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JULY 1979
50p

FULL SPEC TELETEXT DESIGN

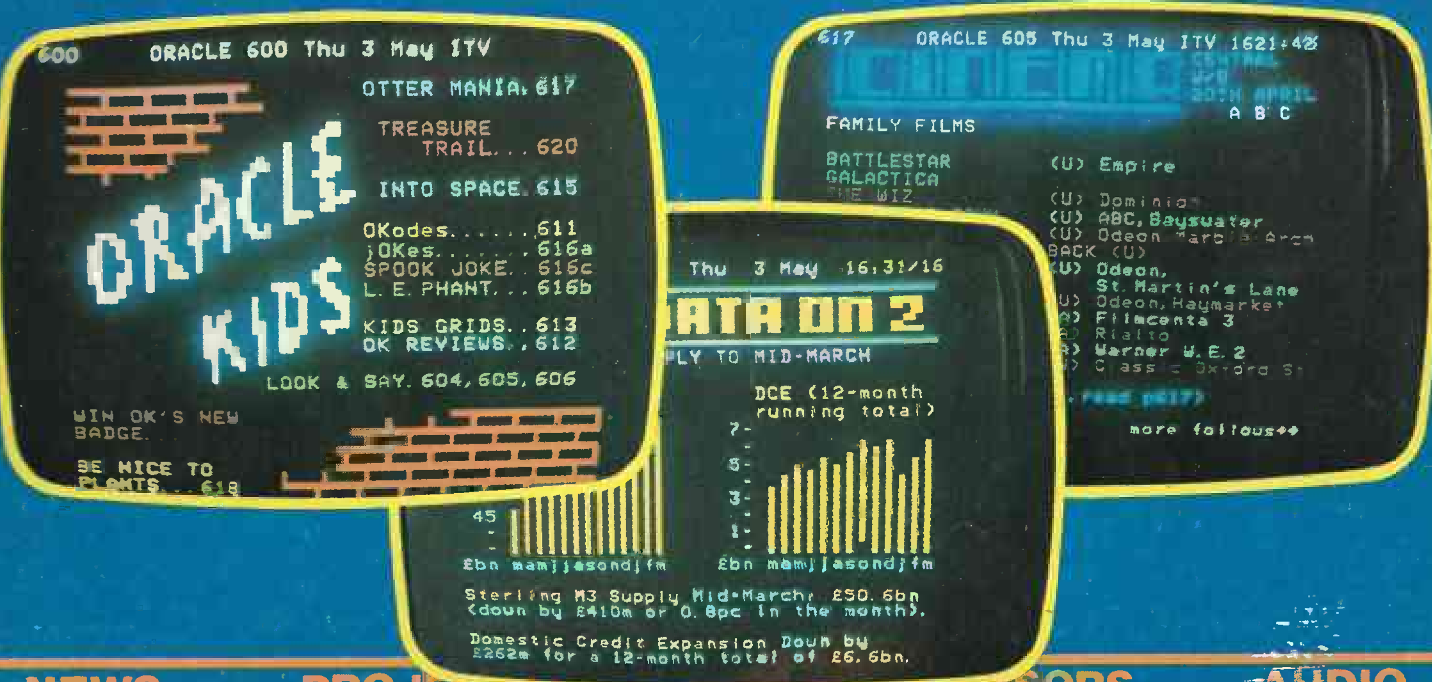
Plugs In To The Aerial Socket!

POLYPHONIC KEYBOARD

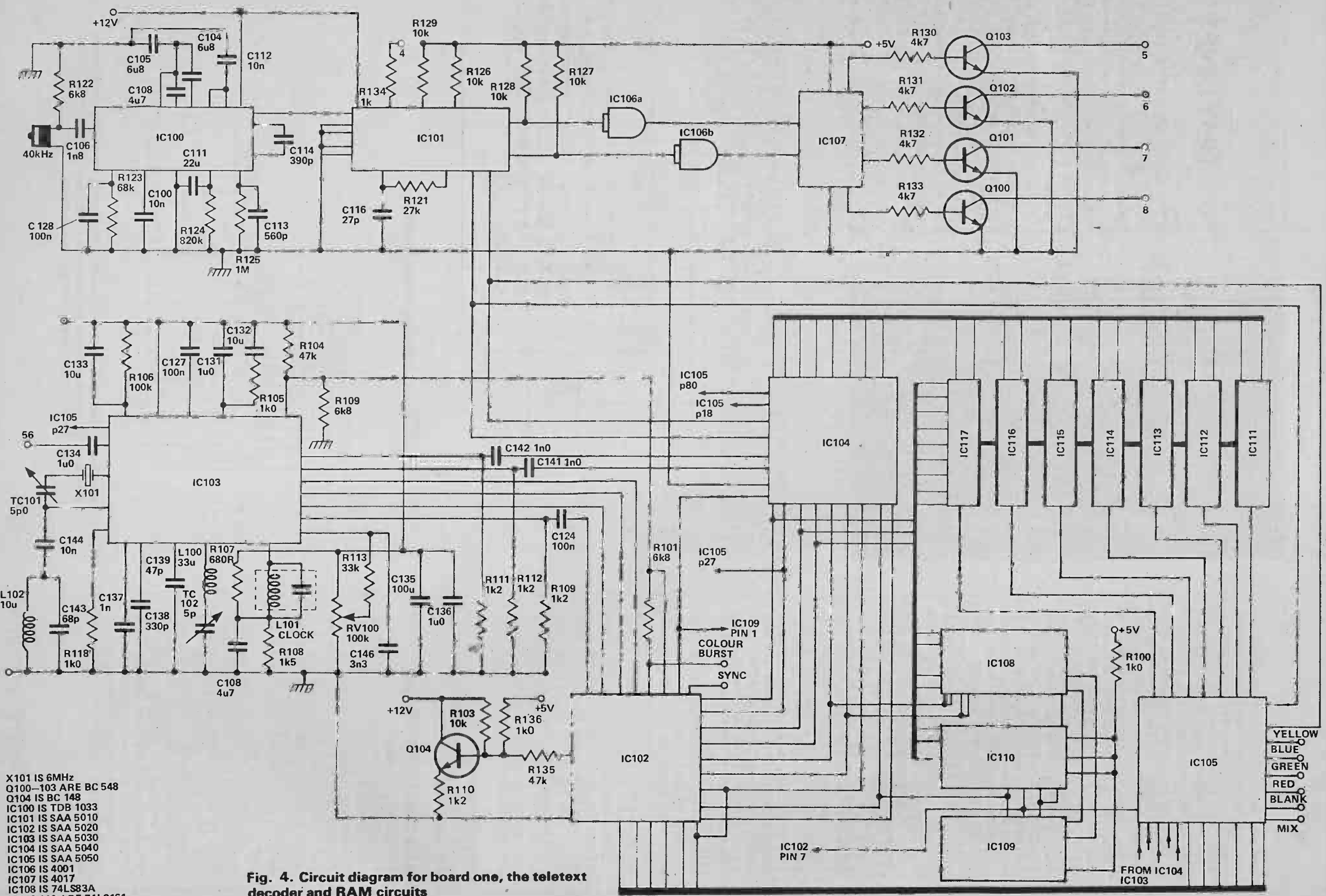
40 CMOS CLOCKS!

LIFE ON OTHER WORLDS

SOIL MOISTURE INDICATOR

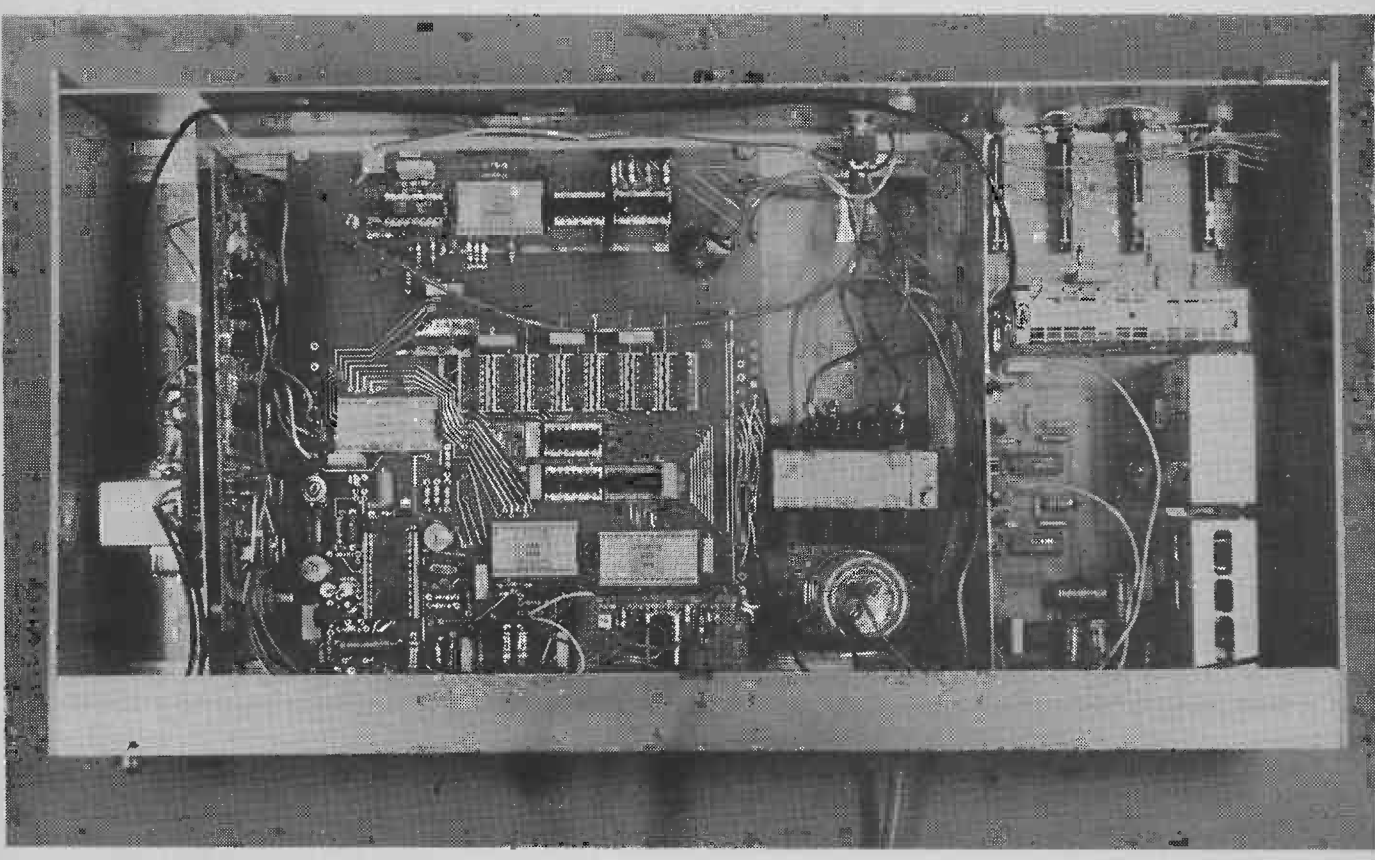


...NEWS... PROJECTS... ...PROCESSORS... AUDIO...

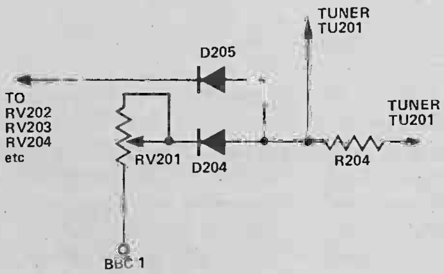


X101 IS 6MHz
Q100–103 ARE BC 548
Q104 IS BC 148
IC100 IS TDB 1033
IC101 IS SAA 5010
IC102 IS SAA 5020
IC103 IS SAA 5030
IC104 IS SAA 5040
IC105 IS SAA 5050
IC106 IS 4001
IC107 IS 4017
IC108 IS 74LS83A
IC109,110 ARE 74LS161
IC111–117 ARE 2102

Fig. 4. Circuit diagram for board one, the teletext decoder and RAM circuits



Above: a unit complete except for mounting of the ultrasonic receiver

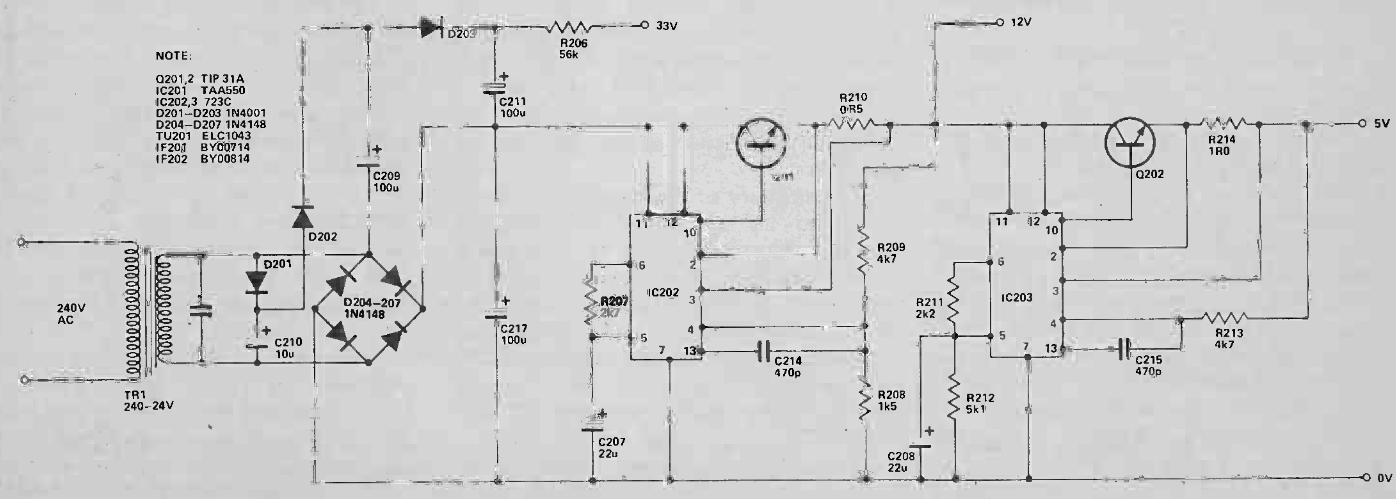


Next month we conclude the project with component overlays, parts lists and some erudite hints upon getting the best results from this superlative design.

ETI

Fig. 5. (Above, left): tuning circuit.

Fig. 6. (Below): Power supply circuitry to produce the three rails needed.



MAGNETIC FIELD AUDIO AMPLIFIERS

Carver Corporation's Model M400 amplifier using the unique 'magnetic cavity' was released in the US a few short months ago. Employing FETs throughout, except for bipolar silicon output transistors, Carver Corp. claims that the M400 has a slew rate around 80 volts per microsecond, hum and noise over 100 dB down, 0.05% distortion and a frequency response from 1 Hz to 250 kHz — all for an expected retail of US$300!

IT REALLY DOES EXIST. ETI first reported Bob Carver's Magnetic Field Audio amplifier in our Australian issue saying . . . *"we hear from normally authoritative sources that Bob Carver — founder of Phase Linear — has developed a totally new concept in audio amplifiers which . . . stores energy in a magnetic field rather than in power supply capacitors . . . his new device generates no heat, weighs a mere five kilos for vast numbers of watts and lasts for ever".*

It seemed a bit hard to take seriously — even though we were totally aware of Bob's previous efforts such as the range of Phase Linear super-amps and the Autocorrelator noise reducer.

But it seems as if this revolutionary concept in audio amplifiers is for real — patent protection has been arranged and preliminary details have been released.

Bob's basic concept is to store energy in a magnetic field rather than very large value electrolytic capacitors — eliminating at the same time the need for a bulky expensive power transformer.

Our circuit drawing shows the essential features. The heart of the circuit is the magnetic cavity (MC). This is basically similar to the AM detector transformer used in conventional AM radios but constructed on a grand scale. A further and significant difference is that the transformer is arranged such that an output occurs as the primary field collapses rather than builds up.

The secondary winding of the magnetic cavity is centre-tapped and the resultant full-wave output is rectified by a pair of high current diodes — the output waveform is thus a conjugate pair of time-varying audio voltages. Further circuitry, described later in this article, provides a feedback loop to remove commutation noise and reduce distortion.

The primary of the magnetic cavity is energised by an amplitude-modulated current (corresponding to the audio signal voltage). The current signal is produced from the audio input, via the optical isolator and modulation and control logic, to the scanning SCR, the ramp SCR, a pair of scanning and commutating diodes, and L1, L2 and C1.

This current signal energises the primary of the magnetic cavity. The time taken for this is called the 'ramp period'. The primary energy is then reflected in the secondary windings (and thence to the speaker) during the subsequent 'scan period'.

As our graph shows, the ramp and scan periods are made up of four separate timing intervals. During the period $t_o - t_2$ an incoming audio signal has caused a magnetic field to 'ramp' up in the primary of the magnetic cavity. At t_2 the field has reached its peak and is beginning to collapse. This collapsing field generates an associated decaying current i_1 and this decaying current falls to zero when the energy in the primary field falls also to zero (point t_3). During the time period $t_2 - t_3$, the control logic provides a positive signal on the gate of the scanning SCR, however this SCR will not again conduct until sufficient voltage is applied between its anode and cathode.

Throughout the scanning period, energy is of course being transferred from the primary of the magnetic cavity to the secondary — and thence to the speaker load.

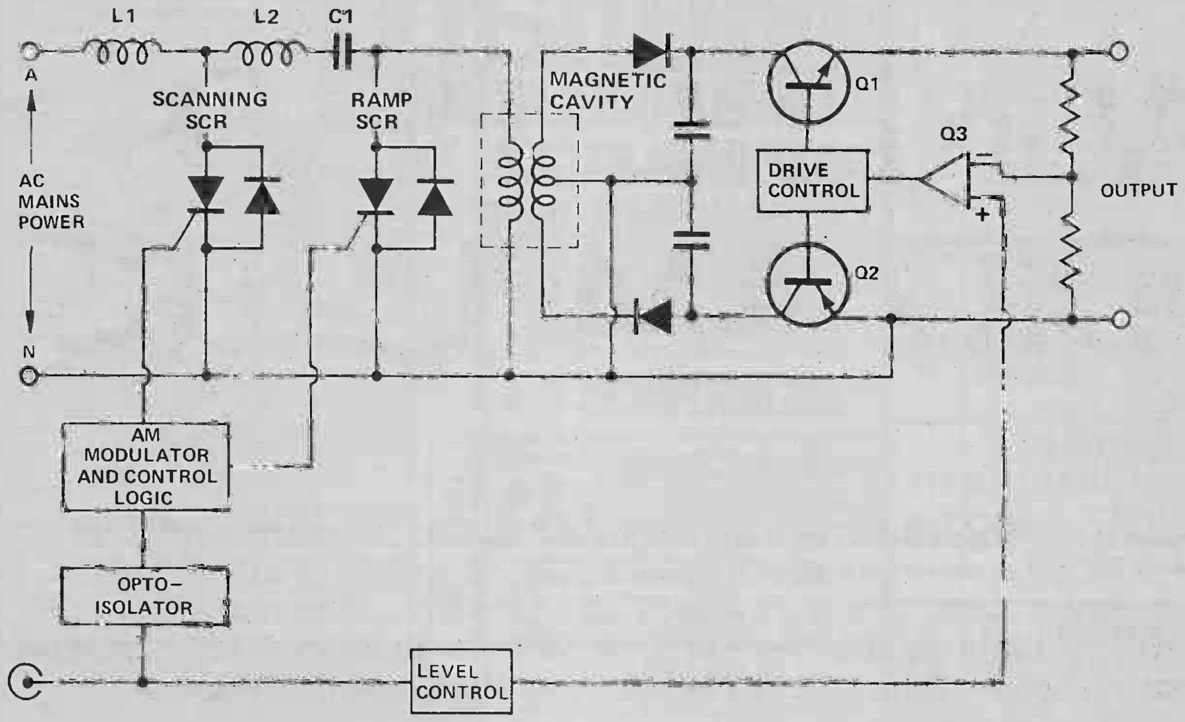


Fig. 1. This schematic shows the major operating components.

At time t_3 the direction of current is reversed – current being no longer maintainable by cavity inductance – and the scanning diode is reverse biased – this causes the scanning SCR to be forward biased and current flows as shown in our sketch.

Summarising then, energy stored in the magnetic cavity is caused to shuttle around the circuit of L1, L2, C1 and the speaker load depending on instructions from the control logic.

Noise and distortion

Components Q1 – Q3 form a feedback loop which reduces the inherently poor bandwidth, noise and distortion to very acceptable levels. Theoretically the circuit has some quite strong objections – at low frequencies Q1 and Q2 will act much as switches except that the feedback correction voltage developed by Q3 will adequately cancel aberrations – but at higher frequencies, i.e. 10 kHz – 20 kHz the modulator circuit is unable to follow accurately the audio input signal. Hence the filtered output from the magnetic cavity is a dc level with a superimposed ac signal and Q1 and Q2 thus operate much as any other conventional amplifier.

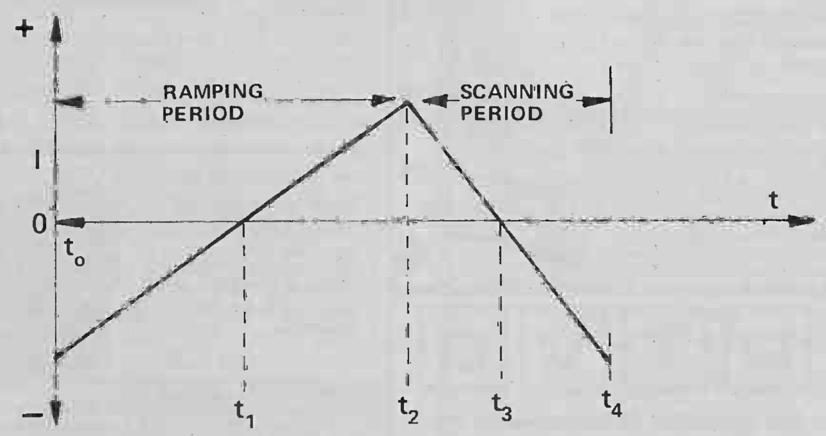


Fig. 2. During the ramping period energy builds up in the primary of the 'magnetic cavity'. Throughout the scanning period energy is transferred from the primary to the secondary of the magnetic cavity and thence to the speaker load via Q1 and Q2.

Nevertheless as less power is generally required at high audio frequencies than at mid frequency and low frequency, amplifier efficiency is very high if fed with music signals. This situation does not of course apply if the amplifier is fed with a high frequency steady tone.

Bob Carver's radical amplifier will be rated in accordance with FTC rules – the specification is expected to include power output: 200 watts-per-channel into eight ohms from 20 Hz to 20 kHz. Total harmonic distortion is expected to be less than 0.08% across this range.

Signal noise ratio is expected to be 100 dBA below rated maximum output. All-up weight is an incredible 5.5 kg.

As far as we are aware the magnetic field amplifier exists at present solely as a prototype unit but we understand that Bob Carver has very real plans for putting the unit in to production at a presently projected price of US $300 or so.

It's a fascinating concept, one that will cause amplifier designers and manufacturers world-wide to furiously rethink their design philosophies. It may even herald the coming of a new hi-fi technology. ETI

POLYPHONIC KEYBOARD CONTROLLER

Tired of playing one note at a time on a boring old monophonic synthesizer? In this design Tim Orr describes how you can build a four octave polyphonic keyboard controller incorporating first note priority.

THE MUSIC synthesizer is probably the most powerful musical instrument of today, and it will most probably form the basis of the next generation of keyboard instruments. However, the synthesizer suffers from one major drawback due to its unique structure. The disadvantage is that it is a monophonic instrument as opposed to traditional keyboard instruments, such as organs and piano's which are polyphonic, or multi-voiced. A brief resumé of synthesizer structure should clarify the reasons behind this.

To start with, the synthesizer is composed of a set of modules or independent circuit packages whose parameters in most cases are voltage controllable. For instance, a voltage controlled oscillator (VCO) has an output frequency (pitch) which is dependant on the magnitude of the input control voltage. These modules can be split up into three distinct groups. Firstly there are Sources, such as:

1. Noise
2. Voltage controlled oscillators

Secondly there are Modifiers which form by far the largest group:

1. Voltage controlled filters (VCF's)
2. Voltage controllled amplifiers (VCA's)
3. Ring modulators
4. Filter banks or graphic equalisers
5. Phase shifters
6. Reverbration

Thirdly there are control voltage sources:

1. Sample and holds
2. Sequencers
3. Transient generators
4. Trigger delays
5. Keyboard controllers

Getting Your Priorities Right

First note priority was adopted for this design, i.e. first note pressed to channel 1, second to channel 2, and so on. If more notes are pressed then the system can cope with, these are locked out. The reason for this, as opposed to last note priority, is that first note priority stops the note jumping that can occur when, momentarily, more notes are pressed than the system caters for.

Binary Notation

When the code (note code) driving the decoder energises a contact which is closed, the output of the OR gate goes high, showing a unique code on the input representing the particular note being pressed. This code, the note code, is arranged such that the lowest note is binary zero, the next note up binary one, the next

two and so on up to N.
The scanning can also be achieved using a multiplexer.

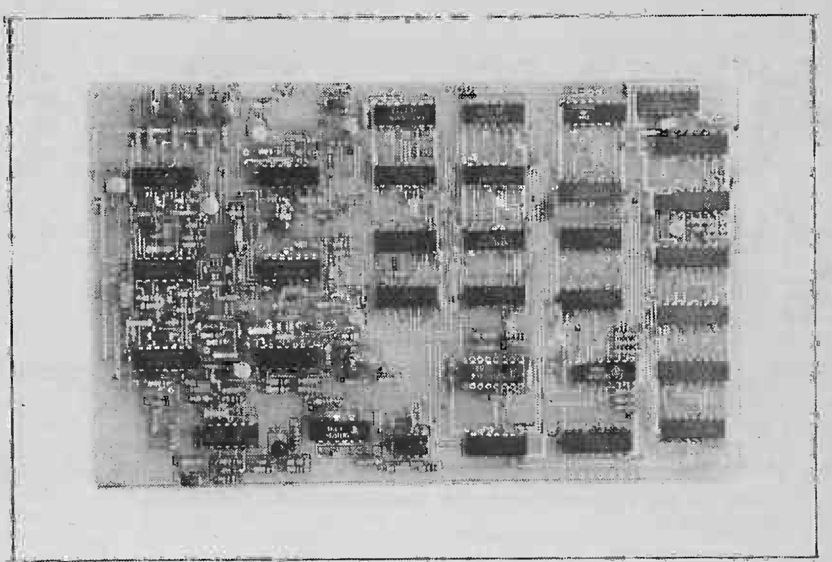
The size of keyboard decided on was a 4 octave one having 49 notes. Hence this makes the value of N 49 and therefore the size of the note code will be 6 bits (64 possibilities). In fact this is useful in that a 6 bit code will be just big enough to scan a 5 octave keyboard (61 notes) if required. In the case of this design it will simply be a mattter of adding 12 extra diodes since the decoder already had a total of 64 outputs. Incidentally, the scanner will have another output not yet mentioned. This is called 63rd note, (the 63rd output on the decoder) which simply provides a pulse to the decision logic to say that a scan has been completed. The multiplexer method would require decoding of the note code to do this.
The scanner simply gives each note a binary code, but how can this be extracted as a set of control voltages with associated gate signals?

Pumping Caps

The note code is changed to an analogue voltage using a D-A converter, the output of which is switched onto the correct analogue channel and held using a set of sample and holds. The gate signals are dealt with in a similar way using CR circuits. The counter for the note code causes the scanner to increment from the lowest note upwards. If three notes are depressed the scanner reaches the lowest note first and causes the output of the D-A to be stored by channel 1 sample and hold, and channel 1 gate capacitor to be pumped up. On moving on the channel counter is incremented, prepairing the output channels for channel 2 data. When the scanner reaches the second note up the process occurs again only using channel 2 and again for channel 3, with the third note. When the scan has been completed the channel counter is reset and made ready for the next scan.

Dying Charge

If on the next scan the notes are still depressed, the gate capacitor will again be pumped up maintaining the gate output high. When a note is released the time constant is such that the gate capacitor's charge dies away in about one and a half scan times, thus removing the gate signal. By experiment it was found that the scan time needs to be about 4 mS. Even when a key is pressed and released very quickly, it will have been scanned about ten times or more. The NAND gate should be mentioned because it allows two adjacent notes to be played. This is because if two notes right next to each other are depressed, the output of the scanner remains high for the duration of both notes and so only one note would be detected. By NANDing the scanner output with the clock the output is broken up allowing adjacent notes to be detected.



The largest of the four PCB's, carrying the logic circuitry.

Note Jumping

Although this circuit will work, it is far from satisfactory. When notes other than the top note are released, the channels on which the remaining notes appear, above the released note, all jump down one place. This makes the instrument very difficult to play as it must be remembered to release the keys from the upper one downwards, to get a chord that dies away nicely without the note jumping effect.

Special Decision

This means that the simple logic must be replaced by some special decision logic, incorporating a memory of notes already activated in previous scans.

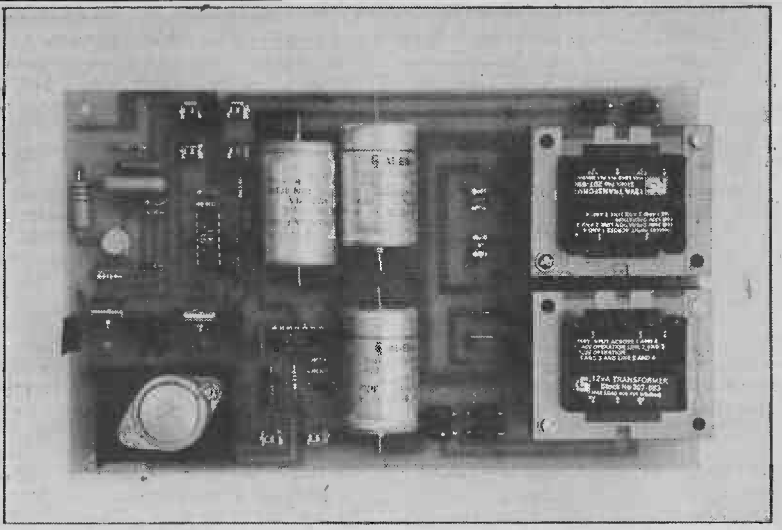
The scheme here is that note codes are gathered into the memory as the scanner sweeps up the keyboard. When the 63rd note is reached, the entire memory is dumped onto the output channels by sequencing the peripheral address lines. It is also necessary to reset all of the gate data bits in preparation for the next scan. This means that while a particular key remains pressed, the gate for that channel will be refreshed on every scan. When the key is released, the gate for that channel will go low when data is again output.

Logical Channels

The effect of the decision logic from the musicians point of view, is that upon playing a chord, say C, E and G the first one depressed normally comes out on channel 1, the second on channel 2 and the third on channel 3 (the difference in time between depresssions need only be milliseconds). There is, however, an exception to this when a note is depressed that is already stored in memory. For instance, if the three note chord described above were depressed such that C was first E second and G third, then it would be expected that C would come out on channel 1, E on channel 2 and G on channel 3. But if a previous chord had been played using the same C which had emerged on channel 2 then the decision logic would cause it to remain on channel 2 and so the E would be placed onto channel 1 and G onto channel 3.

Key Question

Construction of this project will depend almost entirely upon the keyboard it is built around. If you ▶



Power for the keyboard controller comes from this twin transformer board.

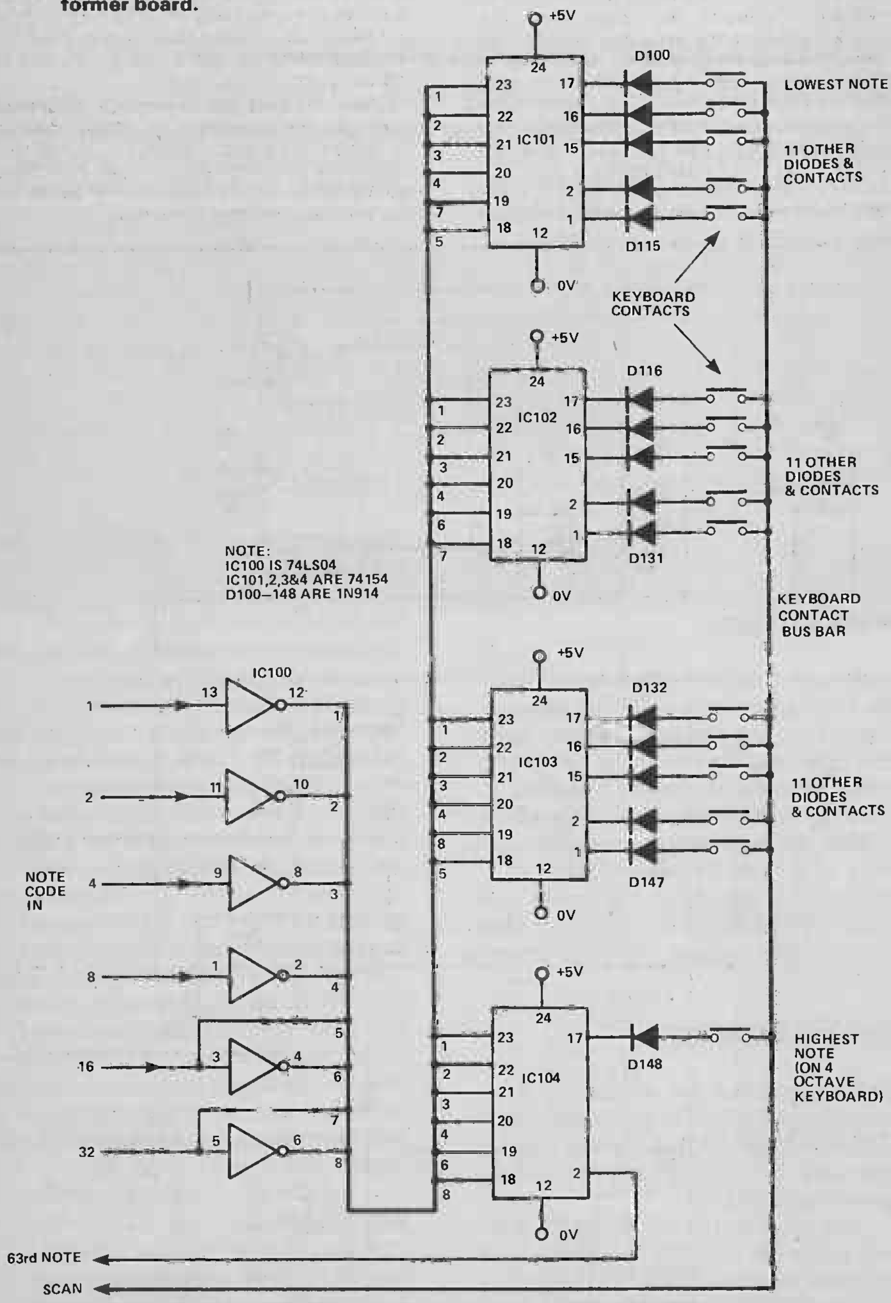


Fig. 1. Circuit diagram of the scanner. The four 74154's are used as a one out of 64 line decoder.

HOW IT WORKS

The Scanner: The IC's used for the scanner itself are 74154, which are one out of 16 line decoders. They are arranged such that one output goes low with the rest remaining high, dependent on the four bit code on the input. These IC's also have a pair of enable inputs both of which must be low. These allow four 74152's to be used as a one out of 64 line decoder, simply by the inclusion of the two inverters on inputs 16 and 32. The 63rd note output is obtained from the 63rd output of the decoder, and the scanner output is taken from the keyboard contact bus bar, having been ORed using the diodes.

Logic: The reaction of the circuit to a new note that has not been picked up by the scanner before is as follows: the note code counter increments the scanner by one note on alternate falling edges of the clock, until it reaches this particular note. The output of the scanner goes high registering that the contact is closed. This triggers the monostable IC12 pin 2 causing its $\bar{Q}$ output to go low long enough to set the decision cycle flip flop IC15 input pin 9 The output of this flip flop pin 11, then inhibits further pulses from clocking the note coder by taking pin 1 of IC15 low. At the same time it initiates the first decision cycle by allowing the counters IC9 (address counter) and IC13 (decision counter) to run by taking their $\overline{\text{clear}}$ inputs high. When the output of the decision counter is zero the memory address counter is clocked round, so that the logic can check if the note is already in the memory.

The memory address counter is incremented on the low going edge of the K pulse, which is simply the clock divided by two. Since the decision counter is only 2 bits it was convenient to derive K using the spare single stage counter in the 7493. Note that K is only active during the decision cycles and data block since the counter is cleared down when the scanner is scanning.

When the address counter reaches the number set on the Phonics switch, it is reset, and the decision counter incremented by one via the NAND gates IC18. This starts the second decision cycle where the logic is looking for a spare location to insert the new note. It has been assumed that channel 1 is in use and that the first available channel is channel 2. The circuit stops the data being entered in channel 1 by observing the state of the gate data output from the gate RAM pin 5. If this output is a logical 'O' the channel is in use and must not be corrupted, and so the address counter is incremented so that the next channel can be tested.

In the case of this example the decision logic succeeds in entering its data in channel 2, but if the decision counter is incremented a second time before an empty channel is found, simply because all channels are in use, the decision cycle is ended and the scan continued. This third condition of the decision counter is decoded by the NAND gate IC16 and the invertor IC19, and reset is achieved via the three input NAND gate IC22 and invertor IC20, which reset the decision cycle flip flop restarting the note code counter and clearing down the memory address and decision counters.

The second and subsequent times that the scanner is stopped by the note that was loaded in channel 2, the decision logic will only get as far as its first test 'Is the note already in the RAM', so when the memory address counter reaches 2 the comparator output goes high acknowledging that the note is already entered. This causes the gate bit to be refreshed (since it is reset during data block) along with the data being re-entered into the note memory, (re-entering the data in the note memory is not necessary but occurs due to circuit architecture) after which the decision flip flop IC15 is again reset and the scanner restarted.

All the time a note remains depressed the decision logic will refresh the gate bit associated with the channel in which the note has been placed. At the end of a scan the gate bits are reset immediately after they have been placed on the output channels meaning that if the note is not still depressed on the next scan the gate signal on the output channel will go low in the next data block period.

During a scan the data valid signal is high, it only toggles in data block. Simply enabling the gate RAM during the decision cycle loads it with a '1', since data valid is the input. Note that loading these Ram's with a '1' results in the output going to a 'O' as they invert. This is the reason for the invertors on the outputs of the note RAM's, which are also tri-state for the computer interface.

The clock for the system is an NE555 timer wired in the astable mode.

The Output Channels

There are two outputs per channel which are multiplexed out by the data block period. These are the gate outputs and the control voltage outputs. The gates are obtained from the CD4099 addressable latch (note that these outputs may need buffering depending on the impedance they are driving as the CD4099 is CMOS). The address lines of the latch are attached to the memory address counter and the input is connected to the gate data line (IC10 pin 2). The enable input of the latch is connected to the data strobe line so that as the data is output from the memory the correct gate state (1 or 0) is stored on the relevant channel.

The data sample pulses are for loading the sample and holds on the analogue channels. They are derived from the 1 of 8 decoder and the clock. To interface between the TTL logic and the analogue switches comparators are used so that the analogue signals can be between —3 volts and +12 volts. All the comparator outputs are disabled when the clock is high by using the two resistors R65 and R53 to feed the reference input to the comparators, the clock signal being attached to R65. The binary codes representing the notes are converted into analogue voltages using the D-A convertor IC14.

As the memory address counter is incremented in data block the data in the note memory is converted into an analogue voltage and passed onto the correct analogue channel by the comparator and analogue switch. The D-A convertor has a current output such that when the resistor R82 is added to convert it into a voltage, the output goes more negative with increasing binary codes. The op-amp IC29 (pins 12, 13 and 14) corrects this by inverting the output of the D-A. It also allows the scaling or volts per octave of the keyboard to be adjusted, by varying the resistor in the feedback loop. Another function that the op-amp allows is the summing of voltages that have to appear on all the output channels at once.

There are three sources of voltage that are summed at this point, the tune voltage, the vibrato voltage, and the pitch bender voltage. The tune voltage is derived from a potentiometer which draws its current from the voltage reference circuit. The vibrato voltage is generated by a standard triangle wave generator comprising a regenerative comparator IC29 pins 8, 9 and 10 and an integrator IC29 pins 5, 6 and 7. The output is coupled to the summing amplifier via a pair of back to back electrolytics to remove any DC offset and a pair of resistors that allow their centre point to be connected to earth via an external vibrato depth potentiometer.

Offsets around the circuit are trimmed out using the trimmer RV1 which obtains its reference from the diode D1. Since the offsets are predominantly in one direction due to Q2 the offset control only works in the negative voltage direction.

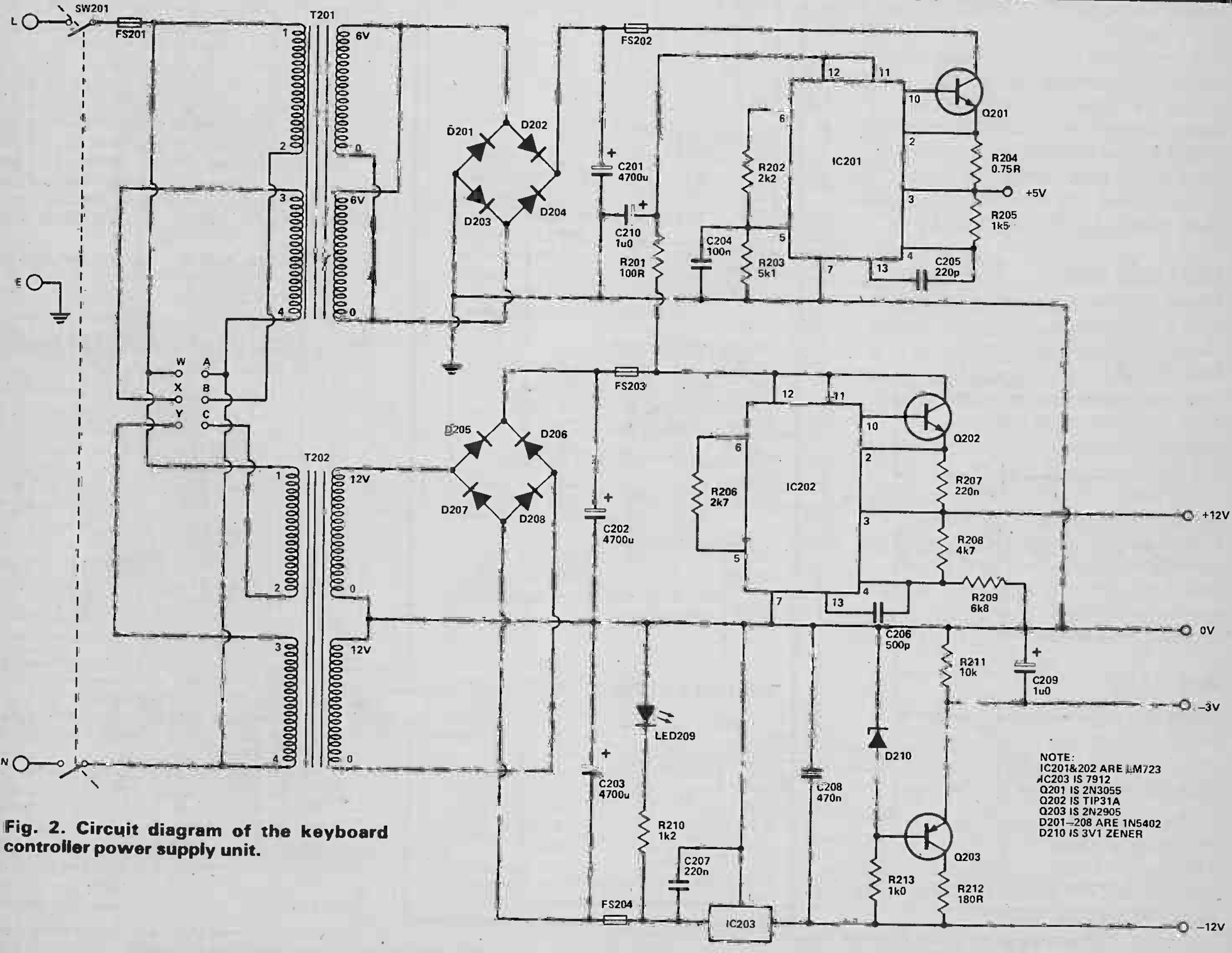


Fig. 2. Circuit diagram of the keyboard controller power supply unit.

employ the ARAK kit, no problems should arise at all. The PCBs are designed to fit their keys and comprehensive instructions are included with the kit.

We have not attempted to go into any detail with any other unit, simply because there is such a great diversity available on the market.

Setting Up

Once the components are all mounted on their boards, each section has to be set up. Let's start with the

PSU

Before the mains is connected to the PSU it should be thoroughly checked for shorts. The three low voltage fuses FS202, FS203 and FS204 should then be removed and the mains turned on. Now check the voltages across the smoothing capacitors C201, C202 and C203 which should be around +8V, +17V and −17V respectively. If this is the case the +12V regulator can be tested by replacing FS203. If this works the +5V regulator can be tested by replacing FS202. As the +5V regulator is supplied from the +12V supply via R201 they must be tested in this order. Finally the −12V and −3V supplies can be tested by inserting FS204. It should be noted that the fuse holders may need bending to give correct contact to the fuses as they are very simple pressed steel pieces for PC mounting.

The Logic Board

Check the logic board thoroughly for shorts on supplies. It is also wise to 'buzz out' every connection on the board to test for continuity which may well save a lot of fault finding time, but note that it will not guarantee correct operation as it does not test for shorts.

When these preliminary tests have been carried out and the power supply unit is functioning correctly power can be applied to the logic board. Firstly only apply the +5V supply until the TTL is known to be working correctly.

And a Log

Once the logic is working the analogue section can be tested. This time some setting up can also be done:

First check the positive reference is sitting at about 6V2 above earth. This level can be increased using the trimmer RV7 if a higher reference is required for any reason.

If the touch circuit is not to be used R63 should be removed as it will probably cause the output of IC29 pin 14 to saturate against one of the supplies as the output of the touch circuit is indeterminate.

R19 sets the maximum glide rate. The smaller it is the longer the maximum glide rate will be. However, it is unwise to make it any smaller as the maximum range is set by the V_{CE} on SAT of the switching transistor, this only creating an offset when it is turned on and not when it is turned off. It may be necessary to increase the value of R19 although problems will probably occur on one channel only and will most likely be remedied by replacing the switching transistor for one with a lower V_{CE} SAT.

ETI ▶

PARTS LIST

BOARD 2

R201	100R
R202	2k2
R203	5k1
R204, R207	0R75 1W
R208	4k7
R209	6k8
R210	1k2
R211	10k
R212	180R 1W
R213	1k
CAPACITORS	
C201-203	4700u 25V electrolytic
C204	100n polyester
C205	220p
C206	500p
C207	220n polyester
C208	470n polyester
C209, C210	1u0 35v electrolytic
SEMICONDUCTORS	
Q201	2N3055
Q202	TIP31A
Q203	2N2905
IC201, IC202	LM723
IC203	7912
D201-208	1N5402
D209	LED
D210	3V1 Zener
MISCELLANEOUS	
TX201	RS 207-683
TX202	RS 207-699

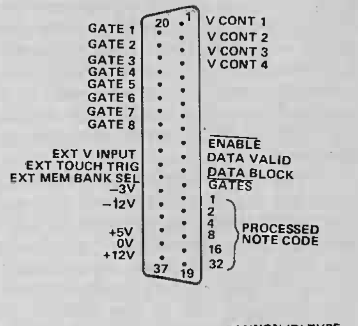
1A, 1A5, A (2 off) fuses and holders, DPST rocker switch.

BOARDS 3 AND 4

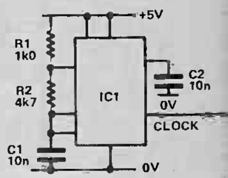
SEMICONDUCTORS

IC100	74LS04
IC101-104	74154
D100-148	1N914

2 off of these components are required, as board 4 is identical to board 3.



CANNON 'D' TYPE CONNECTIONS SKT1



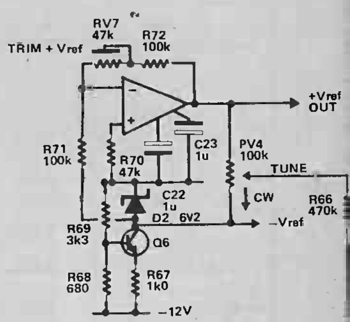
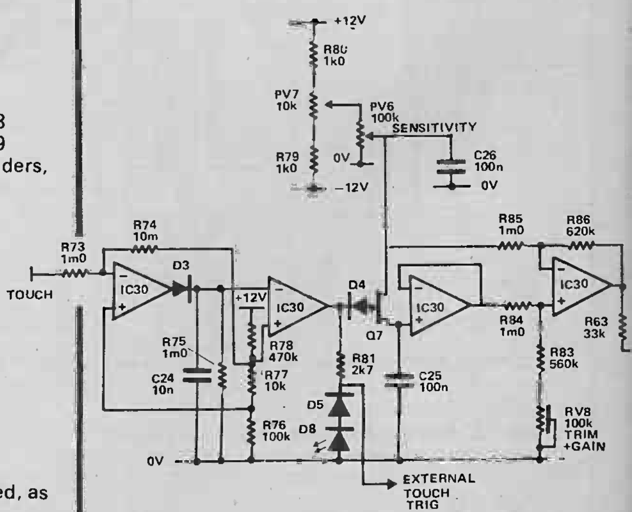
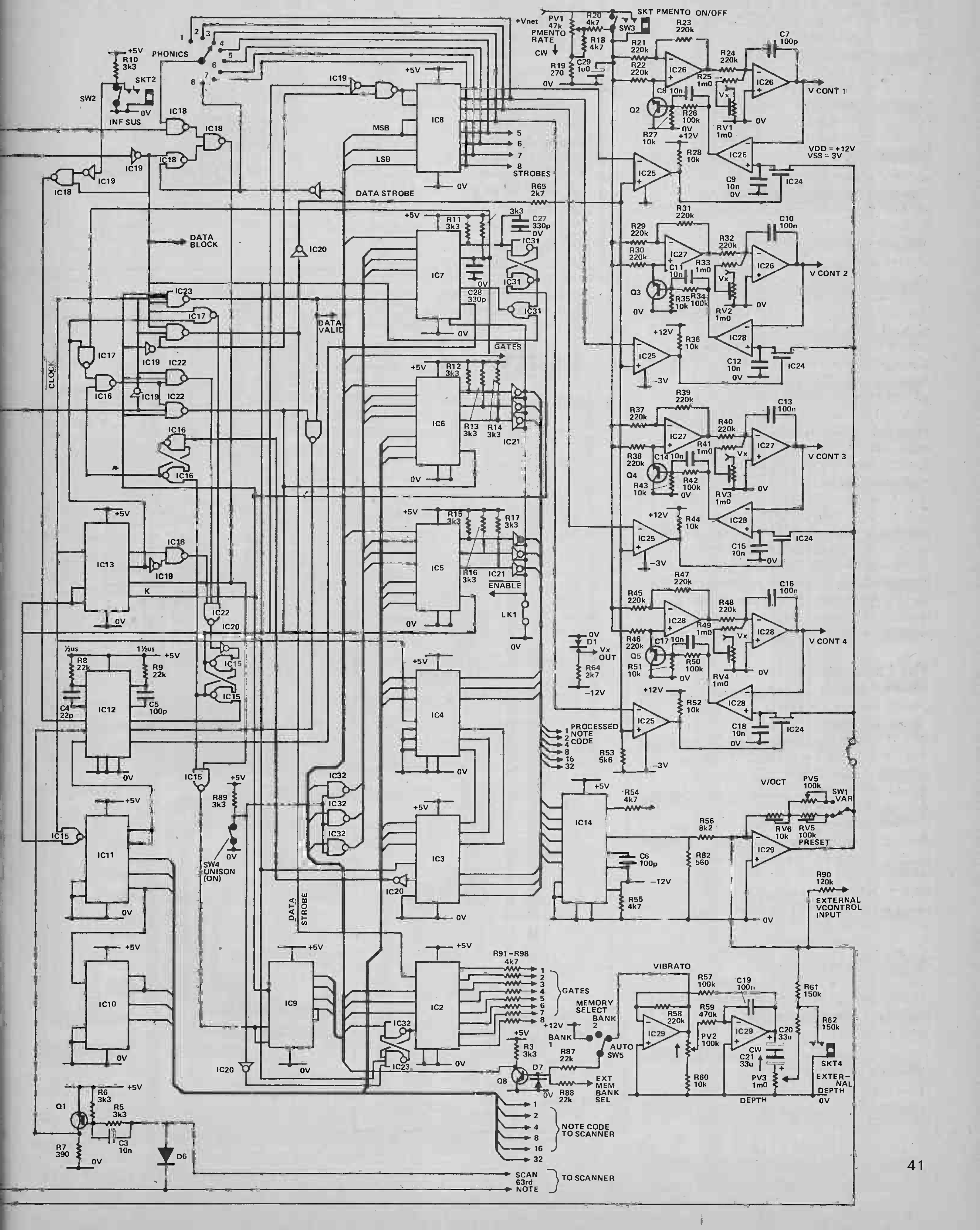


Fig. 3. Circuit diagram of the logic board.




SKT PMENTO ON/OFF
+Vnet
PV1 47k
PMENTO RATE
CW
SW3
PHONICS
SKT2
SW2
INF SUS
DATA STROBE
MSB
LSB
STROBES
DATA BLOCK
DATA VALID
CLOCK
GATES
ENABLE
LK1
K
SW4 UNISON (ON)
V CONT 1
V CONT 2
V CONT 3
V CONT 4
VDD = +12V
VSS = 3V
Vx OUT
PROCESSED NOTE CODE
V/OCT
SW1 VAR
PRESET
EXTERNAL VCONTROL INPUT
VIBRATO
GATES
MEMORY SELECT
BANK 1
BANK 2
AUTO SW5
EXT MEM BANK SEL
DEPTH
SKT4
EXTERNAL DEPTH
NOTE CODE TO SCANNER
SCAN 63rd NOTE
TO SCANNER
DATA STROBE

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FEATURES

PROJECTS

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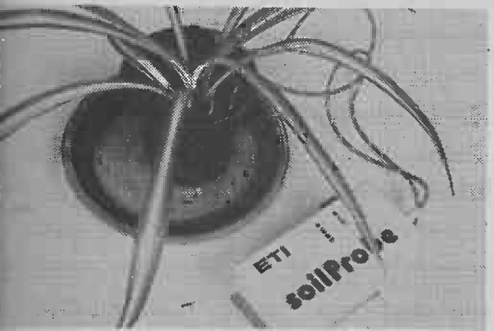

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EDITORIAL AND ADVERTISEMENT OFFICE
25-27 Oxford Street, London W1R 1RF. Telephone 01-434 1781/2. Telex 8811896

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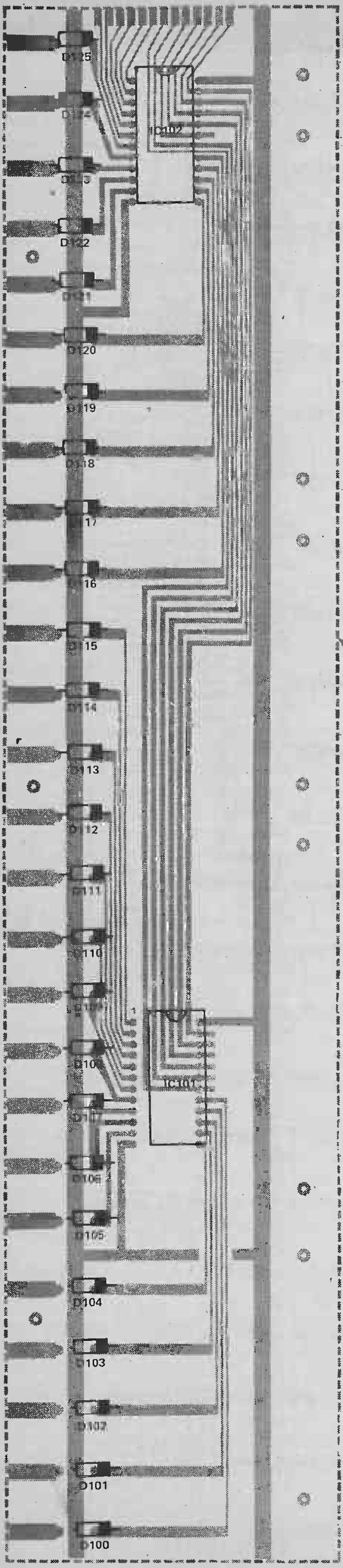


PARTS LIST

RESISTORS	
R1, R67, R79, R80	1k0
R2, R18, R20, R54, R55, R91-R98	4k7
R3-R6, R10-R17, R69, R89	3k3
R7	390R
R8, R9, R87, R88	22k
R19	270k
R21-R24, R29-R32, R37-R40, R45-R48, R58	220k
R25, R33, R41, R49, R73, R75, R84, R85	1MO
R26, R34, R42, R50, R57, R71, R72, R75	100k
R27, R28, R35, R36, R43, R44, R51, R52, R60, R64, R77	10k
R53	5k6
R56	8k2
R59, R66, R78	470k

R61, R62	150k
R63	33k
R65, R81	2k7
R68	680R
R70	47k
R74	10M
R82	560R
R83	560k
R86	620k
R90	120k
POTENTIOMETERS	
PV1	47k
PV2, PV4, PV5, PV6	100k
PV3	1MO Log
PV7	10k
RV1-4	1MO
RV5, RV8	100k
RV6	10k
RV7	47k

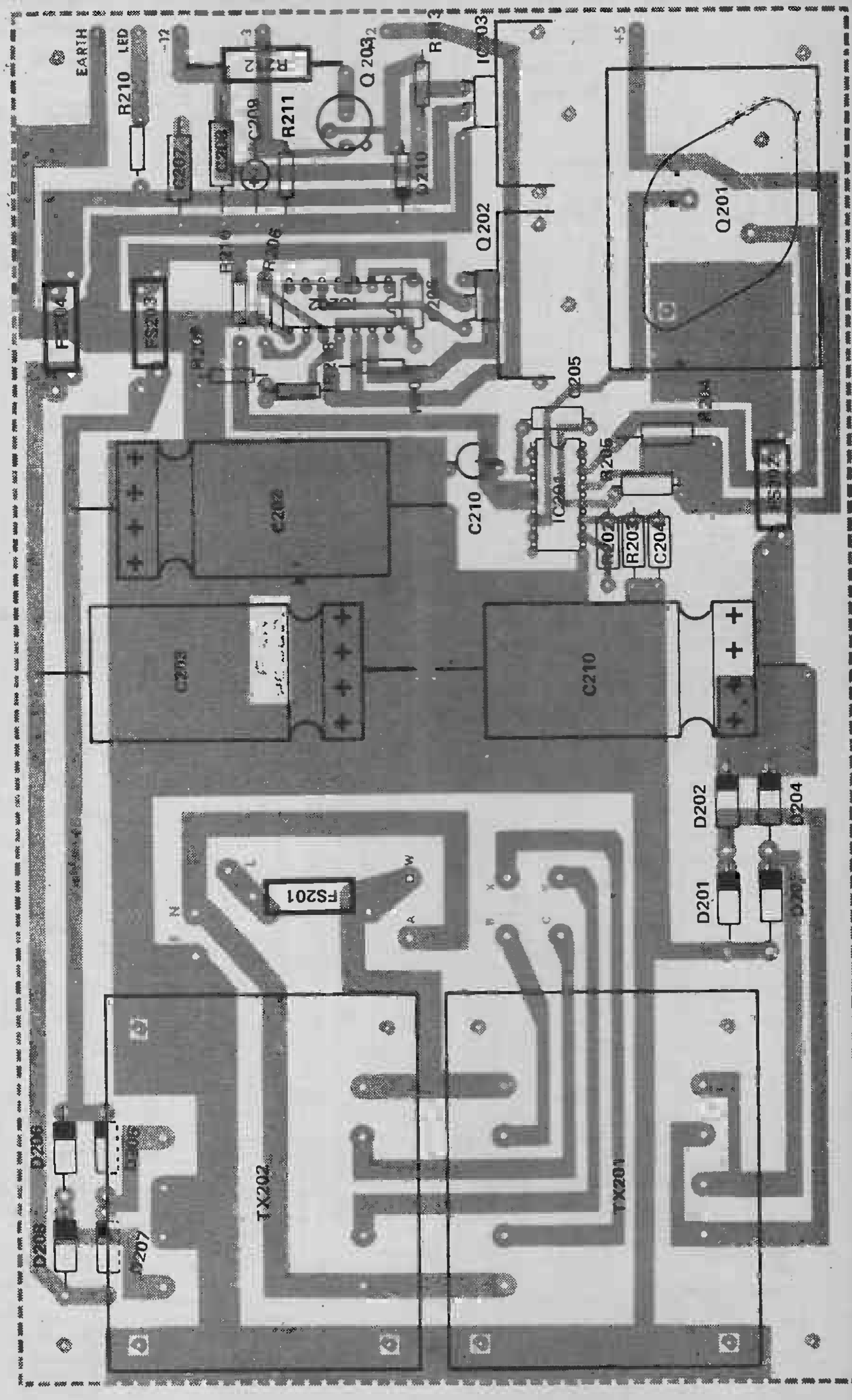


Fig. 4. (below) Component overlay of power supply board.
Fig. 5 (above) One of the two keyboard PCBs, designed to fit Araks keys.

CAPACITORS	
C1-3, C8, C9, C11, C12, C14, C15, C17, C18, C24	10n polyester
C4	22p
C5, C6	100p
C7, C10, C13, C16, C19, C25, C26	100n polyester
C20, C21	33u
C22, C23, C29	1u0 35V electrolytic
C27, C28	330p
SEMICONDUCTORS	
Q1	BCY72
Q2-6, Q8	BC107
Q7	2N5163
IC1	NE555
IC2	CD4099
IC3, IC4	74LS85
IC5-7	7489
IC8	74LS155
IC9-11, IC13	74LS93
IC12	74LS123
IC14	MC1408L-8
IC15-18, IC31, IC32	74LS00
IC19, IC20	74LS04
IC21	74LS366 (or 74LS368)
IC22, IC23	74LS10
IC24	CD4066
IC25	LM339
IC26, IC27, IC28, IC30	TL084
IC29	LM4741
D1, D3-7	1N914
D2	6V2 Zener
D8	LED
MISCELLANEOUS	
37 way 'D' skt, stereo jack (3 off), SPDT switch (4 off), SPDT centre off.	

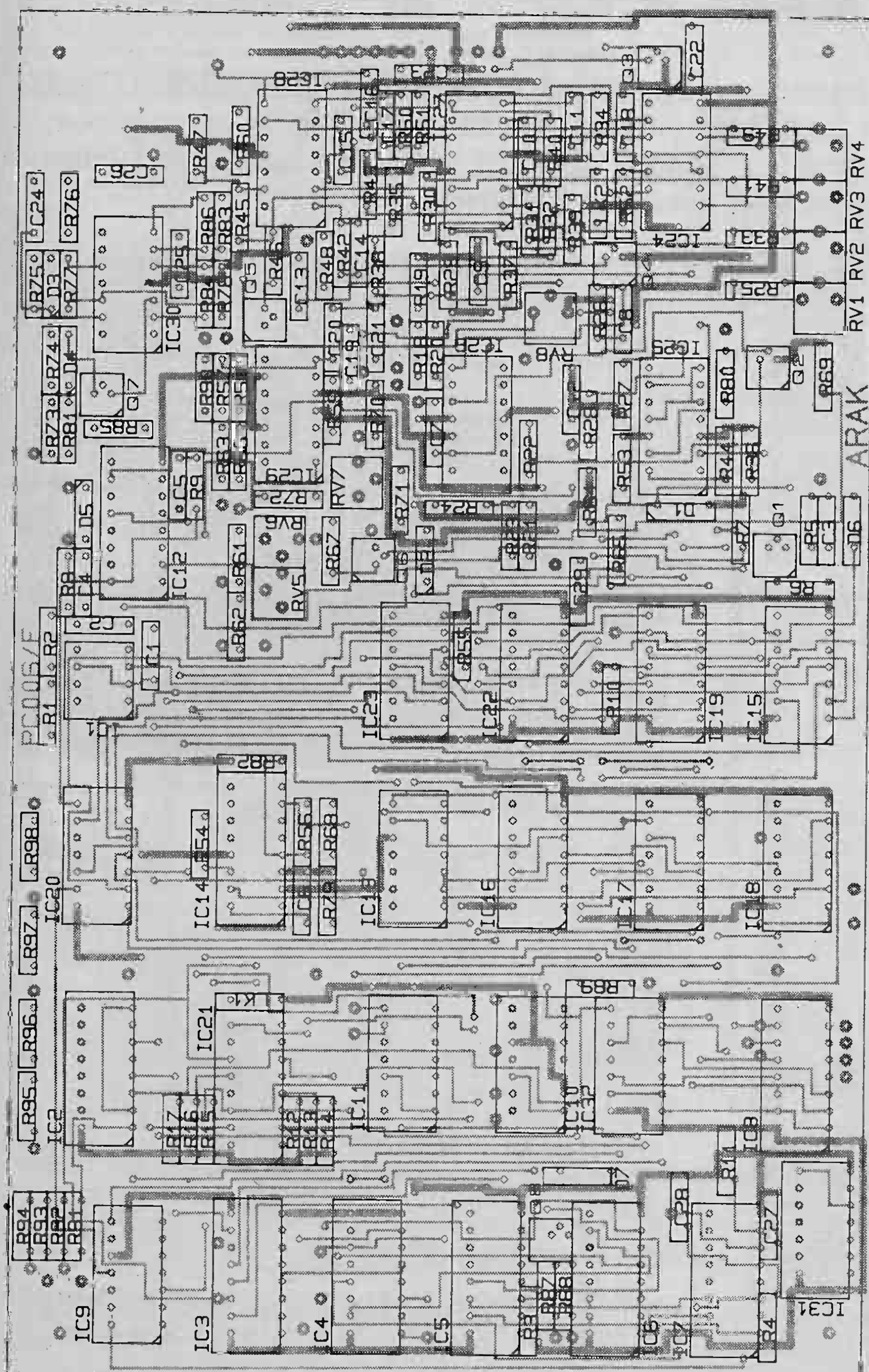


Fig. 6. (above) Component overlay for the logic board.

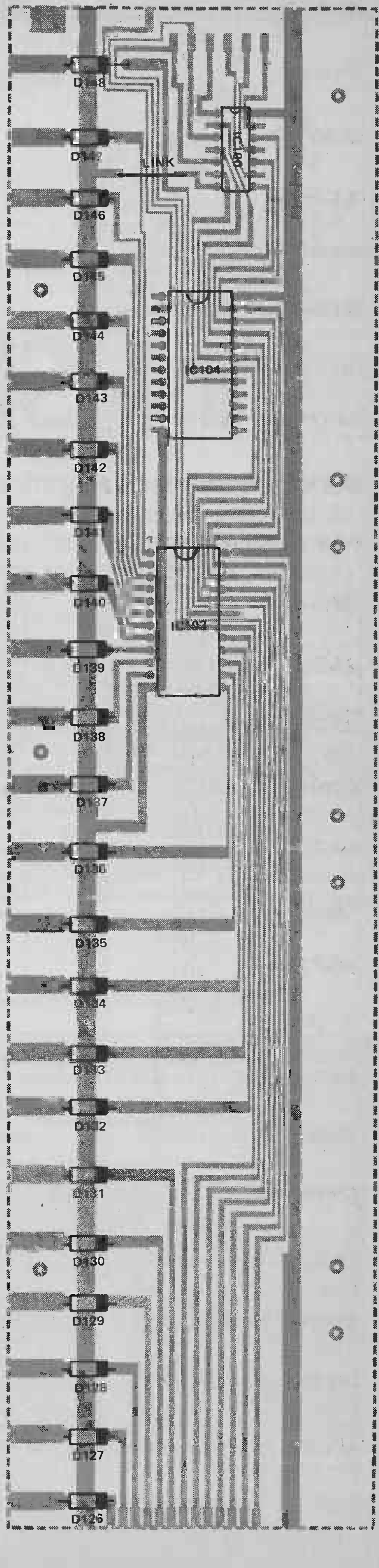


Fig. 7. (Below). One of the keyboard PCBs made to fit Arak's keys.

PARIS IN SPRINGTIME

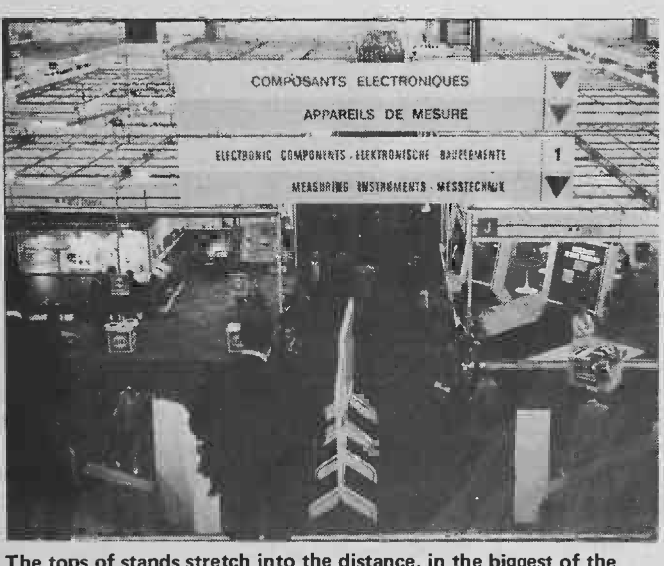
As a London-based magazine, we tend to concentrate our interest on exhibitions and electronics shows in the London area. Lest we become too parochial in our outlook, we decided to see what our fellow Europeans have to offer. We sent our roving reporter, Ian Graham, to Paris to see how the other half live.

I PROBABLY RECEIVE a couple of hundred Press releases every day. Most, concerning orders for electronic equipment won by companies or appointments to the top management of larger corporations or annual accounts, end up in the waste paper bin. Our reports on the cream of the rest appear monthly in our news pages. Occasionally I am invited to attend Press receptions. Again, few are interesting enough to prise us out of our armchairs. However, I did sit up and take notice when I was invited to attend an electronic components exhibition 'sur le continent'. The occasion was the Salon International des Composants Electroniques 79, held in Paris from the 2nd to 7th of April. Well, I thought about it, for several seconds at least, and decided that I had indeed been neglecting our European brothers.

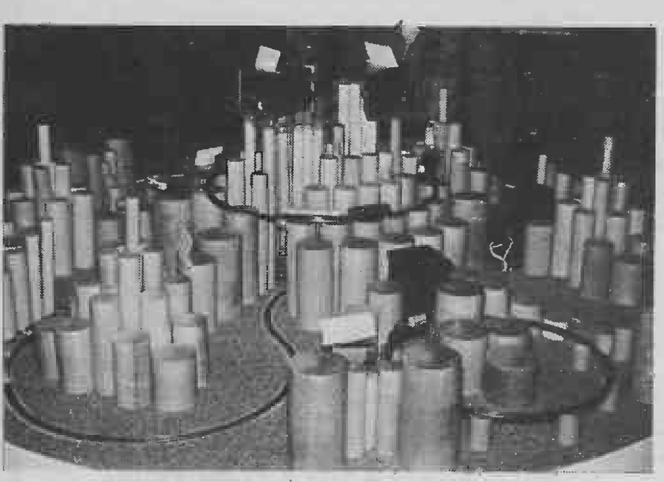
On a sunny April morning I made my way from Charles de Gaulle airport to the exhibition site at the Parc des Expositions in the Place de La Porte de Versailles. My first impression as I emerged from the Metro station was of the unexpected size of the exhibition, which stretched over a staggering 63,000 square metres, split up into four sections. It would have taken several days to see everything on display, certainly more than the single day I had allowed myself.

Although it was essentially a trade show, the atmosphere inside was more akin to that of our own Ideal Home Exhibition. However, great expectations of an entertaining exhibition were not borne out by my admittedly swift tour of the stands.

Row upon row of stands full of goodies — paradise for the exhibition addict.



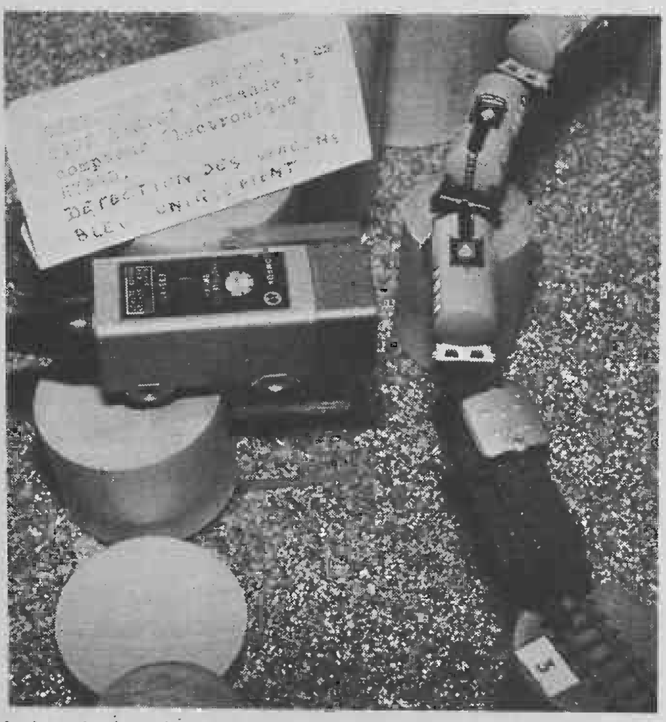
The tops of stands stretch into the distance, in the biggest of the three exhibition halls.



A fun way of counting trains with photocounters. This stand attracted a great deal of interest from people who had probably never seen a photocounter before. This simple display illustrated the principle of the unit admirably for the layman.

Dry Stuff?

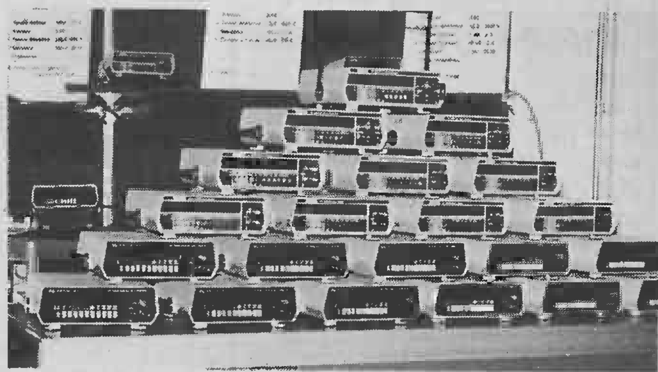
Unfortunately, few exhibitors showed any imagination in the presentation of their wares. Sound to light units and TV games naturally lend themselves to entertaining stands, but what about more mundane electronic components? General Instrument Microelectronics (a British firm, I'm happy to say) managed to make microprocessors a crowd puller (I wouldn't have thought it possible) by using one to control a noise generator. Pretty dry stuff, you might say. However, the generator was producing car engine, gear change, skid and crash noises for a model racetrack. Visitors could control the cars with conventional pistol grips. Well, perhaps a model race track has little to do with microprocessors and vice versa, but it did attract interested visitors. Isn't that what it's all about?



A closer look at the electronic 'train' spotter above. One colour of wagon, in this case blue, can be counted, ignoring the train and all the other wagons.

Eyecatching Pyramids

Another firm displayed photocounters by using them to count wagons on a pyramid of model railway layouts. Talking about pyramids, yet another firm (American) presented a striking display, a pyramid of multimeters. They might uncharitably be called gimmicks, but they *were* eye-catching. Too many exhibitors relied on a glass case full of components accompanied by row upon row of standard black and white exhibition photos, none of which deserved or got a second look. Still, there were plenty of product demonstrations to keep me busy, as I made my way through the maze of stands. There were also lectures. How do you fancy soaking up 'Monolithic Memories' at half nine in the morning? No, neither did I.



Keithley's pyramid of multimeters. We strongly suggest that you don't try this with your Avo. 8's, or if you do, don't blame us if there are disastrous consequences.

Light Entertainment to Heavy Machinery

Although I found plenty to criticise at the Paris show, it put some of our own electronics shows to shame. Whatever you are interested in, from hi-fi to heavy machinery, there's plenty of it at the Salon, with some 1300 firms exhibiting. Hi-fi enthusiasts could spend a day or two wandering round the stands devoted to the love of their life. That goes equally well for every field of interest represented and there wasn't much that was not represented.

See You Next Year

My brief visit to the show was very enjoyable. There was plenty of food and drink to be had from seemingly numerous bars. The French exhibition staff were so good to me that I'm thinking of doing it again next year. If you feel like joining me, the Salon International des Composants Electroniques 80 will be held from March 27 to the 2nd of April. If you feel like nipping across the pond to pay your visit on Sunday, March 30th, don't......they're closed. ETI

MOTOR SPEED CONTROLLER

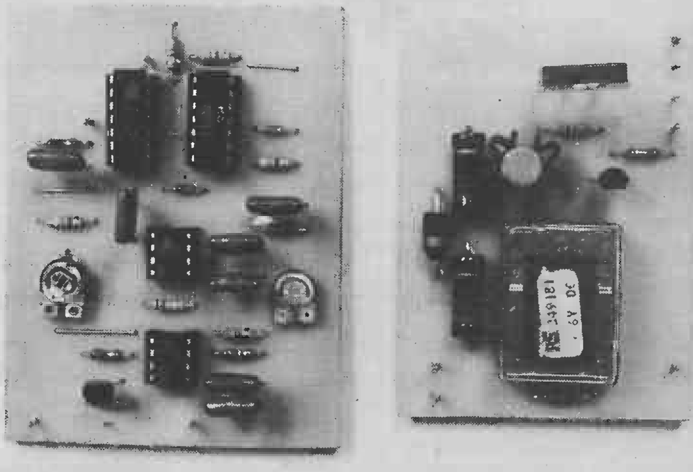
A sophisticated unit that allows control of model electric motor speed and direction via a single radio control channel. The unit can supply peak currents up to 10 amps.

THIS DEVICE lets you use a single channel of your radio control system to control both the speed and direction of an electric model motor. The unit has been designed specifically to control the drive motor of our 1/16th scale Tamiya Leopard tank, but can in fact be used to control any 4V5 to 8V DC electric motor that draws peak current below 10 amps. The unit is ideal for use in model boats and large-scale land vehicles, and costs only a fraction of the price of equivalent commercial units.

The unit derives it's control signals from one of the output channels of a radio control decoder. It accepts standard positive or negative decoder pulses, which have widths variable over the 1 mS to 2 mS range, and is designed to work with systems having fixed frame (or frame repeat) periods of approximately 20 mS. The Strato 4+2 system, published in the May and June editions of ETI, can be used with the controller.

The controller circuit incorporates only two pre-set pots. One of these is a 'set null point' control, and can be used to set the motor speed to zero in any desired position of the transmitter joystick control. The other pre-set is used to set the maximum speed of the motor.

The two pre-sets can be used to give a variety of operating modes. If they are adjusted so that the null point occurs at the centre of the joy stick travel, the motor will have identical maximum speeds in forward and reverse. If the null is set to occur towards the 'low' end of the joy stick travel, the motor will have a high maximum forward speed and a low maximum reverse speed.



Construction And Use

The unit is assembled on two PCB's. Board 1 holds all the logic, timing components, and the two pre-set pots, and board 2 holds the power driver transistors and the relay. Construction of board 1 should present few problems: note, however, that no provision is made on the PCB for decoupling capacitor C8, since we hooked this component into the wiring harness on our prototype unit.

Note when constructing board 2 that power transistor Q4 can either be mounted directly on the board in low- to medium-power applications, or can be mounted externally on a suitable heat sink (such as a vehicle chassis, etc) in high power applications. The relay used on this board is a 6 volt two pole changeover type with a coil resistance of 70R (see Buylines).

When construction is complete, the two boards can be mounted in the model, preferably as far away from interference-generating motors and servos as possible. Board 1 is powered from the radio control decoder supply lines. The signals from the selected output channel of the decoder are fed to either the positive pulses or negative pulses input leads of board 1, depending on the pulse polarity of the particular decoder that is used.

Board 2 is powered from the motor supply leads. Note that the 0V line of the motor supply must be made common with the 0V line of the decoder. Also note that one lead must be connected between R6 on board 2 and pin 4 of IC1 on board 1, and another lead must be connected between R12 on board 2 and Q1 collector on board 1.

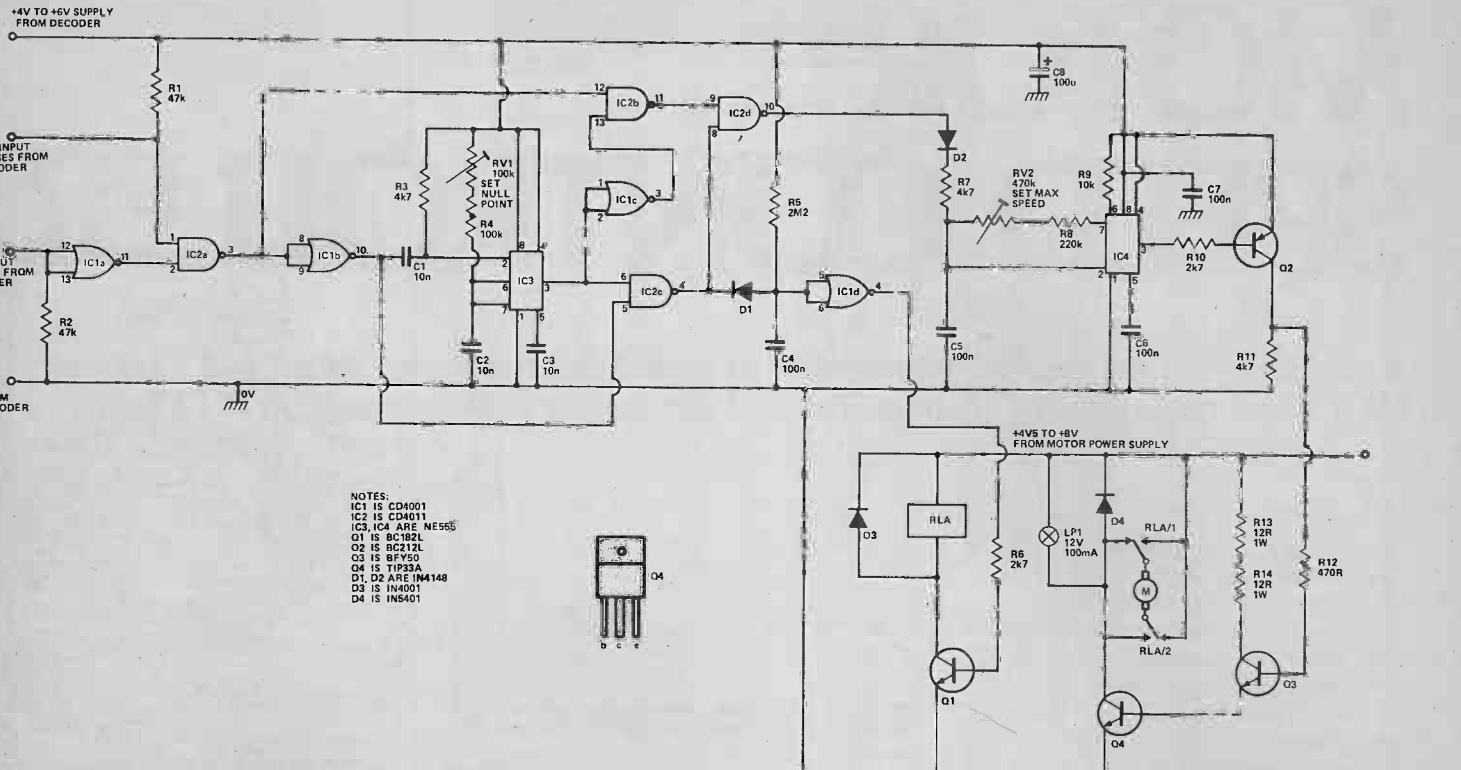


Fig 1. Full circuit diagram for the radio control motor speed controller. The connections for the power type Q4 are shown.

HOW IT WORKS

The input pulses from one channel of the decoder, which have widths that are variable between 1mS and 2mS, are fed to either pin 1 or IC2a (negative input pulses) or to pins 12 and 13 of IC1a (positive input pulses), and appear in positive-going form at the output of IC2a. This positive-going pulse is fed directly to pin 12 ot IC2b, and is fed in inverted form to pin 5 of IC2c: the inverted pulse is also used to trigger reference-pulse generator IC3 via C1. This reference pulse has a nominal width of 1.5mS, which equals the mid-band width of the input pulses from the decoder.

The positive-going reference pulse is fed directly to pin 6 of IC2c, where it is compared with the negative-going version of the input pulse on pin 5. The action of IC2c is such that its output is normally high, but switches low for a period equal to the difference between the reference and input pulse widths only when the input pulse duration is less than that of the 1.5mS reference pulse. This negative-going output pulse, which has a width that is variable between zero and a nominal 0.5mS, is used to rapidly discharge C4 via D1 and thus cause the output of IC1d to switch high and drive relay RLA on via Q1 and R6. This relay, which dictates the direction (forward or reverse) of the motor that is being controlled, is thus off when the input pulses are greater than 1.5mS (nominal), and on when the input pulses are less than 1.5mS.

The 1.5mS reference pulse of IC3 is inverted by IC1c and fed to pin 13 of IC2b, where it is compared with the positive-going version of the input pulse from the decoder. The action of IC2b is such that it's output is normally high, but switches low for a period equal to the difference between the reference and input pulse widths only when the input pulse duration is greater than that of the 1.5mS reference pulse. This negative-going pulse, which also has a width that is variable between zero and a nominal 0.5mS, is fed to pin 9 of IC2d.

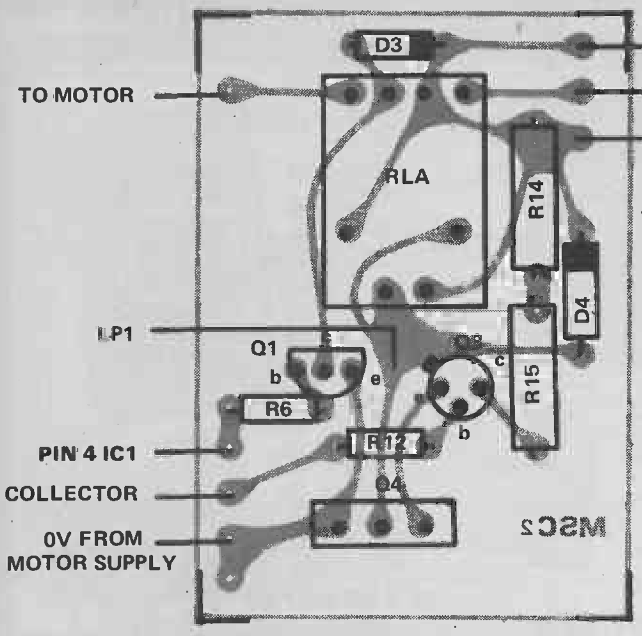
Thus, a negative-going pulse appears on pin 9 of IC2d if the decoder pulse is greater than 1.5mS, or on pin 8 of IC2d if the decoder pulse is less than 1.5mS. Consequently, IC2d generates a positive-going output pulse that has a width that varies from zero on a 1.5mS decoder input pulse to 0.5mS on a 1mS or 2mS input pulse.

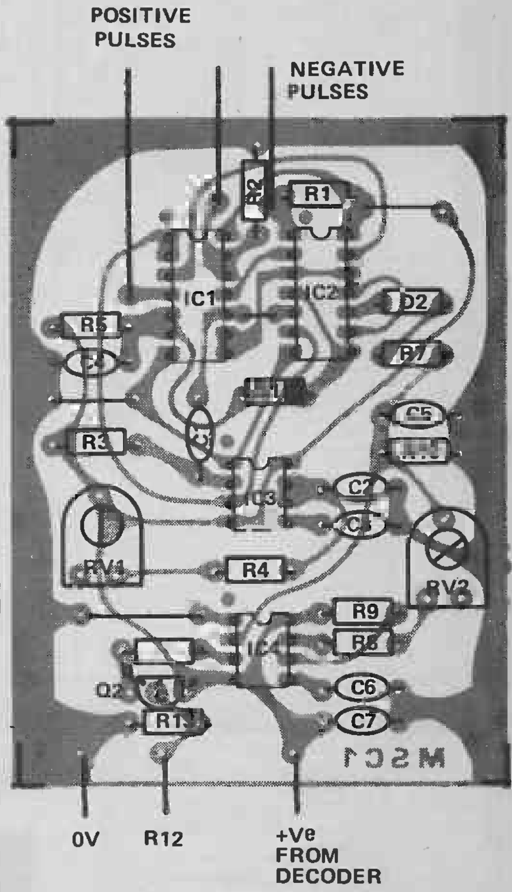
This pulse is fed, via D2, to a pulse-expander circuit designed around IC4, which expands the pulse width by a factor of about 40. The resulting expanded pulse is passed on to the external motor via transistors Q2 to Q4 and the contacts of the relay, and is used to give pulse-width or variable mark/space-ratio control of the motor speed. Diode D4 is used to damp motor back-EMF, and lamp LP1 is used to minimise the effects of interference-generating current surges.

In practice, RV1 is used to adjust the width of the reference pulse (nominally 1.5mS) so that the motor speed is zero when the transmitter joy-stick control is in its central or null position, and RV2 is used to adjust the expansion factor of the pulse expander circuit and thus pre-set the maximum speed of the motor when the transmitter control is in its 'maximum' position.

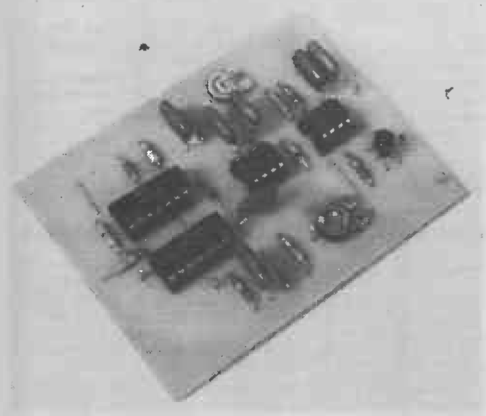
BUYLINES

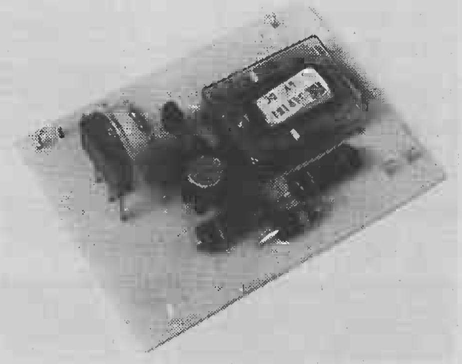
The relay is the only component that calls for comment here. It is a 6 Volt 2-pole changeover type with a coil resistance of 70R, and is available from Greenweld, 443 Millbrook Road, Southampton, SO1 0HX. The price is £3.30, including postage and the usual extras.





Above left and almost absolutely right are the component overlays for the speed controller.





And this is how the boards should look once you've built them up. Check very carefully before switching on.

PARTS LIST

RESISTORS (all ¼w 5%)

R1, 2	47k
R3, 7, 11	4k7
R4	100k
R5	2M2
R6, 10	2k7
R8	220k
R9	10k
R12	470R
R13, 14	12R 1W

CAPACITORS

C1, 2, 3	10n polyester
C4, 5, 6, 7	100n polyester
C8	100u 25V electrolytic

SEMICONDUCTORS

IC1	4001
IC2	4011
IC3, 4	555
Q1	BC182L
Q2	BC212L
Q3	BFY50
Q4	TIP33A
D1, 2	IN4148
D3	4001
D4	IN5401

Relay = 6V, 2-pole changeover type. Coil resistance 70R.

What A Turn On

When installation is complete, turn on all power switches, check that the unit functions correctly, and then adjust pre-set pots RV1 and RV2 for the required operation. To set RV1, move the transmitter joy stick to the required 'null' position, and then adjust RV1 for zero motor speed: under this condition the relay should be on the verge of switching between the on and off states. Next, move the transmitter joy stick fully forward, and adjust RV2 for the desired maximum motor speed. The setting up procedure is then complete.

Finally, note that the operation of the motor speed controller can be adversely affected by electrical interference from motors, etc. All motors in the model must therefore be adequately suppressed. A 100n disc ceramic connected directly across the motor terminals works pretty well in most cases. ETI

40 CMOS CLOCKS

There are many ways of using the CD4001 and CD4011 CMOS ICs to make bistable, astable and monostable multivibrator circuits. Ray Marston presents the definitive work on the subject, with 40 practical circuits.

THE AMATEUR AND PROFESSIONAL circuit designer often finds himself in the situation where he needs to use a minimum-cost CD4001 or CD4011 CMOS pulse or clock generator circuit, or where he needs to use a few spare CMOS NAND or NOR gates from an existing circuit to make up a multivibrator that will meet his specific design needs. In either case, the designer will find a concise guide to practical NAND- and NOR-gate CMOS multivibrator circuits of inestimable value.

This article is just such a guide. It presents some forty different ways of using the low-cost CD4001 and CD4011 quad 2-input gate CMOS integrated circuits in bistable, astable and monostable multivibrator applications. All of the circuits shown can be operated over the full five volts to fifteen volts supply range when used with 'B' series CMOS.

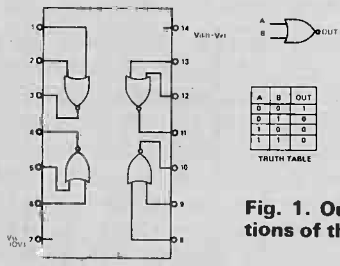


Fig. 1. Outline and pin connections of the CD4001.

THE CD4001 and CD4011 ICs

Figures 1 and 2 show the outlines and pin connections of the CD4001 and CD4011 integrated circuits. These two ICs are quad 2-input gates. The CD4001 provides NOR gate functions and the CD4011 provides NAND gate functions. Fig. 1 shows the truth table of each of the four NOR gates of the CD4001. Note that the output is high if both inputs are low, but goes low if either or both inputs go high. Fig. 2 shows the truth table of each of the four NAND gates of the CD4011. The output is normally high and goes low only if both inputs are high.

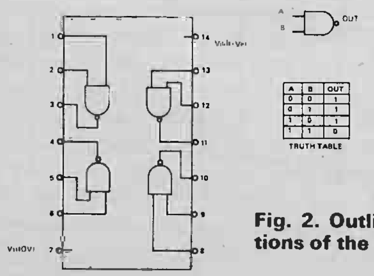


Fig. 2. Outline and pin connections of the CD4011.

The CD4001 and CD4011 are very inexpensive ICs. They typically retail at about 16 pence each in one-off quantities (allowing for some variation between suppliers), which works out at about 4 pence per gate. They can be used in a wide variety of very useful two-gate multivibrator applications and are thus highly cost-effective devices.

Bistable Multivibrator Circuits

The CD4001 and CD4011 can both be used in two-gate R-S (Reset-Set) bistable multivibrator circuits, but have quite different input triggering requirements. Fig. 3 shows the practical circuit and waveforms of a pulse-triggered NOR version of the bistable. The circuit has two outputs, a normal output from IC1a and an inverted output from IC1b. When a positive-going trigger pulse which switches between roughly zero and full supply is applied to the IC1b input, the normal output sets high and locks in this state irrespective of any further signals at the input of IC1b. The output can only be reset low again by applying a positive-going pulse to the input of IC1a, at which point the output goes low and is then immune to any subsequent trigger pulses at the input of IC1a.

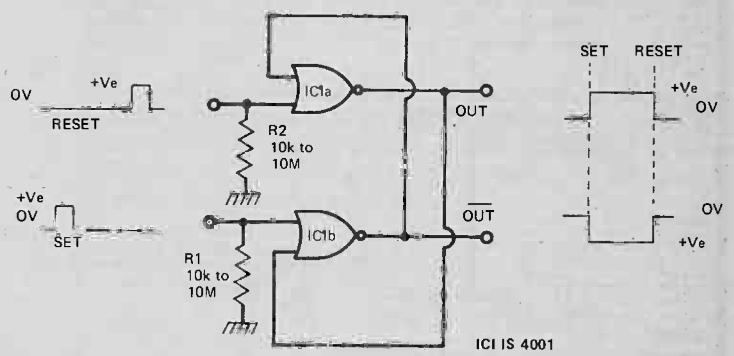


Fig. 3. Practical circuit of a pulse-triggered NOR bistable.

Note that the input terminals of IC1a and IC1b are tied to ground (the zero-volts line) via R1 and R2: these resistors can have any convenient values in the range 10k to 10M. If inputs to IC1a and IC1b are direct-coupled from preceding logic networks, however, R1 and R2 can be omitted from the circuit.

Manual NOR Gate

Fig. 4 shows a manually-triggered version of the Fig. 3 NOR gate circuit. This type of circuit is often referred to as a 'noiseless' switch, since its output is unaffected by the contact bounce, etc., of its two control switches. ▶

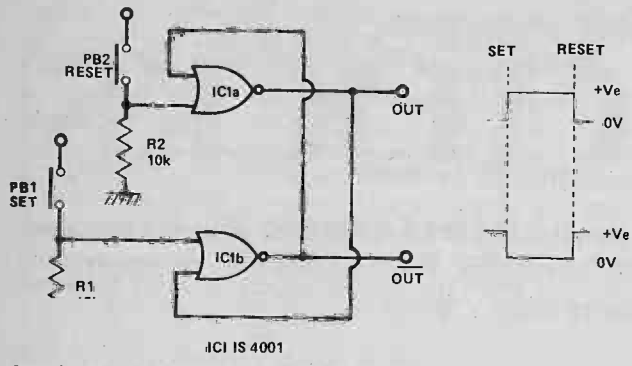


Fig. 4. Manually triggered NOR bistable.

NAND Bistable

Fig. 5 shows the CD411 NAND gate version of the bistable circuit. This circuit is almost identical with that of Fig. 3, except for the positioning of R1 and R2. Note, however, that the NOR gate circuit needs positive-going trigger pulses, while the NAND circuit needs negative-going pulses, and that the set pulse is applied to IC1b in the NOR circuit, but to IC1a in the NAND circuit.

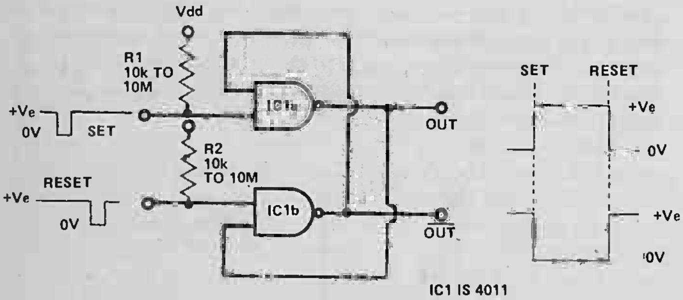


Fig. 5. A CD4011 NAND bistable, pulse triggered.

Manual NAND Bistable

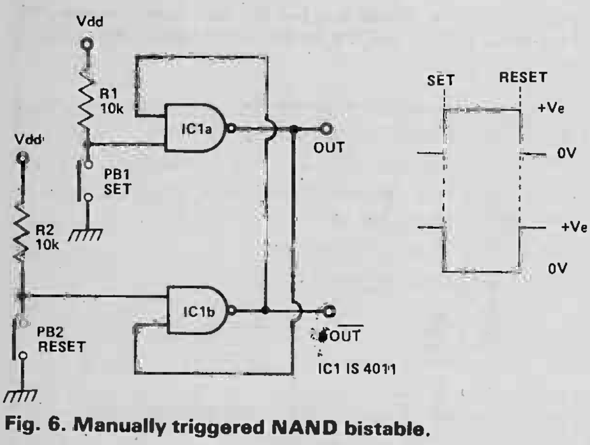


Fig. 6. Manually triggered NAND bistable.

Fig. 6 shows the manually-triggered version of the NAND-type bistable. Note here that although R1 and R2 are shown as having values of 10k, they can in fact have any resistance values from a few thousand ohms up to about 10M, depending on the precise details of the specific application. This versatility leads to the development of the touch-triggered NAND bistable circuit of Fig. 7, in which R1 and R2 have values of 10M, and the circuit can be triggered by placing any resistance that is significantly less than 10M (such as finger resistance) across the touch contacts. R3 and R4 are used in this circuit to protect the inputs of the two gates.

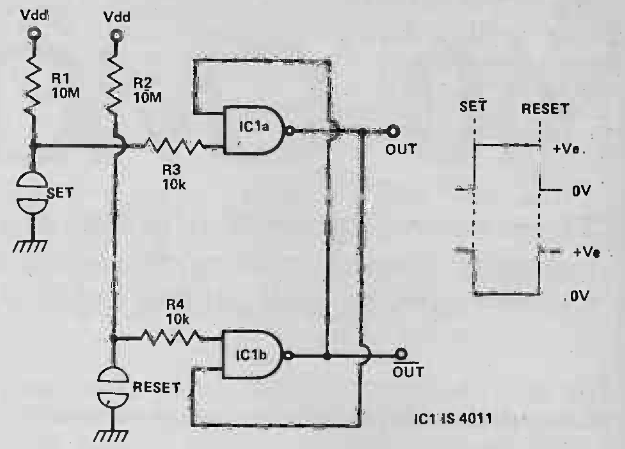
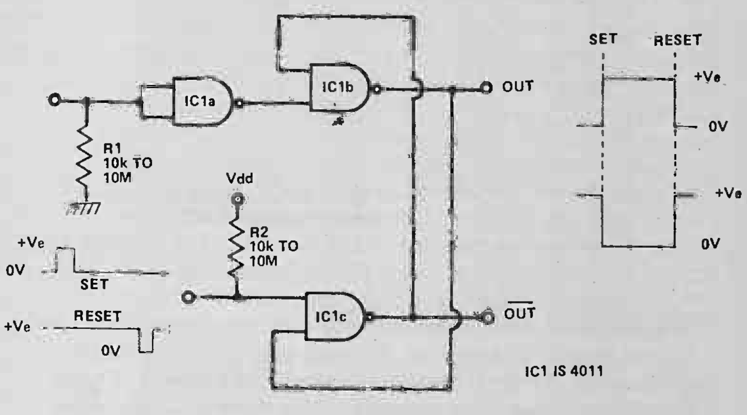


Fig. 7. Touch-triggered NAND bistable.

The bistable circuits that we have looked at so far all use same-polarity (either both positive or both negative) trigger signals. In some applications, however, it is necessary or convenient to use opposite-polarity signals to trigger the bistable, and this type of action can be obtained by placing an inverter stage in series with one or other of the normal bistable input terminals. Figs. 8 and 9 show two alternative circuits of this type.



Using opposite-polarity signals to trigger a 4011 bistable, Fig. 8 (above), and a 4001 bistable, Fig. 9 (below).

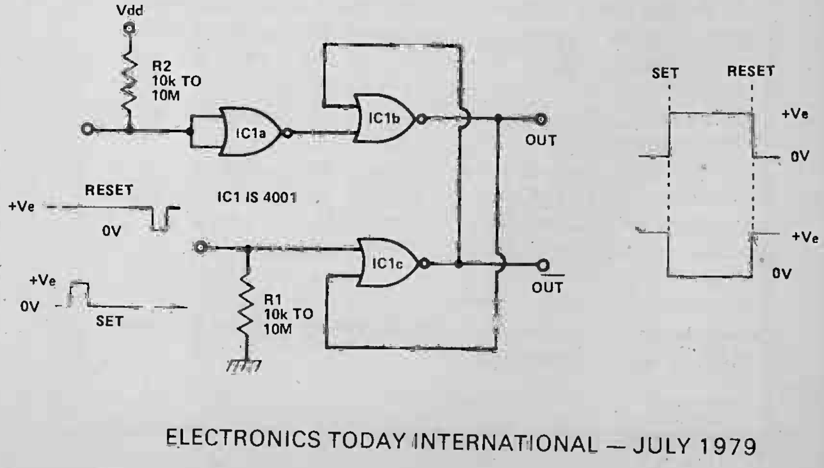


Fig. 10 shows alternative ways of connecting a 2-input NAND or NOR gate so that it acts as a simple pulse inverter stage. These circuits are useful in a multitude of applications.

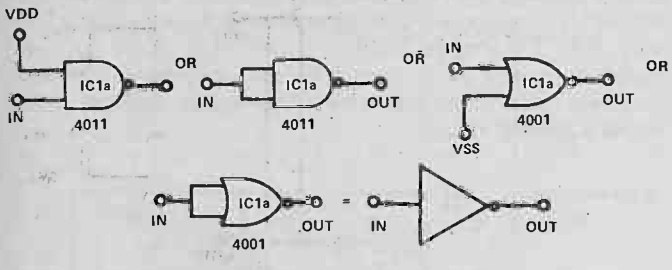


Fig. 10. Using a 2-input NAND or NOR gate as an inverter.

Basic 2-Gate Astable Circuits

The CD4001 and CD4011 can both be used in a variety of basic 2-gate astable multivibrator circuits. In these circuits the gates are connected as simple inverters, so the two types of IC give identical performances.

CMOS Astable

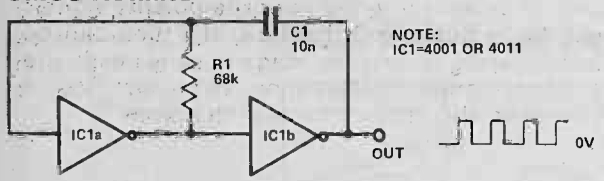


Fig. 11. Circuit of the basic 2-gate CMOS astable.

The most basic and useful 2-gate CMOS astable circuit is shown in Fig. 11. This circuit generates a decent square wave output, has excellent thermal stability and operates at about 1 kHz with the comfort values shown. The frequency is inversely proportional to the C-R time constant, so the frequency can be raised by lowering the values of either C1 or R1. In practice, C1 must be a non-polarized capacitor, and can have any value from a few tens of picofarads to a few microfarads. R1 can have any value from about 4k7 to 10M. For variable frequency operation, wire a fixed and a variable resistor in series in the R1 position.

The output of the Fig. 11 astable circuit switches (when lightly loaded) almost fully between the zero and positive supply voltage levels, but the junction of R1 and C1 is prevented from swinging below zero or above the positive rail levels by the built-in clamping diodes at the input of IC1a. This characteristic causes the operating frequency of the circuit to be somewhat dependent on supply rail voltages. As a rough rule of thumb, the frequency falls by about 0.08% for each 1% rise in supply voltage. Typically, if the frequency of this astable is normalised with a 10 volt supply, the frequency will fall by 4% at 15 volts, or rise by 8% at 5 volts.

Also, the operating frequency of the Fig. 11 circuit depends somewhat on the transfer voltage value of the individual gate that is used and can be expected to vary by as much as 10% between individual ICs. The output symmetry of the waveform is also dependent on the transfer voltage value of the IC and, in most cases, the circuit will give a non-symmetrical output. In the vast majority of 'hobby' and other non-precision applications, these deficiencies of the basic astable circuit are of little practical consequence.

Some can be minimised by using the 'compensated' astable circuit of Fig. 12, in which resistor R2 is wired in series with the input of IC1a. This resistor can have any value between two and ten times that of R1, and its main purpose is to allow the R1-C1 junction to swing freely below the zero and above the positive supply rail voltages during the switching action and thus reduce the dependance of the circuit operating frequency on the supply voltage. Typically, when R2 is given a value ten times greater than R1, the frequency varies by only about 0.5% when the supply voltage is varied between 5 and 15 volts.

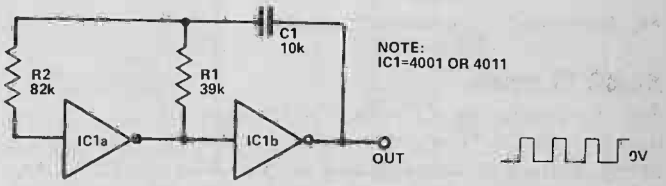


Fig. 12. A compensated astable circuit.

The basic and compensated astable circuits of figs. 11 and 12 can be built with a good number of detail variations. Some of these are shown in Figs. 13 to 18. In the basic astable circuit, for example, C1 alternately charges and discharges via R1. Figs. 13 to 15 show how the basic circuit can be modified to give alternate C1 charge and discharge paths.

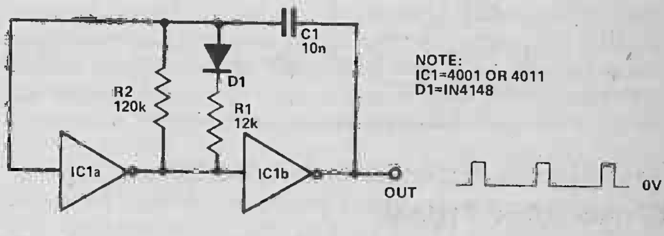


Fig. 13. Modifying the circuit to give C1 alternate charge and discharge paths and produce a non-symmetrical output waveform.

Fig. 13 shows one way of modifying the stable so that it gives a non-symmetrical output waveform. Here, C1 charges in one direction via R1 and R2 in parallel, to give a high output, but discharges in the reverse direction via R2 only, to give a low output.

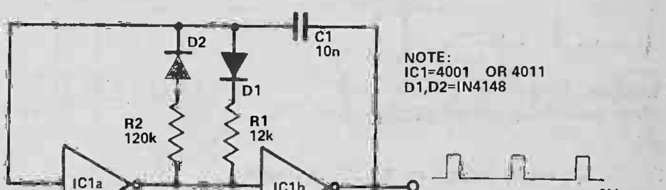


Fig. 14. Controlling the astable's on and off time.

On/Off Control

Fig. 14 shows how the circuit can be further modified by also wiring a diode in series with R2, so that the ON time of the output is controlled only by R1, and the OFF time is controlled only by R2. These two circuits can be made to give variable outputs by replacing either or both of their timing resistors with a fixed and a variable resistor in series. ▶

news digest.................

CARRY—PACKS FROM JVC

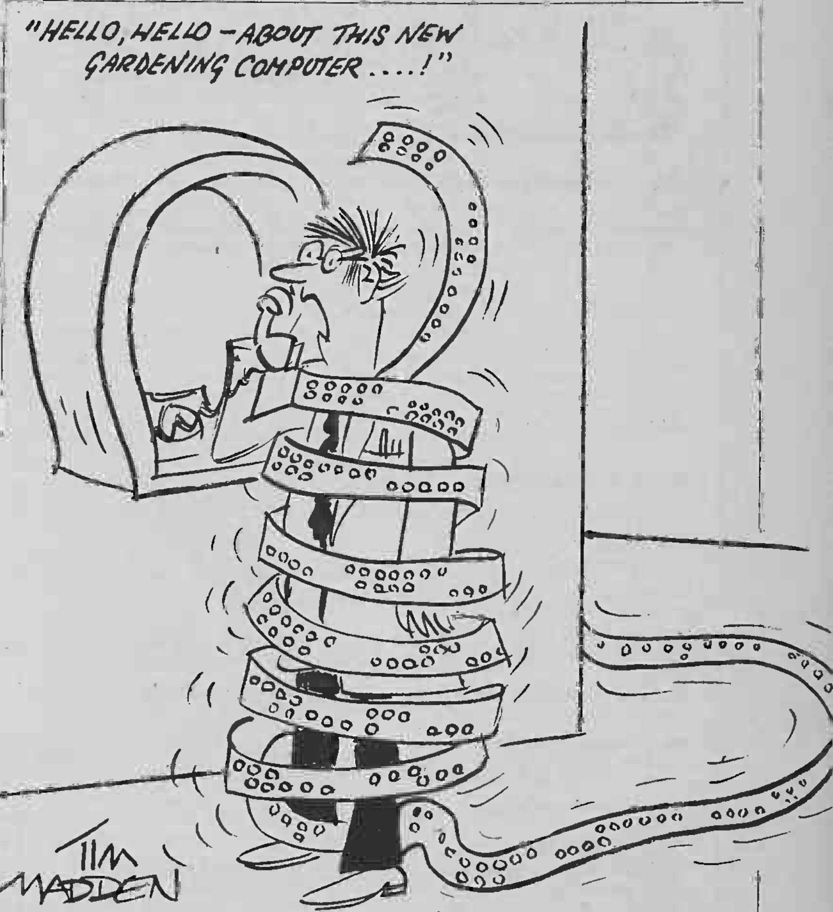
A new range of equipment from JVC brings their VHS domestic video system into the portable market.

Leading the range is the HR4100 colour portable video vassette recorder, with a price tage of £799.92 including VAT' it is fully compatible with all VHS recorders and weighs only 9.3 kg, complete with cassette, battery pack and RF converter.

The new GC4100 colour video camera is a self-contained unit with the camera control unit built into the camera head. Two-tube design uses a new colour strife filter to improve colour reproduction, with an aperture correction circuit to give excellent resolution. Recording is possible with illumination as low as 100 lux. Retail price will be £934.20p.

JVC have also launched the TV41 tuner/timer, which, when connected to the HR4100, provides all the usual record/playback facilities of a deck-type recorder, the HR 3330, is a development of the previous successful model, but also includes extra refinements such as eight day timer, remote-control pause switch and audio dubbing facilities.

For further information on this new video range, contact JVC (UK) Ltd., Eldonwall Trading Estate, Staples Corner, 6-8 Priestley Way, London NW2 7AF.
to give



OPTO FETS

A new trio of opto-coupled FETs, available from Jermyn-Mogul Distribution, feature a minimum isolation resistance of 100 gigohms between input and output.

These new GE opto-couplers consist of a gallium arsenide infra-red emitting diode coupled to a symmetrical bilateral silicon photo detector. The detector is electrically isolated from the input and performs like an ideal isolated FET designed for distortion - free control of low level AC and DC analogue signals. They do this by varying in resistance from between 100 ohms to 300 megohms, the change in resistance being controlled by the amount of current flowing through the infra-red emitting diode.

Applications include isolated variable attenuators, 70 db automatic gain control, remote band switching, sample and hold circuits, optically isolated multiflexers and reed relay replacement. The H11F family come in the popular six pin DIL package.

For products and application sheets contact Jermyn-Mogul Distribution of Vestry Estate, Sevenoaks, Kent.

Variable Symmetry

Fig. 15 shows how the astable can be modified to give a variable symmetry or M/S-ratio output, while maintaining a near-constant frequency. C1 in this circuit charges on one direction via D1-R2 and one half of RV1, and in the other direction via D2-R1 and the other half of RV1. The M/S-ratio can be varied over the range 1:10 to 10:1 via RV1.

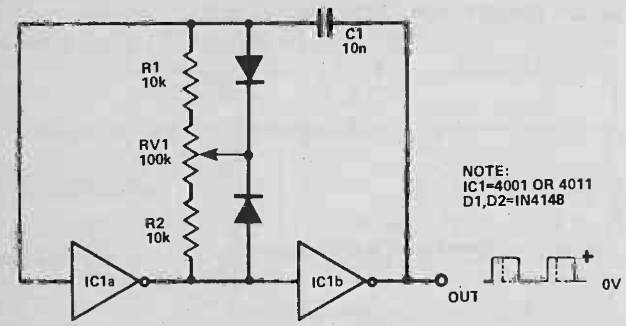


Fig. 15. Controlling the mark/space ratio.

Fig. 16 shows the circuit of a multi-tone push-button activated astable. Normally, when all push-button switches are open, R5 holds the input of IC1a (and thus the output of IC1b) low. Resistors R1 to R4 all have values that are low relative to R5, so the circuit acts as a normal astable when any one of the push-button switches is closed. This circuit can be used in multi-tone musical instruments and gadgets, etc. and has the major advantage that it draws negligible current when in the standby mode. There is no limit to the number of push-button switches that can be used with the circuit.

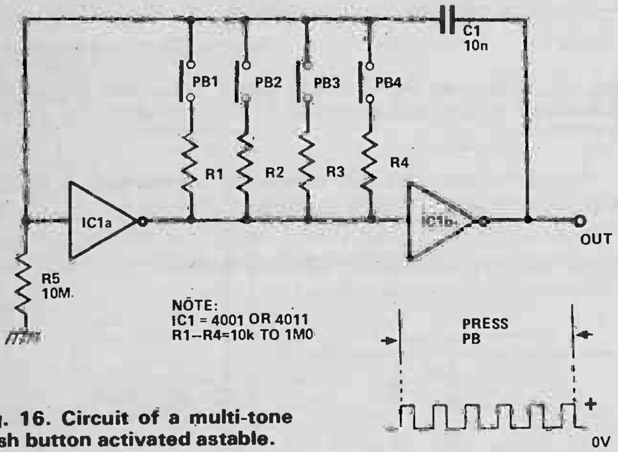


Fig. 16. Circuit of a multi-tone push button activated astable.

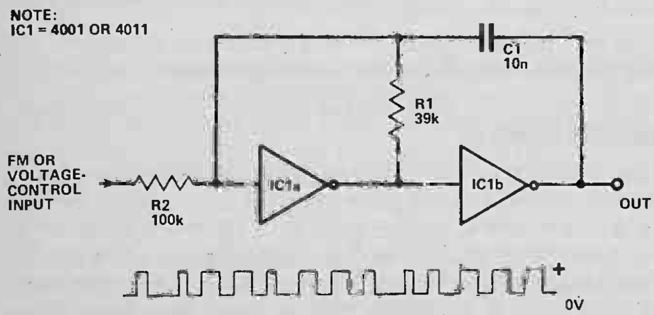


Fig. 17. Frequency modulation of an astable.

Frequency Modulation

Fig. 17 shows how the astable can be subjected to frequency modulation or voltage control of frequency by simply feeding the FM or voltage-control signal to the input of IC1a via a resistance that is much larger than R1 and Fig. 18 shows how the circuit can be further modified to act as a special-effect voltage-controlled oscillator that shuts off when the input voltage falls below a pre-set value.

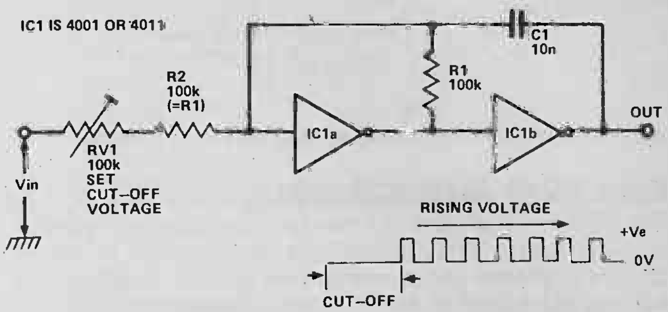


Fig. 18. Using an astable as a voltage-controlled oscillator with an output cut-off.

Gated 2-Gate Astable Circuits

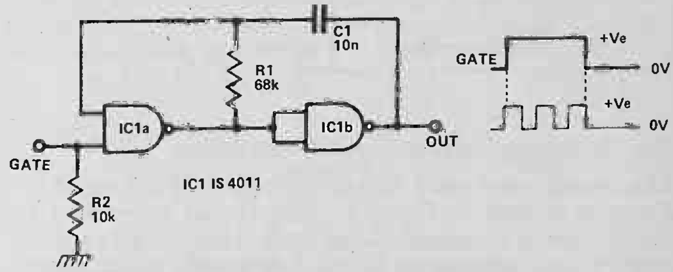


Fig. 19. A NAND astable with a normally-low output, gated by a high input signal.

All of the astable circuits of Figs. 11 to 15 can be modified for gated operation, so that they can be turned on and off via an external signal, by simply using a 2-input NAND or NOR gate in place of the inverter in the IC1a position and applying the input control signal to one of the gate input terminals. The CD4001 and CD4011 ICs can both be used in this type of application, but give quite different types of gate control and output operation. Figs. 19 and 20 show the two basic versions of the gated astable circuit.

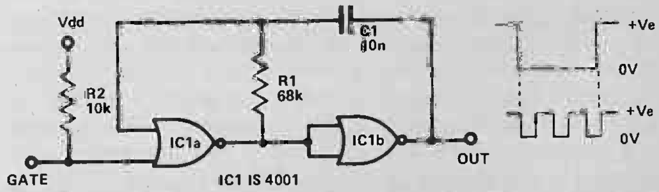


Fig. 20. A NOR astable with a normally-high output, gated by a low input signal.

Note that the Fig. 19 NAND astable circuit has a normally-low output and is gated by a high input signal, while the fig. 20 NOR astable has a normally-high output and is gated by a low input signal. Also note that, although R2 is shown in the diagram as having a value of 10k, R2 can in fact have any value in the range 10k to 10M and can be omitted altogether if the gate signal is applied from a preceeding logic state.

Note in the Fig. 19 and 20 circuits that the output signal terminates immediately the input gate signal is removed. Consequently, any noise present at the gate terminals of these circuits also appears at their outputs.

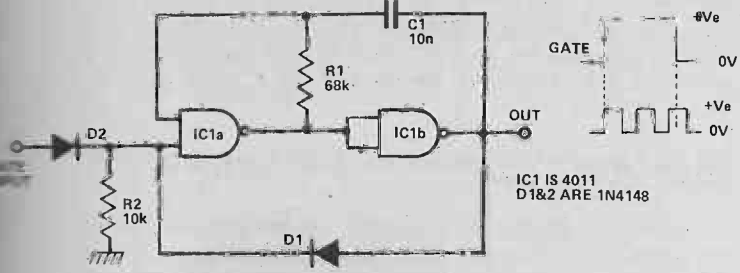
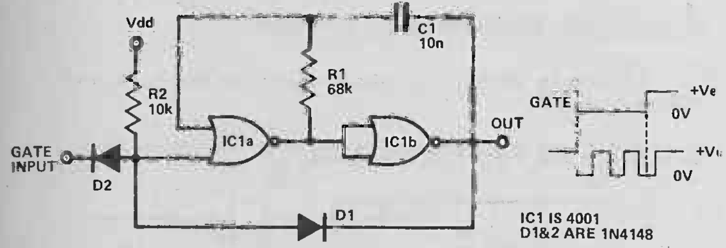
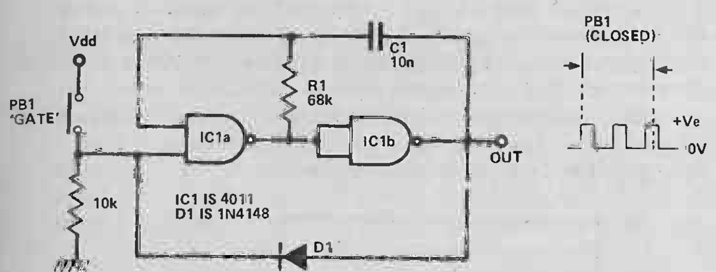


Fig. 21 (above) and Fig. 22 (below) overcome the problem of noise appearing at the gate terminals.



Figs. 21 and 22 show how the circuits can be modified to overcome this defect. Here, the gate signal of IC1a is derived from both the outside world and from the output of IC1b via diode OR gate D1-D2-R2. As soon as the circuit is gated from the outside world via D2 the output of IC1b reinforces the gating via D1 for the duration of one half astable cycle, thus eliminating any effects of a noisy outside world signal. The outputs of the circuits are complete numbers of half cycles. Note that R2 is an essential part of these circuits.



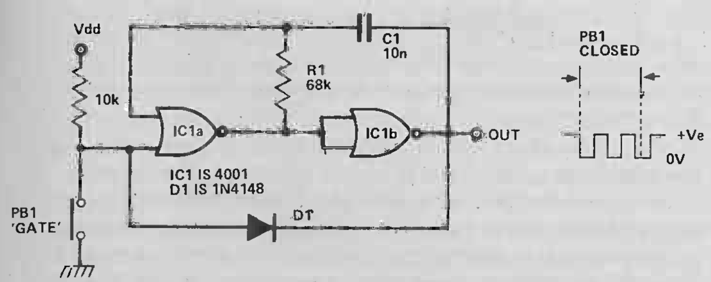


Fig. 23 (top) and Fig. 24 (above) show manually-triggered astables with noise-elimination networks.

Figs. 23 and 24 show manually-triggered versions of the Fig. 21 and 22 circuits. These circuits are of particular value when they are used as low speed clock generators, operating at about 5 Hz: when PB1 is briefly stabbed, the generate a single clean clock pulse: when PB1 is held down, they generate five clean clock pulses per second.

Clock Generator Circuits

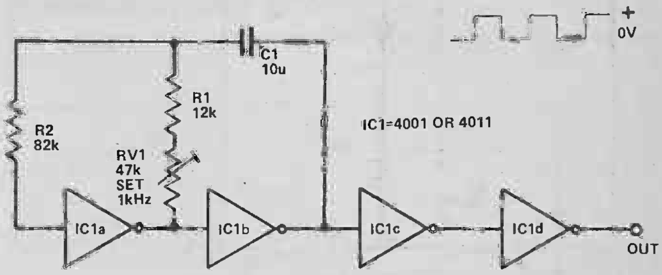


Fig. 25. Speeding up the rise and fall times of the astable output to produce clean clock signals.

The 2-gate astable circuit is generally not suitable for direct use as a clock generator with fast-acting counting and dividing circuits. Such circuits require the use of clean clock signals, with fast rise and/or fall times. The problem is that 2-gate astables designed around 'A' series or non-buffered CMOS produce clock outputs with rather slow rise and fall times, whereas 2-gate astables designed around buffered-output 'B' series CMOS produce outputs with good rise and fall times, but tend to produce 'dirty' clocking if there is the slightest trace of noice on their power supply lines.

Fortunately, these problems can easily be overcome by wiring a couple of inverter-connected gate stages in series with the output of the astable circuit, as shown in the example of Fig. 25. These inverter stages speed up the rise and fall times of the astable output waveform and also produce effective level shifting between the output of the astable and the clock input terminal of any external device, thereby reducing or eliminating the effects of noise on the clock circuit.

The Ring-of-Three Astable Circuit

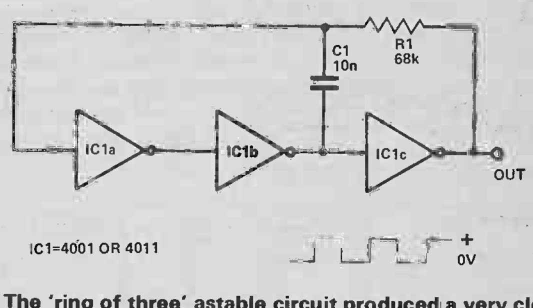


Fig. 26. The 'ring of three' astable circuit produced a very clean output waveform.

An alternative way of making a clock generator is to use the 'ring-of-three' astable circuit of Fig. 26. This circuit is similar to the basic circuit of Fig. 11, except that the positions of R1 and C1 are transposed, and the inverting input stage (IC1a) of the Fig. 11 circuit is effectively replaced by an ultra-high-gain non-inverting stage (comprising IC1a and IC1b in series) in the Fig. 26▶

circuit. Because of the very high gain of its composite input stage, the Fig. 26 'ring-of-three' circuit produces a very clean output waveform, with excellent rise and fall times, and is directly suitable for use as a clock generator.

The 'ring-of-three' astable circuit can be subjected to all of the basic design variations shown for the 2-gate astable. For example, C1 alternatively charges and discharges via R1 in the same way as in the Fig. 11 circuit, so the circuit can be subjected to all of the variations shown in Figs. 13 to 15. It can be designed in either basic or 'compensated' versions, etc.

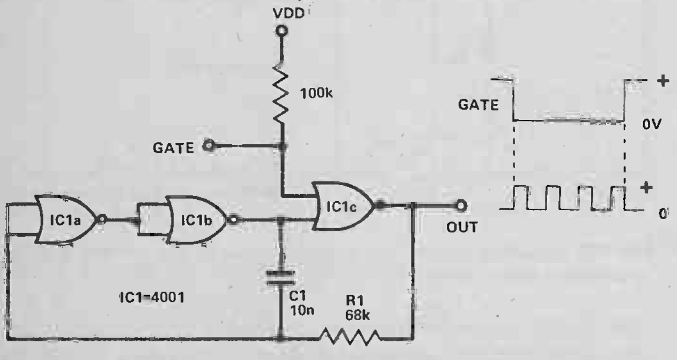


Fig. 27. A gated NOR 'ring of three' circuit with a normally low output, gated by a low input.

The 'ring-of-three' circuit offers interesting possibilities when it is used in the gated mode, because it can be gated on and off via either its IC1b or IC1c stages. Figures 27 to 30 show four variations on this theme.

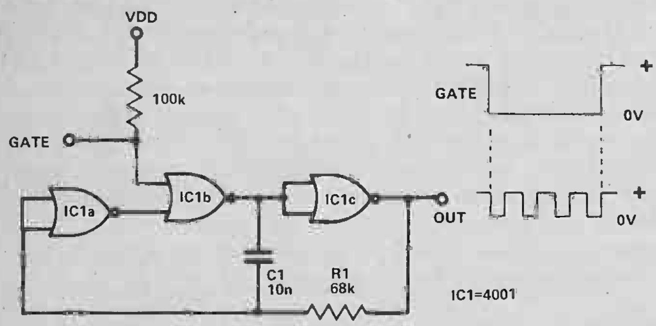


Fig. 28. A gated NOR 'ring of three' circuit with a normally high output, gated by a low input.

Figs. 27 and 28 show alternative versions of the gated NOR-type 'ring-of-three' circuit. Both circuits need a 'low' signal to gate the astable on. Note that the output of the circuit is normally-low if the gate signal is applied to IC1c, or is normally-high if the gate signal is applied to IC1b.

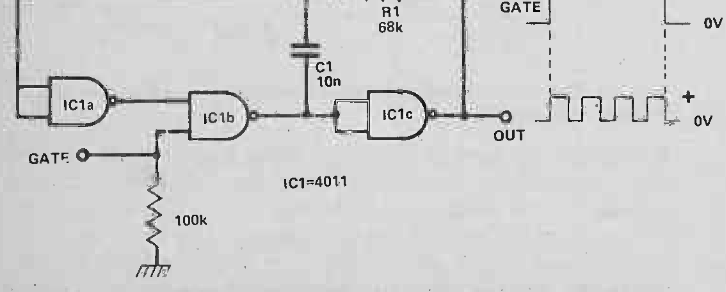


Fig. 29. A gated NAND 'ring of three' circuit with a normally low output, gated by a high input.

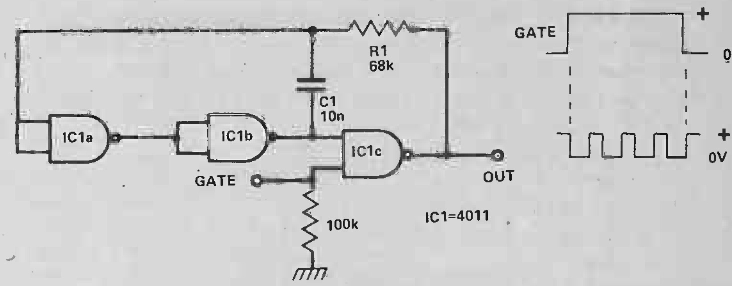


Fig. 30. A gated NAND 'ring of three' circuit with a normally high output, gated by a high input.

Similar variations are found in the NAND version of the gated 'ring-of-three' circuit, as shown in Figs. 29 and 30. These circuit need a 'high' signal to gate them on, and have a normally-low output if the gate signal is fed to IC1b, or a normally-high output if the gate signal is fed to IC1c.

Monostable Multivibrator Circuits

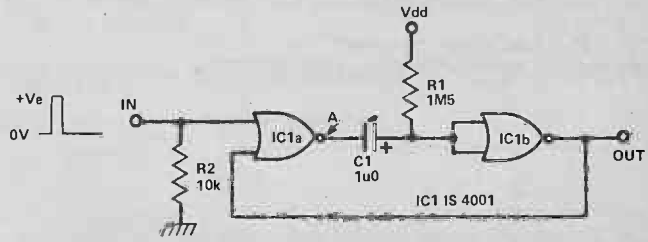
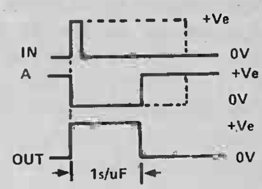


Fig. 31. A 2-gate NOR monostable multivibrator.

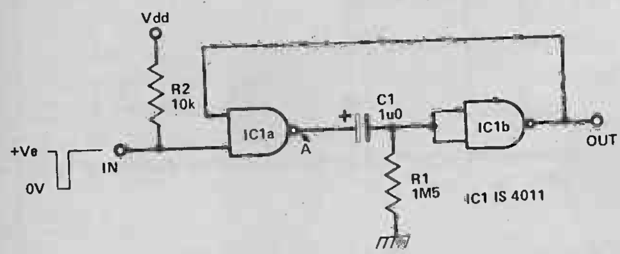


The CD4001 and CD4011 can both be used to make an exceptionally useful type of 2-gate monostable multivibrator or pulse generator circuit. The two basic versions of this circuit are shown in Figs. 31 and 32. In these circuits the duration of the output pulse is determined by the values of R1 and C1, and approximate one second per microfarad of C1 value when R1 has a value of 1M5. In practice, C1 can have any value from roughly 100 p to a few thousand u, and R1 can have any value from about 4k7 to 10M.

One outstanding feature of these circuits is that the input trigger pulse or signal can be direct coupled and has no appreciable effect on the length of the circuit's output pulse: the trigger pulse can be shorter or longer than the output pulse. The NOR version of the circuit has a normally-low output, and is triggered by a positive-going input pulse, while the NAND version of the circuit has a normally-high output and is triggered by a negative-going input pulse.

A signal feature of these circuits is that the pulse signal appearing at point "A" has a length that is equal to that of either the output pulse or the input trigger pulse, depending on which is the greater of the two. This feature is of value when making pulse-length comparators and over-speed alarms, etc.

The Fig. 31 and 32 circuits have only two significant defects. One of these is that the pulse length depends somewhat on the transfer voltage value of the individual IC that is used in the circuit. The other is that the pulse length also depends somewhat on the supply voltage value that is used with the circuit, just as the operating frequency of the basic 2-gate CMOS astable varies slightly with the supply voltage value. These defects are of little consequence in most practical applications, however.



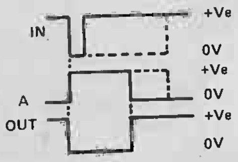
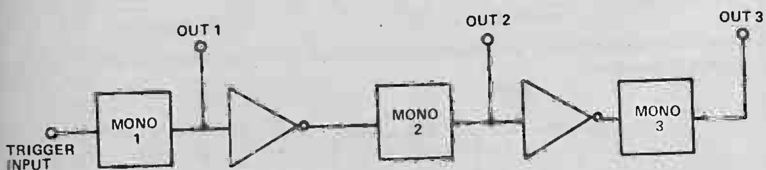


Fig. 32. A 2-gate NAND monostable multivibrator.

If a number of the Fig. 31 and 32 circuits are to be interconnected to give cascaded delays (as in a delayed-pulse generator, for example), an inverter stage must be interposed between the outputs and inputs of successive monostables, to give correct-polarity trigger signals. Figure 33 shows the basic system.



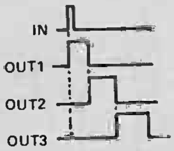


Fig. 33. Using monostables with inverters to produce cascaded delays.

Alarm Call Sound Generator Circuits

A single CD4001 or CD4011 IC and one or more transistors can readily be used to make a variety of types of very useful alarm call sound generator circuits. Figs. 34 to 41 show some practical circuits of this type. In all cases, the circuits can be powered from any supply in the range 5V to 15V and can be used with any speaker in the range 3R to 100R. Output powers range from tens to hundreds of milliwatts, depending on speaker impedances and supply rail voltages used, but can readily be boosted to tens of watts by using additional transistor power-boosting stages.

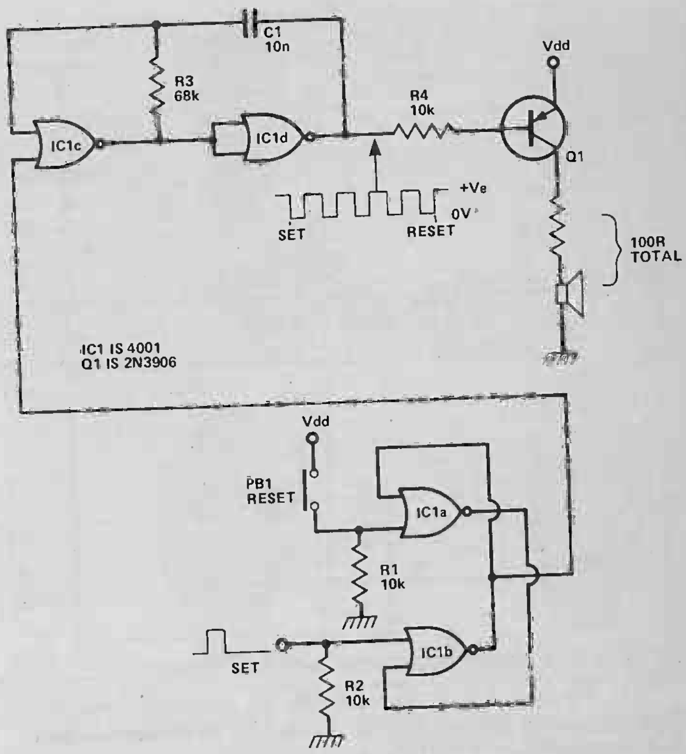


Fig. 34. Circuit of a NOR latching monotone alarm call generator.

Figs. 34 and 35 show two versions of a latching monotone alarm call generator. IC1a and IC1b are wired is applied to the circuit the IC1a-IC1b bistable self-latches and switches on the IC1c-IC1d-1kHz astable tone generator. The circuit can be reset to the OFF state by momentarily closing PB1.

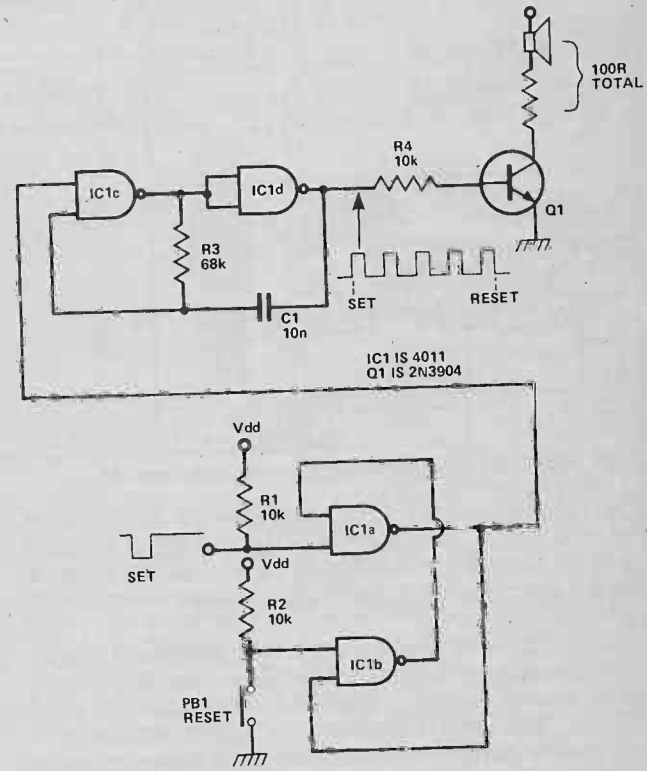


Fig. 35. Circuit of a NAND latching monotone alarm call generator.

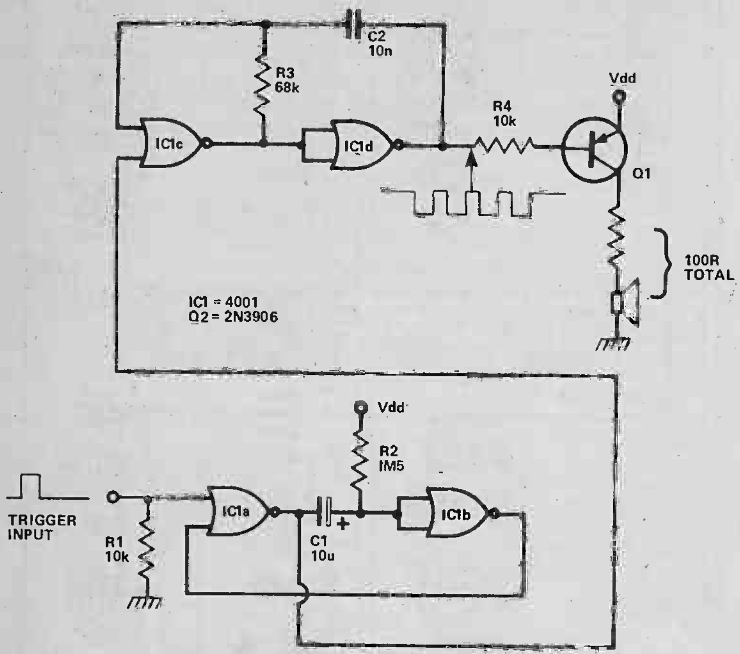


Fig. 36. A NOR alarm call generator with auto turn-off.

Figs. 36 and 37 show versions of an auto-turn-off monotone alarn call generator. IC1a and IC1b are wired as a monostable multivibrator, which turns on the IC1c-IC1d astable for about 10 seconds each time that it is triggered.

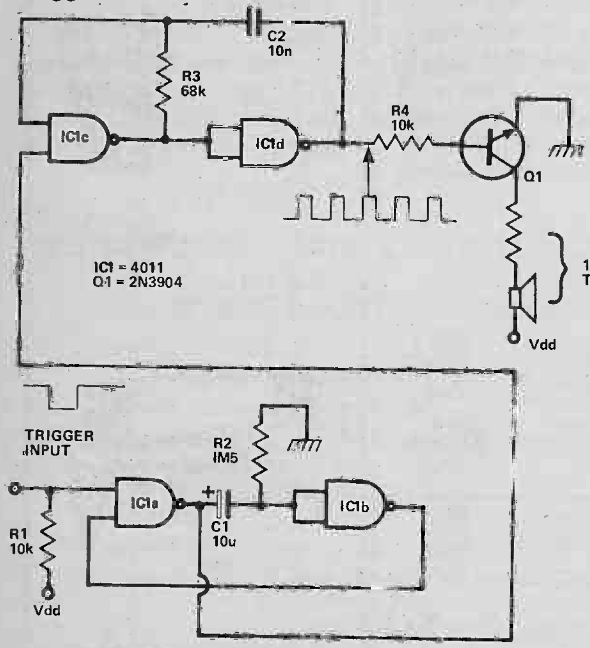


Fig. 37. A NAND alarm call generator with auto turn-off.

The Fig. 38 and 39 circuits generate a pulsed-tone signal, in which a 1 kHz astable (IC1c and IC1d) is gated on and off by a 6 Hz astable (IC1a and IC1b) when a suitable control signal is applied to the input terminal of IC1a.

Finally, Fig. 40 shows a warble-tone generator, which switches through a 2-tone cycle once per second when a suitable control signal is applied to the inputs of IC1a and IC1c, and which generates a sound similar to a British police car siren. The depth of frequency variation of the circuit is determined by R3, which can have any value in the approximate range 120k to 1MO. ETI

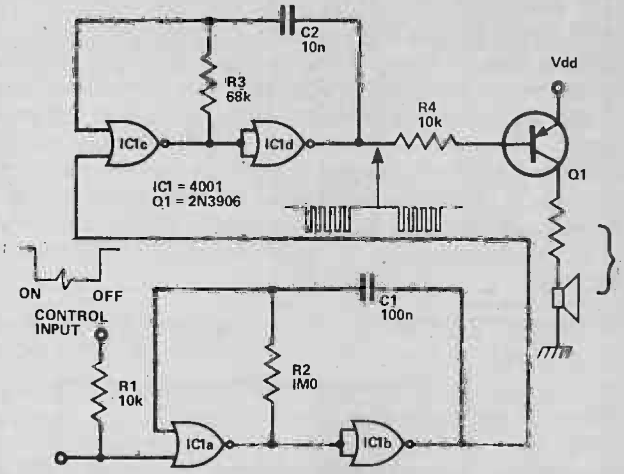


Fig. 38. Generating a pulsed-tone signal with 6Hz and 1kHz NOR astables.

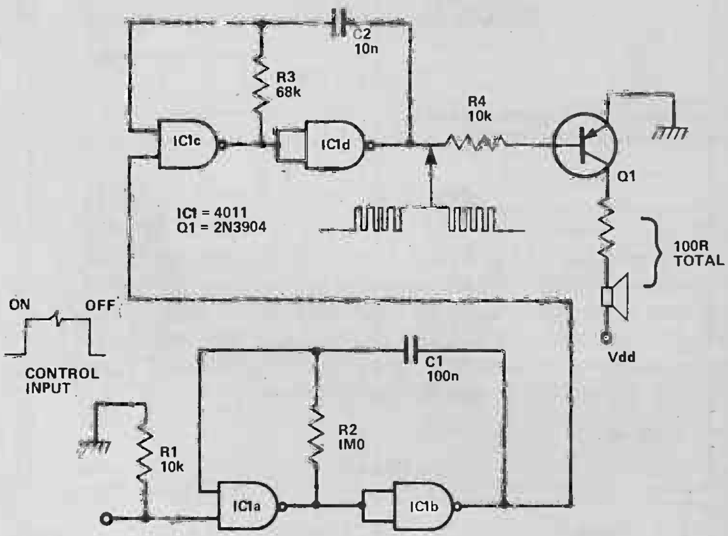


Fig. 39. Generating a pulsed-tone signal with 6Hz and 1kHz NAND astables.

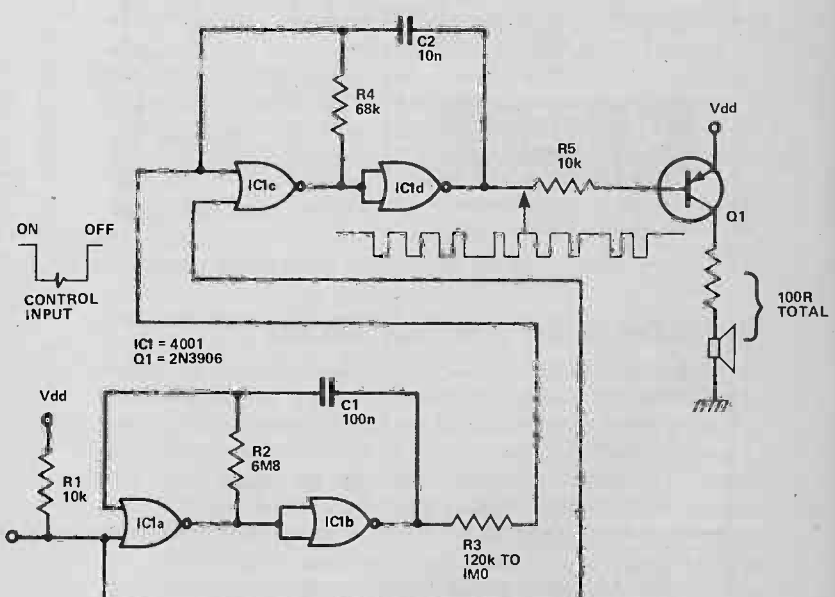
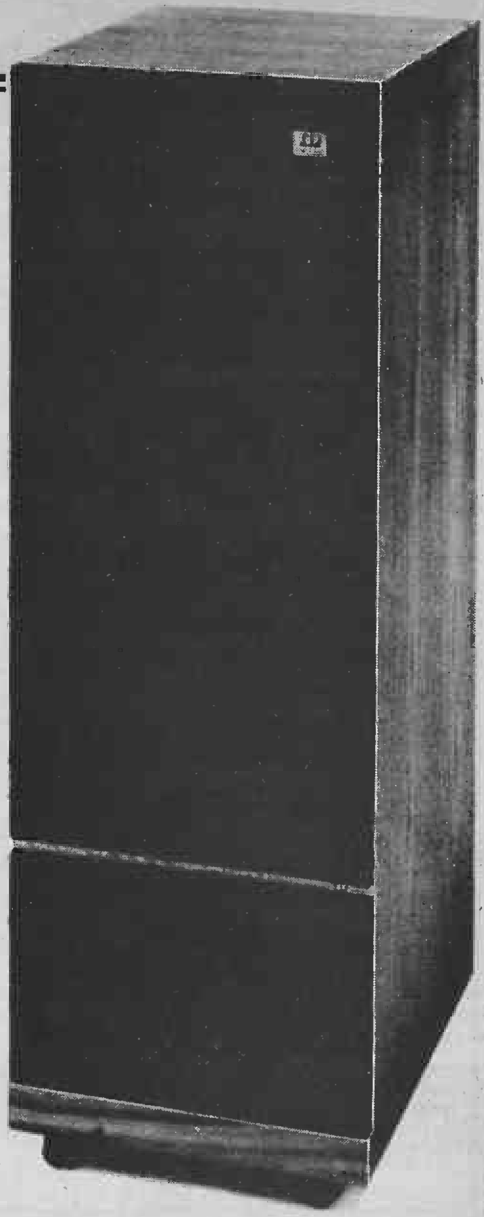


Fig. 40. A warble-tone generator — sounds like a police car siren.

audiophile...

Hi-fi 79 at the Cunard Hotel attracted Ron Harris this month, as did a new record cleaner. Also a good chance to show how witty you are and win a free subscription.



Above: the Monitor Audio MA2 loudspeaker. A highly recommended domestic design.

A TALE OF MANY speakers is what the 1979 Spring hi-fi show turned into. Wandering the halls of the Cunard in search of the sonic grail you get buffeted from side to side by the alternate blasts of sound emanating from the demo rooms. After about two hours of solid listening I start to get ear fatigue and thingd son't seem the same somehow.

In consequence things get done in bursts of two hours at a time punctuated with clincking of refreshments. On the first pass this year it became apparent that it was to be the Year of the Cone.

MA24U

Monitor Audio first. The MA2 is a 'domestic reference' design and stands some 850mm high. (About 33in in English height). It will handle around 100W of programme power, and produces a very nice sound indeed. At about £300 the pair they are going to give the competition a tough time.

Wharfedale have extended their 'E' series upwards into an E90 design which is twice the size of the E70 nearly and more than twice as imposing. We've got no photographs of the beast simply because Wharfedale hadn't got any and haven't kept their promise to send us any since! So there. Its still a nice speaker anyway.

KEFs contribution to the herd was a small one. Tiny in fact. I'd go so far as to say it was so small I almost missed it. The Reference 101 is a bookshelf speaker that just might fit into a bookshelf. This was the real surprise of the show, however, as upon first encounter the almost universal reaction was to hunt the 105s that were not hiding behind the curtains.

The sound was open and spacious with good imaging and a convincing bass response. Very nice one Kef.

Celestions Follies

The Celestion stand was dominated by two huge double boxes which, when energised, did a quick 'room empty' job. The efficiency is somewhat high you see, and the amplifier somewhat powerful.

I think they're designed for PA and studio usage but they are finished in wood veneer and more than likely quite a few dozen will end up in living rooms. Big living rooms I hope. At their price and size they come up against things like the JBLs and for sound quality I personally prefer the P1s (that's what they're called by the way). Well worth the listen if you're in that market.

Below: the Celestion P1. It sounds as imposing as it looks.

Left: JVCs KDA8 computerised cassette deck. It fixes up its own own bias and equalisation levels, and can cope with metal tape.

Right: Goldring headphones! Superex classic CL1s, a good smooth sound at a decent price. No, I'm not gonna tell you how much, find out yourselves!

Head Man

New for heads from Goldring is the Suprex headphone range. Amongst the four models they decided to import the Classic C1 — the middle of the group caught my attention most. They possess a nice smoothness to them that could be lived with. And they're comfortable. Koss take note please. Speaking as someone stuck with the habitual earache engendered by ESP10s the Suprex could be very attractive if for no other reason than that.

Below: KEF's 101 reference model. If your living room (or preference) favours small enclosures then don't miss 'em out.

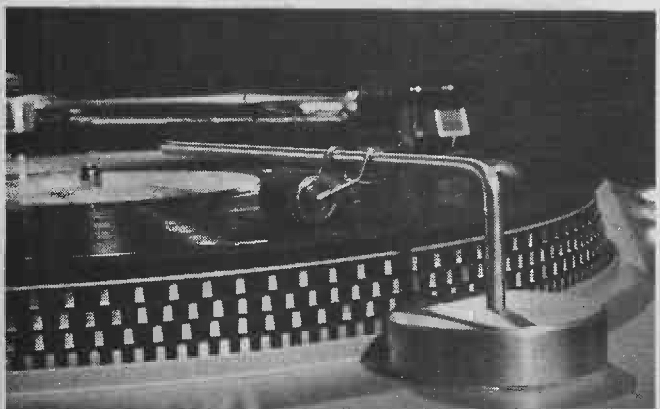
Below: Celestions new Dittons. In the centre is the new 662, which is their new version of our reference-the faithful ole 66. It remains to be compared whether it is *that* much better!

On Your Metal

Scotch and JVC between them made an exhibition of the new metal tape formulations and the JVC KDA8 machine to use them. The KDA8 is quite a story in itself really. It sets up for each type offered to it by recording a test tone and optimising bias, sensitivity and equalisation automatically — it even rewinds to the beginning again and all in 25secs. The demonstration was most impressive — as they usually are — and we hope to do more with the machine in the near future.

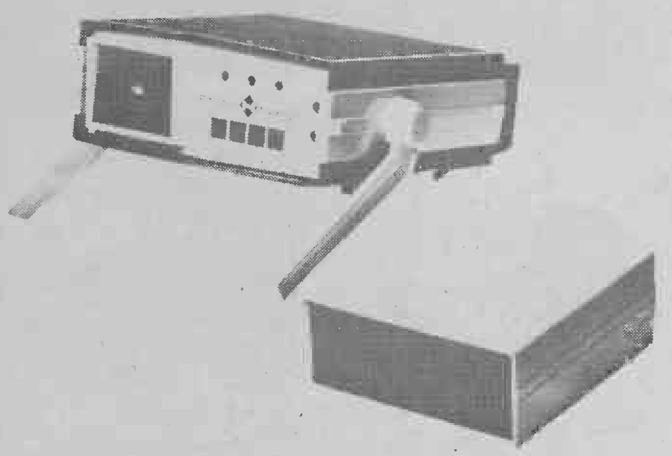
Before anyone asks I could find no possible reason to include the beautiful Felicity Kendal in this months Audiophile. She was not at the exhibition nor has she anything to do with any of the products featured here. That being the case I have no reason to mention the lovely lady and therefore I shall refrain. ETI

Below: No this wasn't at the show but it's worth the look anyway. A new record cleaner called a TANTRACK. Two arms are provided to cope with any turntable height, and the finish is a very posh steel and chrome. Available from Dorking Systems Ltd, 23 South Street, Dorking, Surrey. Price £6.25 plus VAT.



This here picture advertises Marantz. But we couldn't find the Marantz stand!! Now with a picture like this, there just HAS to be a brilliant, witty, superb caption. But *we* can't find THAT either, so its open to you lot. The best wins a years subscription. Closing date June 30th. Mark envelopes 'Audiophile Caption.'

news digest



BARGAIN BOXES

A new service from OK Machine & Tool can save up to 65% on the cost of cases for some commercially produced items.

If you need more than 1000 units, OK can incorporate your special requirements into their latest range of Pac Tec moulded enclosures, available in over 25 sizes.

As an example of the success of their new cost-cutting service, OK have been able to produce 2,500 alarm unit housings for £3.92 each, compared to £5.52 for sheet metal units. Taking the total assembly time into account, the saving rose to 65%. Customised front and rear panels can be supplied.

For further information, contact OK Machine & Tool (UK) Ltd, 48a The Avenue, Southampton, Hants SO1 2SY.

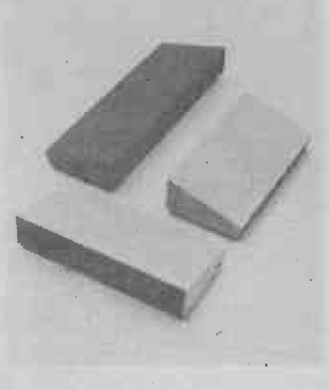
LOW KEY

A new range of enclosures designed for housing a variety of keyboards has recently been introduced by Boss Industrial Mouldings.

Bimconsoles are all-aluminium cases with a textured black base which contrasts with either the semi-gloss sand or charcoal grey top panels.

The top panels slope at about 20 to provide a relaxed keyboard operating position. Vibration is reduced to a minimum by the use of a gasket assembly between top and bottom panels.

Bimconsoles are available in three sizes and are suitable for both prototype and OEM type applications. Further details



from Boss Industrial Mouldings Ltd, Higgs Industrial Estate, 2 Herne Hill Road, London SE24 0AU.

ELECTRONIC TACHO

Orbit Controls are now producing a four decade electronic tachometer for measuring speed, rate, flowrate and frequency.

The 74A 430 has a four decade, solid state, digital readout and a pre-wired timebase, controlled by a high precision 1MHz crystal oscillator.

Flexibility of construction allows pre-wiring to any interval from 1mS to 10S. The unit features high noise immunity and freedom from false triggering counts.

The frequency range extends from 0.5Hz to 10kHz with an input sensitivity of 100mV (adjustable). Input, positive pulse or sinewave, is fully protected to 240V rms. Power may be from 100 – 110V or 210 – 260V 50/60Hz, or from 12V DC.

Further details from Orbit Controls Ltd, Lansdown Industrial Estate, Gloucester Road, Cheltenham, Gloucestershire GL51 8PL

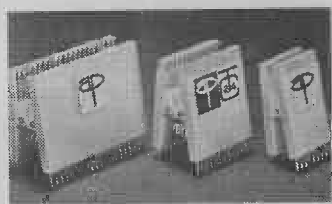
TEST CLIPPY

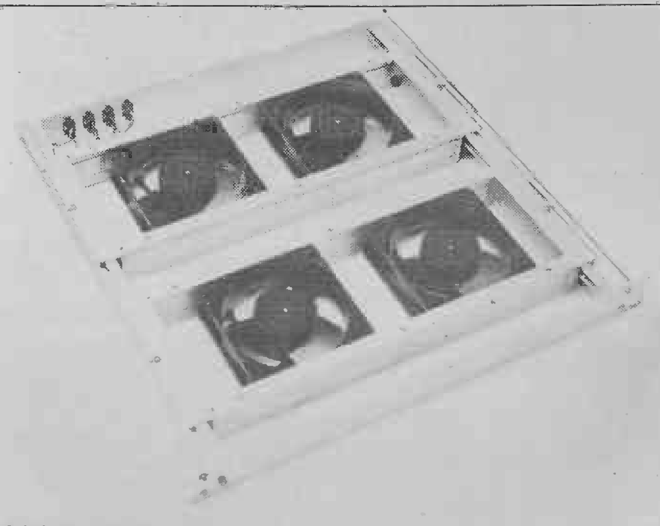
New IC test clips from Lektrokit offer a simple means of accessing any IC pin or lead.

The new aid clips over the IC bringing its individual pin connections out to a set of contacts at the opposite end of the clip. There are test clips available to match 8, 14 and 16 pin DIL packages.

The gold-plated, phosphor bronze spring contacts have been designed to achieve a wiping/cleaning action, making for high reliability.

The TC-14 which, as its name suggests, clips over a 14 pin DIP, costs £2.95. Further details from Lektrokit Ltd., Sutton Industrial Park, London Road, Earley, Reading, Berkshire RG6 1AZ,





COOLING OFF

Got any hot-spots in your cabinets? You can get the air circulating round your equipment with the Vero Electronics Fan Tray (AB 087).

Two versions (1U and 2U) are available for either 115V or 230V (50/60 Hz) input. Each is supplied with four 119mm square axial fans, but additional fans can be fitted as required.

The 2U version has a polyurethane foam filter covering the air intake. If your living room or office isn't a smokeless zone, never fear, the filter is cleanable. Both versions operate at low noise levels.

If you need cooling off, contact Vero Electronics Ltd, Industrial Estate, Chandler's Ford, Hampshire SO5 3ZR.

........news digest......

LATEST CASIO MINIS

Casio have managed to reduce their successful LC-78G calculator in three ways.

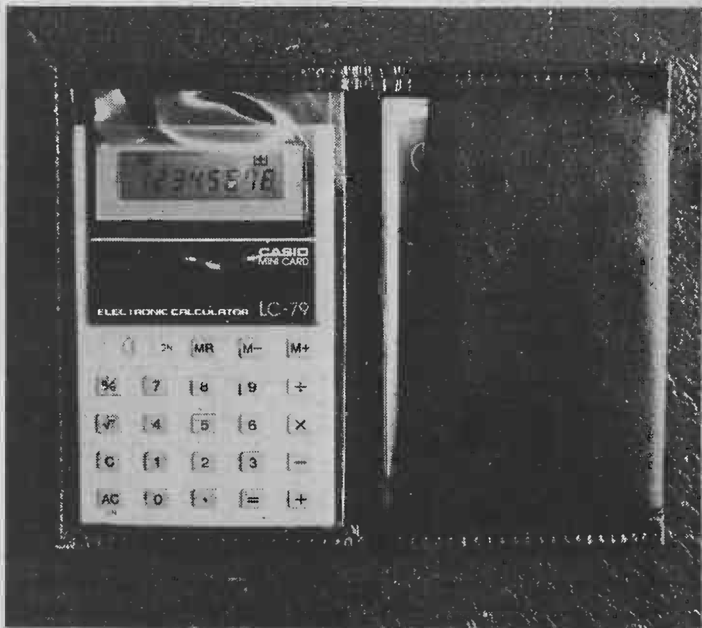
First of all - price. The RRP of the LC-78G is down by £3.00 to £16.95.

Second is the new Casio LC-7 which has the same display and functions except that the fully independent memory is replaced by a simple automatic accumulating memory and a square root function. The LC-78S has a RRP of only £13.95.

Thirdly, thickness has been cut down from four to two millimetres. Casio's new Mini Card LC-79 remains credit card size, but in upright format. It keeps eight digits capacity and LCD, four functions and independent memory plus perfect percent and function indicator. Also featured is a responsive, 'feather touch' keyboard, so light that it can be operated inside its protective wallet. A battery-conserving circuit automatically switches off nine minutes after the last key depression. The Casio LC-79 will retail at £19.95 (or less, if you're lucky).

If you prefer something a bit beefier, try the LC-841, another new one from Casio. With the same technical features as Mini Cards (including independent memory), the LC-841 is 62 x 110mm, but still only 3.9mm thick, with digits 6mm high, and will retail at about £15.95.

For enquiries, get in touch with Casio Electronics Co Ltd, 28 Scrutton Street, London EC2A 4TY.



MILITARY FLASHER

Need a tough twinkler? Oxley are now producing a solid state indicator lamp, type PS/LH/8, in a military style rugged mounting.

The mounting incorporates the latest high brightness, high reliability LEDs. The lamp is fitted with a sealed glass lens and black shroud to optimise the visual effect and afford emitter protection.

Standard colours are available, red, yellow and green, and light output is calibrated to photometric standards to ensure consistent performance. The aluminium alloy body is compatible with standard chassis and provides electromagnetic shielding for military applications. Further details from Oxley Developments Co Ltd, Ulverston, Cumbria LA12 9Qg.

microfile

Henry Budgett wandered across the States in the name of Microfile. This is his report, and other small world shattering items that happened to crop up while he was away.

Pets In Business

THE LONG AWAITED PET add-on's have arrived at last, honest! Launched at a Cafe Royal press conference was a new PET based business system with a price tag of £2,500 excluding software. Utilizing the new, large-keyboard 32K machine with Commodores own dual disk drive and tractor-fed printer it forms the cheapest small business system yet available. The software is being written by a new division of ACT, Petsoft's parent company, called PETACT and will cost between £225 for a single package to about £800 for a complete suite of programs. It will be available in either disk or cassette format and is the first business software for a micro to be written by a professional software house. The software price also includes a day's training for an employee.

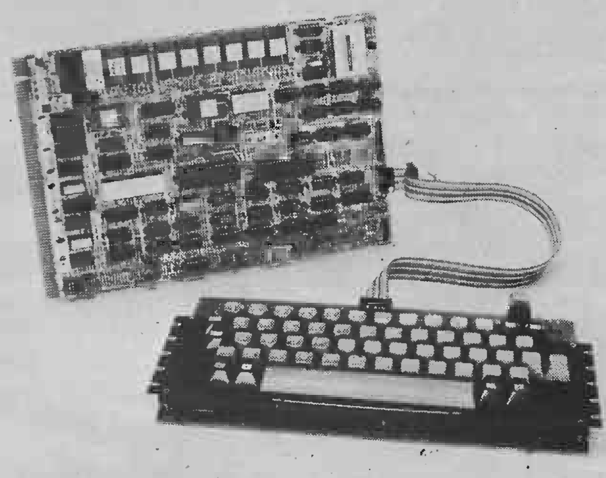
We rather thought that the printer was never going to arrive as it was trapped at Heathrow in customs but it surfaced during the Champagne and Orange cocktails and appeared to be of high quality. The second reason for the Press reception was to announce the forming of an "endorsement" scheme for non-Commodore produced PET add-on's, the PETACT software being the first product to be launched under the scheme.

Deliveries of the new style PET's have started and should be available in most areas now, the disks and printers will start to appear in mid-May at some of the 100 dealers and will hopefully be generally available within a couple of months. Chuck Peddle the father of the PET and KIM was at the reception and gave a strong indication that new and exciting things were on the way in connection with both machines, memory expansion being one possibility.

On a final note the sales of the UK machine were around 3000 during 1978 and this figure had been reached by the end of April of this year, the market is still growing.

Above and below: the new bits for PET.

Below: the new more powerful NASCOM.



NASCOM With Added Plus

After the phenomenal success of the NASCOM I (150,000 sales worldwide) the company have announced a new single board machine called NASCOM II.

Although it is physically the same size as the 'I' and uses the same bus structure it is not intended as a simple upgrade but rather as a new starting point in the home computing market. Based on the Z80A it offers a 75% increase in processing speed along with an 8K Microsoft BASIC in ROM. Several new features are included on the machine, a new 2K monitor with many improvements over the T4, A CUTS cassette interface, 8K of user RAM and a new extended keyboard. The interfaces supplied include an on-board UART for the RS232 or the cassette interface, capable of running at 300 or 1200 Baud, and an uncommitted P10 for two 8 bit ports. The video is run from a 1KA RAM with a 2K character generator, an optional socket is supplied for another 2K graphics ROM which is software selectable. ▶

Both the new monitor and the BASIC can be used with the 'I' and all the peripherals for the 'I' can be used with the 'II' making it the basis of a very nice OEM system. The circuit board is of the usual superb quality and the kit will be available from June at £295 ex VAT. We hope to get our hands on one to review soon and this will be published in CT as close to the release date as possible.

Clubbing Together

A couple of new clubs have sent us details of themselves this month. The first is the Sorcerer Programme Exchange Club, SPEC, which has been formed to promote the Exidy Sorcerer. Rather than having an actual club they are aiming to become an information exchange on useful hints and programs for the machine and would be most grateful for anyone who has some to send them in. The people to contact are Mr G. F. Counsell and Mr M. P. Hannaby at 65 Trafalgar Road, Birkdale, Southport, Merseyside.

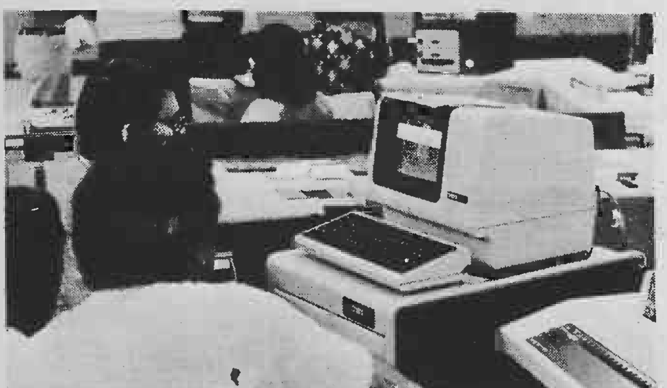
The second club is the South Yorkshire Personal Computing Group, SYPCG, who are appealing to people in the area interested in do-it-yourselr computing. They hope to meet on the second Wednesday of each month with a variety of topics under discussion. Membership is £3 for 1979 and the meetings will be held at 7.00pm in the University of Sheffield. For further information you should contact the Secretary, Mr Tony Rycroft, at 88 Spinneyfield, Moorgate, Rotherham, S. Yorkshire.

Showing It Off USA Style

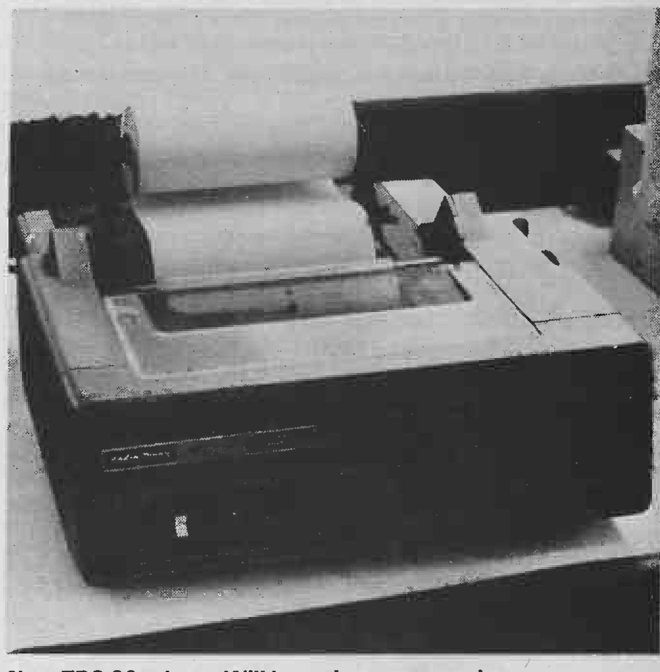
I spent a pleasant weekend in Orlando, Florida, last month at a micro-show. It really was a micro-show, dealing with the machines and also being very small. However this was really an advantage as it allowed free and personal access to the exhibitors rather than the situation which arises at some of the UK exhibitions. The variety of machines was impressive, ranging from an IAM65 to an LSI 11, but there were no PET's, KIM's or Superboards which was rather surprising. The only new machine there was an Z80 based S100 system called Informer which also used an SC/MP for keyboard and video control. Supplied either with or without an integral floppy it looked impressive but is unlikely to appear on this side of the Atlantic.

The show also featured a siminar programme, again on a very informal and personal level which resulted in a most entertaining question and answer forum. The whole show was most professionally run and I only wish that some of the UK shows could adopt a similar attitude and become smaller and more personal instead of bigger and unhelpful. ETI

The biggest business system at the show, an LSI II with dual floppies being used for stock control.



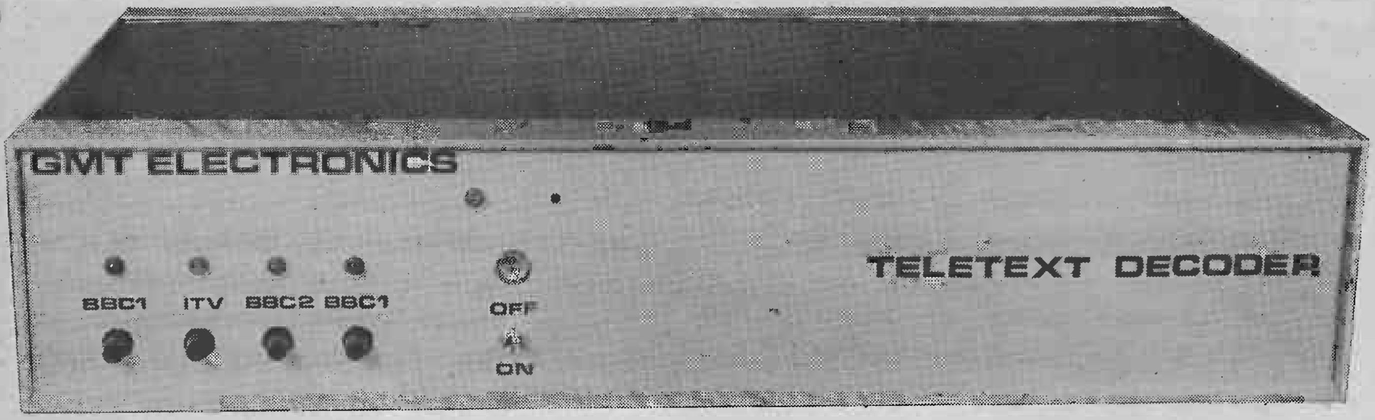
The familiar Apple II with a speech recognition board installed. It worked remarkably well and 'echoed' back your word through a synthesizer.



New TRS 80 printer. Will it reach us, we wonder.

A Texas system with dual floppies and integral thermal printer as well as a Centronics 702 on-line. It played a mean game of Star Trek!

TELETEXT SYSTEM



A complete ultrasonic controlled Teletext design employing the newly released Mullard chip set. Design by GMT Electronics for ETI. Facilities include double size characters and video superimpose.

THIS PROJECT is designed to allow the home constructor to produce himself a full spec Teletext unit at around half the cost of comparable commercial units. The design requires no hard wiring into the set, as it contains its own modulator and works into the aerial socket. Definition usually suffers utilising this method, but here great attention has been paid to overcoming this problem.

As with all decent designs remote control is ultrasonic, and gives both full and half page displays. The keyboard arrives already fitted to the PCB, and only needs the decoder chip and transducer soldering in to produce a complete unit.

A complete kit is available from GMT electronics, which includes plated–through hole PCBs, full metalwork and the hand controller. See Buylines for final details.

Construct-a-Text

Despite the complexity of this project construction is amazingly straightforward, all that is required is to assemble the four boards CAREFULLY following the overlays, and fit these into the chassis. Interwiring between the PCBs is dealt with by following the list given here, and referring to the wire nos. shown on the overlays. Don't be tempted to change this, best results — indeed any results — will only be obtained by strict adherence!

Once you're satisfied that all is as it should be, fit the ICs into their sockets and move on to the setting up.

FACILITIES

Keyboard Commands

RESET	**The screen is cleared and the converter is ready for channel change (timed page is cancelled).**
STATUS	**Television station identification appears top left of screen.**
HOLD	**Displayed page is held.**
TOP	**Large (2x) top half of display.**
BOTTOM	**Large (2x) bottom half of display.**
MIX PAGE	**Cancels both above displays channel video and teletex together.**
TIMED PAGE	**On: — The selected time for the page selected can be inserted and is displayed in the top right of screen (4 Digits). Off: — Above cancelled.**
REVEAL	**Displays hidden characters.**
TEXT	**Calls up teletext. Page 100 selected automatically (currently for BBC 2 Ceefax key in 200).**
CANCEL	**Cancels text.**
DATA	**Used for external data (not used in current design).**
TV ON	**Not used in current design.**
	Last two facilities available for further expansions.

Mine Sweeper

E. A. Johnson

The object of the game is to locate and destroy a moving minesweeper. The ship moves along a set course, but, to avoid destruction it can deviate slightly from the course and alter its speed.

Playing the game

The game is started by entering a number (in the range 0 to 1) into register E, to set the initial position of the minesweeper through a random number generator. A shot is made by entering the xy co-ordinates (into the A and B registers respectively) of the square where the ship is believed to be. The calculator determines the position of the ship and displays the distance by which the shot missed. If the shot is within five units of the ship, damage occurs which slows the ship down in proportion to the nearness of the shot. When the ship is destroyed the display flashes.

After the ship has been destroyed, the number of shots used can be displayed by pressing 'C', and a new game can be started by pressing 'D'.

Method of calculation

The initial value of Θ, which determines the ship's position is determined using the calculator's random number package. The ship's co-ordinates are then calculated by the following equations:

$$x = (50 + 45 \cos 3\Theta) + RNUMX$$
$$y = (50 + 45 \sin 2\Theta) + RNUMY$$

where RNUMX and RNUMY are random numbers (in the range of –3 to +3) to give the ship its avoiding action.

The distance of the shot from the ship is calculated using pythagoras and displayed in integer mode.

The next value of Θ is then given by

$$\Theta = \Theta + \Theta INCR$$

where ΘINCR is originally set to 5, the calculator then determines the new co-ordinates of the ship.

When the distance of the shot from the ship is less than five units, the value of ΘINCR is reduced to slow the ship down. The new value is given by ΘINCR = ΘINCR – (5 ÷ distance).

The above procedure continues until $\Theta INCR \leqslant 0$ when the ship is destroyed.

A new game, if required, is started by automatically generating a new random initial value of Θ.

MINESWEEPER PROGRAM FOR TI 58 & 59

LOC	CODE	KEY
000	43	RCL
	01	1
	44	SUM
	00	0
	43	RCL
	02	2
	91	R/S
	76	Lbl
	33	X
	65	x
010	04	4
	05	5
	85	+
	05	5
	00	0
	85	+
	36	Pgm
	15	51
	71	SBR
	88	D.MS
020	65	x
	06	6
	75	–
	03	3
	95	=
	33	X
	92	INV SBR
	76	Lbl
	15	E
	42	STO
030	09	9
	76	Lbl
	14	D
	05	5
	42	STO
	01	01
	00	0
	42	STO
	03	3
	58	Fix
040	00	0
	36	Pgm
	15	15
	71	SBR
	88	D.MS
	65	X
	03	3
	06	6
	00	0
	95	=
050	42	STO
	00	0
	25	CLR
	91	R/S
	76	Lbl
	11	A
	69	Op
	23	23
	75	–
	53	(
060	53	(
	43	RCL
	00	0
	65	x
	03	3
	54	)
	39	cos
	71	SBR
	33	X
	32	x⇌t
070	00	0
	91	R/S
	76	Lbl
	12	B
	75	–
	53	(
	53	(
	43	RCL
	00	0
	65	x
080	02	2
	54	)
	38	som
	71	SBR
	33	X
	85	+
	05	5
	32	x⇌t
	95	=
	34	√x
090	42	STO
	02	2
	77	x≥t
	00	0
	00	00
	55	÷
	32	x⇌t
	95	=
	35	1/x
	22	INV
100	44	SUM
	01	1
	29	CP
	43	RCL
	01	1
	77	x≥t
	00	0
	00	00
	25	CLR
	35	1/x
110	22	INV
	58	Fix
	91	R/S
	76	Lbl
	13	C
	25	CLR
	43	RCL
	03	3
	91	R/S

Example Game

Comment	Enter	Display
Enter a number between 0 & 1	0.258 E	0
Enter guess for x co-ordinate	50 A	0
Enter guess for y co-ordinate	11 B	65 (Distance)
x co-ordinate	84 A	0
y co-ordinate	70 B	62
x	40 A	0
y	85 B	7
x	43 A	0
y	87 B	3
x	51 A	0
y	89 B	3
x	54 A	0
y	90 A	9.9999999 99 (Flashing)
To display number of shots	C	6
To start a new game	D	0
x co-ordinate	50 A	0
y co-ordinate	11 B	42
ETC.		

Lunar Landing

Sarah J. Owen.

This program was devised for use on the Commodore PR.100 calculator, but is easily adapted for use on any other programmable ones. Imagine you are the Astronaut controlling the final descent of a lunar module, at regular intervals the speed of descent is displayed, the period of burn of the retro–rocket has to be calculated, after allowing for the reducing weight of the fuel on board. . . . . Five speed corrections are allowed, after which the final impact velocity is displayed. If an error is made and all fuel is used, there is just time to transmit an urgent S.O.S. message before destruction on the lunar surface. . . . . . . Due to the lack of program space, the method of selecting the initial random speed is unusual, but ranges between 20 and 100 m.p.h.

Recommended periods for Retro–rocket firing

SPEED	BURN		
5	1.6	180	5.2
7	1.9	200	5.3
10	2.3	220	5.4
15	2.7	250	5.5
20	3.0	270	5.6
30	3.4	300	5.7
40	3.7	330	5.8
50	3.9	365	5.9
60	4.1	400	6.0
70	4.2	450	6.1
80	4.4	500	6.2
90	4.5	550	6.3
100	4.6	600	6.4
110	4.7	660	6.5
120	4.8	730	6.6
130	4.9	800	6.7
150	5.0	900	6.8
160	5.1	1000	6.9

Result of impact speed:–

0 – 5 m.p.h.	PERFECT LANDING
6 – 10 m.p.h.	SLIGHT DAMAGE, LIFT OFF DELAYED.
11 – 15 m.p.h.	STRUCTURAL DAMAGE LIFT–OFF DOUBTFUL
16 – 25 m.p.h.	SEVERE DAMAGE & INJURY – USE SUICIDE PILL.
ABOVE 25 m.p.h.	MODULE & ALL LIFE DESTROYED . . .

SET UP:–

F–CA–F–FP–8–GOTO–00
Mode switch to load – enter program – mode switch to run – goto – 00 enter any two or more numbers (date etc.) Each followed by Xn key. Press R/S – speed of descent displayed.
Allow for weight of fuel remaining, enter period (in seconds) of rocket burn to reduce speed, press R/S – new rate of descent displayed, correct as before. After five speed corrections, impact speed will be displayed. If fuel in excess of 20 seconds is used, module transmits an urgent message before destructing.
Press R/S to re – start.

PROGRAM

Memory 1 – Seconds of fuel left
Memory 0 – Accurate descent speed
N.B. Adjust burn period for weight of fuel, allow 1 m.p.h. for each Second of fuel remaining (approx)

LOC	CODE	KEY
00	21	F
01	63	S
02	21	F
03	51	FRAC
04	74	X
05	81	1
06	91	0
07	95	=
08	51	M
09	91	0
10	53	Xn
11	82	2
12	91	0
13	51	M
14	81	1
15	71	4
16	51	M
17	82	2
18	52	MR
19	91	0
20	74	X
21	62	8
22	84	+
23	52	MR
24	81	1
25	95	=
26	51	M
27	91	0
28	21	F
29	52	INT
30	13	R/S
31	21	F
32	85	M–
33	81	1
34	21	F
35	32	e^x
36	85	–
37	52	MR
38	81	1
39	85	–
40	52	MR
41	91	0
42	74	X
43	95	=
44	35	x
45	51	M
46	91	0
47	52	MR
48	81	1
49	94	+/–
50	15	SKIP
51	14	GOTO
52	73	6
53	63	9
54	52	MR
55	82	2
56	85	–
57	81	1
58	95	=
59	15	SKIP
60	14	GOTO
61	81	1
62	73	6
63	52	MR
64	91	0
65	13	R/S
66	14	GOTO
67	91	0
68	91	0
69	72	5
70	91	0
71	72	5

Mastermind

P. R. Kemble B.Sc.

This program enables the popular game Mastermind to be played on a Hewlett–Packard HP29C calculator.

A five digit number (no two digits the same) is set by one player, and then the second player must deduce what it is. There are 30,240 possibilities.

After each guess the calculator indicates how many digits in the guess were correct and in the right position, and how many were correct but in the wrong position.

To play:

Player A enters a 5 figure number and then presses GSB 1.

Player B enters his guess and presses R/S. After several seconds calculation the display shows a number such as 1.2 which means 1 digit in the right place and 2 more correct figures but in the wrong position.

Player B then enters another guess and presses R/S, etc. until he achieves a score 5.0.

For cheats (!) or if the number set has been forgotten, it is held in STO .5.

The use made of the calculators stores is shown below.
If the number set was ABCDE, and the guess is FGHIJ, then:

STO 0	Used
1	J
2	I
3	H
4	G
5	F
6	Used
7	Used
8	Used
9	Used
.0	E
.1	D
.2	C
.3	B
.4	A
.5	ABCDE

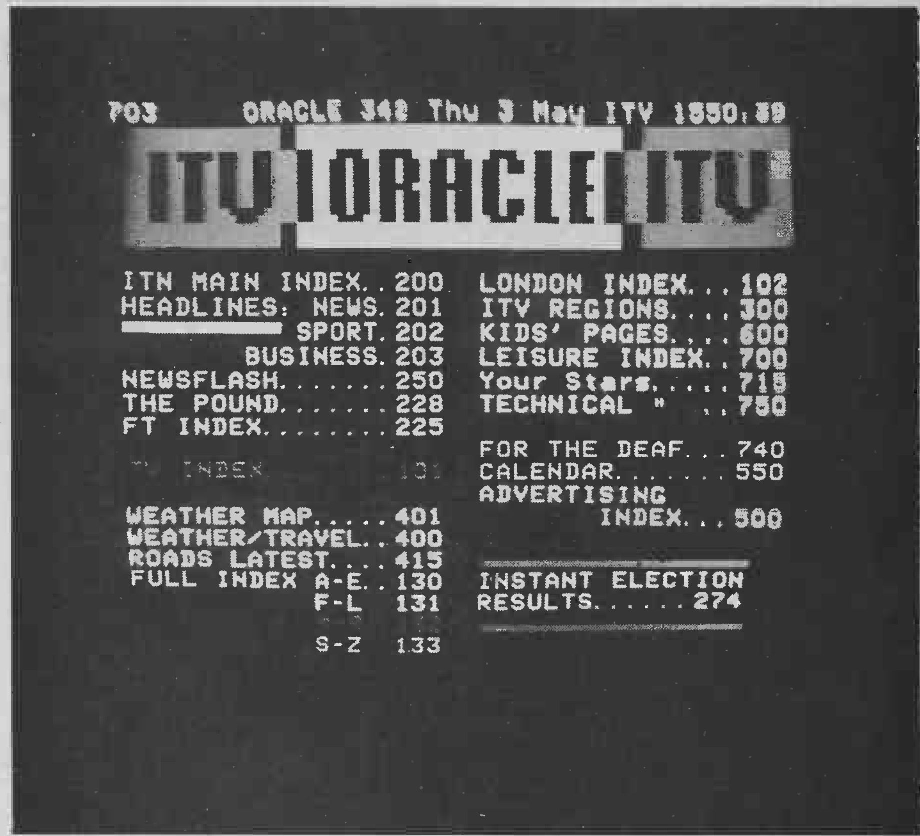
STEP	INSTRUCTION
01	gLBL1
	fFIX1
	STO.5
	1
	4
	CHS
	GSBO
	gLBL9
	0
10	STO7
	STO8
	R
	R/S (Enter guess)
	5
	CHS
	GSBO
	1
	STOO
	gLBL5
20	RCLi
	9
	STO+0
	x≷y
	RCLi
	–
	gx = 0?
	GSB3
	8
	STO–0
30	RCL0
	6
	fx = y?
	GTO4
	GTO5
	gLBL3
	1
	STO+7
	RTN
	gLBL0
40	STO 0
	x≷y
	EEX
	4
	÷
45	gLBL2
	fINT
	STO i
	fLAST x
	gFRAC
50	1
	0
	x
	gISZ
	GTO 2
	RTN
	gLBL 4
	1
	4
	STO 9
60	gLBL6
	RCL 9
	STO 0
	RCL i
	STO 6
	5
	STO 0
	gLBL 7
	RCL i
	RCL 6
70	–
	g x = 0?
	GSB 0
	gDSZ
	GTO 7
	1
	STO–9
	RCL 9
	9
	f x ≠ y?
80	GTO 6
	RCL 7
	STO–8
	1
	0
	STO÷8
	x≷y
	RCL 8
	+
	GTO 9
90	gLBL 0
	1
	STO+8
	RTN

Set up!

1) Disconnect encoder video O/P from the modulator board.
2) Disconnect blanking and picture on (PO) outputs from main board.
3) Connect UHF O/P to set, and UHF aerial to converter.
4) Select spare channel on T/V set.
5) Tune T/V for blank screen (ie. no noise).
6) Switch off.
7) Link P.O. input of UHF and mixer board to 12V.
8) Switch on.
9) Tune RV 201 (front panel to obtain best picture on BBC1.
10) Re-adjust set for best colour picture, modulator RV 401 may need adjustment.
11) Repeat 7 and 8 as required.

12) Switch off.
13) Reconnect steps 1 and 2 remove link step 6.
14) Switch on.
15) Set RV 100 to midpoint.
16) Connect pin 1 1C103(VIP) to 12V.
17) Connect pin 7 via 5M6 to 12V.
18) With transmitter switch to mix mode.
19) Adjust CV101 until characters lock with picture.
20) Switch off.
21) Remove steps 14 and 15.
22) Switch on.

23) Adjust L101 to obtain page header and time clock stepping (note this setting is sharply defined). L101 should not need adjustment (ignore any colour flicker).
24) Switch off.
25) Link pin 10 1C103 to 12V rail.
26) Switch on. Note CV102 and L101 interactive repeat 20 and 24 as necessary.
27) Adjust CV102 for best display (approx ¼ closed).
28) Switch off.
29) Remove step 22.
30) Switch on.
31) Switch to text mode.
32) Adjust CV301 for best colour.
33) Other channels can now be tuned (hit reset followed by channel No 1=BBC1; 2=ITV; 3=BBC2).



Above and below, two typical screen displays from the ITV, Oracle service. Now do you see what you're missing out on?

HOW IT WORKS

Ultrasonic Receiver And Transmitter

In the transmitter the keyboard, commands are encoded by the SAA 5000 which switches the HEF 4069 transmitter IC in the correct code sequence.

This pulse coded 40Hz transmission is received by the TDB 1033 which provides 90dB of gain in AGC system and a carrier filter. The output is fed to the decoder section.

The Decoder

This design is based on the Mullard L.S.I. design and uses four main IC's and a memory section of seven 2102's.

The signal from the TDB 1033 is fed to the SAA 5010 receiver decoder and checked for error content and then produces various outputs.

1. Analogue Controls — Not used in this design.
2. Station Selector Drive Output — Used via an HEF 4011 inverter to step an HEF 4017 station selector.
3. Message Received Output — Used to drive an LED and audible indicator.
4. Control Signals for the SAA 5040 TAC.

SAA 5030 VIP Video Input Processor

The data retrieval section of IC, slices the incoming data signal by means of an automatic adaptive data slicer circuit. This circuit sets the threshold level for slicing at half the data amplitude, regardless of the amplitude of the incoming signal, and provides some compensation for distortion such as co-channel interference; the performance of the system under noisy conditions is thus improved. A clock signal is generate from the sliced data by using an external 6M9375Hz tuned circuit, and this signal is used to clock the data into the TAC integrated circuit.

A 6MHz display system clock is also included in the VIP, the output of which is divided in the TIC to produce a clock pulse every 64us. This signal is passed back to the VIP where it is compared with the incoming line sync signals. By this means, the timing system of the teletext display is phase-locked with the incoming television picture signal.

A 'signal quality' detector circuit is also included. When a signal with a high noise content is being received, or in the absence of an incoming signal, the signal quality detector cuts off the teletext data to the TAC and allows the display system to free-run. Thus the detector prevents the data stored in the memory from being corrupted by noise. This facility, combined with the local display clock, allows a stable display even in the absence of an incoming television signal. Both are essential for after-hours display.

The IC also contains an adaptive sync separator which extracts the sync signals from the incoming video signal and also provides a sync output signal for the timebases of the television receiver. When a full page of text is displayed, the sync output signal is derived from the SAA 5020 TIC.

SAA 5040 TAC Teletext Data Acquisition And Control

The principal function of the data acquisition section of the TAC integrated circuit is to process the teletext data so that it can be written into the memory. The control section processes the information from the remote control

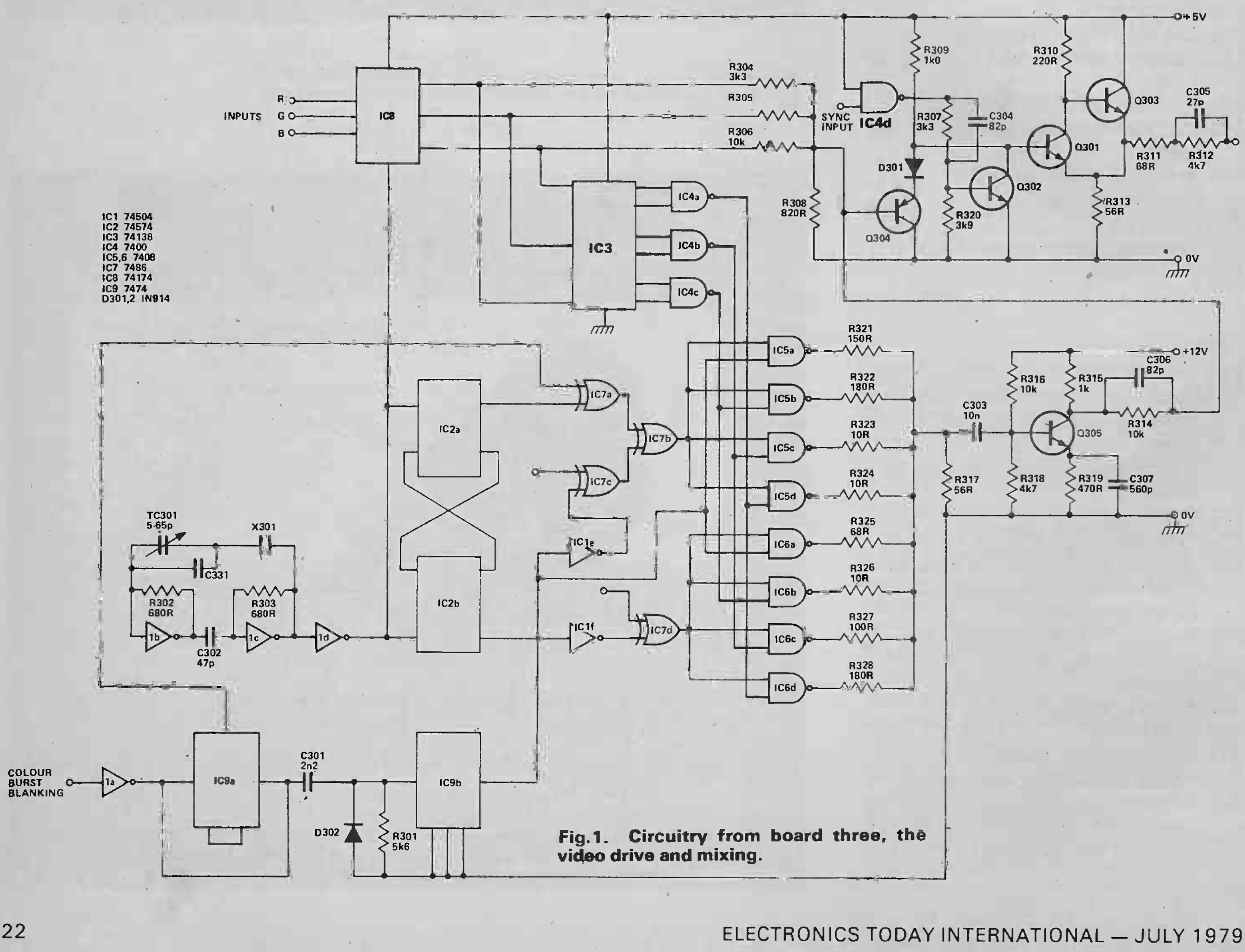


Fig.1. Circuitry from board three, the video drive and mixing.

system, and uses this information to operate the various display functions of the teletext decoder system such as selection of television, teletext, or viewdata modes; page hold, time display, or timed page select.

The data acquisition section, divides the data from the VIP into its component parts. The Hamming-coded address words are checked, and words having a single wrong bit are corrected. Address words having two wrongs bits are rejected. The row address of the incoming data line (one of twenty-four) is fed by this section to the 5-bit row address bus, and the character date is fed through the data to the memory as a sequence of forty 7-bit parallel words.

A signal denoted as WOK (Write O.K.) indicates to the memory when valid data is to be written in, and a WACK (Write Address Clock) signal causes the address counters 74LS161 to step on after each character.

The IC also contains circuits for the implementation of the control bits for the page header.

SAA 5020 TIC Timing Chain

The divider stages in the TIC integrated circuit sub-divide the 6MHz clock signal from the VIP down to 25Hz, the television frame rate, and generate all the timing signals for the teletext display. During the display period, a 1MHz clock signal RACK (Read Address Clock) takes over from WACK to step the character addresses. The address counters 74LS161 are cleared at the end of every line and reset to the first position. After every ten lines during the display, the TIC steps the row address on by one to access the next row of characters in the memory.

In addition to providing all the timing signals for the display, the IC also generates a complete composite sync signal. This signal can be used to drive the timebases of the television receiver without the need for the transmitted sync signal. (This form of operation is also termed 'after-hours' operation.)

Memory Blcok

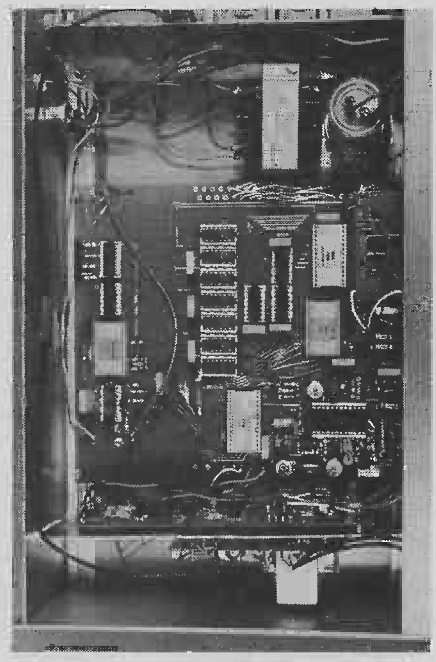
The memory block consists of seven 1k x 1 static RAMs.

SAA 5050 TROM Teletext Read-Only Memory

The read-only memory of the TROM converts the 7-bit character data from the memory into a dot matrix pattern. This matrix is in a 7-by-5 dot form for each character. It also contains a 'character rounding' facility which effectively increases this matrix to 14-by-10 dots, giving improved definition to the displayed characters.

Additional circuits enable various control functions to be performed. These functions are determined by control characters received from the memory. Examples of these control functions are the selection of graphics or alphanumerics, 'flashing' words, or newsflashes and subtitles displayed in boxes within television pictures.

A 'concealed display' function is also provided which can be operated by the user.



BUYLINES

The designers of this project — GMT — have a complete kit of parts available. This includes all metalwork, PCBs and hardware. A manual is also included. Cost is £155 plus VAT (total £178 inc p&p).

As an alternative the teletext decoder board and control system is available separately at £125 for those who wish to wire into their own television.

PCBs and chip sets are available separately also — but are PoA.

See advert on page 6 for address.

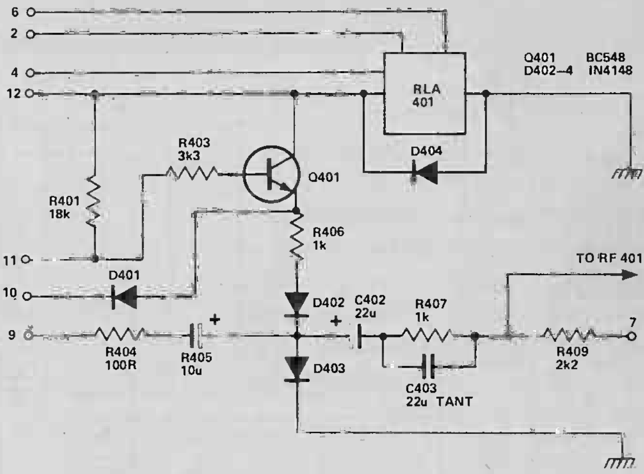


Fig. 2. Relay switching circuit (board four).

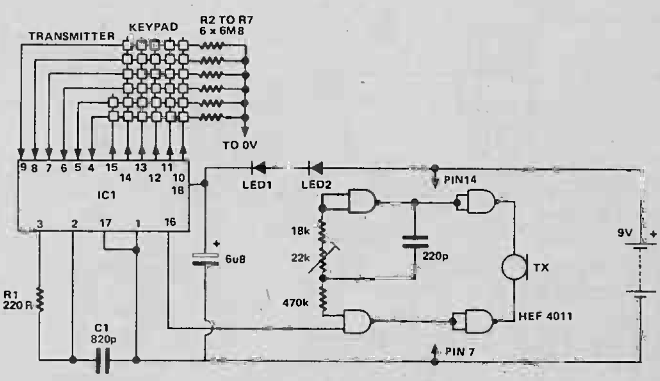


Fig. 3. Hand controller circuitry. Note that no overlay is shown for this, as no constructional work is needed using the kit. IC1 is a SAA5000 for those wishing to go it alone.