB2 on port B. These have been taken out to pins 2 and 3 of SK3 and 4 respectively, of the Decoding Module.

CA1 and CB1 are input only lines, and may be programmed to set a flag, and optionally cause an interrupt when transitions occur on them.

CA2 and CB2 may be programmed as either inputs or outputs. In the discussions which follow we shall be using the CA1 (or CB1) line, and if the reader requires data on the slightly more complex CA2 and CB2 lines he is referred to the Motorola data sheet on the 6821.

The key to understanding the 6821's peripheral control facilities lies in its two control registers CRA and CRB, mentioned briefly last month. One of these registers is dedicated to each port, and both have a similar structure. Table 3.9 gives their format. As may be seen, bits 1 and 0 determine the mode of operation of control lines CA1 and CB1, whilst bit 7 is the flag which monitors the status of the relevant control line.

Table 3.10 gives the four possible states of the lowest two bits of the control register, and their effect on CA1 (or CB1). It will be seen that bit 1 determines whether the flag is set on a high or a low transition of the control line, while bit 0 determines whether the interrupt line $\overline{IRQ}$ (connected directly to Compukit's $\overline{IRQ}$ pin via the Decoding Module) will be activated (taken low) when the flag is set or not. In the discussions which follow we shall not be employing the interrupt facility (which requires handling-routines in 6502 code). The use of interrupts will be treated in a later issue in connection with the 6522 VIA.

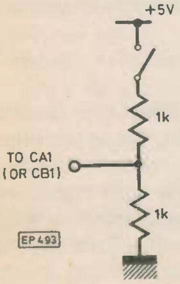


Fig. 3.11. Resistor chain to test flag

Table 3.9 Structure of PIA Peripheral Control Registers

Bit	7	6	5 4 3	2	1	Ø
Control Register A (CRA) at 61341	$\overline{IRQ}$ (CA1)	$\overline{IRQ}$ (CA2)	CA2 Control	DDRA Access	CA1 Control	
Control Register B (CRB) at 61343	$\overline{IRQ}$ (CB1)	$\overline{IRQ}$ (CB2)	CB2 Control	DDRB Access	CA2 Control	

Note: DDRA — The Data Direction and Peripheral Register Access through bit 2 of the control Register was treated last month.

Table 3.10 CONTROL OF INTERRUPT INPUTS CA1 AND CB1

CRA–1 (CRB–1)	CRA–Ø (CRB–Ø)	Interrupt input CA1 (CB1)	Interrupt Flag CRA–7 (CRB–7)	MPU Interrupt Request $\overline{IRQA}$ ($\overline{IRQB}$)
Ø	Ø	↓ Active	Set high on ↓ of CA1 (CB1)	Disabled—$\overline{IRQ}$ remains high
Ø	1	↓ Active	Set high on ↓ of CA1 (CB1)	Goes low when the interrupt flag bit CRA–7 (CRB–7) goes high
1	Ø	↑ Active	Set high on ↑ of CA1 (CB1)	Disabled—$\overline{IRQ}$ remains high
1	1	↑ Active	Set high on ↑ of CA1 (CB1)	Goes low when the interrupt flag bit CRA–7 (CRB–7) goes high

Notes: 1) ↑ indicates positive transition (low to high)
2) ↓ indicates negative transition (high to low)
3) The interrupt flag bit CRA–7 is cleared by an MPU Read of the A Data Register, and CRB–7 is cleared by an MPU Read of the B Data Register.
4) Of CRA–Ø (CRB–Ø) is low when an interrupt occurs (interrupt disabled) and is later brought high, $\overline{IRQA}$ ($\overline{IRQB}$) occurs after CRA–Ø (CRB–Ø) is written to a "one".

TESTING THE PERIPHERAL CONTROL FLAG

We can now proceed to test the operation of the control line CA1. To do this, first connect the resistor network of Fig. 3.11 to pin 2 of SK3 of the Decoding Module. Then reset the PIA using the Reset push button on the Decoding Module, and run the following program:

100 A=61340
120 POKE A+1,0
130 POKE A,255
140 POKE A+1,254
200 PRINT (PEEK (A+1) AND 128)
220 FOR Z=1 TO 100: NEXT
300 GOTO 200

This initialises port A for output as usual, but in line 140, it places 254 into control register A. It may be recalled from last month (see Table 2.1) that the control registers for ports A and B may be directly accessed, and are located at 61341 and 61343 respectively. With 254 in CRA, bit 1 of the register will be high, and bit 0, zero. This sets up the conditions shown in the third row of Table 3.10: ie the interrupt is disabled, and the flag will be set high on a positive going transition of CA1.

The program then monitors the contents of bit 7 of the control register. It should print out a string of zeros, indicating that the flag is not set. Closing the switch in the circuit of Fig. 3.11 will set the flag, and cause the program to print out a series of 128s.

The flag will remain set (and the 128s will continue to register) even when the switch is reopened, in order that the CPU can monitor the flag when it wishes without a risk of missing the control line signal. To clear the flag, one must read (or write to) the associated data register of the PIA. Thus if we insert the line:

210 X=PEEK (A)

into the above program, the screen will register only one 128 after any switch closure, subsequently registering zeros, and indicating that the flag has been reset.

PERIPHERAL CONTROL OF SPEECH OUTPUT

We are now in a position to use control line CA1 (or CB1 which functions similarly) with the Speech Board to inform Compukit when speech output is complete. The Speech Board Busy signal goes low when speech begins, returning high when a word is completed. The Busy line may thus be connected directly to CA1, and the data 1 placed in bit 1 of CRA, and 0 in bit 0. This will cause the flag at bit 7 to go high at the end of each word output, and the program can simply inspect this bit, and enter a waiting loop until it returns high, before outputting the next word. The full connections for the interface are given in Fig. 3.12.

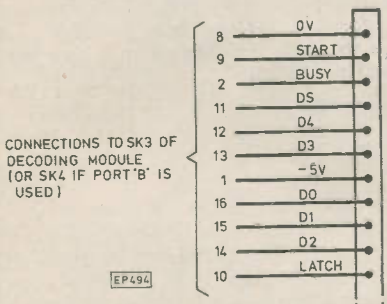


Fig. 3.12. Connections of speech board to SK3

```
70 REM INTERFACING UK101 PROGRAM 8
80 REM SPEECH ROUTINES
100 A=61340
120 POKEA+1,0
130 POKEA,255
140 POKEA+1,254
200 FORA1=1TO16:PRINT:NEXT
210 PRINT,"1. VOCABULARY"
220 PRINT,"2. COUNTING"
230 PRINT,"3. READOUT"
240 PRINT,"4. DICE"
250 PRINT:PRINT:PRINT
260 INPUTAB
270 ONABGOTO300,450,600,750
280 GOTO200
300 PRINT:PRINT,"VOCABULARY"
320 FORWW=0TO23
330 GOSUB2000
340 NEXT
350 GOTO200
450 PRINT:PRINT
460 INPUT"   COUNT TOTAL";AD
470 FORW=0TOAD
480 GOSUB1000
490 FORAE=1TO1000:NEXT
500 NEXT
510 GOTO200
600 PRINT:PRINT:PRINT
610 PRINT,"INPUT NUMBER STRING"
620 INPUTW$
625 W$="0"+W$
630 GOSUB1070
640 GOTO200
750 REM DICE
760 PRINT:PRINT:PRINT
770 PRINT,"DICE ROUTINE"
780 PRINT,"ENTER RANDOM NUMBER"
790 INPUTA6
800 A7=RND(-A6)
810 PRINT:PRINT"   PRESS RETURN FOR EACH THROW"
820 PRINT,"   PRESS ↑ TO EXIT"
830 POKE530,1
840 POKE57088,223
850 A8=PEEK(57088)
860 IFA8=239THENPOKE530,0:GOTO200
870 IFA8<>247THEN840
880 WW=INT(1+6*RND(8))
890 GOSUB2000
900 GOTO840
910 REM
920 REM
1000 REM
1050 W$=STR$(W)
1060 PRINTW$
1070 FORW1=2TOLEN(W$)
1080 WW$=MID$(W$,W1,1)
1085 WW=VAL(WW$)
1090 GOSUB2000
1100 NEXT
1200 RETURN
1900 REM
1910 REM
1920 REM
2000 REM SPEECH POKE
2050 POKEA,128+WW
2060 POKEA,64+WW
2070 A1=PEEK(A+1)
2090 A3=A1AND128
2100 IFA3=0THEN2070
2110 FORA4=1TO100:NEXT
2120 RETURN
OK
```

Table 3.11. Speech handling program

SPEECH PROGRAM

These principles have been put into practice in the program listed in Table 3.11. It performs four different functions according to a menu printed out at the start. "1" gives the full 24 word vocabulary of the board. "2" counts to any predetermined number. "3" speaks a string of figures entered via the keyboard; and "4" initiates a dice routine in which a random number from 1 to 6 is spoken at each press of the Return key.

Incidentally, this last routine uses an apparently unpublished facility of the RND function on Compukit. Calling RND(X) will give a random number *independent* of the value of X for all positive integers. But if X is negative then this has the effect of "seeding" the random number generator to a position *dependent* on the value of X, and can thus be used to start off the generator at a new point.

All four of the routines described make use of one or more of the digit and speech handling routines at lines 1000 and 2000. The first splits up a variable W into a sequence of digits WW (or if entered at 1070 does the same for a string of characters W$). These are then output sequentially by the speech handling routine at line 2000, which simply "speaks" the digit WW, waiting until speech output is complete before a Return is executed either to the first subroutine or to the main body of the program. This is achieved in lines 2070–2100 by examining bit 7 of the PIA control register for a 1.

These two routines should be found useful in other applications of the Speech Board.

NEXT MONTH we will introduce an Analogue Board which plugs directly into the Decoding Module to provide Compukit with an AY–3–8910 Programmable Sound Generator, a D/A converter, an 8 channel A/D converter, and a 6522 Versatile Interface Adaptor, allowing counting and timing operations, as well as providing a second 16 bit input/output port.

PATENTS REVIEW...

Copies of Patents can be obtained from: the Patent Office Sales, St. Mary Cray, Orpingtron, Kent. Price £1·45 each.

3-D VIEWING

Two recent patent applications protect different approaches to the transmission and display of stereoscopic or 3-dimensional TV pictures.

To obtain a realistic 3-D image it is necessary to present each eye with an image of different perspective. It is well known to project cinema films with the left and right eye images separated either by colour or optical polarisation. The audience then wears either coloured or polarised spectacles. If red or green images are superimposed on the screen then the audience wears spectacles which place a red filter over one eye and a green filter over the other. If the two superimposed images on screen are projected by differently polarised light, then the spectacles must have differently polarised filters for each eye. In new British patent application 2 040 134, filed by the Marconi Company of Chelmsford, Essex, the polarisation technique is adapted for TV use. Figure 1 shows a camera with two lenses 4 spaced apart by the natural separation distance of human eyes. Mirrors 5 and 6 and a lens 8 register the resultant two images together on a camera tube 7. Cross-polarised filters 9 and 10 optically separate the beams e.g. the polariser 9 is vertically orientated and polariser 10 horizontally orientated. Both the beams then pass through a liquid crystal cell 11 and a further polariser 12. The cell has electrodes connected to an electrical supply which changes polarity at the TV camera frame rate. This change of electrode polarity switches the liquid crystal filter so that it either rotates the plane of polarisation by 90° or leaves it unchanged. The polariser 12 is of fixed character so as the filter 11 switches between its two optical states, the camera tube 7 alternatively receives images from the two halves of the optical system 2,3.

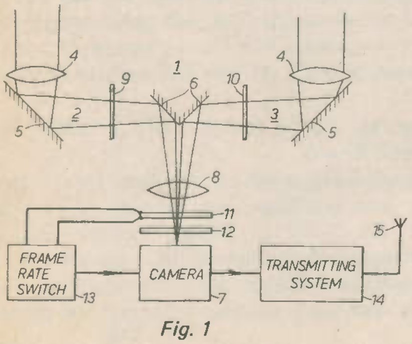


Fig. 1

At the receiver (Figure 2) frame rate signals are extracted from the incoming video signals and used to switch the polarising behaviour of another liquid crystal cell 19. This is sandwiched against a fixed polariser 18 and a TV display tube 16. The viewer wears spectacles with cross polarised filters 21,22. As the filter 19 switches its polarisation effect in synchronism with the filter 11 in the camera, the viewer's left and right eyes respectively see only the images produced by the left and right halves of the camera optical system. This produces a 3-D effect. But as each eye sees only alternate frames there will be noticeable flicker unless the overall frame rate is artificially increased.

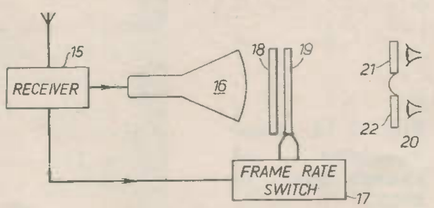


Fig. 2

At the Tokyo Electronics Show in October, 1980, Matsushita (National Panasonic) showed an apparently quite similar system in operation. Members of the public could peer through a fixed pair of "binoculars" at a TV display tube hidden inside a large decorative sphere. Switched filters in the binocular optics chopped the image to produce an impressive, but rather flickery, 3-D effect. Although Matsushita and National Panasonic have not made available any details of the system demonstrated in Tokyo it seems likely that it closely resembles that now being patented by Marconi. It thus remains to be seen who has the earliest patent priority date, Marconi, Matsushita or others working along similar lines. The Marconi date is November 1978.

The second 3-D TV system for which patents have recently been applied works on a quite different principle. William Etra of Oakland, California claims, in International PCT patent application WO 80/01447, to have devised a technique for processing ordinary 2-D video signals so that they create a 3-dimensional effect. But the processed signals remain compatible with existing TV receivers. In other words the Etra system is claimed to offer 3-D from 3-D tv receivers and 2-D from conventional receivers.

It is already known that a pseudo-3-D effect can be produced by artifically colour-fringing out-of-focus objects with magenta and cyan. When viewed through coloured glasses the colour-fringing creates an illusion of depth but for viewers without glasses the blurs are barely noticeable. But it is expensive to modify TV cameras to produce the necessary colour fringing. Etra claims that a similar effect can be obtained, much more cheaply, by taking advantage of the change in position, from TV field to TV field, which occurs when an object is moving across the TV screen. In Europe 25 TV pictures are displayed every second, but each separate picture or frame is built up from two interlaced fields. If an object is moving fast it will be "seen" at a different position by each field and thus reproduced as a blur when the two fields are interlaced to form a full TV picture frame. The patented idea is to use this blur as a basis for colour-fringing.

Fig. 3

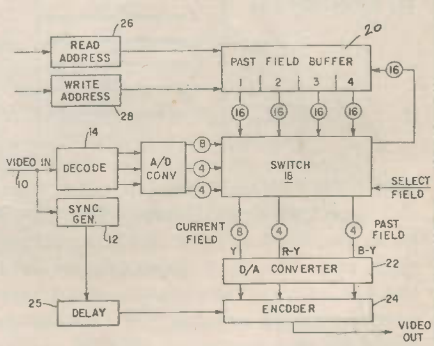
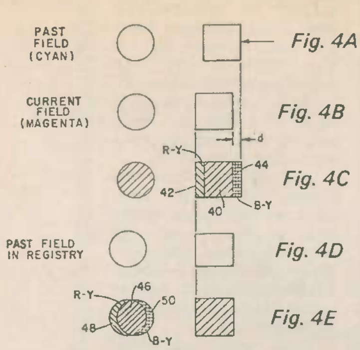


Figure 3 shows an encoder for connection after a TV camera or video recorder. The incoming video signals 10 are separated at 14 into luminance (Y) and chrominance (R – Y and B – Y) components. The components are then converted into digital code for processing to produce the required colour-fringing.

Figure 4A represents a first TV field of a picture frame with a square moving towards a circle. Figure 4B represents the



next TV field of the same frame. By now the square has moved the distance *d*. If the two fields are encoded in complementary colours (e.g. cyan and magenta) then by combining the two fields a colour-fringing effect is achieved. Figure 4C shows a combination of the two fields. The stationary circle includes exactly matching cyan and magenta images without any fringing, while the moving square is depicted by mis-registered cyan and magenta squares. The mis-register shows up as cyan fringing to one side and magenta fringing to the other. According to the inventor if the composite image of Figure 4C is viewed through terest in the TV picture should consist of achieved. It is advantageous however, to take the invention a step further. In practice it is preferable that the major objects of interest in the tv picture should consist of perfectly registered colour components. Usually the major object of interest will be moving—eg. a sportsman running, so Figure 4D and 4E shows how the fringe effect is transferred to the stationary object (the circle) to leave the moving object (the square) free from fringing. The digital signals corresponding to the last four fields are routed by write address 28 to a buffer circuit 20 for temporary storage.

Either manual or computer controls are then used to track a selected moving object and so keep it free from fringing. Selected past and present TV fields are brought into registration by advancing or retarding the starting address of a read circuit 26 for the buffer 20. The technique can of course provide only "psychophysiological" or pseudo-3-D, i.e. the 3-D effect is artificial rather than a true representation of the perspectives seen by a spaced lens camera.

POINTS ARISING

TELETEXT *(August 1980–November 1980)*

Five problems have come to light with the Teletext project:

1. The supplied VDM on the tuner board should have an internal wire link to bring the video output signal to pin 12. The necessary link is shown in Fig. 1.

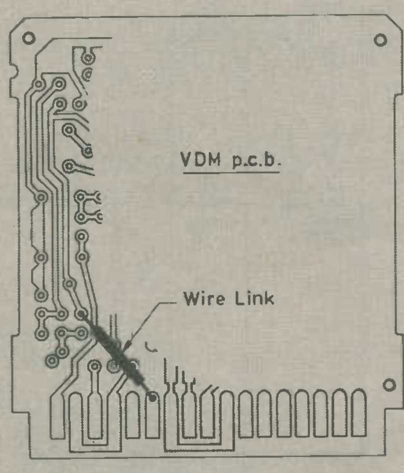


Fig. 1. VDM p.c.b. showing the wire link required to bring the video output signal out to pin 12

2. If the PE1X is used on the Video Summer Board then pins 17 and 10 on the daughter board (Fig. 2.9) should be linked, to bring the blanking signal out to plug 3.
3. The 5V supply for the buffer modification (Fig. 4.3) should be obtained from IC14 pin 18 and the earth connection from IC10 pin 8.
4. The p.c.b. design for the Tuner Board shown in Fig. 4.4 should have pin 11 of IC3 connected to earth and not pin 12.
5. To ensure reliable operation of the blanking signal a pull-up resistor should be used (5k6). This should be connected from pin 10 IC19 to the 12V supply on the Video Summer Board.

News Briefs

JVC'S VIDEO Information Centre is planning a course for the general public on "Camera Operation and Home Video Techniques", and is designed to help users to get the most from their video equipment.

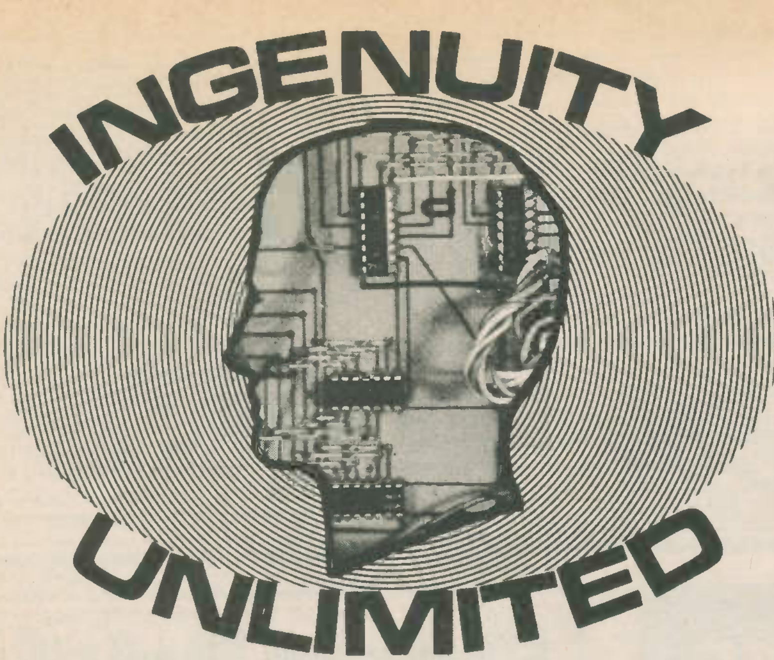
The course will start this year and probably consist of two days of instruction. After the demand for such a course has been assessed, it will be introduced on a weekday basis or as a weekend course.

The Video Information Centre offers professional services to the domestic user — as well as being a showroom for the full range of JVC video equipment, VIC has a fully equipped small studio, editing and dubbing facilities and a tele cine conversion unit among its many facilities. Expert advice is on hand to help users and enquirers with any problem concerning video.

The new course is an additional part of JVC's educational role in video. VIC already runs two courses for dealers, and a third will soon be introduced.

The Video Information Centre is open from 10.00 am–5.00 pm on weekdays and 9.30 am–12.30 pm on Saturdays.

Any member of the public who may be interested in the new course should contact Mike Whyman at the JVC Video Information Centre at 82 Piccadilly, London W1 (01-450 2621).



A selection of readers' original circuit ideas. It should be emphasised that these designs have not been proven by us. They will at any rate stimulate further thought.

Why not submit *your* idea? Any idea published will be awarded payment according to its merits.

Articles submitted for publication should conform to the usual practices of this journal, e.g. with regard to abbreviations and circuit symbols. Diagrams should be on separate sheets, not inserted in the text.

Each idea submitted must be accompanied by a declaration to the effect that it has been tried and tested, is the original work of the undersigned, and that it has not been offered or accepted for publication elsewhere.

PIP GENERATOR

THIS is an improved version of a circuit that was built for use in a stage play, wherein a player took the role of the telephone "speaking clock", and the circuit generated the "pips".

One push-button activates the circuit (after switch on) after which it cycles through a count of three pips before resetting itself ready for the next push-button operation.

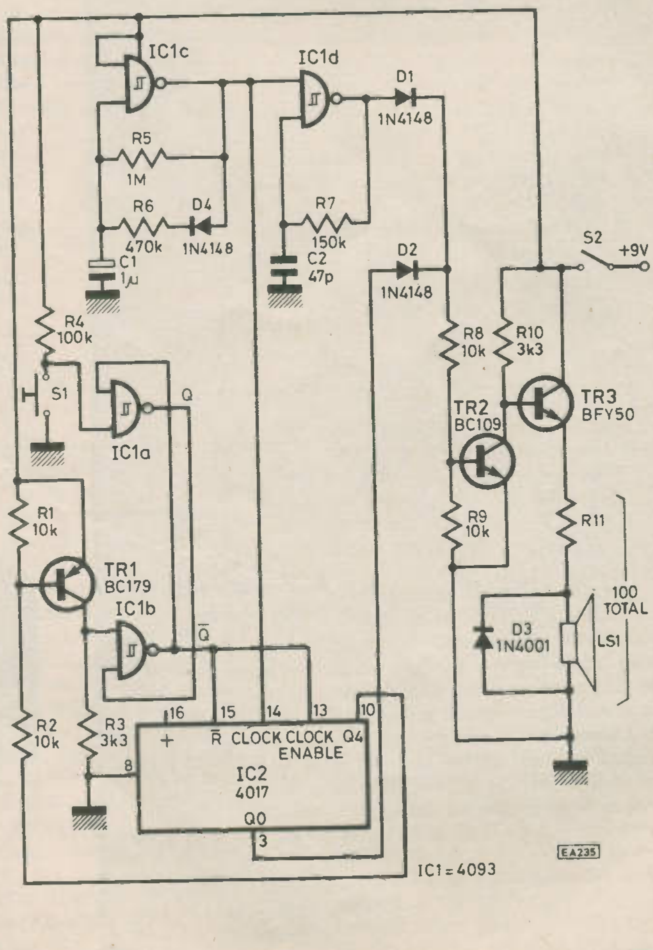
IC1c is configured as a free-running astable multivibrator, with a mark-space ratio of 1:2 and a frequency of approximately 1Hz. Its output provides both clock pulses for IC2, and gate pulses for IC1d, which oscillates at audio frequency.

D1, D2, R8, R9, R10 and TR2, form a two input NOR gate, which gates the audio signal to the amplifier (TR3), and the speaker, depending on the condition of the Q0 output of IC2 (pin 3). This pin is held "high" when IC2 is in its reset state, and goes low on the first clock pulse after the reset is removed.

IC1a and IC1b form a conventional flip flop which is "set" by S1 being momentarily closed, and "reset" when TR1 is switched off by a "high" output from IC2, Q4 (pin 10). Pin 10 goes "high" on the rising edge of the fourth clock pulse from IC1c after the circuit has been activated.

The circuit has always been found to assume its reset state after switch 2 was closed and therefore no initialising circuitry was included.

John D. Ritchie,
Cranwell,
Lincs.



GRAPH DISPLAY UNIT

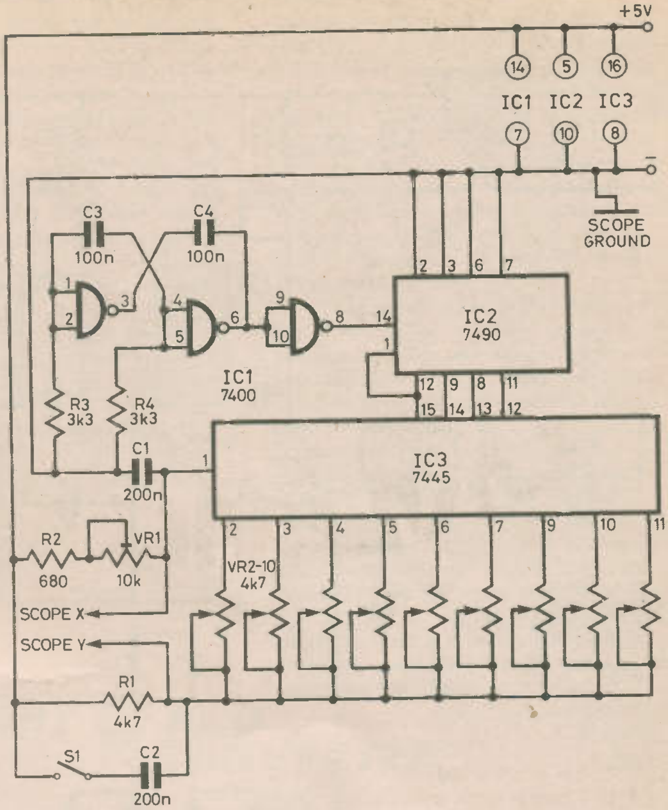
THIS is a device which will display a graph on a cathode ray oscilloscope or converted TV. The graph may be in block form, or a point to point configuration. It will give a simulated computer display with applications in the sales office or classroom and may be expanded to give more entries.

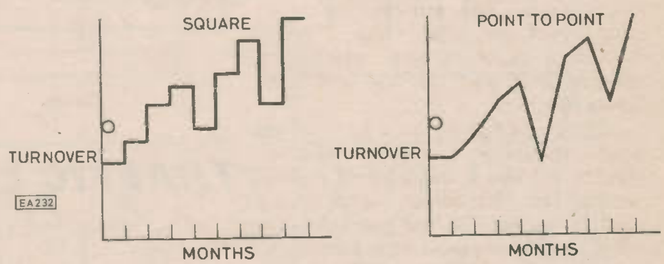
IC1 functions as a continuous clock feeding into IC2 decade binary adder. The four outputs are decoded by IC3 which now operates as a sequential switch with open collectors.

At the decode state 0, C1 is grounded for the duration of one clock pulse, but subsequently begins to charge up via VR1. This potentiometer must be adjusted so that it grounds in the next cycle, before the upper part of the exponential curve is reached. This sawtooth waveform is fed into the X input of the scope. The outputs 1-9 each go to variable resistors which set up wave amplitude. These join a common load R1 where the Y signal is generated. A capacitor C2 of about 200nF will angle off the leading edges of the square waves to produce a simulated point to point graph.

One may be tempted to omit the X generator but during adjustment severe sync problems arise. Rather than calibrate the potentiometers, a simple acetate sheet graticule will permit easy setting up. The perimeter can include a central zero line and minus figures can be entered by simple manipulations.

B. Darnton,
Romsey,
Hants.





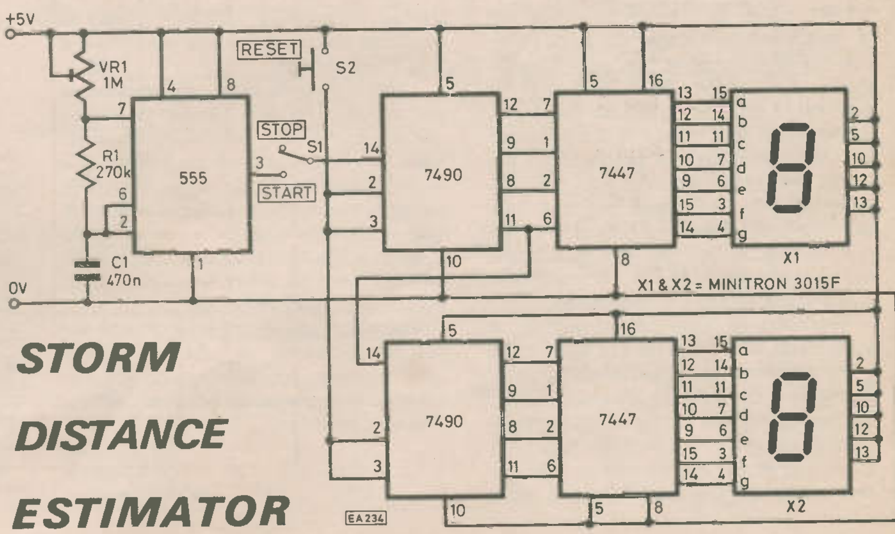
EA232

STORM DISTANCE ESTIMATOR

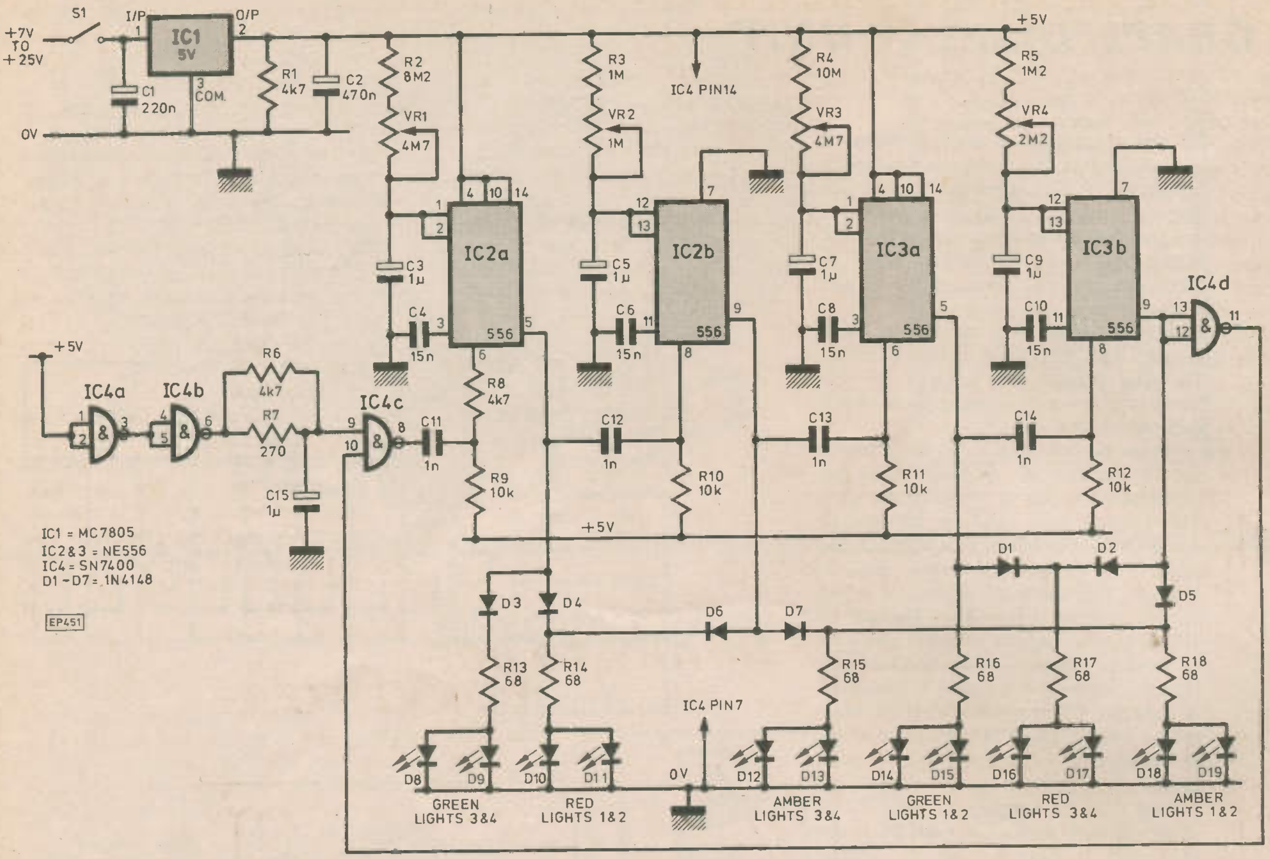
EVER wanted to know how far a thunderstorm is from you? One old method was to count the interval between the lightning and the thunder, giving an answer in miles. But as sound travels at 330m or 1090 feet/second this method is highly inaccurate.

To measure this more accurately a device is needed which counts at approximately 1 count per 3 seconds (sound travelling approximately 1km in 3 seconds). The circuit consist of a 555 timer oscillating at 3·33Hz driving a two digit counter. Display X1 shows ×0·1km and X2 × 1km. To operate the unit S1 is set to the stop position and S2 pressed to reset the counters. When a lightning flash is seen S1 is set to the start position and returned to the stop position when the thunder is heard. The distance is then read.

R. Jonasar
Aylesbury
Bucks



EA234



TRAFFIC LIGHTS

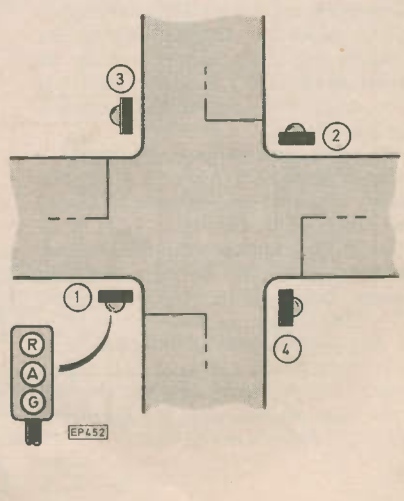
THE circuit is basically two 556 i.c. timers used in a sequential mode to action the sequencing of two sets of traffic lights. The traffic lights being 0·2in diameter. l.e.d.s coloured red, green and yellow. Each half of the 556 is responsible for the respective times generated for the colour sequence, commencing with red eight seconds, red/yellow one and half seconds, green fifteen seconds and amber two seconds, these times may be adjusted by altering values of R/C connected to pins 1 and 2/12 and 13, respectively.

The timers are connected in a monostable mode, the first half of the timer being triggered by negative going pulse through pin 6, output 5 goes positive causing the appropriate colour to be displayed through the respective blocking diode. As the timing period elapses output 5 falls to zero transmitting a negative going pulse through a coupling capacitor to pin 8, triggering the second timing period and a new colour display.

These operations are in turn repeated on the second 556 also further displaying colour sequences, where upon final negative going edge from pin 9 is fed to a SN7400 gate ready to repeat the whole sequence again. The 4·7 kilohm resistor in series with initial trigger will ensure reliable triggering. The SN7400 gates with delay is included only to overcome any spurious triggering at initial switch on.

The colour sequence discussed is for the first set of directly opposite traffic lights note the other pair have exactly the opposite colour sequence of green, amber, red, red and amber.

R. J. Jones,
Keighley,
West Yorkshire.



BINARY TO BCD CONVERTER

IT is easier to comprehend decimal data than pure binary or hexadecimal numbers, but most of the digital circuits operate on the basis of binary numbers alone. It is most convenient if the binary data can be converted to BCD where human observation is required. Such a device can be built with 74185 binary to BCD converter i.c.s, but it becomes an extremely expensive solution when the binary word is long. The given circuit can perform the same task at a lower cost, when the word-length is more than 8 bits long, but it requires considerably longer conversion time.

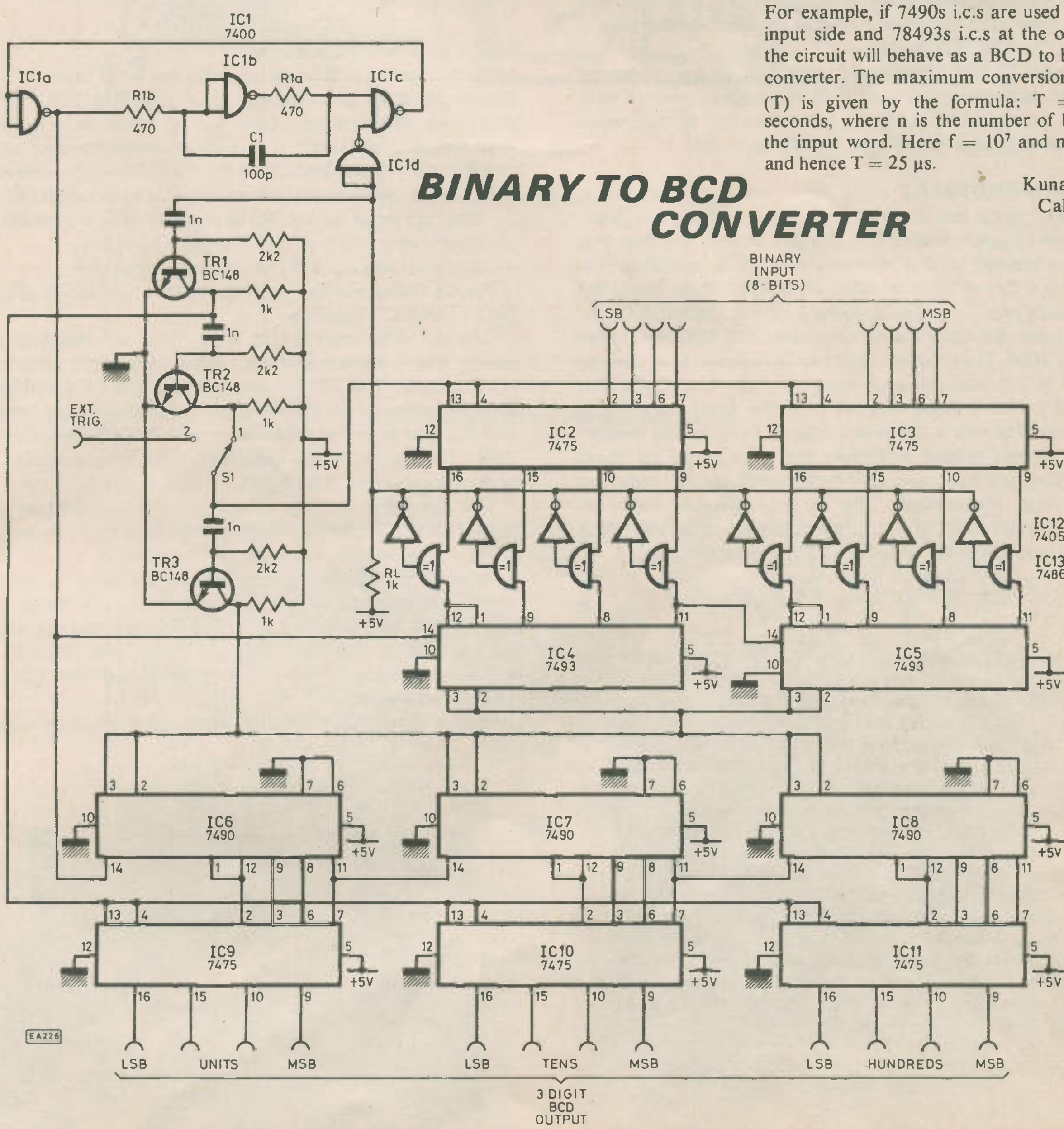
Here the input data is latched by a set of 7475 i.c.s. This data is then compared with the output of a binary counter which counts from zero upwards. The comparator is formed by a set of EXCLUSIVE-OR gates and its outputs are inverted and then wire ANDed. Maximum value of the load resistor R_L can be determined by the formula: $R_{L(max)} = 10{\cdot}4/(N+0{\cdot}4)$ kilohms, where N is the number of bits compared and the minimum value is $R_{L(max)} = 400$ ohms. The binary counter is driven by a high frequency clock and the same clock pulses are also counted by a set of BCD counters (7490s).

When the latched input data and the outputs of the binary counters become equal, the comparator inhibits the clock. At this instant the data in the BCD counters are transferred to the output by another set of 7475 i.c.s.

The clock is built around a 7400 and the frequency is set by C1 at 10 MHz. It can be changed, if necessary, by changing C1 and the frequency is given by $f=1/2C1R1$, where R1 is in ohms and C1 in farads. Three transistors are used in a delay line which controls the correct sequence of operations. If the switch is in position 1 then the circuit will sample the input as soon as one conversion is complete. In position 2 the circuit will sample the input only when a short pulse is applied to the external trigger input and, then, after converting this data it will wait for the next trigger pulse to come.

The circuit as shown is for 8 bit binary input, but it can be easily expanded or reduced by using appropriate numbers of counting i.c.s both in the input and the output side. The input and output latches can be eliminated if they are found redundant in a particular application. This circuit can act as a universal converter if the counting i.c.s are changed according to the need. For example, if 7490s i.c.s are used in the input side and 78493s i.c.s at the output, the circuit will behave as a BCD to binary converter. The maximum conversion time (T) is given by the formula: $T = 2^n/f$ seconds, where n is the number of bits in the input word. Here $f = 10^7$ and $n = 8$ and hence $T = 25$ µs.

Kunal Sen,
Calcutta,
India.



Digital COUNTER/TIMER

PART 2

Dr. MARK SAWIKI and ALEX KOWALEWSKI B.Sc.

CONSTRUCTION of the Universal Counter-Timer is straightforward using the component layout as shown in Fig. 2. (components side).

The only components which are soldered on the copper side are two capacitors i.e. 33µF/10V—tantalum type and a small ceramic 100n. The reason for the above pair of capacitors being soldered into the copper side (main Board) is simple; they should be as close as possible to the pins 8 and 18 on the ICL 7216A chip.

The Intersil 7216A Universal Counter i.c. is manufactured using a low voltage metal gate C-MOS process, and as with all CMOS products, should not be subjected to excessive levels of static charge in storage, handling or use.

GENERAL HARDWARE

All the electronics are planned into three p.c.b.s, i.e. Main Board, Power Supply Board and Display Board. The first two should be screwed to the aluminium chassis, which is formed out of a 2mm thick aluminium sheet, using insulated plastic screws and nuts. The prototype of the Universal Counter/Timer uses standard instrument case (RS 509-901) also obtainable from many other electronic suppliers. A display "window" is cut into the enclosure front panel and the display board p.c.b. is fixed directly into the front panel. It is recommended to use a polarised filter in front of the display segments as this greatly improves the contrast of all visual displays. The authors used a red coloured display filter on the prototype instrument. The l.e.d. segments may be soldered directly into the p.c.b., however, the use of a suitable segment socket (RS 401-730) is possible.

All front panel slide and rotary controls are absolutely standard, obtainable from practically everywhere, one suggestion, however seems to be worth noting; after a few months of using the instrument, the possibility of replacing the HOLD and RESET subminiature rocker switches with subminiature pushbuttons, but obviously this is quite non-critical, merely an operational preference.

SOCKETS AND CABLES

Both channel A/B input sockets are a 75 Ohms BNC type similar to most professional counters. The BNC socket is also used on the output from the oscillator (mounted at the rear of the enclosure). It is highly recommended to use a proper quality screened cable for the following connections:

1) Channel input socket (A) to channel attenuator (A)
2) Channel input socket (B) to channel attentuator (B)
3) Attenuator output (A) to pre-amp input (A)
4) Attenuator output (B) to pre-amp input (B)

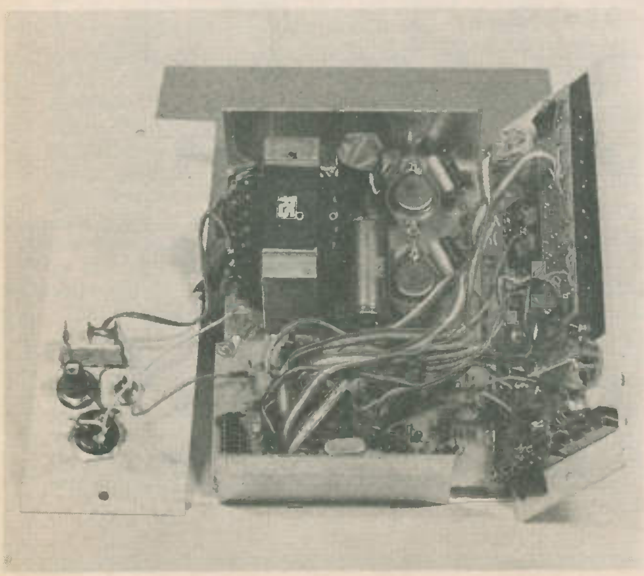
As on many similar occasions, all input leads should be kept as short as feasible.

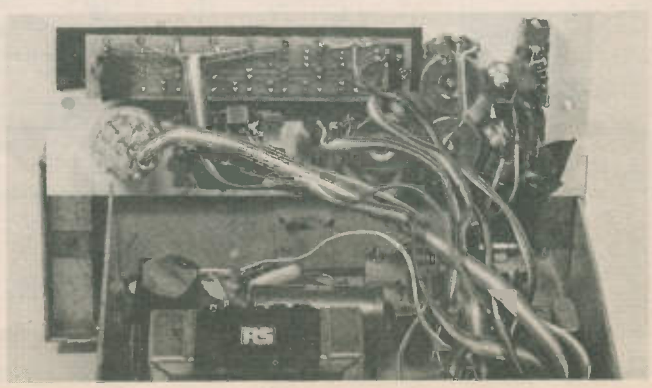
The 7216A Intersil chip is a really excellent one from nearly every aspect and no problems should occur during construction. The 7216A counter chip uses a 10MHz quartz crystal timebase which in this prototype was suppied by RS., and housed in a metal can with wire ended leads (RS. 307-799). The above crystal should be used in conjunction with a crystal socket (RS. 401-936).

For convenience and simplicity, 20 way ribbon colour-coded cables are used, which can be split into any number of ways by tearing between the conductors.

A word about the voltage regulators used in the instrument's power supply unit. Both the TO3 fixed voltage (LM309K) regulators are soldered directly into the p.c.b. and no heatsink is required. The LM309Ks are rated at about 1·2A each (Ref. 5 ± 0·2V) and the instrument uses about 150mA at 5V per rail.

The Power ON/OFF control is a red neon illuminated rec-





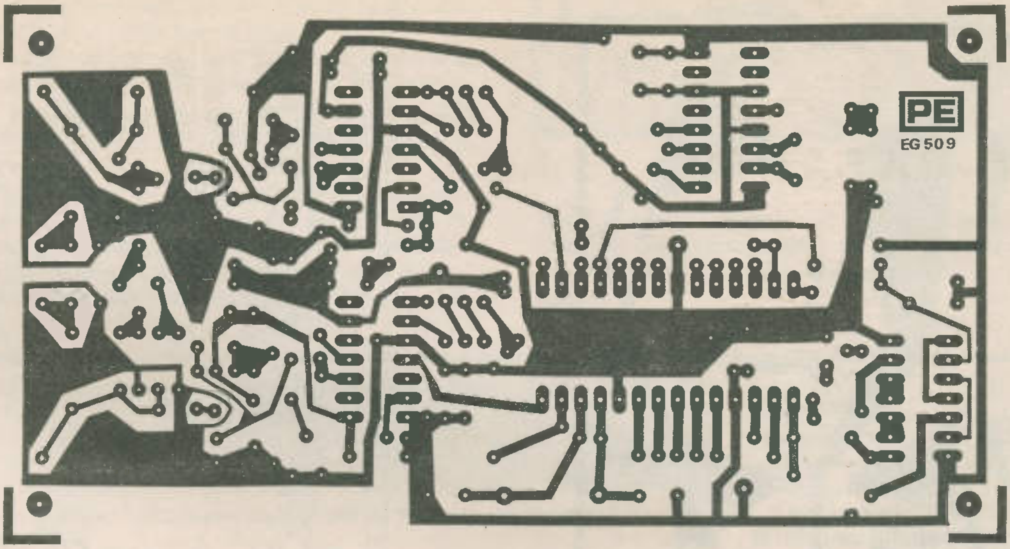
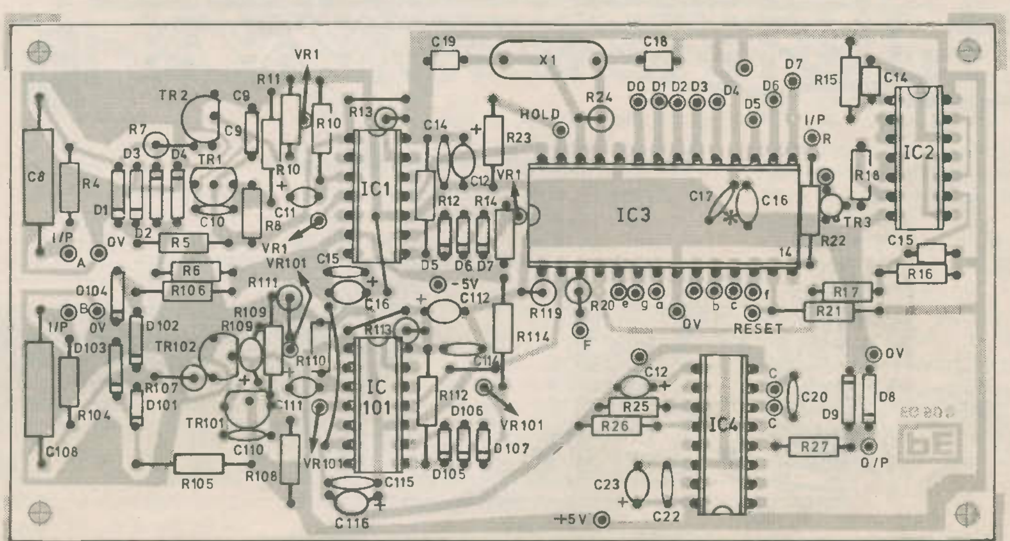


Fig. 2.1. Main Board p.c.b. (actual size)

Fig. 2.2. Main Board component layout



*MOUNTED ON UNDERSIDE OF P.C.B.

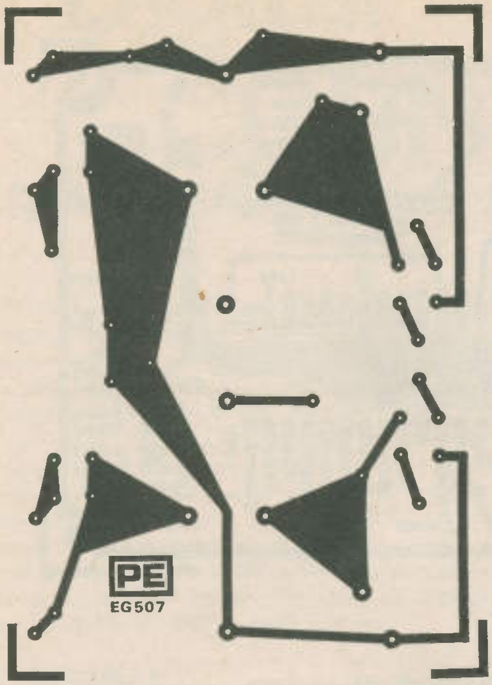


Fig. 2.3. PSU printed circuit (actual size)

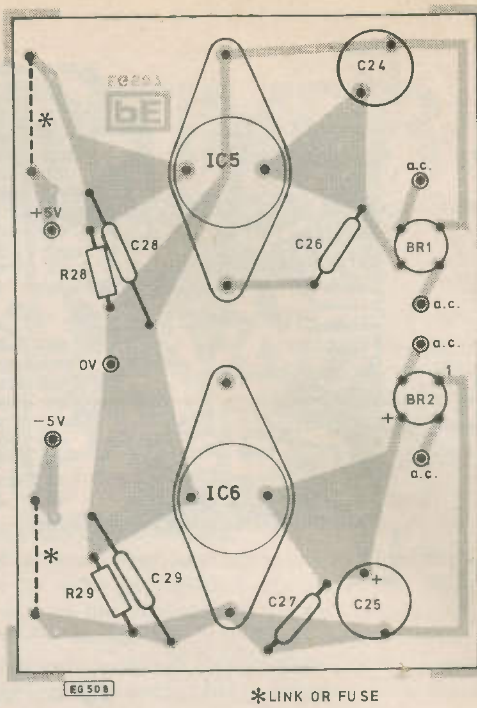


Fig. 2.4. PSU component overlay

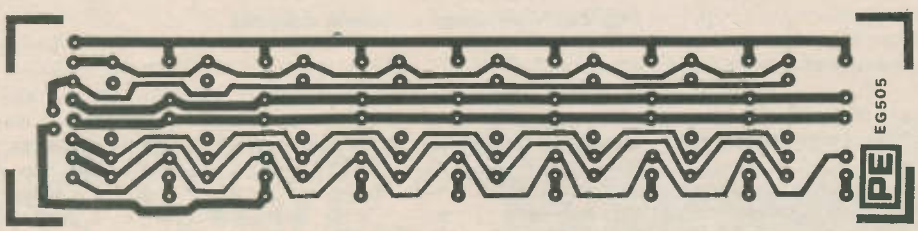


Fig. 2.5. Display Board p.c.b. (actual size)

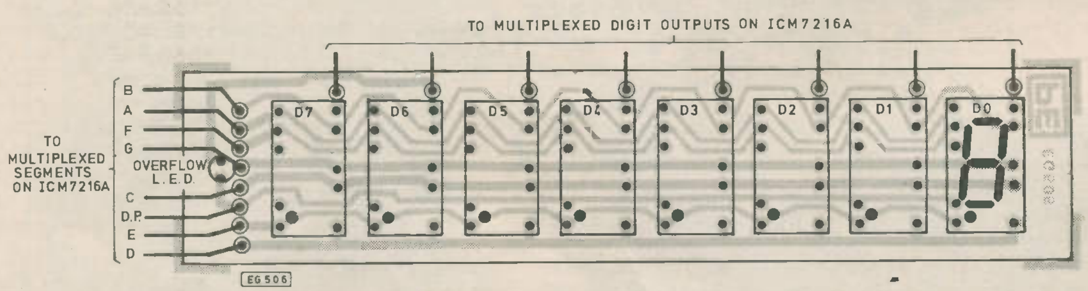


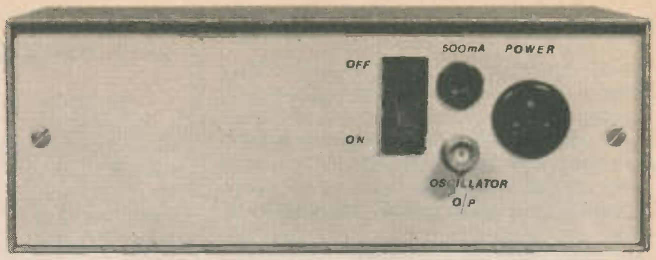
Fig. 2.6. Display Board component overlay

tangular I.E.C. switch mounted on the rear side of the instrument, and a safe 3-pin earthed type mains "Euroconnector" type socket is used.

The supply protection is 500mA/240V "Fast-Blo" 20mm glass type fuse, housed in the appropriate type of fuseholder and mounted directly next to the mains socket.

After completing the assembly of all the components and sub-systems, no alignment or tuning is required and the instrument should work from go. Because of the nature of the ICM 7216 chip, the frequency will be displayed in KHz, and time is displayed in µSec.

The display is multiplexed at 500Hz with about 12·5 per cent duty cycle for the individual digit. The ICM 7216A is designed for common anode display and a typical peak segment current consumption is approximately 25mA. An interesting point is that Intersil claim that in the "Display Off'



mode both digit drivers and segment drivers are turned off, enabling the above display to be used for other functions should the instrument be incorporated into a multi-function system. ★

MICRO PROMPT

The hardware and software exchange point for PE computer projects

OF TELETYPE AND BAUD

Sir—As yet another satisfied compukit UK101 owner I have had particularly great pleasure from the many notes and updates in relation to this system. In this connection I have made a couple of observations that might interest other readers, as well. First, I have found that the hardware modification described by Dr. A. A. Berk in his 'compukit update' of March 1980 can be simplified somewhat.

However, there is no need for his point (3). Leaving pin 11 of IC63 connected with pin 11 of IC57 instead of moving it to pin 12 will still give the 'divide-by-nine' effect that is the aim of the rearrangement. The main difference will be that of the duration of the pulse fed from IC57 to IC63. But since it only functions as a clock pulse for IC63, its duration is not cricitical.

I quite agree that it may be worth while to make the modification switchable, and this will be much easier by leaving pin 11 of IC63 tied to pin 11 of IC57. The remaining changes, including the shift from 'C3' to 'C5' of IC60 for the clock pulses to be fed into IC57, can then be completely taken care of using any ordinary type of double pole, double throw switch. I have found this to work perfectly!

On the other hand, in his 'compukit update' of June 1980, Dr. Berk also refers to a soft BAUD rate modification suggested by Mr. C. S. K. Clapp. It works through the modification of the 6850 ACIA routine, by POKEing 82 into its address of 61440, in combination with the modifications shown in his Fig. 2. As can be seen, the resetting of the counter IC57 after modifying is obtained—not by 'clear'ing, as originally—but by loading a binary number into its data inputs a, b, c and d on reaching its twelfth count. After the modification one of these data inputs is tied to the 'RTS'-output of the ACIA. If this output is at a logical 'low', IC57 will then receive zero to its data inputs (all the others remaining permanently grounded). During initialization through the compukit monitor routine, the 'RTS'-output will be set to a logical 'low' level, corresponding to just this case. Consequently, the counter will then go through a 'divide-by-thirteen' cycle, resulting in 300 BAUD, exactly as in the unmodified case.

By POKEing 82 into the ACIA address, one of the changes produced will be the setting of 'RTS' to a logical 'high' level. This, then, results in presetting the IC57 counter to a non-zero number, with the overall consequence of reducing the counting cycle. However, by connecting 'RTS' with pin 4 (data input b) of IC57 the effect of preloading with binary 0010 (decimal 2) will result, giving a net 'divide-by-eleven' cycle. This is clearly wrong. 'RTS', from pin 5 of IC14 should instead be tied to pin 5 of IC57! This gives preloading with binary 0100 (decimal 4), resulting in a 'divide-by-nine' cycle.

The other effect of 'POKE 61440,82' is to change the internal division ratio of the 6850 ACIA from 1:16 to 1:64 (while maintaining the output format of 1 start bit +8 bits +2 stop bits, with no parity, also used in the default case). Thus, the resulting BAUD rate can readily be calculated from the 125 kilohertz pulse train that IC57 receives from 'C3' of the master counting chain:

$$125000/(9*2*64)=108{\cdot}5$$

This is, of course, exactly the same BAUD rate as that obtained by the hardware modifications described earlier, and it is definitely close enough to the ideal 110 BAUD for problem-free operation with an ordinary teletype printer. I have, as a matter of interest, made it a point here to support this claim by choosing to write these lines on my compukit and have them printed just on such a printer, hooked onto my 108·5 BAUD converted interface through a 20 milliamps current loop. For convenience, I chose the hardware version, myself (although I also tested out the soft BAUD modification). I now can select to my heart's delight from tele-type 110 BAUD, cassette 300 or 600 BAUD, and finally processor frequencies of 1 or 2 megahertz! All works very reliably.

I have nothing but praise for the potential of the compukit system, considering its reasonable price class. And I hope, among other things, to see a great many more write-ups relating to it, in future issues of your interesting magazine.

Gisle K. Dyvik
Norway

UNCRASH

Sir—During my thirteen months use of my Ohio Superboard, I have discovered a few most interesting and original short cuts for anyone using the machine. One I am submitting for publication here. The routine below can be used for any Ohio machine, and the UK101. Its purpose is to get back into BASIC with the user's program intact. During use of the machine, page zero can be disrupted due to a careless POKE, programming error, etc. This is where my routine comes in. With page zero in disarray, it is impossible to get back into BASIC and/or save your program or in any way avoid the loss associated with a crash. However, by doing the following, if the RAM storing the program has not been disrupted, the user may continue programming in the usual way as though nothing had happened.

1) **PRESS** *BREAK, C, BREAK, M*
2) **TYPE:** */4C, 74, A2, 4C, C3, A8, Ø5. AE*
3) **PRESS** *BREAK, W*
4) *A warm start should now occur. You may now carry on in the usual way.*
5) *NOTE: If locations 11 and 12 have been changed, they will now be restored to their original value. They may be changed back to your values by POKEing them in the usual way.*

R. Wells,
Margate.

MAPPING, GET IT RIGHT!

Sir—In your September issue Mr. M. C. Mannering pointed out an error in the address decoding of the UK101. However a second fault also exists in the decoding: The keyboard address decoding only uses address lines A15–A10 for generating the *keyboard enable signals $\overline{RKB}$ and WKB. This results in the keyboard occupying a 1K block of memory from DCØØ-DFFF (Hex), instead of just one location as suggested in the manual.*

As Mr. Mannering found these faults only show up when experimenting with memory mapped peripherals. Thus anyone contemplating adding an expansion should have a clear idea of what areas of memory are available. With this in mind before expanding my Compukit, I made out two useful charts.

The first is a hardware memory map which is intended to show exactly where devices are found in memory and where free blocks occur. The second chart indicates what address decoding is available on-board, and the range of addresses which they cover.

These charts show the two faults, but also indicate the existence of useful empty blocks of memory and spare decode lines available. Two separate 1K blocks with Read and Write $\overline{\text{Enables}}$ are available and would be perhaps suited to an expansion to the video RAM or anything else requiring separate Read, Write Enables. IC17 provides effectively 7 spare decode lines for blocks of 256 Bytes form F1ØØ-F7FF. This is achieved by using A10 as another "Enable" line. This way two expansion's may share a common output provided A10 activates one when high and another when low. Spare "Enable" lines suitable for 8K RAM cards are also available.

I think these charts would be very useful for any of your readers wishing to expand their Compukit, as it helps avoid mistakes like placing a programmable sound generator in the ACIA memory block (or didn't you notice that slip?).

David McDonnell,
Eire

Hmmph . . . Yes, we did notice . . . afterwards! See "PSG Bug", Micro Prompt, November 1980—Ed.

UK101 HARDWARE MEMORY MAP **Fig. 1**

Location: Hex.	Location: Decimal	Memory: Type	COMMENTS
ØØØØ	0	RAM	PAGE ZERO;
TO			SCRATCH PAD RAM
ØØFF	255		
01ØØ	256	RAM	PAGE ONE;
TO			STACK
Ø221	545		
Ø222	546	RAM	UNUSED—USING NEW MONITOR EPROM
TO			This region seems to exist between Ø223 and
Ø2FA	762		Ø2FA
Ø3Ø1	769	RAM	PAGE THREE;
			BEGINNING OF BASIC WORKSPACE
Ø3FF	1Ø23	RAM	END OF FIRST BLOCK OF 1K RAM
Ø7FF	2Ø47	RAM	END OF 2K OF RAM
ØBFF	3Ø71	RAM	END OF 3K OF RAM
ØFFF	4Ø95	RAM	END OF 4K OF RAM
13FF	5119	RAM	END OF 5K OF RAM
17FF	6143	RAM	END OF 6K OF RAM
1BFF	7167	RAM	END OF 7K OF RAM
1FFF	8121	RAM	END OF 8K OF RAM
			END OF ON-BOARD USER RAM
3FFF	16,383		END OF 16K OF RAM
5FFF	24,575		END OF 24K OF RAM
7FFF	32,767		END OF 32K OF RAM
9FFF	4Ø,959		END OF 4ØK OF RAM
			HIGHEST ADDRESS TO WHICH USER MEMORY MAY BE CONTINUOUSLY EXPANDED
AØØØ	4Ø,96Ø	ROM	BEGINNING OF 8K BASIC INTERPRETER
TO			
BFFF	49,151	ROM	END OF BASIC INTERPRETER
CØØØ	49,152		FREE; TOTAL = 4K
TO			
CFFF	53,247		
DØØØ	53,248	RAM	VIDEO REFRESH MEMORY
TO			TOTAL = 1K
Ø3FF	54,271		
Ø4ØØ	54,272		FREE; TOTAL = 2K
TO			
ØBFF	56,319		
DØØØ	56,320	PERIPHERAL	KEYBOARD OCCUPIES THIS BLOCK
TO			TOTAL = 1k
DFFF	57,343		
EØØØ	57,344		FREE; TOTAL = 4K
TO			
EFFF	64,439		
FØØØ	61,44Ø	PERIPHERAL	ACIA; TOTAL = 256 BYTES
TO			
FØFF	61,695		
F1ØØ	61,696		FREE; TOTAL = 1791 BYTES
TO			
F7FF	63,487		
F8ØØ	63,488	ROM/EPROM	OPERATING MONITOR
TO			
FFFF	65,535		END OF DIRECTLY ADDRESSABLE MEMORY

XY VIDEO

Sir—I would like to put forward a much more simple way to 'POKE' information onto the screen. The statement is:

```
LET P=53196 + X + (Y*64)
POKE P, N
```

where X is the x-coordinate
Y is the y-coordinate
X must be > 0 and < the end of the line
Y must be > 0 and < 17
eg. If X=24 and Y=7 and N=161, then a white block will be placed at location 53668.

Gerhart Ellett,
Gt. Yarmouth.

ALWAYS A SIMPLER WAY

Sir—In response to Mr. J. Plews's letter, the INT function in BASIC always rounds down. If one wishes to round to the nearest integer you have to add ·5 (ie. ?INT (10/(2↑1) + ·5) this returns to the value 5.

I'm sure you could have found something better to publish in place of "Just A Little Something". This three line program does the same thing, but for any base less than ten.

```
10 INPUT "NUMBER, BASE"; B$, A
20 FOR B = 1 TO LEN (B$):
   T = T + VAL (MID$(B$, B, 1)) *
   A↑(LEN(B$) – B): NEXT
30 PRINT B$; "=", A: RUN
```

R. Armstrong,
Kilmacolm.
Renfrewshire.

NULL RETURN RECTIFIER

Sir—In the July 1980 Micro Prompt, David Swash pointed out that for the UK101, if Return is pressed in response to an INPUT, then there is a return to command mode, but the program can be restarted using Cont. Although this is true, it is not always very useful, for example if the VDU display is a combination of direct mapping and PRINT statements.

The problem can sometimes be avoided by keyboard polling, or by PEEK (531), this

UK101 ADDRESS DECODING

Fig. 2

NOTE: all outputs are active low

Range (Hex) Low	High	IC No.	Pin No.	In Use	COMMENTS
ØØØØ	1FFF	23	15		8K BLOCK; ENABLES IC22
ØØØØ	Ø3FF	22	7		RSØ: 1K RAM ENABLE
Ø4ØØ	Ø7FF	22	9		RS1: 1K RAM ENABLE
Ø8ØØ	ØBFF	22	1Ø		RS2: 1K RAM ENABLE
ØØØØ	ØFFF	22	11		RS3: 1K RAM ENABLE
1ØØØ	13FF	22	12		RS4: 1K RAM ENABLE
14ØØ	17FF	22	13		RS5: 1K RAM ENABLE
18ØØ	1BFF	22	14		RS6: 1K RAM ENABLE
1CØØ	1FFF	22	15		RS7: 1K RAM ENABLE
2ØØØ	3FFF	23	14		8K BLOCK; UNUSED
4ØØØ	5FFF	23	13		8K BLOCK; UNUSED
6ØØØ	7FFF	23	12		8K BLOCK; UNUSED
8ØØØ	9FFF	23	11		8K BLOCK; UNUSED
AØØØ	BFFF	23	1Ø		8K BLOCK; ENABLES IC17 DECODER No. 1
AØØØ	BFFF	15d	13		BS BASIC SELECT FOR 8K ROM
AØØØ	A7FF	17	7		BSØ; BASIC ROM SELECT
A8ØØ	AFFF	17	6		BS1; BASIC ROM SELECT
BØØØ	B7FF	17	5		BS2; BASIC ROM SELECT
B8ØØ	BFFF	17	4		BS3; BASIC ROM SELECT
CØØØ	DFFF	23	9		8K BLOCK; ENABLES IC20 V LINE ALSO DECODES THIS BLOCK
DØØØ	D3FF	20	12		1K BLOCK; DECODES VIDEO RAM ON READ PORTION OF R/W CYCLE
DØØØ	D3FF	2Ø	7		1K BLOCK; DECODES VIDEO RAM ON WRITE PORTION OF R/W CYCLE
D4ØØ	D7FF	2Ø	13		1K BLOCK; ENABLED ON READ PORTION
D4ØØ	D7FF	2Ø	9		1K BLOCK; ENABLED ON WRITE PORTION
D8ØØ	DBFF	2Ø	14		1K BLOCK; ENABLED ON READ PORTION
D8ØØ	DBFF	2Ø	1Ø		1K BLOCK; ENABLED ON WRITE PORTION
DCØØ	DFFF	2Ø	15		1K BLOCK; ENABLES KEYBOARD ON READ
DCØØ	DFFF	2Ø	11		1K BLOCK; ENABLES KEYBOARD ON WRITE
EØØØ	FFFF	23	7		8K BLOCK; ENABLES ACIA AND MONITOR ROM DECODING
FØØØ	FØFF	17	12		256 BYTES; ACS—ENABLES ACIA ASSUMING A11, A1Ø = Ø
F1ØØ	F1FF	17	11		256 BYTES; ASSUMING A11, A1Ø = Ø
F2ØØ	F2FF	17	1Ø		256 BYTES; ASSUMING A11, A1Ø = Ø
F3ØØ	F3FF	17	9		256 BYTES; ASSUMING A11, A1Ø = Ø
F4ØØ	F4FF	17	12		256 BYTES; ASSUMING A11 = Ø, A1Ø = 1
F5ØØ	F5FF	17	11		256 BYTES; ASSUMING A11 = Ø, A1Ø = 1
F6ØØ	F6FF	17	1Ø		256 BYTES; ASSUMING A11 = Ø, A1Ø = 1
F7ØØ	F7FF	17	9		256 BYTES; ASSUMING A11 = Ø, A1Ø = 1
F800	FFFF	19	6		2K; MCS—ENABLES MONITOR ROM

makes string input difficult. The method I prefer is a very simple subroutine which prevents the Basic Interpreter from returning to command mode on a null INPUT.

The input buffer is in zero page, 13H to 59H, and is terminated by ØØH. If Return is pressed in response to INPUT then ØØH is stored in 13H. This is the flag for return to command mode in the INPUT routines. Most of the INPUT subroutines are within ROM, and not directly modifiable. However there is a vectored jump to output the characters to the VDU. The routine is corruptible at this point.

The subroutine, for the new Monitor ROM, is:

```
Ø23Ø   48          PHA
Ø231   A5  13      LDAZ $13
Ø233   DØ  Ø6      BNE $Ø23B
Ø235   85  14      STAZ $14
Ø237   A9  6Ø      LDAIM $6Ø
Ø239   85  13      STAZ $13
Ø23B   68          PLA
Ø23C   4C  D4  FB  JMP $FBD4
```

This can either be entered directly using the Monitor, or POKEd by a BASIC routine at the beginning of the program. It is protected from Reset, and does not need memory sizing.

To be initialised, the output vector in Ø21AH,Ø21BH needs to be changed from FBD4H to Ø23ØH. Again this can be using Monitor, or POKE538,48:POKE539,2 Reset restores the usual vector so POKE is preferable.

The 6ØH in Ø238 is the character INPUT by pressing Return in response to an INPUT statement. In my UK101 character set ASCII 6ØH prints a space but can be distinguished from 2ØH, the usual ASCII space. For numeric inputs this will produce a REDO error, and should be replaced by 3ØH. Pressing Return will then INPUT zero.

A slight modification to this subroutine enables a program to demand a password, and for the password to be entered without printing to the screen. The modification is that the accumulator is not pushed to stack, and the pull is replaced by a load accumulator instruction. Whatever is loaded will be printed instead of the typed characters.

This modified routine should be called only for the password INPUT, as in the following example:

```
05  POKE1,0:POKE2,0:POKE 530,1
10  DATA........ { To POKE subroutine
20
30
50  PRINT CHR$(12)
60  PRINT "PASSWORD?";
70  POKE538,48 : POKE539,2
80  INPUT P$
90  POKE538,212 : POKE539,251
100 IF P$ = "UK101" THEN 150
110 T = T + 1:IF T = 2 THEN PRINT
    "PROG. ABORTED AND
    ERASED" : NEW
120 GOTO 60
150 PRINT "ACCEPTED"
160 REM BODY OF PROGRAM
```

This gives you two chances to give the password—in this case UK101—and if you fail erases the program. It prevents the use of Return and then LIST to discover the password, Reset, (W)arm Start, LIST is jammed by line 05, as is Control C. It still allows entry to the Monitor, but protecting against this is probably excessive for most programs likely to run on the UK101.

Bob Potter,
Oxford.

DEVELOPMENT TOOL?

Sir—In the July issue of Practical Electronics *you published two programs, a variable save and a screen editor program, although it is possible to load both these programs into memory it is not possible to run them both at the same time. This is an obvious disadvantage as they are both essential aids to program development, and one without the other is a bit of a hindrance to program development. I, having only just started to unravel the mysteries of machine code and not knowing an awful lot about it, was wondering if it is possible to link these two programs together to produce a very useful program development tool. I am hence writing to you to request your help, or that of your readers, to enable the two programs to be executed as one.*

Johann ckh Riedel,
Solihull.

GREMLINS

A compulsive game has been submitted by *Mr. J. Semple* of Jesus College, Oxford. We are told that 60 is a good score, and 89 is the highest so far. We added sound just for fun, and this is underlined for those who have no sound board. Just leave out the indicated instructions for silent suffering. Note that the sound unit is assumed to be located at 61808 and 61809 decimal (**R**1 & R2 in Line 10). Only line 10 need be changed to re-vector for the Sound Board if located elsewhere.

```
10 R1=61808:R2=R1+1:DIMF(13)
20 FORI=1TO16:PRINT:NEXT
30 INPUT"DO YOU WANT INSTRUCTIONS ";A$
40 IFLEFT$(A$,1)="Y"THENGOSUB5010
45 PRINT:INPUT"ENTER GAME SPEED 0-10 ";Z:Z=ABS(Z)
47 FORI=1TO200:NEXT
50 K=57088:POKE530,1:POKEK,0
80 GOSUB1000
100 GOSUB3000
110 POKEK,239:C=PEEK(K)
120 IFC=247THEND=-64:GOSUB2010
130 IFC=127THENPOKE530,0:GOTO4000
140 POKEK,247:C=PEEK(K)
150 IFC=239THEND=-1:GOSUB2010
160 IFC=247THEND=1:GOSUB2010
170 POKEK,251:C=PEEK(K)
180 IFC=239THEND=64:GOSUB2010
190 GOTO100
1000 FORI=1TO16
1010 PRINT:POKE54219,161:POKE54265,161
1020 NEXT
1030 P=53457:POKEP,6:LL=32
1040 S=0:S1=0
1050 F=66:POKE53280,F+32
1060 POKE54220,32
1070 POKE53282,48:POKE53283,48
1080 POKE53456,65:POKE53490,66
1090 POKE54032,68:POKE54066,67
1100 RETURN
2010 LK=PEEK(P+D)
2015 IFLK>64ANDLK<69THEN2025
2020 IFLK<>32THENGOSUB5100:GOTO2100
2025 POKEP,LL
2030 P=P+D
2035 LL=LK
2040 POKEP,6
2050 IFLL<>FTHEN2100
2060 S=S+1:F=F+1:POKEP,188 :GOSUB5150:IFF=69THENF=65
2070 POKE53280,F+32
2080 IFS=10THENS=0:S1=S1+1
2090 POKE53282,S1+48:POKE53283,S+48
2100 FORI=1TO100-10*Z:NEXT
2110 RETURN
3000 CO=CO+1
3010 IFCO<>10THENRETURN
3020 CO=0
3030 PP=53259+46*RND(89)+64*INT(16*RND(76))
3040 IFPEEK(PP)<>32THEN3020
3050 POKEPP,187
3060 RETURN
4000 PRINT:PRINT:PRINTTAB(15);"GREMLIN"
4010 FORI=1TO9:PRINT:NEXT
4020 UU=10*S1+S
4030 PRINT"  YOUR SCORE = ";UU
4040 IFUU>UTHENU=UU
4050 PRINT:PRINT" THE HIGHEST SCORE SO FAR = ";U
4060 PRINT:PRINT:INPUT"DO YOU WANT TO PLAY AGAIN ";A$
4070 IFLEFT$(A$,1)="N"THENEND
4080 PRINT
4090 GOTO30
5010 PRINT"YOU (";CHR$(6)") MUST CIRCULATE THUS:"
5015 PRINT"A..B..C..D..A..B..C  etc."
5020 PRINT"SCORING ONE POINT AT EACH LETTER."
5025 PRINT"...BUT THE GREMLINS WILL OBSTRUCT YOU"
5030 PRINT"WITH INCREASING NUMBERS!"
5035 PRINT
5040 PRINT"MOVE ";CHR$(6);"              UP KEY Y"
5050 PRINT"                    DOWN   B"
5060 PRINT"                    LEFT   G"
5070 PRINT"                    RIGHT  4"
5080 PRINT"    KEY W FOR RESCUE"
5090 PRINT:PRINT:PRINT:RETURN
5100 F(1)=INT(RND(Z)*255)+1:F(6)=INT(RND(Z)*30)+1
5115 F(7)=9:F(8)=30:F(12)=INT(RND(Z)*25)+5:F(13)=0
5120 POKEP,233:GOTO6000
5150 F(2)=Z*10:F(7)=3:F(9)=30:F(11)=250:F(12)=0
5155 F(13)=4:GOTO6000
6000 FORI=0TO13:POKER1,I:POKER2,F(I)
6010 IFI=7THENPOKER2,255-F(I)
6020 NEXT:RETURN
6100 FORI=0TO13:F(I)=0:IFI=7THENF(I)=255
6110 NEXT:GOSUB6000:RETURN
```

TRACE

Sir—When your UK101 BASIC program starts doing things you didn't intend—or vice versa—then the program "Trace" will help to keep an eye on it. When activated, the program continuously monitors the BASIC interpreter and displays the current line number in brackets at the top of the VDU.

The program is small enough to fit into the free RAM at 546 decimal but equally well it can be loaded at the top of memory in the space protected by the "MEMORY SIZE?" request (its size is 87 decimal bytes).

To load Trace simply run the following BASIC program which can be deleted from memory after use if required. It will ask you where to load Trace and your answer will probably be 546 (free RAM), 4008 (top of 4K) or 8104 (top of 8K). It then prints out two bits of information. The first is a command line which will activate Trace when typed in immediate mode (eg: POKE 11,34:POKE 12,2:X=USR(X)) and the second is a location which can be POKEd at any time in immediate mode with a delay count (1 to 255) allowing the running speed of your program being "traced" to be controlled. This location is set to 3 by default but setting it larger will slow your program down and allow you to keep track of the statement numbers on the screen more easily.

```
62999 REM ** TRACE LOADER. P.BECKETT NOV 80 **
63000 DATA169,0,141,28,2,169,0,141,29,2,96
63001 DATA165,136,201,255,208,3,76,155,255,133
63002 DATA173,166,135,134,174,162,144,56,32
63003 DATA232,183,169,91,141,16,208,169,93,141
63004 DATA22,208,32,110,185,162,0,189,1,1,240
63005 DATA10,157,17,208,232,224,5,240,12,208
63006 DATA241,169,32,157,17,208,232,224,5,208
63007 DATA248,162,0,240,3,32,128,254,232,224
63008 DATA3,208,248,76,155,255
63009 INPUT"Type load address";A
63010 FORI=ATOA+86:READX:POKEI,X:NEXT
63011 S=A+11
63012 S1=INT(S/256)
63013 S2=S-S1*256
63014 POKEA+1,S2:POKEA+6,S1
63015 PRINT"For TRACE startup:"
63016 A1=INT(A/256):A2=A-A1*256
63017 PRINT"POKE11,";A2;":POKE12,";A1;":X=USR(X)"
63018 PRINT"TRACE delay count=";A+81
```

Incidentally, the Trace feature is deactivated every time a warmstart is executed. The top of the VDU was used for the printout rather than the bottom so that line-feeds which may be produced by your program don't cause the screen to be obliterated by a column of numbers.

Trace uses routines in the BASIC ROMs as well as the cassette input routine at FE80 as a delay. It was written for the standard UK101 but using the assembler listing (top right), modifications can easily be made if required.

Mr. P. Beckett,
Blackpool.

```
    LDA  #$2D     A9 2D        SUBROUTINE TO SET UP
    STA  $Ø21C    8D 1C  Ø2    CTRL C VECTOR TO POINT
    LDA  #$Ø2     A9 Ø2        TO THE TRACE ROUTINE
    STA  $Ø21D    8D 1D  Ø2    BELOW
    RTS           6Ø
    LDA  $88      A5 88        IS THE MACHINE IN
    CMP  #$FF     C9 FF        IMMEDIATE MODE?
    BNE  A        DØ Ø3
    JMP  $FF9B    4C 9B  FF    YES—GO TO CTRL C ROUTINE
A   STA  $AD      85 AD        NO—STORE CURRENT LINE NO.
    LDX  $87      A6 87        IN AD/AE
    STX  $AE      86 AE
    LDX  #$9Ø     A2 9Ø        CONVERT INTEGER AT AD/AE
    SEC           38           TO FLOATING POINT AT
    JSR  $B7E8    2Ø E8  B7    AC/AD/AE/AF
    LDA  #$5B     A9 5B
    STA  $DØ1Ø    8D 1Ø  DØ    DRAW LEFT AND RIGHT HAND
    LDA  #$5D     A9 5D        SQUARE BRACKETS ON SCREEN
    STA  $DØ16    8D 16  DØ
    JSR  $B96E    2Ø 6E  B9    CONVERT TO ASCII AT 1Ø1
    LDX  #$ØØ     A2 ØØ
B   LDA  $Ø1Ø1,X  BD Ø1  Ø1
    BEQ  C        FØ ØA        TRANSFER 5 CHARACTERS
    STA  $DØ11,X  9D 11  DØ    FROM 1Ø1 ONWARDS TO
    INX           E8           SCREEN. IF A ZERO IS FOUND
    CPX  #$Ø5     EØ Ø5        GO TO C
    BEQ  E        FØ ØC
    BNE  B        DØ F1
C   LDA  #$2Ø     A9 2Ø
D   STA  $DØ11,X  9D 11  DØ    FILL UP REMAINING
    INX           E8           CHARACTERS WITH SPACES
    CMP  #$Ø5     EØ Ø5
    BNE  D        DØ F8
    LDX  #$ØØ     A2 ØØ        SET UP COUNTER
    BEQ  E        FØ Ø3
F   JSR  $FE8Ø    2Ø 8Ø  FE    DELAY ROUTINE
E   INX           E8           LOOP BACK UNTIL COUNT
    CPX  #$Ø3     EØ Ø3        REACHED
    BNE  F        DØ F8
    JMP  $FF9B    4C 9B  FF    GO TO CTRL C ROUTINE
```

INDEX TO ADVERTISERS

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PRACTICAL
ELECTRONICS

VOLUME 17 **No. 3** **MARCH 1981**

CONSTRUCTIONAL PROJECTS

GENERAL FEATURES

NEWS AND COMMENT

OUR APRIL ISSUE WILL BE ON SALE FRIDAY, 13 MARCH 1981
(for details of contents see page 29)

Market Place

Items mentioned are usually available from electronic equipment and component retailers advertising in this magazine. However, where a full address is given, enquiries and orders should then be made direct to the firm concerned. All quoted prices are those at the time of going to press.

by David Shortland and Jasper Scott

LOW PRICED VIDEO

With a recommended retail price of just £399, Hitachi are launching possibly the cheapest colour video camera available today and one which they claim will appeal to both a newcomer to video filming as well as the ardent enthusiast.

The camera, model VKC 750, has a built in double image optical viewfinder which is linked to a 2·8:1 zoom lens with a focal length of 13·5mm to 37·5mm. Perfectly focussed pictures are obtained every time by lining up the images in the viewfinder and being an optical viewfinder, the user sees exactly what the camera sees.

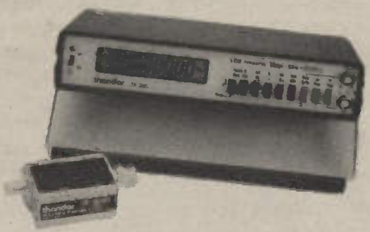
A single pick up tube and the wide use of i.c.s enable the weight and size of the camera to be kept to a minimum. No bigger than a normal 8mm cine camera, it weighs only 4lbs.

Fitted to the camera is a colour temperature control button which operates in conjunction with a balance meter to ensure the correct colour reproduction under varying light conditions. Also on the camera, to get the best possible pictures under dim lighting conditions, there is a high-low sensitivity switch which can be altered when filming in the early evening or under indoor lighting conditions.

A built-in non directional electret microphone of hi-fi sensitivity is fitted to the camera but provision is also made for the connection of an external microphone. Other features include a detachable pistol grip and an on/off button to stop and start the tape.

THANDAR PRESCALER

Designed to provide high sensitivity (better than 10mV r.m.s.) the TP600 from Thandar will extend the upper frequency limit of most frequency meters by a factor of X10 up to a maximum of 600MHz.



The TP600 can be used with the Thandar PFM200 hand-held frequency meter or the Thandar TF200 l.c.d. frequency meter, to extend their frequency range to cover a wide range of specialised applications, including transmitter/receiver test for mobile and ham radio.

The TP600 (pictured here with the TF200 frequency meter) is priced at £37·50 plus VAT. Further information is available from **Sinclair Electronics Ltd, London Road, St Ives, Huntingdon, Cambs. PE17 4HJ. (0480 64646)**

MINI PRINTER

Digitronix Ltd, of Milton Keynes, have launched the Mini-Printer, a compact 32-column printer which they claim to be the lowest-priced universal printer available.

The Mini-Printer accepts conventional ASCII Serial inputs at RS232, TTL and 20 mA current loop levels, at seven baud rates from 110 to 4800, and can therefore interface with almost any microprocessor-based machine. In addition to these user-selectable options, it also accepts data on a parallel port.

The printing unit is of the electrosensitive type, and prints the 64 character ASCII font at 64 characters/sec. on to aluminised paper rolls 59 mm wide. The unit is quiet in operation and has many special features, including double-width characters, and back spacing. On automatic test mode, it will print out a sample set of characters.

The unit is made for the professional market, constructed to a high standard throughout and housed in a rugged steel case size 277 × 138 × 70 mm. Likewise, the electronics are manufactured to provide the highest standard of reliability, especially necessary in remote operation applications for which the Mini-Printer is very suitable.

Mains power is used, but there is provision for low voltage d.c. input, primarily for applications where other Digitronix equipment is interfaced.

Digitronix say that the Mini-Printer is extremely versatile, mainly through the incorporation of a microprocessor based architecture which facilitates reprogramming for special applications. The print font can be changed and, in addition to alphanumeric fonts, the output can be converted to create graphic dot patterns, representing, for example, analogue expressions of measured parameters.

The Mini-Printer is available direct from Digitronix at £195 plus VAT. They can also supply leads, paper etc. For further information contact: **Digitronix Ltd., 10 Burners Lane, Kiln Farm Industrial Estate, Milton Keynes (0908 566888)**

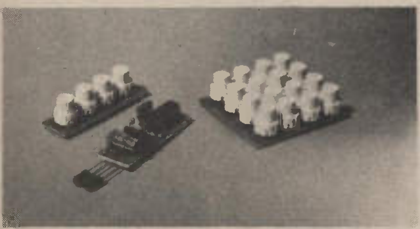
REMOTE CONTROL KITS

TK Electronics, who specialise in Electronic Kits for the hobbyist, have now extended their range of Mini Kits (which include timers and temperature controllers) by introducing a range of remote control kits.

The Mini Kit range consists of units designed to perform certain functions, eg. temperature control, while still retaining full flexibility to enable the user to incorporate them into his own systems if required or alter such parameters as power output or supply voltage.

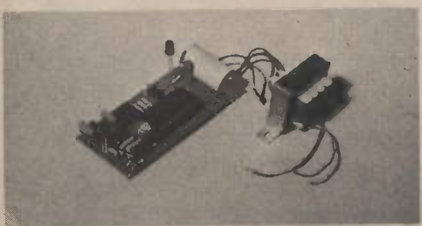
The new kits include the MK6 Simple Infra Red Transmitter, the MK7 Infra Red Receiver, the MK8 Coded Infra Red Transmitter and the MK12 16-Channel Receiver.

The MK6 and MK7 consists of a small hand held transmitter which requires a 9V battery (PP3) and a small mains powered receiver with a triac output cable of switching a mains load of up to 500W. The receiver may be wired for toggle (push on, push off) action or a momentary action, the load being switched off after a preset time, and may be easily modified for operation from d.c. supplies in the 9 to 15 volt range.



The MK8 is an encoded Infra Red Transmitter which also runs from a 9V PP3 battery and measures only 60 x 20 × 13 mm. It can transmit up to 32 different commands depending on the keyboard used. At present the MK9 Four-way and MK10 16-way keypad kits are available for use with this kit, to provide remote switching of up to 4 or up to 16 outputs on the MK12 receiver kit.

The MK12 Receiver is a mains powered unit with 16 CMOS outputs (0 to 15V) which may be interfaced with logic, or used to drive relays or triacs for power switching. A 15V 30mA rail is also available for powering external circuitry if required. The unit may be ordered in the momentary or latched output versions depending upon the application. In the first case, one of the 16 outputs goes high only while a code is being received while the second version latches the output pertaining to the last code received. When assembled, the receiver measures only 60 × 40 × 20 mm. (excluding transformer) and requires only the adjustment of a preset to set up.



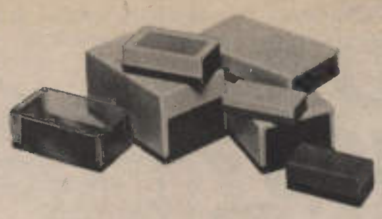
By changing the value of one resistor in the MK8 kit and adjusting the preset on the MK12, simultaneous operation of two or more receivers in the same area can be achieved.

Prices for the kits are as follows; MK6—£4·20, MK7—£9·00, MK8—£5·90, MK9—£1·90, MK10—£5·40, MK12—£11·95. Add 15% VAT and 40p postage.

TK Electronics, 11 Boston Road, London, W7 3SJ.

CUT PRICE CASES

West Hyde Developments have announced significant price reductions on their range of Bocon cases. The reductions have been made



possible by the "Strong Pound", as the cases are manufactured in West Germany.

In particular, West Hyde have reduced prices of the two-tone grey cases in the Bocon range by over 25 per cent. Further details are available from:

West Hyde Developments Ltd., Unit 9, Park Street Industrial Estate, Aylesbury, Bucks. HP20 1ET (0296 20441)

CASIO

The Casio W-100 series of watches, which are able to function underwater to a depth of 100 metres, feature a 12-digit l.c.d. capable of displaying hours, minutes, seconds, am/pm, day, month and year.

Even when operating secondary functions, countdown alarm and stopwatch, and showing appropriate figures in those modes, the W-100's capacity is sufficient to continue dis-

playing the current time in hours and minutes, albeit in an offset position.

Further capabilities include daily alarm function, and half-hourly time signal function.

Casio W series is a range of watches offering a choice of case and bracelet styles. The W-100 itself has resin case and strap at RRP £22·95. W-150C features stainless steel with black resin strap at RRP £27·95. Top of the 'waterproof' range is W-150 with full stainless steel case and bracelet, at RRP £32·50.

HI-FI SOLUTIONS

Two new products that are claimed to give improved sound quality for records and tapes have been introduced by Kanus Chemicals.

"Hi-Degree" solution is simply applied with a soft cloth onto the record surface and penetrates deep into the track to clean away accumulated dust. Static is removed and after one application the record remains permanently anti-static.

Only a microscopic layer which never hardens, softens, thins or gels, is deposited on to the record, providing continuous protection to the track and stylus, reducing wear and maintaining the original sound quality.

It is suitable for all records and eliminates surface 'rustle', reduces scratch noises and improves the quality and clarity of old records.

The second product is 'Eclat' a specially formulated chemical solution designed specifically for magnetic tapes. Applied sparingly with the dropper supplied, Eclat cleans both tape and sound head, removing static and preventing moisture absorption.

Reproduction is enhanced and one of the features is the improved spooling of the tape, preventing binding, breaking and damage when subjected to stopping, shock and uneven tension.

The use of 'Eclat' also eliminates static from the tape and static build up caused by the winding wheels running on the plastic face of the cassette case.

Sixty millilitres of "High Degree" which is sufficient for 100 l.p.s is priced at £2·85 and ten millilitres of "Eclat" which is sufficient for 50 cassettes is priced at £1·80. Both prices include VAT and p&p.

Kanus Chemicals Limited, 56 The Boulevard, Crawley, Sussex, RH10 1XH (0293 25113)

MULTI COMBI

Anyone who has accidentally drilled or nailed through an electric cable or pipe will be interested in the new combined metal detector and voltage probe known as the Multi Combi.

This hand held unit will detect metal objects up to 200 mm and live cables up to 100 mm. There is a sensitivity control for both functions and indication is via a red or yellow l.e.d. the Multi Combi which is powered by a PP3 battery also has a neon test probe for mains checks. When not in use the voltage probe retracts into the body and the search head folds down, automatically switching off the unit.

The Multi Combi is priced at £11·95 inclusive of VAT and p&p.

A Marshall's (London Ltd.), Kingsgate House, Kingsgate Place, NW6 4TA (01-624 8582)

VIDEO GUIDE

With UK sales of video recorders forecast to pass the 300,000 mark by the end of the year, Sony has recognised the need to assist existing owners in utilising their equipment to its best advantage.

The company has produced a 48 page full colour handbook containing comprehensive details not only of the best ways to exploit all facilities of video recorders.

The handbook, entitled 'How To Video', uses simple non-technical language and is available either from Sony's London showroom price 60p or by post (30p extra).

Sony London Showroom, 134 Regent Street, London, W1.

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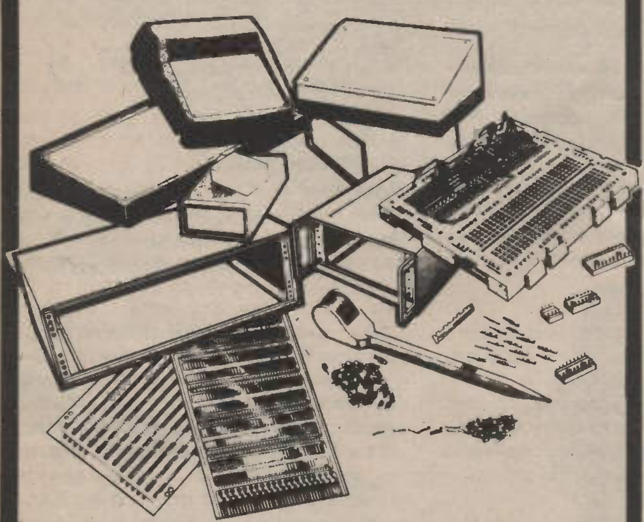

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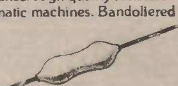

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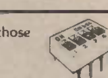

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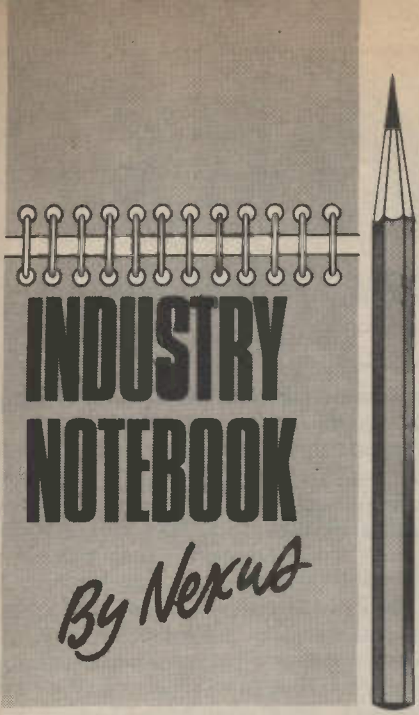

Sparkle

The optimistic sentiment of Industry Notebook throughout 1980 inevitably attracted criticism in a period when British industry in general was being universally portrayed as in a critical state, if not actually wounded beyond recovery. My confidence, of course, was confined to the electronics industry and year-end results proved that confidence was well-founded.

It was a dank December day when GEC, Plessey and Ferranti all brought a touch of sunshine and warmth with their latest trading results. Even in good times the performance of all three would have been creditable. Set against the prevailing gloom they positively sparkled. GEC profits were up from £155 million to £190 million. Plessey first-half profits soared from £19·4 million to £38·6 million. Ferranti was equally impressive with a leap from £3·5 million to £6·4 million. And all three have substantial order books to keep them busy through to 1982 and beyond.

Such results are all the more remarkable when one recalls that quite recently, before major surgery, Plessey's performance was mediocre and Ferranti suffered the humiliation of a 'rescue'. GEC, a conservative plodder rather than a sparkler, proved once again that good products and a diverse market backed by sound management is not only a recipe for survival but also for improvement in bad times as well as good.

Aye, Aye, Sir!

The Racal Group, historically the brightest sparkler of all, is currently maintaining a low profile, financially speaking, while attempting to re-invigorate Decca. Nobody doubts Racal's ability in this respect. Only the length of time needed to effect the transformation.

Chairman Ernie Harrison had no sooner received the Group's 10th Queen's Award than another honour came along. That of Captain of Industry awarded to Harrison by the Livingstone Industrial and Commercial Organisation. Whether the Captain tag will stick is open to question but in the nautical sense it should because Harrison runs one of the tightest and fleetest ships in the business, not to mention new-acquisition Decca with its close association with merchant fleets and navies and his own war-time call-up when he trained as a Fleet Air Arm pilot.

'Captain' Harrison is navigating towards a landfall of £500 million turnover in the current financial year. He will probably make it but with little more, if any, than last year's £61 million pre-tax profits. Racal-Decca is bound to be a drag until its bottom is cleared of branches and that may take a lot longer than a year.

But overall the Group is as lively as ever. On the Racal-Decca trip the new ARPA (Automatic Radar Plotting Aids) radar was well-received. This is the type which is to be a mandatory fit on all large vessels this decade. Racal-Decca hopes to achieve one third of the sales to some 10,000 ships to be fitted and although deliveries will not start until the autumn some 50 sets have already been sold or are in negotiation. R & D cost £2 million and selling price per set is in the £27,000 upwards bracket with a potential sale of £100 million worth over the next ten years.

Elsewhere in the Group a co-operative agreement has been reached with US General Electric in mobile radio which has resulted in the formation of Racal Messenger Ltd headed up by Gerry Whent, a Racal live-wire who says he will be addressing a market worth £500 million a year. Another important agreement is with General Instrument Micro-electronics in which the two companies will co-operate in production of oxide isolated silicon gate CMOS circuits.

Less publicised was another Anglo-USA tie, this time between Decca and Wilcox Electric which has now come to fruition in Racal's emergence as a principal supplier of ILS systems with the first of 37 for the Ministry of Defence already installed at RAF Abingdon. Watch out, too, for Racal penetration of the offshore oil industry spearheaded by Racal-Decca Survey.

De-manning

Although of little consolation to our own unemployed it is worth drawing attention to the difficulties of others resulting not so much by trade recession as of technology change. The flourishing Thomson Group in France, for example, is to axe 5,000 employees by 1983, 4,000 of them in telecommunications because of change in the type of systems being made. This is a parallel of our own switch from electro-mechanical to electronic exchanges. Unskilled labour, according to Thomson will need to be cut by half while qualified engineers employed will increase by one third.

We tend to imagine that drastic changes of this nature are an entirely new phenomenon of the last quarter of the twentieth century. In fact it is only the latest phase of an historical progression. Nobody today would dream of employing a hundred navvies with picks and shovels on motorway construction when a bulldozer manned by a single driver will perform the task quicker, better and more economically.

The silicon chip in its numerous applications is no different in principle, only the newest of a long line of innovative tools invented for a better if not the ultimate 'good' life.

The Association of Professional, Executive, Clerical and Computer Staff (APEX) is complaining bitterly that companies are using the world trade recession as an excuse for shedding staff so that they can introduce new technology 'through the back door'. I don't doubt it, if only because APEX and other like-minded organisations stop it coming through the front door, or let it in only to impose penalties on operation which largely neutralise any planned gains. The Unions, in their view, are performing the function for which they were created but rigid rejection of new practices or excessive demands for compensation can result in total closure as, for example, the Times newspaper group.

According to John Yeomans of Urwick Nexos Ltd, in most Western countries office workers now account for over 50 per cent of the working population and the proportion is still increasing. This area is fertile ground for innovation and the present decade will see enormous expansion in the capital-intensive electronic office. Good news for the supplying electronics industry—bad news for office workers displaced by the electronic revolution.

Continued de-manning or, to put it another way, continuous increase in worker productivity, is here to stay and it seems likely that a level of 10 per cent unemployment will have to be accepted as normal, whatever the pious hopes of politicians.

Captain

Another Captain, unrelated to Captain Ernie Harrison (see above), is Character And Pattern Telephone Access Information Network. This ingenious English-language acronym is remarkable for being purely Japanese in origin and is in fact the name for a Japanese relation of Prestel. Another unusual feature is that the experimental trials proudly started on Christmas Day back in 1979 as if Captain were a special treat, although Japan is a decidedly non-Christian country.

Captain now has over 1,000 terminals operating in the Tokyo area and like Prestel relies on frames of information supplied by nearly 200 organisations such as press agencies, department stores and travel firms. Where Captain differs from other videotext systems is that it will handle hand-drawn pictures and Chinese and Japanese ideographs and syllabaries of extremely complex shape. I often wonder whether the intricacies of Japanese texts and the mental effort to communicate in a far-from-simple script is one reason why the Japanese are so sharp and hard working. Or is our 'simple' 26-character alphabet and formation of words and sentences just as baffling to them as theirs is to us?

AUDIO LINES

BEN DUNCAN

THIS article attempts to answer many of the more perplexing queries associated with audio transmissions in professional and domestic audio applications.

AUDIO MATCHING

Almost without exception, the outputs of audio circuits are treated as voltage sources, and audio equipment interfaces are arranged to cause a negligible voltage loss. There is no intrinsic merit in this approach. Current matching can be equally valid for some systems. But a by-product of transistor audio circuits exhibiting very high open loop gain and using abundant negative feedback (for the sake of good linearity) is a chance to choose the values of input and output impedances. Since audio transducers tend to prefer (or are designed to prefer) voltage matching, audio circuit input and output impedances throughout a system are chosen to accord with this arbitrary matching scheme.

In theory, this boils down to making the input impedance (R_{in}) of a stage at least ten times greater than the output source impedance (R_s) of the preceding stage. In practice, the ratio $R_L/R_s = 10$ is often too low and distortion can result in the preceding stage, particularly when the output voltage approaches the supply rails. A 741 op-amp, for instance, with near 100 per cent negative feedback may have an output impedance of a fraction of an ohm at audio frequencies. But it would not look favourably upon an R_L ten times greater, say 5 ohms, owing to the internal current limit, necessary to prevent excessive dissipation in the i.c.'s output stage.

A 741 will happily feed a 10k load with an output of several volts, however, with $R_L < 2k$, current limiting greatly reduces the output voltage, and the loading decreases the loop gain. The net effect is serious distortion, particularly at high frequencies.

The behaviour of the 741 is typical of the majority of small signal amplifiers, whether discrete or integrated; a good rule of the thumb for these is to make R_{in} no less than 10k. However, the temptation to go to town with ultra-high input impedances is just as partisan as expecting a 741 to drive 600 ohms at $\pm$20dBm. Input impedances in excess of 100k are quite harmless while they are tied down to a low source impedance, but in the case of an unused channel or input (excepting those which can be shorted when redundant), thermal noise, microphony, RFI and capacitively induced hum are foibles to beware of.

In general, input impedances between 10k and 100k are satisfactory. Opt for the 100k region when low cost, domestic audio equipment is being interfaced, and around 10k in PA applications. If you have 300 feet of cable plugged into a 500 watt amplifier, and the plug falls out at the wrong end, or the cable's screen connection breaks, and the amplifier has a 10k input impedance, it will probably do no more than arouse the interest of the sound engineer! On the other hand, an amplifier with a 1M input impedance under the same circumstances is likely to pick up enough RFI, hash, and hum to destroy itself, and an expensive loudspeaker.

BALANCED LINES AND LINE DRIVERS

In professional audio applications, it is often desirable to be able to connect equipment in any combination without worrying about earth loops. Another requirement, being a particularly stringent one in recording studios, is that audio lines must not pick up any interference or stray signals whatsoever.

The balanced line shown in Fig. 1 can meet these requirements. The purpose of the input transformer is to make the signal appear in opposite phases across the lines (B, C). T2, at the input of the following stage, recombines these out of phase signals paying no attention to signals which appear in phase across the lines. The phase of any interfering electromagnetic waves or electric fields acting on the wires will be identical; this assumes that the wavelength of the interference is much greater than the distance between the conductors, which is true up to UHF frequencies, and the induced interference, being in phase, is cancelled out at T2. In addition, the isolating action of the transformer prevents earth loops; the only common earth connections are between the equipment chassis and these earth connections normally have no effect on the signal. Finally, interference picked up and drained to earth via the screen cannot intermingle with the return signal currents, as in a normal screened cable.

The stage feeding the line is appropriately termed a 'line driver' and here is a special case where a small signal stage is required to drive an impedance $\leqslant$10k, typically at levels of

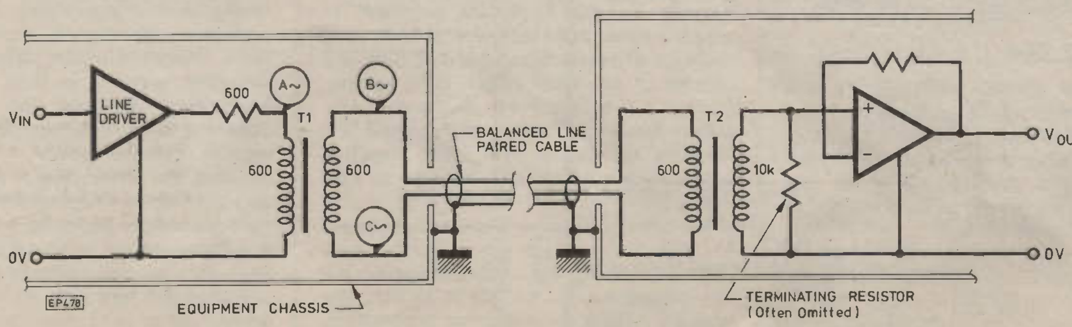

Fig. 1. A balanced line

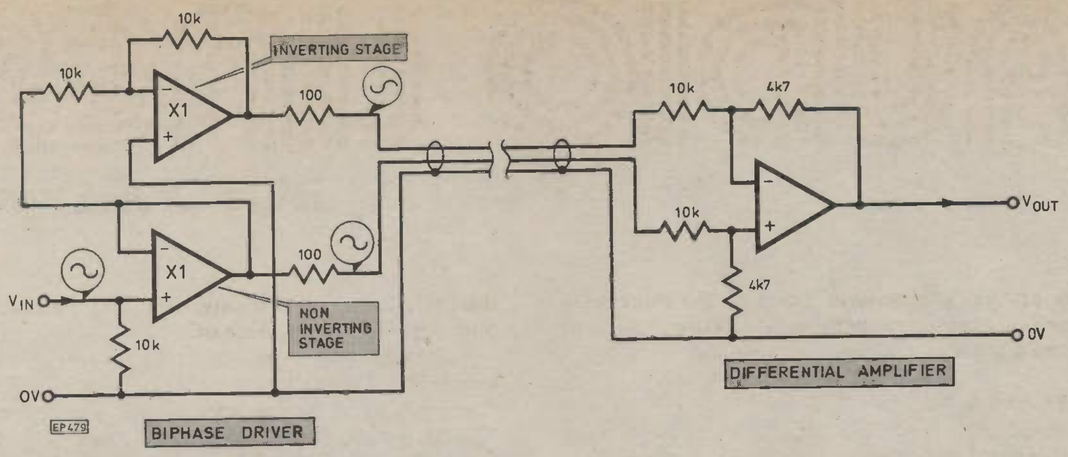

Fig. 2. Op-amp may be used in place of transformers to balance a line

1–10V r.m.s. High performance op-amps are capable of driving 8V r.m.s. or so into 600 ohms, but higher voltages are often required, and here, a discrete stage may be 'tacked onto' the output of an i.c. op-amp. Such a stage usually takes the form of a low-power class AB amplifier. As its name suggests, the line distribution amplifier is similar but designed to be capable of driving several 600 ohm lines simultaneously. This type of amplifier is used primarily by broadcasting organisations for programme distribution, and an essential requirement is that if several of the lines are short circuited, the line distribution amplifier carries on regardless.

The interference rejection properties of a balanced line system depend greatly on the qualities of the transformers. Although transformers can be cheap and elegant problem solvers when correctly applied, they have imperfections and if these are not heeded, transformers can create as many problems as they are intended to solve. Reputable transformer manufacturers will offer numerous models and copious data for this reason; they will also frequently custom-design a transformer for your application. This is by far the best course. Transformers are sometimes disregarded altogether, ostensibly on the basis of cost, and a line is balanced 'electronically'—which is a clumsy way of saying that a pair of op-amps are used to provide the out-of-phase signals. Fig. 2 shows this arrangement, which is cheaper than using a transformer at high levels (1V); the performance, however, is not necessarily any better, particularly at high frequencies, where interference rejection can fail miserably.

QUASI-BALANCED LINES

Balanced lines using transformers are most successful in recording studios and radio stations, where the environment is well ordered, or when used for entertainment in small venues, where cable lengths are short and conditions are not especially arduous. Large rock concert PA systems, on the other hand, often seem to attract the epitome of all that is taboo in a high-quality audio system—RF pick-up, instability, earth loops, plus resonances and response irregularities in the audio band. With the feeling that balanced lines between the mixing desk and the amplifiers cause more problems than they solve, or at best give a false sense of security, some of Britain's more innovative hire companies have broken with tradition and returned to using unbalanced lines—just standard, screened wires.

Another arrangement which breaks with tradition is quasi balancing (Fig. 3). The important point is that the cable screen carries no signal current—as in the balanced line—its purpose is solely to provide electrostatic shielding and to drain interference currents to ground, via the equipment chassis. Note that the screen is connected at one end only.

The long cable coupled to the output of the line driver in Fig. 3 presents an essentially capacitative load at low frequencies. This parallel capacitance introduces a phase lag and can precipitate instability, particularly in op-amp line drivers. One solution is to add a series resistor, as in Fig. 4a. Regrettably, this increases the source impedance of the line, causing a slight loss of headroom at the very least. By placing the series resistor in the feedback loop, low output impedance is restored, but now RFI picked up along the line can easily enter the line driver's input via the feedback loop (Fig. 4b). A series choke can be added in series outside the loop to circumvent this effect; or the choke can simply be used in place of the series resistance in Fig. 4a. In this case, it not only buffers the line capacitance, but acts to reject RFI.

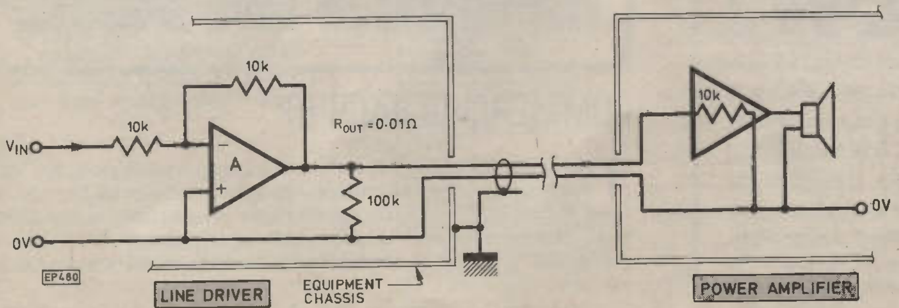

Fig. 3. A quasi-balanced audio line. The cable screen carries no signal current as in the balanced line it being connected at one end only

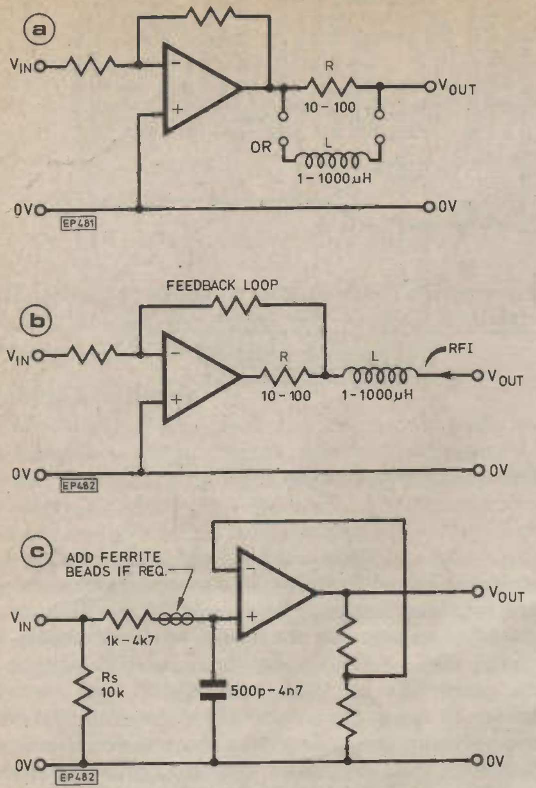

Fig. 4. (a) Overcoming instability caused through a long cable; (b) Preventing RF1 entering a line driver; (c) Attenuating RFI at a line input

RFI rejection is equally important at the input of the stage following the line: a simple RC network will usually suffice here (Fig. 4c) but in exceptional cases, ferrite beads may be added at point 'A'.

EARTHING

Earth loops in both unbalanced and quasi-balanced systems are avoided by simply earthing the 0V rails to the mains earth at one point only in the system. This is usually at the mixing desk to provide the tightest ground for the low-level signals from microphones. 0V rails and chassis earths are kept separate throughout the system; the latter are always connected to mains earth for safety. Equipment other than the mixer may have 0V rails connected to the chassis via a resistor to prevent annoying buzzes due to an open circuit 0V along the line. These resistors appear in parallel, and to prevent the tiny earth loop currents growing to produce an audible hum, a minimum total value of 22–100 ohms is usually advisable. The resistor values will therefore be in the region of 100–4k7 when a lot of equipment is involved. A parallel capacitor may be used to tie the 0V rails to chassis at radio frequencies, though this may aggravate RFI in certain cases.

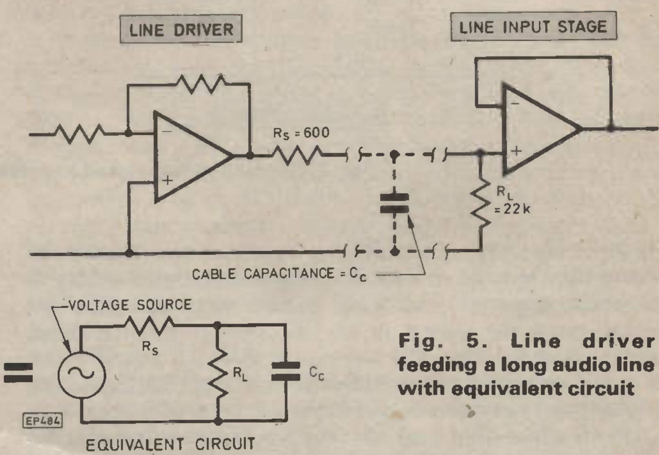

Fig. 5. Line driver feeding a long audio line with equivalent circuit

Finally, long audio lines can exhibit enough capacitance to cause premature high frequency roll off. Looking at Fig. 5, it's obvious that the source impedance (R_s) should be as low as possible to keep the −3dB breakpoint well above the audio band. In the example given, the −3dB point occurs at a paltry 14kHz. However, in balanced line systems, power matching ($R_s = R_L$) is common; usually the impedance is 600 ohms. Power matching provides a 50 per cent voltage loss, but in this example, making R_L 600 ohms instead of 22k will raise the −3dB point to a fairly acceptable 28kHz. However, a voltage matched system using an op-amp or line driver with R_s typically $\leqslant 1$ ohm is clearly a far better arrangement. The moral, then, is to avoid traditional 600 ohm balanced line systems unless you can be sure their limitations aren't going to be balanced by very real advantages. ★

News Briefs

COMMERCIAL BACK-UP

THE originator of the UK101 User Group, Adrian Waters, has formed a company in conjunction with Mr. K. Stale, called 'Computer User Aids'. This full-time situation is expected to enable the organisers to cope more easily with the overwhelming response and demands of the group, and should provide such back-up as various properly marketed kits.

The address of Computer User Aids is: 9 Moss Lane, Romford, Essex, RM1 2QB.

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CEGMON

What can it do for your UK101?

CEGMON is to some extent a "clear up" campaign by Ohio Scientifics, in which a 2516/2716 EPROM replaces the original SYNMON ROM to give the system the benefit of a full 2K monitor and all the facilities that this allows. Ohio's original monitor was all things to all machines, such that the 2K in your Superboard monitor would have only a small part of it dedicated to your particular machine, the rest being there to make the same package compatible with other systems in Ohio's range. This philosophy is a hangover from the days of more expensive memory, and the situation is the same for MONUK101 on the Compukit, which of course, is the son of Superboard!

Now, for the sake of two or three very simple wiring alterations to accommodate the 2716's Enable and supply lines, you can plug in the CEGMON chip and be ready to go; immediately having the following additional power to your programming elbow:

ASCII KEYBOARD

The polled keyboard is decoded in conventional ASCII format, such that with Shift-Lock released it is rather more conventional. The two Shift keys are decoded identically; Carriage-Return, Line-Feed, Rubout and Escape (not UK101) are all accessible regardless of the state of Shifts or Shift-Lock. Control returns the same value from alphabetical keys regardless of Shift or Shift-Lock, whereas Shift-Lock does work with Control for *non-alphabet* keys, to access otherwise inaccessible characters. For the same reason, Shift and Shift-Lock pressed together with alphabetic keys will still produce a range of unrelated characters, in order to allow Shift-K to –0 to access the up-arrow (and others in the range 91–95).

A SCREEN HANDLER

Cegmon's screen control system allows a protected area and a scrolling window. All output to the screen is via a window whose position, height and width are user-definable, and software controllable. Four cursor-position commands, a window-clear command, and full screen-clear, are available, see Table 1. The display starts at the *top* of the screen, and printing is very fast until scrolling is necessary.

Table 1. Cursor Controls

CTRL-J	CHR$(10)	cursor down (Line-Feed)
CTRL-K	CHR$(11)	cursor right
CTRL-L	CHR$(12)	cursor home (to top left of window)
CTRL-M	CHR$(13)	cursor left to start of line (Carriage Return)
CTRL-Z	CHR$(26)	clear screen
CTRL-SHIFT-N	CHR$(30)	clear window

Window-clear is called by CTRL-"up-arrow" or CHR$(30), which clears and homes but does not print the cursor. Total screen clear is implemented by CTRL-Z, or CHR$(26).

Programming with multiple windows is possible, and parameters of the current window are held in five memory locations, from 546–550, see Table 2. SWIDTH needs to be one less than the number of characters to be printed per line.

Table 2. Store Names and Contents

SWIDTH	column width (–1)
SLTOP	low byte of TOP
SHTOP	high byte of TOP
SLBASE	low byte of BASE
SHBASE	high byte of BASE
LTEXT	555 low byte of text-line start
HTEXT	556 high byte of text-line start

Scrolling and clearing operate from the window TOP and BASE inclusive, such that, for example, one section of screen may be scrolled relative to another *static* part of the screen. A danger, however, is that no check is made to ensure that TOP and BASE are within the screen memory! But this does allow any memory-mapped device to be accessed and PRINTed to by defining a window. Ideal for PRINTing colour values or PRINTing to an additional display. This does give the expansionist enormous flexibility.

IN THE MONITOR

Cegmon is not as comprehensive as OSI's Extended Monitor (ExMon), but it may be co-resident with both BASIC and Assembler, and is immediately available on switch-on, of course. It would be useful for developing short m/c routines or for debugging larger routines being developed with an Assembler.

On start-up via M, the monitor's prompt > appears after a clear-screen. The commands then available are:

- **/** jump to data mode, leaving current address unchanged
- **.** "do nothing"—loop back to get address
- **L** sets load flag—calls for input from the BASIC load vector at $FFEB
- **S** save machine code
- **M** do memory block move
- **T** do tabular dump/display of memory contents
- **Z** set a breakpoint
- **R** restart from a breakpoint
- **U** jump to user routine

In the data mode loop the following commands are available:
. return to address mode
/ re-open current address, to correct a mis-type
G start execution at the current address
' enter text entry loop
, increment current address
LF (Line-Feed)—increment current addres, do CR/LF, display new current address and contents on next line
CR (Carriage Return)—as for LF, but do CR only; display by overwriting on same line
(up-arrow, SHIFT-N)—as for LF, but decrement current address

In Command/address mode the following key strokes apply:
/ jump to data mode
On start-up, the current address is set to zero; thereafter it is not changed on a restart.

L load
The m/c load flag is set and the system restarts at the beginning of the data mode loop. It then expects input via the ACIA, either from tape or RS-232 serial interface. Load can run up to 4800 Baud (1MHz machine).

S save
The Syntax is: .Saaaa,bbbb cccc where cccc is the restart address, either to the beginning of the routine for auto-start, or back to the monitor. Code is *saved* from aaaa to bbbb. Save waits until Return is pressed to give you time to start your recorder. The "start" and "go" addresses and hex codes are displayed. It should be noted that the CR which separates each byte is directed to the ACIA, and as a result, this routine cannot vector a user-defined output, i.e. it can only be used through the ACIA for the cassette port and RS-232 interface.

M memory block move
This Syntax is: .Maaaa,bbbb cccc where aaaa is the start of the code to be copied, bbbb is the end, and cccc is the new start location.

T tabular display
Syntax: .Taaaa,bbbb where the code displayed is aaaa—bbbb. The memory contents are displayed as a table of eight-byte blocks.

Z zero—set breakpoint
Syntax: .Zaaaa where aaaa is the address at which the breakpoint is to be inserted. The original content of the chosen address is stored at BRKVAL.

R restart
Restart from a breakpoint.

U jump to user routine
Causes a jump-indirect to a routine whose start address is held in $0233–34. This is useful for calls to regularly-used locations like the Assembler restart.

In Data Mode: the following keystrokes apply:

. exit to command/address mode

/ re-open current address
Used if the value just typed was incorrect.

G go
Sets all registers to $ØØ, and starts execution at the current address.

' start text mode
The text mode expects ASCII text rather than hex digits. Control characters such as cursor controls, and graphics characters, can also be typed direct into memory. No editing is possible without exiting back to the data mode.

A second ' exits back to the data mode on the same line.

, increment current address
Used to space succeeding entries into memory. The contents of the missed addresses are left unaltered.

LF line-feed—increment current address, display on next line

CR carriage-return—increment current address, display on current line

Up-arrow (SHIFT-N)—decrement current address, display on next line
Identical to LF, except that the current address is decremented rather than incremented.

EDITOR
The Editor works in much the same way as that which we published for Compukit in the *November 1980* issue of *PE*, except that it is a full page editor (i.e. the line to be altered need not be listed separately).

The Edit cursor is generated, or eliminated, by CTRL-E, and may be moved around the screen according to the rules shown in Table 3. CTRL-Q copies forward to reproduce on the Edit line at the foot of the screen, and of course, extra characters can be interjected via normal keystrokes, whilst characters can also be "dropped" through the use of CTRL-D.

An editor such as this is the basic next step for anyone wishing to upgrade their system firmware from the standard of the UK101.

Table 3. Edit Cursor Controls

CTRL-E	Generate or remove edit cursor
CTRL-D	Move forward (does not copy)
CTRL-Q	Copy forward (copies characters over which it passes)
CTRL-A	Move backwards
CTRL-F	Move down
CTRL-S	Move up

THE MANUAL
The documentation accompanying CEGMON is well presented and generous in its information, and although most references are intended for the OSI camp, there is very little which does not also apply to the UK101.

Editing, error handling and break-point handling are explained, and much of the philosphy behind CEGMON is revealed too, which is helpful.

A Trace routine, Graph Plotter and other useful software is included in the manual to help the user to make the best use of the facilities available. Perhaps most importantly, a listing of routine entry points, data storage locations, and what each of these does is found at the end of the booklet.

Some of the niggling points of the UK101 remain after fitting CEGMON, like the unnecessary error message on that first attempt at a Command Mode instruction. For instance, after a CTRL-Z (clear screen), the machine will come back with an error message the first time you try to do anything. However, this is familiar behaviour, and the exciting additional facilities which CEGMON provides would, for many users, make it worth the added investment of £29·50 + VAT.

NOTE
The price of these monitors is, in our view, rather high in comparison to the hardware used (2716's are available for under £5·00 retail). However, we understand that another UK101 monitor is being developed by an independent source and this one will sell at less than £20·00. We hope to review it as soon as it is available.

NEXT MONTH...

PE DIGISOUNDER

The PE Digisounder depth gauge features an l.c.d. readout and a presettable depth alarm. The system can be calibrated to show the depth in any desired unit—feet, metres, fathoms and will replace the Seafarer type used in many boats, as it utilises the same ultrasonic transducer.

SPEECH PROCESSOR

Increases the intelligibility of a voice signal by increasing the level of input and reducing noise and harmonic distortion. May be readily inserted in the signal path of PA amplifiers, tape recorders, transmitters and transceivers.

ULTRASONIC INTRUDER ALARM

Protect your home with our updated ultrasonic alarm system. Modifications to the original design include the use of a sensitivity control, single unit construction and a steady alarm output.

PRACTICAL
ELECTRONICS

OUR APRIL ISSUE WILL BE ON SALE FRIDAY 13 MARCH 1981

LISTEN IN WITH OUR

27/28 MHz CONVERTER

M. TOOLEY B.A.

THERE is a considerable and rapidly growing interest in listening to radio transmissions in the 10 and 11 metre bands. This is, in no small way, due to the upsurge in 'CB' activity around 27MHz which, although legal in many European countries, is outlawed in the UK. The amateur 28 to 29·7MHz band is adjacent to the band used for 'CB'. This is also an exciting and somewhat surprising band for listeners, lying as it does on the borders between HF and VHF. How, then, does one begin to listen? Very few domestic receivers have a short wave band which extends above 20MHz and the purchase of a specialist "communications" receiver involves a very considerable outlay. What better than to utilise an existing medium wave receiver in conjunction with a purpose built converter. This is a low cost means of starting and yet it is capable of producing excellent results which will satisfy all but the most discerning. Furthermore, the method is ideally suited to mobile applications where a converter may be readily inserted in the connecting lead between a car aerial and receiver.

The circuit described is a converter for use between 26 and 30MHz, the precise frequency coverage being a matter for the individual constructor's preference. It should, however, be emphasised at the outset that this is a high performance unit which should not be confused with inferior "mixers".

The converter offers the following features:

- low noise high gain cascode front-end;
- dual gate f.e.t. mixer for high conversion gain and excellent strong signal handling performance;
- variable r.f. gain for local/DX listening;
- crystal controlled oscillator to ensure accuracy and eliminate drift;
- regulator to cope with large variations in supply voltage;
- normal operation of the medium wave receiver may be restored at the flick of a switch;
- receiver requires no internal modification whatsoever, converter simply connects in the aerial lead.

Low cost, readily available components are used throughout and the circuit may readily be built and aligned by the complete newcomer to r.f. constructional practice. The inductors, in particular, have been designed with ease of construction in mind however the faint hearted will be pleased to note that the coils are also available ready wound.

FREQUENCY CONVERSION

Frequency conversion is achieved when an incoming signal is combined with a locally generated signal in a device called a mixer. The mixer has a non-linear characteristic so that the oscillator signal is effectively modulated by the incoming signal and additional sum and difference frequency components are present in the output. The basic arrangement of a mixer is shown in Fig. 1. Assuming that the input is at

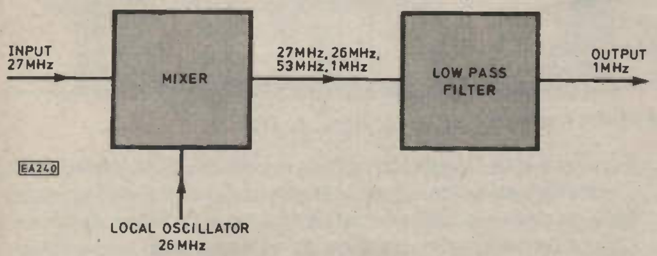


Fig. 1. Frequency conversion process in a mixer

27MHz and that the local oscillator is at 26MHz, the output will contain components at 27MHz, 26MHz (27–26) MHz, and (27 + 26) MHz. Of these only one, the difference, is required. A simple low pass filter may be used to reject the unwanted signals and allow the 1MHz component to pass through. The 1MHz signal will, of course, contain exactly the same modulated information as the 27MHz input signal.

DESIGN CONSIDERATIONS

Local oscillator

A block diagram of the Converter is shown in Fig. 2. The majority of medium wave receivers cover the range 0·6 to 1·6MHz (500 to 188 metres respectively). Thus the converter should produce output signals over this range. The oscillator frequency must therefore be approximately 1MHz below (or above) the centre of the desired input signal range. It will then be possible to tune over a 1MHz wide segment of the 27/28MHz band and the required oscillator frequency may readily be ascertained from the relationship: $f_{osc} = f_{sig} \pm f_{out}$. To ensure a high degree of accuracy and stability the local oscillator should be crystal controlled. This also simplifies the alignment procedure since the crystal guarantees that the oscillator frequency is correct.

Mixer

The mixer must provide an adequate level of isolation between the input signal and local oscillator. This reduces an

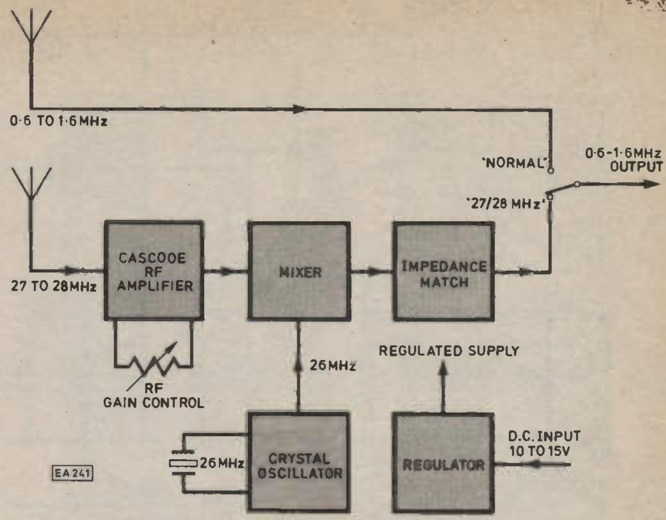


Fig. 2. Block schematic of the Converter

effect known as "pulling" in which the local oscillator frequency changes when a strong input signal is present. This, fortunately, is not normally a problem where the local oscillator is crystal controlled. The mixer must be capable of handling strong signals without cross-modulation or blocking. The dynamic range must therefore be as large as possible but, at the same time, the mixer should exhibit a high value of conversion efficiency. These two requirements are somewhat contradictory since high gain devices can be prone to severe degradation in performance when strong input signals are present. In this respect the dual gate f.e.t. provides a reasonable compromise whilst offering a high degree of isolation and excellent square law characteristics.

RF stage

An r.f. stage is essential in order to provide rejection of the 1MHz signal (which would otherwise appear as an interfering signal going "straight through" the mixer) and to reduce interference from unwanted signals on the image channel at around 25MHz. The r.f. stage also provides some additional gain which can be useful when the input signal level is very small. Selectivity is achieved by the incorporation of several tuned circuits within the r.f. amplifier stage. These can also have the dual function of providing coupling and impedance matching between stages. The active devices in the r.f. amplifier should have a reasonably low noise figure since any noise generated in this stage is given the maximum benefit of amplification in the rest of the receiver.

Voltage regulation

Most constructors will want to incorporate the converter in a vehicle where the supply will be derived from a nominal 12V battery. Under charging conditions, however, the voltage can rise to around 14V and, when the vehicle is stationary with the engine off, the voltage can fall to around 11·5V. Hence a regulator must be fitted so that this somewhat excessive variation is not passed on to the converter where it may cause variations in both gain and operating frequency. Furthermore, since the internal combustion engine and its associated electrical system is a very effective wideband noise generator (in the form of ignition pulses, dynamo "hash" etc.) the supply rail must be adequately filtered over a wide range of frequencies.

CIRCUIT DESCRIPTION

The complete circuit diagram of the Converter is shown in Fig. 3. Diodes D1 and D2 provide input protection and con-

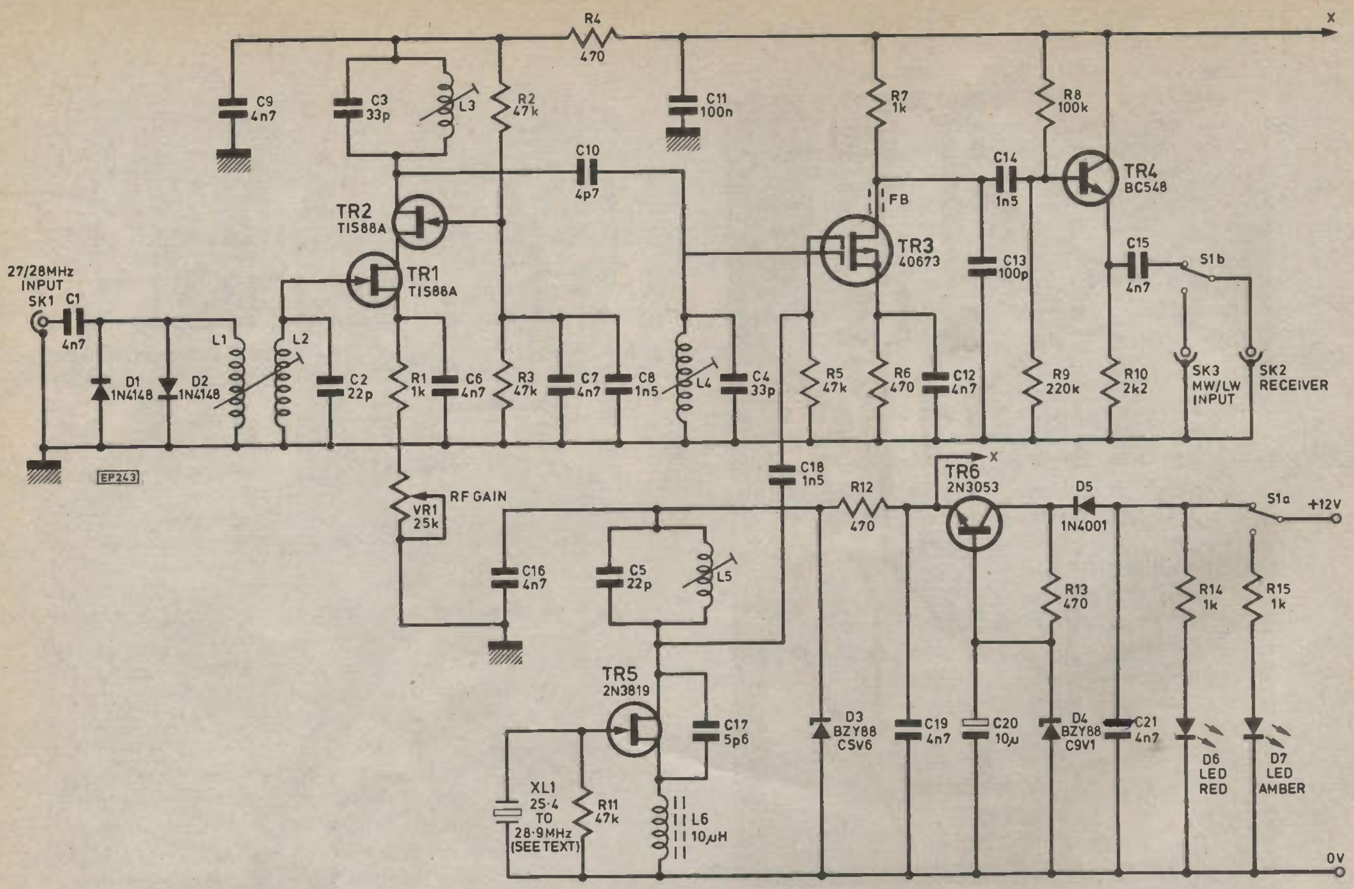


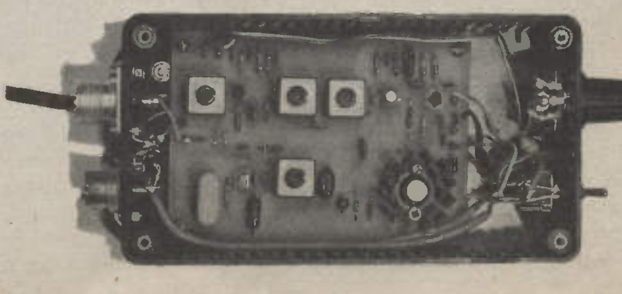
Fig. 3. Circuit diagram of the Converter

duct whenever the input voltage exceeds 1·2V pk-pk. TR1 and TR2 form a cascode r.f. amplifier stage which provides some 26dB of gain with a noise figure of around 2dB. The output of this stage is coupled to the mixer, TR3, via a capacitively coupled bandpass filter formed by C3/L3 and C4/L4. TR5 forms a crystal controlled overtone oscillator, the supply for which is regulated by D3. Oscillator injection is applied to gate 2 of TR3 and the mixer output is developed across R7. The ferrite bead in conjunction with C13 forms a simple low-pass filter and TR4 acts as an impedance matching stage between the mixer and output. The supply rail is regulated at 8·5V by means of TR6 and its associated components. D5 protects against inadvertent reverse polarity connection of the supply and D6 and D7 provide visual indication of the operating status which is either 'normal medium wave' or '27/28MHz'.

CONSTRUCTION

The majority of the components are mounted on a single sided p.c.b., the foil layout of which is shown in Fig. 4. Whilst the component layout is shown in Fig. 5. No other form of construction should be attempted since this may result in severe instability. It is recommended that the components be assembled in the following sequence; resistors, capacitors, diodes, inductors, transistors, crystal. TR6 should be mounted on an adequate heatsink since, in mobile applications, its dissipation can approach 250mW. Care should be exercised when soldering the crystal to the p.c.b. The minimum soldering temperature should be used and excessive contact with the soldering iron should be avoided. Note that the p.c.b. will accommodate any crystals of the following types: HC25/U, HC6/U, HC18/U and HC33/U. The two latter types are wire ended and are preferred for soldering to a p.c.b. To ensure optimum performance and to avoid instability adequate de-coupling is essential. For this reason only modern type disc or miniature ceramic plate capacitors should be used, other types may be very much less efficient. The inductors are wound according to the data given in Fig. 6. Care should be taken to ensure the correct orientation of the former base relative to the p.c.b. Each former should be fitted with a ferrite dust core and the winding secured by means of a drop of "Denfix" or similar polystyrene solution. (Do not use varnish, lacquer or anything containing a solvent which may attack the enamel coating of the wire). When complete the inductors may be soldered to the p.c.b. and the screening cans should be fitted. Constructors who are lucky enough to possess a grid-dip meter may wish to roughly check the resonant frequency of each tuned circuit before soldering the cans in place.

When the p.c.b. is complete carefully check the board for any errors. The board should then be mounted on four short stand-off pillars and wired according to the layout of Fig. 8. All interconnecting leads should be as short and direct as possible and those from SK2 and SK3 should use short lengths of r.f. co-ax cable. The earth connections of SK1,



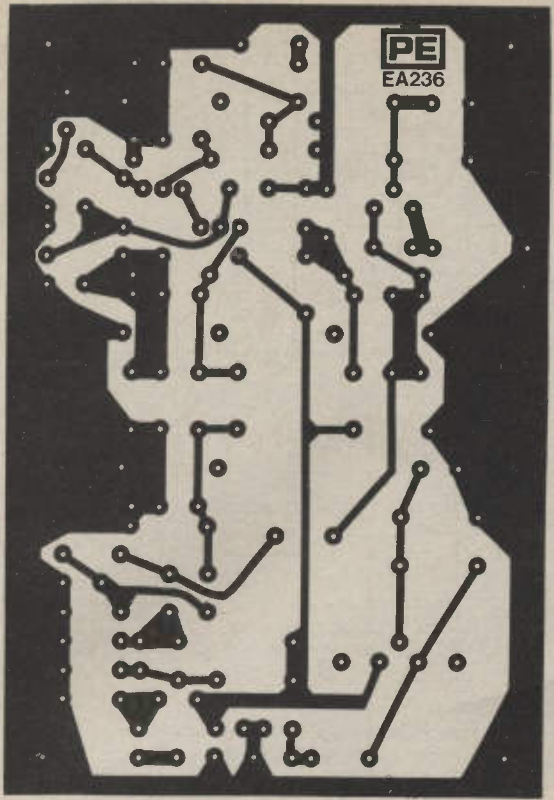


Fig. 4. P.c.b. layout

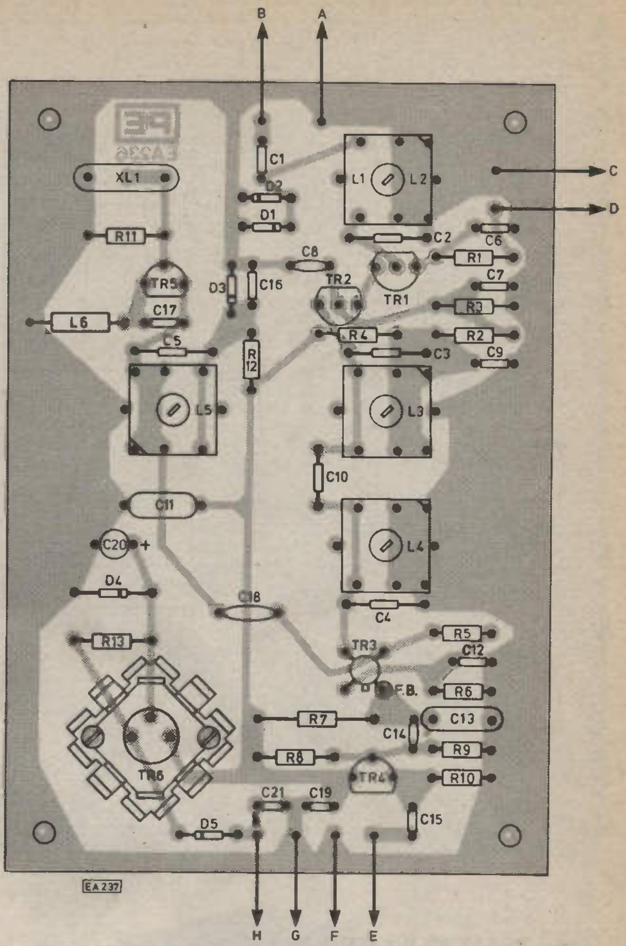


Fig. 5. Component layout

SK2 and SK3 should be linked by copper braid. The input supply lead should preferably also be screened with the outer (screening) returned directly to the common earth connection of the input and output sockets—this helps to reduce ignition interference. Carefully check the wiring before carrying out the initial checks and alignment procedure which follows.

If the unit is to be fitted in a car a diecast metal case should be used to house the components; for other use a plastic box is suitable.

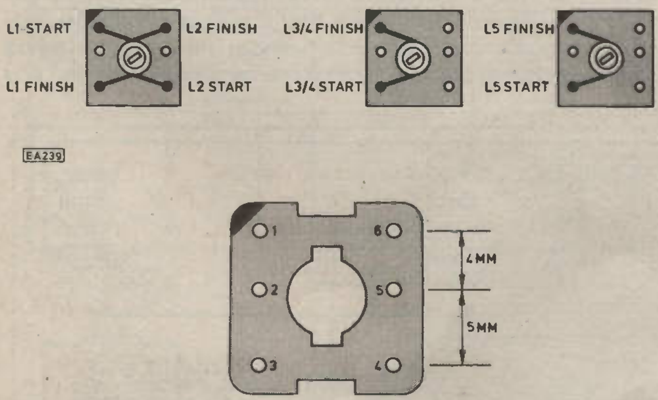


Fig. 6. Coil winding details

INITIAL CHECKS AND ALIGNMENT

Connect the converter as shown in the interconnection diagram of Fig. 7. When the installation is in a car it is recommended that the aerial lead be cut as close as possible to the receiver and the two cut ends of the cable terminated with standard Belling-Lee co-ax plugs which will mate with the sockets on the converter. Should the converter later be removed from the car a standard back-to-back socket connector can be used to rejoin the cut length of cable. The 27/28MHz antenna should be mounted as far away from the engine as possible and in as favourable a position as

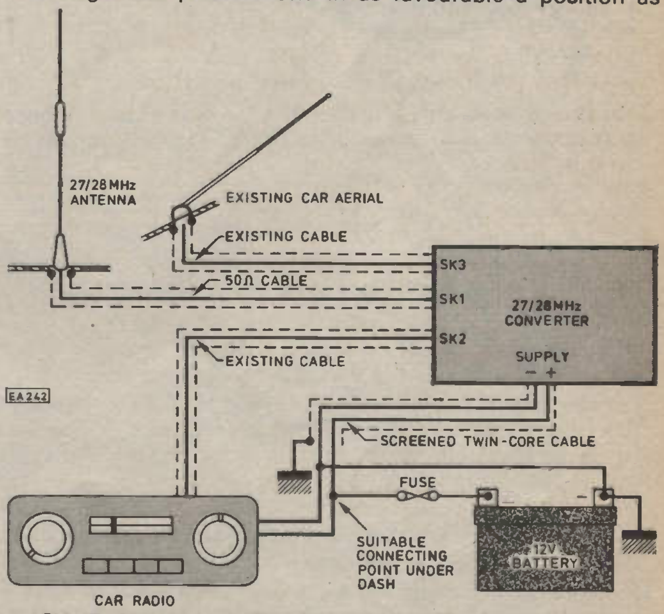


Fig. 7. Interconnection diagram for the Converter. If constructors wish to use only their existing car aerial then SK1 and SK3 should be linked together

COMPONENTS . . .

Resistors

R1, R7	1k (2 off)
R2, R3, R5, R11	47k (4 off)
R4, R6, R12, R13	470 (4 off)
R8	100k
R9	220k
R10	2k2
R14, R15	1k ½W 5% (2 off)

Potentiometers

VR1	25k lin

Capacitors

C1, C6, C7, C9, C12, C15, C16, C19, C21	4n7 (9 off)
C2, C5	22p (2 off)
C3, C4	33p (2 off)
C8, C14, C18	1n5 (3 off)
C10	4p7
C11	100n polyester
C13	100p
C17	5p6
C20	10μ tant

All capacitors should be ceramic plate or disc except where otherwise stated.

Semiconductors

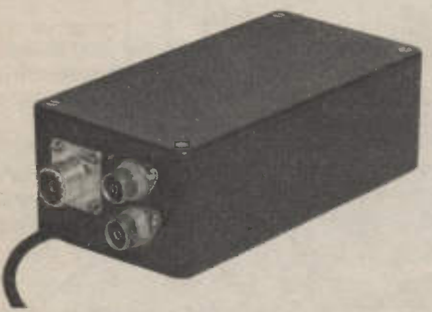
D1, D2	1N4148 (2 off)
D3	BZY 88 C5V6
D4	BZY 88 C9V1
D5	1N4001
D6	Red l.e.d.
D7	Yellow l.e.d.
TR1, TR2	TIS 88A (2 off)
TR3	40673
TR4	BC548
TR5	2N3819
TR6	2N3053

Miscellaneous

S1	D.p.d.t. miniature toggle switch
SK1	"UHF"/SO239 co-ax socket
SK2	Standard Belling Lee co-ax socket
SK3	Standard Belling Lee co-ax socket
L6	10μH r.f. choke

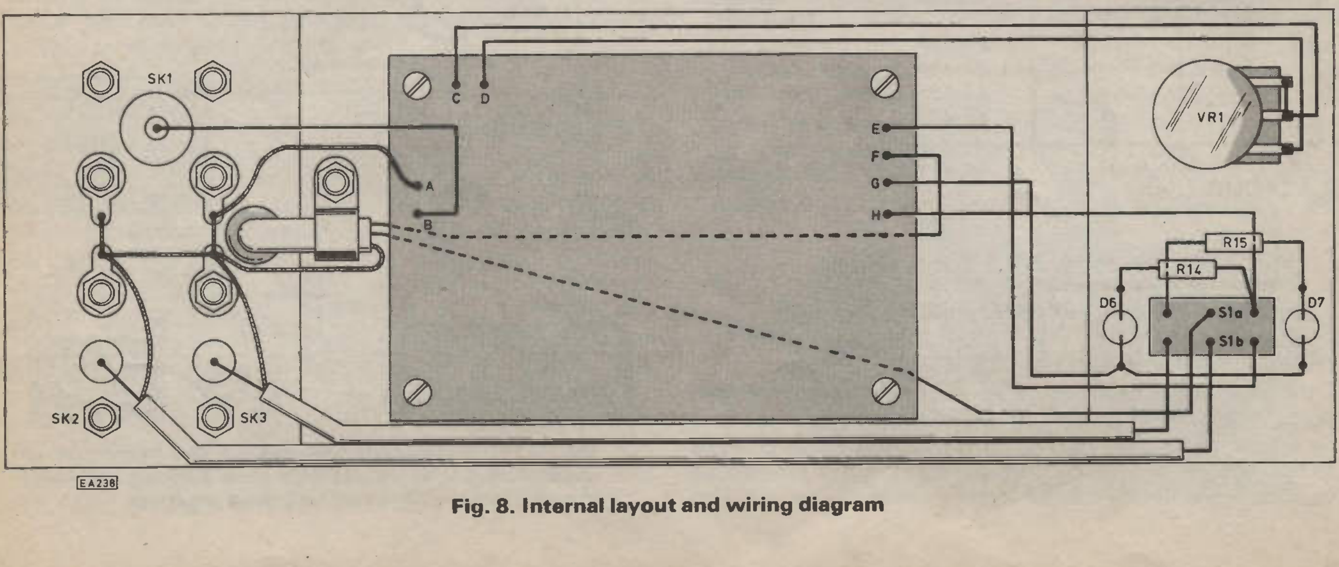
Ferrite bead
Crystal: 26MHz overtone type; HC6/U, HC33/U, HC18/U or HC25/U (see text and crystal frequency chart)
Diecast or plastic case
150 x 80 x 50mm (see text)
Knob. Four stand-off pillars, Grommet, p.c.b.
4 coil formers (type 722/1) fitted with ferrite dust cores, bases and screening cans
26 and 30 s.w.g. enamelled copper wire
Heatsink TO5 17°C/W or better

Constructor's Note
The p.c.b. and all components for this project are available from **Howard Associates, 59 Oatlands Avenue, Weybridge, Surrey KT13 9SU.** Inductors can, if required, be supplied ready wound. Please send s.a.e. for details.



possible. Roof mounting is ideal but the rear quarter or boot lid may be preferable. Alternatively a magnetic mount or gutter clip accessory may be purchased. This allows the aerial to be removed when it is not in use.

Insert a milliammeter to measure the supply current. Check that this is in the range 25 to 35mA and that one of the two l.e.d.'s is alight. If this is not the case carefully recheck the wiring. Tune the medium wave receiver to approximately 1MHz (300 metres), set the function switch to "27/28MHz" and the r.f. gain control to "maximum" (fully clockwise). Using a proper trimming tool (not a metal screwdriver which may easily damage the ferrite cores) set the cores in all inductors so that they are in line with the tops of the cans. Tune the medium wave receiver around 1MHz until a signal is obtained, check that this is at 27/28MHz. Adjust L5 for maximum signal. If, however, no signals are heard turn the core of L5 five turns clockwise (into the former) and



EA238

Fig. 8. Internal layout and wiring diagram

TABLE OF PRINCIPAL 'CB' CHANNEL FREQUENCIES		
'CB' channel number	Frequency (MHz)	Medium wave receiver (kHz)
1	26·965	965
2	26·975	975
3	26·985	985
4	27·005	1005
5	27·015	1015
6	27·025	1025
7	27·035	1035
8	27·055	1055
9	27·065	1065
10	27·075	1075
11	27·085	1085
12	27·105	1105
13	27·115	1115
14	27·125	1125
15	27·135	1135
16	27·155	1155
17	27·165	1165
18	27·175	1175
19	27·185	1185
20	27·205	1205
21	27·215	1215
22	27·225	1225
23	27·255	1255
24	27·235	1235
25	27·245	1245
26	27·265	1265
27	27·275	1275
28	27·285	1285
29	27·295	1295
30	27·305	1305
31	27·315	1315
32	27·325	1325
33	27·335	1335
34	27·345	1345
35	27·355	1355
36	27·365	1365
37	27·375	1375
38	27·385	1385
39	27·395	1395
40	27·405	1405

(Note: Medium wave receiver frequencies are quoted for a 26·0MHz crystal).

TABLE OF MODEL CONTROL FREQUENCIES			
Channel number	Colour code	Frequency (MHz)	Medium wave (kHz)
1	Brown	26·995	995
2	Red	27·045	1045
3	Orange	27·095	1095
4	Yellow	27·145	1145
5	Green	27·195	1195
6	Blue	27·245	1245

(Note: Medium wave receiver frequencies are quoted for a 26·0MHz crystal).

VOLTAGE TABLE		
TR1	source	1·0
	gate	0
	drain	5·4
TR2	source	5·4
	gate	4·0
	drain	7·9
TR3	source	0·7
	gate 1	0
	gate 2	0
	drain	7·0
TR4	emitter	4·8
	base	5·4
	collector	8·4
TR5	source	0
	gate	0
	drain	5·4
TR6	emitter	8·4
	base	9·1
	collector	11·3

The above voltages were measured using a d.c. voltmeter having an input resistance of 10MΩ. The incoming supply voltage was 12V.

CRYSTAL FREQUENCY TABLE		
Tuning Range (MHz)	Crystal Frequency (MHz)	Notes
26·0–27·0	25·4	
26·5–27·5	25·9	
26·6–27·6	26·0—	Preferred crystal for 'CB'
27·0–28·0	26·4	
27·5–28·5	26·9	
27·6–28·6	27·0	
28·0–29·0	27·4	Preferred crystals for 10m amateur band
28·5–29·5	27·9	
28·6–29·6	28·0	
29·0–30·0	28·4	
29·5–30·5	28·9	

again tune the receiver to locate a signal. Once a signal has been obtained adjust the inductors in the following sequence: L3, L4, L1/L2 for maximum. Repeat this procedure several times (there may be some slight interaction between L3 and L4) peaking, if possible, on progressively weaker signals. Signals with heavy fading present should not, of course, be used during the alignment process. The procedure can be considerably simplified if the receiver has a signal strength meter (a somewhat unusual feature in a car radio!) alternatively the alignment can be carried out in the "base station" with the aid of such a receiver and then the converter can be fitted in the vehicle. A slight re-adjustment to L1/L2 will normally be necessary in order to cope with a change of aerial. Where test equipment, such as a calibrated r.f. signal generator, is available the alignment is extremely simple. An attenuated locally generated 27/28MHz signal being substituted for the "off-air" signal provided by the aerial. In this case it is recommended that the tuning of L3 and L4 be staggered to peak at 27·3MHz and 26·9MHz respectively whilst L1/L2 is adjusted for maximum at 27·1MHz (or equivalent frequencies for a 10 metre amateur band version). ★

IMPORTANT NOTE

The Wireless Telegraphy Act only permits the reception of authorised transmissions. In the UK, 'CB' transmissions on 27MHz are, as has been stated before, unauthorised.

See Readout page 42.

Semiconductor UPDATE...

FEATURING SG1547 TDC1023J INS8073 R.W. Coles

POWER MONITOR

Building the power supplies for a project has never been easier, and to some of us, this is the cause of great sadness. There used to be a great deal of satisfaction to be gained from the design of a neat and capable power unit, and it was one of the few areas in electronics where the results of one's design calculations could be readily checked out with little more than a multimeter. Voltage regulators, with their OC29 series pass transistors, Zener diodes, and long-tailed pair amplifier stages were a source of delight (when they worked!) and the addition of ingenious current limiting circuits and overvoltage protection has occupied many a happy hour. Alas, those days are gone, and in today's project a single TO3 can often contain all that is necessary to provide a frustratingly well regulated and protected power supply at a price which makes the do-it-yourself approach completely obsolete.

I came to terms with the "no-thought" power supply design like everyone else, but I have retained an interest in power supplies in general, and because of this I was attracted to a new device from Silicon General, the SG 1547 Power Supervisor. Add one of these to your mutli-rail power supply and you can stop worrying about component failures and other disasters inflicting damage on the rest of the system, because the SG 1547 contains all the necessary circuitry to check up to three output voltages *and* the mains input for correct operation.

Inside the new device there are under and over voltage comparator circuits which compare the outputs from the associated supply with a fixed reference level generated on the chip. If any of the supply rails go over or under their tolerance limit the SG. 1547 produces an output to warn of the fact, and will provide automatic correction if required. Supply tolerance can be adjusted between plus and minus 0% and plus and minus 25% by means of a single external resistor, and the voltages monitored can include one negative rail, thanks to an inverting stage provided on the chip.

A "line-sense" input allows the monitoring of the a.c. mains feeding the power supply, and the SG 1547 provides a TTL level clock at the mains frequency as well as a "mains-failure" indication after a delay set by an external capacitor. Delays can also be incorporated on the under and over voltage outputs by means of capacitors attached to the appropriate package pins, and this is particularly relevent on the over voltage output which is latched and would normally be used to activate a thyristor "crowbar" protection circuit. A particularly novel feature of the chip design is the use of "analogue—OR" gating to save on voltage comparators. The two OR gates, pass, respectively, the most positive and the least positive of the input rails to, respectively, the over voltage and the under voltage comparator circuits, making only two comparators necessary rather than six.

The SG 1547 is housed in a sixteen pin d.i.p. and can be used with a wide range of d.c. supply inputs. Each comparator output is capable of sinking 50 milliamps to drive l.e.d.s. or can fan out to five standard TTL loads.

SEE YOU LATER CORRELATOR

Correlation is a technique for measuring the similarity between two signals, the measure of similarity being expressed as a "correlation coefficient". The more closely a signal resembles another signal with which it is being compared, the higher the correlation coefficient becomes, and this is a very useful property which can be exploited in the processing of digital information, particularly when searching for a desired signal in the presence of noise.

One simple application is the measurement of the distance between a deep space probe, such as Voyager, and planet Earth. A long binary pattern in the form of a "Pseudo Random Binary Sequence" is generated by shift register feedback and transmitted in serial form to the space-craft which receives it and sends it back to Earth. When it is received back at the sending point it will invariably be corrupted by noise, but this is overcome by correlating the received signal with a delayed version of the transmitted sequence. The delay is adjusted until a peak in the correlation coefficient is obtained and the range of the spacecraft can then be directly calculated from the delay setting, despite the presence of signal corruption. The trick here is that when the two signals are shifted by even one bit position, the correlation is negligible, but when they are in step the correlation is good, even though many bits have been corrupted by noise. The same principle can be exploited to send digital data to and from the spacecraft, and can be used in other fields such as medical research and pattern recognition.

Now you may be saying "So What?" and that would have been a perfectly respectable response until today, because the techniques of digital correlation required such expensive bits of hardware that any hobby interest was quite out of the question. From now on, however, digital correlation is an idea who's time has come, and soon no self respecting robot will be without a correlator in its optical system, thanks to the TDC 1023J from TRW LSI Products.

The new chip is a complete 64 bit digital correlator in a 24 pin package, and it consists of four 64 bit serial shift registers, a 64 bit digital summer and a seven bit threshold comparator and register. In operation the serial signal is shifted into the data register at a rate of up to 40MHz and then compared with the data in the reference latches. The two other 64 bit registers are the reference register which accepts new reference words entered in serial before transfer to the reference latches, and the mask register which allows any of the 64 bits to be excluded from the correlation process. The result of a correlation is a seven bit "correlation coefficient" which can be read in parallel form for computer processing. A threshold flag output is also provided to show whether the correlation coefficient exceeds the threshold value loaded into the threshold register.

The TDC 1023J is still a bit expensive for the average domestic robot, but this is only the beginning, correlation is a technique which cannot be ignored!

BASIC MICRO

It had to happen one day, and now it has. New from National Semiconductor comes a microprocessor which can be programmed directly in the BASIC language.

The new chip, coded INS8073, and a relative of the famous SC/MP microprocessor, contains a 2·5K Tiny Basic interpreter with useful features such as branch ON interrupt and LINK to assembly language routines, in addition to the more traditional Basic statements such as IF/THEN DO/UNTIL and FOR/NEXT.

The processor is housed in a 40 pin package, runs from a single 5 Volt supply and has an on board 64 byte RAM array in addition to the usual SC/MP registers. On power up, the INS8073 searches for the external RAM location and size, and will automatically execute any valid BASIC program it finds there.

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PERIOD POWER TESTER

CHRIS LARE

Variable interval switching for surge testing amplifiers etc.

THERE is little need for stringent tests to be performed on electronic equipment designed or built for home use, since any faults that might occur can be quickly rectified by the person concerned. However, if the equipment is intended for use where the designer or builder will not always be available or where a failure can be very embarrassing (e.g. equipment used for public demonstrations or performances) exhaustive tests are required during the commissioning of the equipment.

The tests should be designed to stress every component of the equipment, thus causing premature failure of any dubious devices. Naturally, the tests must be carefully chosen so that no good components fail. Such tests usually include the "soak" where the equipment is left on for many hours at full power, shake and drop tests, overload tests and any others particular to that type of equipment.

These tests all overlook the fact that most equipment fails when it is switched on or off, due to the sudden surge currents and spikes which occur during the stabilisation period. The only way to induce these effects is to keep switching the equipment on and off at short intervals. The design described here is for a simple unit to do just that, with presettable on and off periods.

DESIGN OBJECTIVES

The tester was designed with PA amplifiers and lighting units particularly in mind. A 250 watt amplifier has a massive switch on surge current initially, even though the standing current is very low. Because of this surge it is not really appropriate to use an electronic switch such as a triac, since even a 25 amp version will stand a real chance of failing. Accordingly this design employs a 10 amp relay with a pair of contacts in parallel to switch the load.

If this relay was a low voltage version, many milliamps would be required to drive it, thus requiring a conventional power supply and transformer. Instead this design uses a triac to switch a mains relay, and by firing the triac with pulses the continuous current drawn by the circuit is about 3 milliamps well within the bounds of a simple dropper resistor supply.

THE CIRCUIT

The circuit is centred around two 555 timers, and in the interests of low power consumption one of the fairly recently introduced CMOS 556 timers is used. In Fig. 1 the first timer is connected in astable mode, with variable on and off times, both selected from front panel potentiometers. The diodes in series with the timing resistors determine which resistors are used for charge and discharge, so the functions are completely independent. The second 555 is also connected as a astable, but with a very narrow pulse output of 1·6 kHz. This pulse train only appears when the output of the first 555 is high, by virtue of the connection to the reset line of the second 555. The pulses are then fed directly to the gate of the triac via a 100n capacitor which serves as a d.c. current block when the pulses are not present.

The pulse train is required because the holding current of the triac is very close to that consumed by the relay, and thus there is no guarantee that the triac will remain fired. To drive the triac continuously would be in order, but would require very much more power. The triac is further helped by the 18 kilohm resistor which increases the current.

The power supply follows the usual pattern for mains dropper derived supplies. The excess voltage is dropped by the 18 kilohm resistor, and rectified by the series diode. The resultant voltage is smoothed by C1, and clamped at 15 volts by the Zener diode. Note that the negative d.c. supply is 15 volts below mains neutral, this is to allow the triac to be directly fired.

Two neons were connected across the third set of relay contacts to provide a form of status indication. A 20n ceramic capacitor is required across the switching contacts to help prevent arcing when inductive loads (as are most loads) are being tested.