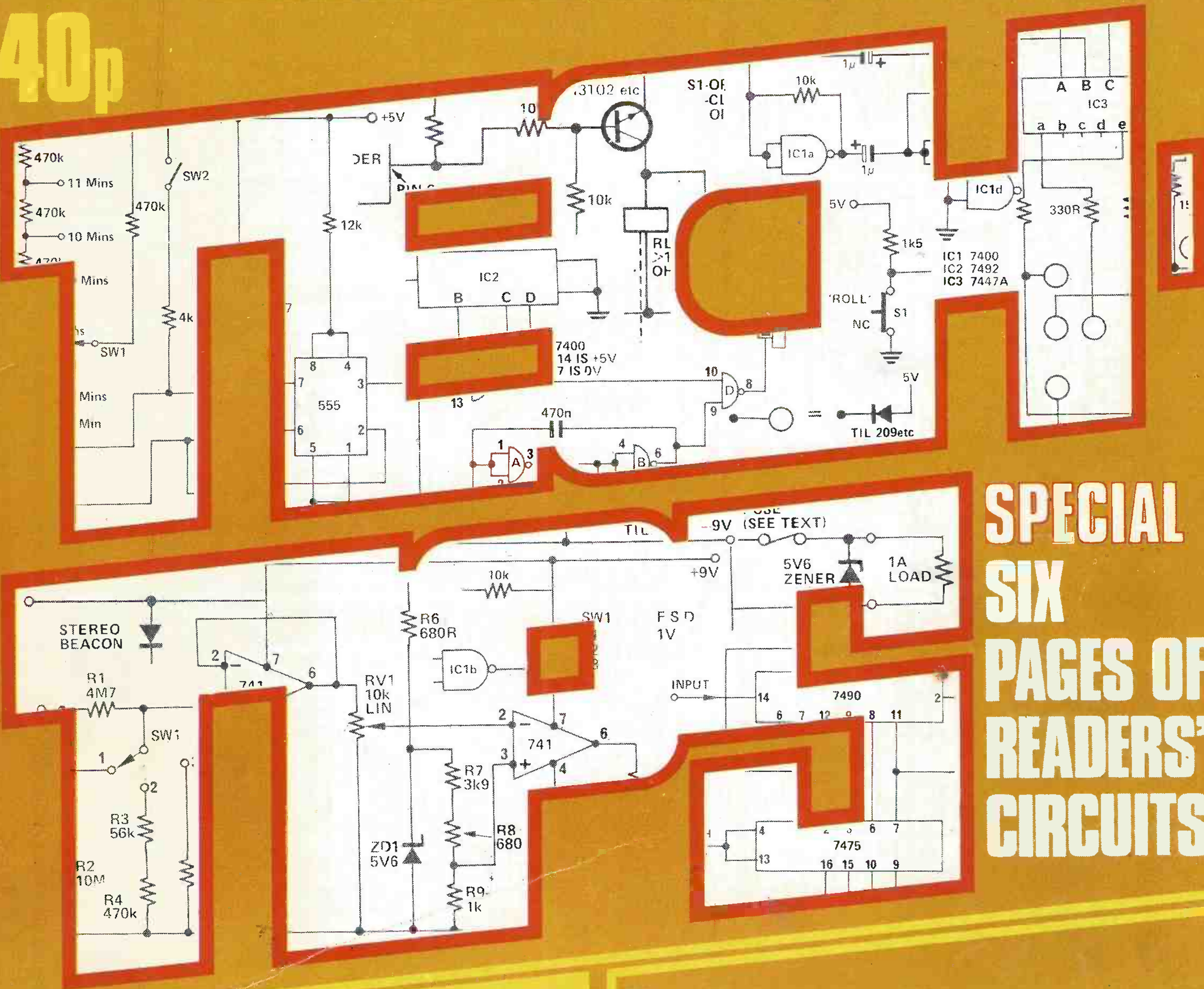
electronics today international

OCTOBER 1977

40p



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OCTOBER 1977 Vol.6 No.10

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SEMICONDUCTORS - COMPONENTS

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Volts	No.	Price
100	TR12A/100	£0.31
200	TR12A/200	£0.51
400	TR12A/400	£0.71

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Volts	No	Price
100	TR110A/100	£0.77
200	TR110A/200	£0.92
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6 Amp TO66 Case

Volts	No.	Price
100	TR16A/100	£0.51
200	TR16A/200	£0.61
400	TR16A/400	£0.77

10 Amp TO220 Case

Volts	No	Price
400	TR110A/400P	£1.12

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BR100 £0.23 D32 £0.23

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PAK	No.	Order No.	Price
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U51	150 Germ. OA70/81 diode	16131	£0.60
U52	100 Silicon Diodes 200mA OA200	16132	£0.60
U53	150 diodes 75mA 1N4148	16133	£0.60
U54	50 Sil Rect Top Hat 750mA	16134	£0.60
U55	20 Sil Rect Stud Type 3 Amp	16135	£0.60
U56	50 400mW Zeners DO7 Case	16136	£0.60
U57	30 NPN Trans BC107/8 Plastic	16137	£0.60*
U58	30 PNP Trans BC177/178 Plastic	16138	£0.60*
U59	25 NPN TO39 2N697/2N1711 sil	16139	£0.60
U60	25 PNP TO59 2N2905 silicon	16140	£0.60
U61	30 NPN TO18 2N706 silicon	16141	£0.60
U62	25 NPN BFY50/51	16142	£0.60
U63	30 NPN Plastic 2N3906 silicon	16143	£0.60*
U64	30 PNP Plastic 2N3905 silicon	16144	£0.60*
U65	30 Germ. 0071 PNP	16145	£0.60
U66	15 Plastic Power 2N3055 NPN	16146	£1.20
U67	10 TO3 Metal 2N3055 NPN	16147	£1.20
U68	20 Unijunction trans IIS43	16148	£0.60
U69	10 1 amp SCR TO39	16149	£1.20
U70	8 3 amp SCR TO66 case	16150	£1.20

Code No's mentioned above are given as a guide to the type of device in the pak. The devices themselves are normally unmarked.

COMPONENT PACKS

Pack No.	Qty.		Order No.	Price
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C2	150	Capacitors mixed value approx (Count by weight)	16165	£0.60
C3	50	Precision resistors Mixed values	16166	£0.60
C4	80	⅛th W Resistors mixed preferred values	16167	£0.60
C5	5	Pieces assorted ferrite rods	16168	£0.60
C6	2	Tuning gangs MW/1W VHF	16169	£0.60
C7	1	Pack wire 50 metres assorted colours single strand	16170	£0.60
C8	10	Reed switches	16171	£0.60
C9	3	Micro switches	16172	£0.60
C10	15	Assorted pots	16173	£0.60
C11	5	Metal jack sockets 3 x 3.5mm 2 x standard switch types	16174	£0.60
C12	30	Paper condensers preferred types mixed values	16175	£0.60
C13	20	Electrolytics trans types	16176	£0.60
C14	1	Pack assorted hardware — Nuts / bolts, grommets, etc	16177	£0.60
C15	5	Mains slide switches ass	16178	£0.60
C16	20	Assorted tag strips and panels	16179	£0.60
C17	15	Assorted control knobs	16180	£0.60
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C19	2	Relays 6 — 24V operating	16182	£0.60
C20	1	Pak. copper laminate approx 200 sq ins	16183	£0.60
C21	15	Assorted fuses 100mA-5 amp	16184	£0.60
C22	50	Metres PVC sleeving assorted size and colour	16185	£0.60
C23	60	½ watt resistors mixed preferred values	16188	£0.60
C24	25	Presets assorted type and value	16186	£0.60
C25	30	Metres stranded wire assorted colours	16187	£0.60

SLIDER PAKS

Pack No.	Qty.		Order No.	Price
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S2	6	Slider potentiometers, all 470 ohms	16191	£0.60
S3	6	Slider potentiometers, all 10k lin	16192	£0.60
S4	6	Slider potentiometers, all 22k lin	16193	£0.60
S5	6	Slider potentiometers, all 47k lin	16194	£0.60
S6	6	Slider potentiometers, all 47k log	16195	£0.60

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		Order No.	Price
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MC2	24 miniature ceramic capacitors, 3 of each value — 100pf, 120pf 150pf 180pf, 220pf, 330pf & 390pf 270pf	16161	£0.60
MC3	24 miniature ceramic capacitors, 3 of each value — 470pf 560pf 680pf 820pf 1000pf, 1500pf, 2200pf & 3300pf	16162	£0.60
MC4	24 miniature ceramic capacitors 3 of each value — 470pf, 560pf, 680pf 820pf, 1000pf, 1500pf, 2200pf & 3300pf	16163	£0.60

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V.A.T.

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CARBON POTENTIOMETERS

SINGLE GANG with wire end terminations 6mm x 50mm plastic shaft 10mm bushes supplied with shake-proof washer and nut Tolerance ±20% of resistance

LINEAR TRACK

Value	No.	Price
1K	1831	£0.22
2K2	1832	£0.22
4K7	1833	£0.22
10K	1834	£0.22
22K	1835	£0.22
47K	1836	£0.22
100K	1837	£0.22
220K	1838	£0.22
470K	1839	£0.22
1M	1840	£0.22
2M2	1841	£0.22

LOG TRACK

Value	No.	Price
4K7	1842	£0.22
10K	1843	£0.22
22K	1844	£0.22
47K	1845	£0.22
100K	1846	£0.22
220K	1847	£0.22
470K	1848	£0.22
1M	1849	£0.22
2M2	1850	£0.22

DUAL GANG. These high-quality pots are fitted with wire end terminations 6mm x 50mm plastic shaft 10mm bushes supplied with shakeproof washer and nut Track tolerance ±20% but matched to within 2dB of each other

LINEAR TRACK

Value	No.	Price
4K7	1851	£0.68
10K	1852	£0.68
22K	1853	£0.68
47K	1854	£0.68
100K	1855	£0.68
220K	1856	£0.68
470K	1857	£0.68
1M	1858	£0.68
2M2	1859	£0.68

LOG TRACK

Value	No.	Price
4K7	1860	£0.68
10K	1861	£0.68
22K	1862	£0.68
47K	1863	£0.68
100K	1864	£0.68
220K	1865	£0.68
470K	1866	£0.68
1M	1867	£0.68
2M2	1868	£0.68

SINGLE GANG SWITCHED. Fitted with double pole on-off switches. The switch action is incorporated within the rotary action of the pot Switch rating 1.5 amps at 250V AC

LINEAR TRACK

Value	No.	Price
4K7	1870	£0.48
10K	1871	£0.48
22K	1872	£0.48
47K	1873	£0.48
100K	1874	£0.48
220K	1875	£0.48
470K	1876	£0.48
1M	1877	£0.48
2M2	1878	£0.48

LOG TRACK

Value	No.	Price
4K7	1879	£0.48
10K	1880	£0.48
22K	1881	£0.48
47K	1882	£0.48
100K	1883	£0.48
220K	1884	£0.48
470K	1885	£0.48
1M	1886	£0.48
2M2	1887	£0.48

VEROBOARDS

DRILLED COPPER P.C.B.

.1 Pitch

Size	No.	Price
2.5" x 5"	2201	£0.46
2.5" x 3.75"	2202	£0.39
2.5" x 17"	2203	£1.42
3.75" x 5"	2204	£0.52
3.75" x 3.75"	2205	£0.46
3.75" x 17"	2206	£1.82
4.75" x 17.9"	2207	£2.34
2.5" x 1" (pack of five)	2208	£0.57

.15 Pitch

Size	No.	Price
2.5" x 17"	2209	£1.13
2.5" x 5"	2210	£0.42
2.5" x 3.75"	2211	£0.31
3.75" x 17"	2212	£1.51
3.75" x 5"	2213	£0.57
3.75" x 3.75"	2214	£0.42
2.5" x 1" (pack of five)	2216	£0.52

DRILLED PLAIN P.C.B.

.1 Pitch

Size	No.	Price
3.75" x 17"	2217	£1.18
3.75" x 2.5"	2218	£0.26
5" x 3.75"	2219	£0.42

.15 Pitch

Size	No.	Price
2.5" x 17"	2221	£0.78
3.75" x 17"	2222	£1.00
2.5" x 5"	2223	£0.26
2.5" x 3.75"	2224	£0.21
5" x 3.75"	2225	£0.36

VERO SPOT-FACE CUTTER
Order No 2231 **Price £0.68**

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Purchase books to the value of £5.00 from the list below and choose any 60p pak from this page FREE.

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BP6	Engineers and Machinists Reference Tables	40p
BP7	Radio & Electronic Colour Codes and Data Chart	15p
BP10	Modern Crystal and Transistor Set Circuits for Beginners	35p
BP14	Second Book of Transistor Equivalents	95p
BP15	Constructors Manual of Electronic Circuits for the Home	50p
BP16	Handbook of Electronic Circuits for the Amateur Photographer	60p
BP18	Boys and Beginners Book of Practical Radio & Electronics	60p
BP22	79 Electronic Novelty Circuits	75p
BP23	First Book of Practical Electronic Projects	75p
BP24	52 Projects Using IC741 (or equivalents)	75p
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196	AF-RF Reactance — Frequency Chart for Constructors	15p
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216	Electronic Gadgets and Games	85p
217	Solid State Power Supply Handbook	85p
219	Solid State Novelty Projects	85p
220	Build Your Own Solid State Hi-Fi and Audio Accessories	85p
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Manufacturer's 'Fall Outs' which include Functional and part Functional Units. These are classed as 'out-of-spec' from the maker's very rigid specifications, but are ideal for learning about I.C.'s and experimental work.

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709-741-747-748-710-588, Etc
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5 I.C.'s 76110 Eqv. to MC1310P-MA767. Data supplied with pak
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U76A AUDIO POWER OUTPUT AMPLIFIERS
8 Assorted types SL403 76013, 76003, Etc Data supplied with pak
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74F 50 Flip-Flops assorted 7470-72-73-74-76-104-109, Etc Order No 16225 **£1.20**

74M 30 MSI Assorted Types 7441-47-90-154, Etc Order No 16226 **£1.20**

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R2	60 mixed ⅛w 1Kohms-8.2Kohms	Order No 16214	£0.60
R3	60 mixed ⅛w 10Kohms-82Kohms	Order No 16215	£0.60
R4	60 mixed ⅛w 100Kohms-820Kohms	Order No 16216	£0.60
R5	40 mixed ½w 100ohms-820ohms	Order No 16217	£0.60
R6	40 mixed ½w 1Kohms-8.2Kohms	Order No.16218	£0.60
R7	40 mixed ½w 10Kohms-82Kohms	Order No 16219	£0.60
R8	40 mixed ½w 100Kohms-820Kohms	Order No.16220	£0.60
R9	60 mixed ⅛w 1 Meg-10Megohms	Order No.16230	£0.60
R10	40 mixed ½w 1 Meg-10Megohms	Order No.16231	£0.60

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BI-PAK

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news digest

DEVELOPMENT KIT TO DEVELOP

Like all good ideas this one seemed obvious once someone else thought of it! Making up PCB's at home is usually a difficult task, and etching panels and labels an impossible one. However a firm by the huge name of Mega Electronics intend that to change.

Introduced this month is their Photolab Kit – a complete UV home PCB production lab. The photograph shows the contents of the kit, drill with 5 bits exposure unit, drafting sheets and grid, etching and developing trays. Alfac transfers. epoxy board, 8 sheets of panel/label material, and chemical developer and etchant. Full instructions are also included. At £44.50 it represents excellent value, especially to schools and the like.

We have had a quick look over the kit, and found it well thought out and excellently produced, but hope to return to it later and give it a thorough 'grilling'.

A SPORTING DISPLAY

Commodore has just introduced a new low-cost digital watch, the CBM 5004 called the 'Sports Watch', it is a five function LED model and will be retailing at around £6.96. CBM have fitted the watch with an adjustable strap which will fit even the slimmest wrist, intending it for the younger market. CBM, 446 Bath Road, Slough, Berkshire SL1 6BB.

TO B OR NOT TO B ......

A complete new range of hi-fi has been launched onto the consumer by Revox. The range is, as usual for them, very much top end of the market stuff.

A B77 is perhaps the biggest surprise, to replace the classic A77 now in it's fourth mark and going well. The new machine has superior styling and a veritable host of new features like LED overload monitors, logic control, built-in editing facilities, twin headphone outlets, switching 'thump' suppressers and coarse and fine speed control....... to name but a few nillion!

The star of the show though has to be Revox's first venture into record

GROWING YER OWN SOLDERWICK

A little old man from Honeywell has been creeping around the Arizona desert divesting cactii of their needles. The loot is then transported to the Honeywell complex in Phoenix for immediate use!

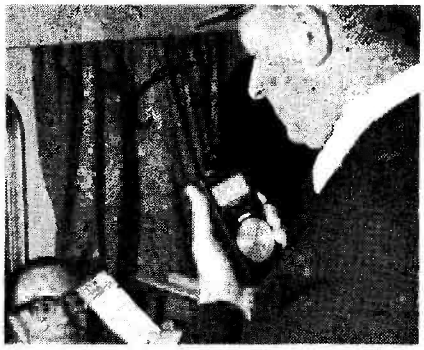
What use you may ask – we certainly did! Until we were told the truth we entertained notions of office politics with avengence – executives' seats transformed to pin cushions, furtive poison darts shooting down the corridors of power......

No such luck. In reality these needles have been found to be superior to steel pins for removing solder splashes across PCB tracks in micro-circuitry. Steel is neither as flexible nor as sharp. Mother Nature 1 - Technology 0.

COMPONENTS – SOMETIMES

Lack of space in this issue has meant that Part 14 of our component series, dealing with batteries, has had to be postponed.

INTERCITY AT 1⅞?



If you use BR at all these days (come on *someone* must!), then the sight of many of the inspectors apparently talking to themselves may have puzzled you.

Well fear not – hysteria has not yet overtaken the APT. Actually the intrepid ticket punchers are merely recording the details of your tickets for later analysis (Big Brother is peering over the railhead it would seem!) on pocket (cassette) dictation machines.

Statistics on who went where and when are, say the railmen, of great value in service and facility planning.

So now you know!

[redacted]

MAKE A DATA

The new edition of the OPTOELECTRONICS D.A.T.A. BOOK is now available, containing 408 pages of information covering electrical, optical and physical characteristics of 7543 devices. Devices produced in countries throughout the world are reported on, including the U.S.S.R.

This manual provides the data needed to replace just about anything electronic that winks, blinks or glows in the dark, not to mention photocouplers and assorted special devices.

The OPTOELECTRONICS D.A.T.A. Book is updated and published twice yearly – and is available from: London Information (Rowse Muir) Index House, Ascot, Berkshire SL5

[redacted]

decks – the B790. This is a departure from the usual pivoted arm concept, and employs a quartz reference PLL for speed conrol of the direct-drive motor. A tacho is also employed for feedback information.

Speed is digitally displayed on four seven-segment LED's. The tone-arm, which is hidden away inside that gantry over the record is of very short construction, and uses magnetic support no less!

Great care has been taken to make the unit impervious to outside horrors, and fool-proof in operation. For instance the tone-arm will not lower if there's no record to lower onto!

We'll do our best to lay hands on one of these machines, and have a more detailed report for you soon.

W.O. Bauch, 49 Theobald St., Borham Wood, Herts WD6 4R7.

MARSHALL YER CASH

Due to the Grunwick postal dispute, which held up orders to Marshall's London premises, the company have decided to extend their '10% off' offer on all orders over £50 for transistors and IC's from the end of August to September 30th.

We've also just heard that Marshall's are opening a second London retail outlet at 325 Edgeware Road – right in the heart of London's electronics Piccadilly.

Although the store will carry the usual Marshalls range, emphasis will be on the new range of high technology devices such as MPU's.

The Memory Programming Service, recently introduced at Cricklewood Broadway, will be available at Edgware Road and the company have approached NS, TI and Mullard to make available hitherto 'trade only' devices to the hobbyist.

Opening date is not finally settled, but mid-September is what they are working towards.

SLIMLINE TV

Hitachi are about to market a mini TV set which utilises an LCD display in place of a tube. The display is 245 by 195 by 40mm.

One interesting speculation is the promise this holds for wrist-TV's and the other extreme – wall mounted sets. These might not be as far distant as we thought.

PLAYING AN ACE

We have another mail-order component firm. Going by the name of Ace Mailtronix, it has a good pedigree behind it and offers the same day despatch on all orders.

There is always room for another good mail order service, and we wish Ace the best of luck. For an idea of their range, see their catalogue in the middle of this issue.

CAPABLE CAPACITY

A new multi-meter from Sanwa, the CX-505, has the capability to measure capacitance, amongst other things. Ranges include four resistance scales, DC voltage from .3V to 1.2kV, AC voltage from 6V to 1.2kV, and DC current from 3mA to 300mA, all full scale. Finally, capacitance is measured using an internal oscillator, and handles capacitors between 100p and 10u. The fully protected movement has a sensitivity of 50k ohms per volt.

Gaps?

Gaps?

It can be a nuisance can't it, going from newsagent to newsagent? "Sorry squire, don't have it — next one should be out soon."

Although ETI is monthly, it's very rare to find it available after the first week. If it is available, the newsagent's going to be sure to cut his order for the next issue — but we're glad to say it doesn't happen very often.

Do yourself, your newsagent and us a favour. Place a regular order for ETI; your newsagent will almost certainly be delighted. If not, you can take out a postal subscription so there's nothing for you to remember — we'll do it for you.

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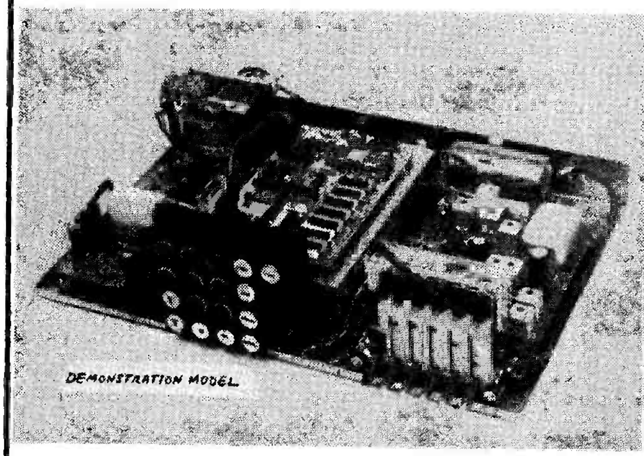
PHOTOCOPYING SERVICE

Due to the steady pressure on our back numbers department, and the dwindling number of issues available, we have set up a photocopying service. This involves our staff in considerable time-consuming endeavour, so we hope our readers understand our decision to apply a flat charge of 50p inclusive. This covers any article, regardless of the number of pages involved, from any ONE issue of ETI.

Please state clearly NAME of article, and from which issue the copy you require is taken.
Address envelope to 'ETI Photocopy Service'.

from aerial → **MANOR SUPPLIES COLOUR TELETEXT** → to aerial plug on TV set



The MANOR SUPPLIES modular equipment incorporates the fabulous Texas TIFAX module which is designed to enable the average constructor to assemble a fully operational unit without the headaches associated with the fitting of hundreds of small I.C.s.

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★ Plugs into aerial socket. (No internal connections to set).
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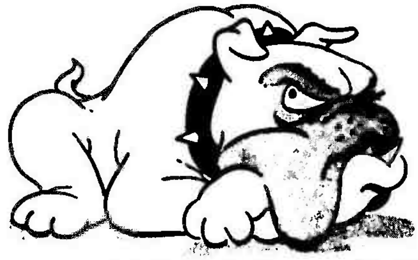
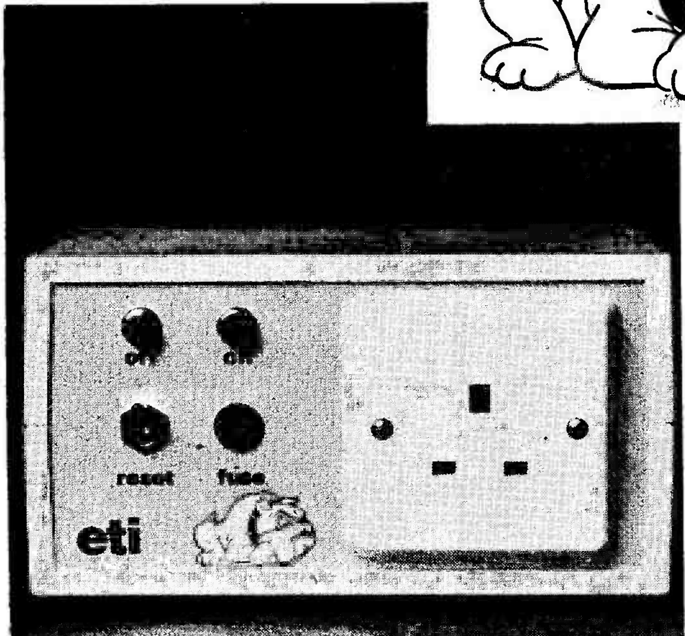
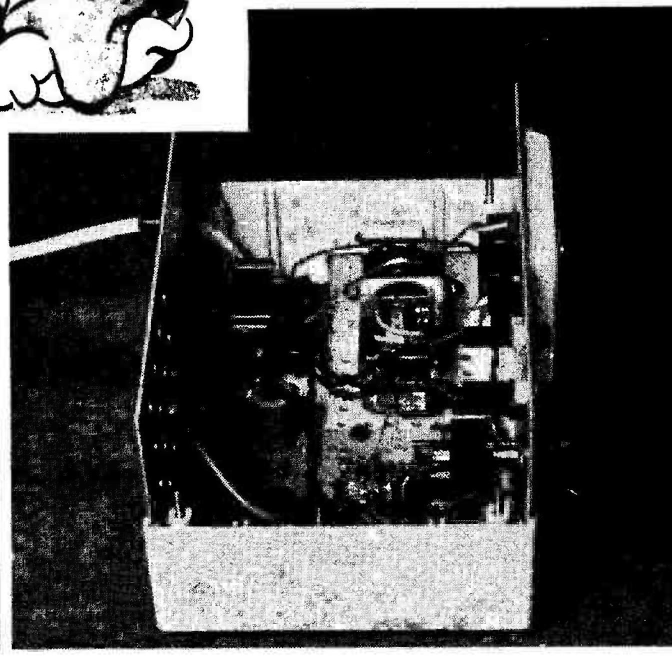






Keep an eye on what's left on, with our project team's . . .

ETI WATCHDOG

IN THESE DAYS of advancing (and shrinking) technology, it can't be long before we have a hi-fi system offered for sale which does everything automatically — even choose the material and listen to it for you. Naturally such a machine would turn itself off once it had finished the session.

Unfortunately the poor old relics we are forced to listen to music on nowadays do not possess this divine power of self termination and more watts are probably wasted keeping the power lights glowing through the night than actually thrilling the neighbours to Status Quo at five past midnight.

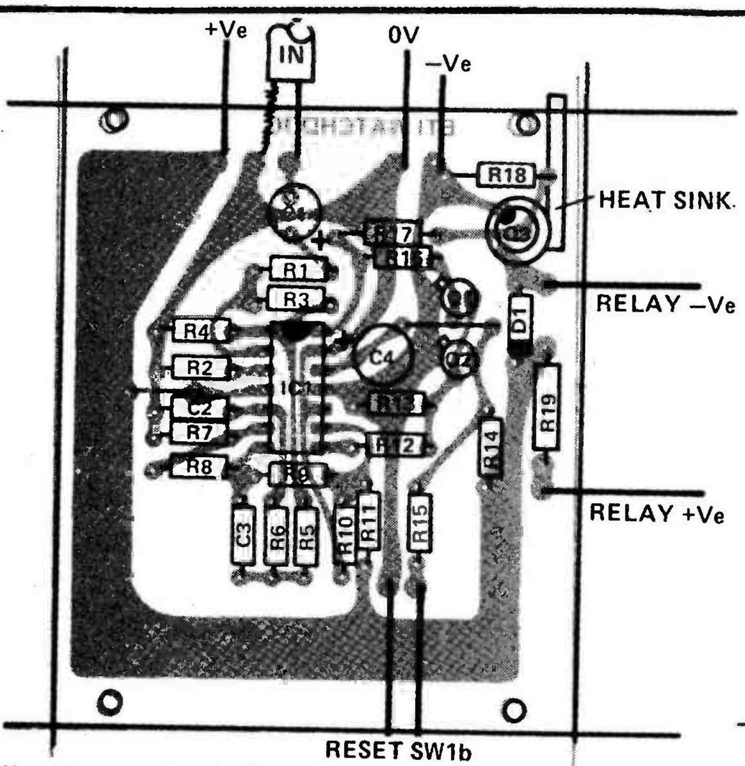
Most, if not all, of us here are guilty of this transgression ourselves, and after many months of *vowing* to do something about — we have. And so we present the Watchdog. It's sole purpose in existing at all is to make sure you CANNOT leave the hi-fi or television running away with the power while you're not using it.

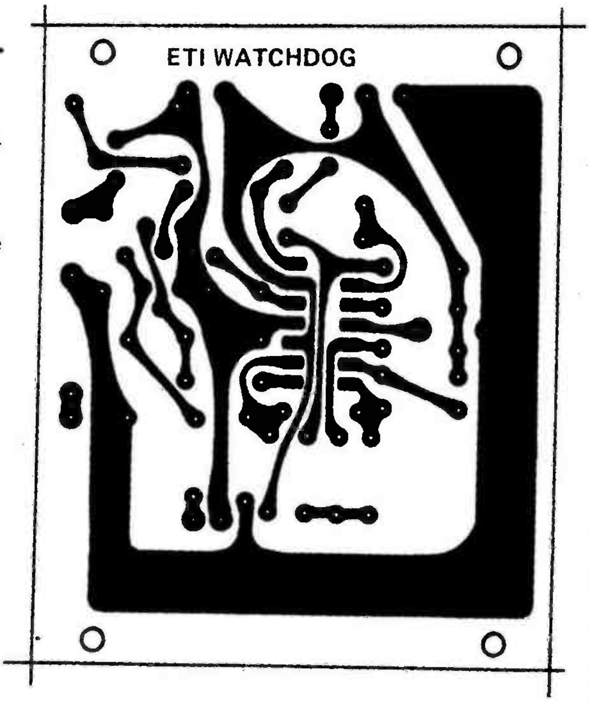
The Watchdog sits in between the mains supply and the equipment, and keeps a monitoring paw on the audio output of whatever is drawing mains supply from it. Once the audio signal has ceased, a (pre-set) time period is allowed to elapse, and then your hi-fi is closed down for you. A filter is included in the circuit such that 'Rover' will ignore white noise such as is generated by a closed-down television or FM station.

Canine Construction

The circuit consists physically of two boards, a relay, transformer and box with front panel components. Assembly of the boards should pose no problems and the layout of the bits within the box is not critical. There will be mains present at many points inside, so please be careful — we don't wish to lose our readers as easily as that. The relay does not have to be bracket mounted, once you're sure the circuit works you could glue the body to the box — but heaven help you in future if it should fail!

The red neon to inform you of the fact that the Watchdog has operated, and is starving the inert system of current, is optional. If omitted it means that the system is entirely 'fail-safe' and once tripped draws no mains current at all. Somehow though the vision of a harassed enthusiast frantically tugging and probing at a piece of persistently dead hi-fi, whilst the Watchdog lurks forgotten and guilty to one side,





Above: component overlay for the watchdog circuitry. Relay and switches are all mounted off-board within the box. Foil patternis shown full size at 83 x 70mm.

PARTS LIST

RESISTORS
(All ¼ W 5% except where stated)

R1	220k (see text)
R2	100k
R3	1M
R4,8,10	10k
R5,6,	8k2
R7,9	39k
R11	4M7
R12	2k7
R13	470R
R14	see text
R15,17	100R
R18	27k
R19	47R ½ W 5%
R20,21	1k ½ W 5%

CAPACITORS

C1,7,8	10u 16V electrolytic
C2	10n polyester
C3	22n polyester
C4	100u 16V tantalum
C5,6	1000u 16V electrolytic
C9,10	10n 1000V mixed dielectric

SEMICONDUCTORS

Q1,2	BC108
Q3	AC128 (fit with heatsink)
Q4	AD161
Q5	AD162
IC1	LM348 (Quad 741)
D1	IN4148
BR1,2	100V 1A Bridge rectifiers
ZD1,2	9V1 400mW zener diode

RELAY

RLA 12V 110R type (octal base) with two S.P.C.O contacts with 7.5A 250vA.C rating (min) Doram: 72-710-3 + octal socket 67-552-3

TRANSFORMER

T1 240V - two 12V windings 0-12, 0-12. 500mA per winding

FUSE

F1 Panel fuse holder and 500mA fuse to suit.

NEONS

N1,2 240V type one red (off) one green (on)

SWITCH

SW1 a,b, Double pole on-off (biased off) R.S.: 316-614

SOCKET

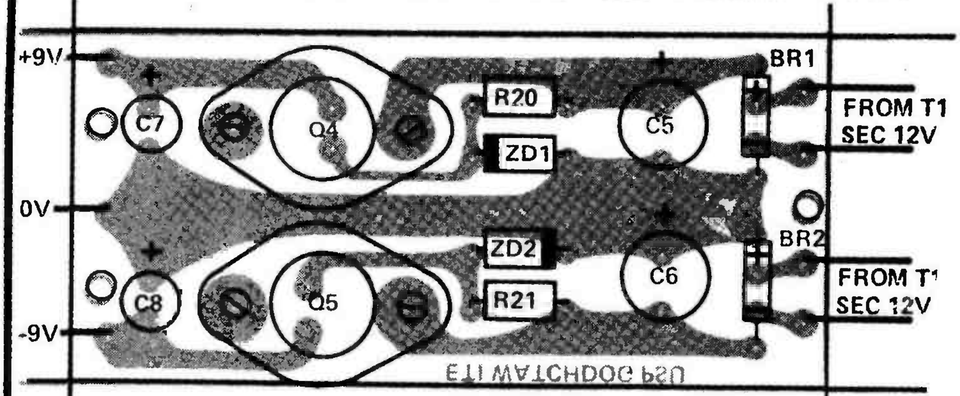
SK1 Panel mounting phono or din socket.

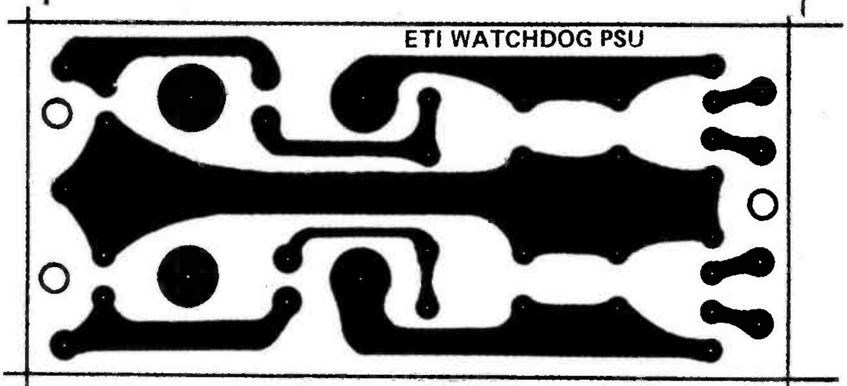
CASE

Verocase 75-1412k

MISCELLANEOUS

BA Socket to suit, 3core mains flex aluminium for heat sink and relay bracket, P.C Boards as pattern, grommet, cable grip, nuts, bolts etc. screened wire, connecting wire.





On the right are the power supply overlay and (full size 103 x 46mm) foil pattern for the watchdog device. Q4 and Q5 are smaller than the usual power type, so even though it looks a bit odd — it isn't!

keeps haunting the editorial mind.

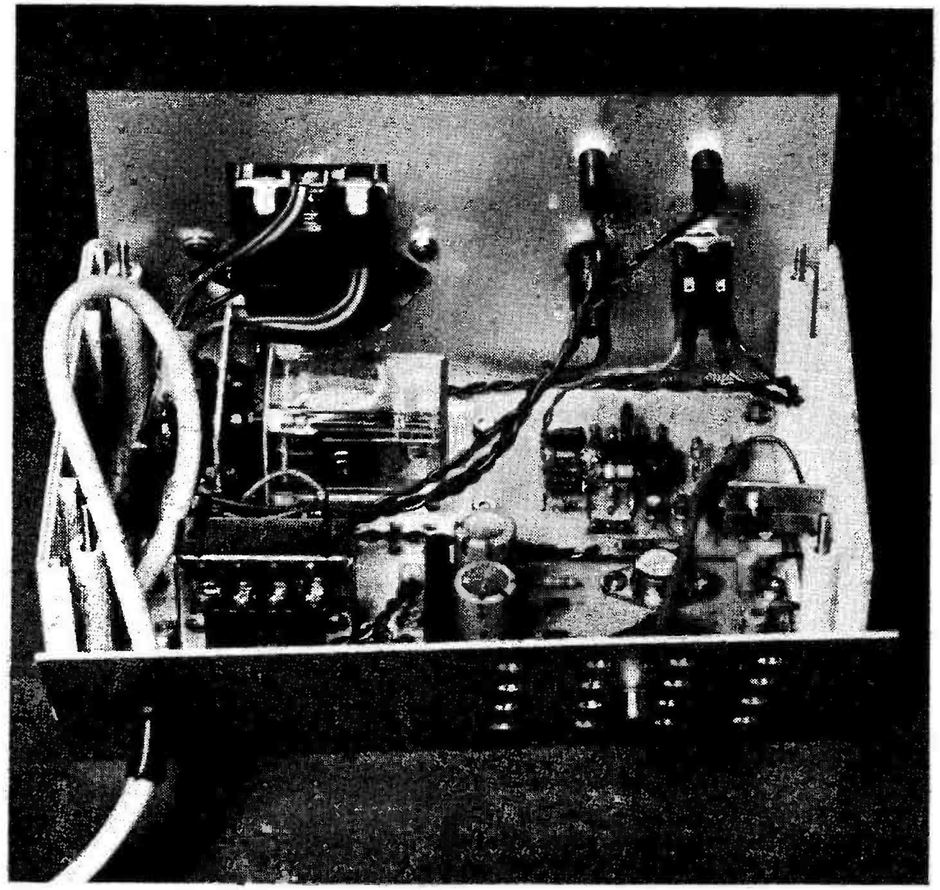
Since the relay is normally operational, current drawn is normally quite high, and so Q3 which drives RLA1 *must* be heatsinked. No options offered. Some ventilation in the back panel would not be wasted effort either, we feel.

House Training

Operation will normally be from a tape output socket or line output in the case of a tape recorder. Sensitivity is about 50mV which proved to be more than adequate in use. As the input filter will reject high frequency energy above about 800Hz thereby eliminating hiss etc, the device will not shut-down on normal signal sources. We would suggest that a delay of about 5 mins, is more than sufficient. A value of 4M7 for R14 gives around this value of delay.

If you want a shorter period, lower the value of R14 — it is very approx 1 minute per Meg with C4 set at 100μF. Too low a value may well affect operation, we have not tried it below 1M, so if you do you're into the dark realms of the unknown. (Incidentally how do you manage to change L P s so quickly?)

An input could be provided from the loudspeakers of your system if you're unable to give doggy his low level audio. A potential divider will be needed to reduce the voltage at the input to stop you knocking the Watchdog's teeth out. For an 8 ohm loudspeaker and amplifier around 20-30W, try 10k and 1k in series across the speaker, with the circuit fed from the junction of the two resistors.



Fitting the Leash

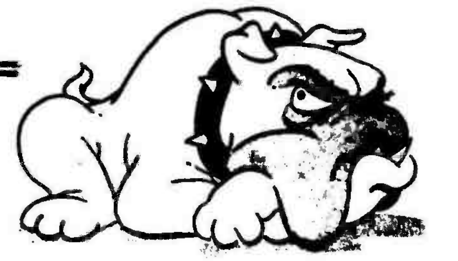
Initial setting up will be subject to the delay period, and so may confuse at first glance. Connect the audio input to SK1, and the Watchdog to the mains outlet. The equipment to be dogged is plugged into the mains socket on the front panel. The red neon should now be on (if you fitted it!) but nothing *else* will be!

Pressing down the reset switch should energise the hi-fi, and bring on the green neon to prove it. You now have however many minutes you allowed yourself with R14 to feed some audio down that wire before Fido gets upset and turns off the system again.

With the variation in level between

Another internal view of the unit, which shows clearly how to mount all the components into the box. This Verobox we employed is now almost certainly only available in two-tone plastic, with the bottom bit grey. Some shops may have stocks of the albino lurking about somewhere, but it could be an exception.

Note that on the PCB in the photo you can see where we paralleled another resistor across R14 to change the timing. This was to adjust the value to exactly what we wanted.



say an off-air television and an FM tuner, the sensitivity may be just too high for your application and if this is so R1 is the component to alter. Raising this in value will reduce the sensitivity of the device.

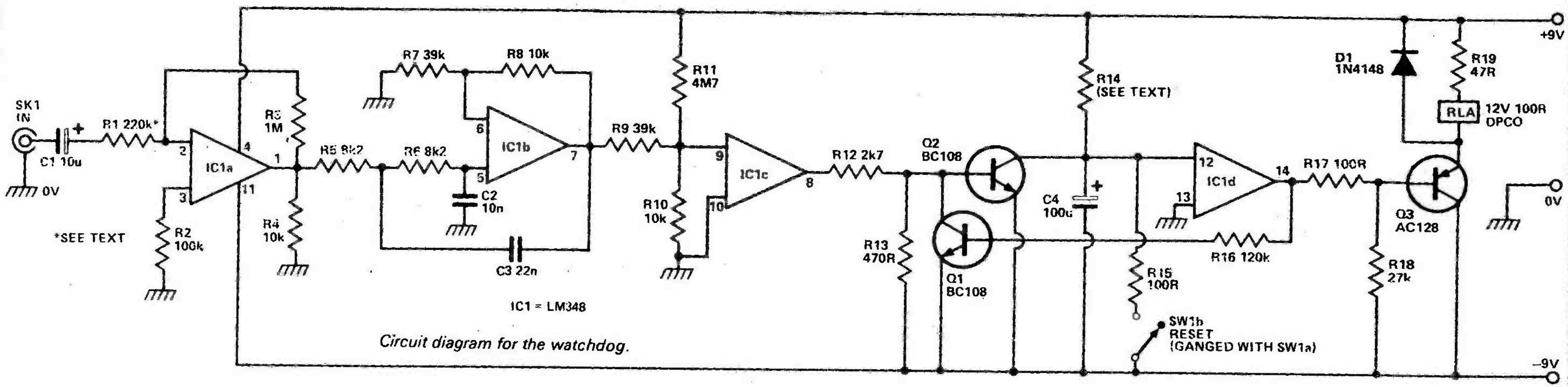
However, this does limit the versatility, and we don't think it will apply to many of you. It might arise say where a television, tuner and record system are all equally likely to be the source under control.

BUY LINES

The only special parts to be bought are (i) the relay which is available from Doram (together with an octal base). This is a 12V coil 110R with two C/O contacts rated at 7.5 amps at 250Vac. The transformer although specified as 500mA per winding can be as low as 300mA per winding. The reset switch must be biased off so once "reset" has been activated, releasing it returns it back to the off state (R.S. stockists can supply it).

The LM348 quad 741 op amp should now be available from most stockists, but if trouble is experienced Marshalls should be able to supply.

The 13A mains socket can be purchased from most electrical retail shops including Woolworths etc. The Vero case used is widely available although colours may vary (some being grey/white). Price: around £15-£17 depending on "shopping around."



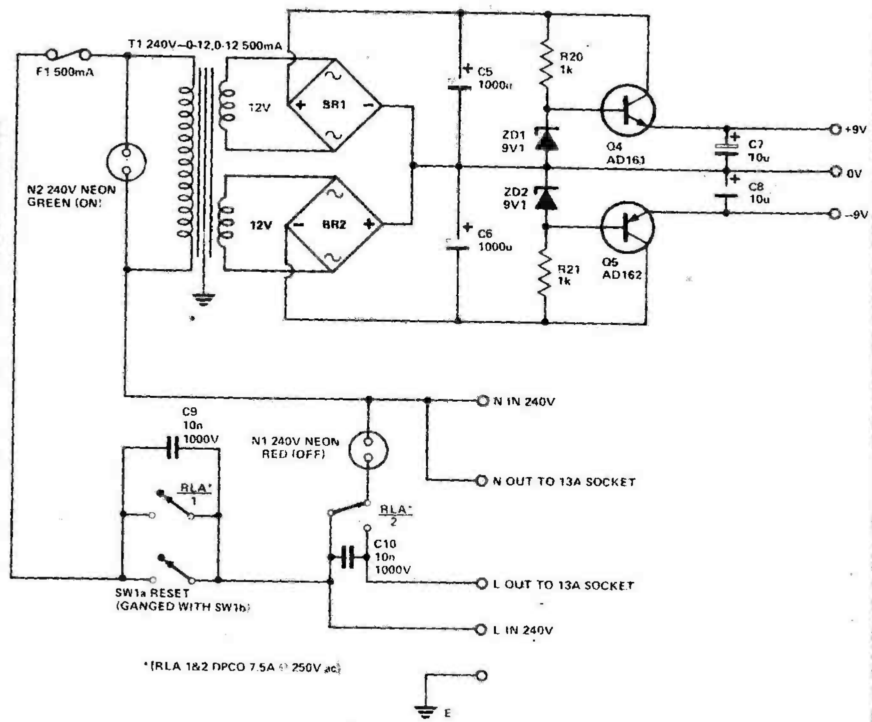
Circuit diagram for the watchdog.

HOW IT WORKS

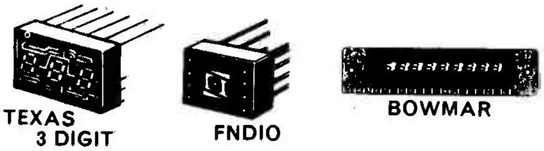
SK1 feeds the input audio of around 50mV minimum to the buffer amp formed by IC1a and associated components. The gain of this stage is determined by the ratio of R3 to R1, and may be changed to vary the unit's sensitivity. IC1b is a second order Bessel low pass filter with break frequency set around 800Hz (when loaded). This is to cut the response to high frequencies such that continuous white noise will not keep the unit switched on.

IC1c and the potential divider R12, R13, square the incoming audio signal and feed this to the base of Q2, keeping it switched on as long as audio is present at SK1. IC1c is an op-amp working at its full open-loop gain such that it will 'clip' any input into a square-wave.

While Q2 is turned on, C4 cannot charge up above earth potential. Once the pulse train is no longer present at the base of Q2, C4 begins to charge via R14. IC1d acts as a comparator, and after the time-delay has elapsed, the output swings high, turning off the relay driver Q3, and disabling the relay which controls the mains to the equipment under consideration. D1 is protection against back EMF generated in the coil. Q1 is wired across Q2 as a 'shut-down' component, in such a way that as soon as the output goes high, this turns on Q1 which then prevents any transient audio, such as switch-off 'thumps' etc re-triggering the Watchdog and keeping it from closing down indefinitely.



Power Supply Circutry to drive watchdog and power switching relay.



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C106C Thyristor 3 amp 300PIV **46p** 10 for £4.
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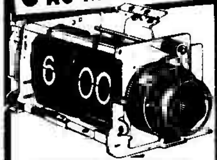

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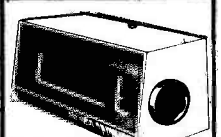

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THIS ARTICLE LOOKS at some of the uses of these new Microprocessor (MPU) integrated circuits and associated components. "In one short article?", you may ask, but we don't mean to go into great programming details, etc, all we intend to do is to show how you could use an MPU in your next project.

ONE ARMED BANDIT RIDES AGAIN!

JOHN MILLER-KIRKPATRICK

Minicomputer or Box of Tricks?

The main function of a microprocessor chip is to replace a whole boxful of TTL and LSI logic gates, not just components for a specific job but a whole range of devices. One of the most logical uses for an MPU chip is in a minicomputer system especially as the cost of such a system is now within the reach of a larger number of hobbyists. The minicomputer system is usually seen as a unit for home information retrieval and/or a controller for complex household lighting, heating or cooking. The system could be programmed to keep recipes, play TV games, help with homework, do the household accounts, etc. Any job or function which is boring, repetitive or requires complex calculations and record keeping can now be done with an MPU. Yes it could do the washing-up but the I/O interface would be too complicated, using a simple keyboard and perhaps your TV as a VDU most of the jobs mentioned above would be quite feasible. As ETI is presenting System 68 for just that purpose this article is not intending to look at the minicomputer type of use for an MPU chip.

"Sort out that box of Rubbish"

How many times has your wife/mother/? complained about your "general purpose electronic component storage system" otherwise known to the family as Dad's Junk Box? To help to keep the peace it is necessary to attempt to sort out all of your resistors, capacitors and ICs about 3 or 4 times per year. These sessions can sometimes be very productive for the home constructor as you can find all sorts of 'lost' goodies which you no longer have a planned use for. When you have finished this massive re-organisation of your supplies you may find that you have an organised storage system for your TTL or other logic ICs, in other words you may now have a boxful of logic to cover most applications in most projects.

Now that peace reigns in the household for a time you may be able to build that project, basically the same as the magazine project but with a few changes dependant both on your preferences and your stock of ICs. Do you find that some times you build exactly as per the magazine article, sometimes you use some of the article and sometimes you have a brainwave?

Everybody Redesigns

Either accidentally or on purpose nearly every electronics constructor redesigns a circuit when he comes to building it. That is exactly what the main intention of this article is — were you beginning to wonder? In order to show how to use an MPU in an otherwise TTL/CMOS project I have used as an example the Electronic One-Armed Bandit project which is now in ETI Top Projects Book 4 and intend to discuss how this could have been built with an MPU. As this project contained about £10 worth of ICs while an MPU design would cost a lot more, a one-armed bandit with an MPU is not an economically feasible proposal. One could argue that MPU chips are going to get cheaper or that you could add enough features to the basic bandit to make it worth the extra money, but for the present let's ignore the cost and talk about the principles involved.

The block diagram of the original bandit is shown as Fig 1, physically it was presented as four units —case, power supply, main logic PCB and display PCB. The display PCB contains a 3 digit counter, 3 decoders and 3 seven segment displays, it also has 12 LED lamps which are used as "spinning wheel' indicators. The lamps flash apparently randomly and then stop and indicate 3 sections of the 12 lamps, some of the combinations of the 3 lamps selected are winners and others are losers.

By referring to the block diagram you can see that three oscillators cause the 3 sets of 4 lamps to flash at different rates, this gives an extra feeling of randomness so that you do not feel too cheated when it has all of your money! Pulling the handle feeds the oscillator outputs to the 3 divide-by-ten counters. When the handle is released the oscillators and counters stop. The states of the stopped counters are now gated into a decoder which produces a set of outputs corresponding to first prize, second, third, fourth or hard-luck! The first four of these outputs cause a number to be loaded into a pre-settable counter which then proceeds to count down to zero whilst at the same time incrementing the payout counter. The payout counter is decremented at each pull of the handle and thus the final unit is a good representation of the real thing, even if it does not have random Hold and Double or Quits features.

Leave that and that but rip the rest out

Any builders of the original unit might be interested enough to do just that and so lets have a look at what we still need in the MPU version. The case would need little or no modification, any mods being the addition of more buttons, lamps, bells and whistles to extend the features of the basic unit. The power supply would need to be changed to give +5V and −12V and or −20V depending on the devices used. MPUs do not require fancy power supplies with millivolt regulation, the 7805 5V regulator and a couple of zeners will suffice.

For the present we will leave the display PCB with its associated counters but it is not indispensable! We are thus left only with the main logic PCB which is exactly where our MPU wants to go.

A microprocessor chip can be thought of as several separate units in one chip. The first unit is a decoder similar to a BCD to seven segment or decimal decoder, the data fed to the decoder is an instruction. Thus an instruction might be decoded so as to cause a clear or an increment of a counter, alternatively it might gate a flip-flop and thus cause an output to change state. Simple MPUs such as SC/MP have about 50 different instructions, the 6800 has about 80, while a Z80 has 130. The range of instructions covers logical operations such as AND, OR and EXCLUSIVE-OR, counter incrementing/decrementing/loading/dumping, or the transfer of data from one part of the chip to another in parallel or serial form. If you wanted to build an MPU you would need shift-registers, counters, decoders, latches and a decoder (ROM), all of these to be interconnected so that each can control/be controlled by any other.

The instructions which we feed into our decoder could be decoded as a transfer of data from a register to a latch which is in turn connected to the outside world. It is convenient to have only one set of information connections to the outside world and thus these connections have to serve as instruction input and as counter input/outputs, this set of lines to the outside is called a bi-directional data bus.

As we need to use this data bus for both instructions and data we need to store each separately internally, thus are born the expressions Instruction Register and Accumulator Register, really just a couple of 8 bit latches. SC/MP has an extension to the Accumulator and naturally enough this is called the Extension Register, it can swap its data with that in the Accumulator and has the additional function of being a shift-register with its serial input and output connected to the outside world. Thus our first instruction could cause the data on the data bus to be latched into the Accumulator, the second instruction swaps data with the Extension and the third and subsequent instructions clock the data in the Extension out to the MPU output pin at the same time as clocking the data on the serial input into the Extension. To build such a device with TTL would require about a dozen packages, with SC/MP it becomes a set of bit patterns input to the decoder.

The 8 bit wide instructions mentioned above have to be presented at the data bus in sequence and as they are required. If they were hard-wired in a very small

Fig. 1. Block diagram of "One Arm Bandit" using conventional TTL/CMOS logic.

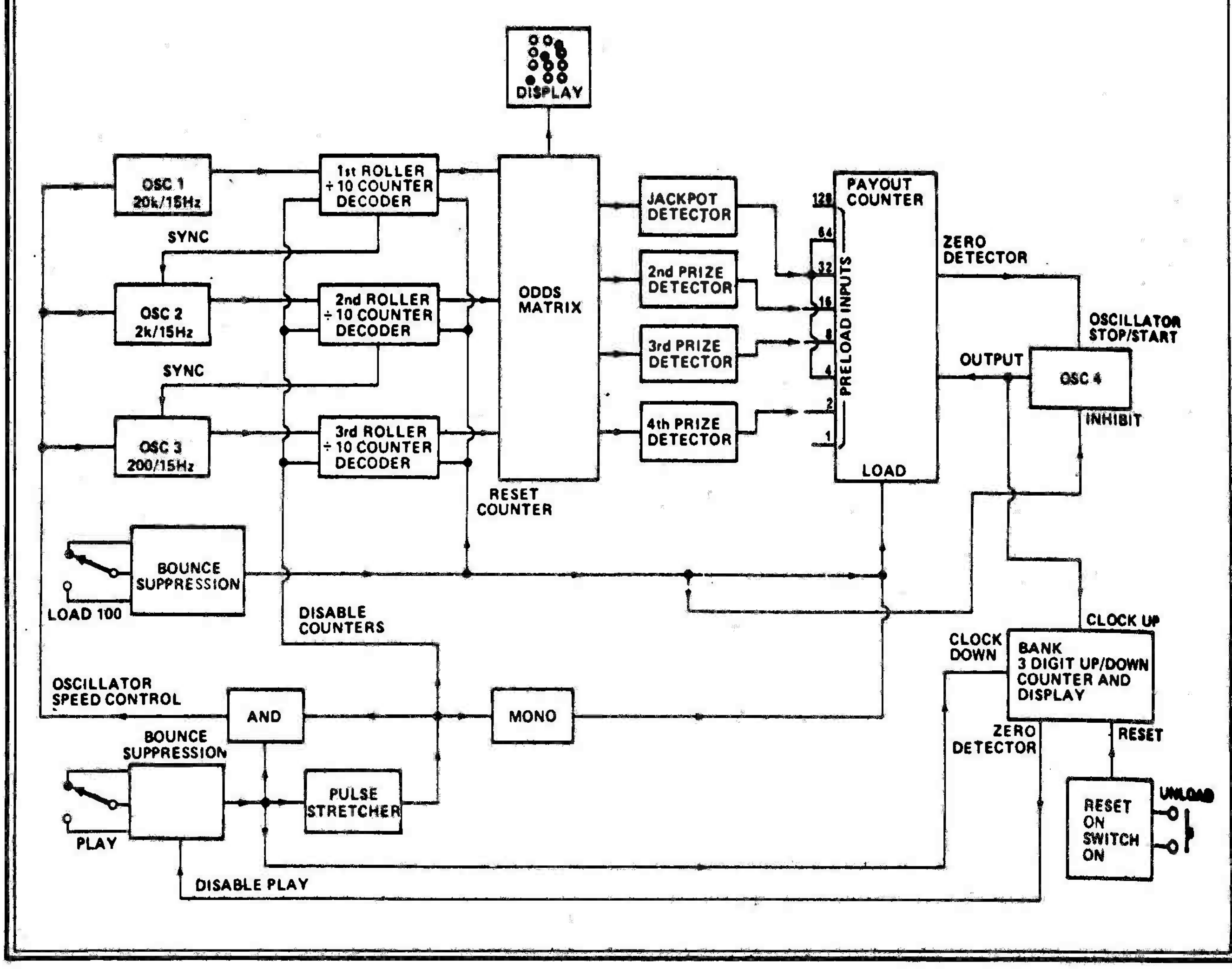
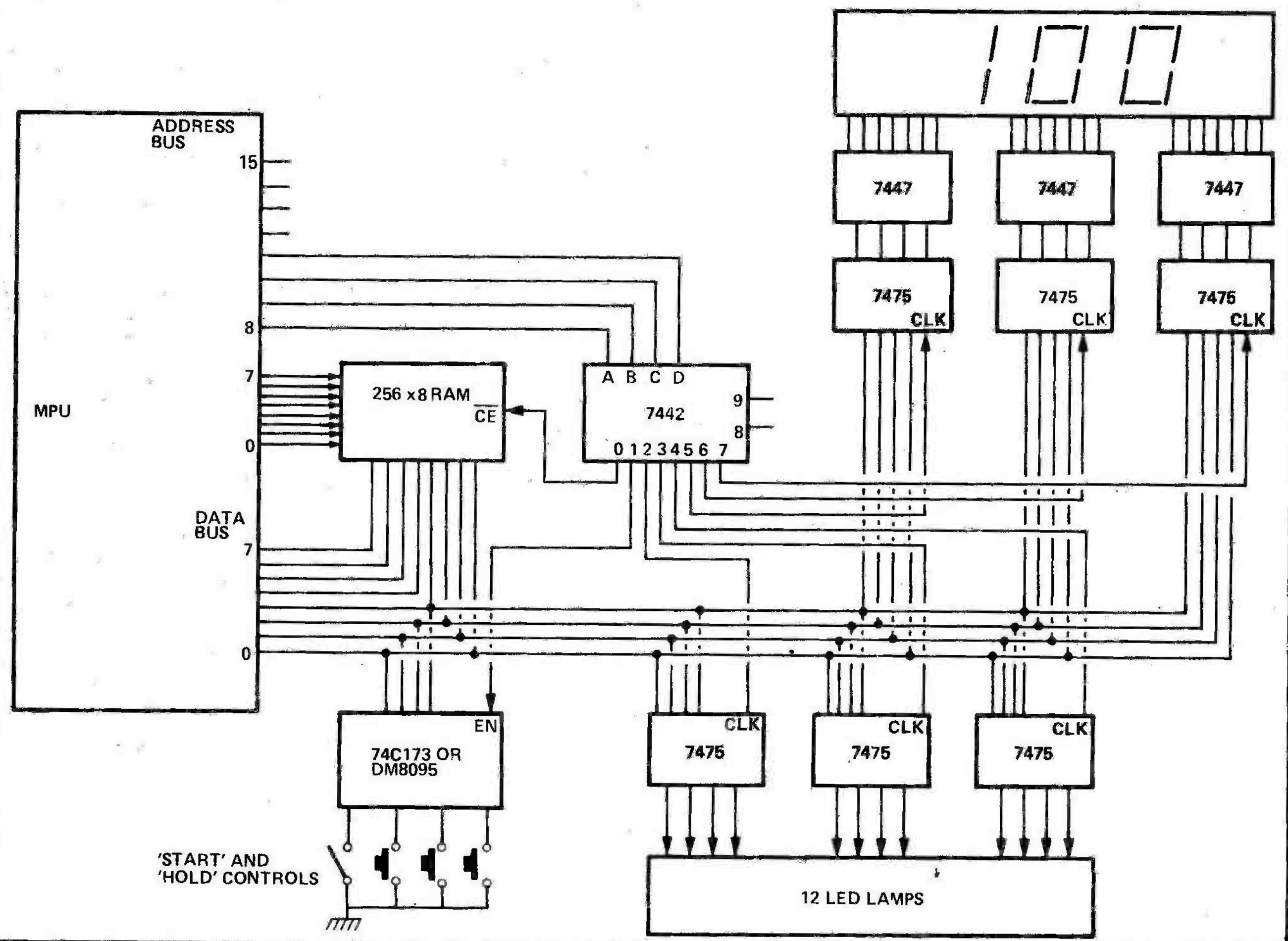


Fig. 2. Block diagram showing "Bandit" based around on MPU chip.



system a 7442 type of decoder could be used to enable each set of bits at a time. The 7442 would need to know the address of the next data unit as this information is supplied by the Address Bus which is normally 16 bits wide thus giving access to 65,536 sets of data in place of the 7442's ten. The Address bus is held internally as a 16 bit parallel access counter which can exchange data with the Accumulator, Extension or Pointer Register. Thus, if we can change the value of the Address bus counter we can point the MPU back to a previous instruction address and thus cause it to enter a loop. The Address register is known as a Pointer register, in SC/MP, for example, there are 4 such registers, PR-O is used for the next instruction address and the other 3 are used to access other addresses for data I/O. By loading a Pointer Register in a manner similar to that of loading the Extension we can either access or any of our 65,536 addressable slots or we can cause the MPU to get its next instruction from any of the slots.

Accumulating data

The Accumulator is used for input/output and also for the results of logical ANDs, OR, and EX-ORs, it can also be used as the result and one of the operands in an ADD instruction.

Data input/output can be accomplished through the serial I/O pins connected to the Extension or via the main data bus. It is usual to have some area of RAM connected to the data bus for storage of intermediate results, a couple of MM 2112 chips gives 256 Pigeon Holes each with 8 bits of data storage. The RAM is accessed by a Pointer Register which selects a) the RAM physical devices and then b) one of the 256 locations within that RAM. The 16 bit pattern for location zero (the first) in a RAM based as hex location 0F00 would be 0000 1111 0000 0000, it is easy to see how this bit pattern could be decoded with AND and NAND gates to give a single enable line signal (one 7420 and two 7421s?). Similarly, if we had a couple of 7475 latches we could decode a particular address (eg 0E00) and use the enable to clock the latches and thus store the data which had been output on the data bus at the same time. These 7475s are to be used for driving the LED lamps in our Bandit so that we need two sets of latches (0E00 and 0E01) to give us a maximum of 16 LED lamps (we need 12). We can use a similar latch but with WIRE-OR or TRI-STATE outputs (74173) to latch data into the MPU from a set of switches such as the start handle or possibly HOLD switches.

Simulation is the Answer

If you had lots of sheets of paper you could pretend to be an MPU pretending to be our bandit. Get someone else to operate you by pulling your left arm as the Start handle and then start counting very fast until they release your arm, if you can manage it count three totals at a time and thus when your arm is released you can write down these three numbers on a scrap of paper. The MPU would do the same thing by sensing the changes in the data from our switch latch, adding to pseudo-counters in RAM locations (scraps of paper) and then stopping when the switch latch changes state again.

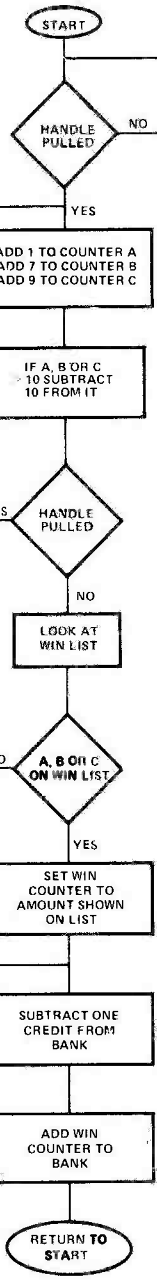


Fig. 3. Flow diagram of software required to run the MPU Bandit.

Now you look at your scraps of paper and decide whether the numbers correspond to any on a list of winning combinations which you have previously compiled. If the combination is a winning one then your list will have a 'Win amount' figure next to the winning combination, this figure is now credited to the players bank. If the player did not win then one unit is taken from his bank. You are now ready to have your arm pulled again.

If we use the existing display PCB we have to add or subtract from the bank by pulsing the bank counters on that PCB. We could keep these counters internally and latch out the BCD data in a similar way to that with the LED lamps, via a couple of latches. These latches would then feed into the BCD to seven segment decoders and on to the displays. There is no reason at all why the BCD to seven segment conversion could not be done within the MPU and seven segment data output to the latches and then directly to the displays.

Hardware and Software

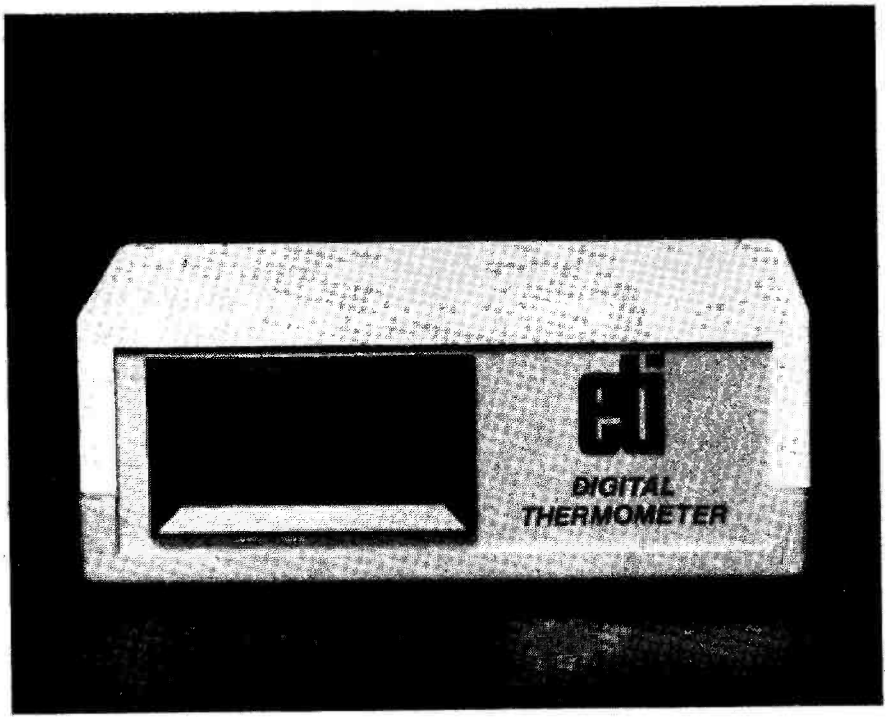
A simple definition used to be that Hardware hurts your foot if you kick it and you cannot kick software. Now that computers are not the giant metal monsters that they used to be this definition is no longer true but hardware is still the physical devices and software the program.

For our application we obviously need an MPU chip and as our application is very simple let's use a SC/MP MPU. We need somewhere to store our program and our pseudo-counters, for this we could use a 256 x 8 bit RAM (2 MM2112s), for a more permanent unit we would have to additionally use a PROM but we can use RAM in this example. We have to enter our program of sequence of bit patterns into the RAM starting at address location 0001 as this is where SC/MP goes to find its first instruction after the reset button is pressed. A simple development system such will allow programming of the RAM with simple toggle switches and the program can be checked out at a very slow speed or as single steps.

We also need a four bit input latch (74173) connected to the handle and HOLD switches and 3 four bit latches (74173 or 7475) for the LED lamp drivers. If you intend to replace the BANK counters with software pseudo-counters then another 3 four bit latches will be needed to latch out the BCD data for each digit. To make accessing of these latches easy we can ignore the top four bits of the address bus and use the next four bits as inputs to a 7442 1 of 10 decoder. This will now break up the addresses into 256 byte lumps, any access to 0000-00FF will enable the RAM, 0100-01FF the switch latch, 0200-020FF and LED latch, etc. A block diagram of this is shown as Fig 2, as you can see the outputs from the 7442 are used as follows.—Output 0 address locations 000-00FF used for main RAM (program & Data)
Output 1 address location 0010 used for switch latch,
Outputs 2, 3, 4 address locations 0200, 0300, 0400 used as LED lamp drivers.
Outputs 5, 6, 7 address locations 0500, 0600, 0700 used as BCD output latches. With the exception of the RAM all of the other devices hung onto the data bus only use bits 0-3 of the data bus, the other bits being ignored.

Conclusions

The system designed here is hopefully one of the simplest MPU circuits you have ever seen. Once you have grasped the idea of using one 8 bit data bus for most of your input/output you are well on the way to understanding MPUs. The very nice thing about MPUs is that for any given hardware configuration there are lots of software possibilities, for instance we have to have a four bit latch for the start switch so why not hang 3 HOLD buttons on it as well? By latching out seven segment data instead of BCD you could use **any** combination of the seven segments plus decimal point to display letters or patterns, by moving up to a 5 x 7 matrix display you could output even more patterns/-letters. At an approximate guess the hardware shown in fig 2 would cost about £25 compared to the £10 for the original (displays not included) but for the extra money you have a much more flexible system. MPU's are not cheap but for what they can do for you they are a bargain!



DIGITAL THERMOMETER

WE HAVE FOR some time been considering the constructon of an accurate electronic thermometer, and the announcement of the new National LM3911 temperature controller was enough to spur us into action and get down to building the thing.

The LM3911 is a highly accurate measurement system for use over the $-25^{\circ}C$ to $+85^{\circ}C$ temperature range. It is fabricated on a single monolithic chip and includes a temperature sensor, stable reference voltage and operational amplifier on chip.

SENSING ATTRACTION

The characteristics of this device make it ideal as the basis for an accurate and easily calibrated thermometer. The chip produces an output of 10mV/°K and all that is necessary to convert the 3911 into an electronic thermometer is to connect it to a scaled voltmeter.

In its simplest form the voltmeter would consist of a moving coil meter with as large a deflection as possible.

It soon became apparent that if we were to make use of the full measurement range available, we would need a very large meter scale. A smaller scale would mean that the temperature could not be read to within a couple of degrees. We wanted our thermometer to be more accurate than this.

Now while we are not in favour of going digital for the sake of it, in this case it seemed that the potential accuracy of a digital display was required.

We threw out our analogue measurement stage and started thinking in terms of VCOs and 7400s. This line of approach seemed very attractive until we looked at the final design.

THERMAL EXPANSION

The component count had gone up dramatically and the accuracy

The circuit for the digital thermometer may conveniently be broken down into three separate building blocks. These are the temperature sensing block, the A to D convertor including the display and the power supply.

We shall start by considering the temperature sensor.

THE TEMPERATURE SENSOR

The LM3911 temperature controller used in this project provides an output voltage which is linearly related to the temperature at which the chip's sensing element is maintained. This output voltage is given by the relationship:

$$V_{out}=T.10^{-2} \text{ volts}$$

Where T is the temperature in degrees Kelvin.

The Kelvin and centigrade scales are related by the following relationship:

$$^{\circ}K=^{\circ}C+273.16$$

Thus at room temperature (about 20°C) the output of the LM3911 will be:

$$V_{out}=(273.16+20).10^{-2} \text{ volts}$$

$$\simeq 3 \text{ volts.}$$

For the A/D convertor to give readings in °C, and to correctly display temperatures below zero, it is necessary to arrange so that at 0°C the output of the LM3911 is 0V.

The components R2, R3, R4, and R5 together with RV1 allow for this adjustment. They enable an adjustable 'offset' voltage to be added to the output of the temperature sensor. This offset is trimmed during the calibration procedure described in the main text.

For more detailed data on the LM3911 see the Data Sheet on page 59 of our September 1977 issue.

THE A/D CONVERTOR

The A/D convertor is based on the new Intersil ICL7107 3½ digit, single chip panel meter. It is intended to drive an LED display directly with a segment current of about 8mA. In addition to a precision dual slope convertor, it contains BCD to seven segment decoders, a clock and a reference voltage.

The detailed operation of this chip is something known only to the design team who produced the IC's mask, so we will have to content ourselves with a brief look at the function of the external components.

The components associated with pins 38, 39 and 40 (C4 and R9), determine the oscillator frequency, which is designed to run at approximately 50 kHz.

The reference voltage for the system is set up using RV2. The chip internally regulates the voltage between pins 1 and 32 at about 2.8 volts. This stable voltage is used as the systems reference.

We shall see later that we require the 7107 to have an fsd of 2.000 V. For this fsd reading we must arrange for the voltage between pins 35 and 36 to be 1.000 V.

Adjustment of RV2 allows this to be accomplished.

The components not yet mentioned take care of auto zero, polarity, etc., and Intersil do not provide details of their exact functions.

The displays are directly connected to the appropriate pins with no interfacing required.

LINKING THE TWO

The ground referenced voltage from the junction of R4, R5 is fed, via a smoothing capacitor, C9, to R6. This connects to the analogue input of the 7107, and apart from considerations of scaling, and a power supply, the circuit should now operate, albeit inaccurately.

SCALING

First scaling. The output of the LM3911 is a voltage increasing at 10mV/°C or 1mV/0.1°C. If then the least significant digit of our display reads in steps of 1mV, it could be thought of as representing 0.1°C temperature steps.

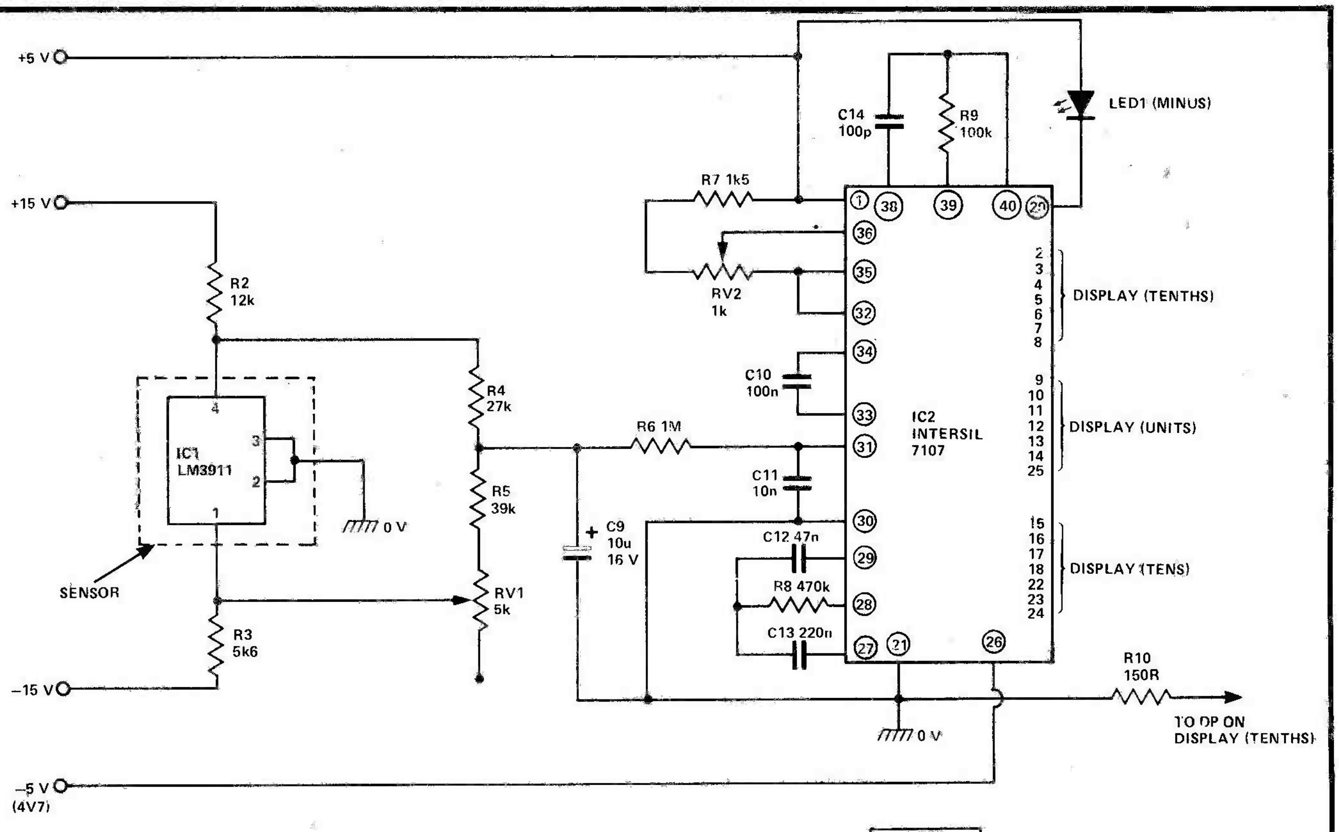
Similarly, the second least significant digit represents 1°C steps and the third 10° steps.

The 7107 is a 3½ digit chip, and if we ignore the most significant digit and arrange an fsd of 2 volts, we will have the required scaling.

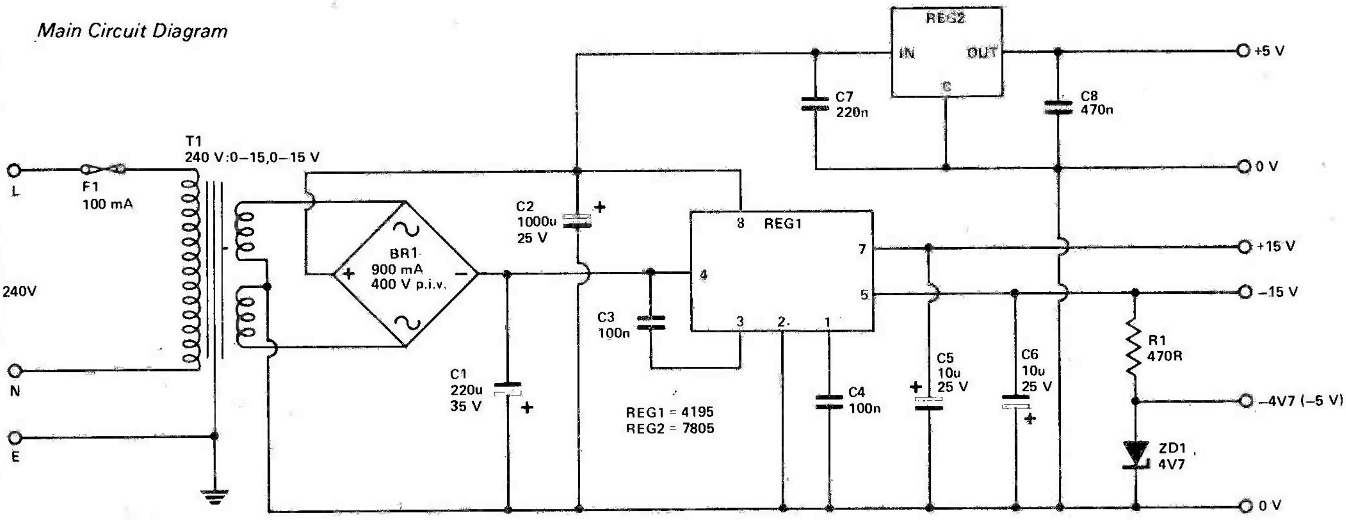
POWER SUPPLIES

The power supply section is quite straightforward. The LM3911 requires a +15/0/—15 stabilised rail, which is provided by REG 1. The 7107 requires +5/0/—5 rails and these are provided by REG 2, ZD1 and associated components.

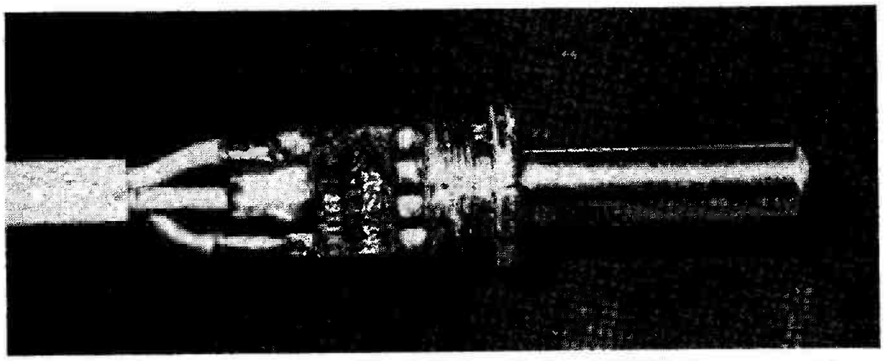
The reason for using a regulator in the 5V rail and not the -5V rail is explained by the fact that the 5V rail supplies the LED current.



Main Circuit Diagram



Power Supply Circuit Diagram



Interior view of our temperature probe. Pins 5, 6, 7 and 8 of the LM3911, those connected to the internal temperature sensing element, have been soldered into a jack plug from which the shaft has been removed. This provides good thermal contact between the probe tip and the sensor chip.

of the unit would have been seriously degraded as many of the new components would drift with temperature and time.

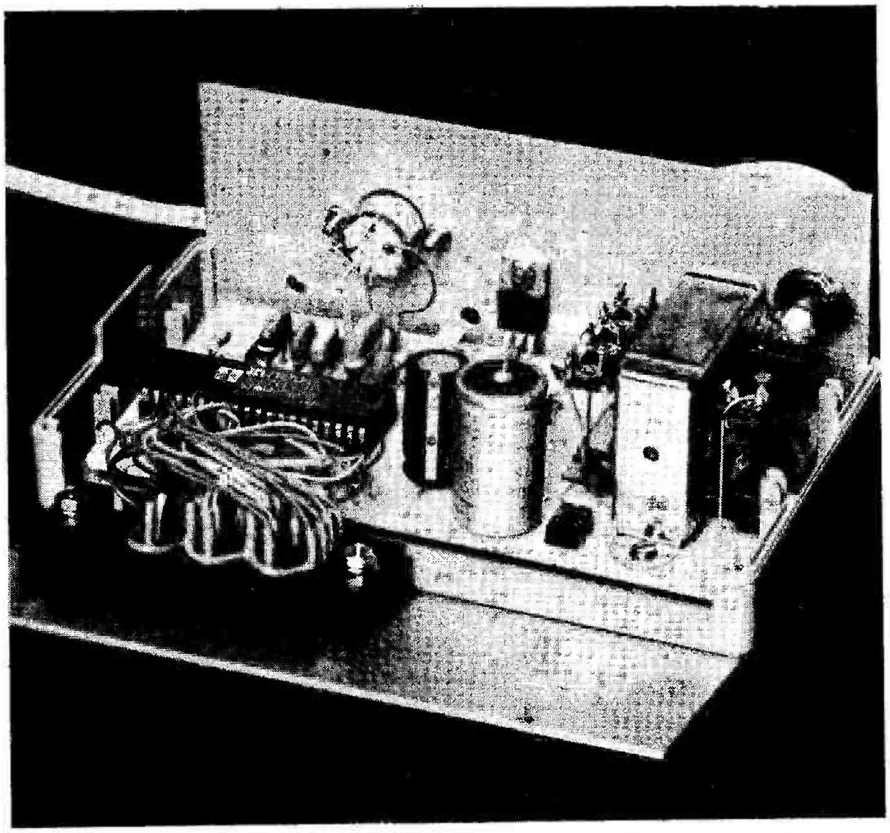
Having firstly rejected the analogue approach, and now come to the con clusion that the digital approach was also out, we were beginning to worry....

It was at this point that a new chip from Intel came to our rescue. The 7107 is a single chip DVM with three and a half digit resolution. The chip needs only a few passive exteranl components to function as a DVM — unlike some single chip DVM's of the past which were little more than overpriced VCO's.

BUY LINES

The 7107 is available fron Rapid Recall at Betterston Street, Drury Lane, London WC2H 9BS. The LM3911 should be obtainable from National Semiconductors Distributors. The voltage regulators we used we obtained from Doram.

The rest of the components should be available from good component shops or from any of the larger mail order suppliers advertising in this magazine.



A view of the interior of the thermometer. The seven segment displays are mounted in the display mounting hardware described in the text and hard wired to the PCB board. The probe is connected to the thermometer via the DIN socket shown on the rear panel.

This looked very promising. the component count would be low and the DVM chip was stable over a wide range of temperatures. In theory all we had to do was hook the temperature chip up to the DVM, add a power supply and we would have a thermometer capable of resolving temperature in 0.1°C steps.

All the components with the exception of IC2 should be mounted on the PCB according to the component overlay shown.

IC2 is a CMOS device and we reccomend that it be mounted in an IC socket. As a further concession to the sensitive nature of this chip it is best not to insert the IC into its socket until all other constructional work has been completed.

After finishing the PCB assembly the display should be wired to the board. The display mounting hardware we used was from Elbar (see page 23 of tha August issue).

Indication of negative temperature is by means of a LED which is mounted in the vacant position of the display mount.

The mounting arrangement for the sensor is largely a matter of choice. We mounted ours in a jack plug from which the central shaft had been removed. If the distance between the sensor and thermometer is large, then screened lead should be used for the interconnection.

There are two adjustments to be made before the thermometer will display the temperature correctly.

The first is to adjust RV1 so that, with the sensor held at 0°C, the display will read all zeros.

The best way of ensuring that the sensor is at 0°C is to immerse the device into a plastic container (flower pot) that has been half-filled with crushed ice, and topped up with cold water to the three-quarter full mark. Care must be taken to ensure that no water can reach the electrical connections to the sensor.

Leave the mixture for five to ten minutes, stirring gently, and at the end of this time adjust RV1 to give an all zero display.

The second adjustment to be made is to RV2. There are two different ways of accomplishing this. The first is to hold the sensor at a second known temperature, well away from zero, and then to adjust RV2 to bring the known temperature, and the reading on the digital thermometer into agreement.

Probably the best way of meeting the above requirement, is to obtain an accurate, limited range thermometer — a clinical thermometer should be ideal.

Place the sensor and clinical thermometer in a container of cool water and slowly add warm water to bring the mixture into the temperature range covered by the clinical thermometer.

When the mixture appears to have settled at the same temperature for a few minutes, adjust RV2 accordingly.

Another source of a stable, known, temperature is the human body. A healthy persons under arm temperature is fairly constant at 37.4°C.

The male members of the ETI staff, for some reason the women would not take part in this test, must be a healthy lot because this method agreed very closely with the first.

The second and perhaps the most accurate procedure, which relies not on a second temperature but upon the accurate trimming of the voltage between two pins on IC2.

If an accurate DVM is used to measure the voltage between pins 35 & 36, then adjustment of RV2 to bring the voltage reading to 1.000 V will complete calibration.

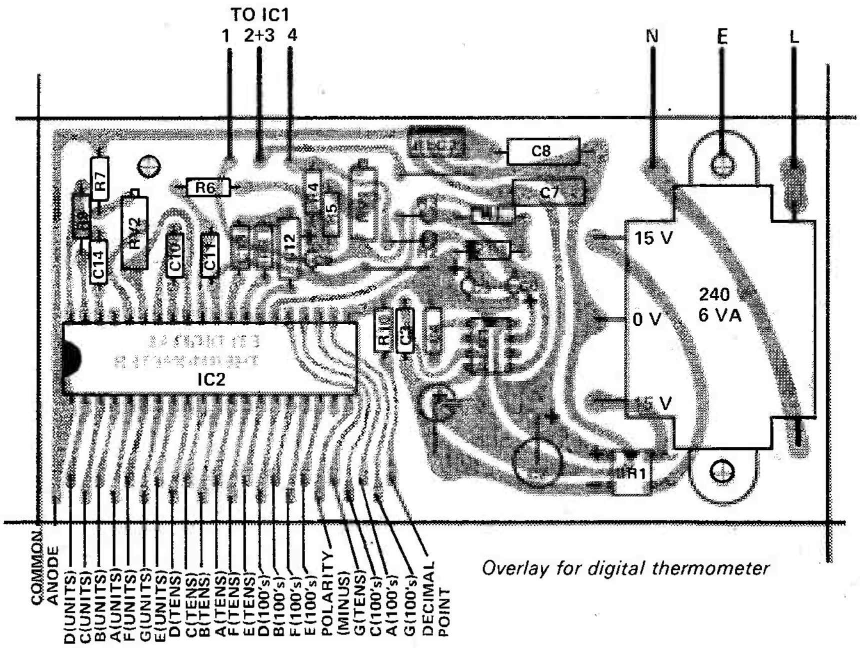
PARTS LIST

RESISTORS (all ¼W 5%)

R1	470R
R2	12k
R3	5k6
R4	27k
R5	39k
R6	1M
R7	1k5
R8	470k
R9	100k
R10	150R

CAPACITORS

C1	220u 35V electrolytic
C2	1000u 25V electrolytic
C3,4,10	100n polyester
C5,6	10u 25V electrolytic
C7,13	220n polyester
C8	470n polyester
C9	10u 16V tantalum
C11	10n polyester
C12	47n polyester
C14	100p polystyrene



Overlay for digital thermometer

POTENTIOMETERS

RV1	5k Multiturn Bourne type (Doram: 62–701–4)
RV2	1k Multiturn Bourne type (Doram: 62–700–7)

SEMICONDUCTORS

BR1	4 pin DIL type: 0.9A 400V (from RS stockists), or other types, ie W04 will fit.
REG1	±15V regulator (Doram 65–360–0)
REG2	7805
IC1	LM3911 (see 'Buy Lines')
IC2	ICL 7107 (see 'Buy Lines')
LED1	TIL209 or similar
DISPLAYS	3 DL707 or similar (see text for mounting unit)
ZD1	4V7 400mW zener

TRANSFORMERS

T1	240V: 0–15V, 0–15V 6VA (Doram 66–113–5)

CASE

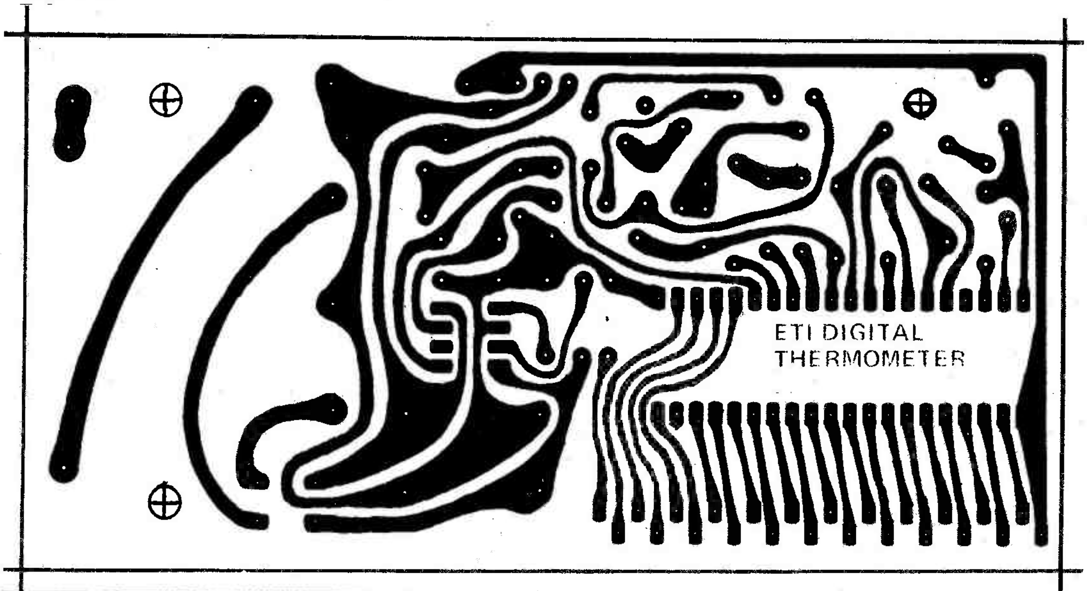
VEROCASE tpye 75–1238D

PROBE

¼" mono Jack plug, Japanese type (see text)

MISCELLANEOUS

PC board as pattern. 5 pin DIN plug and chassis socket.
3 core mains flex, screened lead, nuts, bolts, etc., insulator kit for REG2, connecting wire, grommets.



Foil pattern shown full size (138 x 70mm).

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- * **Smoother running**
- * **Instant all-weather starting**
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Because of the superb design of the Sparkrite circuit it completely eliminates problems of the contact breaker. There is no misfire due to contact breaker bounce which is eliminated electronically by a pulse suppression circuit which prevents the unit firing if the points bounce open at high R.P.M. Contact breaker burn is eliminated by reducing the current to about 1/50th of the norm. It will perform equally well with new, old, or even badly pitted points and is not dependent upon the dwell time of the contact breakers for recharging the system. Sparkrite incorporates a short circuit protected inverter which eliminates the problems of SCR lock on and, therefore, eliminates the possibility of blowing the transistors or the SCR. (Most capacitive discharge ignitions are not completely foolproof in this respect). All kits fit vehicles with coil/distributor ignition up to 8 cylinders.

THE KIT COMPRISES EVERYTHING NEEDED

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Mk. 2 Ready Built Positive Earth @ £14.97	
Ignition Changeover switches @ £4.30	
R.P.M. Limit systems in above units @ £2.42	

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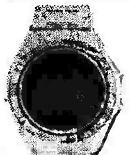
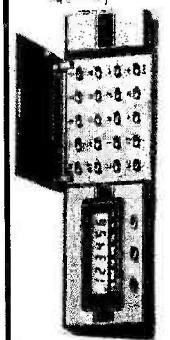
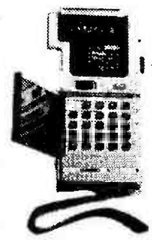
We still have some PAPERMATE pens to give away, so if you spend over £20 on any CASIO products, we will give you a brushed chrome pen worth £3.95. ALSO SEE BELOW. **LOOKING FOR A WATER RESISTANT WATCH WITH STOPWATCH?** Wait until you see our new range. They should knock spots off all the competition. Details next month, or S.A.E.



SUPERB CASIO CASIOTRON WATCHES
Constant LCD display. 8 functions with backlight. All stainless steel cases, battery hatch, water resistant to 130 feet. Many with **STOPWATCH** to 13 hours — not 15 minutes like some watches! Many have **DUAL TIME ZONE** facility as well. One battery lasts around 15 months or more. Display can be easily renewed at minimal cost. Rapid second correction. Rapid adjustment facilities. Easily adjusted bracelets. Presentation box.
R16B (left) **£34.95** R.R.P. £59.95.



CASIO MQ-1. ½ x 1¼ x 4¾ inches, 1.4oz.
Clock. L.C.D. display of hrs., mins., secs., AM/PM.
Calendar. Day, date, month, year.
Stopwatch. Normal and net times to 24 hrs.
Timer. 24 hr. clock, or countdown.
Calculator. Time and Date caculations.
Two tiny batteries last around 18 months.
£34.95. RRP £39.95 (left).
CASIO ST-1. 1x2⅞x5⅛, 4.8oz. Four stopwatch functions 1/10 sec. to 10 hrs.
Standard. Start/stop. **Time out.**
Lap-1. Accumulative lap times.
Lap-2. Individual (Taylor Split) lap times. TOTAL time button.
Calculator. Time calculations. Full access to memory. Sq. roots. Seven % functions. Bright digitron display. 17 hrs. battery (AA).
(Right) RRP £29.95. **£24.95**



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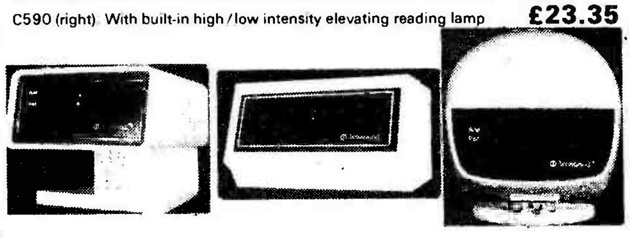
WAKE UP TO TIMEBAND. Precise timekeeping. Solid state reliability and silent running. 9 minute snooze features. Alarm on and mains fail indicators. C500 and C590 can be synchronised to the exact second and will display last minute digit and seconds.

C500 (left) H. 3⅛" x W. 3¾" x D.3⅜". Black or White	**£14.35**
C6110 (centre). As C500 with more sophisticated controls. White only	**£15.90**
C590 (right). With built-in high/low intensity elevating reading lamp	**£23.35**



ACCURIST. New slim quartz analogue (stepping motor) watches. Four basic functions, luminous. Stainless steel/gold plate on strap/bracelet. RR Prices around £50.

CITIZEN. Once the same company, Citizen and Seiko are the two biggest watch manufacturers in the world. We now stock 22 models of these superb quartz analogue and digital watches. **PRICES ON APPLICATION**

NEW FROM IBICO

Swiss made quality watches, water resistant to 100ft (3 at), mineral glass faces.
451 ES CHRONOGRAPH (left) 6 digit LDC display, 6 functions, backlight and stopwatch 1/100 second to 1 hour. Net and lap times. Slim, all stainless steel case and bracelet. **£49.95**
451 ELB (not illustrated). As above but with water resistant leather strap. **£48.50**
406 MS. 6 digit display, 6 functions, light, s/s back and bracelet. **£34.95**
406 MLB (centre). As above but with water resistant leather strap. **£33.95**
700 ANALOGUE (right). 4 basic functions, stepping motor. Tritium night illumination, electronic sound corrector, battery life around 3 years (1000-day module). **£29.50**

SPECIAL OFFER. Buy any of the watches listed below (few left only) and we will give you a PAPERMATE gold plated pen and pencil set (or two pens) worth **£11.40.** **Timeband** TC410 (Gold Plated) £27.95. **TC412** (G.P.) £31.95. TC413 £28.95. WITHOUT PEN DEDUCT £6. **National Semiconductor** DAC5WS £22.90, DAC5YS £25.90. DAC5WB. £24.90. DAC5YB £28.50. DAB5WB (all stainless) £32.50. DAB5YB G.P.) £36.50. **Ibico** 402 ELB £39.95. 402 ES £39.95. 405 ILB £33.50. 405 IS £33.50. Casio S14B (XI-World time, stopwatch, counter, time memory, RRP £129.95) **£69.96.** R19 £29.95. **Decimo** quartz £37.50. **Instar** 2½ functions LCD gold plated and bracelet **£15.50.**

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IBICO 065 LCD. Slimline Executive. Full memory √, %. Long battery life. **£14.80.**

OPTIM. Quartz car clock. Red LED digits come on with ignition. AA approved **£19.95.** Cathedral lounge/alarm clock. Metal case, triangular section. Green ½" display, snooze feature, 2¾x6½x3 inches. Gold/black or silver/black. 2 yr. guarantee. **£19.95.** Optimsport/Technigraph TV games. Four games, variable bat, angle, speed. Remote controls, three sound effects. Mk 1 B/W £24.50, Mk. 1 C, colour £29.95. Mk. 4 Horizontol and vertical bat movement £37.50. Mk. 15C, With gun. 6 games £47.50.

Offers subject to availability. All items advertised are in stock or on order at copy date.
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am stereo

FARCICAL OR FEASIBLE ?

STEREO BROADCASTING is generally associated with FM probably because that's the way it's been transmitted up to now.

But it's perfectly feasible to transmit a stereo programme using modified AM transmitters and receivers. In fact five American-designed systems are being evaluated right now by the USA's National AM Stereo Committee whose subsequent report will be studied by the FCC later this year.

AM stereo broadcasting has the same inherent limitations as AM mono — that is a bandwidth restricted to less than 10kHz. Thus the full audible frequency range can not be transmitted and it is for this, amongst other, reasons that FM transmission is used for high quality stereo broadcasts.

Protagonists of AM stereo accept the limitations inherent in AM broadcasting but point out that the market audience they seek is not the purist FM stereo listener but the 'man-in-the-street'. they say that paople are now so aware of stereo that mono reception is anachronistic, and that if AM stereo could be introduced at sufficiently low cost it would be absurd not to do so.

The main attraction of AM stereo *is* low cost. In fact it's possible to modify an existing AM transmitter to

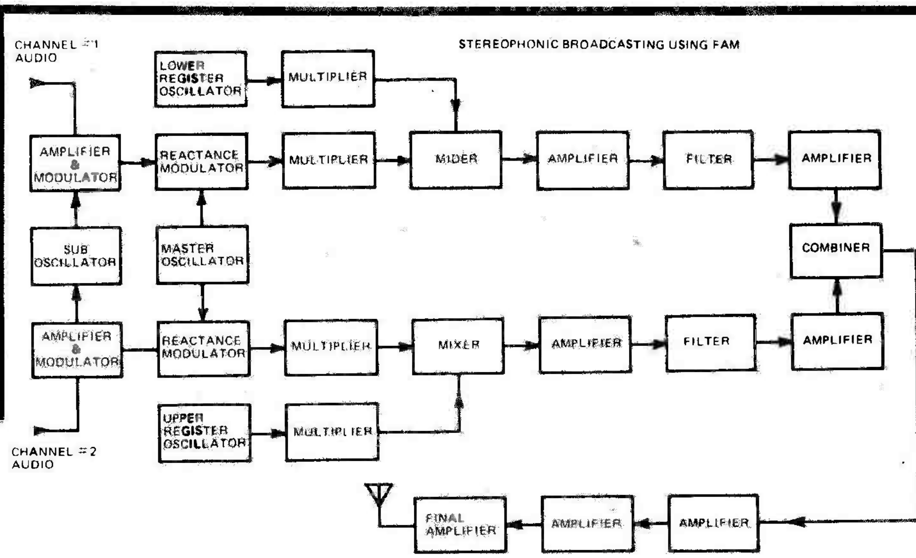


Fig. 1. The Comm Associates transmitter system uses dual RF-modulator paths, one for the upper subcarrier and one for the lower. Matrixing of L and R signals is not necessary.

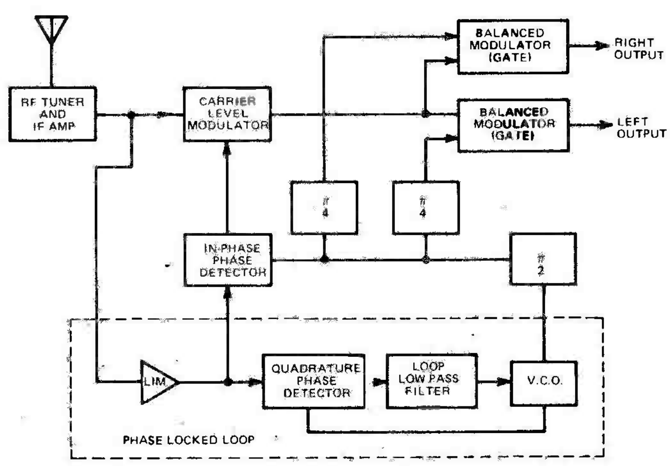


Fig. 2. Motorola's receiver employs both in-phase and quadrature phase detection. In addition, a phase shift system removes cosine modulation inserted at the transmitter.

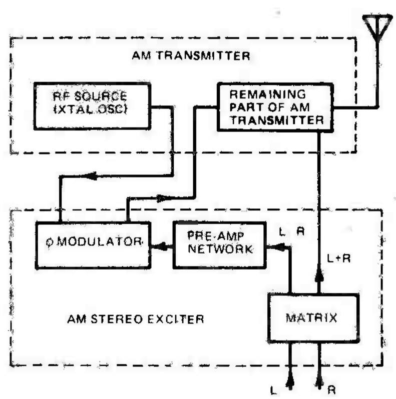


Fig. 3a. The block diagram shows how the L + R and L — R signals are routed through the Belar AM stereo transmitter.

am stereo

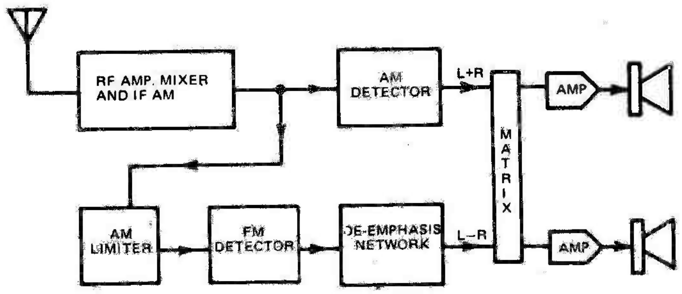


Fig. 3b. The Belar receiver has two IF paths, one to a normal AM detector, and one through limiter stages to an FM detector.

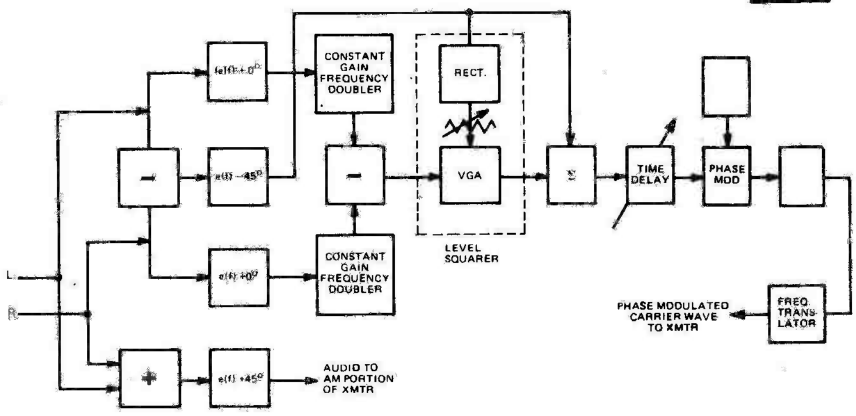


Fig. 4a. In the Kahn transmitter, the L – R signal phase modulates RF from a crystal oscillator. The L and R signals are carried by separate sidebands, and are picked up on a receiver equipped for phase detection.

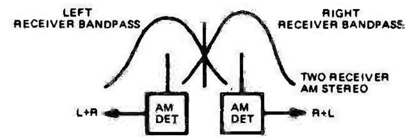


Fig. 4b. The stereo signal from the Kahn transmitter can also be picked up by two mono receivers, one tuned a little high, the other a little low.

stereo operation for well under £6000. Certainly a low power FM transmitter costs not a great deal more, but it's a different matter for the big 100kW plus systems.

Most broadcasting studio equipment is stereo — certainly all modern recording machinery, cartridge players, record players are so made, as is the majority of programme material.

Stereo AM receiving equipment could be inexpensive. Many potential AM stereo listeners already own a record player which could accept an input from an AM stereo decoder. And even if a complete AM stereo receiver were to be required, such could be built for very little more than the cost of it's AM mono equivalent (and would of course offer a whole new market for manufacturers!). Let's consider the five major systems being proposed:

COMM. Associates:

This is probably the simplest proposed system. It is quite different from the other four. The system is called 'Frequency Approach Aperture'; the left channel modulates a carrier just below the main carrier, and the right channel

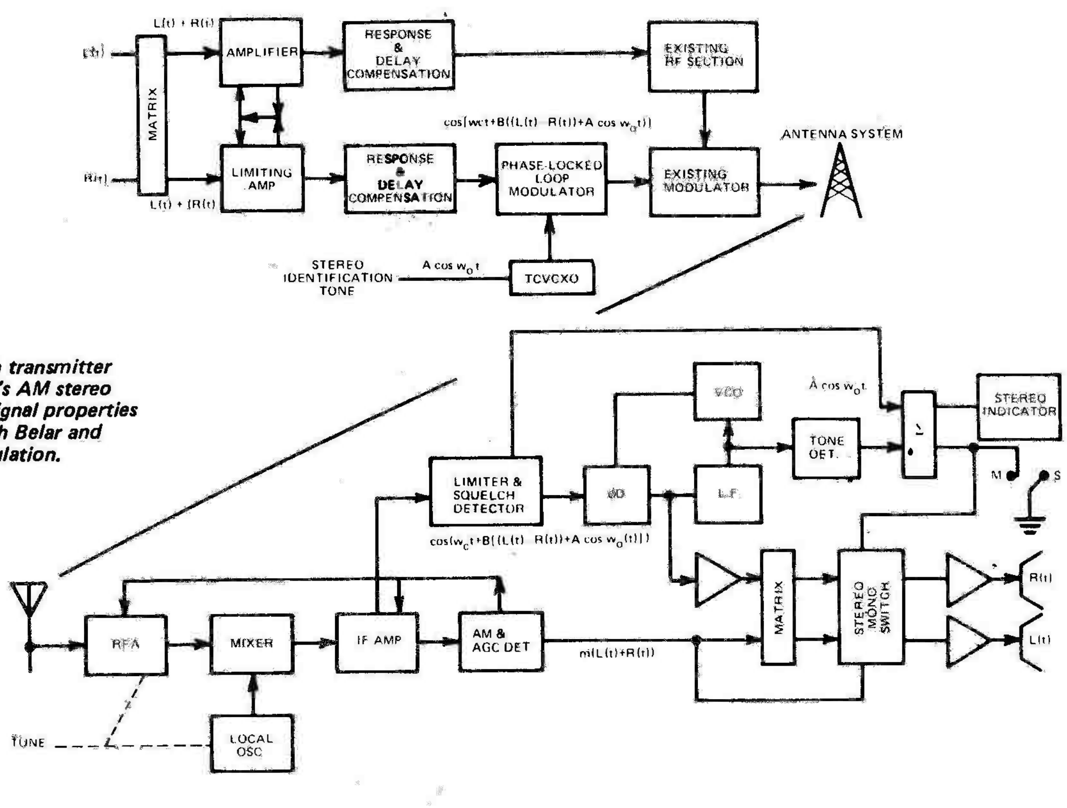


Fig. 5. Block diagram shows both transmitter and receiver stages for Magnavox's AM stereo design. The formulae detail the signal properties at various stages. In common with Belar and Kahn, the system uses dual modulation.

modulates a carrier just above the main carrier. The combined signal goes to a band-pass filter which seperates out the upper sideband of the lower carrier plus the lower sideband of the upper carrier (Fig. 1). The output from the bandpass filter is the transmitted signal.

The simplest way to receive the Comm. signal is via two AM receivers — one tuned to the upper sideband, one to the lower sideband! A more elegant way is to use a receiver in which the two signals are separated by filters and then passed on through two separate IF strips and demodulators.

It is important to note that this is not a matrix system. Claimed advantages are good noise characteristics, excellent fidelity and all the well known advantages of supressed carrier single-sideband transmission.

Motorola:

This system uses circuitry vaguely similar to that used in colour TV transmission. The system called 'C-Quan' uses two carriers operating at the same frequency but separated by phase quadrature. Motorola say that a major part of their design is in the elimination of distortion caused when the stereo signal is being received on mono receivers, this distortion apparently caused by some interaction between modulation components. This problem is overcome, claim Motorola, by modulating both the in-phase and the quadrature components by the cosine of the modulation angle.

Motorola's 'C-Quan' receiver is shown in the lower part of Fig. 2. As may be seen, the IF travels along two separate paths, one to an in-phase detector, the other to a quadrature detector. Further elements then remove the cosine term (generated in the transmitter). Finally, the two channels pass through synchronous detectors which recover the left channel and right channel signals.

Belar:

Originally described and demonstrated by RCA. Belar Laboratories propose a matrix system in which an L+R signal amplitude modulates the transmitter just as in mono transmission, while the L—R signal is processed so as to frequency modulate an RF carrier which in turn modulates the transmitted AM signal.

The transmitted carrier thus contains both AM and FM sidebands. The FM sidebands contain the stereo information (i.e. the L—R signal) and the AM contains the L+R signal — the latter of course being totally receivable on any standard unmodified AM mono receiver.

Belars proposed stereo receiver is shown in Fig. 3a and b.

Kahn:

Although more complex than the Comm. Associates proposal Kahn Communications' system is equally as elegant. Here the carrier is phase modulated with the L—R signal and then amplitude modulated with the L+R signal. Some very sophisticated circuitry is used to produce the resultant carrier which has the left channel on one sideband and the right channel on the other.

The transmitted signal can be received in various ways. A normal mono AM receiver tuned right onto the carrier will receive the normal AM envelope (the L+R signal). Stereo reception can be obtained either by using a receiver with phase detection for separating out the L+R and L—R signals — or by using two separate mono receivers (or circuits) one tuned slightly above the carrier, the other slightly below.

The Kahn system has been quite thoroughly tried and proven by stations XETRA (Mexico) and WFBR (Baltimore). Apparently the results were excellent with good freedom from interference, and excellent mono and stereo reception. Over 15 dB separation was achieved merely by using two mono receivers, and well over 35 dB using the phase detection.

Magnavox:

This system is similar in some ways to those of Kahn and Belar. Magnavox amplitude modulates the L+R signal and phase modulates the L—R signal. A 5 Hz tone frequency modulates the carrier to provide a reference for a wide-band phase-locked loop which generates a phase-modulated signal. This signal is in turn modulated by the L+R signal before transmission.

The receiver consists of a single IF strip the output of which is then split and passed to an envelope detector (for the L+R signal) and to limiters and a phase-locked loop which demodulates the phase-modulated (L—R) signal.

Wait and FCC

At present there is no clear indication from the FCC that AM stereo broadcasting will be introduced at all — let alone any particular system. But the proposals are being taken very seriously by the FCC as well as by the companies involved. And unlike the four channel fiasco in which the manufacturers of four competitive and non-compatible systems fought to establish a hold in a largely disinterested market, AM stereo will, if adopted, be backed by the FCC — who will also determine which system will be used.

keep on the straight and narrow with

SPIRIT LEVEL

AN ETI PROJECT TEAM DESIGN

IN ORDER TO DRIVE a car safely your mind must be clear, and your reaction to situations as sharp as possible. Drink not only dulls the brain, but slows reaction time as well. Unfortunately it also seems to make most drivers over-confident of their ability to drive correctly, usually with the result that they get 'bugged' by the police — and rightly so!

What we are offering here is a simple method of proving to someone, especially yourself, that those 24 pints HAVE had some effect after all! Although the device operates by demonstrating an increase in the time taken to react to a given stimulus, it is *not* meant as an accurate 'reaction timer'. and should not be treated as such.

Field testing our design. Well it's a good excuse anyway . . . isn't it? Working around the table; in the background we have the landlady of our favourite pub, to the left of her is Gary Evans Editorial Assistant, Ron Harris Assistant Editor and actually holding the evil machine Diego Rincon our new Art Editor.

Down In Nine

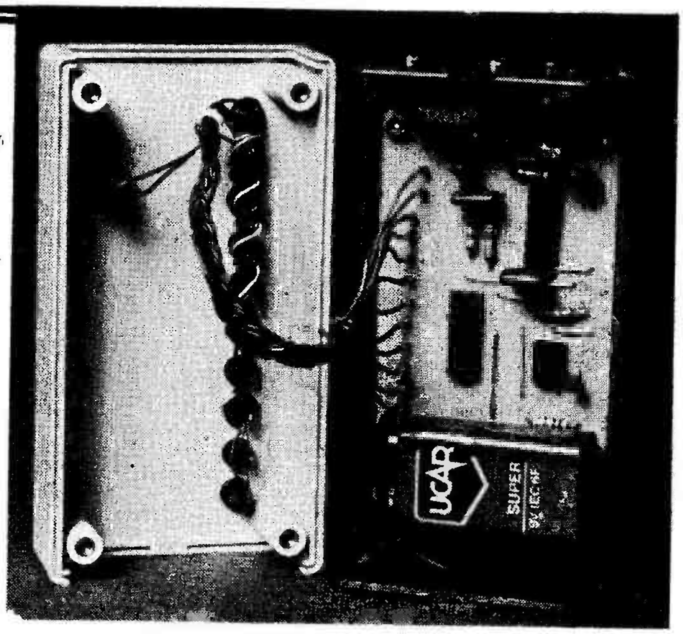
To use the Spirit Level, switch on and press the reset button. After what seems like an hour (actually about 8 seconds) the light will begin to 'move' rapidly up the column of LEDs as the circuit cycles through. When it reaches the top, it will stop there. Your task is to prevent it reaching '9'. Pushing the 'Stop' button holds the LED on whatever number it was passing through at that instant.

So the more you drink, the slower you will be able to react, and the higher up the column will rise the glow (if you can't stop it at all before it reaches the top — put a pillow on the floor quick, you're about to pass out!). With component values as we have them, it takes about 0.4 seconds to cycle from 0 to 9.

Originally we had a shorter 'wait' period before the oscillator was switched on, but this was too easy to anticipate — any longer and it becomes boring. Slower cycle times are not a good idea, since there will then have to be a greater effect to make any difference to the score. Make it quicker by all means — see 'How it Works' for the relevant details if you intend to meddle!

Half And Half Pint

Take a reading before you touch the ale. We found the average to be 3 or 4 (in a sober condition!). As the evening progresses and the number of pints rises, so will your score. Even one pint, if given time to be ingested, can take away that 'edge', and add one to your score. If you were averaging 3 half an hour ago, and now can't do any better



Left: Our most unusual subject! Long John here insisted (by flapping his wings and squawking at 100dB) upon his turn. He failed. Maybe he couldn't find the button, the smell of alcohol was too much for him.
Right: Internals and all that. Layout within a box of this restricted dimensions is somewhat critical! Our PCB and a PP3 will live in harmony within the Verobox specified. The six links on the board can be clearly seen here — make sure you don't miss any of them out when wiring up

than 6 you're only half the driver you were!

Now before our readers condem us as converts to Alcoholics Anonymous, let us add this was conceived as a 'fun' project and remains so. Drinking and driving is never a good idea, and you'll get much more fun out of the game if you *don't* have to play it in earnest to avoid being breathylised.

Construction Points

The only problem to be faced in construction of our Spirit Level is that of keeping the size down sufficiently to make it portable. Why oh why does *nobody* produce a decent small box to fit a PP3 and a PCB?? The vero box we employed is *nearly* ideal, but a few millimetres more would allow the battery to slot in sideways, and make the box much more versatile. Anyway, gripe over.... back to work. Build up

HOW IT WORKS

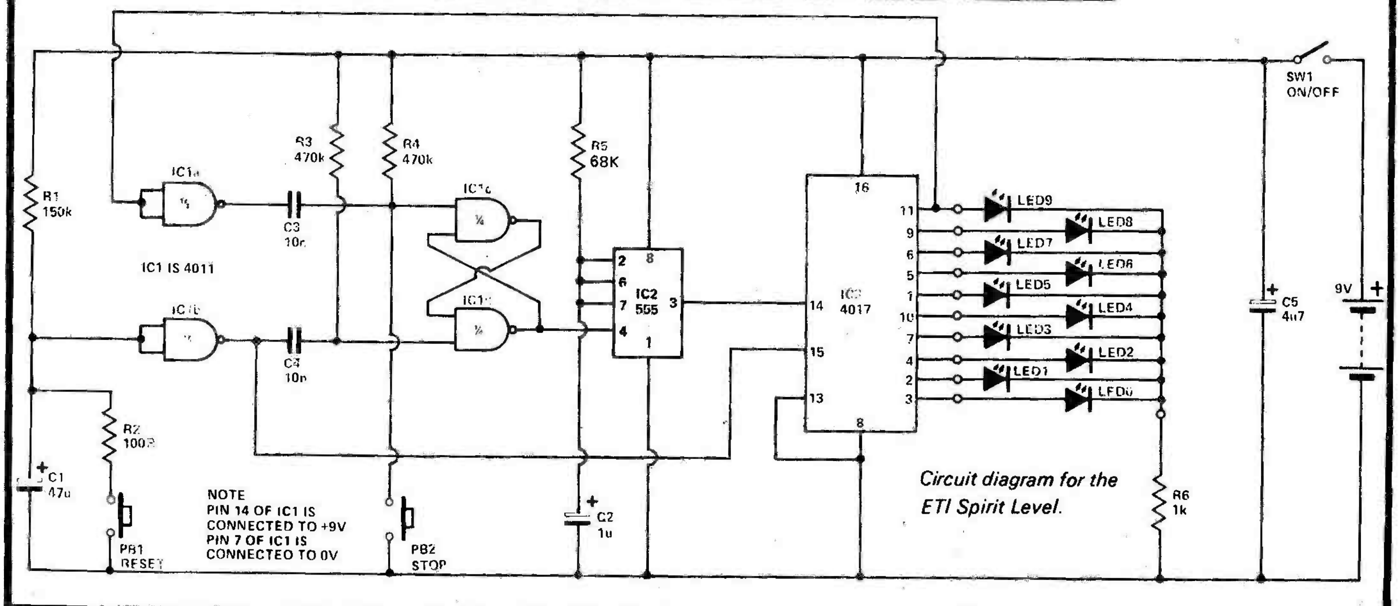
The LED display column is driven from the output of a 4017 CMOS decoder. This counts and outputs, in decimal form, the input pulses presented to pin 14.

These are produced by IC2 a 555 wired as an astable. Timing period for this is determined by R5 and C2 according to the formula t=1.4RC.

IC1c and IC1d are wired as a toggle circuit,normally holding the reset pin low so that operation is inhibited. Upon switching on C1, starts to charge through R1 giving the time delay to avoid anticipation on the part of the player. After about 8 seconds IC1b's input goes high, the output goes low and the toggle action takes the 555 reset, pin 4, high so that the oscillator will run.

IC3, the 4017, will count the pulses until output 'a' is enabled. Normally the chip would recycle to nought and start again. However the connection to the inverter, IC1a will reset the toggle and stop the astable by forcing the reset pin low.

Pressing the reset button PB1 takes IC3 reset to zero and sets the toggle back to inhibit. The 'Stop' facility is provided by PB2 and R4 which reset the toggle by halting IC2.



Circuit diagram for the ETI Spirit Level.

This is what our box looked like when we'd finished it. It might be advantageous if the "o" LED was spaced away from the remaining column, so that it indicates a "waiting" mode rather than anything else.

the board as per the overlay, keeping components as close to the PCB as possible. Leave the ICs until last or, better still, use holders, low profile versions of which should just go in. As the chips are CMOS — watch it when handling them.

Keep all wires to the LEDs as short as you reasonably can so that when the box is closed up too much strain is not placed on the components inside due to overcrowding. Refer to the internal photograph to see how our workshop layed theirs out if you are in any doubt or trouble.

Before switching on, check the polarity of the LED column, and the orientation of the chips, it can be an expensive 'short cut' not to bother!

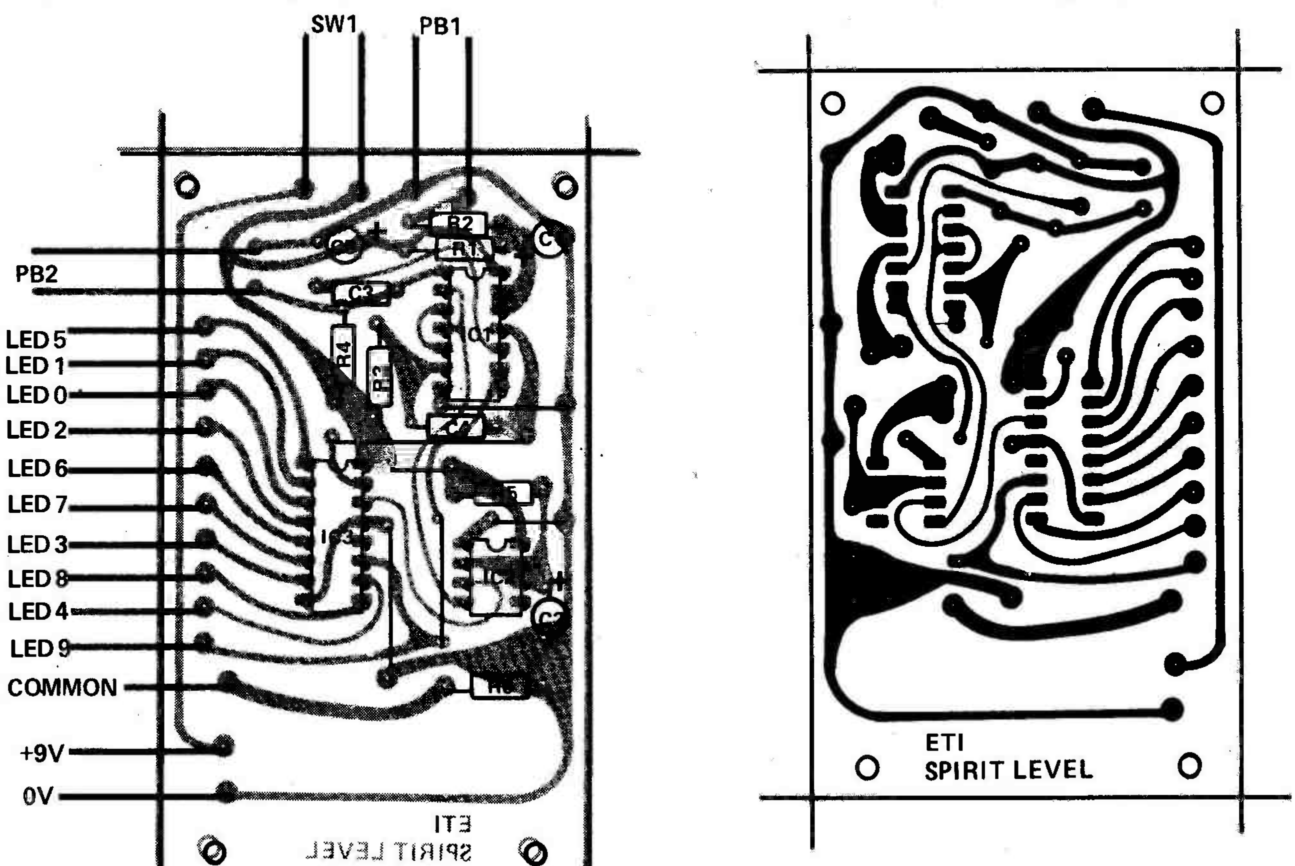
Getting The Bird

People's reactions to the Spirit Level can be quite hilarious, especially after a few 'jars'. We found disbelief and accusations of cheating to be the most common. For some reason our prototype possessed the property of attracting the pub parrot who insisted on his turn! He failed misrably, so if your driving home tonight and see a car driven by a parrot heading for you — not only are you sloshed, so is he! ●

Our thanks go to the landlord of ETI's local, The Black Horse in Rathbone Place, for his patience and loan of his pub (and parrot!).

PARTS LIST

RESISTORS		C2	1u 16V	SWITCHES	
R1	150k	C3,4	10n polyester	PB1,2	push to make single pole.
R2	100R	C5	4u7 16V		
R3,4	470k			SW1	rocker action single pole
R5	68k				
R6	1k	SEMICONDUCTORS		TEST GEAR	
		IC1	4011	1 barrel IPA draught bitter	
		IC2	555	2k5 bottles high stability Scotch	
		IC3	4017	5 litres Vodka (high tolerance)	
CAPACITORS		LED1-9	TIL209	1 Parrot (optional)	
C1	47u 16V		or similar.	1 Drunk (obligatory).	



Overlay and full size foil pattern for our Spirit Level.

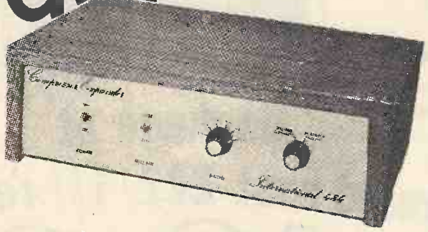
What to look for in the November issue: On Sale October 7th

Programmable Calculator Survey

AS MOS techniques have become more and more refined, each LSI chip has been capable of containing ever more circuitry, and this is most evident in the field of calculators. Even a couple of years ago, all programmable calculators were ultra-high price, specialist luxuries. Now you can buy one for around £16. Next month we're taking a serious in-depth look at some leading examples of the intelligent button-box. Prices of the machines included wind their way up to £100 or more — but more money does not necessarily mean more machine power.

Or does it? Find out next month.

Compander



THIS IS our second venture in this field, and is prompted purely by the success of the first. This is a "scaled down" version using the NE571 chip but offering performance comparable to our more complex and costly design. A must for serious hi-fi fans.

Digital Clock Plus

NOT JUST ONE clock, but as many as you like! Complete construction details for a whole range of options — choice of display between LED and fluorescent, 4-year calendar, *two* independent alarm times, forward and *reverse* time setting, battery back-up, three function "wake-up" outputs, snooze and sleep, time zone (updated) register, 12/24hr display seconds display . . . instead of us filling up the page with all these features, why not read it yourself next month in ETI?

LED Pendant

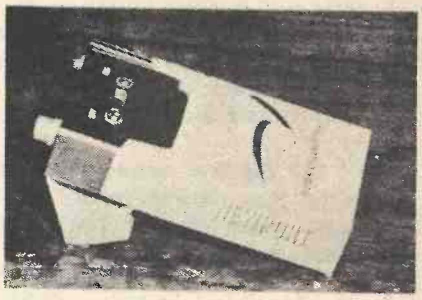
BEING AN ETI reader, it is almost inevitable that you are highly attractive to beautiful women. Problem is these delicious creatures are rarely tolerant of what they regard as, a crumby, strange hobby: electronics.

Amaze your girlfriend(s), wife, mother, mistress(es), sister or granny and build them a piece of electronic jewellery (it costs far, far less than they will imagine, a quality of all good presents). Just touch the pendant and their initials flash up in sequence on a 7-segment led and then turn off (it can't handle some initials).

LCD Calculator Offer

A REALLY NOVEL, just released, calculator from CBM at a 26% saving over regular price: the LG5K. It's not the facilities that'll bowl you over — though they inclue a 4-key memory, % and square root facility — but the extraordinary battery life which alone could save you the cost of the calculator in just over a year. Leave it on continually and CBM guarantee battery life of 5000 hours (that's nearly 7 months in English). It's also incredibly thin (6mm) and no bigger than a normal diary. It's an unusual ETI offer but we're sure you'll find it exceptional value at £10.95, only from ETI.

BUGGING



This bug, built into a cigarette packet, has a range of 200 metres.

DID THE British Secret Service bug No 10? Frankly we don't know but bug technology is a fascinating subject and extremely sophisticated.

Next month we take a look at bugs, bugging and how they're "swept" using high technology.

The photograph above shows one commercial bug which will fit into a cigarette packet.

SKEET

TO BE ENTERTAINING, an electronic game should require a fair amount of skill with perhaps a sprinkling of luck. Our "Skeet" project next month satisfies both requirements.

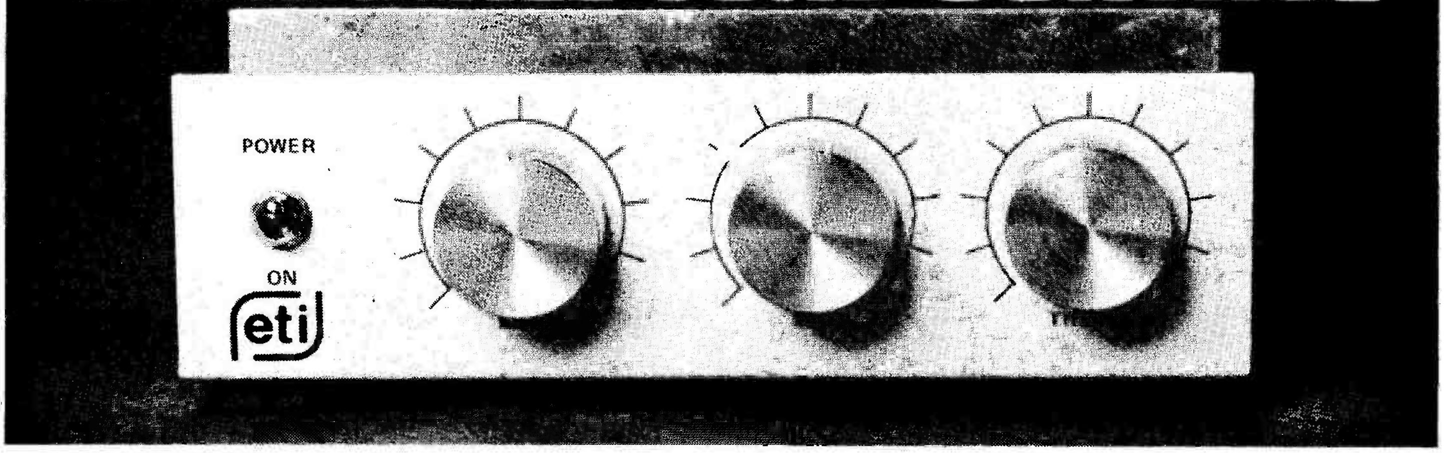
Using only a handful of components, a line of leds represent the flight path of the skeet, the object of the game is to "bag" it as it flies past a fixed marker. Simple? Don't you believe it till you try it.

Noise Reduction Systems

DOLBY, DNL et al are now widely used in sound reproduction but are surprisingly poorly understood.

The articles described here are in an advanced state of preparation but circumstances may necessitate changes in the issue that appears.

3 CHANNEL TONE CONTROL



WHEN LISTENING to your favourite L.P., if your hi-fi system were perfect, if your listening room did not colour the speaker's output and if your idea of balance coincided with that of the recording engineers — there would be no need for a tone control.

The perfect world alluded to in our first paragraph does not, unfortunately, exist as anyone over 21 (inches or months) will readily testify to. This means that in most cases some form of tone control is a desirable, if not essential, item in any amplifier.

HOW IT WORKS

The input signal is fed via SK1 to the first active stage built around IC1. This is configured as a non-inverting amplifier whose gain is set by the ratio of R3 and R1. In this case the gain is set at unity. This initial stage is required to isolate the following stage from any loading effects.

The O/P from ICI is fed via three frequency shaping networks to IC2. The three networks built around RV1, RV2, RV3 are also included in the feedback path of IC2, another inverting op-amp stage.

The components associated with the three variable resistors are chosen to give the required frequency control.

Tone of Voice

A tone control will alter the relative levels of the different frequencies present in any signal passed through it. In most designs the audio spectrum of frequencies falls into two bands, bass and treble, and will either boost

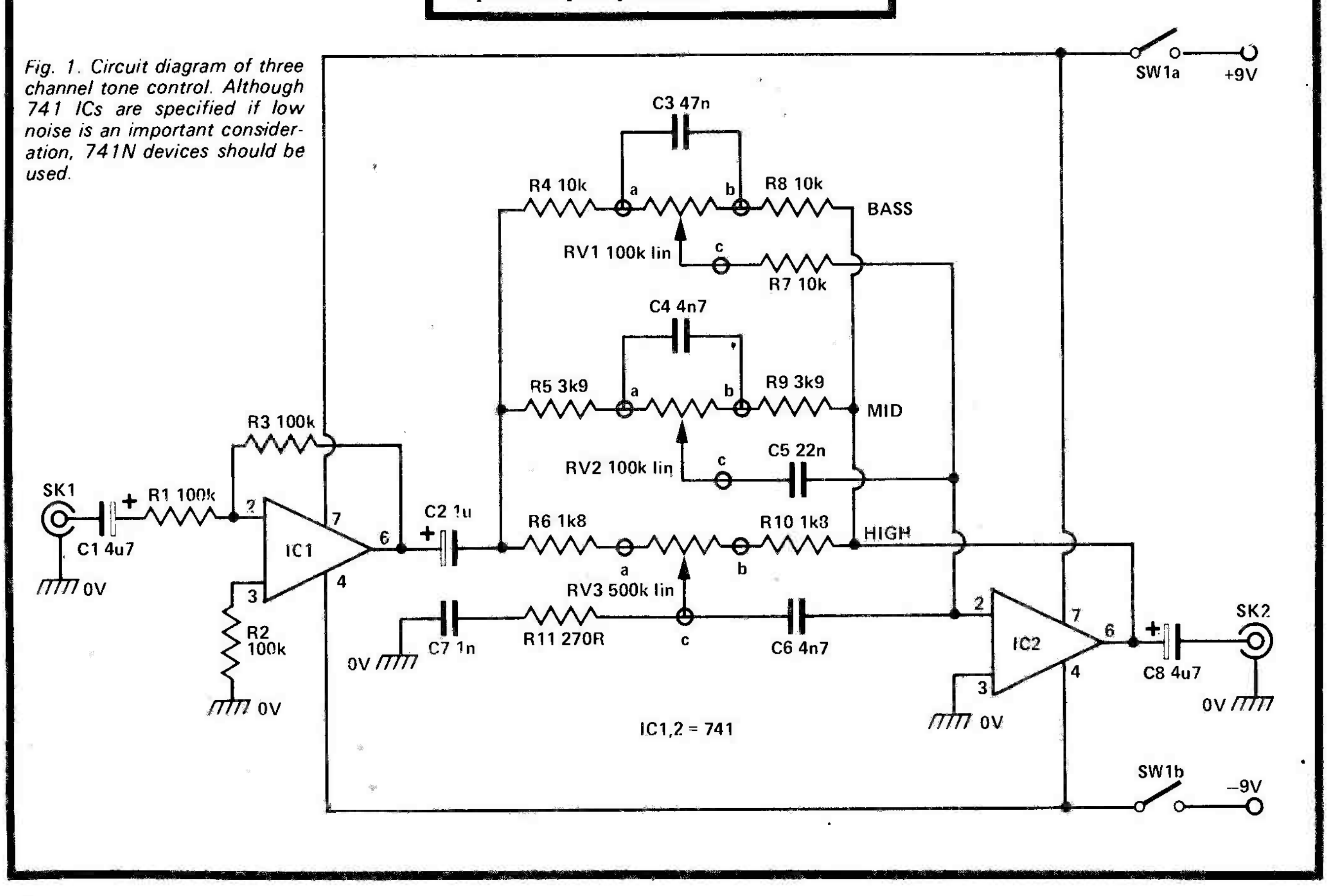


Fig. 1. Circuit diagram of three channel tone control. Although 741 ICs are specified if low noise is an important consideration, 741N devices should be used.

or cut these with respect to the mid-frequencies. A graphic equaliser, which is after all just a tone control with lots of channels, splits the audio frequencies into ten or more bands and allows each of these to be boosted or cut.

These two examples represent the extremes of tone control designs, the two channel unit not providing enough control while the equaliser represents expensive overkill in a lot of cases.

Voice of Tone

Between these two extremes comes our three channel control. Bass and treble functions are as most tone controls while the mid, or presence, control provides a means of controlling the mid-frequencies.

These frequencies, which are not affected by the controls of two channel units, have a large effect on the 'colour' of the sound. This is because the fundamental frequencies of many instruments, and indeed the human voice, lie in the range of frequencies covered by this mid control.

Assembly Point

Mount the components on the PCB as per the overlay diagram, paying particular attention of the ICs and electrolytic capacitors which must be correctly orientated.

Mounting of the PCB is largely a matter of personal taste. Our prototype was mounted on a chassis but it may easily be incorporated in an existing piece of equipment.

The power supply in the prototype was provided by two 9V batteries but any well smoothed 9-0-9V supply could be used.

We built our unit as a mono control and if stereo operation is required two boards will have to be used with either separate, or perhaps, ganged pots.

Toning Up

If the unit is built as our prototype, and not incorporated in an amplifier, it should be connected between the existing preamplifier and the power amplifier.

After that it's a question of switching on and twiddling the knobs until the 'sounds' suit your particular tastes.

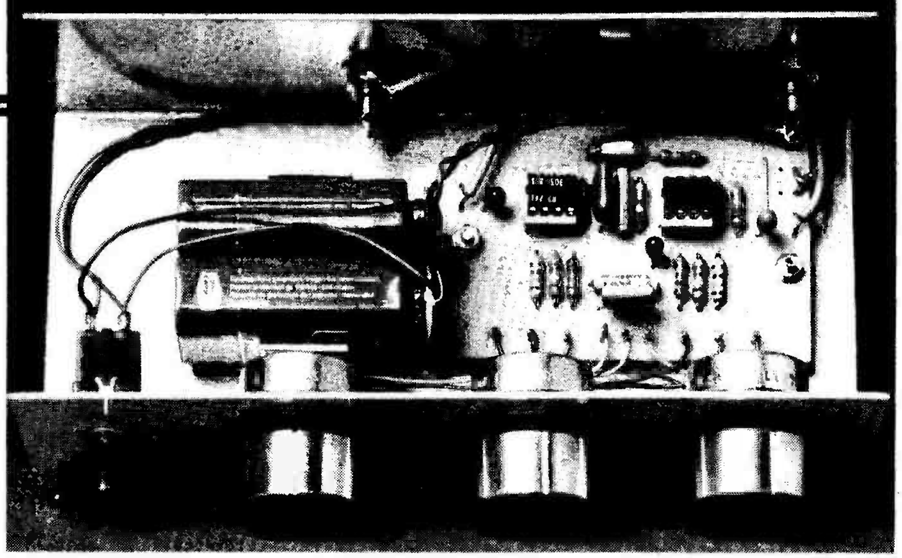


Fig. 2. The prototype was built as a mono version and mounted on an aluminium chassis. If built as part of an amplifier the battery power supply could be replaced with a well smoothed 9-0-9 mains PS.

BUY LINES

The components used in this project should be available from most component shops and are certainly available from any of the large mail order suppliers.

The integrated circuits specified are standard 741 types. However, should a lower noise version be required 741N types could be used.

PARTS LIST

RESISTORS all ¼ 5%

R1,2,3	100k
R4,8	10k
R5,9	3k9
R6,10	1k8
R11	270R

CAPACITORS

C1,8	4u7 25V electrolytic
C2	1u 16V electrolytic
C3	47n polyester
C4,6	4n7 polyester
C5	22n polyester
C7	1n ceramic or polystyrene

SEMICONDUCTORS

IC1,2	741 or 741N

POTENTIOMETERS

RV1,2	100k lin rotary
RV3	500k lin rotary

SWITCH

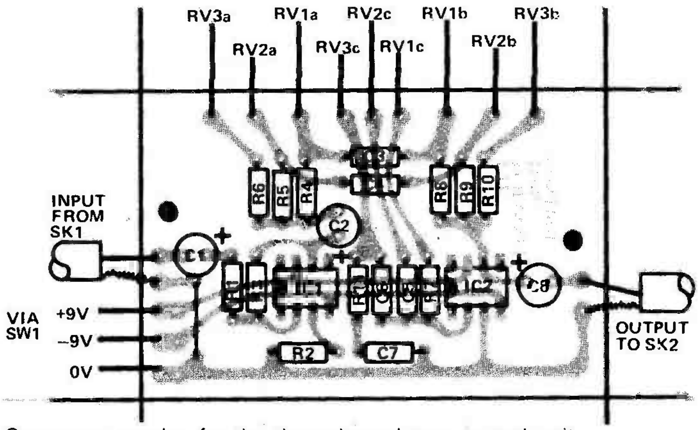
SW1	DPST miniature toggle

SOCKETS

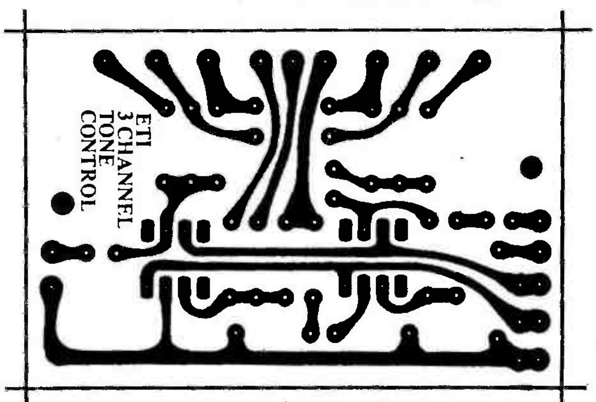
SK1,2	Panel mounting phono sockets or DIN sockets

MISCELLANEOUS

2 X PP3 Batteries, clips, knobs, PCB as pattern, nuts bolts etc., screened wire, connecting wire, chassis to suit application.



Component overlay for the three-channel tone control unit. Note if stereo version is required the boards may readily be mounted vertically above one another.



PCB foil pattern is shown full size (73mm x 48mm).

MICROFILE

Microman Gary Evans takes a look at algorithms and a video display device

IN ANY CROWD of people to whom you are describing the latest trauma experienced in the construction of your microcomputer system, there is bound to be someone who will interrupt and ask: "What are you going to do with it when it's finished?"

Cling on to your thread

If your only plans for the completed item are to give yourself the chance to tell Mr Spock where to put his photon torpedo in some grand bust up with the Klingons, it is best to keep this quiet. Answers like this will relegate the status of the home computer builder to the level of lower technology hobbies, such as playing with trains.

By far the best reply to such a question, the one which we most often use, is to say "for anything that you care to think of"

This reply has the overwhelming advantage of proving a reliable conversation stopper in most cases, allowing you to resume your narrative.

It is also by and large true. True because there are not many things that a micro, complete with the necessary hardware and software, could not tackle.

The applications in theory are endless, but in practice will be limited by the problem of designing the hardware. To describe the actions required to do the washing up would not be too difficult, but the machinery involved would be frightening.

Most of us will therefore be concerned with the data processing abilities of our system.

Process your sins

Now the word process covers a multitude of sins, from summing two numbers, to trying to convince your machine that it's Bobby Spasky (or is it Boris Starsky) manipulating pseudo chessmen within its midst.

To write the software in the former case should prove no problem but in the latter example it would be difficult to know where to begin. It is with problems like this that the algorithm helps.

An algorithm is a means of plotting the strategy of a problem, a tool to enable people to solve problems.

Most books on algorithms in the past have either been for the specialist, wanting to know about the latest research in the field, or for the beginner. This month we have come across a book which falls between these two extremes.

It is the Algorithm Writer's Guide, published by Longman. Its subject is how to write algorithms, ranging over many different types and forms. It is written with the designer of algorithms in mind.

We found this book interesting, showing us how we should set about analysing problems. What questions to ask, in what order and how to represent these on a flow chart. From a flow chart it should prove easier to get your machine up to grand master standard.

Lowering our standards

For some time now we here at ETI have considered modifying the line and field drive circuits of an old TV set to bring them in line (sorry) with the American specifications for these circuits.

Having had a look at some circuit diagrams it seems that changing a few capacitors, and possibly resistors, should be enough to complete the conversion. This would reduce the number of lines to 525 (from 625) and increase the field oscillator frequency from 50Hz to 60Hz.

The reason for wanting to perform this task is to enable us to use the many chips now appearing on the American market which can do wonderful things on a TV screen.

Seeing these devices advertised at prices that would make them cheap even after shipping charges, bad exchange rates, etc., but not being able to use them is becoming too much to bear for some of us at ETI.

The latest in this category is RCA's CDP1861. This is a graphic generator IC which enables a 256 byte segment of memory to be displayed on a TV screen.

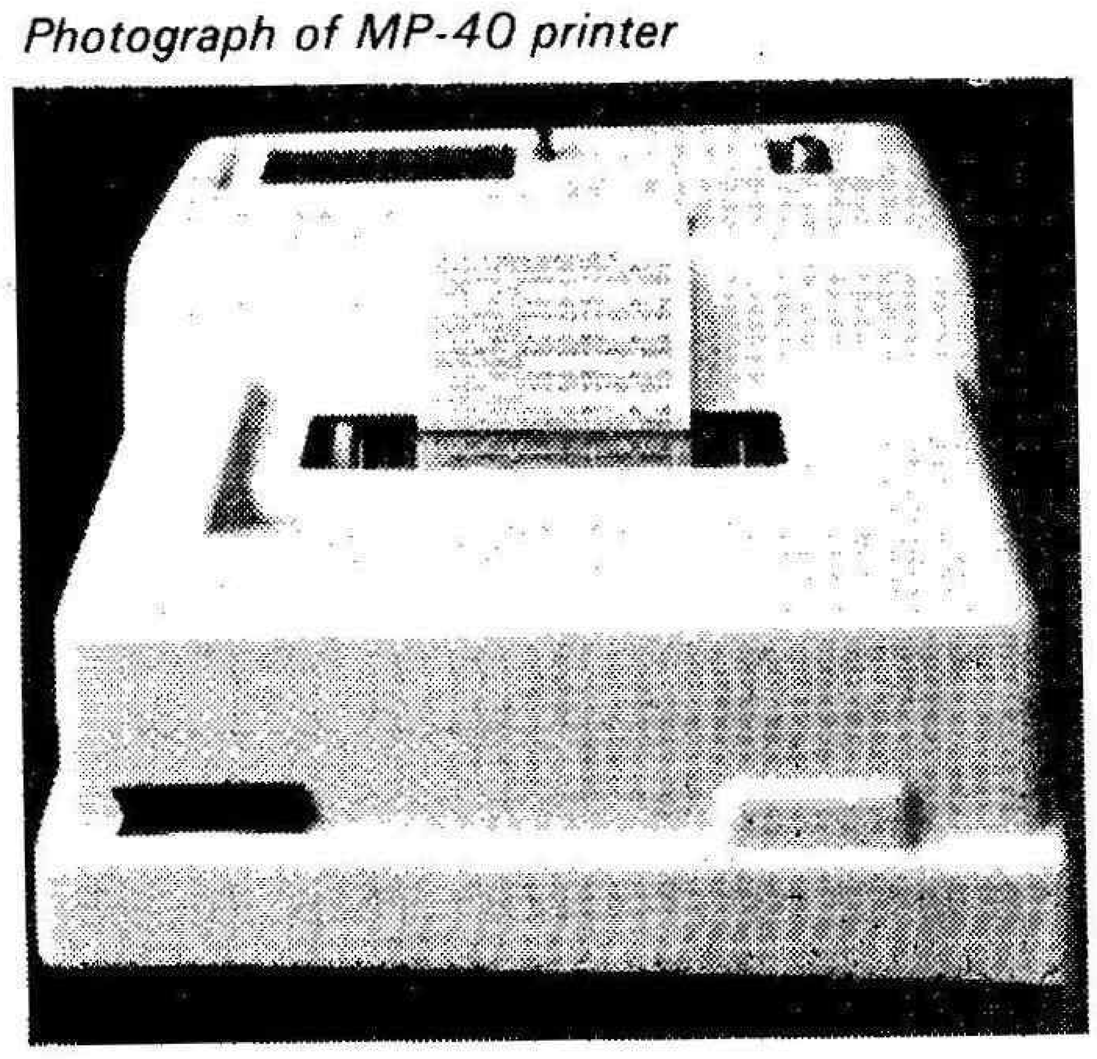
The chip is perhaps best thought of as a parallel to serial converter of a very superior nature, as its serial output is a 1 volt composite video/sync signal.

The 256 byte block of memory selected is interrogated by the 1861 using DMA techniques and the data displayed as a series of dots on the TV screen. If a memory bit is one the TV will display a white square, if the bit is zero, a black square.

With an external component count of three, and these only resistors, the 1861 will turn any US TV into a VDU (how about that for initialese).

RCA tell us that they are working on a souped up version of this chip for Europe, but when it will be ready is anybody's guess. In the meantime write and tell us what Crossroads looks like in 525 lines.

Photograph of MP-40 printer



Hard news —

Obtaining hard copy from a system is a problem faced by many people. With supplies of TTYs drying up, and many being difficult to interface to when obtained, there is a need for cheap hard copy devices.

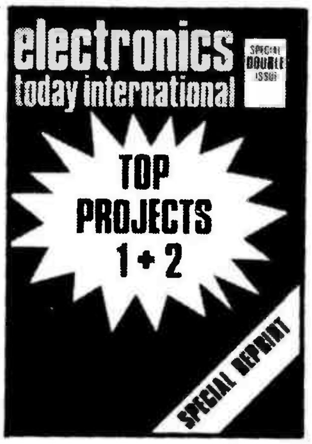
News of such a device has just reached us. It is the M-40 matrix printer, made by Romca Electronics, a Dutch firm with agents in this country.

The standard MP-40 printer contains a TTL level, bit parallel, character serial interface. It converts a six bit ASCII coded character into a 5 x 7 dot matrix alphanumeric set.

Also available are interfaces to allow RS232 or 20 milliamp current loop applications and another to provide direct software control of the print solenoids. This latter feature allows many special character founts to be printed.

Prices are from £150, and for further details contact Romca Electronics U.K., 7 Dordells, Basildon, Essex.

SPECIALS FROM ETI

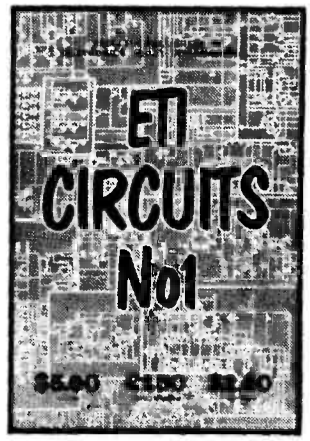


TOP PROJECTS No. 1 + No. 2

A massive 180 page book containing all the projects originally described in our first two Top Projects Books -- originally published in October 1974 and June 1975 -- which are now out of print.

Projects include: Master Mixer, 100W Guitar Amp, Low Power Laser, Printimer, Transistor Tester, Mixer Preamp, Logic Probe, Simple Amp, Ni-Cad Battery Charger, Loudhailer, 'Scope Calibrator, Electronic Ignition, Automatic Car Theft Alarm, Turn Indicator Canceller, Brake Light Warning, LM380 Circuits, Temperature Alarm, Aerial Matcher, UHF TV Preamp, Metal Locator, Four Input Mixer, Super Stereo, IC Power Supply, Rumble Filter, IC Tester, Ignition Timing Light, 50W Stereo Amp PLUS MANY MORE.

£2.50 + 25p P&P

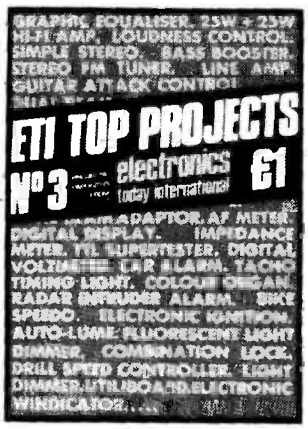


ETI CIRCUITS No. 1

Contains nearly 250 circuits, largely taken from the best of our Tech-Tips. Great care has been taken to index each circuit for rapid selection. An additional section at the back gives plenty of reference data including transistor specs and equivalents.

Sales of this publication have been excellent -- hardly surprising when the circuits cost less than 1p each!

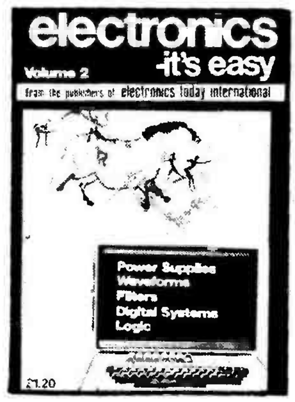
£1.50 + 25p P&P



TOP PROJECTS No. 3

Originally published in March 1976 Top Projects No 3 contains 27 constructional projects including Graphic Equaliser, International 25W Stereo Amp, Simple Stereo, New Sound for your Guitar, Bass Booster, Line Amplifier, Loudness Control, Electronic Ignition, Tacho Timing Light, Car Alarm, Dual-Beam Adaptor, AF Meter, Impedance Meter, Digital Display, Digital Voltmeter, TTL Supertester, Fluorescent Light Dimmer, Radar Intruder Alarm, Light Dimmer, FM Tuner, Colour Organ, Drill Speed Controller plus many more.

£1.00 + 25p P&P

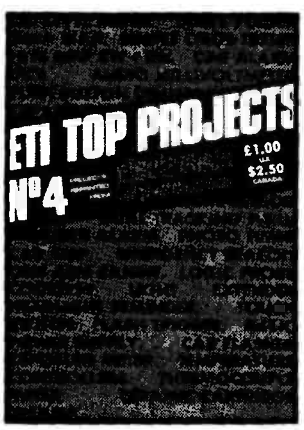


ELECTRONICS – IT'S EASY

Our successful series (which finishes with this very issue!) is to be available in three volumes.

Volume 1 has now been reprinted to meet the continuing demand, and can be ordered from our offices — as can Volume 3. Regrettably Volume 2 is at present sold out.

£1.20 + 25p P&P



TOP PROJECTS No. 4

Published October, 1976. This includes Sweet-Sixteen Stereo Amp, Waa-Waa, Audio Level Meter, Expander-Compressor, Car Anti-Theft Alarm, Headlight Reminder, Dual-Tracking Power Supply, Audio Millivoltmeter, Thermocouple Meter, Intruder Alarm, Touch Switch, Push-Button Dimmer, Exposure Meter, Photo Timer, Electronic Dice, High Power Beacon, Temperature Controller, Electronic One-Armed Bandit, plus many more.

£1.00 + 25p P&P

ETI 4600 SYNTHESISER

A complete reprint of our superb synthesiser design, published with Maplin Electronics (who also supply the parts). This reprint will also be of interest to those not specifically wanting to build the unit as the circuitry is highly original and is in fact patented by ETI!

£1.50 + 25p P&P

TOP PROJECTS No. 5

Twenty-two complete projects including: 5W Stereo Amp, Stage Mixer, Disco Mixer, Touch Organ, Audio Limiter, Infra-Red Intruder Alarm, Model Train Controller, Reaction Tester, Headphone Radio, STD Timer, Double Dice, G.P. Power Supply, Logic Tester, Power Meter, Digital Voltmeter, Universal Timer, Breakdown Beacon, 1-2 Hour Timer, Heart Rate Monitor, IB Metal Locator and Temperature Meter.

£1.00 + 25p P&P

HOW TO ORDER

HOW TO ORDER

ETI Circuits No 1 and Top Projects No 5 are available at newsagents or direct from ETI. Others are available only direct from ETI.

Postage and packing is 25p overseas. Send remittance in sterling only.

ETI Specials,
ETI Magazine,
25-27 Oxford Street,
London W1R 1RF.

Please mark the back of your cheque or PO with your name and address.

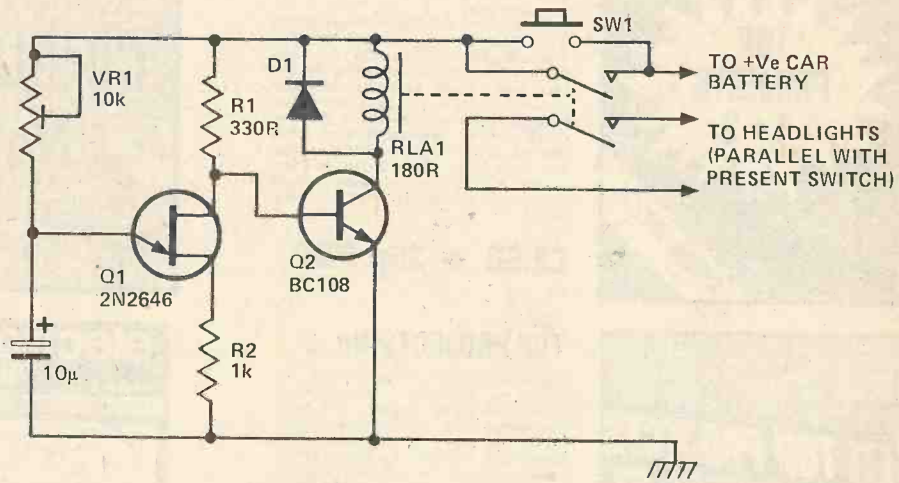
Headlight Delay Unit

D. Chivers

This circuit will operate a car's headlights for a predetermined time to light up the driveway or path after the driver has left the car, thus enabling him (or her) to open the front door without knocking over the milk bottles.

SW1 is pushed and Q2 is turned on closing the relay and turning on the car's headlights. C1 begins to charge through VR1 until Q1 turns on, turning Q2 off. The relay will then open switching off both the lights and the unit.

The delay is governed by the time taken for the capacitor to charge, which is about one minute.

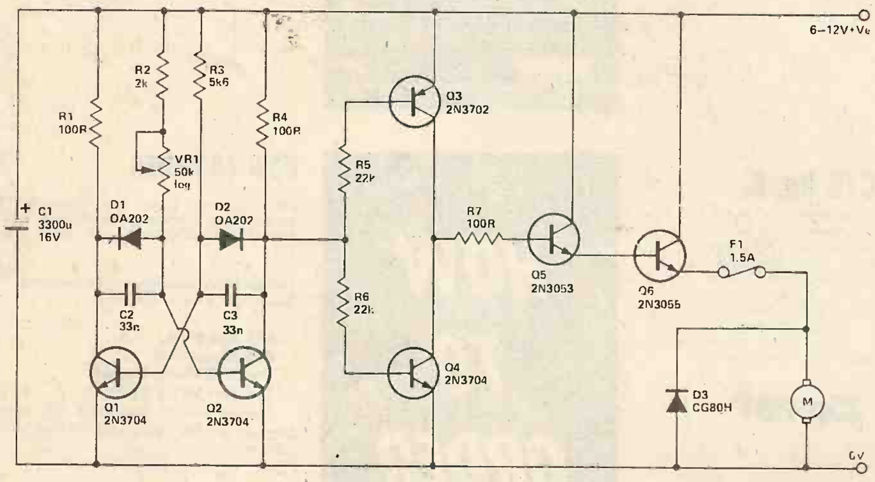


DC Motor Speed Controller

D. Strange

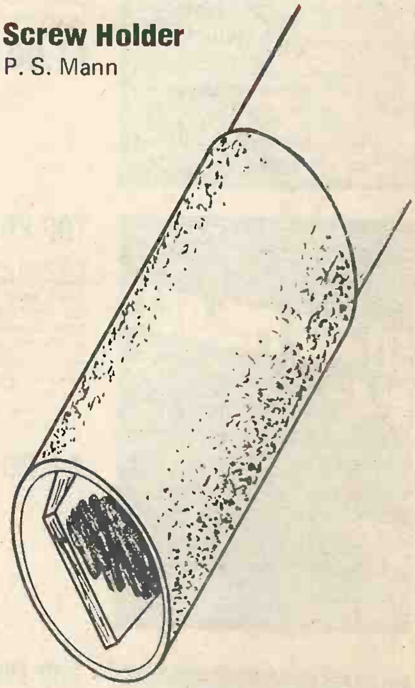
Simple controllers for DC motors as previously published have been found to be limited in their application. This new design is capable of controlling a wide range of DC motors enabling high torque to be available at low speed.

In the circuit, Q1 and Q2 form a multivibrator operating at about 7kHz. VR1 is used to alter the mark/space ratio of the square wave which is fed via R5 and R6 to the bases of complementary transistors Q3 and Q4. The joined collectors of Q3 and Q4 are switched hard between positive rail and zero volts, turning on and off completely the output transistors Q5 and Q6. Consequently the dissipation of the output transistors is very low. D3, a power germanium diode, is inserted across the motor to suppress transients which were found to reduce torque by approximately 30% in the prototype. A silicon power diode with a germanium diode such as the OA5 in parallel is equally efficient at transient suppression.



Screw Holder

P. S. Mann



This simple but ingenious idea should help relieve the frustration of trying to fit tiny screws into awkward places.

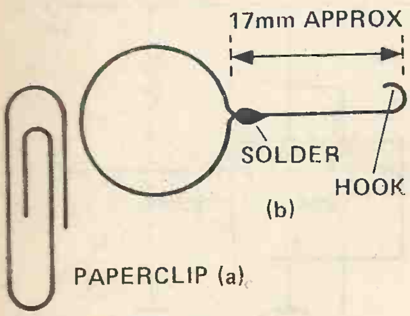
A short length of insulation is put over the end of a small screwdriver until flush with the end.

The screw can then be slipped into the insulation until it engages with the screwdriver. where it will be held in place by the insulation.

Tech-Tips is an ideas forum and is not aimed at the beginner. We regret we cannot answer queries on these items.

ETI is prepared to consider circuits or ideas submitted by readers for this page. All items used will be paid for. Drawings should be as clear as possible and the text should preferably be typed. Circuits must not be subject to copyright. Items for consideration should be sent to ETI TECH-TIPS, Electronics Today International, 25-27 Oxford St., London W1R 1RF.

-tips



Desoldering Aid

C. G. Dixon G8CGK

Have you ever tried unsoldering resistors from a PCB - especially when the wire on the solder side has been bent over? One hand to hold the soldering iron, another to hold the PCB and yet another to hold the resistor with a pair of fine nosed pliers - which invariably slip off! Here is a better way to do it.

First of all hold the PCB in a vice or, as in the photograph, steady it with a block of wood having a slot cut in it. Next, take an ordinary paper clip and bend it as shown in the sketch so that the ring is a comfortable fit on the first finger of the left hand. Now hook the gadget under the wire at the end of the resistor (or capacitor), heat up the solder and when it is molten pull back with the first finger, at the same time pressing with the thumb and second finger on the PCB.

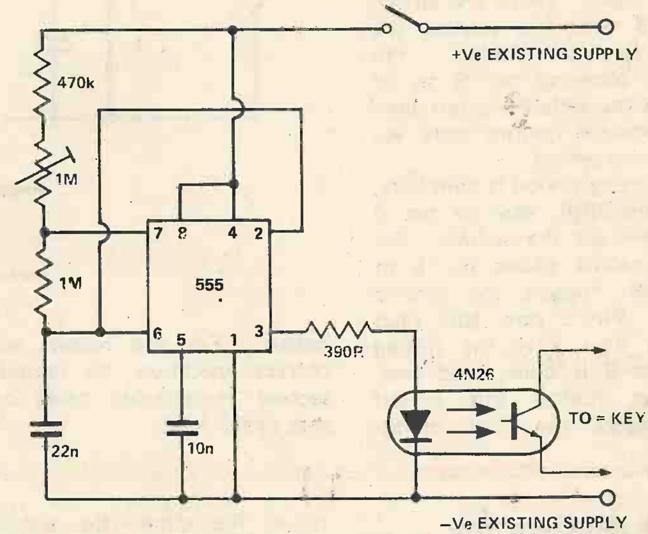
WARNING! BEWARE! Don't be tempted to use copper wire instead of the paper clip - copper conducts heat very well and the ring may not be easy to remove from your finger in a hurry!

Calculator Stopwatch

K. C. Phillips,

This circuit can be fitted to any calculator with an automatic constant, to enable it to be used as a stop-watch. The 4N26 Opto Coupler prevents any coupling problems with the ' = ' key. The 555 timer is set to run at a suitable frequency and connected to the existing calculator battery via the push-on push-off switch and the existing calculator on-off switch.

This circuit has been fitted to a Hanimex ESR master calculator, with the timer set at 0.05 sec, which is slow enough not to interfere with the debounce circuitry. By using the ' memory to display' key, it is possible to record 2 individual times, as the constant is held after exchange.



Solid State Switch

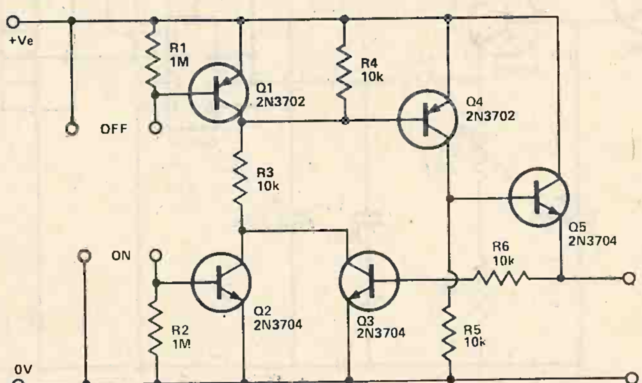
N. C. Burkinshaw

The circuit was designed for use as a solid-state calculator on-off switch, as the mechanical equivalent was found to be unreliable.

Layout is not critical and the switch will operate with a supply from +6V to +15V and current consumption in the 'OFF' state is a negligable 30μA.

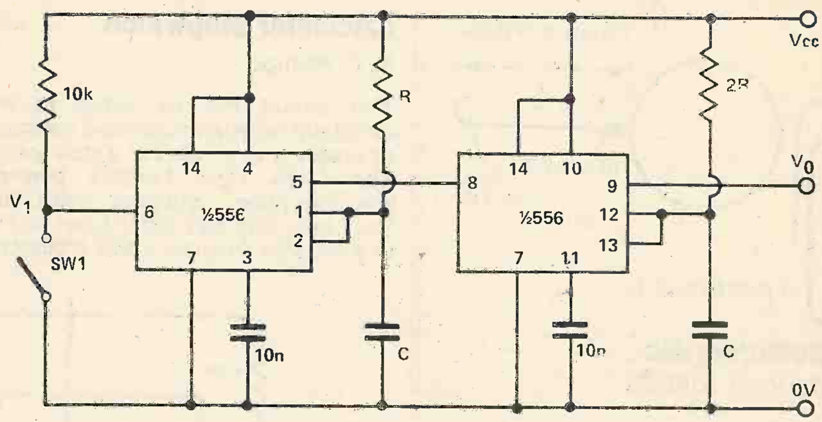
A finger across the 'OFF' contacts turns Q1 off and takes the base of Q4 to the +ve rail, turning Q4 off. This in turn stops Q5 conducting, and R6 and Q3 latch the circuit in this state.

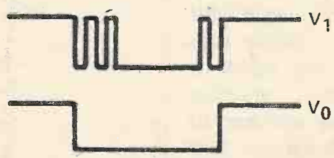
Touching the 'ON' contacts takes R3 to ground turning Q4 on. Q5 now contacts and again R6 and Q3 latch the circuit.



Contact Debounce

A. V. Bates.





The circuit described below can be used to provide contact debounce, or can be used as a dual retriggerable monostable.

With SW1 in the off position, pin 5 is low, and holds pin 9 high - the same as the input. When the switch closes, pin 6 goes low causing the monostable to start timing. Pin 5 goes high allowing pin 9 to go low. As the monostable is retrigger-able, any contact bounce only ex-tends the timing period.

When the timing period is complete, pin 5 remains high, due to pin 6 being held low by the switch. Re-leasing the switch allows pin 5 to go low which triggers the second monostable. Pin 9 now goes high and remains high after the timing period as pin 8 is being held low. Any bounces during this period merely retriggers the first mono-stable. For this reason, to ensure correct operation, the period of the second monostable must be twice that of the first.

The period of the bounce supp-ression is the timing period of the first monostable, and is given by:

T (seconds) = 0.693 x R x C.

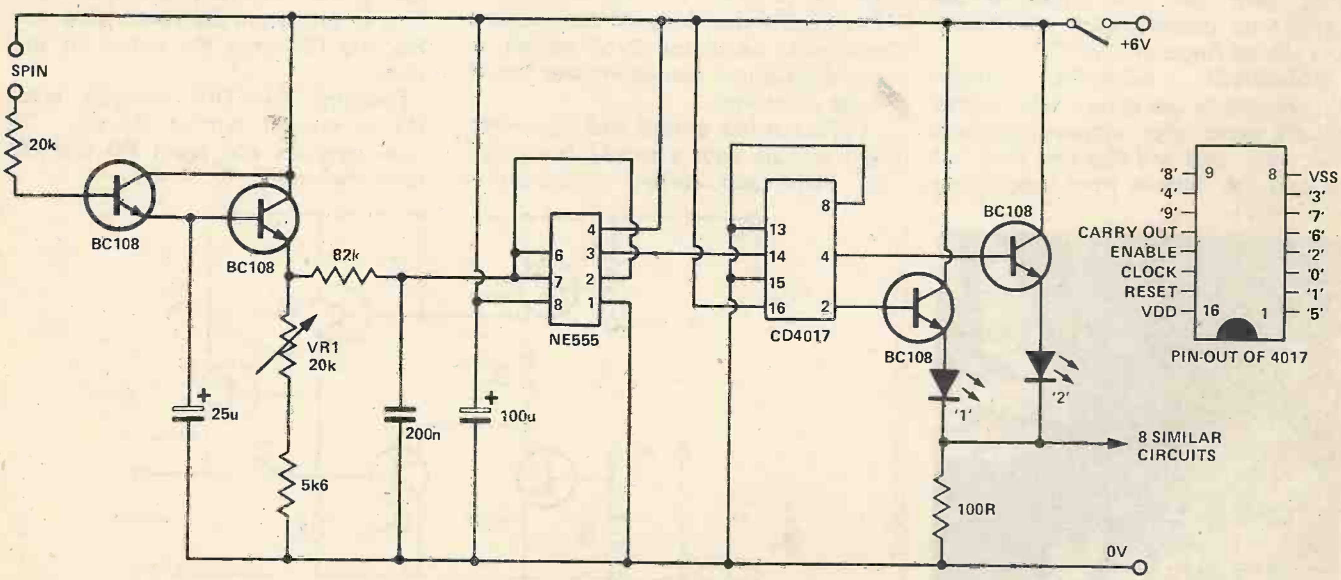
Touch-Spin Mini Roulette

David Ian

Ten LEDs arranged in a circle form the 'wheel' for this miniature roulette.

A finger held on the 'SPIN' contacts will cause the LEDs to flash in order round the circle, the speed slowly increasing. When the finger is removed the flashing will slow and one LED will remain lit.

The LEDs are mounted behind a red translucent perspex panel with the numbers 0 to 9 marked on a clear sheet of celluloid mounted between the LEDs and the perspex. With a current of 20 to 30mA through the LED the winning number is clearly illuminated. VR1 can be adjusted to change the time taken for the 'spinn-ing' to stop.



PLUGS – SOCKETS

18. Audio

18. Audio	Q	P	TH
DINSPKRPL		10	
DIN3PINPL		14	
DIN5P180PL		16	
DINSPKRSK		8	
DIN3PINSK		14	
DIN5P180SK		12	
¼" J.PL INS-M		20	
¼" J.PL SCR-M		40	
Mono ¼ J.SK		22	
¼" J.PL INS-S		30	
¼" J.PL SCR-S		50	
STER ¼ J.SK		26	
3.5mm J.PL		14	
3.5mm J.SK		10	
Phono PL Red		8	
Phono PL Black		8	
Phono PL Green		10	
Phono PL Blue		8	
Phono PL Yellow		8	
Phono PL Ivory		10	
Single Phono SK		10	
Twin Phono SK		14	
Four Phono SK		18	

19. DC Power	Q	P	TH
TR 2.1		19	
TR 2.5		19	
PP3 Press Stud		9	

20. COAX P/S	Q	P	TH
AL COAX PL		20	
Surface SK		23	
Flush SK		25	

21. XTAL HC6U SKT		14	

22. I.C. SKTS	Q	P	TS
8 PIN DIL		21	
14 PIN DIL		24	
16 PIN DIL		27	
TO18 Transistor		12	
TO5 Transistor		12	

23. Instrument 4mm etc.

Push Terms	Q	P	TS
Red		18	
Black		18	
Blue		18	
Yellow		18	
White		18	

4mm Terms	Q	P	TS
Red		33	
Black		33	
Blue		33	
Green		33	
White		33	
Yellow		33	

4mm Plugs	Q	P	TS
Red		16	
Black		16	
Blue		16	
Green		16	
White		16	
Yellow		16	

4mm Sockets	Q	P	TS
Red		15	
Black		15	
Blue		15	
Green		15	
White		15	
Yellow		15	

25. Presets Min. Horiz.

Value	Q	P	TH
100Ω		8	
220Ω		8	
470Ω		8	
1K		8	
2.2K		8	
4.7K		8	
10K		8	
22K		8	
47K		8	
100K		8	
220K		8	
470K		8	
1M		8	
2.2M		8	

26. Presets Min. Vert.

Value	Q	P	TH
100Ω		8	
220Ω		8	
470Ω		8	
1K		8	
2.2K		8	
4.7K		8	
10K		8	
22K		8	
47K		8	
100K		8	
220K		8	
470K		8	
1M		8	

27. Pots Log.	Q	P	TH
4.7K		33	
10K		33	
22K		33	
47K		33	
100K		33	

28. Pots Lin.	Q	P	TH
4.7K		33	
10K		33	
22K		33	
47K		33	
100K		33	
220K		33	
470K		33	
1M		33	

29. Pots Log. with DP.SW.

Value	Q	P	TH
4.7K		80	
10K		80	
100K		80	

30. Pots Tandem Log.

Value	Q	P	TH
4.7K		110	
10K		110	
22K		110	
47K		110	
100K		110	
220K		110	
470K		110	

31. Pots Tandem Lin.

Value	Q	P	TH
4.7K		110	
10K		110	
22K		110	
47K		110	
100K		110	

Total

24. Resistors ¼W (Packs of 3) Carbon Film 5%

E12	1.0	1.2	1.5	1.8	2.2	2.7	3.3	3.9	4.7	5.6	6.8	8.2
X10												
X100												
X1K												
X10K												
X100K												
X1M												
X10M	Please enter qty in packs in appropriate box											

	Qpk	Ppk	TH
Total Packs = Resistors		6	

SEMICONDUCTORS

32. Transistors

32. Transistors	Q	P	TS
AC128		27	
AC187		21	
AC188		21	
AC187/8MP		53	
AD161		75	
AD162		75	
AD161/2MP		160	
BC107		13	
BC108		13	
BC109		13	
BC177		19	
BC178		19	
BC179		19	

	Q	P	TH
BC182L		11	
BC183L		11	
BC184L		11	
BC207		11	
BC208		11	
BC209		11	
BC212L		11	
BC213L		11	
BC214L		11	

	Q	P	TS
BC301		32	
BC303		32	
BCY70		20	
BCY71		20	
BD131		68	
BD132		70	
BD131/2MP		140	
BFY50		23	
BFY51		23	
BFY52		23	
BSX20		21	
TIP31A		42	
TIP32A		44	
TIP41A		59	
TIP42A		59	
TIS43		35	

	Q	P	TH
ZTX107		14	
ZTX108		14	
ZTX109		14	
ZTX300		17	
ZTX500		18	

	Q	P	TS
2N2219		29	
2N2646		92	
2N2905		28	
2N3053		22	
2N3054		73	
2N3055		65	

	Q	P	TH
2N3702		11	
2N3703		11	
2N3704		11	
2N3705		11	
2N3706		11	

	Q	P	TS
2N3819		24	

	Q	P	TH
2N3904		11	
2N3906		12	

33. Signal Diodes

Type	Q	P	TH
AA119		7	
OA47		9	
OA90		7	
OA91		7	
OA202		9	
IN4148		4	

34. Rectifiers

Type	Q	P	TS
BY127		14	
IN4001		5	
IN4002		7	
IN4004		7	
IN4005		8	
IN5401		14	
IN5404		16	
W04 1A/400V		31	
1.6A/200VBR		43	
2A/200VBR		74	

35. Zeners 400mW

Voltage	Q	P	TH
3.3		12	
3.9		12	
4.7		12	
5.1		12	
5.6		12	
6.2		12	
6.8		12	
8.2		12	
9.1		12	
10		12	
15		12	

36. Zeners 1.3W

Voltage	Q	P	TH
4.3		20	
4.7		20	
5.1		20	
6.2		20	
6.8		20	
8.2		20	
9.1		20	
10		20	
12		20	
15		20	
18		20	
20		20	
24		20	
27		20	
30		20	
33		20	

37. Power Control

Type	Q	P	TS
SCR 1A/400V		60	
SCR C106		64	
SCR 5A/400V		84	
TRIAC 6A/400V		118	
DIAC		24	

38. Voltage Regulators

Type	Q	P	TS
7805		155	
7812		155	
7815		155	
723DIL		60	

39. OP Amp.	Q	P	TS
741 DIL8		30	

40. Audio Amp

Type	Q	P	TH
TBA810S		160	

41. Timers	Q	P	TS
555		50	
556		99	

42. Radio	Q	P	TH
MC1310P		225	
CA3089E		295	
ZN414		145	

43. CMOS	Q	P	TS
4000		26	
4001		26	
4011		26	
4013		50	

44. TTL 74 Series

Type	Q	P	TS
7400		15	
7402		18	
7404		18	
7410		18	
7413		35	
7447		110	
7474		35	
7475		72	
7490		62	
7493		65	
74121		45	
74141		90	

SWITCHES

45. Toggles	Q	P	TS
MIN SPST		80	
MIN SPDT		85	
MIN DPDT		93	

46. Slide Switch

Type	Q	P	TS
DPDT MIN		19	

47. Push Switches

Type	Q	P	TS
MIN Make		20	
MIN Break		20	

48. MIN Multipole Rotary

Type	Q	P	TH
1 Pole 12-way		54	
2 Pole 6-way		54	
3 Pole 4-way		54	
4 Pole 3-way		54	

WIRES

49. Single Wire-PVC Stranded

Price/10m Coil	Q	Pcl	TS
Black		25	
Blue		25	
Brown		25	
Green		25	
Grey		25	
Orange		25	
Pink		25	
Red		25	
Violet		25	
White		25	
Yellow		25	

50. Mains Lead MIN 3-Core

Price/Metre	Q	Pm	TS
Black		13	
White		13	

51. Mike Cable - Medium

Price/Metre	Q	Pm	TS
Single		10	
Twin		16	

52. Figure 8 Twin

Price/Metre	Q	Pm	TS
Black		7	
White		7	
Grey		7	

53. Extra Flex

Price/Metre	Q	Pm	TS
Red		9	
Black		9	

54. Books

Constructor Guides	Q	P Newnes	TZ
Electronic Comps		180	
Printed CCTS		180	
Elec. Diagrams		180	
Simple CCTS		199	
Practical Projects		199	
Project Plans		199	
110 Semicon CCTS		250	
110 Op Amp CCTS		250	
110 Digital CCTS		250	
20 Solid State CCTS		195	
Beginners Electronics		225	
Q&A Transistors		100	
Q&A I.C's		100	

TOTALS (Two Rates!) TH = TS = TH = | TH = TS = | TH = TS = | TS = TZ =

MAIL ORDER FORM/CATALOGUE

CUSTOMER NAME (Block Caps)

ADDRESS

Post Code

Despatch Date		TOTALS		ACE USE ONLY
DISCOUNT	1	Front H.		
Orders over £5 Less 5%	2	Back H.		
Over £20 Less 10%	3	Total H.		
Deduct Discount from Total 9	4	Front S.		
	5	Back S.		
	6	Total S.		
	7	Total Z.		
	8	P & P		
	9	3 + 6 + 7 + 8		
		Discount		
	10	Total Sent		

PLEASE COMPLETE THE COMBINED CATALOGUE/ORDER FORM AS FOLLOWS:– WRITE THE QUANTITIES REQUIRED IN COLUMN Q AGAINST THE ITEM TO BE ORDERED. MULTIPLY Q BY P AND WRITE RESULT INTO COLUMN T. ON COMPLETING THE ORDER FORM ADD UP ALL THE COLUMN TOTALS TS, TH AND TZ SEPARATELY AND WRITE TOTALS INTO PANEL AT THE TOP OF FORM. ALL PRICES ARE INCLUSIVE OF VAT AT THE CURRENT RATE AND ARE SHOWN IN PENCE. P & P IS FREE ON ORDER OF £2 AND ABOVE – ADD 20p FOR SMALL ORDERS. EXPORT ORDERS FREE OF VAT – DEDUCT 2% FROM TS AND 6% FROM TH TOTALS FOR SURFACE MAIL. AIRMAIL PRICES AS UK (I.E. VAT CHARGE BECOMES AIRMAIL CHARGE) ALL GOODS GUARANTEED 1 YEAR IF CORRECTLY USED. ALL ORDERS DESPATCHED ON DAY INSTRUCTION RECEIVED SUBJECT TO AVAILABILITY. PRICES ARE "EACH" EXCEPT RESISTORS, CERAMICS AND WIRE.

ACE MAILTRONIX LTD
Tootal St. Wakefield
West Yorkshire WF1 5JR

CAPACITORS

01. Electros-Axial

Value (μF)	Q	P	TH
1/63V		10	
2.2/63V		10	
4.7/63V		10	
10/63V		10	
10/25V		10	
22/25V		10	
47/25V		10	
100/63V		25	
100/25V		10	
220/25V		25	
470/63V		37	
470/25V		34	
1000/63V		46	
1000/25V		54	
2200/25V		85	

02. Tantalum-Beads

Value (μF)	Q	P	TH
0.47/35V		14	
1.0/35V		14	
2.2/35V		16	
4.7/35V		17	
10/25V		21	
22/16V		24	
47/6.3V		24	

03. Polyester Radial

Value (μF)	Q	P	TH
0.001		7	
0.0022		7	
0.0047		7	
0.01		7	
0.022		7	
0.047		7	
0.1		8	
0.22		9	
0.47		18	
1.0		18	
2.2		36	

04. Polystyrene

Value (pF)	Q	P	TH
10		6	
22		6	
33		6	
47		6	

TOTALS TH =

04. Polystyrene (cont.)

Value (pF)	Q	P	TH
100		6	
150		6	
220		6	
330		6	
470		6	
680		6	
1000		6	
1500		6	
2200		6	
3300		6	
4700		9	
10000		9	

05. Ceramics 50V (Pack 3)

Value (pF)	Q	Ppk	TH
22		10	
33		10	
47		10	
100		10	
150		10	
220		10	
270		10	
330		10	
470		10	
560		10	
1000		10	
2200		10	
4700		10	
0.01 μF		10	
0.022μF		10	
0.047μF		10	

What additional products would you like to see in the Ace Range?

New Product Suggestions

TH =

FUSES/HOLDERS

06. Fuseholders

Type	Q	P	TS
Chassis 1¼		12	
Chassis 20mm		7	
Panel 1¼		33	
Panel 20mm		28	

07. Fuses Quick Blow

20mm	Q	P	TS
250m/a		4	
500m/a		4	
1A		4	
2A		4	
3A		4	
5A		4	
1¼"			
500m/a		7	
1A		7	
2A		7	
3A		7	
5A		7	
Plug Top 1"			
2A		7	
3A		7	
5A		7	
13A		7	

HARDWARE

08. Heat Transfer

Type	Q	P	TS
TO3 Mica Set		9	
TO220 Mica Set		8	
TO5 Sink		19	
TO220 Sink		19	

09. CROC-Clips

Insulated	Q	P	TS
Red		6	
Black		6	
Ins. Handles			
Red		8	
Black		8	

10. Terminal Block 12W

Type	Q	P	TS
2A		26	
5A		28	

11. Buzzer 12VDC

Type	Q	P	TS
Little Fuse		162	

TS =

12. Cases (complete) Sizes in mm

Polystyrene

L x D x H	Q	P	TS
75 x 56 x 35		58	
95 x 71 x 35		69	
115 x 95 x 37		83	

Vero ABS 75 Series

L x D x H	Q	P	TS
205 x 140 x 40		390	
205 x 140 x 75		430	
205 x 140 x 110		555	
154 x 85 x 40		240	
154 x 85 x 60		300	
154 x 85 x 80		350	

Vero Poly 65 Series

L x D x H	Q	P	TS
100 x 50 x 25		180	
100 x 50 x 40		210	
125 x 65 x 40		230	
150 x 80 x 50		260	
188 x 110 x 60		340	
Vero Sloping Top			
220/174/100 52		690	
171/121/75-37.5		450	

13. Boards

Vero	Q	P	TS
0.1 2.5" x 3.75"		50	
0.1 3.75" x 3.75"		59	
0.1 2.5" x 5"		59	
0.1 3.75" x 5"		66	

Dec & Blob	Q	P	TS
S. Dec		216	
T. Dec		399	
TO5 Adapt		200	
DIL Adapt		210	
0.1 Blob 2.5"/5"		33	
0.1 Blob 2.5"/3.75"		25	
0.1 Blob 3.75"/5"		50	
D 3.6" x 2.4"		22	
D 2.4" x 7.3"		46	
IC 4.5" x 3"		39	
IC 4.8" x 3.2"		44	

TS =

14. Die Cast Boxes (Size mm)

L x D x H	Q	P	TS
114 x 64 x 30		112	
114 x 89 x 55		179	

15. Knobs ¼ Spindles

Collet-Black	Q	P	TS
15mm Plain (P)		33	
15mm Lined (L)		38	
Nut Cover (P)		7	
Nut Cover (L)		13	
Pointer 15mm		4	
Cap-Black 15		4	
Cap-Red 15		4	
Cap-Grey 15		4	
Cap-Green 15		4	
Cap-Blue 15		4	
Cap-Yellow 15		4	
21mm Plain		45	
Cap-Black 21		4	
Cap-Red 21		4	
Pointer 21		5	

16. Miscellaneous

Vero Stand Offs	Q	P	TS
Pillars 6mm		3	
Pillars 15mm		3	
Solder			
18 Savbit/Metre		7	
Solda Mop		72	
Dalo PCB Pen		115	

17. Indicators

	Q	P	TS
LED TIL209 Red		15	
LED 0.2" Red		15	
LED 0.2" Green		35	
LED 0.2" Yellow		35	
7SEG LED .3" Red		100	
LESL/HDR Red		27	
LESL/HDR Amber		27	
LESL/HDR Green		27	
LES Bulb 6V		12	
LES Bulb 12V		12	
230V Neon Red		27	
Fix Clip 0.2 LED		3	

TS =

ISSUE No.1 VALID UNTIL PUBLICATION OF ISSUE NO.2.

REG. OFF: 26 CASTLE RD, WAKEFIELD, W. YORKS WF2 7LZ.
REGISTERED IN ENGLAND NO. 1318894 VAT REG. 182 9494 22
DIRECTORS: V. A. CHABLE D. OWRAM (Secretary)

PRICES INCLUDE V.A.T

PLUGS – SOCKETS

18. Audio	Q	P	TH
DINSPKRPL		10	
DIN3PINPL		14	
DIN5P180PL		16	
DINSPKRSK		8	
DIN3PINSK		14	
DIN5P180SK		12	
¼" J.PL INS-M		20	
¼" J.PL SCR-M		40	
Mono ¼ J.SK		22	
¼" J.PL INS-S		30	
¼" J.PL SCR-S		50	
STER ¼ J.SK		26	
3.5mm J.PL		14	
3.5mm J.SK		10	
Phono PL Red		8	
Phono PL Black		8	
Phono PL Green		10	
Phono PL Blue		8	
Phono PL Yellow		8	
Phono PL Ivory		10	
Single Phono SK		10	
Twin Phono SK		14	
Four Phono SK		18	

19. DC Power	Q	P	TH
TR 2.1		19	
TR 2.5		19	
PP3 Press Stud		9	

20. COAX P/S	Q	P	TH
AL COAX PL		20	
Surface SK		23	
Flush SK		25	

21. XTAL HC6U SKT 14

22. I.C. SKTS	Q	P	TS
8 PIN DIL		21	
14 PIN DIL		24	
16 PIN DIL		27	
TO18 Transistor		12	
TO5 Transistor		12	

23. Instrument 4mm etc.

Push Terms	Q	P	TS
Red		18	
Black		18	
Blue		18	
Yellow		18	
White		18	
4mm Terms			
Red		33	
Black		33	
Blue		33	
Green		33	
White		33	
Yellow		33	
4mm Plugs			
Red		16	
Black		16	
Blue		16	
Green		16	
White		16	
Yellow		16	
4mm Sockets			
Red		15	
Black		15	
Blue		15	
Green		15	
White		15	
Yellow		15	

25. Presets Min. Horiz.

Value	Q	P	TH
100Ω		8	
220Ω		8	
470Ω		8	
1K		8	
2.2K		8	
4.7K		8	
10K		8	
22K		8	
47K		8	
100K		8	
220K		8	
470K		8	
1M		8	
2.2M		8	

26. Presets Min. Vert.

Value	Q	P	TH
100Ω		8	
220Ω		8	
470Ω		8	
1K		8	
2.2K		8	
4.7K		8	
10K		8	
22K		8	
47K		8	
100K		8	
220K		8	
470K		8	
1M		8	

27. Pots Log.	Q	P	TH
4.7K		33	
10K		33	
22K		33	
47K		33	
100K		33	

28. Pots Lin.	Q	P	TH
4.7K		33	
10K		33	
22K		33	
47K		33	
100K		33	
220K		33	
470K		33	
1M		33	

29. Pots Log. with OP.SW.

Value	Q	P	TH
4.7K		80	
10K		80	
100K		80	

30. Pots Tandem Log.

Value	Q	P	TH
4.7K		110	
10K		110	
22K		110	
47K		110	
100K		110	
220K		110	
470K		110	

31. Pots Tandem Lin.

Value	Q	P	TH
4.7K		110	
10K		110	
22K		110	
47K		110	
100K		110	
		Total	

24. Resistors ¼W (Packs of 3) Carbon Film 5%

E12	1.0	1.2	1.5	1.8	2.2	2.7	3.3	3.9	4.7	5.6	6.8	8.2
X10												
X100												
X1K												
X10K												
X100K												
X1M												
X10M												

Please enter qty in packs in appropriate box

Total Packs = Resistors	Qpk	Ppk	TH
		6	

SEMICONDUCTORS

32. Transistors	Q	P	TS
AC128		27	
AC187		21	
AC188		21	
AC187/8MP		53	
AD161		75	
AD162		75	
AD161/2MP		160	
BC107		13	
BC108		13	
BC109		13	
BC177		19	
BC178		19	
BC179		19	
	Q	**P**	**TH**
BC182L		11	
BC183L		11	
BC184L		11	
BC207		11	
BC208		11	
BC209		11	
BC212L		11	
BC213L		11	
BC214L		11	
	Q	**P**	**TS**
BC301		32	
BC303		32	
BCY70		20	
BCY71		20	
BD131		68	
BD132		70	
BD131/2MP		140	
BFY50		23	
BFY51		23	
BFY52		23	
BSX20		21	
TIP31A		42	
TIP32A		44	
TIP41A		59	
TIP42A		59	
TIS43		35	
	Q	**P**	**TH**
ZTX107		14	
ZTX108		14	
ZTX109		14	
ZTX300		17	
ZTX500		18	
	Q	**P**	**TS**
2N2219		29	
2N2646		92	
2N2905		28	
2N3053		22	
2N3054		73	
2N3055		65	
	Q	**P**	**TH**
2N3702		11	
2N3703		11	
2N3704		11	
2N3705		11	
2N3706		11	
	Q	**P**	**TS**
2N3819		24	
	Q	**P**	**TH**
2N3904		11	
2N3906		12	

33. Signal Diodes

Type	Q	P	TH
AA119		7	
OA47		9	
OA90		7	
OA91		7	
OA202		9	
IN4148		4	

34. Rectifiers

Type	Q	P	TS
BY127		14	
IN4001		5	
IN4002		7	
IN4004		7	
IN4005		8	
IN5401		14	
IN5404		16	
W04 1A/400V		31	
1.6A/200VBR		43	
2A/200VBR		74	

35. Zeners 400mW

Voltage	Q	P	TH
3.3		12	
3.9		12	
4.7		12	
5.1		12	
5.6		12	
6.2		12	
6.8		12	
8.2		12	
9.1		12	
10		12	
15		12	

36. Zeners 1.3W

Voltage	Q	P	TH
4.3		20	
4.7		20	
5.1		20	
6.2		20	
6.8		20	
8.2		20	
9.1		20	
10		20	
12		20	
15		20	
18		20	
20		20	
24		20	
27		20	
30		20	
33		20	

37. Power Control

Type	Q	P	TS
SCR 1A/400V		60	
SCR C106		64	
SCR 5A/400V		84	
TRIAC 6A/400V		118	
DIAC		24	

38. Voltage Regulators

Type	Q	P	TS
7805		155	
7812		155	
7815		155	
723DIL		60	

39. OP Amp.	Q	P	TS
741 DIL8		30	

40. Audio Amp

Type	Q	P	TH
TBA810S		160	

41. Timers	Q	P	TS
555		50	
556		99	

42. Radio	Q	P	TH
MC1310P		225	
CA3089E		295	
ZN414		145	

43. CMOS	Q	P	TS
4000		26	
4001		26	
4011		26	
4013		50	

44. TTL 74 Series

Type	Q	P	TS
7400		15	
7402		18	
7404		18	
7410		18	
7413		35	
7447		110	
7474		35	
7475		72	
7490		62	
7493		65	
74121		45	
74141		90	

SWITCHES

45. Toggles	Q	P	TS
MIN SPST		80	
MIN SPDT		85	
MIN DPDT		93	

46. Slide Switch

Type	Q	P	TS
DPDT MIN		19	

47. Push Switches

Type	Q	P	TS
MIN Make		20	
MIN Break		20	

48. MIN Multipole Rotary

Type	Q	P	TH
1 Pole 12-way		54	
2 Pole 6-way		54	
3 Pole 4-way		54	
4 Pole 3-way		54	

WIRES

49. Single Wire-PVC Stranded

Price/10m Coil	Q	Pcl	TS
Black		25	
Blue		25	
Brown		25	
Green		25	
Grey		25	
Orange		25	
Pink		25	
Red		25	
Violet		25	
White		25	
Yellow		25	

50. Mains Lead MIN 3-Core

Price/Metre	Q	Pm	TS
Black		13	
White		13	

51. Mike Cable - Medium

Price/Metre	Q	Pm	TS
Single		10	
Twin		16	

52. Figure 8 Twin

Price/Metre	Q	Pm	TS
Black		7	
White		7	
Grey		7	

53. Extra Flex

Price/Metre	Q	Pm	TS
Red		9	
Black		9	

54. Books	Q	P	TZ
Constructor Guides		**Newnes**	
Electronic Comps		180	
Printed CCTS		180	
Elec. Diagrams		160	
Simple CCTS		199	
Practical Projects		199	
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110 Op Amp CCTS		250	
110 Digital CCTS		250	
20 Solid State CCTS		195	
Beginners Electronics		225	
Q&A Transistors		100	
Q&A I.C's		100	

TOTALS (Two Rates!) TH =	TS =	TH =	TH =	TS =	TH =	TS =	TS =	TZ =

-tips

Anti-surge Voltage Regulator

A. Wey

This high gain voltage regulator with only two transistors has characteristics superior to those of the commonly used compound emitter-follower type.

The circuit was used in a 30 watt stereo amplifier which not only required a well regulated supply. but also an output voltage that would rise slowly from zero volts when the system was first turned on. This slow application (about 2 seconds) to the power amplifiers allowed the 2000μF output capacitors to charge without causing excessive collector current in the output transistors.

Typical regulator output impedance is 0.1 ohm.

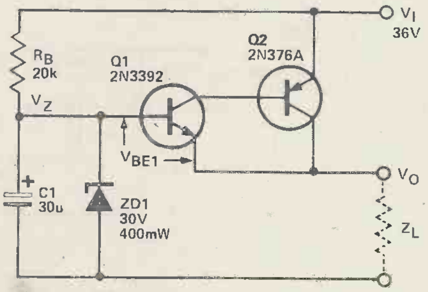
Output voltage is expressed by:

$$V_O=V_Z-V_{BE1}$$

Output voltage rise time is expressed by:

$$T=R_BC_1\ln(1-V_Z/V_I)$$

Some digital systems require a preset turn on sequence for their power supplies. By setting appropriate R_B/C_1 values, the circuit's output rise time can be set to provide this sequence or delay.



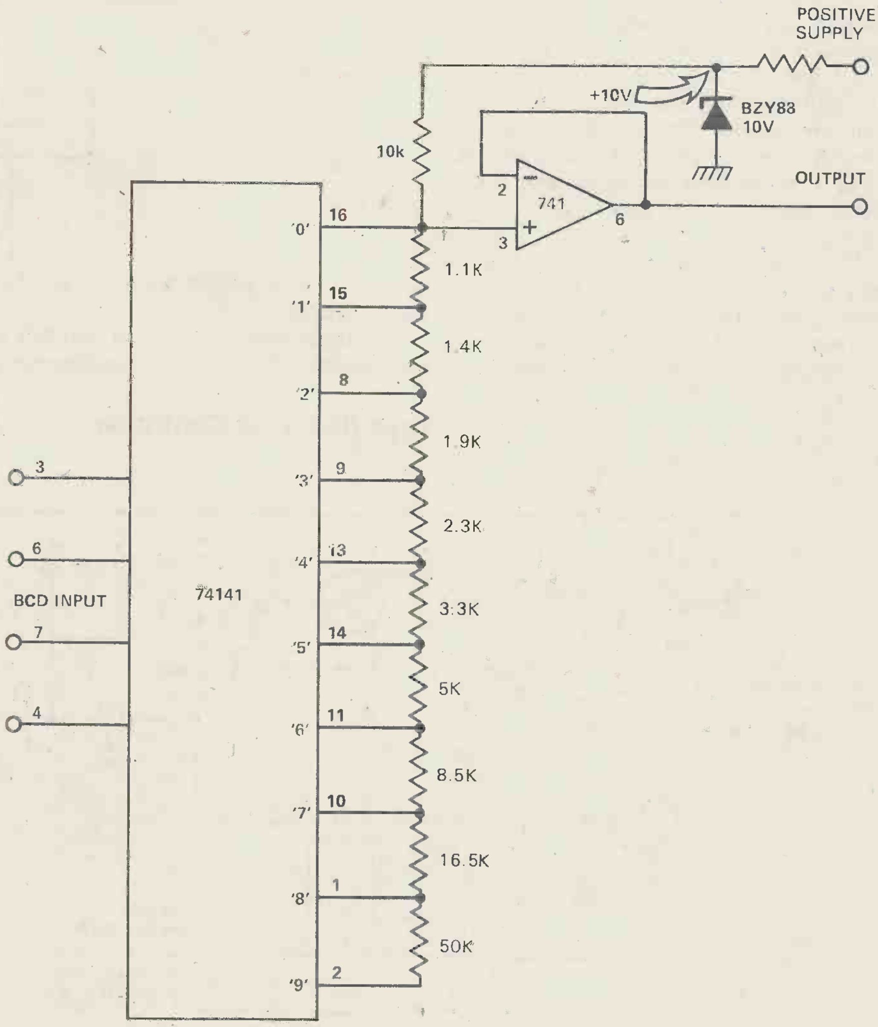
BCD to Analog Converter

C. R. Poole

This circuit will convert four-bit BCD into a variable voltage from 0-9V in 1 volt steps. Only two IC's are used, both are readily available.

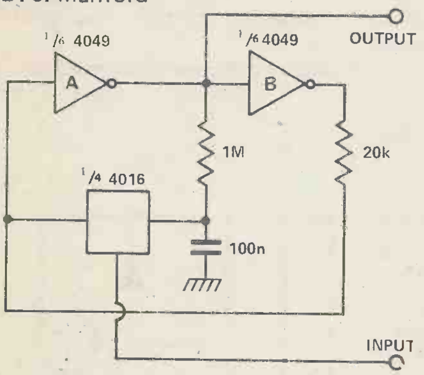
The SN74141 is a 'Nixie' driver, and has ten open-collector outputs. These are used to earth a selected point in the divider chain, determined by the BCD code at the input, and so produce a corresponding voltage at the output.

The accuracy of the circuit depends on the tolerance of the resistors and also the accuracy of the reference voltage. However, presets can be used in the divider chain, with correct calibration. The 741 is used as a buffer.



Improved SPST Switch Flip-flop

D. J. Manford



This circuit was developed from the SPST switch flip-flop shown in last November'"Tech-Tips", and has the advantage that it can be driven by an input refered to earth— logic outputs or push-buttons.

When the input to the 4016 goes high it connects together the input to A, and C. This 'flips' the latch.

The 20k resistor between the output of invertor B and the input of A is needed as the 4016 cannot pull the output of inverter B down directly.

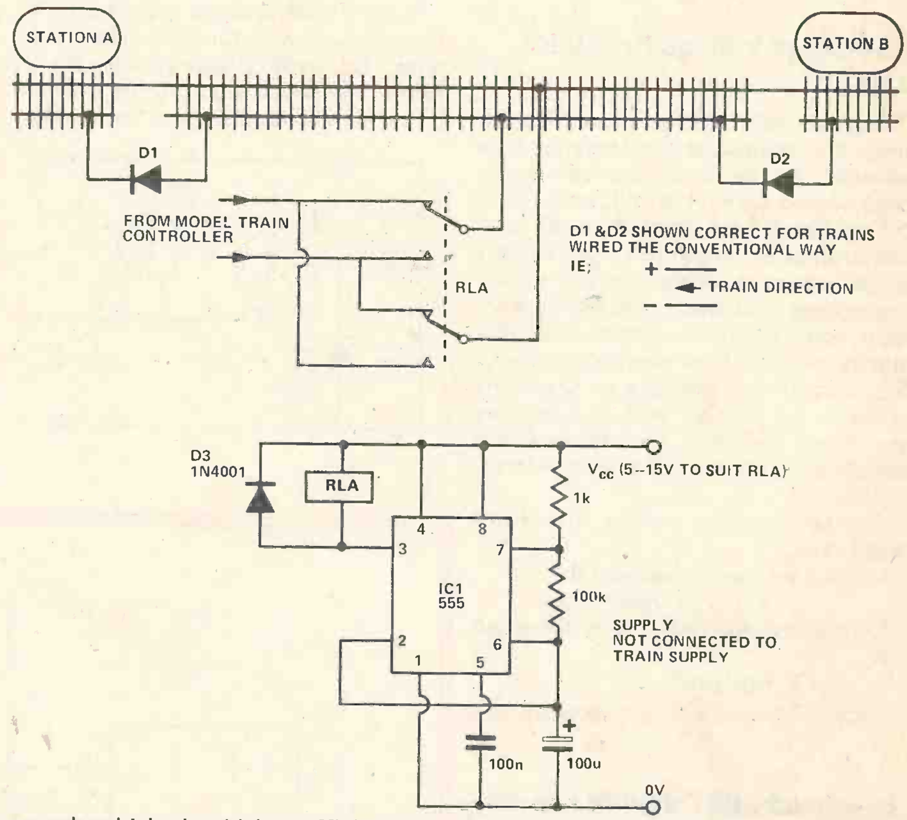
Model Railway

E. A. Parr.

This simple circuit provides an interesting little branch line service for a model railway. A small country railbus starts at a station , stops, then returns to the first station again, the cycle repeating indefinitely.

The track is arranged to have two isolated station sections at each end. The power is fed to the centre long section via a changeover relay, RLA. Diodes D1 and D2 feed the staion sections and ensure that a train in station A can only move towards station B and vice versa. The diode connections are correct for conventionally wired trains.

RLA is under control of a 555 timer. This is connected as an oscillator with almost equal mark/space ratio. The period is longer than the time taken for the train to travel from one station to the other. When the train reaches the station, as the diode will be reverse biased, it will stop. When, however the relay changes over the diode will conduct, and the train can return to the first station.

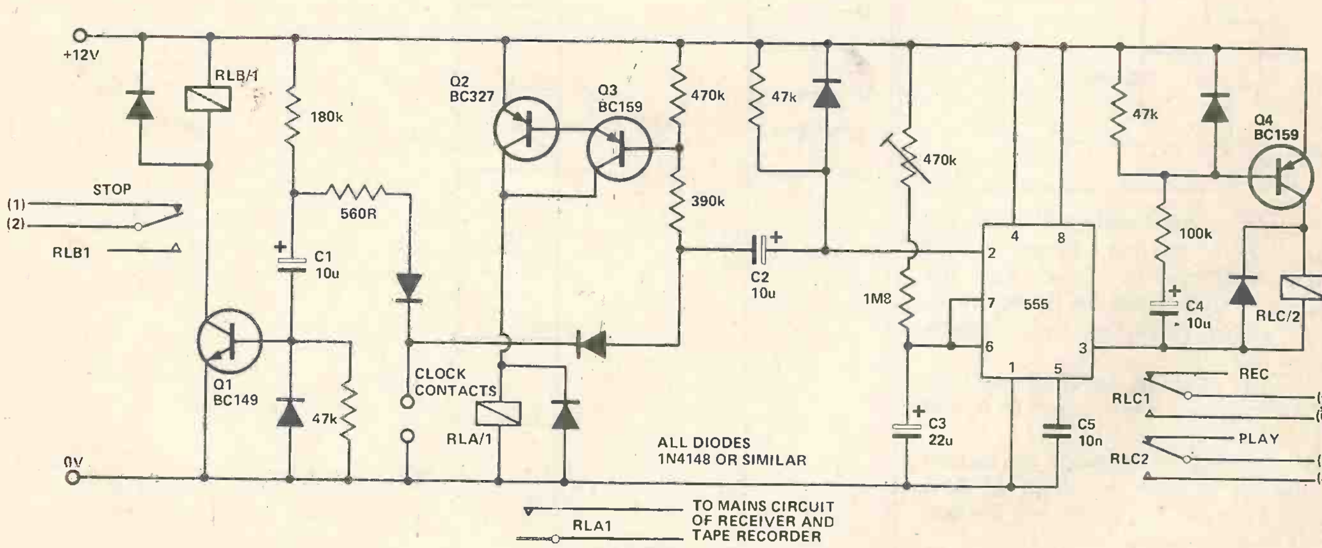


The half period of the oscillator should be made equal to the journey time plus the stop required at the station. The values shown give about 12 seconds which should be sufficient for most layouts.

The stop/start is unramped, but this is not particularly noticeable at the speed all self respecting branch line trains travel.

Tape Recorder Controller

D. H. E. King



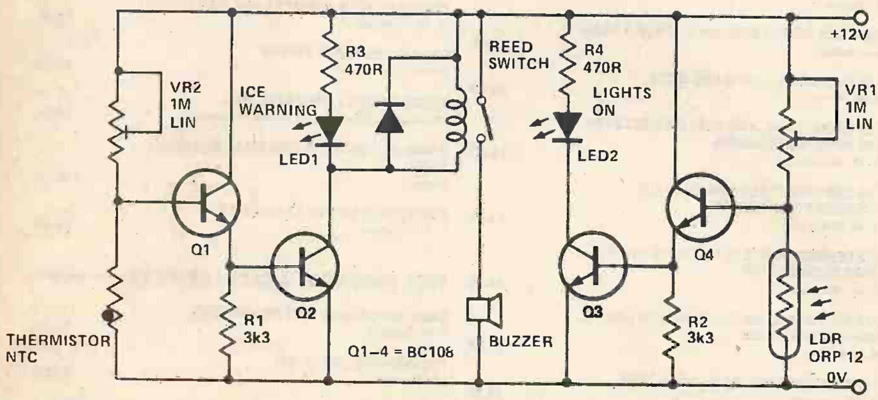
-tips

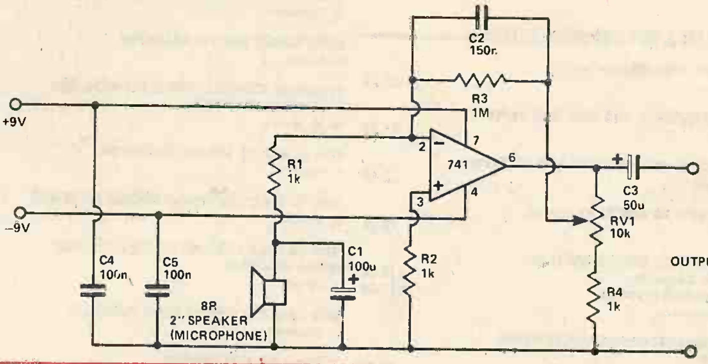
Ice Warning and Lights Reminder

D. Chivers

This simple device will tell a driver if his lights should be on and will warn him if the outside temperature is nearing zero, by lighting a LED and sounding a buzzer.

The units action is self explanatory; VR1 adjusts sensitivity for temp--erature, VR2 for light. Both therm--ister and LDR should be well protect--ed. Most high gain NPN transistors will work and the experimenters junk box will almost certainly hold some.





Heartbeat Preamplifier

P. J. Tyrrell

This simple circuit, when connected to an audio amplifier, allows one to listen to heartbeats. The low freq--uency gain is set by R1 and R3, in conjunction with VR1 and R4. VR1 permits the gain to be varied over the range 60-80 dB.

C1 and C2 introduce some low frequency cut, reducing 50Hz pickup whilst C4 and C5 help prevent insta-bility caused by the high gain of the circuit.

The output should be connected to the magnetic cartridge input of the audio amplifier, with the bass turned up high.

The circuit shown enables a solenoid operated tape recorder to be left to record a programme unattended. It was originally designed to be used on a Revox A77, in conjunction with a digital clock based on the Caltex CT7001, but could be adapted for other recorders, clocks, or mechan--ical time switches. The clock is set to switch on one minute before the programme starts, and switch off as it finishes.

When the clock contacts close, RLA is operated via Q2 and Q3, applying power to the receiver and recorder. At the same time C1 is discharged, and C2 applies a negative pulse to pin 2 of the timer, which triggers, discharging C4. The out--put of the timer goes high for one minute, allowing time for the re-corder and receiver to warm up. As the timer output goes low, C4 charges through Q4 momentarily, operating RLC which starts the recorder.

At the end of the preset time the clock contacts open, discharging C2 through Q2 and Q3 which delays RLA from dropping out by approx--imately 5 seconds. As the clock contacts re-open C1 charges through Q1, operating RLB opening the normally closed stop contacts for a short period, stopping the recorder. After the 5 second delay has elapsed, RLA opens, removing power from the equipment.

RLB and RLC may have light con--tacts, but RLA must be a heavy duty mains rated type. Ideally the digital clock should be crystal controlled, to eliminate short term mains freq-uency fluctuations. The numbers shown in brackets are the approp-riate pin connections on the 10 way remote control plug of a Revox A77.

Battery Tester

R. N. Soar.

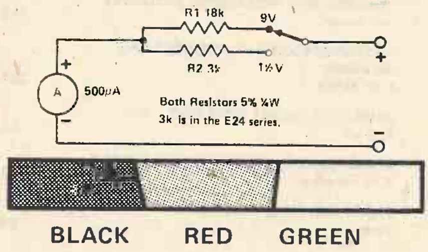
This circuit was designed as a simple tester for 1.5 and 9 volt batteries.

It uses a cheap 500μA recording level meter of the kind used in cassette recorders, costing around 80p.

The scale is as indicated in the diagram and can be interpreted as follows—

BLACK—Replace battery
RED—Weak battery
GREEN—Good battery

A new battery should give a full scale deflection.



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DIGITAL ELECTRONICS BY EXPERIMENT PART 1

IAN SINCLAIR'S NEW SERIES IS DESIGNED TO IMPART THEORETICAL KNOWLEDGE THROUGH SIMPLE PRACTICAL EXPERIMENTS.

MANY EXPERIENCED constructors with several acres of transistor circuits behind them still fight a little shy of using digital integrated circuits. The reasons for this are not difficult to see. Most of the transistor circuits with which an experimenter learns his trade are fairly simple and show rather well how a transistor works, giving a feeling of confidence to the user.

The many excellent projects using digital integrated circuits which have been published do not give any such help to the constructor, however. They may be comparatively easy to build on a prepared PCB, they may even be reasonably easy to understand, but they *do not* give the constructor the experience which enables him to design confidently with ICs.

This series is intended to remedy that deficiency, so that the reader will gain a firm grasp of the principles of digital IC behaviour, how they work, and also a considerable amount of "hands-on" experience on a board designed to make experimenting with digital ICs particularly easy. We shall confine ourselves to the smaller scale ICs so that nothing as involved as a microprocessor will be used — the components however are chosen so that they give a good range of experience with some useful devices.

One and none

We can assume that any reader of ETI will already have *some* knowledge of what digital circuits are about, but perhaps a very brief reminder may be of some use. Digital ICs are made up from transistor circuits of very high gain, designed to run with inputs and outputs which can take up only two possible states which we call 1 and 0. In most applications, 0 will mean a voltage very near to earth potential, and 1 near to the full supply rail.

The ICs we shall use in this course will be from the well-known TTL series, developed by Texas, and also available from several other manufacturers. There are several reasons for this: the devices are readily available and at very low prices and advertised in ETI, they are much less easily damaged electrically than the alternative CMOS.

Going places with nothing

When an input of a TTL gate is left open-circuit it automatically reverts to a "1". The reason for this is that the input to TTL gates is to one emitter of a multiple-emitter transistor whose base is connected through a limiting resistor to the +5 V line. Leaving an input o/c means that the emitter terminal will take up the same voltage as the base terminal. This cannot be done when CMOS devices are used.

For our course on digital electronics we shall need seven digital ICs and one "jumbo" display, a full inventory of semiconductors being shown in Table 1, and in addition we shall also need a few other assorted components as noted therein. Where a source of 5 V supply is not available, a stabiliser can be included on the board, so that the experiments can be carried out using a car battery or any dc supply in the 6 V to 12 V range. Note that the current taken will be up to 350mA.

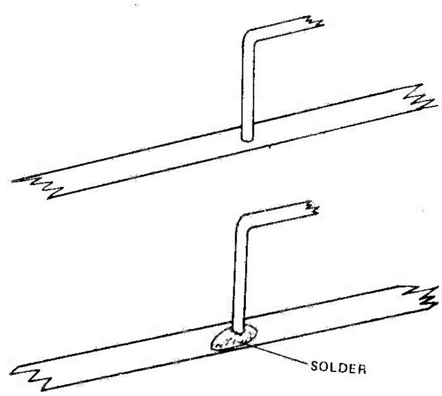


Fig. 1. The method of attaching components to the Blob Boards. The "leg" can be simply bent to one side and then solder "blobbed" over the lead to hold it. Since the boards are tinned, and the leg ought to be, a sound joint is ususally obtained.

Heart to heart

The heart of the whole project is the circuit board on which the ICs and all other components can be mounted. This is one of the new series of "Blob Boards" — recently announced in ETI — in this case the ZB-8-IC. Blob Boards consist of wide strips of tinned copper on the usual insulating board, and their main feature is that components are mounted on the same side of the board as the strips.

This, of course, is not a new principle in digital IC construction, since this method has been used for some time where digital ICs are mounted on double-sided boards.

Housing and boarding

The ZB-8-IC as its name suggests, has mounting pads for eight ICs, including the display which we have specified. The suggested layout for the ICs is shown in Fig. 3, where we can see that the top left hand corner houses the 7414 Schmitt inverter, and the 7400 Nand gate; the top right hand corner has the two 7476 J-K flip-flops. At the bottom left hand corner, we have a 7494 shift register and the 7490 decade counter. The bottom right hand corner contains the 7447 BCD-7 segment decoder-driver and the display. All of the ICs have conventional DIL fourteen or sixteen pin bases, but the display has a base which is an eighteen pin type with several pins omitted, so that this will just fit the pads on the board. The spacing between the lines of pins (0.6") is a little on the large side compared to the other ICs, but with

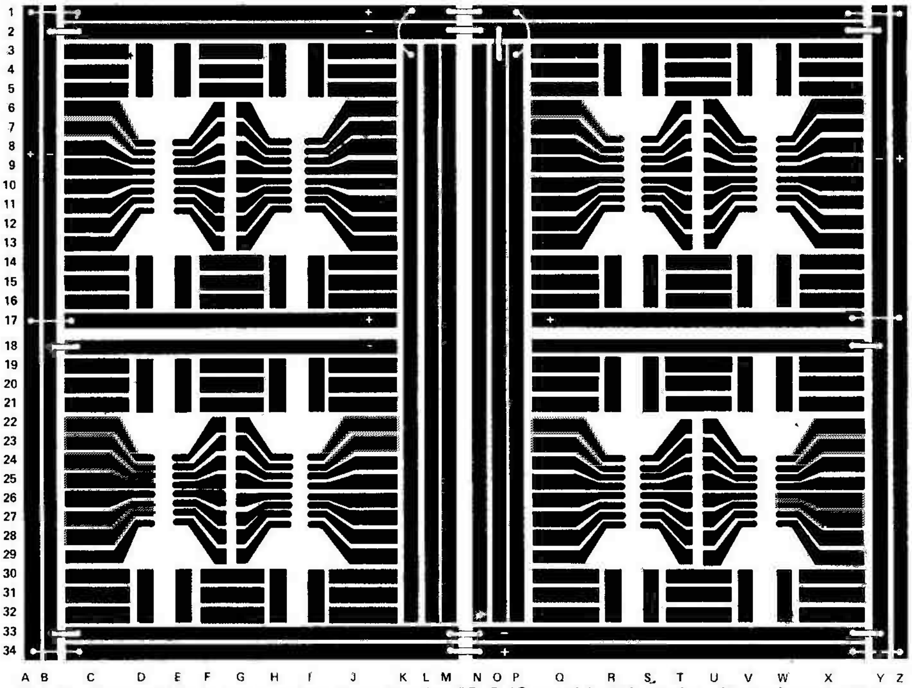
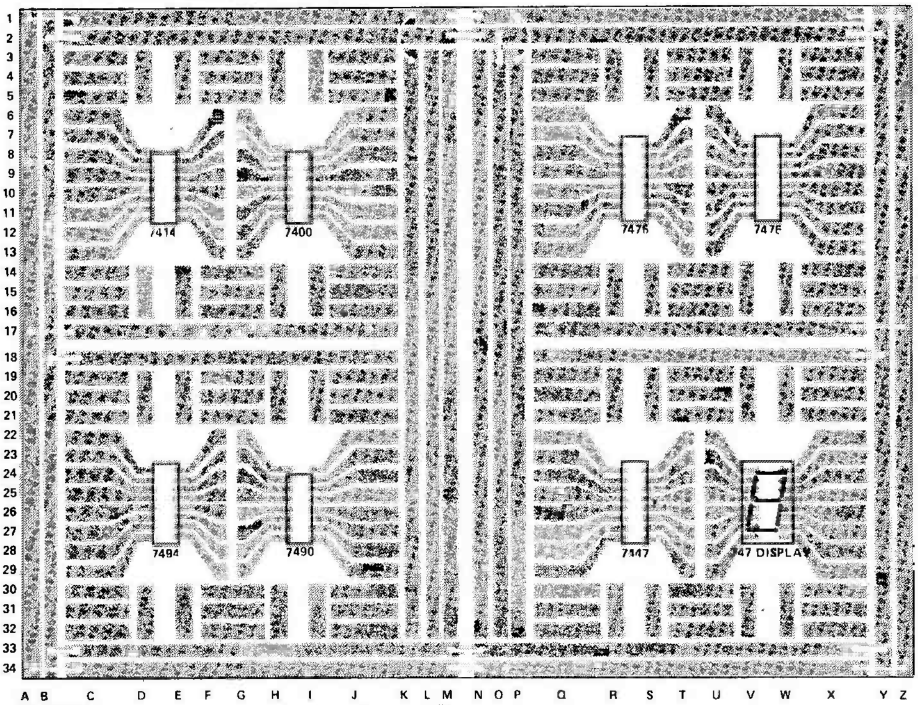


Fig. 2. Above: This is the track pattern for the ZB-8-IC used in this series. Note the wire links which need to be made in order more easily facilitate application.

Fig. 3. Below: Components in place on the board. Note that unlike our usual overlays, the tracks are on the SAME side as the components.



care it can be accommodated. In the circuits which we are using we shall not normally need the decimal point on the display, but its connection may as well be made just in case.

Before any experiments are started then, it is advisable to solder all the ICs and the display on to the board, so that this does not have to be done when it becomes cluttered by other components. Since each circuit mounts on to pads which are isolated unless other connections are made, no harm is done by leaving an IC soldered on to the board.

It is for this reason, incidentally, that it is not desirable to use CMOS circuits in such a project, since the protection diodes built into CMOS ICs will operate only when the power supplies are connected.

In the prototype, the lines running round the edge of the Blob-board were used for supplies, the outer line taken as the positive 5 V line, and the inner as earth. It is quite convenient also if the shorter lines running across the board between each pair of IC pads are also used as 1 and 0 lines as well. The vertical lines at the centre of the board may also be used. If a stabilised 5 V supply is available for operating the board then little else needs to be done other than connecting the power pack to the lines at the edge of the board.

Stable lines

If a stabilised supply is not available, however, a stabiliser should be built on to these lines. A suitable circuit is shown in Fig. 7 using a BD131 and 2N697, both of which are readily obtainable.

It is extremely important that TTL circuits should not be operated at voltages above 5.25 V AT ANY TIME, since the inputs to TTL circuits are to the emitters of transistors, with the bases connected to the positive supply. If the inputs to the emitters are earthed (at 0V), too much current will flow in the base-emitter junctions, though if all the inputs are earthed, over-voltage is much less likely to cause much harm.

Led about the board

Above and below each mounting pad there are several short pads usually three horizontal and two vertical, and these are very useful for mounting components such as LEDs, which are used to indicate the state, 0 or 1, of any output. Note that on most LEDs there is a flat portion of the plastic case near the leadout wires which indicates which leadout wire is

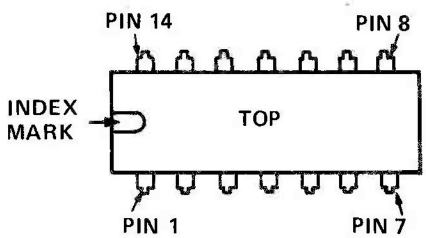
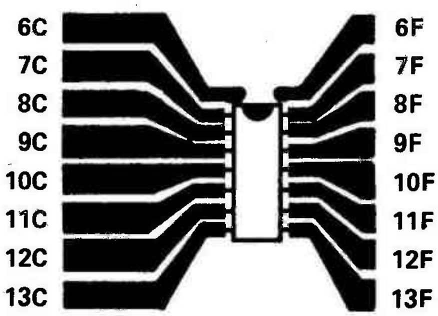


Fig. 4. To Right: The layout for the digital TTL series. This is looking down at the device from above. Usually, but NOT always power is applied to pin 14 and pin 7 is earthed.

Fig. 5. Bottom: Positioning the ICs onto Blob-Board pads. Make usre the legs line up.



HOW IT WORKS

The action of the circuit is as follows. The connection of the 1k resistor between the collector and the base of the BD131 normally ensures that the BD131 remains conducting, but the 4.3 V zener diode ZD1 will set the voltage at the base of the 2N697 at about 4.3 volts less than the voltage at the emitter of the BD131. The 2N697 will start to conduct when its base voltage is approximately 0.6 V positive to its emitter voltage, that is when the emitter of the BD131 is at about 4.9 V positive.

An increased voltage here will cause more current to flow in the 2N697 (each 80 mV increase of voltage at the base of a conducting transistor causes the collector current to rise tenfold), drawing current through the 1k resistor and therefore lowering the voltage at the base and emitter of the BD131; in this way the circuit stabilises at about 4.9 — 5.0 V. The second zener diode, ZD2 is a 5.6 V type which is a safety measure should the BD131 ever fail to a short circuit. In the event of such failure, ZD2 could absorb the extra current until the power supply fuse melted. If a battery is used as a source, a 500 mA fuse should be included.

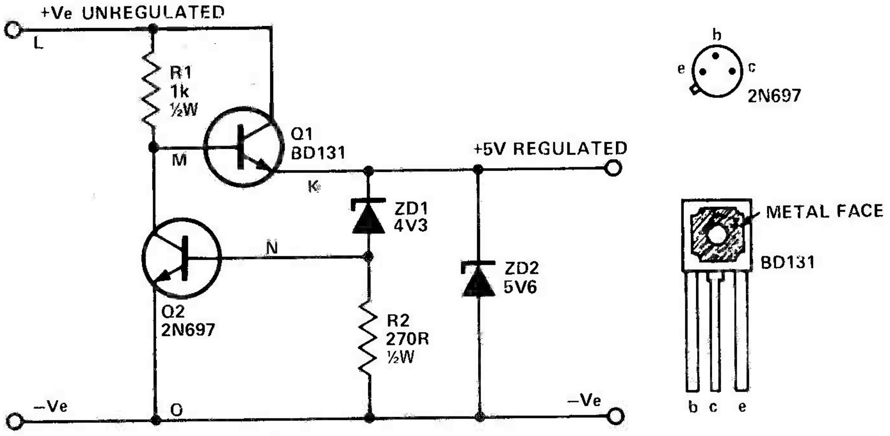
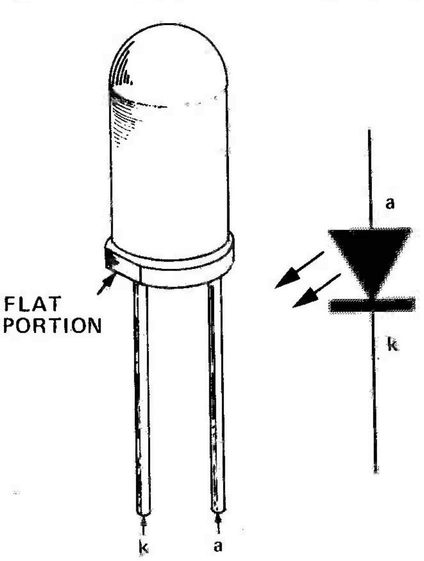


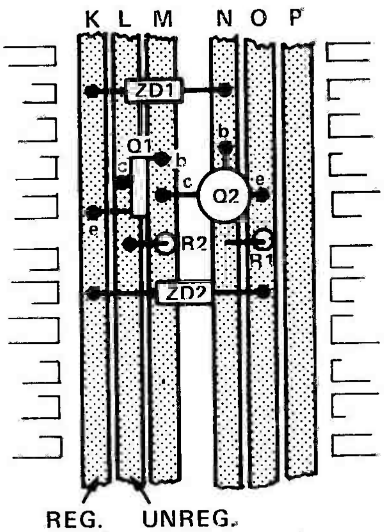
Fig. 7. Above: Circuit diagram for a suggested power supply to run the experiments, and, Fig. 8., below, a layout to build this circuit onto the board itself.

the cathode. Since we are using the LEDs to light on a "1" state, the cathode of each LED is connected to earth, and the anode through a limiting resistor to the IC output. This resistor value is higher than we would normally use, but suits this application, as we do not want the LEDs to draw too much current from the IC outputs. When we come to use the display, we shall also use large value limiting resistors.

With all the ICs mounted in place, we are ready to start our work on Digital Electronics By Experiment series, with the first set of experiments in next month's issue.

Fig. 6. Identifying led connections has caused many a paralysed moment of doubt-look for the flat bit, if there's one present then your problems are over.





PARTS LIST

COMPONENTS NEEDED FOR THE SERIES

Note: Only the essential basic components are listed here. For various additional suggested experiments, additional resistors and capacitors will be needed; these values will be critical.

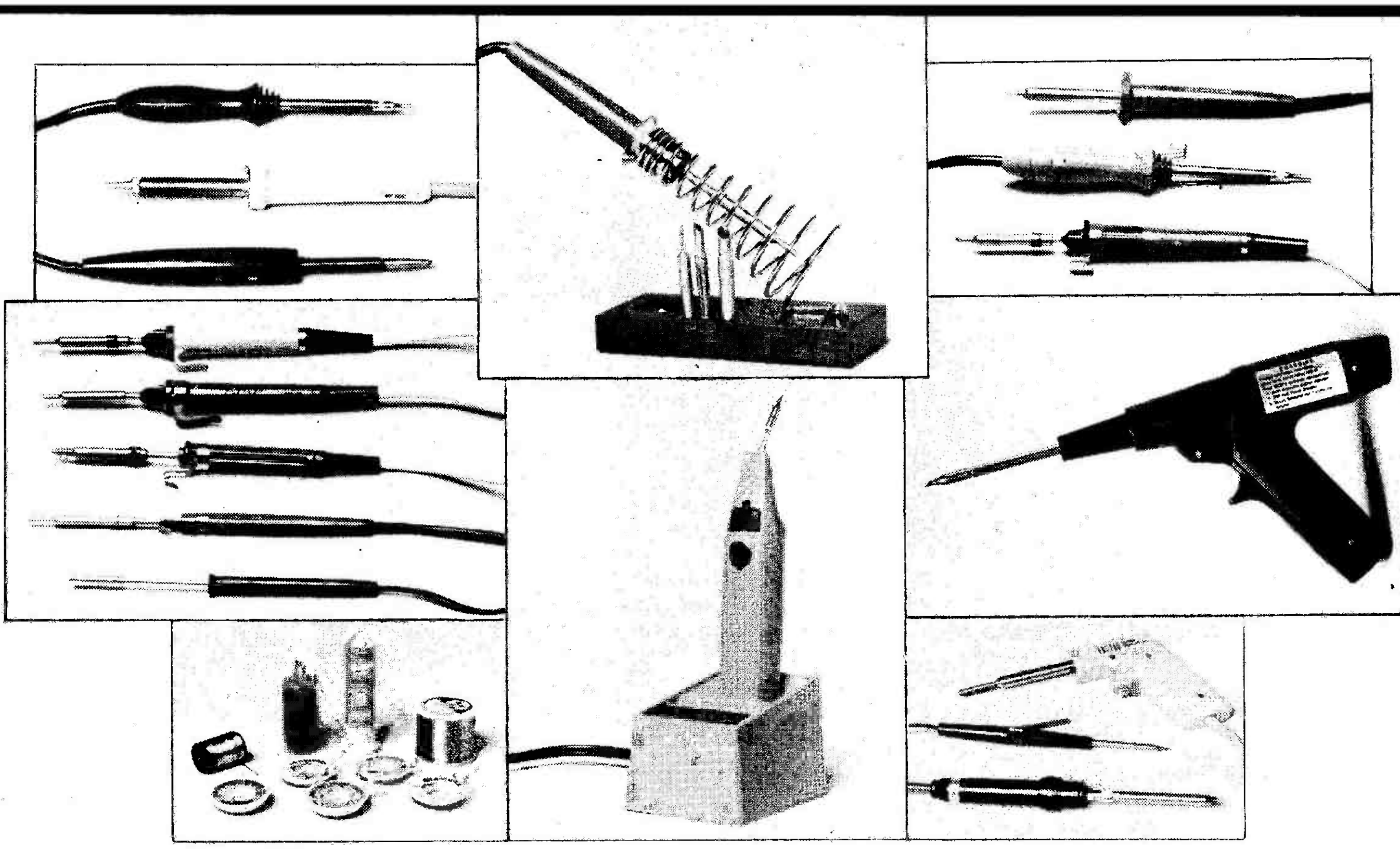
SEMICONDUCTORS
1 x SN7414N
1 x SN7400N
2 x SN7476N
1 x SN7494N
1 x SN7490N
1 x SN7447N
1 x 747 Display

OTHER COMPONENTS
1 x 0.1uF
1 x 1.0uF
1 x 10uF
1 x 100uF
1 x 680uF
1 x 1000uF
All the above 10V working, or more.
10 x 470R resistors, 0.125W or more
6 Miniature push-button switches (Sintel)
5 metres of single-core wire

STABILISER COMPONENTS
1 x 2N697
1 x BD131
1 x 4V3 Zener Diode
1 x 5V6 Zener Diode
1 x 270R 0.5W
1 x 1k, 0.5W

BOARD
1 ZB-8-IC Blob-Board

For a few applications in later parts of this series, a silicon NPN transistor may be used as an alternative to some long stretches of wiring (to connect a reset terminal on a counter). For this application, any working small signal type is suitable.



soldering iron survey

IN THE EARLY DAYS of electronics a soldering iron was something you heated on a gas ring, happily those days are long gone (at least we hope ETI readers have stopped!); this was when a breadboard was really a breadboard . . . the modern equivalent bears as much resemblance as Concorde does to the Wright Brothers' first machine. There are four basic types of iron that are commonly used in electronics.

1. Continuous heat
2. Temperature controlled
3. Quick heat
4. Rechargeable

Each of these types has particular usage and characteristics, and the correct iron must be picked for the job, not much use having a 240 V iron in the middle of a field where you need a rechargeable iron (providing it's got a charge!).

Most irons consist of three basic parts, the handle, a heating element and a bit. The heating element can operate off a voltage in the range 0V5 to 250V, also the heating power (measured in watts) can vary from 50W to 300W. The bit can come in dozens of shapes, sizes and finishes — each particular one being correct for different jobs. Obviously no manufacturer makes a 300W ¼ inch diameter iron with a ⅛ inch triangular gold plated bit, but the variety is endless. We hope that you can find the perfect iron(s) for your own use after reading this article.

Without soldering irons, the electronics industry would collapse overnight, in order to prevent this, dozens of irons are produced by a multitude of firms. Why do we need them? Simple, until some bright spark can come up with a conductive glue — that can be used and dissolved at room temperature — we have to use solder, and to use solder we need a source of high temperature. Solder used in electrical connections is an alloy of tin and lead. Tin when pure melts at 327°C and can be 'plastic' from 183°C when impure. Lead melts at 232°C when pure and can be 'plastic' from 183°C also. Any movement during the 'plastic' stage will result in a faulty joint, therefore both metals are unsuitable on their own. However, when they are mixed we get a different set of characteristics and the melting temperature is lower than for the pure metals, also the 'plastic' region changes. When the mixture is 63% tin and 37% lead the 'plastic' region disappears, and the solder changes from solid to liquid at precisely 183°C. In practice a small 'plastic' region is desirable, so 60% tin to 40% lead (60/40) is used for virtually all electronic solder — this has a 'plastic' range of about 5°C, and means that the chance of moving a joint, while in the 'plastic' state is quite small.

Flux

So armed with 60/40 solder and a soldering iron, we can join leads together . . . or can we? Not quite, all metals are covered with an oxide film which prevents the solder fusing with the metal. This film is formed virtually instantaneously, on contact with atmospheric oxygen, so cleaning leads before soldering will not help. For a reliable low resistance joint, this oxide must be removed by a flux during the soldering. Electrical flux is made of wood or gum resin, with a small quantity of activator. The molten resin wets the solder and the metal, and the activator dissolves the oxide present, enabling the solder to flow freely and form a molecular bond, with the metal.

Modern solders have the correct flux in the stripes (like toothpaste); the most common type uses 5 resin cores. No additional flux is required when this type of solder is used, any excess hardens on the surface of the joint. Acidic flux must NEVER be used on electronic equipment, as it will corrode the component leads and pcb tracks. Also the use of any solder/flux combination other than normal, will void any component, kit or equipment guarantee.

A Bit About Bits

Virtually all bits are made from copper, to provide maximum heat transfer from element to tip. However because pure copper does not last very long, when used as a bit, various coatings are available to prolong its useful life. Nickel or chromium is used to coat the body of most bits, this stops the molten solder 'running back' over the whole bit, and helps prevent oxidation. Pure iron can also be used on the tip of bits to give a very long life.

Copper bits have the advantages of low initial cost, and give the best solder flow — but need to be filed back into shape at fairly frequent intervals. Iron coated bits must NEVER be filed, as this will destroy their coating, and should be wiped on a damp sponge when hot to remove excess solder. The actual shape of the tip is important and five types are common.

1. Single Chisel, this is the standard shape which can be used for most applications. Provides maximum accessibility and visibility, is available in most sizes.

2. Tapered Chisel, is the standard shape on a reduced tip size, the taper provides maximum heat transfer to the tip.

3. Double Chisel, has two faces with an included angle of usually 80°. Intended to allow simultaneous contact with component lead and pcb track.

4. Tapered Double Chisel, for pcb work on small sizes, gives maximum heat transfer in confined spaces.

5. Screwdriver, is a double faced bit with small included angle, used for tags and awkward locations.

Continuous Heat Irons

The most common soldering iron is the continuous heat type, mainly because they are the easiest to make and hence the cheapest! They usually consist of an element of resistance wire, in an insulated barrel, onto which the bit either slips over or into, although some brands have a screw-in bit. They are manufactured in wattages from 5W to 250W, but for general use the ones in the 15W to 30W range are commonly used. These irons are left running continuously, and as a result tend to wear out bits quite rapidly, and can often provide too much heat (if not used regularly during a session).

Voltages available range from 6V to 240C AC/DC, although most irons used in the home are 240V, low voltage operation via a transformer has the advantage of much higher safety. Most people find the continuous heat type of iron satisfactory for general hobby work.

Key to heading photographs

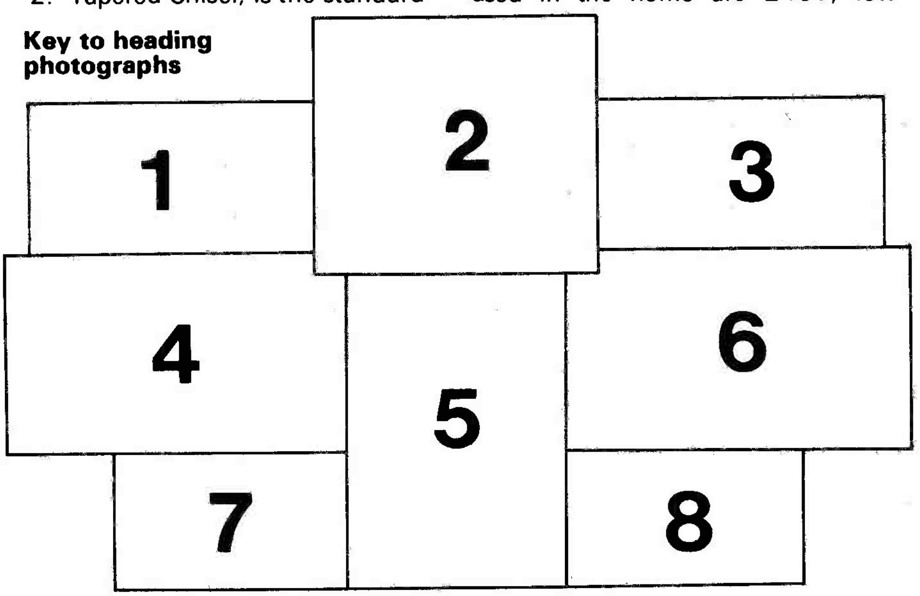


Photo 1: Top to bottom, Greenwood Electronics Oryx 50, Weller WP60D and Light Soldering Developments TC50. All these irons are temperature controlled.

Photo 2: Light Soldering Developments, Conqueror iron complete with stand and spare bits.

Photo 3: Top to bottom, Adcola K2000 series, Greenwood Electronics Oryx 30 and Antex X25. These irons are all continuous heat types in the 25W to 30W range.

Photo 4: Top to bottom, Antex CX, S&R Brewster Type 1, Antex C, Adamin 15 and Oryx 9. These irons are continuous heat types in the range 8W3 to 18W.

Photo 5: Wahl Isotip Quick charge iron, distributed by Greenwood Electronics. Rechargeable, cordless iron for field and bench use.

Photo 6: Scope Cordless, distributed by A.G.B. Southern Cross, rechargeable gun type.

Photo 7: Solder and desoldering braid in various sizes, available from Adcola, Multicore and Light Soldering Developments.

Photo 8: Top to bottom, Ersa Sprint from Greenwood Electronics, Scope Miniscope and Superspeed (both from A. G. B. Southern Cross). These three are instant heat types with built in triggers or switches.

Temperature Controlled Irons

These irons are about twice the price (at least) of the common continuous type, but worth every penny! They are commonly used on production lines, where their advantages can save large sums in preventing component replacement — due to overheating or bad joints. Basically they maintain a set, optimum, temperature all the time they are on.

There are three basic methods employed to keep irons at a fixed temperature. Weller use the Curie effect in magnetic materials to interrupt the supply to the element. When a ferromagnetic material is heated above its Curie point it stops being magnetic, for nickel this temperature is 360°C and for iron it is 727°C. On the same sort of principle as mixing tin and lead to obtain a new characteristic, a specific Curie point can be obtained by mixing ferromagnetic materials.

On the Weller iron a different bit is required for each temperature, when cold a small piece of ferromagnetic material (called the sensor by Weller) attracts a magnet. This magnet is connected via a spring to a switch in the elements supply lead. When the iron reaches operating temperature, the sensor forgets that it is magnetic and the magnet pulls away — switching off the element, the sensor cools down and becomes magnetic again, attracts the magnet . . .

The only drawback is that a different bit must be used for each specific temperature, although you do know exactly what temperature you are getting. Also because the bits are rather special they are more expensive than normal.

The second common method used in temperature controlled irons is a mechanical thermostat. This method is used by Greenwood Electronics and Light Soldering Developments in their Oryx 50 and TC50 respectively. Both operate on the expansion of a sensor which operates a switch, the big advantage over the Curie system is that the temperature can be altered easily. In fact both irons can have their temperatures altered whilst in use, the disadvantage is that without some form of measurement instrument, you can't tell the exact operating temperature.

The third and most sophisticated

Manufacturer or Distributor	Model	Wattage	Voltages available	Bits* (mm)	Temp °C	Leakage Current	Length (mm)	Weight (g)	Inclusive Price	Other information
Continuous heat										
Greenwood	Oryx 9	8.3	6, 12, 24	4 (2)	325		157	7	3.34	Low power, general purpose
L.S. Developments	Adamin 15	12	6, 12, 15, 24, 115, 220, 240	2.4 (13)	360		181	14	3.60	● Precision, hand wound element.
L.S. Developments	Standard 90	12	6, 12, 24, 50, 115, 220, 240	2.4 (4)	360		190	20	4.20	●□ Available as 16W (420°C) also, hand wound element.
L.S. Developments	Adamin 18	15	6, 12, 15, 24, 115, 220, 240	2.4 (13)	400		181	14	3.60	● Precision, hand wound element.
Antex	C	15	24, 50, 100, 115, 220, 240	2.3 (8)		10 μA	160	28	3.92	Kit SK1 available, including spare bits and storage box.
Antex	CCN	15	220, 240	2.3 (5)		1 μA	180	20	4.18	Ceramic shaft used, for ultra low leakage.
Antex	CX	17	115, 240	2.3 (5)	370	5 μA	190	40	3.92	Double shaft encloses element.
Adcola	Invader L706	17	12, 24, 110, 220, 240	3.2 (15)	360	18 μA	196	42	5.20	●ΔAvailable as 20W (410°C) also
Antex	G	18	115, 220, 240	2.3 (3)		10 μA	160	28	4.18	More powerful version of model C.
S&R Brewster	Type 1	18	110, 240	3 (3)		10 μA	195	120	3.70	Weight includes lead, slotless bit construction.
L.S. Developments	Conqueror	18	12, 24, 115, 220, 240	3.2 (15)	400		200	35	3.82	●□ Stainless steel shaft.
L.S. Developments	Standard 142	20	6, 12, 24, 50, 115, 220, 240	3.6 (8)	380		200	35	4.28	●□ Available as 22W (420°C) also, hand wound element.
Adcola	Invader L646	23	12, 24, 110, 220, 240	4.7 (16)	360	180 μA	222	57	5.37	●Δ■ Available as 25W (410°C) also
L.S. Developments	Standard 187	24	6, 12, 24, 50, 115, 220, 240	4.7 (8)	380		203	50	4.40	●□ Available as 27W (420°C) also
Antex	X25	25	120, 240	3.2 (4)		5 μA	220	50	3.92	Two DIL bits available in range.
Antex	MLX	25	12	3.2 (2)		5 μA	220	50	4.59	Fitted with crocodile clips, battery version of X25
Adcola	Invader L1076	27	12, 24, 110, 220, 240	6.3 (12)	360		216	71	5.54	●ΔAvailable as 30W (410°C) also
Greenwood	Super 30	27	115, 220, 240	4.8 (9)	365	3 μA	204	115	4.10	Weight includes lead, neon built in, long life element.
Temperature Controlled										
Weller	TCP-2	45	24	3.2 (40)	260, 315, 370, 430, 490		210	—	10.88	Change tip to alter temperature, Curie effect, holder/supply available.
L.S. Developments	TC 50	50	24, 50, 115, 240	3.2 (10)	180-420		220	70	10.04	Continuously variable while running (allen key), neon light built in, expansion thermostat.
Greenwood	Oryx 50	50	12, 24, 50, 115, 240	3.2 (10)	200-400		200	—	8.86	Continuously variable while running (allen key), neon light built in, expansion thermostat.
Weller	WP 60D	60	240	3.2 (18)	315, 370, 430		210	—	14.32	Change tip to alter temperature, Curie effect
Greenwood	Oryx 75	75	220, 240	3.2 (10)	300-425		230	107	14.31	Continuously variable, solid state control.
Quick Heat										
A.G.B. Southern	Mini Scope	75	2.5/6	2 (1)			215	50	5.10	Transformer £6.35, 5 second warm up, element in tip.
A.G.B. Southern	Superspeed	150	2.5/6	6.4			250	100	5.10	Transformer £6.35, 5 second warm up, element in tip.
Greenwood	Ersa Sprint	150/80	210, 240	6.4			200	200	10.58	Two position trigger, 80/150W power 10 second heat up.
Rechargeable										
Greenwood	Isotip Standard	50	115, 240	4 (4)	370		203	150	16.63	12 hour charge, 125 joints, built in light, 5 second warm up, charger supplied.
Greenwood	Quick charge	50	115, 240	4 (4)	370		203	150	18.90	4 hour charge, otherwise same as Isotip standard, drill attachment available.
A.G.B. Southern	Scope cordless	60	240	2.4 (1)			275		18.15	12 hour charge, 100-300 joints, 6 second warm up transformer £6.35
Weller	WC 100	100	115, 240	1.5 (2)	430		—	—	—	Not available in UK till late 1977.

All prices listed are 1 off, inclusive of VAT and postage. For fuller details of any iron contact the manufacturer direct.

Adcola Products Ltd., Adcola House, Ganden Road, London SW4 6LH.
Antex Ltd., Freepost, Plymouth PL1 1BR.
S. & R. Brewster Ltd., 86-88 Union Street, Plymouth, PL1 3HG.
Greenwood Electronics Ltd., Portman Road, Reading RG3 1NE.
Light Soldering Developments Ltd., 97/99 Gloucester Road, Croydon, Surrey.
Multicore Solders Ltd., Wood Lane End, Hemel Hempstead, Herts HP2 4RQ.
A.G.B. Southern Cross Ltd., Cell Farm, Church Road, Old Windsor, Berks.
Weller Division, Cooper Tools Ltd., Wear District 6, Washington, Tyne and Wear, NE37 1NA.

● Burnproof cable available to order
□ Inbuilt neon available to order
ΔAdcola 'Invader' range being replaced with K1000 and K2000 range late 1977
■ 12V version complete with protective sleeve, to enable storage while hot £6.57
*Bit supplied followed by number of alternative bits available

method, is used in the Oryx 75 from Greenwood Electronics, a temperature sensor controls a triac, with all the circuitry built into the handle. Adcola, Light Soldering Develodpments and Weller, all produce similar systems but they all use an external control unit.

Quick Heat Irons

In general quick heat irons are very powerful, with 150W not being unusual. Main advantage is that as well as being fast to heat up (usually less than 10 seconds) they cool down quickly as well. This means that they can be used in confined spaces, to apply enormous heat to a specific point. Not really for delicate electronic work, but ideal for intermittent handyman usage.

These irons fall into two types, normal mains powered (such as the Ersa Sprint from Greenwood Electronics), and low voltage high current (Superspeed from A.G.B. Southern Cross). The low voltage types are unusual, in that the heating current is passed through the bit itself.

Rechargeable Cordless Irons

The drawback with soldering irons always was that you needed a source of power, be it mains or a car battery. With the advent of high power rechargeable NicCad batteries this changed. The first company to produce a cordless rechargeable iron, was the Wahl Corporation — the Isotip Standard. Since then Scope and Weller have also produced irons on the same principle. Gone are the days of ½-mile extension cables, you can solder a hundred or so joints anywhere.

Not really intended to continuous use in a workshop, rechargeable irons are mainly used for field repairs (sometimes literally). The Isotip comes complete with stand/charger unit and is available in 12 hour and 4 hour charge versions, the Scope Cordless is unusual in that it is a pistol shape — its performance is otherwise similar to the Isotip Standard. The Weller WC 100 is available in the U.S.A. (and in the U.K. shortly).

Although relatively expensive, rechargeable irons are valuable for the professional repairman, and can be expected to undergo much development in the future. In fact we wonder if the disposable iron is just around the corner?

Choice of Iron

When soldering new components, with 60/40, a bit temperature of 250°C is adequate. For melting old solder a temperature of 315°C is required, 370°C for large connections. An iron of 15W to 30W is suitable for most purposes, if you do a lot of construction a temperature controlled iron is a wise investment. Quick heat irons should be used for heavy connections around the house, rechargeable irons are unique; if you need one, you need one. Rather than having to keep changing bit size, consider two irons — one 15W with a fine bit and a 25W with a larger bit.

Other soldering accessories to obtain include desolder braid or a desolder gun, a stand for your iron, spare bits in a wide selection, heatshunt to protect delicate components and last but by no means least, decent sidecutters to snip component leads –whoops nearly forgot, solder in thin and thick gauges. Remember soldering is an art, and to get artistic results you need good tools. ●

ETI DATA SHEET

570/571 DUAL COMPANDOR — SIGNETICS

The 570/571 is a versatile low cost dual gain control circuit in which either channel may be used as a dynamic range compressor or expandor. Each channel has a full wave rectifier to detect the average value of the signal; a linearized, temperature compensated variable gain cell; and an operational amplifier.

Circuit description

The 570/571 compandor building blocks, as shown in the block diagram, are a full wave rectifier, a variable gain cell, an operational amplifier and a bias system.

The full wave rectifier rectifies the input current which flows from the rectifier input, to an internal summing node which is biased at V_{REF}. The rectifier current is averaged on an external filter capacitor tied to the C_{RECT} terminal and the average value of the input current controls the gain of the variable gain cell. The gain will thus be proportional to the average value of the input signal for capacitively coupled voltage inputs.

The speed with which gain changes to follow changes in input signal levels is determined by the rectifier filter capacitor. A small capacitor will yield rapid response but will not fully filter low frequency signals. Any ripple on the gain control signal will modulate the signal passing through the variable gain cell. In an expandor or compressor application, this would lead to third harmonic distortion, so there is a tradeoff to be made between fast attack and decay times, and distortion.

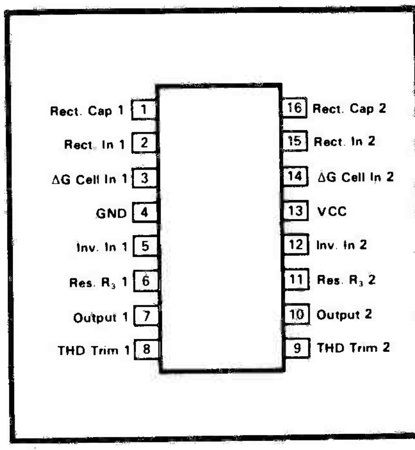
A compensation scheme built into the ΔG cell compensates for temperature, and cancels out odd harmonic distortion. The only distortion which remains is even harmonics, and they exist only because of

Features

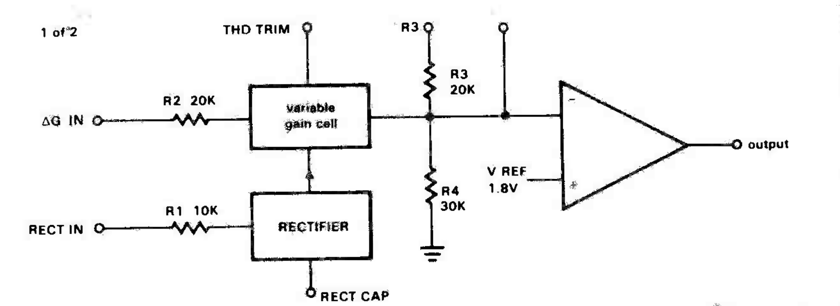
- Complete compressor and expandor.
- Temperature compensated
- Greater than 110dB dynamic range
- Operates down to 6Vdc
- System levels adjustable
- Distortion may be trimmed out

Applications

- Telephone subscriber compandor
- High level limiter
- Low level expandor — noise gate
- Dynamic noise reduction systems
- Voltage controlled amplifier
- Dynamic controlled amplifier
- Dynamic filters



BLOCK DIAGRAM



internal offset voltages. The THD trim terminal provides a means for nulling the internal offsets for low distortion operation.

The operational amplifier (which is internally compensated) has the non-inverting input tied to V_{REF}, and the inverting input connected to the ΔG cell output as well as brought out externally. A resistor, R_3, is brought out from the summing node and allows compressor or expandor gain to be determined only by internal components. The output stage is capable of ±20mA output current. This allows a +13dBm (3V5 rms) output into a 300 ohm load which, with a series resistor and proper transformer, can result in +13dBm with a 600ohm output impedance.

Basic expandor

Figure 1 shows how the circuit would be hooked up for use as an expandor. Both the rectifier and Δ G cell inputs are tied to V_{IN} so that the gain is proportional to the average value of V_{IN}. Thus, when V_{IN} falls 6dB, the gain drops 6dB and the output drops 12dB.

The maximum input that can be handled by the circuit in Figure 1 is a peak of 3V. The rectifier input current should be limited to $1 = 3V/R_1 = 3V/10K = 300\mu A$. The ΔG cell input current should be limited to $1 = 2V8/R_2 = 2V8/20K = 140\mu A$. If it is necessary to handle larger input voltages than 0—±2V8 peak, external resistors should be placed in series with R_1 and R_1 to limit the input current to the preceding values.

The output of the expandor is biased

BASIC EXPANDOR

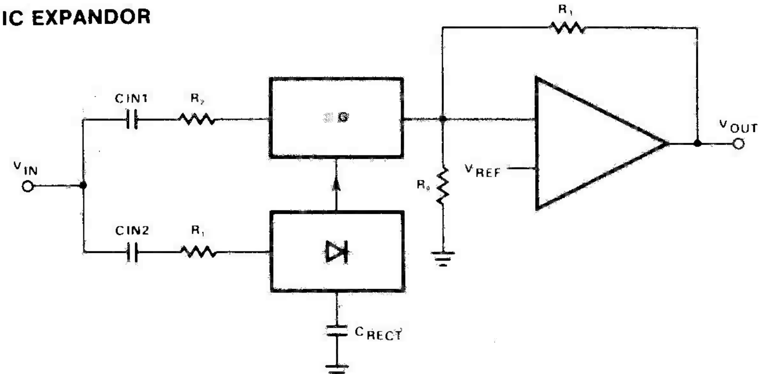


Figure 1

up to 3V by the dc gain provided by R_1 and R_4. The output will bias up to the values shown in the following equation. For supply voltages higher than 6V, R_4 can be shunted with an external resistor to bias the output up to $\frac{1}{2}V_{CC}$.

To obtain the largest dynamic range out of this circuit, the rectifier input should always be as large as possible (subject to the $\pm 300\mu A$ peak current restiction).

Basic Compressor

Figure 2 shows how to use the NE570/571 as a compressor. It is just an expandor in the feedback loop of an op amp. If the input rises 6dB, the output can rise only 3db. This is so because the 3dB increase in output level produces a 3dB increase in gain in the ΔG cell, yielding a 6dB increase in feedback current to the summing node.

The same restrictions as to rectifier and ΔG cell maximum input current still hold, which place a limit on the maximum compressor output. As in the expandor, the rectifier and ΔG cell inputs could be made common to save a capacitor, but low level tracking accuracy would suffer. Since there is no dc feedback path around the op amp through the ΔG cell, one must be provided externally. The pair of resistors R_{DC} and the capacitor C_{DC} must be provided.

Absolute Maximum Ratings	
V_{CC}	18 Vdc (571)
V_{CC}	24 Vdc (570)
T_A	−40to + 70° C
P_D	400 mW

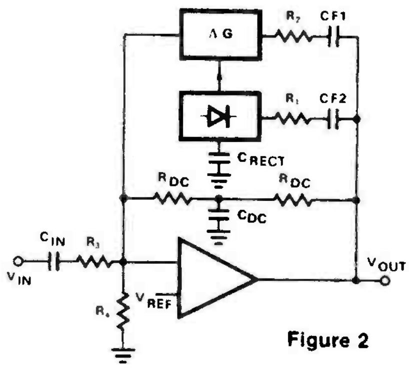


Figure 2

For the largest dynamic range, the compressor output should be as large as possible so that the rectifier input is as large as possible (subject to the $\pm 300\mu A$ peak current restriction). If the input signal is small, a large output can be produced by reducing R_3, with the attendant decrease in input impedance, or by increasing R_1 or R_2. It would be best to increase R_2 rather tnan R_1 so that the rectifier input current is not reduced.

Distortion Trim

Distortion can be produced by voltage offsets in the ΔG cell. The distortion is mainly even harmonics, and drops with decreasing input signal (input signal meaning the current into the ΔG cell). The THD trim terminal provides a means for trimming out the offset voltages and thus trimming out the distrotion. The circuit shown in Figure 3 is suitable, as would be any other capable of delivering '30µA into a 100ohm resistor tied to 1V8.

THD TRIM NETWORK

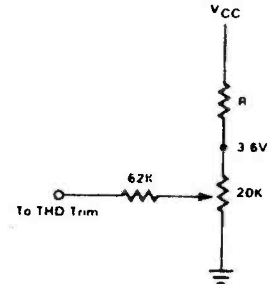


Figure 3

The Signetics 570 and 570 and 571 are due to be available shortly, for further details contact Mullard Ltd, Mullard House, Torrington Place, London WC1E 7HD.

SINTEL FOR KITS

FAST SERVICE We guarantee that Telephone Orders for goods in stock, received by 4.15 p.m (Mon-Fri) will be despatched on the same day by 1st Class Post (some heavy items by parcel post) and our stocking is good. Private customers should telephone and pay by giving their Access or Barclaycard number, with a minimum order value of £5. Official orders, no minimum.

ANNOUNCEMENT

FURTHER INFORMATION ON Z80 COMPUTER SYSTEMS AVAILABLE SOON FROM SINTEL

We will be offering two different packages. The first system, the **RESEARCH MACHINES 380Z,** will be available built and tested and also in kit form. This is a fully independent computer system when used in conjunction with a television and cassette recorder.

The second system, the **RESEARCH MACHINES 280Z,** will be available in uncased kit form, with a-low cost keyboard. The RESEARCH MACHINES 280Z is designed to set a new low in computer system pricing and it will bring a full computer system within reach of many more private computer enthusiasts.

(These computers are designed and manufactured in Oxford by SINTEL S parent company RESEARCH MACHINES LIMITED, and will be sold through SINTEL).

RESEARCH MACHINES 380Z will have the following specifications: BUILT-IN VDU: The 380Z has a UHF output which plugs into the aerial socket of a **completely unmodified** domestic television The TV screen will then display 24 rows of 40 characters (960 characters). The unit can display the 128 character IS07 set, including upper and **lower** case ASCII. VDU GRAPHICS: The 380Z can display graphics on the TV screen on a matrix of 80 (horizontal) x 72 (vertical). Graphics and alphanumeric characters can be intermixed. INPUT: Very high quality, robust keyboard with ASR-33 standard layout. CASSETTE INTERFACE CUTS. Kansas City standard, 300 bits per second. CPU SPEC: Z80 Microprocessor. Fully buffered bus. RANDOM ACCESS MEMORY 4K bytes dynamic RAM minimum. The system can accommodate up to 32K bytes without adding any memory PCBs. Using a page select mode, the computer memory can be expanded indefinitely. FIRMWARE (This means software supplied and available at Switch-On, in ROM, otherwise known as the MONITOR). MONITOR COMMANDS: List Memory, Modify Memory, Load From Cassette, Dump On Cassette, Single Step 'Trace', Go To User Programme, Breakpoint, etc. SOFTWARE: We Will Be Offering: Extended Monitor, Various Basics, Text Editor with both a sequential and immediate mode, Machine Language Graphics Subroutines, Games Packages, Resident Assembler. HARDWARE CONFIGURATION: Computer is house in an instrument case with power supply, and a lot of room for expansion. Keyboard is in a separate case. All connections between units are made with unpluggable connections.

RESEARCH MACHINES 280Z

An exciting new low-cost computer using the Z80 microprocessor, suitable for amateur use or as a professional Engineer's Computer Development Kit. RESEARCH MACHINES 280Z features optional power supply, a low cost keyboard, VDU UHF output providing an ASCII alphanumeric display on a domestic television, cassette interface and a reasonable amount of random access memory. This system offers exceptional value for money. It will cost somewhere between the price of a Manufacturer's Development Kit using hex display and keyboard, and a fully cased computer system

Each character position on the VDU is written in to and can be read by the CPU as a memory location This means that the VDU is software controlled and can be programmed to operate in any mode, including page mode, scrolled, immediate mode editing, or fully addressable cursor. The whole VDU can be filled with new data in less than 10mSecs! Screen refreshing does not use any of the Z80's time.

Because of the high-speed software control, the VDU can display dynamic graphics for games and simulations

CMOS

Mainly RCA

		CD4020	1.28	CD4040	1.11	CD4066	0.63	CD4096	1.08
		CD4021	1.04	CD4041	0.86	CD4067	3.85	CD4097	3.85
		CD4022	0.94	CD4042	0.86	CD4068	0.23	CD4098	1.13
CD4000	0.17	CD4023	0.23	CD4043	1.01	CD4069	0.23	CD4099	1.90
CD4001	0.18	CD4024	0.80	CD4044	0.96	CD4070	0.51	CD4502	1.24
CD4002	0.17	CD4025	0.23	CD4045	1.45	CD4071	0.23	CD4510	1.41
CD4006	1.20	CD4026	1.78	CD4046	1.37	CD4072	0.23	CD4511	1.72
CD4007	0.18	CD4027	0.58	CD4047	1.04	CD4073	0.23	CD4514	2.84
CD4008	1.00	CD4028	0.92	CD4048	0.58	CD4075	0.23	CD4515	3.24
CD4009	0.58	CD4029	1.18	CD4049	0.58	CD4076	1.34	CD4516	1.40
CD4010	0.58	CD4030	0.58	CD4050	0.58	CD4077	0.45	CD4518	1.25
CD4011	0.20	CD4031	2.30	CD4051	0.94	CD4078	0.23	CD4520	1.19
CD4012	0.23	CD4032	1.02	CD4052	0.94	CD4081	0.23	CD4527	1.64
CD4013	0.58	CD4033	1.44	CD4053	0.94	CD4082	0.23	CD4532	1.39
CD4014	1.04	CD4034	1.97	CD4054	1.20	CD4085	0.74	CD4555	0.90
CD4015	1.04	CD4035	1.22	CD4055	1.36	CD4086	0.74	CD4556	0.90
CD4016	0.58	CD4036	3.29	CD4056	1.36	CD4089	1.60	MC14528	1.22
CD4017	1.04	CD4037	0.98	CD4059	4.93	CD4093	0.92	MC14553	4.68
CD4018	1.03	CD4038	1.10	CD4060	1.15	CD4094	1.94	IM6508	8.05
CD4019	0.58	CD4039	3.20	CD4063	1.13	CD4095	1.08		

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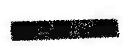

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6800 CPU CARD

Designed by John Miller-Kirkpatrick

THIS MONTH WE consider the construction of the 6800 control card for System 68 and introduce you to ETIBUG software.

Bits on Board

The PCB has been designed as a single sided board with about 30 wire links on the top side to give lowest cost with maximum flexibility. Most of the links are marked on the component overlay with the addition of some optional links to and from the uncommitted buffers in IC13. The first step in the construction is to mount the IC sockets in the positions shown and then to connect the wire links. The points marked D0-D7 next to IC8 should be linked to the corresponding points below them. Similarly points marked F-M should be connected to their corresponding points elsewhere on the board.

With the optional links recommended the group of address lines A12-A15 are connected to the four spare buffers in IC13 (designated T-W on the overlay). The outputs from these buffers (P-S) are taken to the 16 pin socket connections A-D. This will make the upper address lines available at the 16 pin socket which is intended to supplement the standard 31 way connector. The signals available at these two connectors are shown in Fig. 1.

With all of the wire links connected the resistors and capacitors should be soldered in position.

Prepare a few short links of wire to act as test probes which may be inserted into the IC sockets, arm yourself with a voltmeter and you are ready to start checking out the construction so far.

It is simplest to check out the general wiring and address decoding without the main MPU and memory in position, as these are the most expensive and delicate ICs do not insert them until you have completed the checks noted below.

31-way bus connector

The connector is as per S68 preferred bus structure with U/C pins as follows —

Pin 2	KBD	Keyboard enable output.
Pin 3	VDU	VDU enable output.
Pin 4	400	External enable output for addresses X'x400'—X'x7FF'
Pin 7	100	External enable output for addresses X'x100'—X'x1FF'
Pin 8	VMA	NAND output of VMA and $\phi 2$
Pin 9	ENBL	"Page" enable for MPU card, in basic system connect to connector pin 8 "VMA".

16-pin socket connector

Pin 1	NMI	Non maskable Interrupt input.
Pin 2	IRQ	Interrupt Request Input.
Pin 3	2	Clock phase 2 output.
Pin 4	NC	
Pin 5	1	Clock Phase 1 output.
Pin 6	HALT	
Pin 7	RESET	
Pin 8	GND	
Pin 9	Optional	
Pin 10	Optional	
Pin 11	Optional	
Pin 12	Optional	
Pin 13	GND	
Pin 14	RESET	
Pin 15	NC	
Pin 16	HALT	

Fig. 1. Signals available at 31-way bus connector and at 16-pin socket.

I See Power

Apply the 5V power supply to the PCB and check for +5V and GND at the correct positions for each IC location. Having satisfied yourself that you are not going to damage any ICs when you insert them you can now temporarily remove the power supply and install all ICs except ICs 1, 6, 7 and 8.

At this stage by using your wire probes, some taken via a pull up resistor (1k) to 5V and some taken to OV, the address decoding chips may be checked. The buffered I/O lines may be verified in a similar fashion.

Other Off-board signals

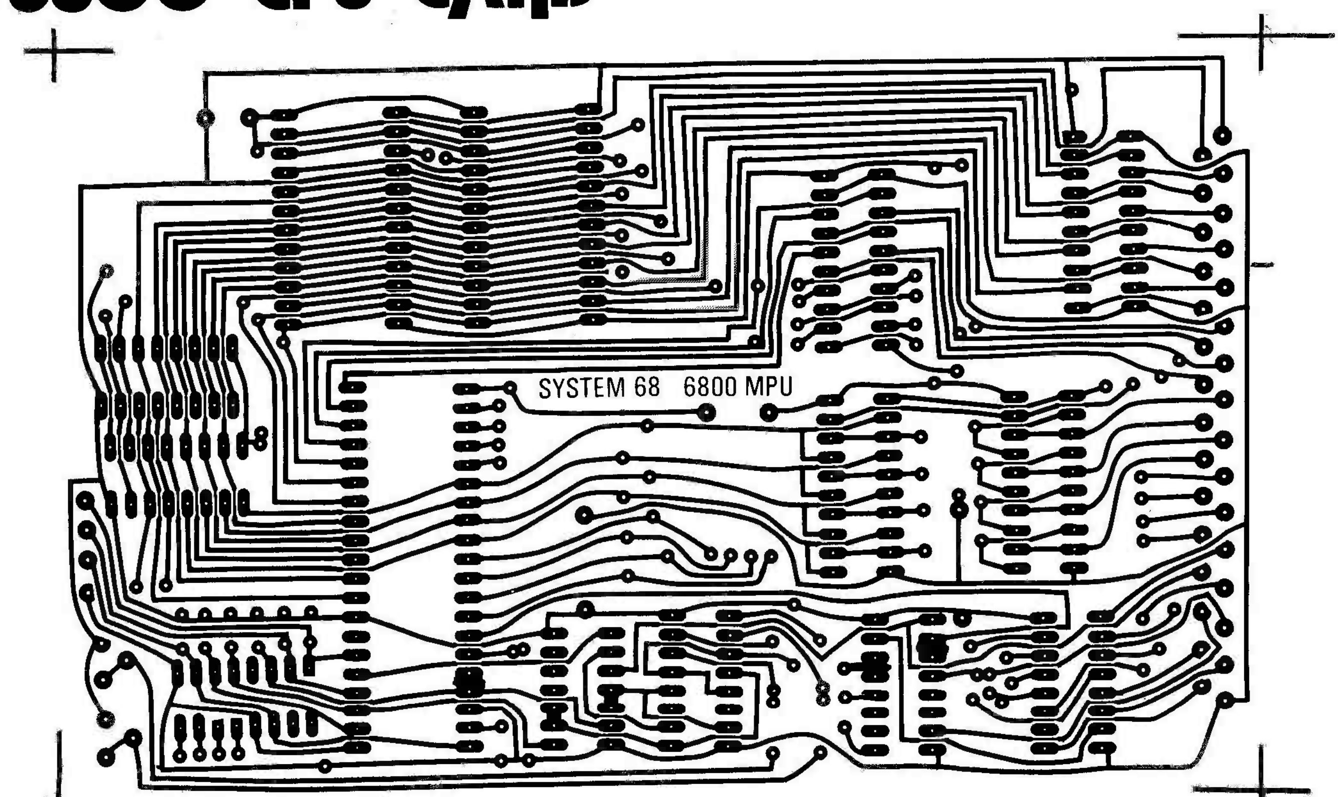
Two options are given for the control signals such as RESET and the interrupts, they are present as front panel switches and are also available at the 16 pin socket. A set of resistors pulls these signals into the RUN condition and a logic '0' applied to any signal input enables that control.

Connect the switches SW2-SW4 (and the optional SW1 if required) and check that they produce the correct signals at IC1 and the 16 pin connector.

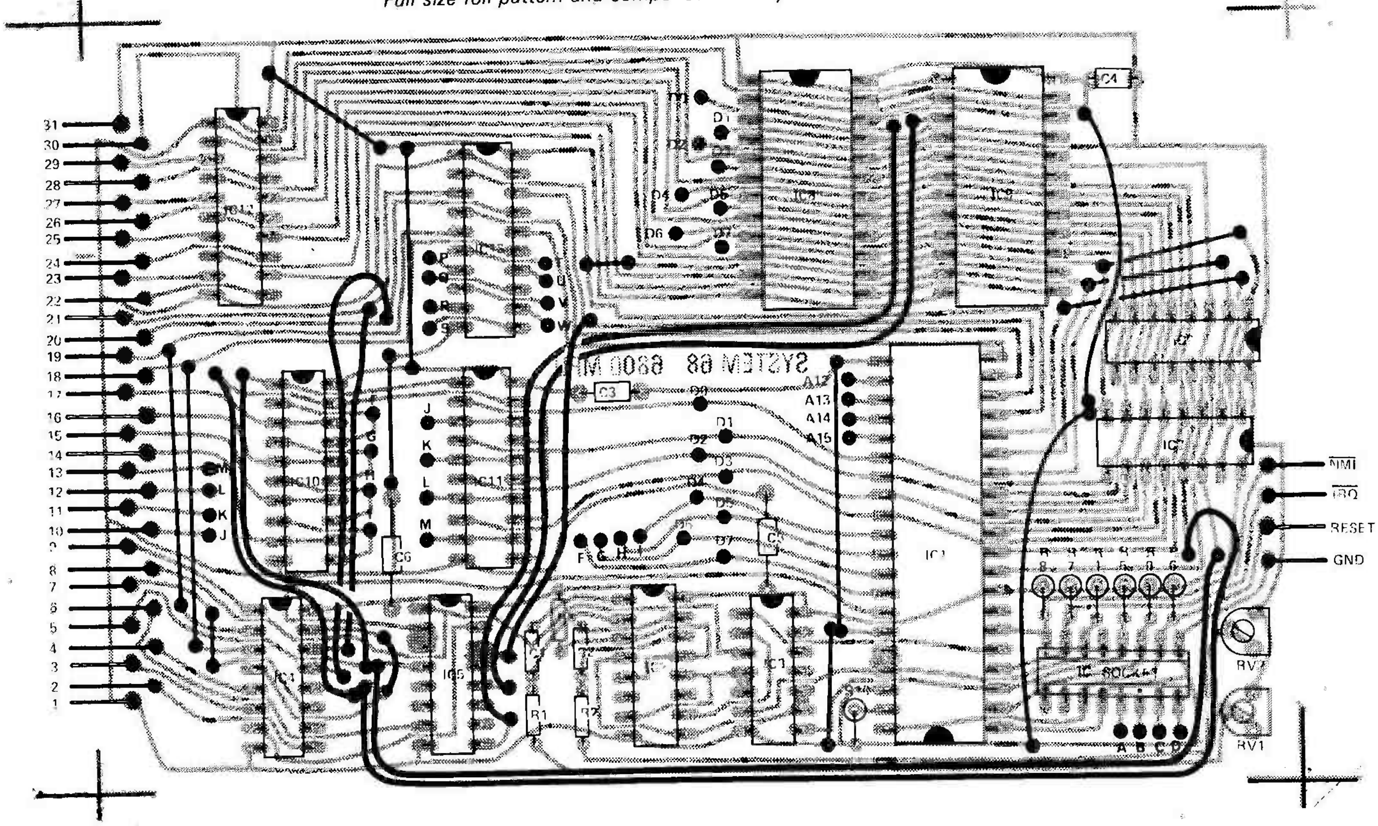
Clock Watching

To adjust the clock first set RV1 and RV2 to their mid-points. If you have an oscilloscope available check that the waveforms produced at IC1 pins 3 and 37 are as shown last month, note that each clock is high for the same time period and low for a longer time period, thus there is no overlap in the two clock signals. Without a scope there is no test that can be done at this stage except to check for an oscillation of approximately the correct frequency.

-6800 CPU CARD



Full size foil pattern and component overlay for CPU card.



MPU Input

The 6800 MPU chip is internally protected from damage by static and so there is no need to handle it with rubber gloves from a distance of twenty feet whilst strapping yourself to the drainage system. However, it is an expensive 40 pin IC and as such deserves a certain amount of care in handling it, make sure that all of the pins are straight and that they all appear to be making contact with the socket after insertion. At this stage you can also insert ICs 6, 7 and 8 with the same handling precautions. Before you turn the power check the polarity of these four ICs, at a cost of about £50 it's worth a double check.

IC4	A11	A10	A09	A08	ENBL	Check for —
	0	0	0	0	0	Low at ICs 6 & 7 pins 13.
	0	0	0	1	0	Low at X '100' enable output.
	0	0	1	0	0	Low at X '200' enable output (optional).
	0	0	1	1	0	Low at KBD (X'300') enable output.
	0	1	x	x	0	Low at RAM X '400' enable output.
	1	0	x	x	0	Low at VDU (X '800') enable output.
	1	1	0	x	0	Low at IC9 pin 3 (X 'C00')
	1	1	1	x	0	Low at IC8 pin 3 (X 'E00').
	x	x	x	x	1	All above outputs high.

IC2	pin10	VMA	R/W	
	0	x	x	$\overline{VMA.\Phi2}$, $\overline{RDS}$, $\overline{WDS}$ all high.
	x	0	x	$\overline{VMA.\Phi2}$, $\overline{RDS}$, $\overline{WDS}$, all high
	1	1	0	$\overline{VMA.\Phi2}$ low, $\overline{WDS}$ low, $\overline{RDS}$ high.
	1	1	1	$\overline{VMA.\Phi2}$ low, $\overline{WDS}$ high, $\overline{RDS}$ low.

Also check RDS and WDS signals are correct at G1 and G2 of ICs 10, 11 and R/W of ICs 6, 7.

Fig. 2. Truth table for use in the verification of the memory decoding circuits.

Bus Conductors

Install the 31-way connector and check that the PCB slides into the case without fouling. If you intend to connect the 16 pin connector to the rear connector of the case then wire up a second 31 way plug to a 16 pin plug (or ignore the socket and wire straight into the PCB).

Select a location in the case and wire up a 31 way socket (or sockets) to the existing VDU and power supply sockets, the connections for the PCB connector are shown in Fig. 1, those for the additional connector are user selectable.

The Crunch

Before installing the MPU card in the case turn on the power supply to the case and VDU cards and allow your TV and VDU controller to warm-up. We will assume at this stage that you are thoroughly satisfied with the operation of the VDU and keyboard part of the system. As we have just checked the MPU portion and we assume that the Software is correct there will be few or no problems from here on. If you have not fully checked the rest of the system then you are in for a few very trying hours.

With the system warmed-up and settled turn off the power, push in the MPU card and power-up. If you can see the character string 'ETIBUG' on the screen then you are just about home and dry. If nothing happens try operating RESET and/or the carriage return key of the keyboard. If still nothing happens then check the power supply at the 31 way connectors or look for smoke signals. If it still doesn't work then go back to checking the VDU, Keyboard and MPU card as separate entities.

Taking the MIK

We have given a lot of thought to the development of the ETIBUG software that forms the moniter program of our System 68.

We finally decided to base our software on Motorola's well known MIKBUG because many 6800 users are familiar with the characteristics of this firmware package. In addition there is a lot of software around that uses the MIKBUG subroutines and any system using this software must have the same or similar subroutines available at effectively the same memory locations.

The MIKBUG firmware assumes operation with a PIA plus interface circuitry in order to cater for a TTY I/O device.

ETIBUG has been developed to allow the System 68 VDU together with an ASCII encoded keyboard to provide the system's I/O. It has therefore been necessary to rewrite the MIKBUG I/O routines.

Apart from these changes to the I/O sections of MIKBUG we have changed the effective PIA Addresses to X'8300 for the input (keyboard) port and to X '8800 for the VDU start address. It has also been necessary to change all internal references to the PROM subroutines from X' EO xx or X' E1xx to X'EExx and X'EFxx. We have also changed some of the MIKBUG instructions which dealt exlusively with TTY requirements (i.e. punch off, reader on etc).

ETIBUG contains a feature in addition to the standard MIKBUG functions in that it contains a command loop which causes it to look for PROM at X'ECOO (IC9). If PROM exists at this location ETIBUG will branch to it. This feature makes expanding the software an easy operation.

These minor changes should allow most MIKBUG orientated software to be used with System 68 with only minimal changes.

As ETI is not (yet) a software journal we unfortunately do not have enough space within our pages to provide a fully annoted software listing of ETIBUG.

We have had to limit ourselves to a brief discussion of the major difference between MIKBUG and ETIBUG, namely the I/O routines.

It is not necessary to obtain a full listing of ETIBUG as PROMS which have been programmed will be available. For those of you who want a full listing we have produced an ETI Software Sheet which details all of the differences between ETIBUG and MIKBUG. This sheet in conjunction with Motorola's Engineering Note 100 (describing the MIKBUG ROM) will provide all the necessary information.

For a copy of the ETI Software Sheet please send 20p (this may be in postage stamps) to our reader services department, mark envelope software.

Detailed flow charts of the new I/O routines are shown in Figs. 5 and 6. They start at the same addresses as the equivalent MIKBUG routines, GET KBD at EFAC and PUT VDU at EFD1. They also use and save the same registers.

How to use ETIBUG

On turning on the power to your System 68 and assuming that everything else is in order the software will respond with a carriage return command and the word 'ETIBUG,' if this does not happen or if at any time you wish to enter the control software routines press the RESET switch. Whatever else the system may have been doing this switch always causes the ETIBUG software to take over.

In order to write and execute a program in System 68 you have to have a control program with facilities to examine and, if necessary, change the data at any given area of RAM.

Modify Command (M)

The program must also be capable of starting the execution of your program from any address in RAM. In ETIBUG the most used command will be 'M' to display and modify memory, it is called up and used as follows —

Enter 'M' and a four digit Hex address. ETIBUG replies with the address and the data found at that address, if the data is the same as that required then CR will cause ETIBUG to address the next byte of memory in the same way.

If the data needs to be changed then a space is entered followed by the required data and finally a CR. The system will write the required data in the RAM location, check that the data has been written and continue to the next RAM location.

ETIBUG	M 0002		
ETIBUG	0002	00	
ETIBUG	0003	00	
ETIBUG	0004	00	
ETIBUG	0005	00	0F
ETIBUG	0006	00	40
ETIBUG	0007	00	60
ETIBUG	0008	80	
ETIBUG	0009	30	A0
ETIBUG	000A	A0	C0
ETIBUG	000B	20	E0
ETIBUG	000C	00	
ETIBUG	000D	00	
ETIBUG	000E	00	
ETIBUG	000F	00	
ETIBUG	0010	FE	00?
ETIBUG			

Fig. 3. Example of the 'M' command. User inputs are underlined.

If the area addressed is not RAM then the routine will not agree the write check and will respond with a '?'.

In our example we have changed some locations in the range 0002 to 0001 but when we try to access 0010 we find that data cannot be written to this address either because it is ROM or because there is no memory at that location.

Print Command (P)

We can now use the data we have entered at addresses 0002-0005 as these are the parameters for the 'P' print command. Locations 0002-3 contain the sixteen bit address of the start of the area to be printed and locations 0004-5 contain the end address. Thus in the above example we have requested a start of print at 0000 to end at 000F, by entering the print command we instruct the system to print that area and then to return to control mode.

ETIBUG P
PRINT:
130000000000000000 F406080
A0C0E000000000
ETIBUG

The print produced shows the record length as byte 1 (13) (decimal 19), the start address as bytes 2 and 3 and then 16 bytes of data which are the same as when we had finished the 'M' command.

Load Command (L)

As an alternative to using the 'M' command we could have used the 'L' Load command which will load hexadecimal data from the input device into the area specified. As this is designed in MIKBUG to enable loading from paper tape the data requires a data length and starting address in the same format as that produced by the 'P' command. In addition you need to tell it when you are ready to start and stop entering data in this way, ETIBUG uses the same commands as MIKBUG which are S1 for start and S9 to return to command routine. Thus we could have entered our example above as

ETIBUG L S113000000000000
000F406080A0C0E
000000000S9.
ETIBUG

Two other cammands allow for the display of the 6800 registers and to execute the program pointed to by the program counter with the parameters set up in the registers. Various instructions cause the actual working registers to be dumped onto the stack and control to be returned to another routine. One of these is the SWI Software Interrupt which can be used as an instruction in a program under test to transfer control back to ETIBUG at that point. ETIBUG can then print the registers which have just been dumped onto the stack by use of the 'R' Registers command.

Examine Register (R)

The format of the 'R' command is as follows—

ETIBUG R 03 04 05 0607 0809
A042
ETIBUG

The character R is entered after the ETIBUG symbol and causes the VDU to output the contents of the MPU registers in the following sequence: Condition Code Register, B Accumulator, A Accumulator, Index Register, Program Counter and Stack Pointer.

It should be noted that the Stack Pointer is stored last, and that it takes eight memory locations to store the contents of the registers on the stack.

Thus in the example above, we have

Address	Register	Contents
A043	CCR	03
A044	ACCB	04
A045	ACCA	05
A046/A047	X REG	06 07
A048/A049	PC	0809
	SP	A042

Go To User Prog (G)

If we use the 'M' or 'L' command to change the values held in the above registers we can direct that the 'G' execute command goes to a routine of our choice with the registers set up with the required data. The format of the execute command is
ETIBUG G

Sample Program

Although we have outlined the use of each of the commands above the best way to understand their operation is to use them. To this end we have written a sample program. Our sample program adds the five values in locations X'A0 through X'A4 using ACC. A and stores the result in location X'A5. The intermediate total is kept in ACC. A; ACC. B is used as a counter to count down the loop. The index register contains a "pointer" (i.e., X contains the address) of the next location to be added.

First we must select an area of RAM in which to put the program. The basic system has RAM in locations 0000—00FF of which locations between 0000 and 007F are used by ETIBUG as scratch pad memory. The user memory therefore begins at 0080. We shall enter our program, using the load (L) function, beginning at this point.

ETIBUG LS1 14 0080 8E 00 FF 4F C6 05 CE 00 A0 AB 00 08 5A 26 FA 97 A5 3F S9.

Do not worry if you make a

Addr.	Instr.	Label	Mnemonic	Description
0080	8E	STRT	LDS X'FF	Define stack in user area
0081	00			
0082	FF			
0083	4F		CLRA	Total=0
0084	C6		LDAB 05	Initialise counter
0085	05			
0086	CE		LDX X'AO	Point X to AO
0087	00			
0088	AO			
0089	AB	LOOP	ADDA O,X	Add 1 location to total
008A	00			
008B	08		INX	Point X to next loc.
008C	5A		DECB	Done all 5 locs?
008D	26		BNE LOOP	Branch if not
008E	FA			
008F	97		STAA X'A5	Save answer
0090	A5			
0091	3F		SWI	Go to ETIBUG

Fig. 4. Sample program to illustrate use of ETIBUG system commands. The program will add the data in locations X'AO to X'A4 together and store the result in X'A5.

mistake as this can be corrected using the 'M' command. The way that the System 68 VDU works means that there is no need to enter a CR at the right hand side of the screen, the above characters can be entered as a continuous stream.

Next the data should be entered in locations X'A0 through X'A4. We shall use the 'M' format for this task.

ETIBUG M 00A0 xx 1
ETIBUG 00A1 xx 2
ETIBUG 00A2 xx 1
ETIBUG 00A3 xx 2
ETIBUG 00A4 xx 3

It is now necessary to set up the contents of the various registers with the values necessary to run our program. As the program itself takes care of setting up ACC. A, ACC. B and the index register while the conditions code register does not concern us, it is only necessary to set up the program counter.

To accomplish this use the R instruction to display the current contents of all registers.

ETIBUG R 03 04 05 0607 0809 A042

From this we see that the program counter at X'A048/A049 has a value of 0809.

Use the M command to alter this to X'0080.

ETIBUG M A048 08 00
A049 0980

We have now set up the necessary registers and entered the program. If you now enter

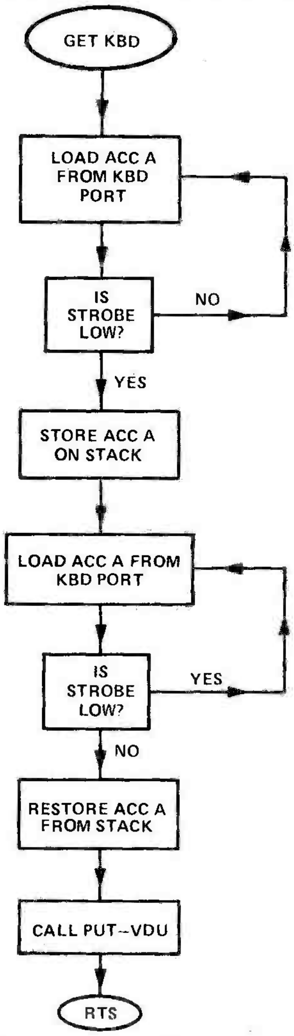
ETIBUG G

the program will run and when finished return control to ETIBUG. If the 'M' command is now used to examine location X'A5 it should contain the answer to our calculation.

ETIBUG M 00A5 09

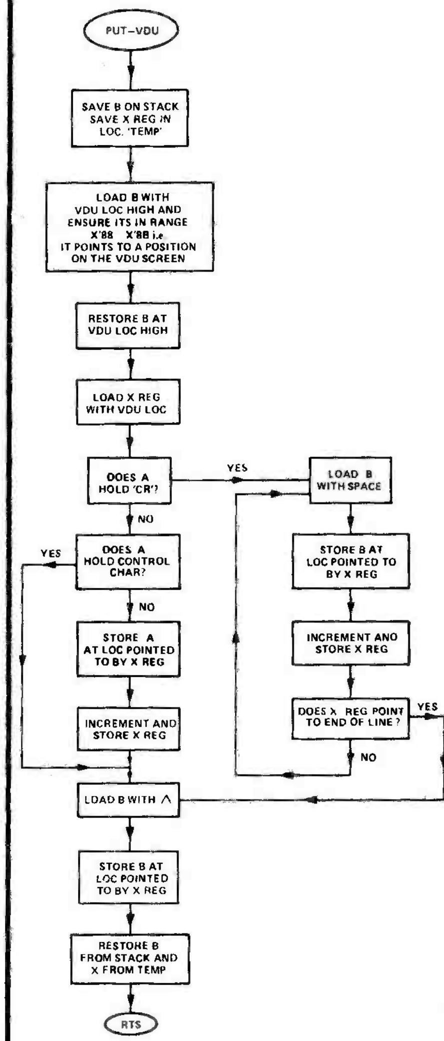
This sample program was intended to demonstrate the various facilities of the ETIBUG monitor. Now it's over to you — the range of possibilities with even the basic system is vast. Please let us know of any software you develop for System 68; we would hope to publish any of the more interesting software we receive.

This is the end of the Basic System 68, in future issues we intend to cover extensions to the Basic unit with RAM and prom cards, Teletype interface, CUTS Cassette interface, PROM programmer, extended software including BASIC and ASSEMBLER and many other projects.



Flow chart representation of ETIBUGS load from keyboard routine, GET KBD. This is called as a subroutine from the main program and in turn calls the put-VDU routine.

The keyboard strobe is connected as bit 7 of KBD port.



Flow chart of ETIBUG's output to VDU routine. This routine uses both ACC.B and the index register and so saves these registers initially, restoring the original values before exiting. ACC. A is assumed to hold the character to be output.

DATA SHEET

MC 6800 MPU-THE SOFTWARE — INSTRUCTION MAP AND SET

MSB \ LSB	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0	*	NOP (INH)	*	*	*	*	TAP (INH)	TPA (INH)	INX (INH)	DEX (INH)	CLV (INH)	SEV (INH)	CLC (INH)	SEC (INH)	CLI (INH)	SEI (INH)
1	SBA	CBA	*	*	*	*	TAB (INH)	TBA (INH)	*	DAA (INH)	*	ABA (INH)	*	*	*	*
2	BRA (REL)	*	BHI (REL)	BLS (REL)	BCC (REL)	BCS (REL)	BNE (REL)	BEQ (REL)	BVC (REL)	BVS (REL)	BPL (REL)	BMI (REL)	BGE (REL)	BLT (REL)	BGT (REL)	BLE (REL)
3	TSX (INH)	INS (INH)	PUL (A)	PUL (B)	DES (INH)	TXS (INH)	PSH (A)	PSH (B)	*	RTS (INH)	*	RTI (INH)	*	*	WAI (INH)	SWI (INH)
4	NEG (A)	*	*	COM (A)	LSR (A)	*	ROR (A)	ASR (A)	ASL (A)	ROL (A)	DEC (A)	*	INC (A)	TST (A)	*	CLR (A)
5	NEG (B)	*	*	COM (B)	LSR (B)	*	ROR (B)	ASR (B)	ASL (B)	ROL (B)	DEC (B)	*	INC (B)	TST (B)	*	CLR (B)
6	NEG (IND)	*	*	COM (IND)	LSR (IND)	*	ROR (IND)	ASR (IND)	ASL (IND)	ROL (IND)	DEC (IND)	*	INC (IND)	TST (IND)	JMP (IND)	CLR (IND)
7	NEG (EXT)	*	*	COM (EXT)	LSR (EXT)	*	ROR (EXT)	ASR (EXT)	ASL (EXT)	ROL (EXT)	DEC (EXT)	*	INC (EXT)	TST (EXT)	JMP (EXT)	CLR (EXT)
8	SUB (A) (IMM)	CMP (A) (IMM)	SBC (A) (IMM)	*	AND (A) (IMM)	BIT (A) (IMM)	LDA (A) (IMM)	*	EOR (A) (IMM)	ADC (A) (IMM)	ORA (A) (IMM)	ADD (A) (IMM)	CPX (A) (IMM)	BSR (REL)	LDS (IMM)	*
9	SUB (A) (DIR)	CMP (A) (DIR)	SBC (A) (DIR)	*	AND (A) (DIR)	BIT (A) (DIR)	LDA (A) (DIR)	STA (A) (DIR)	EOR (A) (DIR)	ADC (A) (DIR)	ORA (A) (DIR)	ADD (A) (DIR)	CPX (A) (DIR)	*	LDS (DIR)	STS (DIR)
A	SUB (A) (IND)	CMP (A) (IND)	SBC (A) (IND)	*	AND (A) (IND)	BIT (A) (IND)	LDA (A) (IND)	STA (A) (IND)	EOR (A) (IND)	ADC (A) (IND)	ORA (A) (IND)	ADD (A) (IND)	CPX (A) (IND)	JSR (IND)	LDS (IND)	STS (IND)
B	SUB (A) (EXT)	CMP (A) (EXT)	SBC (A) (EXT)	*	AND (A) (EXT)	BIT (A) (EXT)	LDA (A) (EXT)	STA (A) (EXT)	EOR (A) (EXT)	ADC (A) (EXT)	ORA (A) (EXT)	ADD (A) (EXT)	CPX (A) (EXT)	JSR (EXT)	LDS (EXT)	STS (EXT)
C	SUB (B) (IMM)	CMP (B) (IMM)	SBC (B) (IMM)	*	AND (B) (IMM)	BIT (B) (IMM)	LDA (B) (IMM)	*	EOR (B) (IMM)	ADC (B) (IMM)	ORA (B) (IMM)	ADD (B) (IMM)	*	*	LDX (IMM)	*
D	SUB (B) (DIR)	CMP (B) (DIR)	SBC (B) (DIR)	*	AND (B) (DIR)	BIT (B) (DIR)	LDA (B) (DIR)	STA (B) (DIR)	EOR (B) (DIR)	ADC (B) (DIR)	ORA (B) (DIR)	ADD (B) (DIR)	*	*	LDX (B) (DIR)	STX (B) (DIR)
E	SUB (B) (IND)	CMP (B) (IND)	SBC (B) (IND)	*	AND (B) (IND)	BIT (B) (IND)	LDA (B) (IND)	STA (B) (IND)	EOR (B) (IND)	ADC (B) (IND)	ORA (B) (IND)	ADD (B) (IND)	*	*	LDX (IND)	STX (IND)
F	SUB (B) (EXT)	CMP (B) (EXT)	SBC (B) (EXT)	*	AND (B) (EXT)	BIT (B) (EXT)	LDA (B) (EXT)	STA (B) (EXT)	EOR (B) (EXT)	ADC (B) (EXT)	ORA (B) (EXT)	ADD (B) (EXT)	*	*	LDX (EXT)	STX (EXT)

DIR = Direct Addressing Mode
EXT = Extended Addressing Mode
IMM = Immediate Addressing Mode
IND = Index Addressing Mode
INH = Inherent Addressing Mode
REL = Relative Addressing Mode
A = Accumulator A
B = Accumulator B

*Unimplemented Op Code

ABA	Add accumulators
ADC	Add with carry
ADD	Add
AND	Logical AND
ASL	Arithmetic Shift Left
ASR	Arithmetic Shift Right
BCC	Branch if Carry Clear
BCS	Branch if Carry Set
BEQ	Branch if Equal to Zero
BGE	Branch if Greater or Equal Zero
BGT	Branch if Greater than Zero
BHI	Branch if Higher
BIT	Bit Test
BLE	Branch if less or Equal
BLS	Branch if Less or Same
BLT	Branch if Less than Zero
BMI	Branch if Minus
BNE	Branch if not Equal to Zero
BPL	Branch if Plus
BRA	Branch Always
BSR	Branch to Subroutine
BVC	Branch if Overflow Clear
BVS	Branch if Overflow Set
CBA	Compare Accumulators
CLC	Clear Carry
CLI	Clear Interrupt Mask
CLR	Clear
CLV	Clear Overflow
CMP	Compare
COM	Complement
CPX	Compare Index Register
DAA	Decimal Adjust
DEC	Decrement
DES	Decrement Stack Pointer
DEX	Decrement Index Register
EOR	Exclusive Or
INC	Increment
INS	Increment Stack Pointer
INX	Increment Index Register
JMP	Jump
JSR	Jump to Subroutine
LDA	Load Accumulator
LDS	Load Stack Pointer
LDX	Load Index Register
LSR	Logical Shift Right
NEG	Negate
NOP	No Operation
ORA	Inclusive Or Accumulator
PSH	Push Data
PUL	Pull Data
ROL	Rotate Left
ROR	Rotate Right
RTI	Return from Interrupt
RTS	Return from Subroutine
SBA	Subtract Accumulators
SBC	Subtract with Carry
SEC	Set Carry
SEI	Set Interrupt Mask
SEV	Set Overflow
STA	Store Accumulator
STS	Store Stack Register
STX	Store Index Register
SUB	Subtract
SWI	Software Interrupt
TAB	Transfer Accumulator A to B
TAP	Transfer Accumulators to Condition Code Register
TBA	Transfer Accumulator B to A
TPA	Transfer Condition Code Register to Accumulator
TST	Test
TSX	Transfer Stack Pointer to Index Reg
TXS	Transfer Index Reg. to Stack Pointer
WAI	Wait for Interrupt

ELECTRONICS TOMORROW

by John Miller-Kirkpatrick

THERE IS A NEW LP on sale in the States, it's called something like "The Best of Software, Vol 1". It has a whole mass of games, file routines, subroutines, etc., written in BASIC and encoded in each of CUTS, TARBELL and ALTAIR cassette modes for playing directly into the cassette interface of a microprocessor. How long before Messrs K-Tel or Arcade start advertising their latest LP on television "You 100 favourite BASIC games", a fantastic two volume set for only £1.99, available from your local Woolworths, W. H. Smith, or any other good Software shop? The latest dance craze in five years' time could well be the "Payroll Routine", by Bert Twiddle and his formation Z80s.

With the current price drops taking place in the field of MPUs and support devices, the lost cost (£200) minicomputer is a viable proposition and a complex TV games player for about £50 will probably be on the market in time for Christmas (start letting the hints drop now). Although cassette or LP distribution of software is a low cost method — assuming that most people have either a cassette recorder or a record player — the problem of low cost direct-access media has yet to be solved.

Film for Thought

You can now buy a complete Mini-Floppy system in America which will interface to various buses complete with BASIC, Assembler and DOS (Disk Operating System) for under $700. A Mini-Floppy drive on its own would cost under $400, with DIY Hardware and Software you could have a complete add-on DOS system for under $500. The only problem is to find a similar system which will cost under $50.

After discussing the problem in last December's issue I received some interesting and novel ideas from readers, most of which required a magnetic film on a drum or a disk. Unfortunately the production of this magnetic film was going to be expensive for the average amateur and would be one job better suited to experts. Then, to the rescue, came E. Heath of Dorset who wrote to me recently and enclosed a sample of a magnetic paint which he has developed as a result of the comments in the magazine. With the sample was a leaflet describing the 'Liquid Magnetic Film', a description of a suitable Polyvinyl sheeting, a card reader design, and a suitable data recording circuit.

The paint is applied (using a built-in brush) evenly over the area to be sensitised and allowed to dry. When it is dry a very fine wet & dry paper is used to rub down the surface to give maximum sensitivity, Acetone can be used to remove unwanted film. Those of you who had great ideas for low cost direct access units can now put your ideas to the test by contacting Mr Heath at 26 Broad Street, Lyme Regis, Dorset, I am sure that he would like to discuss the problems with you.

Bubbling under from Texas

The solution to the cheap mass direct storage problem may not be by using magnetic film at all but by using magnetic bubbles. This is a new technology being developed by Texas Instruments in Dallas which can only be described as a lot of very small bubbles rushing around on a complex model train layout with sidings and passing loops. To indicate the size of these bubbles and of the train layout a 92,304 bit bubble memory device exists, built into a dual in-line package, it measures less than half a cubic inch in volume. The price of bubble memory systems is said to be competitive with the cost of Floppy storage media — I think they are including the cost of the Floppy drive in that comparison not the cost of the Diskette. The TBM 0103 is organised as 641 x 144 bits with an average access time of 4.0 ms and a data rate of 50Kb/s, they can be easily extended in units of eight to give additional 92,000 bytes of storage.

It is expected that the cost of a single bubble chip and associated interface would be $75 in mass volume with that figure reducing to a half within a year. Assuming that a 700,000 bit Mini-floppy system costs $700 (0.1c per bit) and that 738,000 bits of bubble cost $600 (0.09c per bit) the projected price per bit could have the Floppy makers worried. However, if you want to double the size of available memory the bubbles would cost another $600 for 8 chips whereas the Mini Floppy would cost about $10 for another diskette — it depends how you define direct-access storage.

Memory Mania

Texas Instruments are also forging ahead with other mass storage devices such as RAM, EPROM and a new 64K CCD memory the TMS3064. This is organised as 16 addressable 4096 serial-parallel-serial loops (I don't know what *that* means!). The maximum data rate is 5 Mbits per second with a maximum access time of 800 US requiring 300mW of power and all in a 16 pin DIL package. No price indication is given and so a comparison with other memory types cannot be given.

Case for a Case

Want to make a really professional job of your System 68 VDU and keyboard? Try contacting West Hyde Developments in Northwood about their VTE 101 CRT Terminal Enclosure. It boasts — ribs and bosses for component mounting, ventillation grills (including blower opening), Plexiglass screen and all presented in high impact plastic. The price is in the area of £80 but I was round at West Hyde the other day and I saw one there, they really are quite attractive. The only question is, 'can your wife afford to buy you an £80 Christmas present?'

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7414	0.72
7417	0.43
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7425	0.30
7427	0.30
7430	0.16
7432	0.28
7437	0.35
7441AN	0.76
7442	0.65
7445	0.90
7447AN	0.81
7448	0.81
7470	0.32
7472	0.26
7473	0.30
7474	0.32
7475	0.47
7476	0.36
7480	0.55
7482	0.75
7486	0.32
7489	2.80
7490AN	0.49
7491AN	0.65
7492	0.57
7493	0.45
7494	0.85
7495	0.67
7496	0.82
74100	1.07
74107	0.35
74121	0.34
74122	0.40
74123	0.65
74141	0.78
74145	0.68
74154	1.30
74164	0.93
74165	0.95
74174	1.40
74175	0.94
74180	1.06
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74196	1.64

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AC127	0.16	BC186	0.20★	BF184	0.20	OC71	0.35	2N3771	1.60
AC128	0.16	BC187	0.24★	BF185	0.20	OC72	0.22	2N3772	1.90
AC128K	0.25	BC207B	0,12★	BF194	0.10★	OC84	0.40	2N3773	2.10
AC141	0.22	BC212	0.11★	BF196	0.12★	OC139	1.30	2N3819	0.28★
AC141K	0.34	BC212L	0.12★	BF197	0.12★	OC140	1.30	2N4347	1.10
AC142	0.18	BC213	0.12★	BF224J	0.18★	OC170	0.23	2N4348	1.20
AC142K	0.32	BC213L	0.14★	BF244	0.17★	TIP29A	0.44★	2N4870	0.35★
AC176	0.16	BC214	0.14★	BF257	0.30	TIP30A	0.52★	2N4871	0.35★
AC176K	0.32	BC214L	0.15★	BF336	0.35★	TIP31A	0.54	2N4918	0.60★
AC187	0.18	BC237	0.16★	BF337	0.32★	TIP32A	0.64	2N4919	0.70★
AC187K	0.36	BC238	0.16★	BF338	0.45★	TIP41A	0.68	2N4920	0.50★
AC188	0.18	BC300	0.34	BFW30	1.25	TIP42A	0.72	2N4922	0.58★
AC188K	0.32	BC301	0.32	BFW59	0.30	2N404	0.40	2N4923	0.46★
AD149	0.45	BC302	0.40	BFW60	0.36	2N696	0.20	**CMOS PLASTIC**	
AD161	0.35	BC303	0.46	BFX29	0.26	2N697	0.20	4000BE	0.20
AD162	0.35	BCY30	0.55	BFX30	0.30	2N706	0.15	4001BE	0.20
AF114	0.20	BCY31	0.55	BFX84	0.23	2N1131	0.15	4002BE	0.20
AF115	0.20	BCY32	0.60	BFX85	0.25	2N1132	0.16	4006BE	1.05
AF116	0.20	BCY33	0.55	BFX86	0.25	2N1302	0.40	4007BE	0.20
AF117	0.20	BCY34	0.55	BFX87	0.20	2N1303	0.40	4008BE	0.93
AF118	0.50	BCY38	0.50	BFX88	0.20	2N1304	0.45	4009BE	0.52
AF124	0.25	BCY39	1.15	BFX89	0.90	2N1305	0.45	4010BE	0.52
AF125	0.25	BCY40	0.75	BFY11	1.10	2N1306	0.50	4011BE	0.20
AF126	0.25	BCY42	0.30	BFY18	0.50	2N1307	0.50	4012BE	0.20
AF139	0.35	BCY54	1.60	BFY40	0.50	2N1308	0.60	4013BE	0.50
AF239	0.37	BCY70	0.12	BFY41	0.60	2N1309	0.60	4014BE	1.00
AL102	1.45	BCY71	0.18	BFY50	0.20	2N1711	0.24	4015BE	0.95
AL103	1.30	BCY72	0.12	BFY51	0.18	2N2102	0.44	4016BE	0.54
AU107	3.30★	BD115	0.55	BFY52	0.19	2N2217	0.30	4017BE	1.00
AU110	1.75★	BD131	0.36	BFY53	0.25	2N2369	0.14	4018BE	1.10
AU113	1.60★	BD132	0.40	BFY64	0.35	2N2369A	0.14	4019BE	0.50
BC107	0.09	BD135	0.36★	BFY90	0.90	2N2483	0.20	4020BE	1.12
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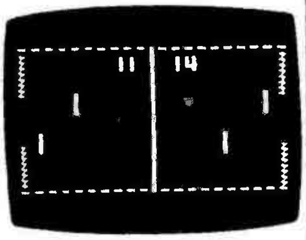

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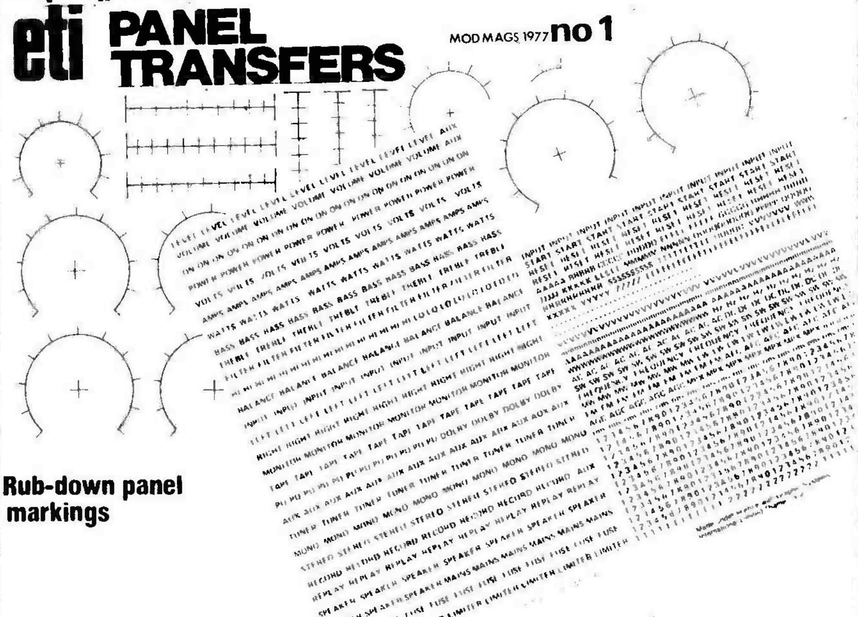

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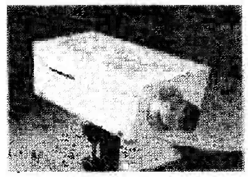

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160V: 0·039, 0·15, 0·22 **13p;** 0·33, 0·47 **22p;** 0·68, 1·0 **29p;** 1·5 **33p;** 2·2 **38p;** 4·7 **47p.**
DUBILIER: 1000V: 0·01, 0·015 **16p;** 0·022 **18p;** 0·047 **16p;** 0·1 **34p;** 0·47 **43p.**

POLYESTER RADIAL LEAD (Values in µF). **250V:**
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ELECTROLYTIC CAPACITORS: Axial lead type (Values are in µF)
250V: 100µF, **50p; 100V:** 20µF **63V:** 0·47, 1·0, 1·5, 2·2, 2·5, 3·3, 4.7, 6·8, 8, 10, 15, 22, **9p;** 47, 32, 50 **12p;** 63, 100, **27p; 50V:** 1·0, **9p;** 50, 100, 220, **25p;** 470, **50p;** 1000, 2200, **68p; 40V:** 22, 33, **9p;** 100, **12p;** 3300, **62p;** 4700, **64p; 35V:** 33, **7p;** 330, 470, **32p;** 1000, **49p; 25V:** 10, 22, 47, **6p;** 80, 100, 160, **8p;** 220, 250, **13p;** 470, 640, **25p;** 1000, **27p;** 1500, **30p;** 2000, **34p;** 3300, **52p;** 4700 **54p; 16V:** 10, 40, 47, 68, **7p;** 100, 125, **8p;** 470, **16p;** 1000, 1500, **20p;** 2200, **34p; 10V:** 4, 100 **6p;** 540, **10p;** 100, **14p.**
TAG-END TYPE: & **70V:** 2500, **98p;** 4700, **121p; 64V:** 3300, **94p; 40V:** 4000 **70p;** 2500 **65p; 25V:** 4700, **48p; 16V:** 4500 **38p; 40V:** 2000+2000 **95p.**

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10V: 22µF 33, 47 **6V:** 47, 68 **3V:** 100µF, **20p** each

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100V: 0·001, 0·002, 0·005, 0·01µF **5p**
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0.1µF, 0·15, 0·2 **7p. 50V:** 0·47µF **10p**

CERAMIC CAPACITORS 50V
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1000, 1800, 2000, 2200 **20p** each

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DPDT **35p**
4 pole on off **58p**
SUB-MIN TOGGLE
SP changeover **59p**
SPST on/off **54p**
DPDT 6 tags **78p**
DPDT Centre off **92p**
DPDT Biased **115p**
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1A DP c. over **16p**
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3.5mm	**15p**	**10p**	**8p**		**12p**
MONO	**23p**	**15p**	**13p**	**20p**	**18p**
STEREO	**31p**	**18p**	**15p**	**24p**	**22p**

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CO-AXIAL (TV)	**14p**	**14p**	**14p**
PHONO assorted colours	**9p**	**5p 1-way**	**15p**
Metal screened	**12p**	**8p 2-way**	—
		10p 3-way	—
BANANA 4mm	**10p**	**12p**	—
2mm	**10p**	**10p**	—
1mm	**8p**	**8p**	—

SWITCHES ★ PUSH BUTTON:
Miniature Non Locking
Push to Make **15p** Push to Break **25p**
ROCKER (white) 10A 250V
SP changeover centre off **28p**
ROCKER: (black) on/off 10A 250V **23p**
ROCKER: Illuminated (white)
Lights when on: 3A 240V **52p**
ROTARY: (ADJUSTABLE STOP) 1 pole / 2-12 way. 2p/2-6W, 3p/2-4W, 4p/2-3W **41p**
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7404	20	7484	95	74165	120	4025AE	19
7405	22	7485	125	74166	161	4026AE	185
7406	44	7488	36	74167	362	4027AE	60
7407	44	7489	390	74170	186	4028AE	95
7408	22	7490	43	74172	590	4029AE	109
7409	22	7491	80	74173	175	4030AE	58
7410	15	7492	53	74174	173	4033AE	145
7411	25	7493	40	74175	90	4034AE	195
7412	25	7494	85	74176	120	4040AE	110
7413	40	7495	73	74177	116	4042AE	85
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7417	39	74100	135	74182	85	4045AE	145
7420	16	74104	48	74184	184	4046AE	135
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7422	24	74107	33	74188	650	4048AE	58
7423	30	74109	84	74190	194	4049AE	60
7425	30	74110	54	74191	165	4050AE	55
7426	35	74111	76	74192	120	4054AE	120
7427	36	74116	193	74193	120	4055AE	134
7428	48	74118	115	74194	120	4056AE	135
7430	18	74120	105	74195	95	4060AE	115
7432	28	74121	34	74196	118	4067AE	380
7433	48	74122	50	74197	118	4068AE	22
7437	30	74123	73	74198	248	4069BE	22
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7446	116	74143	314	4002AE	17	4082AE	23
7447	82	74144	314	4006AE	115	4502AE	135
7448	80	74145	90	4007AE	18	4507AE	55
7450	17	74147	275	4009AE	60	4510AE	135
7451	17	74148	160	4010AE	60	4511AE	175
7453	17	74150	128	4011AE	19	4512	115
7454	17	74151	79	4012AE	18	4516AE	140
7460	17	74153	82	4013AE	55	4518AE	130
7470	32	74154	150	4015AE	99	4519AE	65
7472	28	74155	76	4016AE	55	4520AE	130
7473	32	74157	95	4017AE	104	4528AE	140
7474	36	74158	80	4018AE	105	4532AE	128
7475	36	74159	225	4019AE	60	4539AE	120
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AY-1-5051	125	MM2112N★	350
AY-1-67216	195	MM50326★	750
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AY-5-1230★	490	NE555★	41
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CA3011★	82	NE561★	395
CA3014★	137	NE562B★	395
CA3018	72	NE565A★	175
CA3020	170	NE566★	170
CA3023	170	NE567V★	182
CA3028A★	102	RAM2102-2★	247
CA3035	170	ROM2513★	750
CA3036	180	SG3402★	255
CA3043	190	SL414A	220
CA3046	80	SN72733	125
CA3048	220	SN76003	240
CA3075	175	SN76013	150
CA3080	80	SN76023	150
CA3081	190	SN76033	235
CA3089E	210	SN76115	215
CA3090A	420	SN76227	175
CA3123E	200	TAA621A	238
CA3130★	94	TAA661A	155
CA3140	95	TAA700	353
ICM7205	1150p	TAA960	300
LM300H	170	TAD100	150
LM301A	39	TAD110	170
LM308	140	TBA120S	90
LM318	195	TBA540Q	220
LM379	395	TBA550Q	355
LM380	98	TBA641BX11	225
LM381	170	TBA651	170
LM382	125	TBA800	90
LM3900	65	TBA810S	110
LM3909N	70	TBA820	80
M252AA★	950	TBA920Q	350
M253★	997	TDA2020	320
MC724★	175	ZN414	110
MC845P	150	ZN424	130
MC1303L	148		

TRANSISTORS

	p		p		p		p		p		p
AC117	35	BC158	12	BF184★	28	OC28★	75	ZTX303	22	2N3704	11
AC125★	22	BC159	13	BF185★	30	OC29★	75	ZTX304	24	2N3705	12
AC126★	18	BC160★	32	BF194	10	OC35★	80	ZTX311	15	2N3706	10
AC127★	18	BC167	12	BF195	10	OC36★	80	ZTX314	24	2N3707	11
AC128★	18	BC168	12	BF196	14	OC41★	17	ZTX341	20	2N3708	12
AC141★	22	BC169C	14	BF197	15	OC42★	17	ZTX500	17	2N3709	12
AC141K★	38	BC170	11	BF198	15	OC44★	25	ZTX501	15	2N3710	12
AC142★	20	BC171	11	BF200	37	OC45★	17	ZTX502	19	2N3711	12
AC142K★	38	BC172	11	BF224A	15	OC46★	35	ZTX503	19	2N3716★	245
AC176★	18	BC177★	18	BF244B	34	OC70★	25	ZTX504	51	2N3771★	164
AC187★	18	BC178★	16	BF256★	45	OC71★	23	ZTX531	28	2N3772★	175
AC188★	19	BC179★	18	BF257★	34	OC72★	27	ZTX550	18	2N3773★	275
ACY17	35	BC182	10	BF258★	38	OC77★	56	2N526★	40	2N3819	22
ACY18	28	BC182L	12	BF259★	48	OC79★	53	2N696★	15	2N3820	44
ACY19	25	BC183	10	BF594	30	OC81★	27	2N697★	21	2N3823★	60
ACY20	24	BC183L	11	BF595	28	OC81D★	31	2N698★	39	2N3824★	39
ACY21	29	BC184	11	BFR39	30	OC82★	25	2N699★	45	2N3866★	90
ACY22	16	BC184L	12	BFR40	30	OC82D★	35	2N706★	17	2N3903	15
ACY28	21	BC186	22	BFR79	30	OC83★	28	2N706A★	19	2N3904	18
ACY39	78	BC187★	23	BFR80	30	OC84★	44	2N707★	50	2N3905	18
ACY40	24	BC212	12	BFX18★	54	OC84N★	44	2N708★	19	2N3906	18
ACY44	39	BC212L	13	BFX29★	28	OC123★	115	2N914★	18	2N4037★	39
AD140	69	BC213	11	BFX38★	38	OC139★	140	2N916★	27	2N4058	15
AD149★	90	BC213L	13	BFX53★	40	OC140★	125	2N918★	34	2N4061	13
AD161★	42	BC214	14	BFX55★	40	OC141★	157	2N920★	51	2N4064★	255
AD162★	42	BC214L	16	BFX64★	38	OC170★	40	2N930★	18	2N4191★	66
AF114★	20	BC307B	15	BFX81★	141	OC171★	42	2N961★	61	2N4236	47
AF115★	20	BC328	18	BFX84★	27	OC201★	125	2N1131★	22	2N4289	24
AF116★	20	BC338★	21	BFX85★	28	OC202★	135	2N1132★	23	2N4859	35
AF117★	23	BC441★	37	BFX86★	28	OC203	150	2N1302★	30	2N4871	50
AF118★	47	BC461★	40	BFX87★	27	OC204★	150	2N1303★	30	2N5135	12
AF121★	33	BC462★	37	BFX88★	28	TIP29	43	2N1304★	55	2N5136	12
AF124★	30	BC547	20	BFY50★	19	TIP29A	45	2N1305★	55	2N5138	12
AF125★	30	BC548	20	BFY51★	19	TIP29C	68	2N1306★	55	2N5179	60
AF126★	30	BC549C	20	BFY52★	19	TIP30	52	2N1307★	55	2N5180	60
AF127★	33	BC558	28	BFY65★	25	TIP30A	56	2N1308★	48	2N5191	65
AF139★	40	BCY30★	55	BSX20★	20	TIP30B	64	2N1613	20	2N5305	40
AF178★	70	BCY32★	65	BSY65★	32p	TIP30C	74	2N1671★	150	2N5457	35
AF179★	70	BCY34★	80	BSY95A	18	TIP31★	52	2N1671B	190	2N5458	36
AF180★	70	BCY39★	88	BU105★	170	TIP31A★	54	2N1893★	27	2N5459	36
AF181★	48	BCY40★	90	BU205★	210	TIP31B★	58	2N2160★	100	2N5485	42
AF185★	60	BCY55★	204	BU208★	295	TIP31C★	68	2N2217★	40	2N6027	35
AF186★	48	BCY59★	18	E5567	48	TIP32★	60	2N2218A★	25	40311★	38
AF239★	44	BCY70★	18	M08001★	158	TIP32A★	63	2N2219A★	24	40313★	93
ASY26★	40	BCY71★	21	MJ400★	90	TIP32B★	80	2N2220A★	26	40316★	60
ASY29★	40	BCY72★	18	MJ491★	200	TIP32C★	83	2N2221A★	21	40317★	38
BC107★	9	BD115★	52	MJ2955★	120	TIP33★	95	2N2222★	21	40326★	40
BC107B★	10	BD121★	148	MJE340★	50	TIP33B★	112	2N2303★	250	40327	48
BC108★	9	BD124★	140	MJE370★	68	TIP33C★	120	2N2369★	14	40347★	65
BC108B★	12	BD131★	40	MJE371★	80	TIP34★	110	2N2483★	30	40348★	73
BC108C★	12	BD132★	45	MJE520★	65	TIP34A★	115	2N2484★	30	40360★	43
BC109★	9	BD133★	60	MJE521★	74	TIP34B★	140	2N2614	54	40361★	43
BC109B★	12	BD135	49	MJE2955★	110	TIP35★	219	2N2646★	52	40362★	43
BC109C★	12	BD136	50	MJE3055★	70	TIP35A	225	2N2904A★	24	40411★	295
BC113	20	BD137	42	MPF102	38	TIP35C★	270	2N2905A★	25	40412★	42
BC114	20	BD138	47	MPF103	36	TIP36A★	270	2N2906★	18	40476	170
BC115	20	BD139	54	MPF104	36	TIP41A★	66	2N2907★	20	40594	90
BC116	20	BD140	57	MPF105	36	TIP41B★	73	2N2907A★	22	40603★	58
BC117	20	BD142	53	MPF106	50	TIP42A★	78	2N2926G	10	40636★	110
BC118	15	BD145★	55	MPF107	50	TIP42B★	82	2N2926O	8	40673★	55
BC119	25	BDY17★	195	MPSA05	32	TIP2955★	69	2N2926R	8		
BC135	13	BDY60★	128	MPSA06	32	TIP3055★	56	2N2926Y	8	**Matched Pair 10p extra**	
BC136	15	BDY61★	147	MPSA55	35	TIS43	32	2N2011★	30		
BC137	15	BF115★	22	MPSA56	35	TIS44	27	2N3053★	17		
BC140★	34	BF154★	22	MPSA70	26	TIS46	40	2N3054★	50		
BC142★	24	BF156★	29	MPSU02	60	TIS50	47	2N3055★	55		
BC143★	24	BF173★	25	MPSU05	64	TIS74	47	2N3441★	140		
BC147	7	BF177★	26	MPSU06	32	TIS91	24	2N3442★	140		
BC148	7	BF178★	28	MPSU52	70	ZTX107	12	2N3525★	96		
BC149	9	BF179★	33	MPSU55	70	ZTX108	10	2N3614★	169		
BC153	25	BF180★	33	MPSU56	82	ZTX109	15	2N3615★	135		
BC154	20	BF181★	33	MPU131★	39	ZTX300	14	2N3663	32		
BC157	10	BF182★	33	OC25★	65	ZTX301	14	2N3702	11		
		BF183★	33	OC26★	95	ZTX302	19	2N3703	12		

NOISE DIODES
Z5J **105p**

DIAC★
ST2 **25**

DIODES

	p		
AAZ15	15	OA85	12
AEY11	60	OA90	6
BA100	10	OA91	6
BA102	10	OA95	8
BY100	24	OA200	9
BY126	14	OA202	8
BY127	14	IN914	4
OA9	9	IN916	5
OA10	40	IN4001 2★	5
OA47	8	IN4003★	6
OA70	8	IN4004 5★	6
OA79	12	IN4006 7★	7
OA81	15	IN4148	4
		3A 100V★	18
		3A 400V★	20
		3A 600V★	27
		3A 1000V★	30

ZENERS
Range 3 3V to 33V
400MW **9p**
1 3W **18p**

VARICAPS
MVAM2 **135p**
BB104 **40p**
BB105B **40p**
MVAM115 **95p**

★BRIDGE RECTIFIERS
(plastic case)

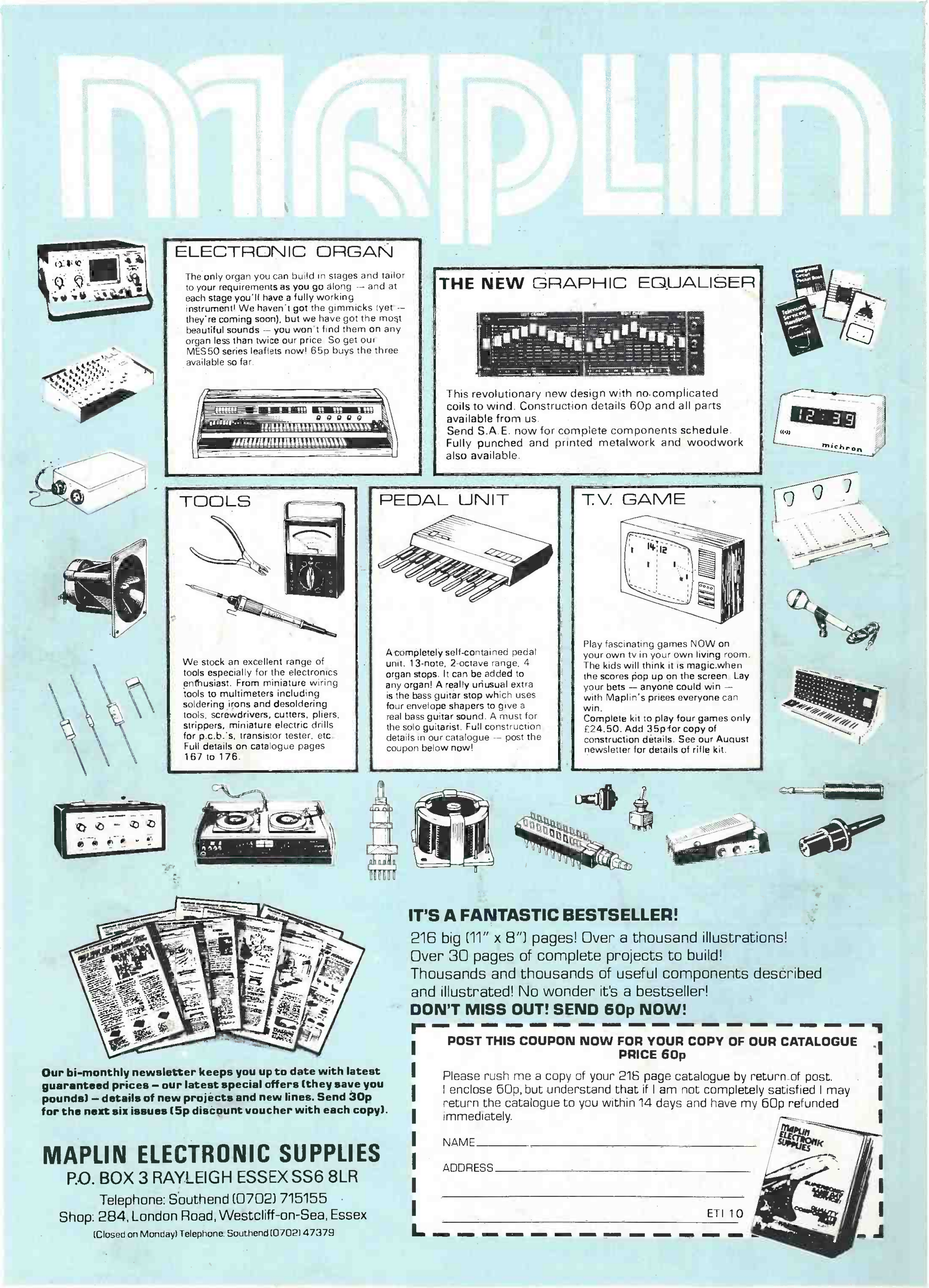
	p
1A50V	20
1A100V	22
1A200V	26
1A400V	29
1A600V	34
2A50V	35
2A100V	44
2A200V	46
2A400V	53
4A100V	72
4A400V	79
4A800V	120
6A100V	73
6A400V	92
BY164	56

TRIACS★

3A 400V	113
6A 400V	140
8A 400V	160
10A 500V	195
15A 400V	240
15A 500V	285
30A 400V	398
40430	110
40669	110

THYRISTORS★ SCRs

1A50V	38
1A 100V	42
1A 200V	47
1A 400V	52
3A 100V	43
3A 400V	110
5A 400V	120
7A 200V	120
7A 400V	135
8A 400V	150
C106D	55
TIC44	25
TIC45	37
2N4444	191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