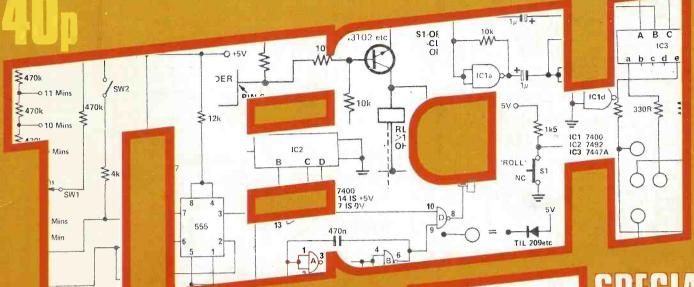
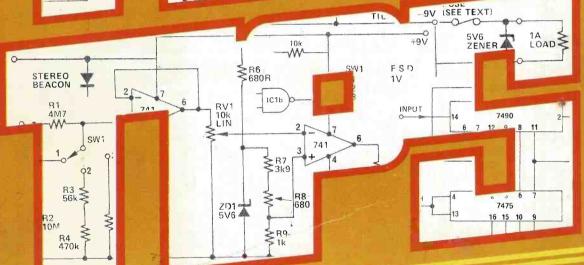
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SPECIAL

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CONSTRUCTION. . . DEVELOPMENTS . . . AUDIO



NEW MM5204 PROM PRICES
National Semiconductors have reduced the price of the MM5204Q UV
erasable PROM to only £10.95 for a 512 byte PROM. We can supply
these PROMs blank at this price or for only a little extra we can supply
them programmed with one of our software routines. Examples are:
VDUBUG SC/MP control for System 68. 512 bytes, program charge

KITBUG SC/MP control for introkit, 512 bytes, program charge £11.00 NIBL SC/MP BASIC language, 4K bytes, program charge £10.00 Wa can also arrange programming to your specification from paper tape, hex listing or even flowchart — send details for quote.

TEMPORARY STORAGE

TEMPORARY STORAGE
This month we include in our stock list two new program starage media. The first is the ER3401 Electrically Alterable ROM which can be programmed like a RAM but can be removed from its power supply and still retain its data for up to 10 years. The second is a low power CMDS RAM the MM74C920 which has the high R/W speed of a RAM but can be run on standby batteries for even a charged capacilor) for long periods without data loss. Both units come in a four bit wide configuration with the ER3401 having 1024x4 bits and the MM74C920 having 256x4 bits.

Prices per chip are: ER34D1.....£28.85 MM740920 £11.83

P297 Power Supply
NEW SCRUMPI PRICE

NEW SCRUMPI PRICE
You can now have a complete MPU kit for less than £60! Our new price
on our SCRUMPI kit is only £55.56 for SC/MP. 256 bytes RAM.
switches, LEDs, etc., for review see Practical Electronics Aug. 77.
Other kits we stock are:
INTROKIT SC/MP from NS. requires TTY or KBDKIT ... £66.33
KBDKIT adds to INTROKIT to give complete system ... £66.50
LCDS Nationals ready built development system ... £334.33

SYSTEM



MPU SUPPORT 74C00 Quad NAND 74C04 Hex Inverter 0.25 74C10 Triple NAND 74C42 BCD-Dec Decoder 0.25 0.95 74C157 Quad Selector 74C163 4 bit counter 1.15 74C164 PISO Shift reg 1.15 74C165 SIPO Shift reg 74C173 TriState Quad Latch . . . 0.95 1.75 DM8095 TriState Hex Buffer DM8096 Invert 8095 DM81LS95 TriState Buffer (8 True) 1.45 DM81LS96 TriState Buffer (8 Inv) 1 DM81LS97 TriState Buffer (4+4 True) 1 45 1.45 DM81LS98 TriState Buffer (4+4 Inv)

DS8833 TriState Transceiver (4 bit)
DM8678 CAB Char Gen 5x7 15.20
DM8678 BWF Char Gen 7x9 . . 15.20
DM74LS139 Dual 2-4 line decoder 1.50 **MPU KITS**

SCRUMPI 55.56 INTROKIT KBDKIT (for INTROKIT) 66.50

SOFTWARE in 5204 PROMs SC/MP VDUBUG SC/MP NIBL (BASIC) 6800 HALBUG

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MEMORIES RAMS

MM2102-2 1Kx1 650nS RAM . MM2112-2 256x4 650nS RAM 3 08 MM74C920 256x4 CMOS RAM 2114 1Kv4 RAM 24.00 **Erasable PROMs**

MM1702Q 256x8 MM5204Q 512x8 11.90 10.95 MM2708Q 1024x8 31.15 N.B. Can be supplied programmed

Elect. Alterable ROM ER3401 1Kx4 EAROM 950nS 28.25

Communications MM5307AA Baud Rate Generator 12.68 MM5303 (AY-5-1013) UART 6.34 Crystal for 5307

MPU Chips 12.00 SCMP2 NMOS 10.00

System 68 VEROCASE KIT SC/MP Control Card with VDUBUG PROM 32.40 6800 Control Card with ETIBUG PROM

74 10 4K PROM Card (5204) with 2 blank PROMs 46.30

CLOCK CHIPS & KITS TYPE SPECIAL FEATURES

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MM5309 7 seg + BCD. RESET ZERO 8.53	12.50
MM,5311 7 seg + BCD 4.26	8.00
MM5312 7 seg + BCD 4 DIGIT ONLY	
MM5313 7 seg + BCD	
MM5314 7 seg + BASIC CLOCK	7.00
MM5315 7 seg + BCD RESET ZERO 6.50	
MM5316 Non-mpx ALARM 7.50	
MM5318 7 seg + BCD External digit select 4.93	8.00
MM5371 ALARM. 50 Hz	
MM5378 CAR Clock. Crystal control. LED 9.86	14.00
MM5379 CAR Clock Crystal control Gas discharge 9.86	
MK5025 ALARM. SNOOZE	9.00
MK50395 UP/ DOWN Counter — 6 Decade 12.10	15.10
MK50396 UP/DOWN Counter — HHMMSS 12.10	15.10
MK50397 UP/DOWN Counter - MMSS.99 12.10	15.10
FCM7001 ALARM. SNZ. CALENDAR. 7 seg	12.50
FCM7002 ALARM. SNZ. CALENDAR. BCD 9.00	
CT7003 ALARM. SNZ. CALENDAR. Gas discharge 9.00	
FCM7004 ALARM. SNZ. CALENDAR. 7 seg 9.00	12.50°
AY5. 1202 7 seg. 4 digit	
AY5. 1230 7 seg. ON and OFF ALARM	TBA
All above clock kits include clock PC board, clock chip, socket and C	A3081

driver IC. MH15378 also includes crystal and trimmers. When ordering kit, please use prefix MHI, e.g. MHI 5309.

DISPLAYS

DL707, 704, 701 0.3" DL727, 728, 721 0.5" DL747, 750, 746 0.6"	4.31	Litronix class 2 product DL707E
22, ,		DELATE W. da . Rated J.C. 1.00

IVITI	DIST	LAINIO	
MHI707/4 digit 0.3"	7.60	MH1707E/4	
MHI707/6	1.00	MHI707F/6	53.55

WIMI/0//6	MHI/U/E/6 5.70
MHI727/4 0.5" 2.322 9.70	MHI727E/4 5.30
MHI727/6	MHI727E/6
MHI747/4 0.6" 11.40	MHI747E/4 7.20
MHI747/6 17.30	MHI747E/6 9.90
	473747 (47607

Any one or two of the above MHI display kits will interface directly with any of the MHI clock kits

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SOCKETS 24, 28 or 40 pin 0.60 Soldercon strip skts. 50 pins 0.30

4.30

	0119	α	DI
74C00 Quad NAND	0.2	25	M
74C04 Hex Inverter	0.2	:5	M
74C10 Triple NAND			M
74C42 BCD Decoder	0.9	5	
74C157 Quad Selector			X.
74C163 4 bit counter			M
74C164 PISO register			M
74C165 SIPO register			M
74C173 3S Quad latch			
74LS139 Dual 2-4 Dec			E
DM8095 3S Hex buffer .			E
DM8096 Inv 8095			M
DM81LS95 3S 8 bit buff			M
DM81LS96 Inv 95			×
DM81LS97 3S 4+4 buffe			Ď
DM81LS98 Inv 97			_
		_	

RITS & BYTES MM2102-2 1Kx1 RAM MM2112-2 256x4 RAM 3.08 MM74C920 256x4 CMOS RAM 11.83 24.00 X2114 1Kx4 RAM MM1702Q 256x8 EPROM 11.90 MM5204Q 512x8 EPROM 10.95 M2708Q 1024x8 EPROM 31.15 PROM prices for blank devices R3401 1024 x 4 EAROM 28.85 MM5307AA Baud Rate Gen 12.68 MM5303 (AY-5-1013) UART **6.34** (tal for 5307 TBA Xtal for 5307 TBA DM8678 Char Gen . . . 15.20 (both CAB & BWF avail.)

CLOCK MODULES

LT601 Alarm Clock Module, similar to MA1002	6.00
MTX1001 Transformer	0.90

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6 Amp	TO66 Cas	е .	10 Amp	TO220 Cas	e
Volts	No.	Price	Voits	No	Price
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200	TR16A/200	£0.61		DIACS	
400.	TR16A/400	£0.77	BR 100 £		£0.23
			DK 100 £	J.23 U32	£0.23

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U70	8 3 amp SCR TO66 case	16150	£1.20

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Pack				
No.	Qty.		Order No	. Price
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C2	150	weight) Capacitors mixed value approx (Count	10104	1.0.00
C2	, 50	by weight)	16165	03.03
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C4		Visth W Resistors mixed preferred	10100	EU.BU
	00	values	16167	£0.60
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Č6		Tuning gangs MW/1W VHF	16169	0.60.°
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. 020	1	Pak, copper laminate approx 200 sq		
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C22	50			
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with wire end terminations 6mm x 50mm plastic shaft 10mm bushes supplied with

	Sitting-Direct Mas	ner and nut	olerance _ 20 %	or resistance	14
	LINEAR TRACK			LOG TRACK	
Value 1K 2K2 4K7 1OK 22K 47K 100K 22OK 47OK 1M 2M2	No. 1831 1832 1833 1833 1834 1835 1836 1837 1839 1840	Price '£0.22 '£0.22 '£0.22 '£0.22 '£0.22 '£0.22 '£0.22 '£0.22 '£0.22 '£0.22	Value 4K7 10K 22K 47K 100K 220K 470K 1M 2M2	No. 1842 1843 1844 1845 1846 1847 1848 1849 1850	Price £0.22 £0.22 £0.22 £0.22 £0.22 £0.22 £0.22 £0.22 £0.22

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L	INEAR TRA	CK I		LOG TRACK	(
Value	No.	Price	Value	No.	Price
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10K	1852	.£0.68	10K 8	1861	88.03"
22K	1853	°£0.68	22K	1862	'£0.68
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100K	1855	*£0.68	100K	1864	'£0.68
220K	1856	'£0.68	220K	1865	*£0.68
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	LINEAR TRACK			LOG TRACK	
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3 75" x 17"		2206	£1.82	3 75" x 3 75"		2214	£0.42
4 75" x 17 9"		2207	£2.34	2 5" x 1"	(pack of five)	2216	€0.52
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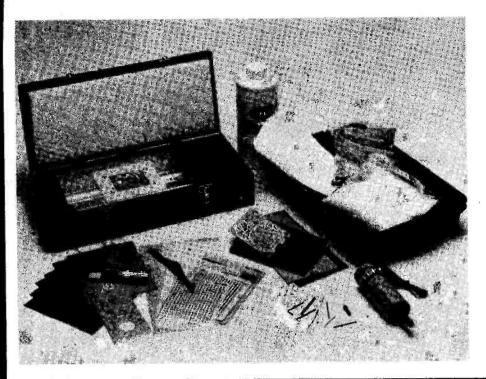
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merre eligest



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 lowcost 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 head-phone outlets, switching 'thump' suppressers and coarse and fine speed control...... to name but a few million!

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 11/8?



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.

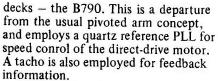
So now you know!

MAKE A DATA

The new edition of the OPTOELEC-TRONICS 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



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 \$t., Borham

Wood, Herts WD6 4R7.







■nows digost

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?

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.

For a subscription, send us £6.00 (£7.00 overseas) and tell us which issue you want to start with. Please make your payment (in sterling please for overseas readers) to ETI Subscriptions and keep it separate from any other services you want at the same time.

ETI Subscription Service Electronics Today International 25-27 Oxford Street, London, W1R 1RF





Gaps?

BACK NUMBERS

These cost 60p each inclusive of postage. Overseas charge: 70p each all inc., sterling only. All orders to ETI BACK NUMBERS DEPT.

We CANNOT supply the following issues: All 1972; January, February, April, May, August, October and November 1973; January, March, September, October, November and December 1974; January, June, July, August, September 1975; January, February, March, April, June and November 1976; May 1977.

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.

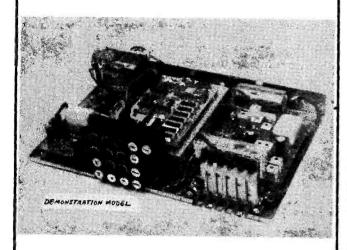
Please state clearly NAME of article, and from which issue the copy you require is taken.

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.

SPECIAL FEATURES

- * Plugs into aerial socket. (No internal connections to set)
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 Upper and lower case characters.
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- Allows for increase in number of data lines.
- Texas Tifax XM11 module supplied fully tested and guaranteed and ready for use.

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NOW AT 172 West End Lane, London, NW6

PRICE. TOTAL

£218.00 + VAT, 121/2% P/P £2.50. D/L case extra £13.80 + VAT 121/2%

No. 1 FOR TELEVISION **SPARES**

Units can be purchased in stages to spread out cost. Separate pack list on request.

CALLERS WELCOME AT SHOP PREMISES

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* COMPLETE KIT *

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Ready drilled PCB to accept components

A professional product for the home constructor. It has been designed by engineers using the most modern techniques and components. It will appeal both to the confirmed hobbyist and to the man who simply wants to 'have a go'. The kit contains everything except a mains lead. The only tools required are a small soldering iron, solder, screwdriver and wire cutters.

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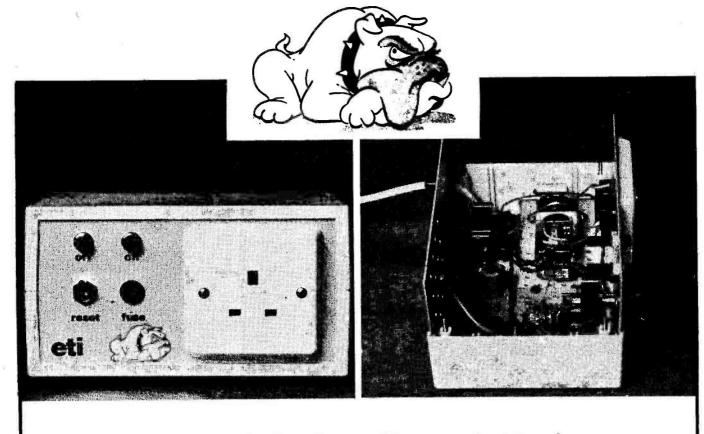
GIVE YOURSELF A TREAT

Why not pay us a visit and see for yourself the full range of top-quality watches; clocks; treasure tracers; electronic ignition; TV games and battery eliminators.





SEE OUR COMPONENTS ADVERT ON PAGE 80



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

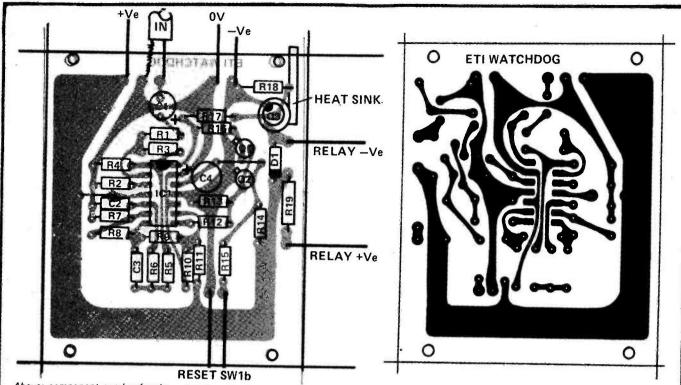
purpose in existing at all is to make sure you CANNOT leave the hi-fi or television running away with the power while you're not using it.

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 pattern is shown full size at 83 x 70mm.

PARTS LIST

RESISTORS		FUSE
(All 1/4 W 5%	except where stated)	F1
R1	220k (see text)	•
R2	100k	NEONS
R3	1 M	N1,2
R4,8,10	10k	,2
R5,6,	8k2	SWITCH
R7,9	39k	SW1 a,b,
R11	4M7	211. 0,0,
R12	2k7	
R13	470R	
R14	see text	
R15,17	100R	
R18	27k	
R19	47R ½ W 5%	
R20,21	1k ½ W 5%	
CAPACITOR	S	
C1,7,8	10u 16V electrolytic	
C2	10n polyester	
C3	22n polyester	
C4	100u 16V tantalum	
C5,6	1000 u 16V electrolytic	
C9,10	10n 1000V mixed d	ielectric
SEMICONDL	JC FORS	
Q1,2	BC108	
Q3	AC128 (fit with heatsing	nk)
Q4	AD161	
Q5	AD162	
IC1	LM348 (Quad 741)	
D1	IN4148	
BR1,2	100V 1A Bridge rectif	fiers
ZD1,2	9V1. 400mW zener d	ode
RELAY		
RLA	12V 110R type (octal	base)
	with two S.P.C.O conta	octs
	with 7.5A 250vA.C rat	ing (min)
	Doram: 72-710-3	
	+ octal socket 67-552-	3
TRANSFORM		
T 4	04017	

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!

Panel fuse holder and 500mA fuse to suit.

240V type one red (off) one green (on)

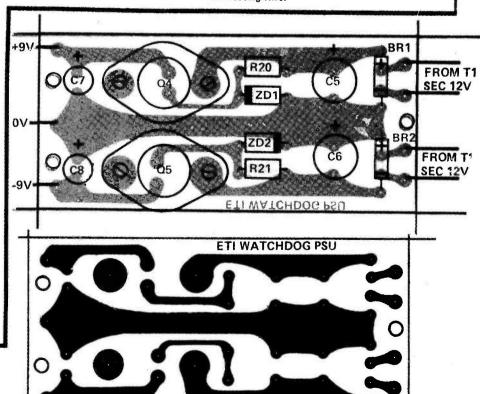
Double pole on-off (biased off) R.S.: 316-614

SOCKET SK1

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.



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

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. Sensiti-

vity 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.

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 100 μF. 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.

be an exception.
See 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.

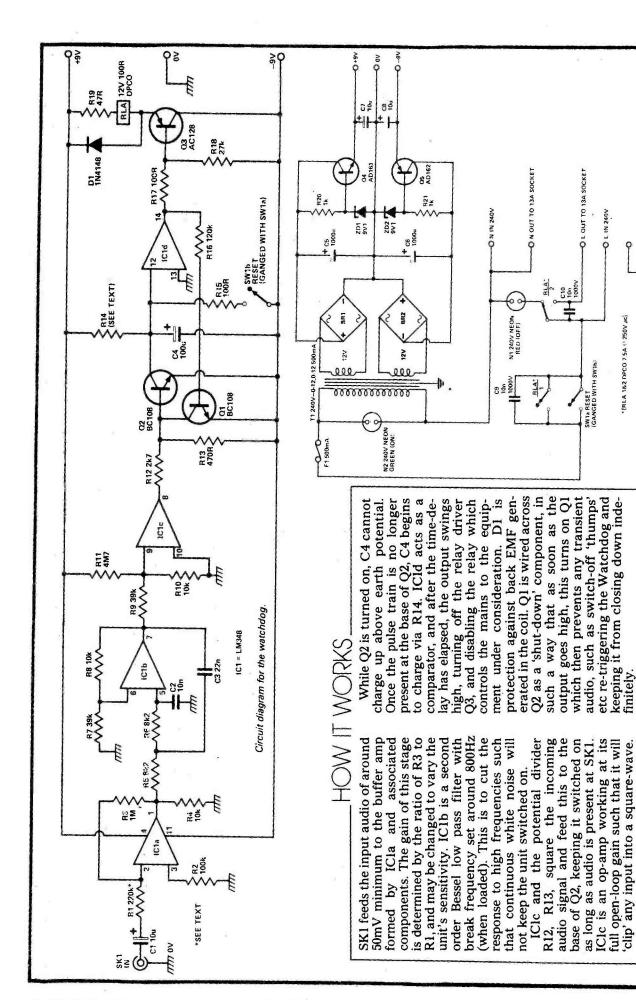
However, this does limit the versatility, and we don't think it will apply to many of you. It might arise say where a television, tuner and record system are all equally likely to be the source under control.

SOY 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.

National 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.'



Power Supply Circutry to drive watchdog and power switching relay.







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SUPPLY PANEL containing 6 high quality 0.1uF 10% 1KV poly capacitors. 102 x 19 x 75mm 35p 10 for £2.50.

ALMA push button reed switches, push to make. High reliability. $18 \times 27 \times 18$ mm 25p 25 for £5, 100 for £20.

Borroughs 9 digit Panaplex calculator display. 7 segment, 0.15" digits, neon type, with red bezel, socket & instructions. £3.50 10-£30

Built 5 watt power amplifier Gould - Advance. 4–8 ohms output, up to 24V supply, 500mV into 2K input, Complete with instructions, $11.5 \times 6 \times 3\text{cm}$ £3.00 10 for £22.50

Suitable power supply for above, in kit form. £2.20

Valve type 40:1 Output transformer 61 x 51 x 42mm 75p 10 for £6.

Output transformer for EL84 type valves 80 x 53 x 34mm 95p 10 for £8, Clocking oscillator PYE DYNAMICS thick film 1MHz 5V supply 19 x 25 x 6mm 85p 10 for £7, 100 for £55.

FAIRCHILD FND10 0.15" 7 segment display 80p 10 - £6.50, 100 - £50.

C106C Thyristor 3 amp 300 PIV 46p - 10 for £4. C106D Thyristor 3 amp 400 PIV (250 V RMS) 66p - 10 for £5.50

7 button selector switch with built in 100K pots, Ideal for use with varicap tuned FM sets and TVs $120\,x\,64\,x\,55mm$ £2.50 10 for £20

Bowmar 9 digit calculator display with P.C. connector 0.1" digits, common cathode with red bezel, £1.25 10 for £10,

FND500 0.5" common cathode 7 segment LED display. £1.25 6 for £7. Texas 19 gold plated 'snap' key contacts on gold plated P.C. Boardall kinds of useful applications, 65p 10 for £5, 100 for £40.

charger and battery eliminator, for charging up to 12 volt nickel ium batteries. SPECIAL PRICE £5.

OSMOR change over reed relay with 12V coil. Approx. 20mA operating current. 59 x 17 x 13mm 75p 10 for £6, 100 for £50.

Small mains transformers with 240V pri. 12V @100mA 60 \ 10 x 42mm 95p 10 for £7.50. 24...0- 24 ₪ 100mA 68 x 35 x 43mm 95p 10 for £7.50 24V @ 60mA · 24V @ 150mA 80 x 45 x 48mm £1.25

I.C. Audio Power by TOSHIBA 35 WATT module. 8 ohms o/p 200 mV into 47K for full output. 0.3% distortion (max). 60V power supply required. £8.50 10 for £75.

10.7MHz crystal filters, 25KHz band width for NBFM, £7 10 for £60. Texas 4+5 Digit C. Cathode Display with 16 pin DIG. Bases. Pair £1.85 10 pairs £17.

214" 35 ohms speakers, ideal for that small space, 75p 10-£6, 190-£50 3 DIGIT 7 SEGMENT DISPLAYS, C, cathode pack of 2 with data (one or more segments are missing). 60p pack, 10 packs for £5.

Mullard ZN1171 Nixie tube ONLY £1.30 10 for £10, 100 for £90. Mullard ITT.5870L Nixie tube ONLY £1.30 10 for £10, 100 for £90.

BECKMAN 500KHz triggerable clocking oscillator for use with calculator chips etc. 5V supply. 25x10x12mm £1 10 for £8, 100 for £65.

Re-settable thermostatic switch. A push button on-off switch which automatically drops out when the ambient temperature exceeds 72° C. $47 \times 29 \times 46$ mm 75p 10 for £6.50.

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Calculator chip CT5002 12 digit four function for common cathode multiplex displays. ONLY £1.95 complete with circuit.

1MHz HC6U quartz crystals. For frequency meters, clocks, frequency references etc. 17x19x7mm £3 10 for £25.

SWR and field strength meter. A must for every 'ham'. Rugged con-struction, good for transmitters up to 1KW, 51 x 51 x 153mm £9.95

Avo meter movements for a military version of the Avo 8. Precision 37.5 micro Amp (50 uA with integral shunt) movement. Electronic voltmeter circuit available on request. £8.50.

28 pin calendar/clock chip type MK5017BB for use with common cathode LED displays (with circuit). £4.49 MK50250 Alarm clock chip for most LED displays. £4.50 with circuits. 5012 12 digit calculator chip. 4 functions, with circuits & data. £4.15 Pack of BC171A Transistors BC107 Plastic 75p 10 packs £6, 100 - £50.

Pack of BC171A Transistors BC107 Plastic 75p 10 packs 16, 100 - 1200. TEXAS AMPLIFIERS SN76023N £1.75 10 for £15 TBA800 £1.20 10 for £10 SN76023N £1.75 10 for £15 TBA810S £1.20 10 for £10 SN76023N £1.75 10 for £15 TBA820S £1.10 10 for £10 AY8-500 GAME CHIP BY G1. £7.99 TBA120S 75p 10 for £6.50 The INCOMPARABLE FERROGRAPH 20 We are able to offer a limited quantity of these superb British manufactured stereo amps. These 20-20 Watt amps are offered with full guarantees in full working order, with wooden cabinet. All units are Brand New. Send now for full specification & data sheet. Try beating our price of £49.50 +£2.50 pp.

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TAPEHEADS
Stereo Cassette R/RP Head (200 ohm)
£2.25
Marriott Heads R/RP1 - £1.50
Marriott Record/Replay & Erase Head £1.75
Miniflux R9N Erase £2.25
R/RP1/3 Tapehead ½ Track £0.65
MULLARD TUNER MODULES
LP1171 Combined AM/FM | F strip £4 *LP1179 FM front end with AM tuning gang, used with LP1171 - £2 *LP1171 & 79 pair - £7.30
*LP1157 complete AM strip - £2.05 *Ferrite Aerial - 95p with circuits.

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XRPS17% TRACK £3.25, XRPS18% TRACK RED £3.25, XRPS36% TRACK £6.75, XES11 % TRACK ERASE £1.25, BX/RP/63% TRACK £2.25

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TEXAN FM £23.50 VAT £2.93 TUNER KIT POST ETC. 25p BUILT £28.50 Vat £3.56

Build the matching Texan stereo tuner!
Features advanced varicap tuning. Phase lock loop
decoder. Professionally designed circuit. Everything you need
is in the kit. From the glass fibre pcb to the cabinet itself.
Excellent spec: 2.5 uV aerial sensitivity. 500 mV output (adjustable).
Tuning range 87-102 MHz. Mains powered.

SPECIAL OFFER BUILT AMPLIFIERS

6+6 WATT STEREO 24/28v 8ohm

Input 50/60 M/V. Into 500K Tone Controls on P/C £4.95

4 pots £3.50 extra Size $15.5 \times 14 \times 4.5 \text{ c/m}$ WITH CIRCUIT

10+10 WATT STEREO PA6/25

Input 300 M/V. Into 100K'cs Size 18 x 7.3 x 4.8 cm

24 volt £5.95 4 ohm WITH CIRCUIT

T4/RF LONG-MEDIUM & F/M TUNER WITH MC1310 DECODER **★5-BUTTON SELECTOR SWITCHES.★INPUT SELECTORS FOR GRAM &** TAPE * Supplied complete with FRONT-END TUNER AND FERRITE

THIS QUALITY AMPLIFIER £10.95 WITH CIRCUIT

POWER UNIT KIT FOR ABOVE MODELS 25/28 VOLTS £2.95

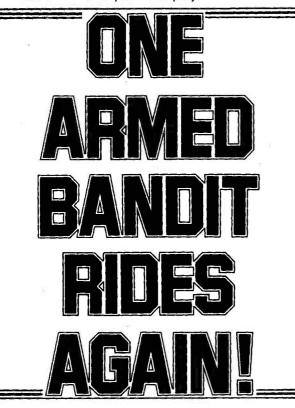
AERIAL * SIMPLE INTERCONNECTIONS * Size 19 x 13 cm.

RADIO

All mail to: Henry's Radio 404 Edgware Rd, London W2

LONDON W2: 404 6 Edgware Road. Tel: 01-723 1008

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.



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.

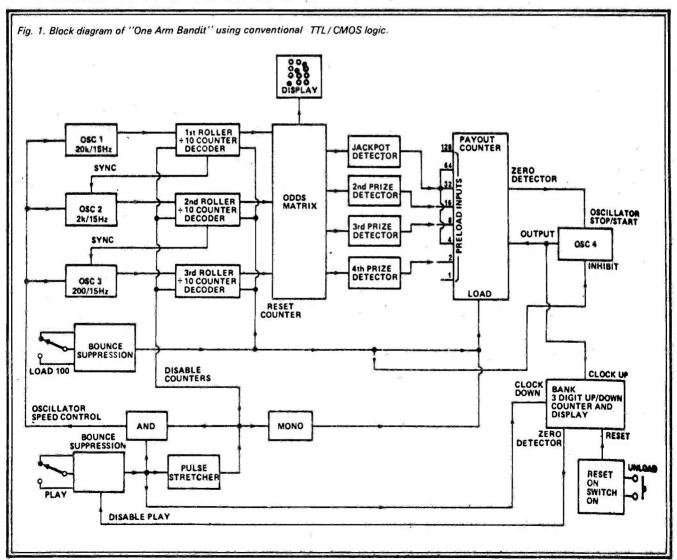
A microprocessor chip can be thought of as several separate units in one chip. The first unit is a decoder similar to a BCD to seven segment or decimal decoder, the data fed to the decoder is an instruction. Thus an instruction might be decoded so as to cause a clear or an increment of a counter, alternatively 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.

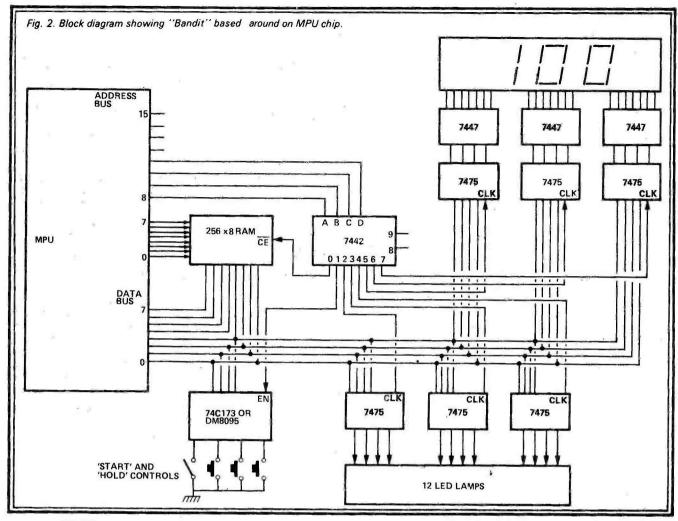
The instructions which we feed into our decoder

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





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

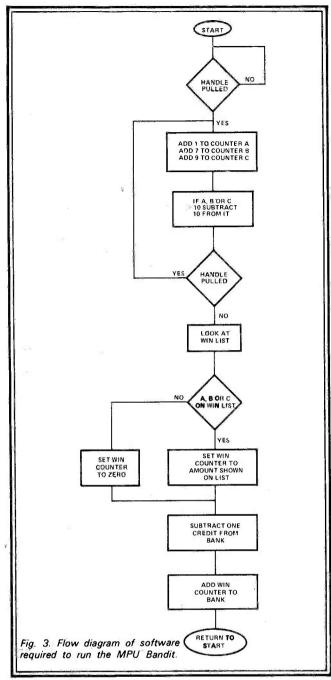
The Accumulator is used for input/output and also for the results of logical ANDs, OR, and EX-ORs, it can also be used as the result and one of the operands in an ADD instruction.

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 (eq. 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.



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!

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Bamp		0.75	20 amp		1.70		
12 amp		0.85	25 amp		2.00		

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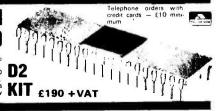
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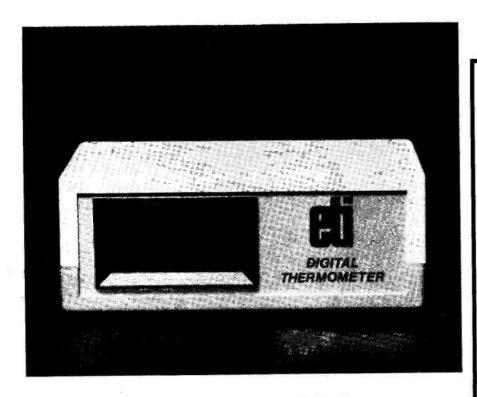
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WE HAVE FOR some time been considering the constructon of an accurate electronic thermometer, and the announcement of the new National LM3911 temperature controller was enough to spur us into action and get down to building the thing.

The LM3911 is a highly accurate measurement system for use over the -25° 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/ ^oK 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:

Vout=T.10-2 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:

Vout=(273.16+20).10-2 volts

≏3 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

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 31/2 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 funct-

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.

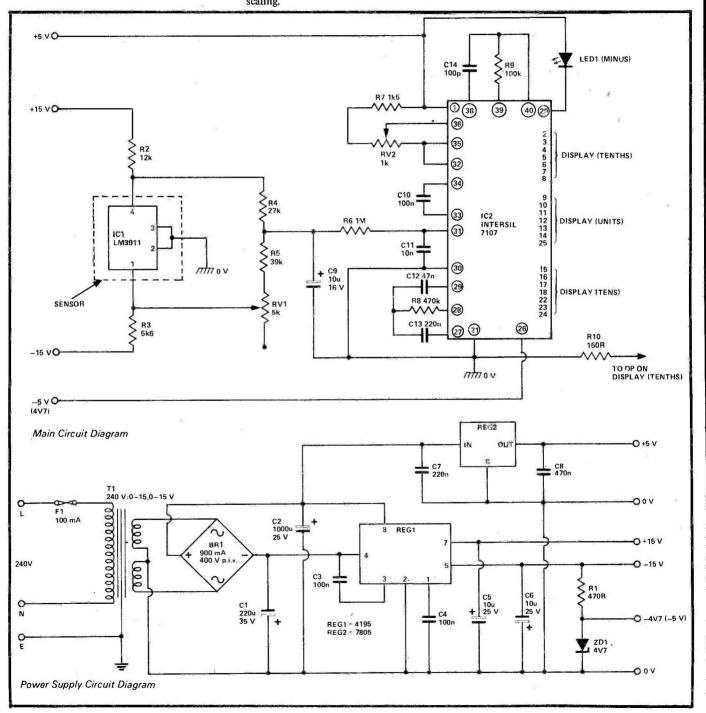
The 7107 is a 3½ digit chip, and if we

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.





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 external 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 recomend 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,

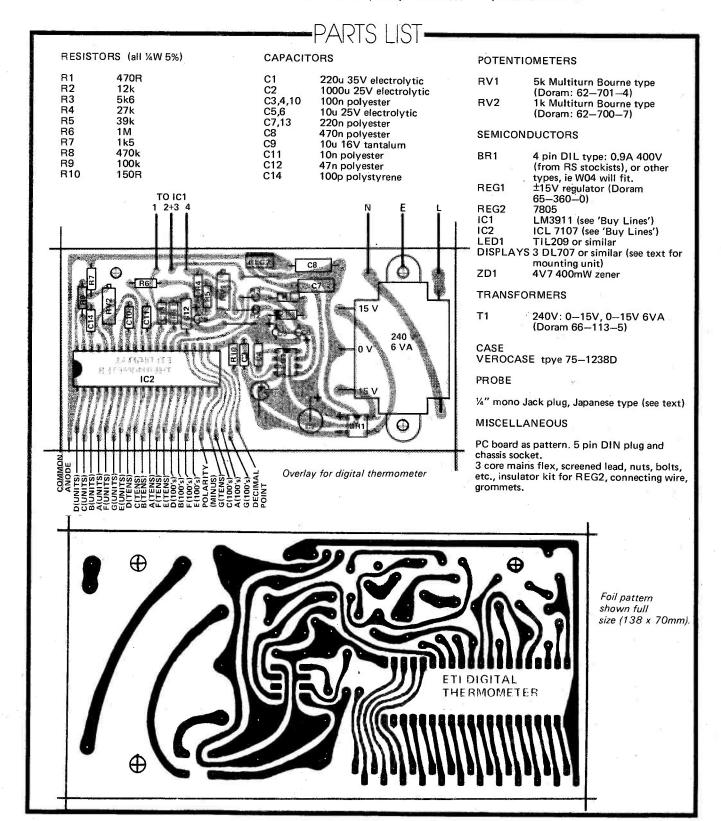
temperature is the human body. A healthy persons under arm temperature is fairly constant at 37.4°C.

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 be tween 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.



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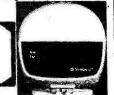
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STEREO BROADCASTING is generally associated with FM probably because that's the way it's been transmitted up to now.

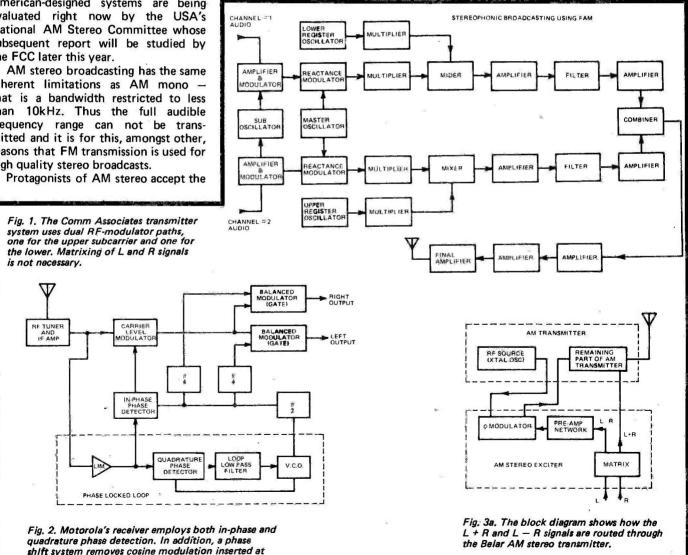
But it's perfectly feasible to transmit a stereo programme using modified AM transmitters and receivers. In fact five American-designed systems are being evaluated right now by the USA's National AM Stereo Committee whose subsequent report will be studied by the FCC later this year.

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.

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 anachro-

nistic, 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



the transmitter.



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.

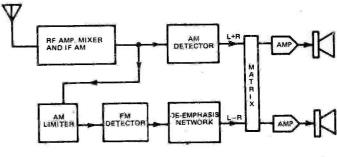


Fig. 3b. The Belar receiver has two IF paths, one to a normal AM detector, and one through limiter stages to an FM detector.

LEVEL SQUARER

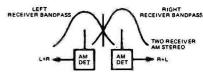


Fig. 4b. The stereo signal from the Kahn transmitter can also be picked up by two mono receivers, one tuned a little high, the other a little low.

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.

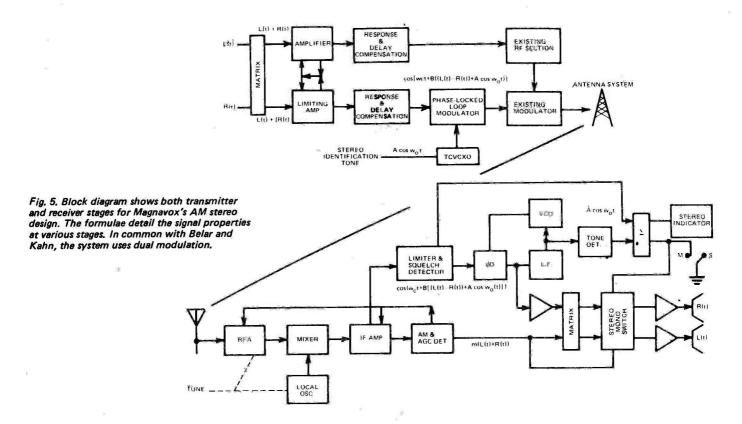
Most broadcasting studio equipment is stereo — certainly all modern recording machinery, cartridge players, record players are so made, as is the majority of programme material.

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 manu-

facturers!). 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



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 singlesideband 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 AMcontains 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.

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 1F 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.



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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! Al-



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.



though 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.

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!

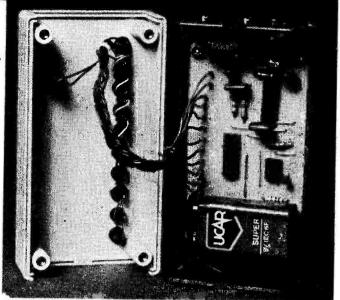
Half And Half Pint

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

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

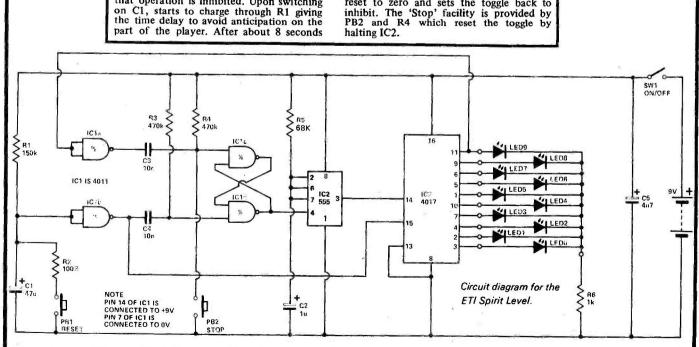
The LED display column is driven from the output of a 4017 CMOS decoder. This counts and outputs, in decimal form, the input pulses presented to pin 14.

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 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.



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 orien-

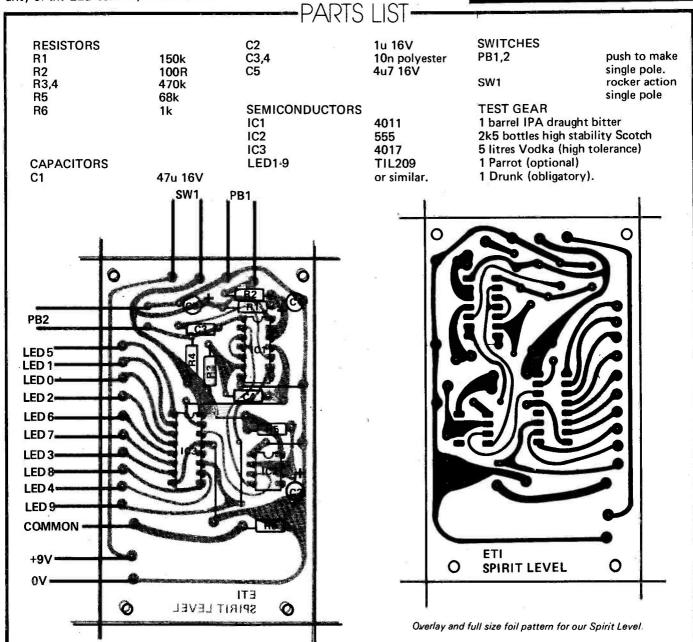


tation of the chips, it can be an expensive 'short cut' not to bother!

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!).



ETI SPECIAL OFFER CAMBRIDGEPROGRAMMABLECALCULATOR

REGULAR READERS will remember our review of this amazing little calculator in our July issue. Since then we have been itching to present it as an offer! Well here it is. Complete with program library.

Up until now, programmable calculators have been generally beyond the financial reach of many, but at this price there is no excuse any more!

For the few people unaquainted with the programmable we had better give a brief run down of what it can do. As you can see from the keyboard, all the common scientific functions are readily available to hand. What makes this machine really different however is it's 36 step programme facility.

Basically, what the program memory does is to 'remember' up to 36 'button pushes' and execute the whole lot again in a single operation of the 'RUN' key. Just think what



A comparable package at

time that would save on all those repetitive jobs!

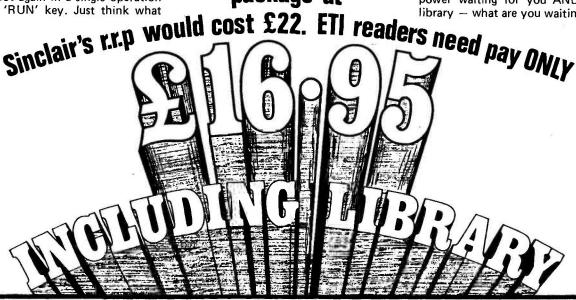
You'll quickly learn to write your own programmes as we've done at ETI: our accounts section are using programmes and this calculator, not for novelty value, but to save time!

Sinclair have however written an enormous number of programmes covering electronics, maths', engineering and business, as well as games such as 'Moon Landing'.

Sinclair have prepared a special book containing nearly 300 programmes, especially, and exclusively for ETI.

All programs are given in a clear easy to follow form, with key strokes and 'check symbol' side by side.

Buy your programmable from us at £16.95 and we'll throw in one complete library FREE! (usual price £4.95). With all this computing power waiting for you AND a free library — what are you waiting for??.



To: ETI/CAMBRIDGE PROGRAMMABLE OFFER ETI MAGAZINE 25/27 OXFORD STREET, LONDON W1R 1RF. Please supply Sinclair Cambridge Programmable(s) with special programme library, for which I enclose (at £16.95 each inclusive). Cheques and P.O.'s made payable to ETI Magazine. N.B. To assist us to speed your order, please write your name and address on the reverse of cheques. We regret the offer only applies to U.K. and Northern Ireland A high level of stock of this calculator are held but please allow 28 days for delivery before becoming concerned.	We are carrying a limited number of these calculators at our offices in Oxford Street. Our offices are very close to Tottenham Court Road Underground.
Name Date	Please complete the 'edgewise' coupon in block capitals as it will be used to despatch your unit, so be patch your

electronics today

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

Programmable Calculator Survey high price, specialist luxurie can buy one for around \$16.

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

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.

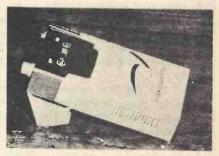
Amaze your girlfriend(s), wife, mother, mistress(es), sister or granny and build them a piece of electronic jewellery (it costs far, far less than they will imagine, a quality of all good presents). Just touch the pendant and their initials flash up in sequence on a 7-segment led and then turn off (it 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 FTI

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.

ICE TRADING

RELAYS Wide range of AC and DC relays available from stock Phone or write in your enquiries

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CENTRIFUGAL BLOWER

Mig by Smiths industries 230 240v ac Ministrier Model Series

\$E7200 Size 950mm x 8.2mm x 8.2mm Aperture 38mm x 3.1mm 12

c.f.m £2 75 Post 50p. Mfg by Fracmo 115 / 230V ac 2800 3400

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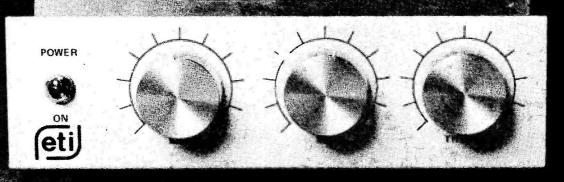
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3 CHANNEL TONE CONTROL



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

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.

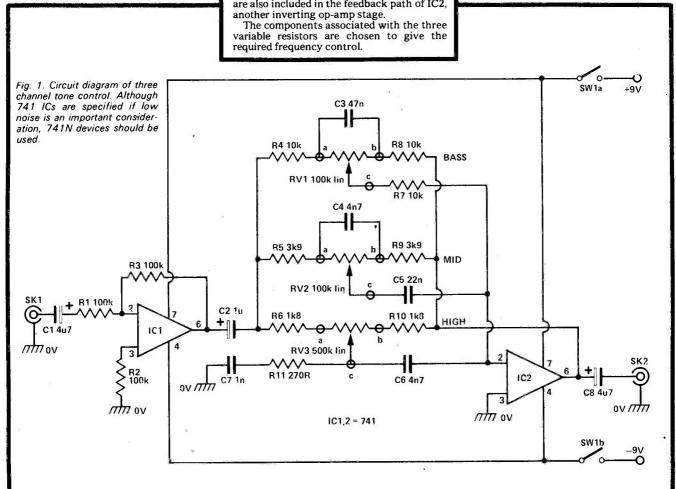
The O/P from ICI is fed via three

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.

means that in most cases some form of tone control is a desirable, if not essential, item in any amplifier.

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



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

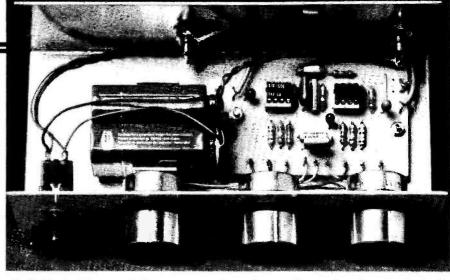


Fig. 2. The prototype was built as a mono version and mounted on an aluminium chassis. If built as part of an amplifier the battery power supply could be replaced with a well smoothed 9.0-9 mains PS.

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

270R

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.

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.

RESISTORS all ¼ 5% **SEMICONDUCTORS** R1,2,3 100k IC1.2 741 or 741N R4,8 10k R5,9 3k9 POTENTIOMETERS R6.10 1k8 100k lin rotary

CAPACITORS

R11

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

RV1,2

RV3 500k lin rotary

SWITCH

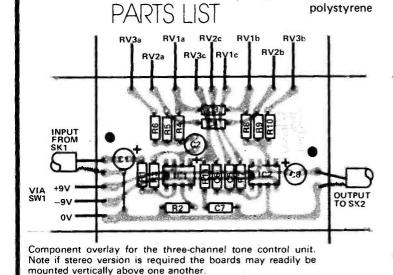
SW₁ **DPST** miniature toggle

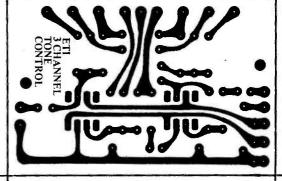
SOCKETS

SK1,2 Panel mounting phono sockets or DIN sockets

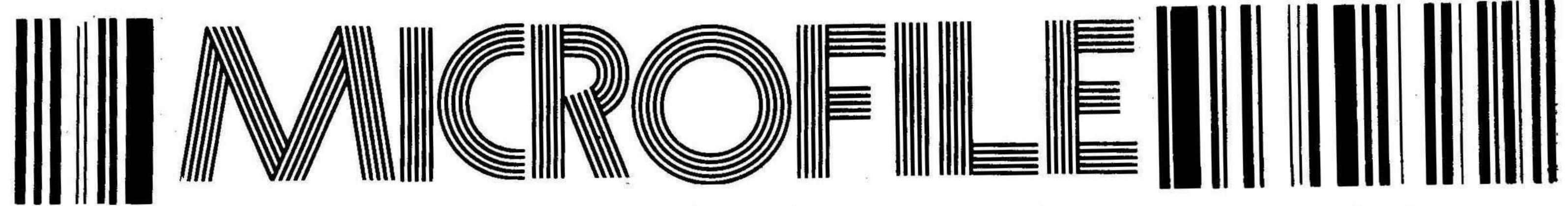
MISCELLANEOUS

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





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



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

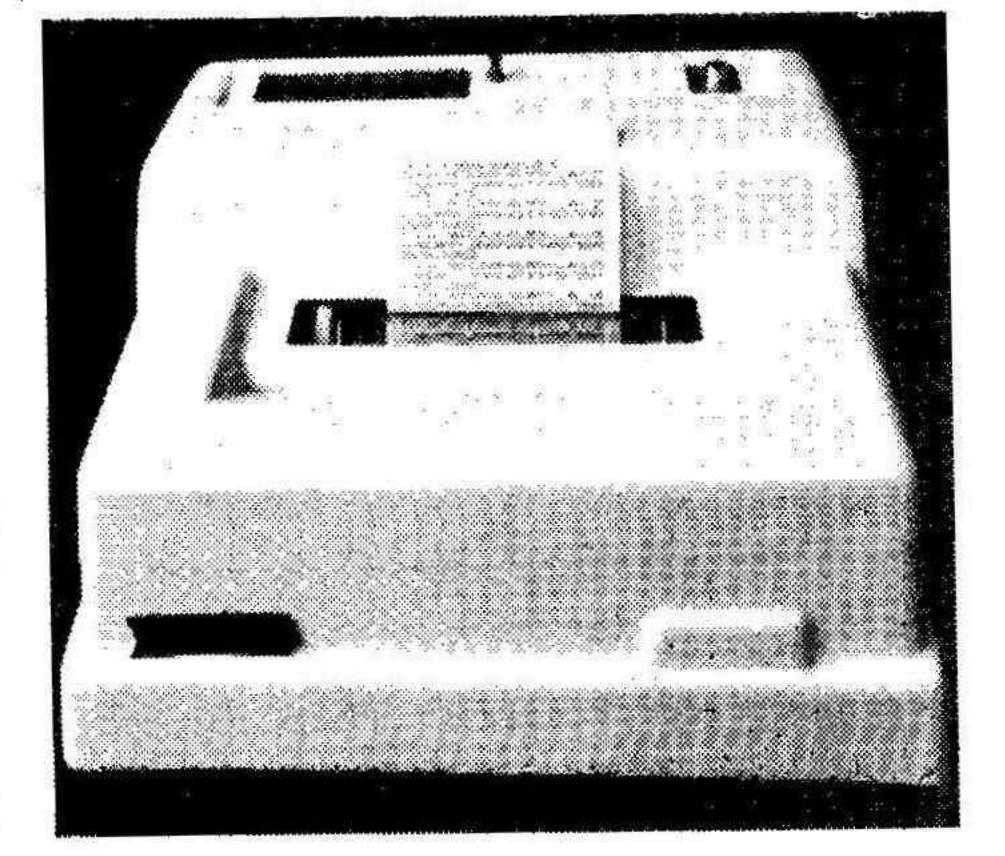
For some time now we here at ETI have considered modifying the line and field drive circuits of an old TV set to bring them in line (sorry) with the American specifications for these circuits.

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

Photograph of MP-40 printer



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.

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.

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.

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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 Superbester Fluorescent Light Dimmer. Radar Intruder Alarm. Light Dimmer. FM. Tuner. Colour. Organ. Drilf Speed Controller plus many more;

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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.

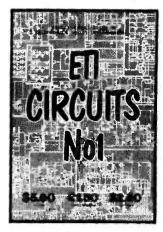
£1.00 + 25p P&P



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, Heapthone 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.

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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.

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



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



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!

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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 oversees. 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.



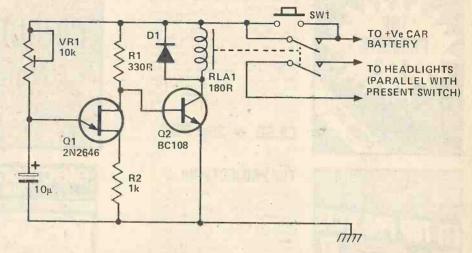
Headlight Delay Unit

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 Ω 2 is turned on closing the relay and turning on the car's headlights. C1 begins to charge through VR1 until Ω 1 turns on, turning Ω 2 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.



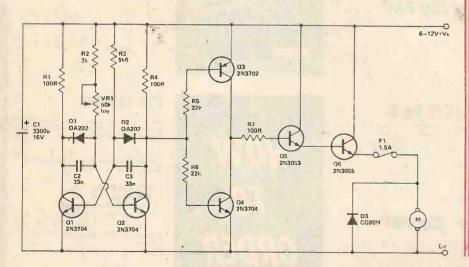
DC Motor Speed Controller

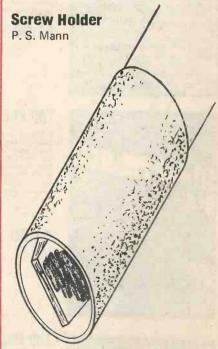
D. Strange

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 fail and zero volts, turning on and off completely the output transistors Q5 and Q6. Consequently the dissi--pation 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.





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

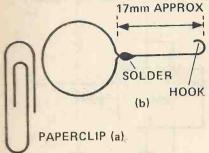
A short length of insulation is put over the end of a small screwdriver until flush with the end.

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.

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.





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!



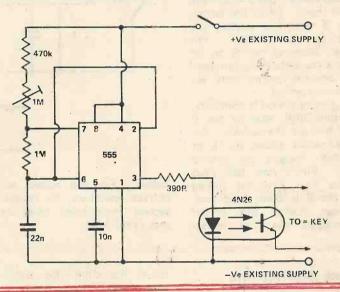
Calculator Stopwatch

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

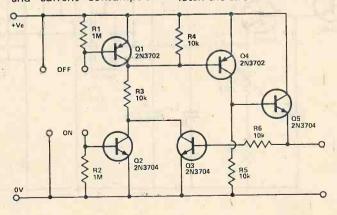
The circuit was designed for use as a solid-state calculator on-off switch, as the mechanical equivalent was found to be unreliable.

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 $30\mu A$.

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.





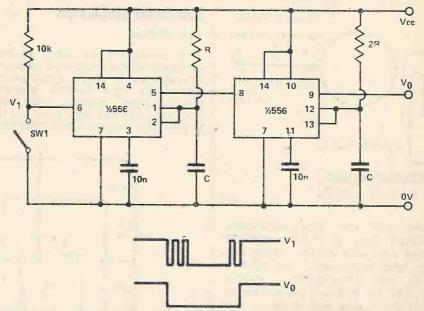
Contact Debounce

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 retriggerable, any contact bounce only extends the timing period.

When the timing period is complete, pin 5 remains high, due to pin 6 being held low by the switch. Releasing 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 suppression 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 lan

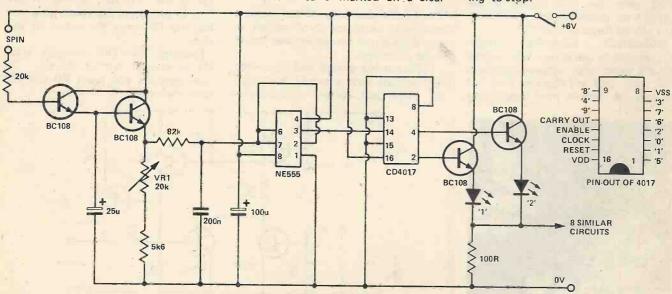
Ten LEDs arranged in a circle form the 'wheel' for this miniature roulette.

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.

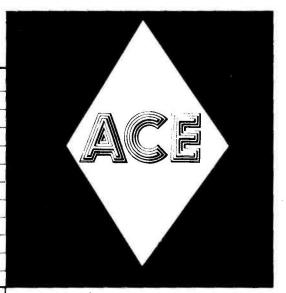
The LEDs are mounted behind a red translucent perspex panel with the numbers 0 to 9 marked on a clear

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 'spinning' to stop.



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	10	1500	6	250m/a 4	205 x 140 x 75	430	Nut Cover (L)	13
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	9			Black 6	0.1 Blob 2.5"/3.75"	25	LESL/HDR Green	27
	18			Ins. Handles	0.1 Blob 3.75"/5"	50	LES Bulb 6V	12
	8			Red 8	D 3.6" x 2.4"	22	LES Bulb 12V	12
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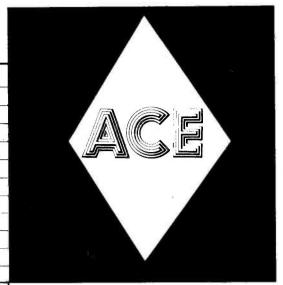
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CA3089E 295 Elec	lectronic Comps 180
	rinted CCTS 180 lec. Diagrams 180
Time O P TH 42 CMOS O P TS Sim	imple CCTS 199
X1K AA119 7 4000 26 Prac	ractical Projects 199
OA47 9 4001 26 Pro	roject Plans 199
X10K / (401) 20 110	10 Semicon CCTS 250 10 Op Amp CCTS 250
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Beg	eginners Electronics 225
	&A Transistors 100 &A I.C's 100
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01. Electros-Axial		PTH	06. Fuseholders		Polystyrene	O D TC	LxDxH	Q P TS
Value (µF) QPTH	100	6	Туре	Q P TS		Q P TS	114 × 64 × 30	112 179
1/63V 10	150	6	Chassis 1¼	12	75 x 56 x 35	58	114 x 89 x 55	
2.2/63V 10	220	6	Chassis 20mm	7	95 x 71 x 35	69	15. Knobs ¼ Spind	
4.7/63V 10	330	6	Panel 1¼	33	115 x 95 x 37	83	Collet-Black	Q P TS
10/63V 10	470	6	Panel 20mm	28	Vero ABS 75 Series	3 0 52	15mm Plain (P)	33
10/25V 10	680	6	07. Fuses Quick B			Q P TS	15mm Lined (L)	38
22/25V 10	1000	6	20mm	Q P TS	205 x 140 x 40	390	Nut Cover (P)	7
47/25V 10	1500	6	250m/a	4	205 x 140 x 75	430	Nut Cover (L)	13
100/63∨ 25	2200	6	500m/a	4	205 x 140 x 110	555	Pointer 15mm	4
100/25V 10	3300	6	1A	4	154 x 85 x 40	240	Cap-Black 15	4
2 2 0/ 2 5∨ 25	4700	9	2 A	4	154 x 85 x 60	300	Cap-Red 15	4
470/63V 37	10000	9	3A	4	154 x 85 x 80	350	Cap-Grey 15	4
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1000/63V 46		Ppk TH	1¼"		LxDxH	Q P TS	Cap-Blue 15	4
1000/25V 54	22	10	500m/a	7	100 x 50 x 25	180	Cap-Yellow 15	4
2200/25V 85	33	10	1A	7	100 x 50 x 40	210	21mm Plain	45
	47	10	2A	7	125 x 65 x 40	230	Cap-Black 21	4
02. Tantalum-Beads	100	10	3A	. 7	150 x 80 x 50	260	Cap-Red 21	4
Value (µF) QPTH	150 .	10	5A	7	188 x 110 x 60	340	Pointer 21	5
0.47/35V 14 ·	220	10	Plug Top 1"		Vero Sloping Top		16. Miscellaneous	
1.0/35V 14	270	10	2A	7	220/174/100-52	690	Vero Stand Offs	Q P TS
2.2/3.5V 16 I	330	10	3A	7	171/121/75-37.5	450	Pillars 6mm	3
4.7/35V 17	470	10	5A	7	13. Boards		Pillars 15mm	3
10/25V 21	560	10	13A	7	Vero	Q P TS	Solder	
22/16V 24	1000	10	HARDWARE		0.1 2.5" x 3.75"	50	18 Savbit/Metre	7
47/6.3V 24	2200	10	08. Heat Transfer		0.1 3.75" x 3.75"	59	Solda Mop	72
03. Polyester Radial	4700	10	Type	Q P TS	0.1 2.5" × 5"	59	Dalo PCB Pen	115
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0.001 7	0.022µF	10	TO220 Mica Set	8	Dec & Blob	Q P TS	LED TIL209 Red	15
0.0022 7	F بر0.047 F	10	TO5 Sink	19	S. Dec	216	LED 0.2" Red	15
0.0047 7			TO220 Sink	19	T. Dec	399	LED 0.2" Green	35
0.01 7	What additional product		09. CROC-Clips		TO5 Adapt	200	LED 0.2" Yellow	35
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0.22 9			Ins. Handles	U	0.1 Blob 3.75"/5"	50	LESL/HDR Green	
0.47 18			Red	8	D 3.6" x 2.4"	22	LES Bulb 6V	12
1.0 18		34	Black	8	D 2.4" x 7.3"	46	LES Bulb 12V	12
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04. Polystyrene				Q P TS	IC 4.8" x 3.2"	44	Fix Clip 0.2 LED	3
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23. Instrument 4mm etc. Push Terms		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 ZN3702 11 ZN3703 11 ZN3704 11 ZN3706 11 ZN3706 11 ZN3706 11 ZN3706 11 ZN3819 Q P TH ZN3904	20 20 20 20 27 20 30 30 20 33 20 33 20 33 20 33 20 33 20 33 20 33 20 33 20 33 20 34 20 35	Black 25 Blue 25 Blue 25 Brown 25 Green 25 Grey 25 Orange 25 Pink 25 Pink 25 Yiolet 25 Yiolet 25 Yellow 25
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TOTALS (Two Rates!) TH =	TS = TH =	TH = TS =	TH = TS =	TS = TZ =



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:

VO=VZ-VBE1

Output voltage rise time is expressed by:

T=RBC1In(1-VZ/VI)

Improved SPST Switch Flip-flop

D. J. Manford

1/6 4049

1/6 4049

1/4 4016

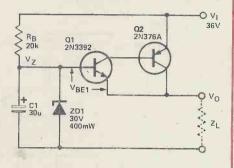
1NPUT

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.

Some digital systems require a preset turn on sequence for their power supplies. By setting appropriate RB/C1 values, the circuit's output rise time can be set to provide this sequence or delay.



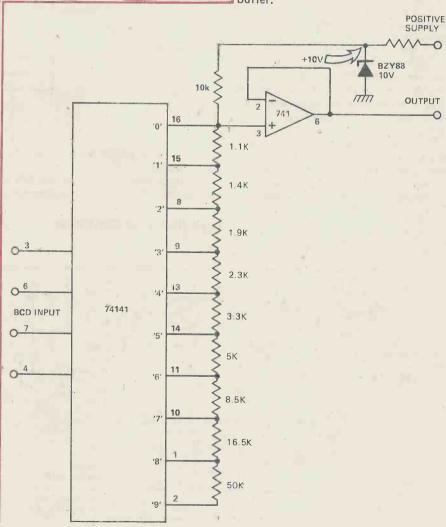
BCD to Analog Converter

C. R. Poole

This circuit will convert four-bit BCD into a variable voltage from 0-9V in 1 volt steps. Only two ICs 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.





Model Railway

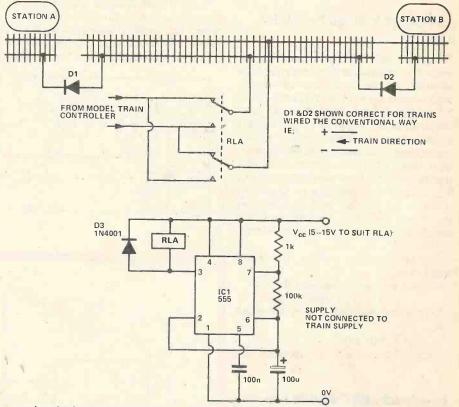
E. A. Parr.

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 cap 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

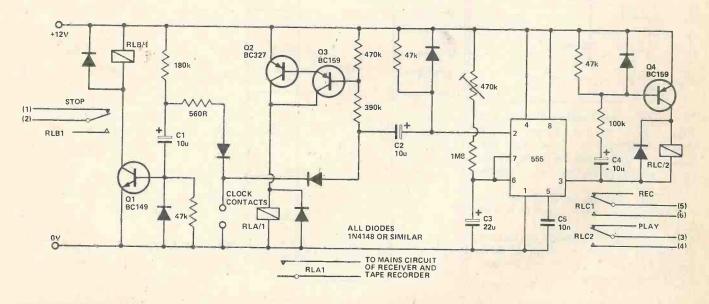


seconds which should be sufficient for most layouts.

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



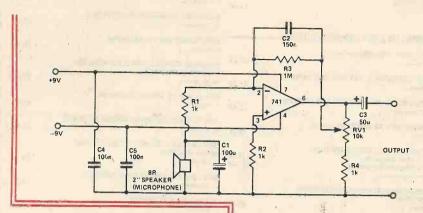


Ice Warning and Lights Reminder

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 temperature, VR2 for light. Both thermister and LDR should be well protected. Most high gain NPN transistors will work and the experimenters junk box will almost certainly hold some.



+12V ≥ R4 470R R3 SWITCH 470R VR2 LIGHTS WARNING LED2 LED1 02 81 LDR THERMISTOR BUZZER Q1-4 = BC108ORP 12 0,0

Heartbeat Preamplifier

P. J. Tyrrell

This simple circuit, when connected to an audio amplifier, allows one to listen to heartbeats. The low frequency 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 instability 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 mechanical 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 output of the timer goes high for one minute, allowing time for the recorder 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 approximately 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 contacts, but RLA must be a heavy duty mains rated type. Ideally the digital clock should be crystal controlled, to eliminate short term mains frequency fluctuations. The numbers shown in brackets are the appropriate pin connections on the 10 way remote control plug of a Revox A77.

Battery Tester

R. N. Soar.

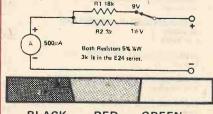
This circuit was designed as a simple tester for 1.5 and 9 volt batteries.

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.



BLACK RED GREEN

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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

SOLDER

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.

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.

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

High quality modules for stereo, mono and other audio equipment.



Fitted with Phase Lock-loop Decoder

The 450 Tuner provides instant program selection at the touch of a button ensuring accurate tuning of 4 pre-selected stations. any of which may be altered as often as you choose, by simply: changing the settings of the pre-set controls.

changing the settings of the preset commons.

Used with your existing audio equipment or with the BI-KITS

STEREO 30 or the MK60 Kit etc. Alternatively the PS12 can be used if no suitable supply is available, together with the Transformer T538.

The S450 is supplied fully built, tested and aligned. The unit is easily installed using the simple instructions supplied.

- * FET Input Stage
- VARI-CAP diode tuning
- Switched AFC
- Multi turn pre-sets
- LED Stereo Indicator

Typical Specification: Sensitivity 3 volts Stereo separation 30db Supply required 20-30v at 90 Ma max.

OUR PRICE

£13.75

POSTAGE & PACKING

Postage & Packing add 25p unless otherwise shown. Add extra for airmail. Min. £1.00



Enjoy the quality of a magnetic cartridge with your existing ceramic equipment using the new M.P.A. 30, a high quality pre-amplifier enabling magnetic cartridges to be used where facilities exist for the use of ceramic cartridges only.

It is provided with a standard DIN

input socket for ease of connection

Full instructions supplied.

The Stereo 30 comprises a pre-amplifier, power amplifiers and power supply. This, with only the addition of a transformer or overwind will produce a high quality audio unit suitable for use with a wide range of inputs i.e. high quality ceramic pick-up, stereo tuner, stereo tape deck etc. Simple to install, capable of producing really first class results, this unit is supplied with full instructions, black front panel knobs, main switch, fuse and fuse holder and universal mounting brackets enabling it to be installed in a record plinth, cabinets of your own construction or the cabinet available Ideal for the beginner or the advanced constructor who requires Hi-Fi performance with a minimum of installation difficulty (can be installed in 30

> TRANSFORMER £3.25 plus 50p p & p TEAK CASE £5.45 plus 70p p & p

STEREO PRE-AMPLIFIER

Frequency Response + 1dB 20Hz

A top quality stereo pre-amplifier tone control unit. The six push-button selector switch provides a choice of inputs together with two really effective filters for high and low frequencies, plus tape

MK. 60 AUDIO KIT: Comprising 2 x AL60's. 1 x SPM80. 1 x BTM80. 1 x PA100. 1 front panel and knobs. 1 Kit of parts to include on/off switch, neon indicator, stereo headphone sockets plus instruction booklet. COMPLETE PRICE £34.90 plus 85p postage.

TEAK 60 AUDIO KIT:

Comprising: Teak veneered cabinet size 16%"x11½"x3%", other parts include aluminium chassis heatsink and front panel bracket plus back panel

and appropriate sockets ect. KIT PRICE £13.2! plus 85p postage

KHz. Sensitivity of inputs
Tape Input 100mV into 100K ohms Tape Input 100mV into 1
 Radio Tuner 100mV into 100K ohms Magnetic P.U. 3mV into 50K ohms

P.U. Input equalises to R1AA curve with, 1dB from 20Hz to 20KHz. Supply -- 20-35V at 20mA.

Dimensions x 89mm x

NEW

10w R.M.S. AUDIO AMPLIFIER MODULE

The AL30A is a high quality audio amplifier module replacing our AL20 & 30. The versatility of its design makes it ideal for record players, tape recorders, stereo amps, cassette and cartridge players. A power supply is available comprising a PS12 together with a transformer T538, also for stereo, the pre-amp PA12.

SPECIFICATION

- Output Power 10w. Supply 22 to 32 volts.
 R.M.S.
- Load Impedance 8 to
- Sensitivity 90my for full output.
- Frequency Response 60Hz to 25KHx + 2db.
- Input Impedance 50K
- Total Harmonic Distortion Less than .5% (Typically
- Max. Heat Sink Temp 80°c.

ONLY £3.65

Dimensions 90 x 64 x 27mm



25 Watts (RMS)

* Max Heat Sink temp 90C. * Frequency response 20Hz to 100KHz * Distortion better than 0.1 at 1KHz * Supply voltage 15-50v * Thermal Feedback * Latest Design Improvements * Load — 3,4,8, or 16 ohms * Signal to noise ratio 80db * Overall size 63mm. 105mm. 13mm.

Especially designed to a strict specification. Only the finest components have been used and the latest solid-state circuitry incorporated in this powerful little amplifier which should satisfy the most critical A.F.

Power supply for AL30A, PA12, SA450, etc.

OUR PRICE Input voltage 15-20v A.C. Output voltage 22-30v D.C. Output current 800 mA Max. Size 60mm x 43mm x 26mm. Transformer T538 £3.20

Frequency Response 20Hz-20KHz (-348). Bass and Treble range 1248. Input Impedence 1 meg ohin Input Sensitivity 300mV. Supply requirements 24V.5mA. Size 152mm

P.O. BOX 6. WARE. HERTS.

NEW PA12 Stereo

18 BALDOCK ST., WARE, HERTS OPEN 9 to 5.30 Mon. / Şat.

Stabilised Power Supply Type SPM80

SPM80 is especially designed to power 2 of the AL60 Amplifiers, up to 15 watts (R.M.S.) per channel simultaneously. With the addition of the Mains Transformer BMT80, the unit will provide outputs of up to 1.5A at 35V. Size: 63mm. 105mm. 30mm. Incorporating short circuit protection.

Transformer RMT80 £5.30 + 86p postage

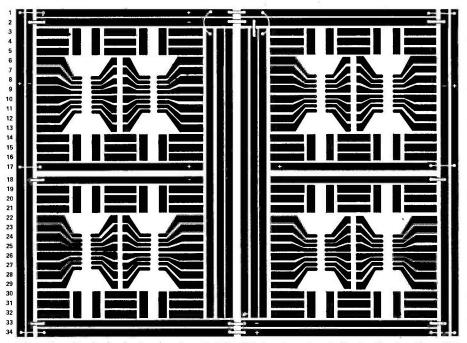
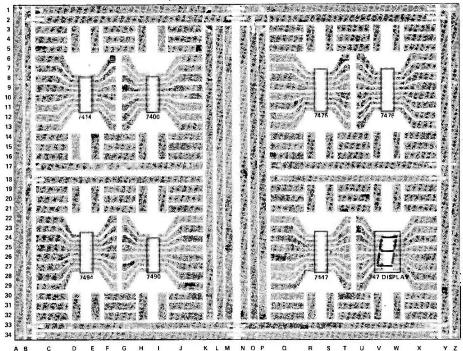


Fig. 2. Above: This is the track pattern for the ZB-8-IC used in this series. Note the wire links which need to be made in order more easily facilitate application. Fig. 3. Below: Components in place on the board. Note that unlike our usual overlays, the tracks are on the SAME side as the components.



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

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.

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.

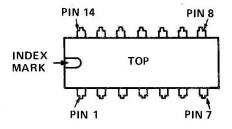
Stable lines

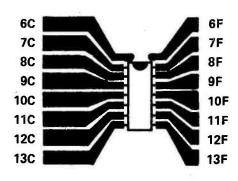
If a stabilised supply is not available, however, a stabiliser should be built on to these lines. A suitable circuit is shown in Fig. 7 using a BD131 and 2N697, both of which are readily obtainable.

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 OV), 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





HOW IT WORKS

The action of the circuit is as follows. The connection of the lk 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 lk 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.

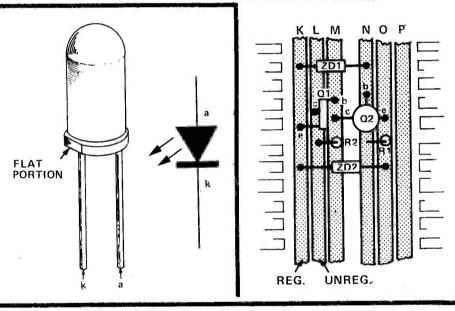
+Ve UNREGULATED R1 +5V REGULATED BD131 ZD1 4V3 METAL FACE BD131 ZD2 R2 2N697 270R -Ve

Fig. 7. Above: Circuit diagram for a suggested power supply to run the experiments, and, Fig. 8., below, a layour 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

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

COMPONENTS NEEDED FOR THE SERIES

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

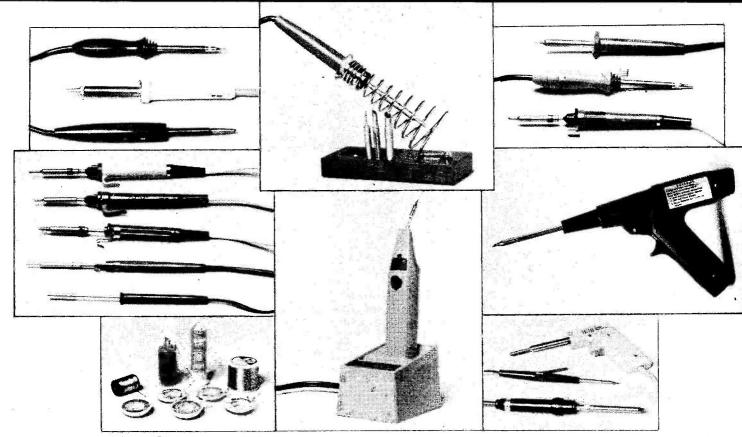
STABILISER COMPONENTS

- 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.



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 readors 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.

- Continuous heat
 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 1/4 inch diameter iron with a 1/8 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.

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 screwin 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

Key to heading photographs

2 3

4 5

7 8

Photo 1: Top to bottom, Greenwood Electronics Oryx 50, Weller WP60D and Light Soldering Developments TG50. 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. 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.

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 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

54	Manufacturer or Distributor	Model	Wattage	Voltages available	Bits (mm)	Temp °C	Leakage Length Weight Current (mm) (g)	Length mm)	Weight (g)	Inclusive Price	Inclusive Other information Price
	Continuous heat	eat									
	Greenwood	Oryx 9 Adamin 15	8.3	6, 12, 24 6 12 15 24 115 220, 240	4 (2) 2.4 (13)	325 360		157	7 4	3.34	Low power, general purpose Precision, hand wound element.
	L.S. Developments		12 t	6, 12, 24, 50, 115, 220, 240	2.4 (4)			190	20	3.60	●☐ Available as 16W (420 C) also, hand wound element. ■ Precision, hand wound element.
	Antex		. 	24, 50, 100, 115, 220, 240	2.3(8)		1	160	788	3.92	Kit SK1 available, including spare bits and storage box.
	Antex Antex	z S S	17	115, 240	2.3 (5)	370		190	245	3.92	Colombia shart ascu, for anna for comago. Double shaft encloses element.
	Adcola	Invader L706 G	14	12, 24, 110, 220, 240 115, 220, 240	3.2 (15) 2.3 (3)		18-A 10-A	196 160	47 28	5.20 4.18	More powerful version of model C.
	S&R Brewster		8 6	110, 240	3 (3)			195	120	3.70	Weight includes lead, slotless bit construction. T Stainless steel shaft.
	L.S. Developments		50 50 50 50 50 50 50 50 50 50 50 50 50 5	6, 12, 24, 50, 115, 220, 240	3.6(8)	380		200	32	4.28	Available as 22W (420 C) also, hand wound element.
	Adcola I S Developments	Invader L646 Standard 187	23 24	12, 24, 110, 220, 240 6, 12, 24, 50, 115, 220, 240	4.7(8)		A~081	203	20	4.40	Available as 27W (420 C) also
	Antex		25 25		3.2 (4)		5A	220	20	3.92	Two DIL bits available in range. Fitted with crocodile clips, battery version of X25
	Adcola Greenwood	Invader L1076	27	12, 24, 110, 220, 240	6.3 (12) 4.8 (9)	365	*	204	71	5.54	ΦΔAvailable as 30W (410°C) also Weight includes lead, neon built in, long life element.
	Temperature Controlled	Controlled	i								×
	Weller	TCP-2	45	. * * * * * * * * * * * * * * * * * * *	3.2 (40)	260, 315,	370	210	E	10.88	Change tip to alter temperature, Gurle
	L.S.Developments	TC 50	20	24, 50, 115, 240	3.2 (10)			220	70	10.04	enect, notice / supply available. Continuously variable while running (allen
	Greenwood	Oryx 50	20	12, 24, 50, 115, 240	3.2 (10)	200-400		200	1	8.86	Continuously variable while running (allen key).
	Weller	WP 60D	09	240	3.2(18)	315, 370,		210	3 12	14.32	Change tip to alter temperature, Curie effect
F	Greenwood	Oryx 75	.75	220, 240	3.2 (10)		10	230	107	14.31	Continuously variable, solid state control.
LECT	Quick Heat A.G.B. Southern	Mini Scope	75	2,5/6	2 (1)		34	215	90	5.10	Transformer £6.35, 5 second warm up,
RON	A.G.B. Southern	Superspeed	150	2.5/6	6.4			250	100	5.10	Transformer £6.35, 5 second warm up, plement in tin
ICS T	Greenwood	Ersa Sprint	150/80	210, 240	6.4			200	200	10.58	Two position trigger, 80 / 150W power 10 second heat up.
חם	necessar years				1				C L	0	

and low voltage high current Cross). are sensor controls a triac, with all the Light Soldering Developdments and Weller, all produce similar systems method, is used in the Oryx 75 from circuitry built into the handle. Adcola, but they all use an external control

Greenwood

Southern

Heat Irons Duick 1

In general quick heat irons are very apply enormous heat to vork,

The low voltage types are unusual, in that the heating current is passed through the bit itself Superspeed from A.G.B.

Rechargeable Cordless Irons

was the Wahl Corporation - the and Weller have also produced irons on the same principle. Gone are the can solder a hundred or so joints The drawback with soldering irons always was that you needed a source rechargeable NicCad batteries this days of 1/2-mile extension cables, you produce a cordless rechargeable iron, of power, be it mains or a car battery company Since then With the advent of The first sotip Standard. changed.

Not really intended to continuous

shape - its performance is otherwise similar to the Isotip Standard. The unit and is available in 12 hour and 4 hour charge versions, the Scope (sometimes literally). The Isotip comes complete with stand/charger Cordless is unusual in that it is a pistol WC 100 is available in U.S.A. (and in the U.K. shortly). Veller

development in the future. In fact we the professional repairman, and can expected to undergo much echargeable irons are valuable for Although relatively expensive, around the corner?

Choice of Iron

60/40, a bit adequate. Cis 2500 with

need one, you need one. Rather than Quick heat irons should be used for rechargeable irons are unique; if you able for most purposes, if you do a lot heavy connections around the house, trolled iron is a wise investment ine bit and a 25W with a larger bit Other soldering accessories of construction a temperature An iron of 15W to

plo

When soldering new components, temperature For melting

₹

consider two irons - one 15W with a eads -whoops nearly forgot, solder in soldering is an art, and to get artistic spare bits in a wide selection, decent sidecutters to snip component having to keep changing bit size, heatshunt to protect delicate components and last but by no means least obtain include desolder braid desolder gun, a stand for your

> Shop and trade enquiries welcome When you make your own you need the Seno **GS** Etching Svstem!

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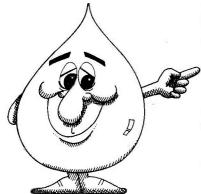
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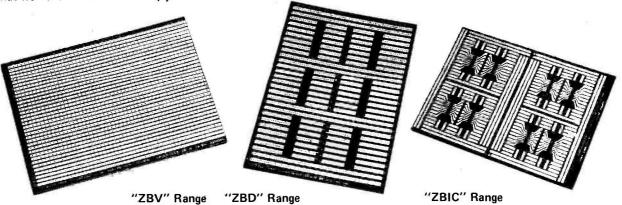


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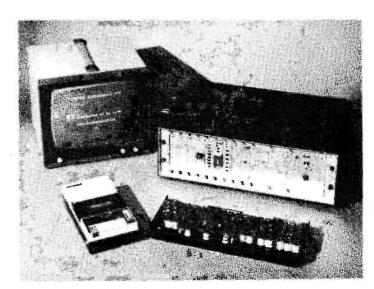
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570/571 DUAL COMPANDOR

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.

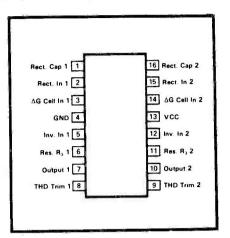
A compensation scheme built into the ΔG cell compensates for temperature, and cancels out odd harmonic distortion. The only distortion which remains is even harmonics, and they exist only because of

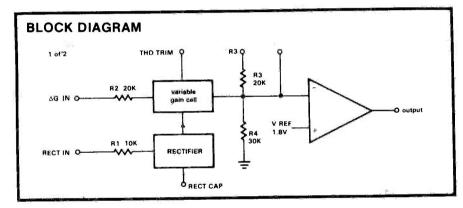
Features

- 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





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

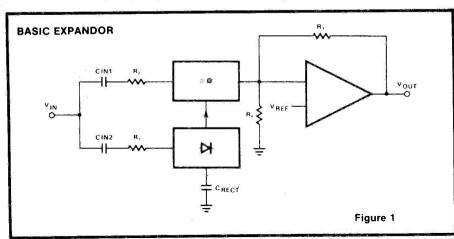
expandor gain to be determined only by internal components. The output stage is capable of \pm 20mA output current. This allows a + 13dBm (3V5 rms) output into a 300 ohm load which, with a series resistor and proper transformer, can result in + 13dBm with a 600ohm output impedance.

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 $1 = 3V/R_1 = 3V/10K = 300 \, \text{µA}$. The ΔG cell input current should be limited to $1 = 2V8/R_2 = 2V8/20K = 140 \, \text{µA}$. If it is necessary to handle larger input voltages than $0-\pm 2V8$ 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



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).

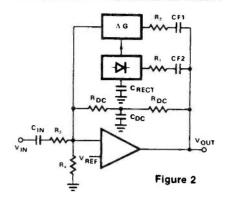
Basic Compressor

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

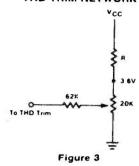


For the largest dynamic range, the compressor output should be as large as possible so that the rectifier input is as large as possible (subject to the $\pm 300\mu$ A peak current restriction). If the input signal is small, a large output can be produced by reducing R_3 , with the attendant decrease in input impedance, or by increasing R_1 or R_2 . It would be best to increase R_2 rather than 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 ' $30\mu A$ into a 100ohm resistor tied to 1V8.

THD TRIM NETWORK



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The second system, the RESEARCH MACHINES 2802, 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).

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RESEARCH MACHINES 3802 will have the following specifications: BUILT-IN VDU; The 3802 has a UHF output which plugs into the aerial socket of a completely unmodified domestic television. The TV screen will then display 24 nows of 40 characters (950 characters). The unit can display the 128 character ISO7 set, including upper and lower case ASCII. VDU GRAPHICS The 3802 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: 280 Microprocessor. Fully buffered bus. RANDOM ACCESS EMMORY 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 MontTOR, 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 sequental and immediate mode, Machine Language Graphics Subroutines, Games Packages, 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.

between units are made with unplugable connections.

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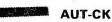
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CARD

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

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					
		s as per S68 preferred			
bus st	ructure	with U/C pins as			
follows	_				
Pin 2	KBD	Keyboard enable			
		output.			
Pin 3	VDU	VDU enable out-			
		put.			
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 φ2			
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	Optiona	ıl.				
Pin 10	Optiona	ıl				
Pin 11	Optiona	ıl				

Pin 12 Optional

Pin 13 GND

Pin 15 NC

Pin 16 HALT

Pin 14 RESET

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.

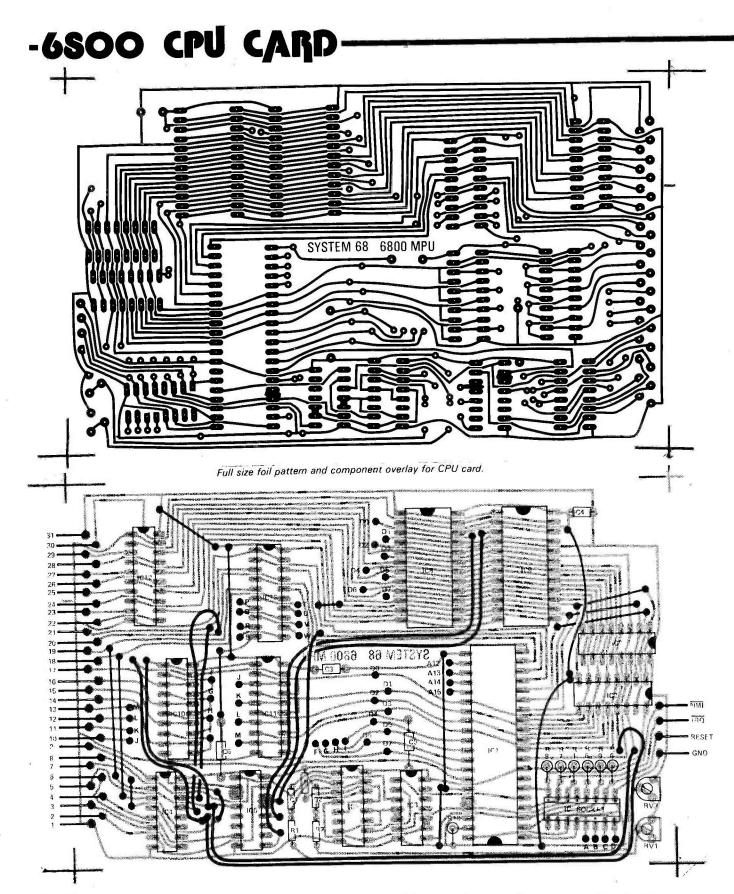
Other Off-board signals

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.



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.
l l	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	0	Low at RAM X '400' enable output.
ĺ	1	Q	X	X	0	Low at VDU (X '800') enable output.
	1	1	O	×	0	Low at IC9 pin 3 (X 'C00')
	1	1	1	X	0	Low at IC8 pin 3 (X 'E00').
1	X	X	×	X	1	All above outputs high.
IC2						
	pin 1	0 1	/MA	R.	/W	
	0		X)	<	\overline{VMA} , $\overline{\Phi 2}$, \overline{RDS} , $\overline{\overline{WDS}}$ all high.
	×		0		(<u>VMA. Φ2</u> , RDS <u>, WD</u> S, all <u>high</u>
	1		1	()	VMA. $\Phi 2$ low, WDS low, RDS high.
R)	1		1		1	$\overline{\text{VMA.}\ \Phi2}$ low, $\overline{\text{WDS}}$ high, $\overline{\text{RDS}}$ 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' E0 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

-6500 CPU CARD

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.

		100	
ETIBUG	<u>M</u> 000)2	
ETIBUG	0002	00	
ETIBUG	0003	00	
ETIBUG	0004	00	
ETIBUG	0005	00	<u>OF</u>
ETIBUG	0006	0.0	<u>40</u>
ETIBUG	0007	00	<u>60</u>
ETIBUG	8000	80	
ETIBUG	0009	30	<u>A0</u> .
ETIBUG	000A	AO	. <u>CO</u>
ETIBUG	000B	20	<u>E0</u>
ETIBUG	000C	00	
ETIBUG	000D	00	
ETIBUG	000E	00	
ETIBUG	000F	00	
ETIBUG	0010	FE	00?
ETIBUG			
Fin 2 Evan	only of the	10.01	amand Ils

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:

ETIBUG

13000000000000000 F406080 A0C0E0000000000

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 <u>L</u> S1130000000000000 000F406080A0C0E 000000000S9.

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 P 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

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

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

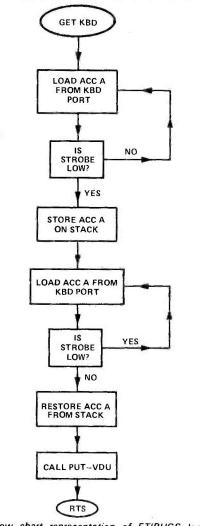
From this we see that the program counter at X'A048/A049 has a value of 0809.

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

ETIBUG <u>M</u> A0<u>48</u> 08 00 A049 0980

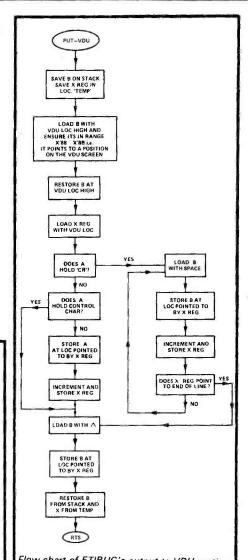
We have now set up the necessary registers and entered the program. If you now enter

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



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.

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.

DATA



SHEET

MC 6800 MPU-THE SOFTWARE - INSTRUCTION MAP AND SET

LSB	D	1	2	3	4	5	6	7	8	9	A	В	С	a	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	*	•	·	*	TA8 (INH)	TBA (INH)	•	DAA (INH)	٠	ABA (INH)	٠	•	•	•
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)	٠	RTI (INH)	٠		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 (IMM)	CMP (A) (1MM)	SBC (A)	•	AND (A) (IMM)	BIT (A) (IMM)	LDA (IMM)	٠	EOR (IMM)	ADC (IMM)	ORA (IMM)	ADD (A)	CPX (IMM)	BSR (REL)-	LDS (IMM)	٠
9	SUB (DIR)	CMP (DIR)	SBC (A)	*	AND (DIR)	BIT (DIR)	LDA (DIR)	STA (A)	EOR (DIR)	ADC (A)	ORA (DIR)	ADD (A)	CPX (DIR)		LDS (DIR)	STS (DIR)
A	SUB (A)	CMP (IND)	SBC (A)	•	AND (A)	BIT (A)	LDA (IND)	STA (A)	EOR (A)	ADC (A)	ORA (IND)	ADD (A)	CPX (IND)	JSR (IND)	LDS (IND)	STS
В	SUB (EXT)	CMP (A)	SBC (A)		AND (EXT)	BIT (A)	LDA (EXT)	STA (A)	EOR (EXT)	ADC (A)	ORA (EXT)	ADD (A)	CPX (EXT)	JSR (EXT)	LDS (EXT)	STS (EXT)
С	SUB (B)	CMP (B)	SBC· (IMM)	*	AND (B)	BIT (B)	LDA (B)	*	EOR (IMM)	ADC (B)	ORA (B)	ADD (B)	*		LDX (IMM)	
D	SUB (DIR)	CMP (DIR)	SBC (DIR) (B)	•	AND (DIR)	BIT (DIR)	LDA (DIR) (B)	STA (DIR) (B)	EOR (DIR)	ADC (DIR) (B)	ORA (DIR)	ADD (8)	•	٠	LDX (DIR)	STX (DIR) (B
E	SUB (IND) (B)	CMP (IND)	SBC (B)	٠	AND (IND)	BIT (IND)	LDA (IND)	STA (B)	EOR (B)	ADC (B)	ORA (IND)	ADD (B)	•	•	LDX (IND)	STX (IND)
F	SUB (EXT)	CMP (EXT)	SBC (EXT)	•	AND (B)	BIT (B)	LDA (EXT)	STA (B)	EOR (EXT)	ADC (EXT)	ORA (EXT) (B)	ADD (B)	•		LDX (EXT)	STX (EXT)

Direct Addressing Mode
 Extended Addressing Mode
 Immediate Addressing Mode

IND INH REL Index Addressing Mode
 Inherent Addressing Mode
 Relative Addressing Mode = Accumulator A = Accumulator B

*Unimplemented Op Gode

ABA	Add secumulators	CLI	Clear Interrupt Mask	PUL	Pull Date
200	Add with cerry	CLR	rClear and we would be a supplied to	ROL	Route Left
* (A(C))*	Add	CLV	Clear Overflow	ROR	Rotete Right
· ARD	Logical AND		Compare Park	871	Betom from Interrupt : 100 100 100
* 451.	Arithmetic Shirk Left	COM	Complement	RTS	Totarn from Subrouting
LASP.	Arithmetic Shift Right	CPX	Compare Index Register	384	Sustract Adol/muliitors
e prot	Breach of Carry Clear	DAA	Decimal Adjust	580	Subtract with Carry
843	Brench If Carry Set	DEC	Decrement	Sec	Ser Chee
BEG	Branch I/ Boxel to Zvro	DES	Decrement a ack Pointer	SEC SEC	Set Intercupy Mark.
	Branch if Greater or Squal Zero	DEX	Decrement Index Register	SEV	- Set Overflow
	Branch If Greater than Zero	EOA	Exclusive Or	#X	Store Accumulator
· 844	Branch if Higher	INC	Sincrement		
11 BUT	Bit Test	INS	Increment Stack Pointer	STX	Store Seek Robers Store Index Register
BLE	Branch If Yess or Equal	XWF	Increment Index Rigister	SUB	Subtract
31.5	Branch If Law or Same	JMP	Jump	SWI	Software Interrupt
	Branch if Less than Zaro	JSR	Jump to Subroutine	TAS	Transfer Accumulation A To 8
BIAL	Britisch 11 Minus	I Da	Load Accumulator	TAP	Transfer, Accountation to Calabian Us
655	Branch If not Equal to Zero	LDS	Load Stack Pointer	100	Code Register
901	Branch If Plus	LOX	Load Index Register	丁音 A。	A reference Association of the A.C. 1992 A.C.
EGA -	Branch Always	LSR	Logical Shift Right	TPA	Figure 4 countilists 1945 4. Thinks 4 countilists 1945 4. Accomplish
	Branch to Subroutine				e. Acres of the Control of the Contr
	Branch If Overtige Glear	NEG	Negare	787	
	Branch It Overflow Sirt	NOP	No Operation	TSX	Transfer Stock Polester with the Page
667	Compare Accomulators	ORA	Inclusive Or Accumulator	TXS	Comparables sale of Comparables
CLC	Clear Carry	PSH	Push Data	HAI.	Help for Interrupt
A Comment		9 100		4 4 4	
		State State State			

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It IN SNIPS, 7", £2.25.
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Instructions, opport in the stage of the sta

CC7 (W600) Standard, TYPE AA7 (W600) Finer tip E1 1b each.
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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 280s.

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 lavout 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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PIV	14	3A	3A	4A	6A	8A	10A	16A
	(TO5)	(STUD)	(C106)	(TO220)	(TO220)	(TO220)	(T0220)	(TO 220)
200	0.35	0.50	0.45	0.40	0.58	0.60	0.68	1.14
400	0.40	0.60	0.50	0.45	0.87	0.88	0.98	1.40
600	0.65	0.85	0.70	_	1.09	1.19	1.26	1.80

BT106 £1.00, BT107 £1.60, BT108 £1.60, BT109 £1.00, BT116 £1.00, 2N3525 £0.50

TRIACS-Plastic TO-220 Package Isolated Tab

	4A		A 6.5A			5.5A	10A		15A	
	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)
100V	0.60	0.60	0.70	0.70	0.78	0.78	0.83	0.83	1.01	1.01
200V	0.64	0.64	0.75	0.75	0.87	0.87	0.97	1.01	1.17	1.17
400V	0.77	0.78	0.80	0.83	0.97	1.01	1.13	1.19	1.70	1.74
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SERIES		MEMOR		LM301A	0.401
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7425 7427	0.30	7495	0.67	MC1304P	1.60×
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7437	0.35	74107	0.35	MC1351P	1.20*
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7442	0.65	74122	0.40	MC1353P	0.75
7445	0.90	74123	0.65	MC1458P	0.77
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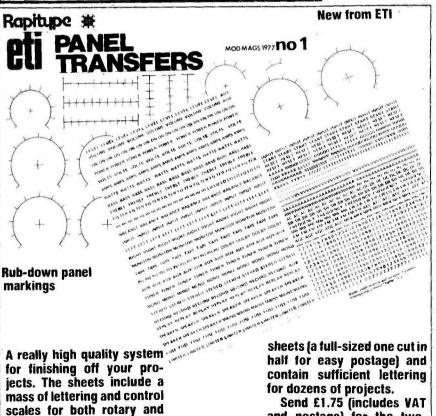
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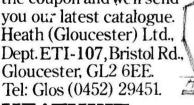
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Preamplifier

The HY5 is a mono hybrid amplifier ideally suited for all applications. All common input functions (mag Cartridge, tuner, etc.) are catered for internally, the desired function is achieved either by a multi-way switch or direct connection to the appropriate pins. The internal volume and tonce circuits merely require connecting to external potentioneters (not included). The HY5 is compatible with all LLP power amplifiers and power supplies. To ease construction and mounting a P.C. connector is power amplifiers and power supplies. To ease construction and mounting a P.C. connector is

supplied with each pre-amplifier.

FEATURES: Complete pre-amplifier in single pack — Multi-function equalization — Low noise — Low distriction — High overload — two simply combined for stereo

APPLICATIONS: HIFT: — Mixers — Disco — Guitar and Organ — Public address

SPECIFICATIONS:

SPECIFICATIONS:
INPUTS Magnetic Pick-up 3mV Ceramic Pick-up 30mV Tuner 100mV Microphone 10mV.
Auxiliary 3-100mV; input impedance 47kl) at 1kHz.
OUTPUTS Tape 100mV; Main output 500mV R.M.S
ACTIVE TONE CONTROLS Treble - 12dB at 10kHz: Bass + at 100Hz
DISTORTION 0.1% at 1kHz; Signal / Noise Ratio 68dB
OVERLOAD 3BdB on Magnetic Pick-up. SUPPLY VOLTAGE - 16.50'.
Price £5.22 + 65p VAT P&P free
HY5 mounting board B1 48p + 6p VAT P&P free

HY30 15 Watts into 8Ω

The HY30 is an exciting New kit from LLP, it features a virtually indestructible LC with short circuit and thermal protection. The kit consists of LC, heatsink, P.C. board, 4 resistors, 6 capacitors mounting kit, together with easy to follow construction and operating instructions. This amplifier is ideally suited to the beginner in audio who wishes to use the most up-to-date technology available FEATURES: Complete kit.— Low Distortion.— Short, Open and Thermal Protection.— Easy to Build APPLICATIONS: Updating audio equipment.— Guitar practice amplifier.— Test amplifier.— Audio oscillator.

SPECIFICATIONS:

OUTPUT POWER 15W R M.S. Into 8() DISTORTION 0.1% at 15W INPUT SENSITIVITY 500mV FREQUENCY RESPONSE 10Hz-16kHz -- 3dB SUPPLY VOLTAGE + 18V Price £5:22 + 65p VAT P&P free.



25 Watts into 8Ω

60 Watts into 8Ω

The HY50 leads I.L.P is total integration approach to power amplifier design. The amplifier features an integral heatsink together with the simplicity of no external components. During the past three years the amplifier has been refined to the extent that it must be one of the most reliable and robust High Fidelity modules in the World. Fidelity modules in the World

FEATURES: Low Distortion — Integral Heatsink — Only five connections — 7 Amp output transistors

FEATURES: Low Distortion — Integral Heatsink — Only five connections — 7 Amp output transistors — No external components
APPLICATIONS: Medium Power Hi-Fi systems — Low power disco — Guitar amplifier
SPECIFICATIONS: INPUT SENSITIVITY 500mV.
OUTPUT POWER 25W RMS in 8() LOAD IMPEDANCE 4-16() DISTORTION 0.04% at 25W at 1kHz
SIGNAL/NOISE RATIO 75dB FREQUENCY RESPONSE 10Hz-45kHz — 3dB
SUPPLY VOLTAGE = 25V. SIZE 105 50 25mm.
Price £6.82 + 85p VAT P&P free

HY120

The HY120 is the baby of LLP's new high power range designed to meet the most exacting requirements including load line and thermal protection, this amplifier sets a new standard in modular

design
FEATURES: Very low distortion — Integral Heatsink — Load line protection — Thermal protection — Five connections — No external components
APPLICATIONS: Hi-Fi — High quality disco — Public address — Monitor amplifier — Guitar and

organ SPECIFICATIONS:

SPECIFICATIONS:
INPUT SENSITIVITY 500mV
OUTPUT POWER 60W RMS into 80. LOAD IMPEDANCE 4-160. DISTORTION 0.04% at 60W at 1 kHz

SIGNAL/NOISE RATIO 90dB FREQUENCY RESPONSE 10Hz-45kHz -3dB. SUPPLY VOLTAGE

±35V. Size 114 x 50 x 85mm

Price £15.84 + £1.27 VAT P&P free

HY200

The HY200 now improved to give an output of 120 Watts, has been designed to stand the most rugged conditions, such as disco or group while still retaining true Hi-Fi performance FEATURES: Thermal shutdown — very low distortion — Load line protection — Integral Healight —

120 Watts into 8Ω

No external components.

APPLICATIONS: H.Fi — Disco — Monitor — Power Slave — Industrial — Public address

SPECIFICATIONS:
HPUT SENSITIVITY 500mV

OUTPUT POWER 120W RMS into 8() LOAD IMPEDANCE 4-16() DISTORTION 0 05% at 100W at 100W.

SIGNAL/NOISE RATIO 96dB FREQUENCY RESPONSE 10Hz-45kHz - 3dB SUPPLY VOLTAGE 45V

SIZE 114 x 100 x 85mm

Price £23.32 + £1.87 VAT P&P free.

HY400

240 Watts into 4Ω

The HY400 is I.L.P.'s "Big Daddy." of the range producing 240W into 4QI It has been designed for high prover discolor public address applications. If the amplifier is to be used at continuous high power levels a cooling fan is recommended. The amplifier includes all the qualities of the rest of the family to lead the market as a true high power hi-fidelity power module.

FEATURES: Thermal shutdown — Very low distortion — Load line protection — No external

components.

APPLICATIONS: Public address — Disco — Power slave — Industrial.

SPECIFICATIONS:

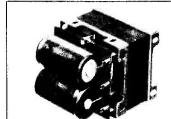
OUTPUT POWER 240W RMS into 4\(\Omega\) LOAD IMPEDANCE 4-16\(\Omega\) DISTORTION 0.1% at 240W at

SIGNAL/NOISE RATIO 94dB FREQUENCY RESPONSE 10Hz-45kHz - 3dB SUPPLY VOLTAGE

INPUT SENSITIVITY 500mV SIZE 114 x 100 x 85mm

Price £32.17 + £2.57 VAT P&P free.

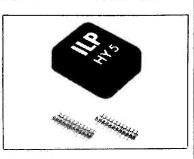
POWER SUPPLIES PSU36 suitable for two HY30's £5.22 plus 65p VAT P/P free PSU50 suitable for two HY50's £6.82 plus 85p VAT P/P free PSU 70 suitable for 2 HY 120's £13.75 plus £1.10 VAT P/P free PSU90 suitable for one HY200 £12.65 plus £1.01 VAT P/P free PSU180 suitable for two HY2000's or one HY400 £23.10 plus £1.85 VAT P/P free

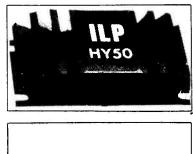


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AMBIT announce a new addition to the catalogue - information on TOKO's new ceramic ladder filters, 2.4kHz SSB filters etc. HF coils, new flat faced low cost panel meters. Catalogue 45p

DETECKNOWLEDGEY

Metal locator principles and practise, including some of the facts that the manufacturers of £100+ metal locators wouldn't like you to know !! £1.00 The "onic Ferret 4000 - A little detector technology of our own. The VCO b. sed metal locator for the electronics constructor, including platsic moldings for housings of electronics and search coil, tubing etc. Can be set up using just a test meter, 'All in' price £34.26 inc PP and 8% VAT.

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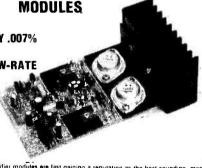


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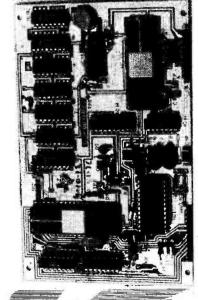
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TANTALUM BEAD CAPACITORS 359: 0 1 JF, 0 22 0 -33, 0 47, 0 58 1-0, 2 24 5 -33, 4 7, 6 8 25V: 1-5, 10 20V: 1-5 16V: 10 JF 13 p each 10V: 22 F, 33, 47 6V: 47, 68 3V: 100 JF, 20p each OPTO ELECTRONICS * LEDs + clip TIL209 Red 17 POTENTIOMETERS (AB or EGEN) Carbon Track, ¼W Log & ¼W Unear values 1K9 & 2K9 Ilm, only) Siagle gang 5K9-2M9 single gang 5K9-2M9 single gang 0 / P switch 5K9-2M9 dual gang stereo 70 7454 7460 7470 7472 7473 7474 7475 7476 13p 24p 25p 16p TIL211 Grn TIL212 Yellow | No. .2" Red .2" Amber Green low OCP70 ORP12 MYLAR FILM CAPACITORS SLIDER POTENTIOMETERS 0-25W log and linear values 60i 5KB-500KB single gang 10KB-500KB dual gang Self Stick Graduated Bezels MYLAR FILM CAPACITORS 100V: 0-001, 0-002, 0-005, 0-01 F 5p 0-015, 0₂02, 0-04, 0-05, 0-056 F 6p 0.1 F, 0-15, 0-2 7p, 50V: 0.47 F 10p 130 ORP12 68p 2N5777 54p 7 Seg Displays TIL312 & 313 3 C. Anode 125p C. Cath 125p TIL321 & 322 5" C. Anode 140p C. Cath 140p DL703 C. Cth 99p DL707 C.A 99p DL707 C.A 1J0p FNO 357 140p P52888280888958549618499022203730003030777746844444 1 11 11222220155355444770 ACC11220 ACC122121 ACC1221 ACC1220 ACC CERAMIC CAPACITORS 50V PRESET POTENTIOMETERS Range: 0-5pF to 10,000pF 0-015uF, 0-022uF, 0-033uF, 0 047uF 4p; 0.1uF 6p. 140p 140p 99p 99p 130p SILVER MICA (Values in pF) 3-3, 4-7, 6-8 10, 12, 22, 33, 47, 50, 68, 75, 82, 85, 100, 120, 150, 220, 9p each 250, 300, 330, 360, 390, 500, 16p each 1000, 1800, 2000, 2200 20p each SWITCHES* TOGGLE 2A 2 SPST DPDT CERAMIC TRIMMER CAPACITORS 2-7oF 4-15oF 6-25oF 8-30oF 20p 2A 250V BC 183 BC 184 BC 184 BC 184 BC 184 BC 187 BC MINIATURE TYPE TRIMMERS 4 pale on off 58 SUB-MIN TOGGLE 2 5-6pF; 3-10pF; 10-40pF 5-**25pF; 5-45pF**; **60pF**; **8**8pF; SUB-MIN TOGG SP changeover SPST on. off DPDT 6 tags DPDT Centre off DPDT Brased SLIDE 250V: 1A DPDT 1A DP C. over ½A DPDT 4 sple c/over Boxes, cases, crystals, earphones, gas sensors, knobs, lamps and holders, panel meters, transformers and many more items available. 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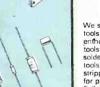














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