

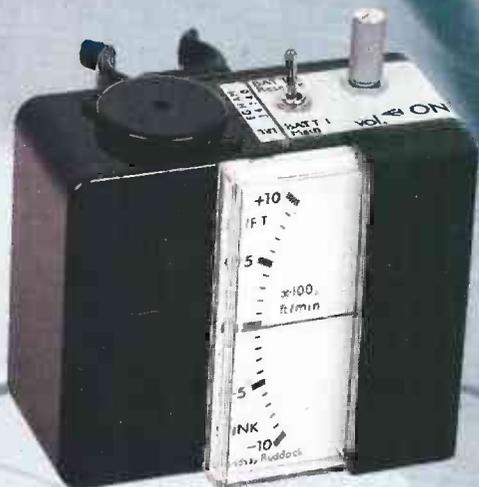
electronics today

INTERNATIONAL

APRIL 1984 95p

DON'T HANG AROUND

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Mains-borne remote control system – plug in and switch on from anywhere in your house!

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BRITAIN'S LEADING
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High performance, low price kits for today's musicians

DIGITAL DELAY LINE



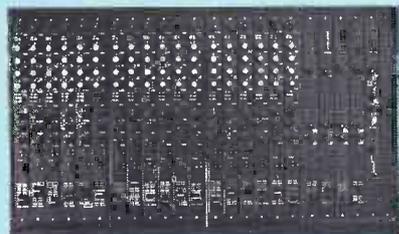
Digital delay circuitry is an absolute necessity for high quality studio work, but usually comes with a four-figure price tag.

Powertran can now offer you digital quality for the price of a high analog unit. The unit gives delay times from 1.6mSecs to 1.6 secs with many powerful effects including phasing, flanging, A.D.T., chorus, echo and vibrato. The basic kit is extended in 400mSec steps up to 1.6 seconds simply by adding more parts to the PCB.

Complete kit **£150** Parts for extra 400mS delay (up to 3) **£14.95**

'DESTINY' MIXER

This versatile mixer offers a maximum of 24 inputs, 4 outputs, and an auxiliary channel. Input channels have Mic/Line, variable gain, bass/treble, and middle frequency equaliser. Output channels have PPM displays and record/studio outputs. There are send/return jacks, auxiliary, pan and fader controls, and output and group switching. There is also a head-phone jack and built-in talk-back microphone.



Input channel **£23.00**
 Output channel **£23.00**
 Aux. channel **£26.00**
 Blank panel **£3.50**
 Base unit and front **£33.00**
 Pair of end cheeks **£25.00**
 Power supply and cabinet **£22.50**

TRANSCENDENT 2000

ETI single board synthesizer.



This professional quality 3-octave instrument is transposable 2 octaves up or down, giving an effective 7-octave range.

There is portamento pitch bending, VCO with shape and pitch modulation, VCF with high and low pass outputs and separate dynamic sweep control, noise generator and an ADSR envelope shaper. Other features include special circuitry with precision components to ensure tuning stability.

Complete kit **£150**

MPA 200

100 watt mixer/amplifier



Here's a rugged, professionally finished mixer amp designed for adaptability, stability and easy assembly. Using new super-strength power transistors and a minimum of wiring, it offers a wide range of inputs (extra components are supplied for additional inputs), 3 tone controls, each with 15dB boost and 15dB cut, and a master volume control.

Complete kit **£58.00**

SP2-200

2-channel, 100-watt amplifier



The SP2-200 uses two of the power amplifier sections of the MPA 200 (above), each with its own power supply. A custom designed toroidal transformer enables both channels to simultaneously deliver over 100W rms into 8 ohms. Each channel has its own volume control, and a sensitivity of 0.775mV (OdBm) makes this amplifier suitable for virtually all pre-amps or mixers.

Complete kit **£75.00**

CHROMATHEQUE 5000

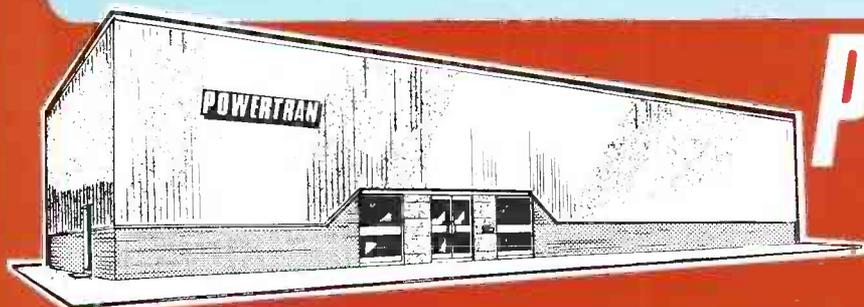
ETI 5-channel lighting effects system



Many lighting control units are now available. Some perform switching and others modulation of light output according to musical input. The Chromattheque combines both functions. It controls 5 banks of lamps up to 500W each in either analog or digital mode. And the 5 channels give more colours and more exciting linear and random sequencing than is possible with 3 or 4-channel systems. Versatile light level controls enable the lights to be partially on to suit the mood of the occasion. Wiring is minimal and construction straightforward.

Complete kit **£58.00**

Allow 21 days for delivery



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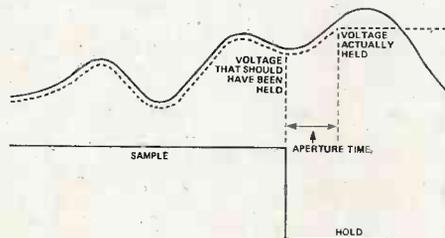
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SWITCHES TOGGLE 2A/250V 35p SPST 48p DPDT SUB-MIN TOGGLE SPST on/off 58p SPDT on/off 64p SPDT on/off 85p SPDT on/off 105p DPDT 6 legs 105p DPDT centre off 88p DPDT based both ways 145p DPDT 3 positions on/off 185p 4-pole 2 way 220p SLIDE 250V DPDT 1A 14p DPDT 1A c/off 15p DPDT 1/2A 13p PUSHBUTTON 6A with 10mm Button SPDT latching 150p DPDT latching 200p SPDT moment 150p DPDT moment 200p Mini Non Locking Push to Make 15p Push to Break 25p DIGITAL Switch Assorted Colours 75p each ETI PROJECTS We stock most of the parts 	DIP SWITCHES (SPST) 4 way 85p; 6 way 80p; 8 way 85p; 10 way 125p (SPDT) 4 way 180p ROTARY SWITCHES (Adjustable Stop type) 1 pole/2 to 12 way; 2 pole/2 to 6 way; 3 pole/2 to 4 way; 4 pole/2 to 3 way 48p ROTARY: Mains DP 250V 4 Amp on/off 88p ROTARY: (Mk-a switch) Make a multi-way. Shafting assembly has adjustable stop. Accommodates up to 6 wafers (max. 6 pole/12 way + DP switch). Mechanism only 90p WAFERS: (make before break) to fit the above switch mechanism. 1 pole/12 way 2 pole/6 way; 3 pole/4 way; 4 pole/3 way; 6p/2 way 65p Mains DP 4A Switch to fit Spacers 4p. Screen 6p ROCKER SWITCHES ROCKER: 5A/250V SPST 28p ROCKER: 10A/250V SPST 38p ROCKER: 10A/250V DPDT c/off 95p ROCKER: 10A/250V DPST with neon 85p THUMBWHEEL Mini front mounting switches Decade Switch Module 275p B.C.D. Switch Module 298p Mounting Cheeks (per pair) 75p JUMPER LEADS (Ribbon Cable Assembly) Length 14 pin 16 pin 24 pin 40 pin Single ended 145p 185p 240p 380p Double ended DIP (Header Plug) Jumper 6 inches 185p 205p 300p 485p 6 inches 195p 215p 315p 480p 24 inches 210p 235p 345p 540p 36 inches 290p 370p 480p 525p IC Female Header Socket Jumper Leads 36" Single ended 20 pin 34 pin 40 pin Double ended 180p 260p 300p 370p 480p 525p	VEROBOARD 0.1in 2 1/2 x 3 1/2 95p 2 1/2 x 5 110p 3 1/2 x 3 1/2 110p 3 1/2 x 5 125p 4 1/2 x 17 420p 4 1/2 x 17 590p Pkt of 100 pins 55p Spot face cutter 150p Pin insertion tool 185p VERO WIRING PEN + spool 340p Spare spool 75p Combs 85p FERRIC CHLORIDE 1 lb bag Anhydrous 195p + 50p p&p ULTRASONIC TRANSDUCER 40KHz 350 pr COPPER CLAD BOARDS Fibre Single-sided Double-sided S.R.B.P. S/Speed 6" x 6" 100p 125p 95" x 85" 6" x 12" 175p 225p 110p DILL SOCKETS Low Profile Wire 8 pin 8p 25p 14 pin 10p 35p 16 pin 10p 42p 18 pin 18p 52p 20 pin 20p 60p 22 pin 22p 65p 24 pin 25p 70p 28 pin 28p 80p 40 pin 30p 90p EDGE CONNECTORS 26 way — 111p 28 way — 180p 2x15 way — 165p 2x18 way 21p 175p 2x22 way 21p 250p 2x23 way 175p — 2x25 way 28p 275p 2x26 way 190p — 2x30 way 310p — 2x36 way 380p — 2x40 way 380p — ANTEX Soldering IRONS C15W 510p; C517W 510p C18W 525p; K525W 500p Spare 8 1/2 85p; Elements 230p Iron Stand 175p; Heat Shunt 30p SIL SOCKET 0.1" pitch 20 way 65p SOLDERCON PINS Ideal for making SIL or DIL Sockets 100 pins 75p 500 pins 350p ALUM BOXES 3 x 2 x 1" 85p 4 x 2 1/2 x 2" 100p 4 x 2 1/2 x 2 1/2" 103p 4 x 4 x 2" 105p 4 x 4 x 2 1/2" 120p 5 x 4 x 1 1/2" 99p 5 x 4 x 2" 120p 5 x 2 1/2 x 1 1/2" 90p 5 x 2 1/2 x 2 1/2" 120p 6 x 4 x 3" 150p 7 x 4 x 3" 180p 8 x 6 x 3" 210p 10 x 4 x 3" 240p 10 x 7 x 3" 275p 12 x 5 x 3" 280p 12 x 8 x 3" 295p VOLTAGE REGULATORS 1A TO220 Plastic Casing +ve 5V 7805 40p 7905 45p 12V 7812 40p 7908 40p 15V 7815 40p 7912 45p 18V 7818 40p 7915 45p 24V 7824 40p 7918 45p 7924 45p 100mA '092 Plastic package 5V 78L05 30p 79L05 50p 6V 78L06 30p — 8V 78L08 30p — 12V 78L12 30p 79L12 50p 15V 78L15 30p 79L15 60p IC:7660 248p RC4194 375p RC4195 180p LM309X 135p LM317K 150p LM317KP 450p LM323K 450p LM337 175p LM723 Var 30p TRANSFORMERS 3-0-3V, 6-0-6V, 9-0-9V, 12-0-12V, 15-0-15V @ 100mA 98p pcb mounting. Miniature. Split Bobbin 3VA: 2x6V-0-25A, 2x9V-0-15A, 2x12V-0-12A, 2x15V-0-1A, 200p 6VA: 2x6V-0.5A, 2x9V-0.3A, 2x12V-0.25A, 2x15V-0.2A 270p Standard Split Bobbin type: 6VA: 2x6V-0.5A, 2x9V-0.4A, 2x12V-0.3A, 2x15V-0.25A 290p 12VA: 2x6V-1.3A, 2x9V-1A, 2x12V-0.8A, 2x15V-0.5A 345p (350p p&p) 0.5VA, 2x15V-0.4A, 2x20V-0.3A 345p (350p p&p) 2x6V-1.5A, 2x9V-1.2A, 2x12V-1A, 2x15V-0.8A, 2x20V-0.6A 385p (60p p&p) 50VA: 2x6V-4A, 2x9V-2.5A, 2x12V-2A, 2x15V-1.5A, 2x20V-1.2A, 2x25V-1.0A 520p (60p p&p) Specially wound for Multirad computer PSUs 50VA: Outputs +5V/5A, +12V, +25V, -5V, -12V at 1A 620p (60p p&p) 2x15V-2A, 2x30V-1.5A, 2x45V-1A 965p (75p) P&P charge to be added over and above our normal postal charge.	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**NEXT
MONTH**

AN ARGUS SPECIALIST PUBLICATION

electronics today

INTERNATIONAL

EPROM Programmer

The Universal EPROM Programmer published in August 1983 surprised us with its popularity, so we're doing it again! Well, not exactly — this project will be for the ZX81 and will allow programming and duplicating for the more common EPROMs — 2516s, 2716s, 2532s and 2732s.

ZX81s are so cheap — especially second-hand — that it should be less expensive to build this project and buy a ZX than to build a special-purpose stand-alone EPROM programmer. This cheapness opens new possibilities for the '81 as a component rather than a computer in its own right.

Because the Spectrum has dynamic RAM, this project can't be adapted to work on that machine. However, we have a Spectrum version on the drawing board . . .



The ZX81 — the shape of EPROM programmers to come.

Midi Drum Synth

Not a mini and not a full-sized drum synth, this is to whet your appetites for the full-sized synthesiser that is, as yet, a mere twinkle in the editor's eye . . . Actually, we're simple chaps here on ETI, keyboards being rather too difficult for us, which is why we're so keen on drum synths. Also, attaching them to the office walls means that we get a much more pleasant sound when a certain deputy editor on Hobby Electronics takes to 'head banging' (Status Quo are alive and, er, well . . .).

Microtanic Profile

Regular readers will have noticed that we have published a number of projects for the Microtan-65 computer, mainly because we consider this to be the best computer for the experimenter who is really committed to building his or her own hardware. To help complete the picture, Mike Bedford will be taking a look at the hardware you can buy as kits and as ready-made boards.

Also in the May issue . . .

Part 2s of the Mains-Borne Remote Controller and the Vertical Speed Indicator, Digest, Tech Tips, Machine Code Programming, and anything else we are able to cram in!

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ISSUE, ON SALE APRIL THE 7th.**

Articles described here are in an advanced state of preparation. However, circumstances may dictate changes to the final contents.

The Logic Probes

Spend Less

Test More



LP-1 Logic Probe

The LP-1 has a minimum detachable pulse width of 50 nanoseconds and maximum input frequency of 10MHz. This 100 K ohm probe is an inexpensive workhorse for any shop, lab or field service tool kit. It detects high-speed pulse trains or one-shot events and stores pulse or level transitions, replacing separate level detectors, pulse detectors, pulse stretchers and pulse memory devices.

All for less than the price of a DVM

£34.50*

Model LP-3 illustrated



LP-2 Logic Probe

The LP-2 performs the same basic functions as the LP-1, but, for slower-speed circuits and without pulse memory capability. Handling a minimum pulse width of 300 nanoseconds, this 300 K ohm probe is the economical way to test circuits up to 1.5 MHz. It detects pulse trains or single-shot events in TTL, DTL, HTL and CMOS circuits,

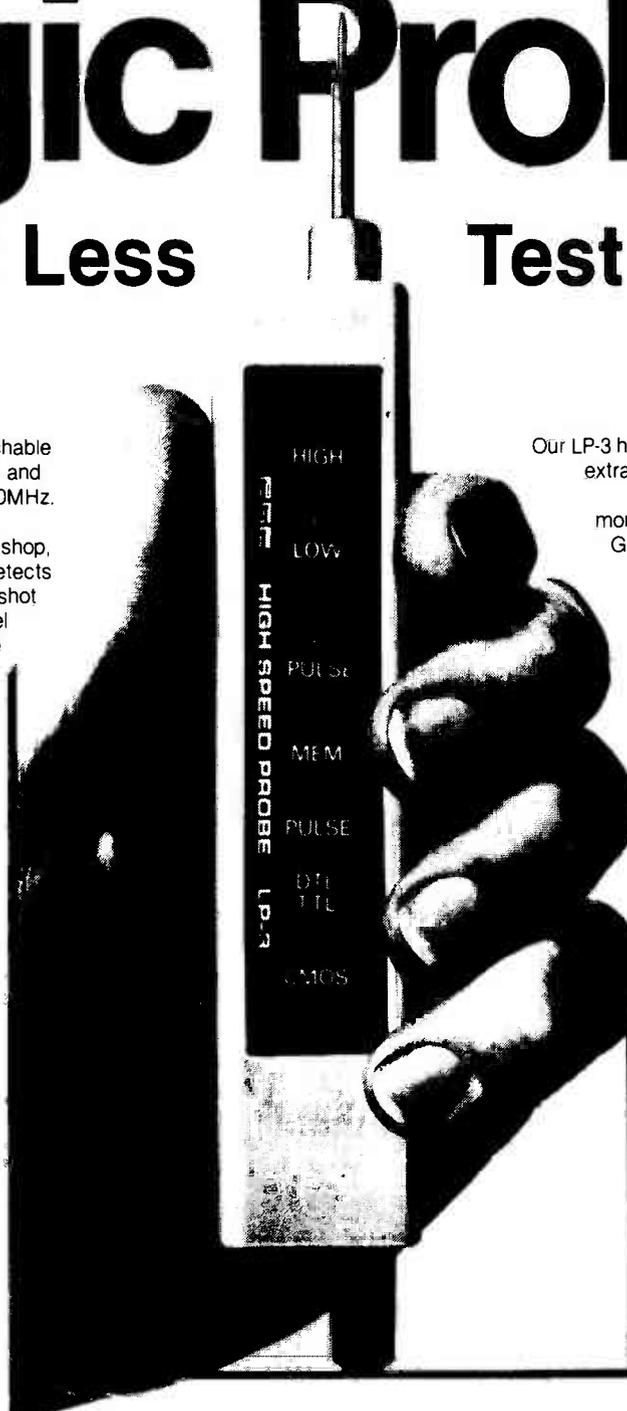
replacing separate pulse detectors, pulse stretchers and mode state analysers.

(Available in kit form LPK-1 £14.50)

£21.00*

Model LP-3 illustrated

*price excluding P&P and 15% VAT



LP-3 Logic Probe

Our LP-3 has all the features of the LP-1 plus extra high speed. It captures pulses as narrow as 10 nanoseconds, and monitors pulse trains to over 50 MHz. Giving you the essential capabilities of a high-quality memory scope at 1/1000th the cost.

LP-3 captures one shot or low-rep-events all-but-impossible to detect any other way.

All without the weight, bulk, inconvenience and power consumption of conventional methods.

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The Digital Pulser: another new idea from G.S.C. The DP-1 registers the polarity of any pin, pad or component and then, when you touch the 'PULSE' button, delivers a single no-bounce pulse to swing the logic state the other way. Or if you hold the button down for more than a second, the DP-1 shoots out pulse after pulse at 1000 Hz.

The single LED blinks for each single pulse, or glows during a pulse train. If your circuit is a very fast one, you can open the clock line and take it through its function step by step, at single pulse rate or at 100 per second. Clever! And at a very reasonable price.

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Model LP-3 illustrated

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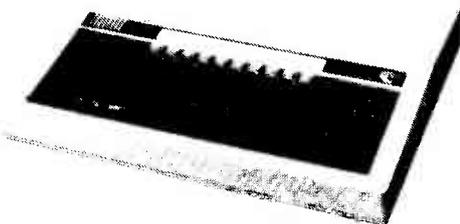
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BBC Micro Computer System

OFFICIAL DEALER

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Software from ACORNSOFT/
PROGRAM POWER/GEMINI in
stock

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B + DFS £409
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Manual £87
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FLOPPY DISC INTERFACE

£84 + £15 installation

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All drives are supplied with manual, form disc and cables.

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* These drives are switchable between 40/80 tracks. 40/80 Switch Module 1 x 400k and 2 x 400k Drive £32

DISKETTES: in packs of 10 W: Wabash M: 3M 40 track SSSD W: £15 M: £17.50; 40 track DSSD M: £22;

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FLOPPY DISC Drive Head Cleaning Kit £14.50

Phone or send for our BBC leaflet

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Your BBC computer can be converted into a business machine with the addition of a TORCH Z80 disc pack. The Torch pack with twin disc drive and the Z80 processor card greatly enhances the computer's data storage and processing capability. Z80 card comes complete with 64K RAM and a CP/M compatible operating system. In addition to BBC owner's user guide and a systems disc the package is supplied with PERFECT software package comprising of DATABASE, WORD PROCESSOR & SPREADSHEET and COMANEX a interactive business management game. Complete Package for £730 + £8 carr.

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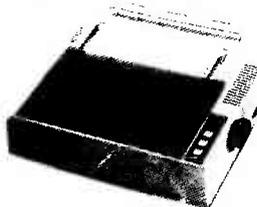
SANYO DR101 Data Recorder £34 +
£2.50 carriage
BBC Tape Recorder £28.50 + £2.50 carriage
Cassette Lead £3 + £1 carriage
HOBBIT Floppy Tape £135 + £2.50 carriage
HOBBIT Zero Memory Option £25 + £1 carriage
Computer Grade C12 cassette 50p each.
£4.50 for 10 + £1 carriage

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Parallel Printer Lead £10 + £1 carriage
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Epson Serial Interface 2K £40 + £1 carriage
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carriage
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'TIME-WARP'

BBC REAL-TIME-CLOCK/CALENDAR:

A low cost unit opens up the total range of Real-Time applications. With its full battery backup, possibilities include an Electronic Diary, automatic document dating, precise timing & control in scientific applications, recreational use in games etc — its uses are endless and are simply limited by one's imagination. Simply plugs into the user port — no specialist installation required — No ROMs. Supplied with extensive applications software. £29.00

BBC EPROM PROGRAMMER

A fully self-contained Eprom Programmer with its own power supply, able to program 2516, 2716/32/32A/64/128 single rail Eproms.
★ Personality selection is simplified by a single rotary switch.
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★ Warning indicator to show programming in progress.
★ Programmer can read, blank check, program and verify at any address/addresses on the EPROM.
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Programmer complete with cables, software and operating instructions: £89.00 - £2 p. & p.

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Assembly Lang programming on BBC
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EPROM ERASERS

UV1T Eraser with a built-in timer and mains indicator. Built-in safety interlock to avoid accidental exposure to the harmful UV rays. It can handle up to 5 eproms at a time with an average erasing time of about 20 mins. £59 + £2 p&p.
UV1 as above but without the timer £47 + £2 p&p.
UV140 up to 14 Eproms £61
UV141 as above but with timer £79

★ ★ ATTENTION ★ ★

All prices in this double page spread are subject to change without notice.

PRODUCTION PROGRAM: P8000

P8000 provides reliable gang programming of up to 8 EPROMS simultaneously with device sizes up to 16k x 8 bytes. Devices supported range from 2704 to 27128 in single and three rail versions. Simple menu driven operation ensure easy eprom selection and reliable programming in minimum programming times. £695 + £6 carriage.

ACORN IEEE INTERFACE

This IEEE 488 standard interface is a general purpose system for exchanging digital data between a number of devices in a local area. The interface complies with the IEC 625-1 standard and can be connected to upto 14 other devices.
Interface board is supplied complete with software in ROM, interconnecting cables IEEE cable for connection to an external device and a comprehensive manual. £282.50 + £2.50 carr.

SMARTMOUTH

Speech Synthesiser for BBC

The 'infinite vocabulary' self-contained speech synthesiser unit. Uses only 5-10 bytes per word — no ROMs required — simply plugs into the user port. (Has Aux. Audio output skt.). Supplied with Demo/Development programs and simple software instructions, £37 + £2 p. & p.

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No of ways	Header Plug	Receptacle	Edge Conn
10	90p	85p	120p
20	145p	125p	195p
34	175p	150p	240p
40	220p	190p	340p
50	235p	200p	390p

D CONNECTORS

No of ways			
9 15 25 37			
MALE		80p	105p 160p 250p
Solder		150p	210p 250p 365p
Angled			
FEMALE		105p	160p 200p 335p
Solder		165p	215p 290p 440p
Angled		90p	85p 90p 100p
Hoods			
IDC 25 way plug		385p	Socket 450p

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SOCKETS 24-pin £5.75
28-pin £8.00 40-pin £9.75

DIL SWITCHES

4-way 70p 8-way 130p
6-way 100p 10-way 150p

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1 end 145p 165p 240p 350p
2 ends 210p 230p 345p 540p

24" Ribbon Cable with Sockets
1 end 160p 200p 280p 300p
2 ends 290p 370p 480p 525p

Ribbon Cable with D. Conn.
25 way Male 500p Female 550p

RS 232 JUMPERS

125 way D1
24 Single end Male £5.60
24 Single end Female £5.25
24 Female Female £10.00
24 Male Male £9.50
24 Male Female £9.50

DIL HEADERS

Solder Type IDC Type
14pin 40p 100p
16pin 50p 110p
24pin 100p 150p
40pin 200p 225p

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36 way plug Centronics Parallel Solder £5.25 IDC £5.50
36 way socket Centronics Parallel Solder £5.50 IDC £5.20
24 way plug IEEE Solder £5 IDC £4.75
24 way socket IEEE Solder £5

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(Grey/meter)
10 way 40p
16 way 60p
20 way 85p
26 way 120p
34-way 160p
40-way 180p
50-way 200p
64-way 280p

EURO CONNECTORS

DIN 41617 Plug Skt
21 way 160p 165p
11 way 170p 170p
DIN 41617
2 x 12 way 51 Pin 220p 275p
2 x 12 way Ang. Pin 230p 320p
1 x 12 way 51 Pin 260p 300p
1 x 12 way Ang. Pin 375p 400p

EDGE CONNECTORS

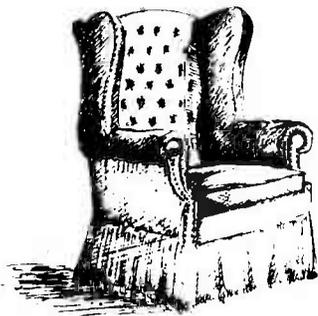
	0.1"	0.156"
2 x 18-way	—	140p
2 x 22-way	190p	240p
2 x 23-way	175p	—
2 x 25-way	225p	220p
2 x 28-way	200p	—
1 x 43-way	280p	—
2 x 43-way	395p	—
1 x 77-way	400p	500p
5100 Conn	—	600p

TEST CLIPS

14-pin 375p 16-pin £4
40-pin £10.30

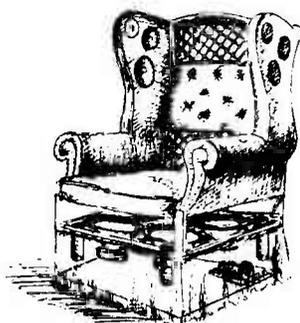
DIGEST

Not An April Fool



OK, we know it's our April issue and that you, being perceptive, are not unnaturally sceptical about odd-sounding things which appear in ETI this month, but believe us, this one's for real. It's a chair. That's right, a fine English hand-made chair. But this is a very unusual chair, carefully concealed within its

sumptuous upholstery is a three way speaker system which can deliver sound levels in the region of 110 dB with an input of 8 watts. Carefully avoiding puns about electric chairs (although Barry Manilow at 110 dB should be the death of anybody), ETI has spared every effort to bring you full details. No one can accuse us of sitting down on the job!



The Acoustic Chair is, its manufacturers claim, designed specifically for the extended frequency

response and wider dynamic range of modern digital and direct cut recordings. It will reproduce bass frequencies down to 15Hz with explosive wavefronts that you can feel as well as hear and is capable of sound levels exceeding the threshold of pain. It enables you to listen to music unaffected by the acoustics of the listening room, with excellent stereo imaging and with little disturbance from ambient noise. Low frequencies are handled by powerful bass drivers, with acoustic vents below the midrange and high frequency units and additional vents below the pelvis and around the spine where conventional sounds are picked up by bone conduction. Low mid-range, midrange and high frequency drivers are mounted in the chair wings and are

aligned for phase accuracy. The complete system can handle input powers up to 300 watts and has a nominal impedance of 8 ohms.

Quite what all this costs we do not know, but with an idea like this you can expect the price to fall sharply as the inevitable competition gets under way. Hobby Electronics are reliably reported to be working on a quadrophonic water bed and it can only be a matter of time before someone comes up with the holophonic loo-seat. Before crazed readers take an axe to the Tannoys and the Parker-Knoll, we should point out that further mind-and-posterior-numbing details can be had from the Acoustic Chair Company, 35 Britannia Row, London N1, tel 01-226 3377. Happy April!

Ambit Moves

Following their takeover by Circuit Holdings PLC, a division of Bulgin, Ambit International will shortly be moving to Broxbourne in Hertfordshire. The company say their business has expanded steadily to the point where the premises at Brentwood are no longer large enough for them.

The Broxbourne site is presently in use by Circuit Holdings, and all present Ambit staff will be given the opportunity to move to the new site.

Bill Poel, Ambit's founder and until very recently its managing director (and also some time editor of a magazine which attempted to compete with ETI — the gall of it!) has left Ambit and joined Amsoft, the software division of Amstrad Ltd.

Show Offs!

Time was when electronics exhibitions were few and far between, eagerly anticipated highspots of the enthusiasts' year. Now, anyone attempting to cover them all would need wings and the ability to be in several places at once. It's only two months since we last gave you a rundown on forthcoming events but already a large pile of new press releases has accumulated. So get out those well-thumbed diaries and make a note of some of these.

Human Factors in Manufacturing is a conference rather than an exhibition and is aimed at production managers and other industrial personnel. It takes as its starting point the proposition that, in spite of the current level of development and seeming sophistication of industrial robots, human beings are still industry's most important asset. Known as HUMAN-1 for short, the conference will take place at the Park Lane Hotel, London, from the third to the fifth of April, and details are available from The Conference Organisers (HUMAN-1), IFS (Conferences) Ltd, 35-59

High Street, Kempston, Bedford MK42 7BT, tel 0234 83605.

The second event is the ACC Micro-Robotics Conference which takes place on the 21st of April at the Central Hall, Westminster, London. It is run alongside the Association of London Computer Clubs' Easter Fair, and features talks and demonstrations by leading manufacturers and an opportunity for novice constructors to try their mice against the old hands on a micromouse maze. No details of opening times or admission prices are given in the press release so you will either have to turn up on the day and hope for the best or get in touch with the organisers in advance. The address is 69 Uplands Court, Greenview Avenue, Shirley, Surrey CRO 7QW, tel 01-777 9806.

The Electronic Production Efficiency Exposition (EPEE) will be held at the National Exhibition Centre, Birmingham, from the first to the third of May. It is mainly of interest to those working in the electronics industry and sets out to consider the factory of the future. Entrance tickets will cost £3.00 and car parking tickets £2.00 on the day but those who apply in advance will get both free. Contact Network Events Ltd, Printers Mews, Market Hill,

Buckingham MK18 1JX, tel 0280 815226.

Communications '84 is one of several exhibitions organised by the Institution of Electrical Engineers and takes place in Birmingham on the 16th, 17th and 18th of May. The IEE do not give any details of the exhibition's coverage but we have had a number of press releases from companies in the microwave, satellite, cable, and military command and control communications fields saying that they will be exhibiting. For details of this and the other conferences, vacation schools and seminars organised by the IEE, contact them at their headquarters, Savoy Place, London WC2R 0BL, tel 01-240 1871.

Hard luck on those who are interested in both speech technology and machine control systems because conferences on those two topics take place at exactly the same time, the 23rd, 24th and 25th of October. However, since both take place in Brighton, real knowledge vultures may be able to commute rapidly between the two. The International Conference on Speech Technology is concerned with speech synthesis and speech recognition systems and aims to make available to British industrialists the benefits of a technol-

ogy which is already widely used in Japan and the United States. The International Conference on Machine Control Systems is concerned with the intelligent control of individual production processes and the linking of such controllers to provide overall management. The organisers claim the conference will be a revelation to those who think they already know all there is to know about machine control systems. Details of both conferences can be obtained from IFS (Conferences) Ltd at the address given above for the HUMAN-1 conference.

The International Test and Measurement Exhibition and Conference (ITAME) takes place at Olympia 2, London, from the 30th of October to the 1st of November, and the organisers say it will cover all areas of electronic test and measurement. The same people are also organising Electronic Displays '84 at the Kensington Exhibition Centre, London on the 27th, 28th and 29th of November, an event which should not be confused with the Electronics Displays exhibition at Frankfurt which we mentioned in February News Digest. For details contact Network Events at the address given above for the EPEE event.

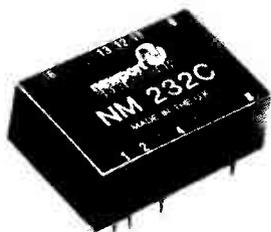


2 Inch Video Monitor

5V RS232C Module

Newport components have introduced an RS232C interface module. The NM232C requires a single 5 volt supply only and provides one transmit and one receive channel. Both channels are fully EIA — RS232C compatible and the logic input and output are TTL/CMOS compatible. The package is low profile DIL style of 9 mm total height and a pin row spacing of 0.5 inch with a pitch of 0.1 inch. The no load current is typically 10 mA representing just 50 mW of quiescent power consumption.

Applications are anticipated in all areas of micro computing and peripheral design requiring data exchange rates up to 19.2 kbaud. The NM232C will also be useful in



battery powered designs requiring RS232C capability with low power consumption. The device uses less board space than the standard integrated circuit solution and does not require $\pm 12V$ supply rails. Indeed the internally generated positive and negative supplies are also made available for external use, although at limited current levels. Newport Components Ltd, 134 Tanners Drive, Blakelands North, Milton Keynes MK14 5BP, tel 0908-615232.

The TV25 from Thandar Electronics is a lightweight, low power miniature monochrome video monitor. It operates from a standard 1 volt composite video signal via a 75 ohm BNC connector and is designed to be used in applications where space is of prime importance. Desk-mounted security surveillance or closed circuit television camera viewfinders are typical examples.

The TV25 is self-contained in an attractive aluminium case measuring 150 x 105 x 49mm, and utilises a high resolution 50mm (2") diagonal CRT giving a usable viewing area of 40 x 30 mm. Stable picture lock is ensured by the use of phase locked line and injection locked oscillators. Front panel

controls are provided for brightness and contrast in addition to on/off, and rear panel controls include 525/625 switch, 75 Ω bridge facility, focus and line and field control. Fitted with internal re-chargeable Nickel Cadmium batteries, the monitor can also be powered from an external regulated 5 to 7 volts DC power supply or from an unregulated 12 volt DC source through the adaptor/charger supplied. Mains adaptor/chargers for 117, 220 and 240 volt operation are available as optional accessories. The TV25 costs £135.00 plus VAT, and further information is available from Thandar Electronics Ltd, London Road, St Ives, Huntingdon, Cambs PE17 4HJ, tel 0480-64646.

Hand-held Transistor Tester

A new addition to Osborne Electronics 4000 series of hand-held test units is the model 4500 transistor tester. Completely self contained, the unit simplifies and speeds the task of checking the PN junctions of discrete semi-conductors whether in or out of circuit.

The model 4500 measures just 32 x 22 x 100 mm and weighs 75 grams. It readily rests between thumb and forefinger and features an integral series of LED's which indicate the junction status.

PNP or NPN transistors, diodes and open or short circuit junctions can be instantly identified and operation remains reliable even when parallel circuit values approach 270 ohms or 33 microfarads. In operation, the two test probes are connected across the junction to be checked and the junction state is immediately displayed. The unit's integrated circuitry ensures a very long battery life.

The model 4500 costs £16.00 plus VAT and is available from Osborne Electronics, Binstead Road, Ryde, Isle of Wight, tel 0983-63622.



Flat Response?

No, you haven't been watching too much TV, the cones in those loudspeakers really are square and flat. They're the new DX70 loudspeakers from Tamon of Japan, a two-way system using a 1 1/2" tweeter and a 6" bass driver, both with flat cones. They are rated at 45W RMS, 90W peak and have a frequency response which is said to extend from 50Hz to 40kHz. The cabinet finish is dark mahogany, and they should be on sale by the time this issue

appears at an anticipated price of £130 a pair.

Of course, flat cone loudspeakers are nothing new in themselves, and many will remember a novel piano shaped (or was it ear shaped?) design which appeared some years ago. A number of more conventionally packaged units have also appeared, but flat cone systems have yet to make any significant impact on the world's loudspeaker markets. It will be interesting, therefore, to see if Tamon have now got the formula right or if, as with their predecessors, the response from the 'speaker buying public is as flat as the cones themselves.

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Front load. Free stand or rack mount
Exchangeable type (via lid removal) **£550.00**
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DIABLO/DRE 44-4000A/B 5+5 ex stock from 1000's of spares for **£30, 4000, 3200, HAWK** ex stock. Plus in house repair, refurbishing service. Call for details or quotation. **£995.00**

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250,000 other relays **EX STOCK** call for details.

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Keep your hot parts **COOL** and **RELIABLE** with our range of **BRAND NEW** professional cooling fans.
ETRI 69XU01 Dim. 92 x 92 x 25 mm. Miniature 240 v equipment fan complete with finger guard **£9.95**.
GOULD JB-3AR Dim. 3" x 3" x 2.5" compact very quiet running 240 v operation. **NEW £6.95**
BUHLER 69.11.22. 8-16 v DC micro miniature reversible fan. Uses a brushless motor for extremely high air flow, almost silent running and guaranteed 10,000 hr life. Measures only 82 x 52 x 22 mm. Current cost **£32.00**. **OUR PRICE ONLY £12.95** complete with data.
MUFFIN-CENTAUR standard 4" x 4" x 1.25" fan supplied tested **EX EQUIPMENT** 240 v at **£6.25** or 110 v at **£4.95** or **BRAND NEW** 240 v at **£10.50**. 1000's of other fans **EX STOCK** Call for Details. Post & Packing on all fans **£1.60**

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SD5A As recommended by Z X81 news letter, matchbox size up to 1000 watt load **£5.95**
L2127 compact completely cased unit with 3 pin fitted socket. Up to 750 watts **£9.99**

COMPUTER 'CAB'

All in one quality computer cabinet with integral switched power PSU, Mains filtering, and twin fan cooling. Originally made for the famous **DEC PDP8** computer system costing thousands of pounds. Made to run 24 hours per day the PSU is fully screened and will deliver a massive +5v DC at 17 amps, +15v DC at 1 amp and -15v DC at 5 amps. The complete unit is fully enclosed with removable top lid, filtering, trip switch, 'Power' and 'Run' LEDs mounted on Ali front panel, rear cable entries, etc. etc. Units are in good but used condition - supplied for 240v operation complete with full circuit and tech. man. **Give your system that professional finish** for only **£49.95** + Carr. Dim. 19" wide 16" deep 10.5" high. Useable area 16" w 10.5" h 11.5" d. Also available **LESS PSU**, with **FANS** etc. Internal dim. 19" w 16" d 10.5" h. **£19.95**. Carriage & insurance **£9.50**.

VIDEO MONITORS

5" CASED Superb little unit made by **HITACHI** in ergonomically designed free standing case. Very high definition will display small but readable 132 columns wide! 12v DC opp. @ 800 ma, so ideal for mobile use. Supplied in **AS NEW** condition complete with data. Composite 75 ohm vid inp. Black & White **CRT £48.00** or Green **CRT £55.00** Carr & Ins **£5.00**
12" CASED. Made by the British **KGM Co.** Designed for continuous use as a data display station, unit is totally housed in an attractive brushed aluminium case with **ON-OFF, BRIGHTNESS** and **CONTRAST** controls mounted to one side. Much attention was given to construction and reliability of this unit with features such as, internal transformer isolated regulated DC supply, all components mounted on two fibre glass PCB boards - which hinge out for ease of service, many internal controls for linearity etc. The monitor accepts standard 75 ohm composite video signal via **SO239** socket on rear panel. Bandwidth of the unit is estimated around 20 Mhz and will display most high def graphics and 132 x 24 lines. Units are secondhand and may have screen burns. However where burns exist they are only apparent when monitor is switched off. Although unguaranteed all monitors are tested prior to despatch. Dimensions approx 14" high x 14" wide by 11" deep. Supplied complete with circuit, 240 volt AC operation **ONLY £45.00 PLUS £9.50 CARR.**
24" CASED. Again made by the **KGM Co** with a similar spec to the 12" monitor. Originally used for large screen data display. Very compact unit in lightweight alloy case dim 19" H x 17" D x 22" W. All silicon electronics and composite video input make an ideal unit for schools, clubs, shops etc. Supplied in a used but working condition **ONLY £55.00 PLUS £9.50 CARR & INS.**

SAVE **£250**

SUPER PRINTER SCOOP BRAND NEW CENTRONICS 739-2



The "Do Everything Printer" at a price that will NEVER be repeated. Standard **CENTRONICS** parallel interface for direct connection to **BBC, ORIC, DRAGON** etc. Superb print quality with full pin addressable graphics and 4 type fonts plus **HIGH DEFINITION** internal **PROPORTIONAL SPACED MODE** for **WORD PROCESSOR** applications. 80-132 columns, single sheet, sprocket or roll paper handling plus much more. Available **ONLY** from **DISPLAY ELECTRONICS** at the ridiculous price of **ONLY £199.00** + VAT complete with full manual etc. Limited quantity - Hurry while stocks last.
Options: Interface cable (specify) for **BBC, ORIC, DRAGON** or **CENTRONICS** 36 way plg **£12.50**. Spare ribbon **£3.00** each. **BBC** graphics screen dump utility program **£8.50**. Carriage and Insurance **£10** + **V.A.T.**

ONLY **£199**

8" WINCHESTERS

BASF 6172 23 mb 8" winchester disk drive. Complete unit consists of sealed cavity with 3 x 8" platters and CPU based control logic on 3 pcb's. Multiplexed i/o with the **BASF "DISK BUS"** interface is via a single 40 way cable. Units have been carefully removed from believed working equipment - but at the staggering price of **ONLY £125.00** are sold without guarantee. Supplied complete with 200 + page tech manual. Additional +5V DC, -12VDC, +24VDC **£45.00** Carriage & Ins **£10.00**

GE TERMIPRINTER

A massive purchase of these desk top printer-terminals enables us to offer you these quality 30 cps printers at a **SUPER LOW PRICE** against their original cost of over **£1000**. Unit comprises of full **QWERTY**, electronic keyboard and printer mech with print face similar to correspondence quality typewriter. Variable forms tractor unit enables full width - up to 13.5" 120 column paper, upper - lower case, standard **RS232** serial interface, internal vertical and horizontal tab settings, standard ribbon adjustable baud rates, quiet operation plus many other features. Supplied complete with manual. Guaranteed working **£130.00** or untested **£45.00**, optional floor stand **£12.50** Carr & Ins **£10.00**.

TELETYPE ASR33 I/O TERMINALS

Fully fledged industry standard **ASR33** data terminal. Many features including **ASCII** keyboard and printer for data I/O auto data detect circuitry. **RS232** serial interface, 110 baud, 8 bit paper tape punch and reader for off line data preparation and ridiculously cheap and reliable data storage. Supplied in good condition and in working order.
Options: Floor stand **£12.50** + VAT
KSR33 with 20ma loop interface **£125.00** + Sound proof enclosure **£25.00** + VAT

SOFTY 2

The amazing **SOFTY 2**. The complete "toolkit" for the open heart software surgeon. Copies, Displays, Emulates ROM, RAM and EPROMS of the 2516, 2532 variety. Many other features include keyboard, UHF modulator. Cassette interface etc. Functions exceed capabilities of units costing 7 times the price! Only **£169.00** pp **£1.95** Data sheet on request

PROFESSIONAL KEYBOARD FOR

An advantageous purchase of brand new surplus allows a great **QWERTY**, full travel, chassis keyboard offer at fractions of their original costs.
ALPHAMERIC 7204/60 full **ASCII** 60 key, upper, lower + control key, parallel TTL output plus strobe. Dim 12" x 6" +5 & -12 DC. **£39.50**.
DEC LA36 Un-coded keyboard with 67 quality, **GOLD**, normally open switches on standard X, Y matrix. Complete with 3 LED indicators & i/o cable - ideal micro conversions etc. pcb DIM 15" x 4.5" **£24.95** Carriage on keyboards **£3.00**.

SUPER DEAL? NO - SUPER STEAL!!

The FABULOUS 25CPS TEC Starwriter BRAND NEW AT ONLY **£499** + VAT

Made to the very highest spec the **TEC Starwriter FP1500-25** features a heavy duty die cast chassis and **DIABLO** type print mechanism giving superb registration and print quality. Micro-processor electronics offer full **DIABLO/QUME** command compatibility and full control via **CPM Wordstar** etc. Many other features include bi directional printing, switchable 10 or 12 pitch, full width 381 mm paper handling with upto 163 characters per line, friction feed rollers for single sheet or continuous paper, internal buffer, standard **RS232** serial interface with handshake. Supplied absolutely **BRAND NEW** with 90 day guarantee and **FREE** daisy wheel and dust cover. Order **NOW** or contact sales office for more information.
Optional extras: **RS232** data cable **£10.00**. Tech manual **£7.50**. Tractor feed **£140.00**. Spare daisy wheel **£3.00**. Carriage & Ins. (UK Mainland) **£10.00**.



DATA MODEMS

Join the communications revolution with our range of **EX TELECOM** data modems. Made to most stringent spec and designed to operate for 24 hrs per day. Units are made to the **CCITT** tone spec. With **RS232** i/o levels via a 25 way 'D' skt. Units are sold in a tested and working condition with data. Permission may be required for connection to **PO** lines.
MODEM 2B "Hackers Special" fully fledged up to 300 baud full duplex, **ANSWER** or **CALL** modes. **AUTO ANSWER**. Data i/o via standard **RS232** 25 way 'D' socket. Just 2 wire connection to comms line. Ideal networks etc. Complete with data, tested, ready to run at a **NEW SUPER LOW PRICE** of **ONLY £65.00** + VAT + Carr.
MODEM 20-1 Compact unit for use with **MICRONET, PRESTEL** or **TELECOM GOLD** etc. 2 wire direct connect. 75 baud transmit 1200 baud receive. Data i/o via **RS232** 'D' socket. Guaranteed working with data **£49.95**
MODEM 20-2 same as 20-1 but 75 baud receive 1200 baud transmit **£130.00**
DATL 4800 sync service. **RACAL** type **MPS4800** ex **TELECOM** good condition. **£395.00** + VAT.
NEW DSL2123 Multi Standard modem selectable V23 300-300 bps, V23 75-1200, V23 1200 75 full duplex. Or 1200-1200 half duplex modes. Full auto answer via modem or CPU. LED status indicators. **CALL** or **ANS** modes Switchable **CCITT** or **BELL 103 & 202**. Housed in ABS case size only 2.5" x 8.5" x 9". **£286.00** + VAT
For further data or details on other **EX STOCK** modems contact sales office.
Carriage on all modems **£10.00** + VAT.

SEMICONDUCTOR 'GRAB BAGS'

Mixed Semis amazing value contents include transistors, digital, linear, I.C.'s triacs, diodes, bridge recs, etc. etc. All devices guaranteed brand new full spec with manufacturer's markings, fully guaranteed. **50 + £2.95** 100 + **£5.15**.
TTL 74 Series A gigantic purchase of an "across the board" range of 74 TTL series I.C.'s enables us to offer 100+ mixed "mostly TTL" grab bags at a price which two or three chips in the bag would normally cost to buy. Fully guaranteed all I.C.'s full spec. 100 + **£6.90** 200 + **£12.30** 300 + **£19.30**

DEC CORNER

MOSTEK CRT 80E Brand new dual emulocard, 280 based **VT100 PLUS** emulator with graphics etc **£499.00**
BA11-MB 3.5" 5" **PSU, LTC** **£345.00**
DL111-J 4 x 5 1/4 **EIA** interface **£310.00**
RK05-J 2.5 **MB** disk drives **£650.00**
PDP1105 Cpu, Ram, i/o, etc. **£450.00**
RT11 9v 3B doc kit or 20 ma **£270.00**
LA36 Decwriter **EIA** or 20 ma **£175.00**
MBLBJA PDP 8 async i/o **£75.00**
K18E PDP 8 Bootstrap option **£75.00**
DILOG DQ100 **RK05 LSI 4 x RK05** disk controller **£450.00**
LAXX-NW LA180 **RS232** serial interface and buffer option **£130.00**
LAX34-AL LA34 tractor feed **£25.00**
1000's of **EX STOCK** spares for **DEC PDP8 PDP11 PDP15** & peripherals. Call for details. All types of Computer equipment and spares wanted for prompt **CASH PAYMENT**

66% DISCOUNT

Due to our massive bulk purchasing programme which enables us to bring you the best possible bargains, we have thousands of I.C.'s, Transistors, Relays, Caps, P.C.B.'s, Sub-assemblies, Switches, etc. etc. surplus to our requirements. Because we don't have sufficient stocks of any one item to include in our ads, we are packing all these items into the "BARGAIN PARCEL OF A LIFETIME". Thousands of components at giveaway prices! Guaranteed to be worth at least 3 times what you pay. Unbeatable value!! Sold by weight.
2.5kls **£4.25** + pp **£1.25** 5kls **£5.90** + **£1.80**
10kls **£10.25** + pp **£2.25** 20 kls **£17.50** + **£4.75**

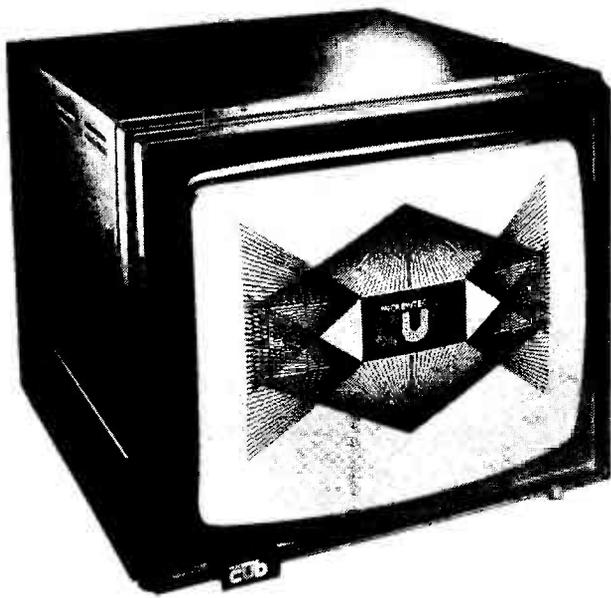
ALL PRICES PLUS VAT

All prices quoted are for UK Mainland, paid cash with order in Pounds Sterling PLUS VAT Minimum order value **£2.00**. Minimum Credit Card order **£10.00**. Minimum **BONA FIDE** account orders from Government depts., Schools, Universities and established companies **£20.00** Where post and packing not indicated please ADD **£1.00**. + VAT Warehouse open Mon-Fri 9.30 - 5.30 Sat. 10.15 - 5.30. We reserve the right to change prices and specifications without notice. Trade, Bulk and Export enquiries welcome

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Display ELECTRONICS



Spectrum-Compatible Colour Monitor

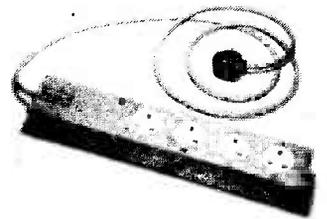
After a period of selling to the education market, Microvitec have launched their Sinclair Spectrum-compatible colour

monitor onto the consumer market. They claim it is the only low-complexity colour display equipped to handle the output of

the Spectrum, Britain's most popular home computer.

The 1431/MZ comes in a metal cabinet with die-cast frame surround finished in matt black to match the appearance of the Spectrum. Inside, the picture tube and control circuitry of the RGB/TTL input models is retained while an additional card carries the Spectrum interface which effectively converts to the RGB/TTL format the luminance ('U') and chrominance ('V' & 'Y') signals appearing at the output port of later Spectrum models. Since the interface can be switched in or out of the circuit, the monitor can also be driven by computers with conventional RGB/TTL outputs, such as the new Sinclair QL.

Over a million Spectrums have now been sold, many of them to first-time buyers who may now wish to up-grade to more recent machines. By designing the monitor to accept two input formats, Microvitec expect it to generate wide sales opportunities. The Microvitec 1431/MZ costs £249.00 plus VAT and is available from any of the growing number of Microvitec Dealers. Further details and a list of dealers are available from Microvitec Limited, Futures Way, Bolling Road, Bradford, West Yorkshire BD4 7TV, tel 0274 390011.



Multi-Output Portable Filter

New from Roxburgh Suppressors is a multi outlet portable mains filter. Rated at 13 amps total load, the unit is fitted with four 13 amp sockets and is constructed in a steel case with neon mains indicator.

The LF134 filter module incorporates an earth line choke and a large replaceable 'Varistor', providing a high degree of protection from mains transients and interference for micro computer systems and their peripherals. It comes complete with 2 metres of mains lead and a 13 amp plug, is ready for use, and costs £62.25 plus VAT and carriage. For details contact Roxburgh Suppressors Ltd, Eagle road, Rye, East Sussex, tel 0797 223725.

Oscilloscope Accessories

Otter Electronics is a recently formed British company whose staff includes the designer responsible for the Scopex range of analogue oscilloscopes. They intend to specialise in oscilloscope accessories and ancillary equipment and have just launched two new instruments, a μ amplifier and an isolation amplifier.

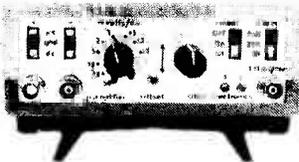
a bandwidth limiting switch is provided to reduce the upper frequency limit to 20KHz or 1KHz.

The amplifier will find many uses in audio and video work, enabling monitoring of signals direct from playback heads and measuring ripple. Even physiological signals come within its performance. Battery operation from PP3 batteries means that the amplifier can quickly convert an oscilloscope for very low level signal observation.

rejection. The output remains constant at 100mV/division giving a useful gain boost for older, less sensitive oscilloscopes. The amplifier will find great acceptance in diverse fields from power engineering, examining SCR and triac gate firing pulses, switch mode power supplies, and eliminating ground loops to medical research, where complete isolation between subject and measuring instrument is essential. Battery operation from PP3 batteries means that the amplifier

can quickly and easily extend an oscilloscope's performance at any time.

The μ amplifier costs £144.00 plus VAT and the isolation amplifier costs £157.00 plus VAT. Both prices include packing and delivery. Otter say they are developing further new instruments, some of which will be unveiled later this year. Otter Electronics Ltd, Otter House, Weston Underwood, Olney, Buckinghamshire MK46 5JS, tel 0234 - 712445.



The μ amplifier enables signals as minute as 100 μ V from DC to 2MHz to be viewed and measured on most oscilloscopes. The amplifier offers sensitivities from 100 μ V/division to 50mV/division with AC or DC input coupling and maintains a constant output of 100mV/division. To make full use of the high sensitivity a differential input is provided so that common mode signals can be minimised, and to improve the display



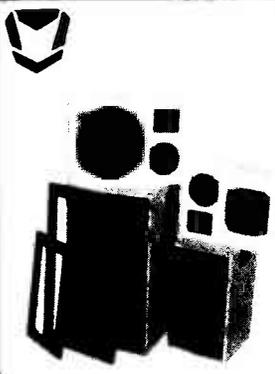
The isolation amplifier offers a safe way of making measurements on floating circuits up to 1,500V from ground. The input amplifier offers sensitivities from 10mV/division to 5V/division (50V with probe set to X10) AC or DC coupled. Signals from the input amplifier are coupled to the output amplifier by a pair of differentially connected 'optocouplers', thus ensuring good linearity and high common mode

New Chip Cuts Z80 Component Count

A new high speed Z80 peripheral chip designed to replace several discrete ICs has just been introduced by Verospeed. Called the Mostek Serial Timer Interface, this powerful new chip incorporates a USART (Universal Synchronous/Asynchronous Receiver/Transmitter), two binary timers, two full function timers, and eight bi-Directional I/O lines with individually programmable interrupts.

The Z80 STI is designed to operate at 4MHz and is therefore compatible with the higher speed members of the Z80A Peripheral Family. Selection and control of the on-chip function is made by means of 24 internal registers which are accessed via the system bus. It is packaged in a standard 40-pin DIL, allowing peripheral functions previously requiring the use of several components to be realised in a minimum of printed circuit board area.

For further details, or a complete 400-page catalogue listing over 7500 components, contact Verospeed, Stansted Road, Boyatt Wood Industrial Estate, Eastleigh, Hants, tel 0703 641111.



MULLARD SPEAKER KITS

Purposefully designed 40 watt R.M.S. and 30 watt R.M.S. 8 ohm speaker systems recently developed by MULLARD'S specialist team in Belgium. Kits comprise Mullard woofer (8" or 5") with foam surround and aluminium voice coil. Mullard 3" high power domed tweeter. B.K.E. built and tested crossover based on Mullard circuit, combining low loss components, glass fibre board and recessed loudspeaker terminals. SUPERB SOUNDS AT LOW COST. Kits supplied in polystyrene packs complete with instructions.

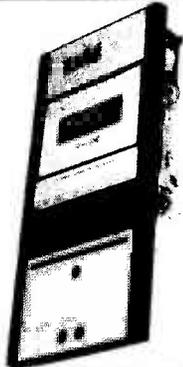
8" 40W system — recommended cabinet size 240 x 216 x 445mm
 Price £14.90 each + £2.00 P & P.
 5" 30W system — recommended cabinet size 180 x 175 x 295mm
 Price £13.90 each + £1.50 P & P.

Designer approved flat pack cabinet kits, including grill fabric. Can be finished with iron on veneer or self adhesive vinyl etc.
 8" system cabinet kit £9.00 each + £2.50 P & P.
 5" system cabinet kit £7.00 each + £2.00 P & P.

STEREO CASSETTE TAPE DECK MODULE

Comprising of a top panel and tape mechanism coupled to a record/play back printed board assembly. Supplied as one complete unit for horizontal installation into cabinet or console of own choice. These units are brand new, ready built and tested.

Features: Three digit tape counter. Autostop. Six piano type keys, record, rewind, fast forward, play, stop and eject. Automatic record level control. Main inputs plus secondary inputs for stereo microphones. Input Sensitivity: 100mV to 2V. Input Impedance: 68K. Output level: 400mV to both left and right hand channels. Output Impedance: 10K. Signal to noise ratio: 45dB. Wow and flutter: 0.1%. Power Supply requirements: 18V DC at 300mA. Connections: The left and right hand stereo inputs and outputs are via individual screened leads, all terminated with phono plugs (phono sockets provided). Dimensions: Top panel 5 1/2" x 11 1/2". Clearance required under top panel 2 1/2". Supplied complete with circuit diagram and connecting diagram. Attractive black and silver finish.
 Price £28.70 + £2.50 postage and packing.
 Supplementary parts for 18V D.C. power supply (transformer, bridge rectifier and smoothing capacitor)



LOUDSPEAKERS POWER RANGE

THREE QUALITY POWER LOUD-SPEAKERS (15", 12" and 8" See Photo). Ideal for both Hi-Fi and Disco applications. All units have attractive cast aluminium (ground finish) fixing escutcheons. Specification and Prices.

15" 100 watt R.M.S. Impedance 8 ohms. 50 oz. magnet. 2" aluminium voice coil. Res. Freq. 20 Hz. Freq. Resp. to 2.5KHz. Sens. 97dB. Price: £34.00 each + £3.00 P&P
 12" 100 watt R.M.S. Impedance 8 ohms. 50 oz. magnet. 2" aluminium voice coil. Res. Freq. 25Hz. Freq. Resp. to 4 KHz. Sens. 95dB. Price £26.00 each + £3.00 P&P.
 8" 50 watt R.M.S. Impedance 8 ohms. 20 oz. magnet. 1 1/2" aluminium voice coil. Res. Freq. 40Hz. Freq. Resp. to 6 KHz. Sens. 92dB. Black Cone. Price: £9.50 each. Also available with black protective grille Price: £9.99 each. P&P £1.50.



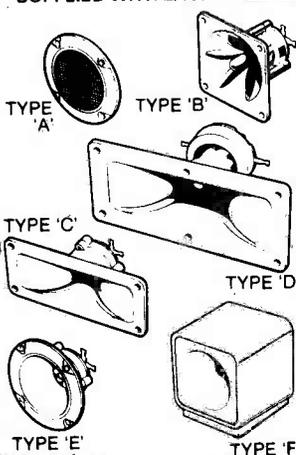
12" 85 watt R.M.S. McKENZIE C1285GP (LEAD GUITAR, KEYBOARD, DISCO) 2" aluminium voice coil, aluminium centre dome. 8 ohm imp., Res. Freq. 45Hz., Freq. Resp. to 6.5KHz., Sens. 98dB. Price £24.00 + £3 carriage.

12" 85 watt R.M.S. McKENZIE C1285TC (P.A., DISCO) 2" aluminium voice coil. Twin cone. 8 ohm imp., Res. Freq. 45Hz., Freq. Resp. to 14KHz. Price £24.00 + £3 carriage.

15" 150 watt R.M.S. McKENZIE C15 (BASS GUITAR, P.A.) 3" aluminium voice coil. Die cast chassis. 8 ohm imp., Res. Freq. 40Hz., Freq. Resp. to 4KHz. Price £49 + £4 carriage. Cabinets fixings in stock S.A.E.

PIEZO ELECTRIC TWEETERS MOTOROLA

Join the Piezo revolution. The low dynamic mass (no voice coil) of a Piezo tweeter produces an improved transient response with a lower distortion level than ordinary dynamic tweeters. As a crossover is not required these units can be added to existing speaker systems of up to 100 watts (more if 2 put in series). FREE EXPLANATORY LEAFLETS SUPPLIED WITH EACH TWEETER.



TYPE 'A' (KSN2036A) 3" round with protective wire mesh, ideal for bookshelf and medium sized Hi-fi speakers. Price £4.29 each.

TYPE 'B' (KSN1005A) 3 1/2" super horn. For general purpose speakers, disco and P.A. systems etc. Price £4.99 each.

TYPE 'C' (KSN6016A) 2" x 5" wide dispersion horn. For quality Hi-fi systems and quality discos etc. Price £5.99 each.

TYPE 'D' (KSN1025A) 2" x 6" wide dispersion horn. Upper frequency response retained extending down to mid range (2KHz). Suitable for high quality Hi-fi systems and quality discos. Price £7.99 each.

TYPE 'E' (KSN1038A) 3 3/4" horn tweeter with attractive silver finish trim. Suitable for Hi-fi monitor systems etc. Price £4.99 each.

TYPE 'F' (KSN1057A) Cased version of type 'E'. Free standing satellite tweeter. Perfect add on tweeter for conventional loudspeaker systems. Price £10.75 each
 P&P 30p ea. (or SAE for Piezo leaflets).



OMP 12 LOUDSPEAKER

The very best in quality and value.

Ported tuned cabinet in hard-wearing black vinyl with protective corners and carry handle. Built and tested, employing 12in British driver and Piezo tweeter. Spec 100 watts RMS; 8 ohms; 45Hz-20KHz; Size: 20in x 15in x 12in; Weight: 30 pounds.

Price: £63.00 each
 £120 per pair
 Carriage: £5 each £7 per pair

BK ELECTRONICS

Prompt Deliveries
 VAT inclusive
 prices
 Audio Equipment
 Test Equipment
 by
 Thandar
 and
 Leader

PANTEC

HOBBY KITS. Proven designs including glass fibre printed circuit board and high quality components complete with instructions.

FM MICROTRANSMITTER (BUG) 90/105MHz with very sensitive microphone. Range 100/300 metres. 57 x 46 x 14mm (9 volt)
 Price: £7.99p

DIGITAL THERMOMETER -9.9 C to +99.9 C. LED display. Complete with sensor. 70 x 70 mm (9 volt) Price: £27.60p

3 WATT FM TRANSMITTER 3 WATT 85/115MHz varicap controlled, professional performance. Range up to 3 miles 35 x 84 x 12 mm (12 volt) Price: £12.49p

SINGLE CHANNEL RADIO CONTROLLED TRANSMITTER/RECEIVER 27MHz Range up to 500 metres. Double coded modulation. Receiver output operates relay with 2amp/240 volt contacts. Ideal for many applications. Receiver 90 x 70 x 22 mm 9/12 volt) Price: £16.49 Transmitter 80 x 50 x 15 mm (9/12 volt) Price £10.29 P&P All Kits + 75p each S.A.E. for complete list.



3 watt FM Transmitter

BSR P256 TURNTABLE

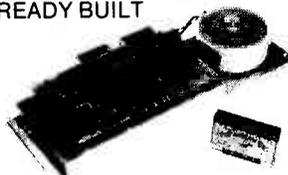
P256 turntable chassis ● S shaped tone arm ● Belt driven ● Aluminium platter ● Precision calibrated counter balance ● Anti-skate (bias device) ● Damped cueing lever ● 240 volt AC operation (Hz) ● Cut out template supplied ● Completely manual arm. This deck has a completely manual arm and is designed primarily for disco and studio use where all the advantages of a manual arm are required

Price £32.35 each. £2.50 P&P



OMP POWER AMPLIFIER MODULE

READY BUILT



New model.
 Improved specification

MOSFET versions available up to 300W. R.M.S.

NEW OMP100 Mk.II POWER AMPLIFIER MODULE Power Amplifier Module complete with integral heat sink, toroidal transformer power supply and glass fibre p.c.b. assembly. Incorporates drive circuit to power a compatible LED Vu meter. New improved specification makes this amplifier ideal for P.A., Instrumental and Hi-Fi applications.

SPECIFICATION
 Output Power:— 110 watts R.M.S.
 Loads:— Open and short circuit proof 4/16 ohms.
 Frequency Response:— 15Hz - 30KHz -3dB.
 T.H.D.:— 0.01%.
 S.N.R. (Unweighted):— -118dB ±3.5dB
 Sensitivity for Max Output:— 500mV @ 10K.
 Size:— 360 x 115 x 72 mm Price:— £31.99 + £2.50 P&P Vu Meter Price:— £8.50 + 50p P&P.

HOME PROTECTION SYSTEM

Better to be 'Alarmed' than terrified. Thandar's famous 'Minder' Burglar Alarm System. Superior microwave principle. Supplied as three units, complete with interconnection cable. FULLY GUARANTEED.

Control Unit — Houses microwave radar unit, range up to 15 metres adjustable by sensitivity control. Three position, key operated facia switch — off — test — armed. 30 second exit and entry delay.
 Indoor alarm — Electronic swept freq. siren. 104dB output.
 Outdoor Alarm — Electronic swept freq. siren 98dB output. Housed in a tamper-proof heavy duty metal case.

Both the control unit and outdoor alarm contain rechargeable batteries which provide full protection during mains failure. Power requirement 200/260 Volt AC 50/60Hz. Expandable with door sensors, panic buttons etc. Complete with instructions

SAVE £128 Usual price £228.85
 BKE's PRICE £99.p&p£4
 S.A.E. for colour brochure

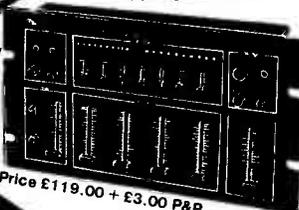


READY BUILT



STEREO DISCO MIXER

STEREO DISCO MIXER with 7 band graphic equaliser and 10 segment L.E.D. Vu Meters. Many outstanding features.
 5 inputs with individual fader controls:—
 2 Mag. turntable, 2 Aux. plus Mic. with talk-over switch. Headphone monitor. Master output control with Hi-Low outputs. Compatible with our OMP Power Amplifiers.
 Size: 360 x 200 x 120 mm. Supply 240V/50Hz AC.



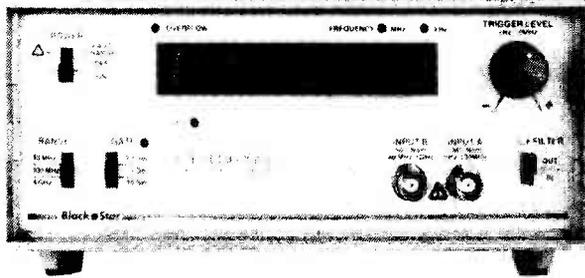
Price £119.00 + £3.00 P&P.

B.K. ELECTRONICS

UNIT 5, COMET WAY, SOUTHEND-ON-SEA, ESSEX, SS2 6TR



★ SAE for current lists. ★ Official orders welcome. ★ All prices include VAT. ★ Sales Counter. ★ All items packed where applicable in special energy absorbing PU foam. ★ Please phone 0702 527572 ★



GHz Frequency Counters

The Meteor Series of Frequency Counters, designed and manufactured in Britain by Black Star, is now available fitted with a Temperature Compensated Crystal Oscillator (TCXO) for extra accuracy and temperature stability.

The Meteor 1000X measures typically from 2Hz to 1.2GHz with <math>< 50\text{mV}</math> sensitivity at 1GHz, features a temperature stability of $\pm 0.5\text{ppm}$ from -10 C to $+40\text{ C}$, and an ageing rate of $< \pm 1\text{ppm}$ per year, and setability of $< \pm 0.2\text{ppm}$. The other models in

the range, the Meteor 100X (2Hz-100 MHz) and the Meteor 600X (2Hz-600 MHz) are available with the same TCXO. All models are battery or mains powered and are fitted with a trigger level control, a low pass filter and offer three gate times (0.1 sec, 1 sec and 10 sec).

The Meteor 'X' series of Counters come complete with mains adaptor/charger, a comprehensive instruction manual, and a year's guarantee, and a wide range of optional accessories is available. The Meteor 100X costs £225 plus VAT and postage and packing, and further details are available from Black Star Limited, 9A Crown Street, St Ives, Huntingdon, Cambs PE17 4EB, tel 0480 62440.

SHORTS

- Greenwell's 1984/85 electronic components catalogue has 84 pages and lists audio modules, books, cases, kits and test equipment as well as semiconductors and the more mundane components. VAT inclusive prices are quoted on the page, credit card orders can be taken by telephone, and the catalogue complete with bargain lists costs £1 including postage from Greenwell, 443 Millbrook Road, Southampton SO10HX, tel 0703-772501.

- Greenpar Connectors have issued a short form catalogue of their range of RF connectors. Each series is extensively illustrated and there is a useful guide to the principal differences between the various series and their respective applications. Greenpar Connectors, P.O. Box 15, Harlow, Essex CM20 2ER, tel 0279-27192.

- Thorn EMI has published an 8-page brochure entitled "A Comparison of the Performance of Photomultiplier Tubes and Silicon Photodiodes". The paper is intended as an aid to equipment designers and scientists engaged

in all fields of light measurement and is available free of charge from the Sales Office, Thorn EMI Electron Tubes Ltd, Bury Street, Ruislip, Middlesex HA4 7TA, tel 08956-30771.

- Following the demise of Scopex Instruments Ltd and the subsequent acquisition of their assets by Bridage Scientific Instruments, a new company has been formed called Scopex Electronics Ltd. They report that production of the Scopex 14D15 dual beam oscilloscope and the 14D10 video model is now in full swing again and that the first samples are ready for despatch to customers. Bridage Scientific Instruments, 63-65 High Street, Skipton, North Yorkshire BD23 1EF, tel 0756-69511.

- A new MIL Standard covering electrical, physical and environmental test methods for microelectronic devices has been published by the United States Department of Defence. MIL-STD 883C, Test Methods and Procedures for Microelectronics, supercedes MIL-STD 883B, contains 488 pages, and costs £39.05 from London Information (Rowse Muir) Ltd, Index House, Ascot, Berkshire SL5 7EU, tel 0990-23377.

400V Transistor Optocouplers TUG Of War

Motorola has introduced a new series of optocouplers utilizing gallium arsenide infrared emitting diodes optically coupled to phototransistor detectors with 400 volt breakdown ratings. This is a significant increase over the previous industry maximum of 300 volts, and permits these devices to be used in applications such as high-voltage solid-state relays, copy machines, etc, without the need for voltage divider circuits or other compensating designs.

The MOC8204 has a current transfer ratio of 20, the MOC8205 a current transfer ratio of 10, and the MOC8206 a current transfer ratio of 5.0. All devices are currently available in the standard 6-in DIP package. In addition to the high breakdown voltage, the devices feature a very high peak isolation voltage of 7500 V AC (min), and are UL recognized (file number E54915). For further information contact Motorola Ltd, European Literature Centre, 88 Tanners Drive, Blakelands, Milton Keynes MK14 5BP, tel 0908-614614.

The Tangerine Users Group has been in the battles a bit recently and some members may be a bit worried as to what is going on. The simple answer is that the original TUG has now suspended operation, but a new users group is fast rising from the remains of the old and should be in operation within a month or two.

The new users group will be run by Colin Nowell, a member of TUG from its inception and a contributor to its newsletter. He takes over from Bob Green who has moved on to do other things. Colin was unable to tell us too much about the problems with TUG when we spoke to him, but he assured us that they are now being dealt with and that the new users group will be run by him personally in an effort to avoid any recurrence. He says he is in contact with the computers' manufacturers and that, as a bit of a carrot to tempt back any wavering members, he has a full CP/M implementation using a Z80 control card ready to run on the Microtan. So hang in there, TUG members, and wait and see what happens.

- Marshall's 1984 electronic component catalogue has 56 pages and lists over 8000 items. They will accept orders over the telephone from credit card holders and the catalogue costs 75p to callers or £1 post paid to UK addresses and comes with a price list valid until June. A. Marshall (London) Ltd, 85 West Regent Street, Glasgow G2 2AW, tel 041-322 4133/5.

- Sircal Instruments are introducing a 2716 and 2732 EPROM programmer for use with the ZX81. It requires four 9V batteries, operates using simple POKE statements, and has an extension bus for further peripherals. SAE for details to Sircal Instruments (UK) Ltd, Southfields Court, Sutton Common Road, Sutton, Surrey SM1 3JE, tel 01-644 0981.

- The Scots really are brave — at least where high technology is concerned. A recent poll carried out by the market research company Taylor Nelson & Associates found that only 22% of people in Scotland suffer from what they call 'technofear', an aversion to high technology products. The figure was 35% in the North of England and the midlands and 44% in the South.

- The Independent Broadcasting Authority have produced a 48-page illustrated book entitled "Compatible Higher-Definition Television" which discusses the problems associated with providing higher-definition domestic television which remains compatible with existing systems and receivers. Copies are available free to educational centres and technical libraries and to firms, engineers and students directly involved in Broadcasting. The IBA Engineering Information Service, Crawley Court, Winchester SO21 2QA, tel 0962-822444.

- B&R Electrical products of Harlow, probably best known for their range of relays, have produced a nine-minute video film on electrical safety. The professionally produced film is entitled "Because it's not worth the risk" and uses commentary and animated graphics to illustrate the dangers of electricity and the value of Residual Current Circuit Breakers (RCCBs) in minimising those dangers. It is available for hire by schools, colleges, etc for £3.00 a day or can be purchased for £29.95 from The Education Department, B & R Electrical Products Ltd, Temple Fields, Harlow, Essex CM20 2BG.

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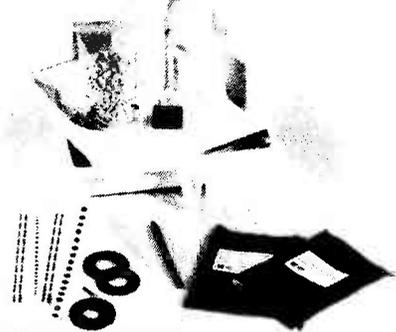


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VERTICAL SPEED INDICATOR

Of special interest to hang gliding enthusiasts but unusual enough to inspire flights of fantasy in even the most vertigo ridden of armchair adventurers; Lindsay Ruddock describes a vertical speed indicator using a silicon piezo-resistive pressure sensor.

The vario and the altimeter, in that order, are the hang glider pilot's first and most important instruments. The altimeter measures height, but it is the vario which helps the pilot get high.

Vario is short for variometer, which means a VSI or vertical speed indicator to the gliding fraternity. In order to stay airborne, the glider pilot seeks out areas of rising air, the most important of which are called thermals — bubbles of warm air rising from the ground on sunny days (visualise a pan of water boiling on a stove). Using a vario to read the rate of climb or sink, the pilot flies to centre on the core of the rising air.

Essential as the vario readout may be, hang glider pilots do not want to spend their flying time staring at a panel meter. Also, flying sites can get very crowded. A light NNW wind on Devils Dyke in Sussex will see as many as fifty hang gliders airborne at one time. Accordingly, as well as a visual readout usually on a panel meter, hang gliding varios must have an audio tone which sounds when the glider is climbing. What is being measured, of course, is the net effect of the glider's sink rate and the lifting air. However the audio must do much more than simply distinguish between lift and sink, so the pitch of the tone is made to vary according to the strength of the lift.

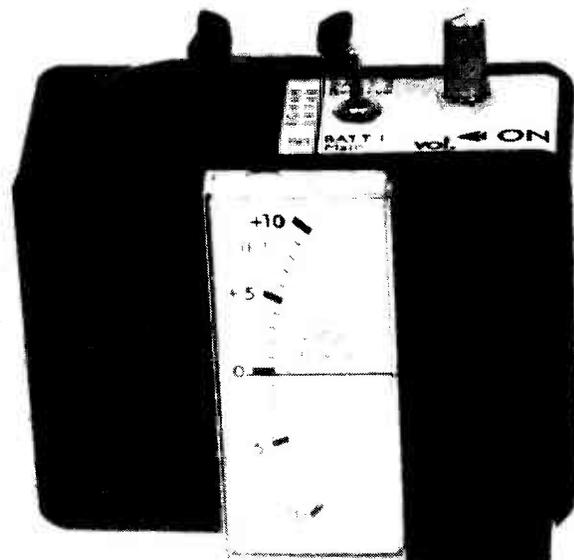
The circuit described generates interrupted tone audio, the type recognised as being the easiest to follow. It sounds as a series of

friendly encouraging beeps, the pitch rising steadily through an octave from zero lift to full scale. The rate of interruption is optimally chosen to begin at 2Hz at zero lift and progresses steadily to 4Hz at full scale. The visual readout is still necessary as the audio only gives relative information.

There are two viable types of vario for hang gliding, the flask type and the pressure derivative type. Both work by detecting the change in atmospheric pressure with height, but do it in different ways.

The flask uses a reservoir flask vented to the atmosphere via a narrow passageway or constriction.

As atmospheric pressure changes, air flows into or out of the flask and it is this airflow which is measured to indicate vertical speed. A pair of closely matched resistance wires are placed one in front of the other in the constriction in the flask vent. The wires are connected as two arms of a Wheatstone bridge, and are directly heated by passing a current through them. The one in front gets cooled more than the other by air flowing into the flask and vice versa. This temperature difference causes the bridge to unbalance and the resulting signal is amplified to drive a display and an audio tone generator.





The vario described in this article is of the pressure derivative type. The difference between this type and the flask type is that here the absolute value of atmospheric pressure is measured directly using a silicon chip pressure transducer. The resulting signal, which represents altitude, is then differentiated to obtain a rate of climb signal, hence the name 'pressure derivative vario'. Figure 1 is a block diagram of the instrument.

A very big advantage can immediately be seen; since we are only concerned with rates of change, the instrument is inherently self-zeroing. Much of the very high gain required can be placed before the differentiator, and in this way, long term drift in the transducer and first amplifier is ignored by the differentiator circuit and does not show in the output.

Although the idea is simple, a

successful vario of this type needs very careful design. The overall circuit amplification is very high and the circuit impedance in the differentiator stage is very high. The problems are those of noise, drift and stability.

Noise and drift are dealt with by choosing suitable low noise, low drift components and, most importantly, by the elimination of PCB surface conduction. In the bandwidth we are concerned with

PROJECT : Vertical Speed Indicator

(0 to 1 Hz), surface conduction (surface leakage) is an extremely noisy process, easily swamping noise originating elsewhere in the circuit and also showing up as output drift. Fortunately, guard tracks around the sensitive circuit points prevent PCB surface leakage and consequently eliminate the accompanying noise.

Figure 2 is a graph of atmospheric pressure against altitude plotted for the International Standard Atmosphere. Clearly the gradient or derivative of such a curve is not a constant. Plotting the gradient of the pressure curve in fact gives us Fig. 3. For our purposes we would like Fig. 3 to be a horizontal straight line, ie, uniform rate of change of atmospheric pressure with altitude. However, Fig. 3 shows that atmospheric pressure falls off more slowly the higher one goes, with the result that an uncompensated pressure derivative vario will under-read by a factor which can be read off from Fig. 3.

Although an awareness of the under-reading characteristic is useful, the extra complexity of compensation has not been included in the circuit presented here. We said earlier that a vario is primarily an indicator in gliding and providing the zero is stable, the absolute accuracy at all altitudes is of lesser importance. With a cloudbase at a typical 4000 feet on the better days of an English summer, the error can be completely ignored, and in other parts of the world, where hang gliders are regularly flown to 18,000 feet, it is sufficient that the pilot remembers the general trend of Fig. 3.

The design requirements for a vario are:

1. Reasonably small weight and size.
2. Long battery life and dual batteries.
3. Scale ± 1000 feet per minute (or ± 10 Knots).
4. Accuracy 10% at sea level, with a known calibration error with height.
5. Resolution 20 fpm ($\approx 4''$ per second).
6. Nicely responsive (fairly light damping).
7. Stable zero.

The first requirement goes without saying. The second, dual batteries, means a reserve is always available. A battery, no matter how long it lasts, must go flat sometime. Low battery indicators are now reliable enough especially with Ni-Cads but are too easily ignored.

A scale of ± 1000 fpm was chosen as it caters for the vast majority of flying conditions. An alternative could be ± 1500 fpm but this makes the scale a little cramped. Other possibilities are switched scales (± 1000 and 2000 fpm) or compression of the upper part of the scale, both of which introduce greater complexity.

Absolute accuracy is not an important feature. For gliding pur-

poses, the vario is used in a relative mode as an indicator — hence the name VSI. Calibration to 10% at SL is more than adequate, and provided the zero position is stable, the absolute accuracy at all altitudes is of lesser importance.

The limit to resolution is set by circuit noise. Full scale deflection (± 1000 fpm) at the output is ± 1.25 V, which corresponds to $\pm 18\mu\text{V}$ at the transducer output.

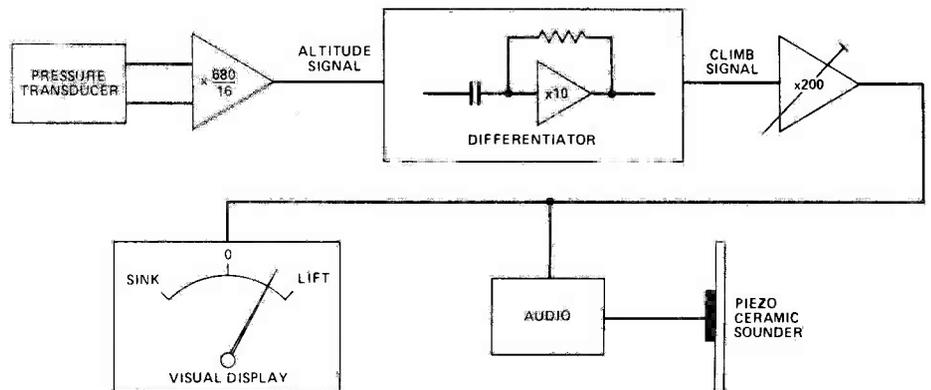


Fig. 1 Block diagram of the vario.

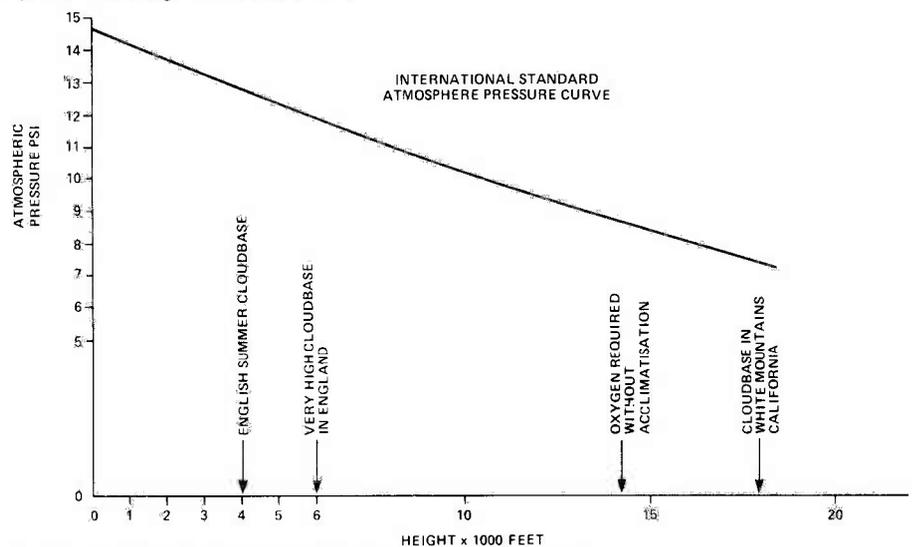


Fig. 2 International Standard Atmosphere (ISA) curve.

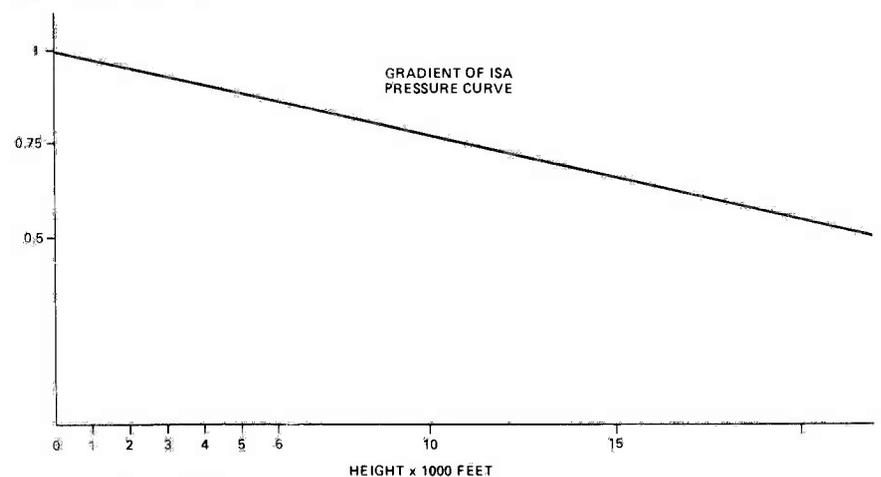


Fig. 3 Gradient of ISA pressure curve.

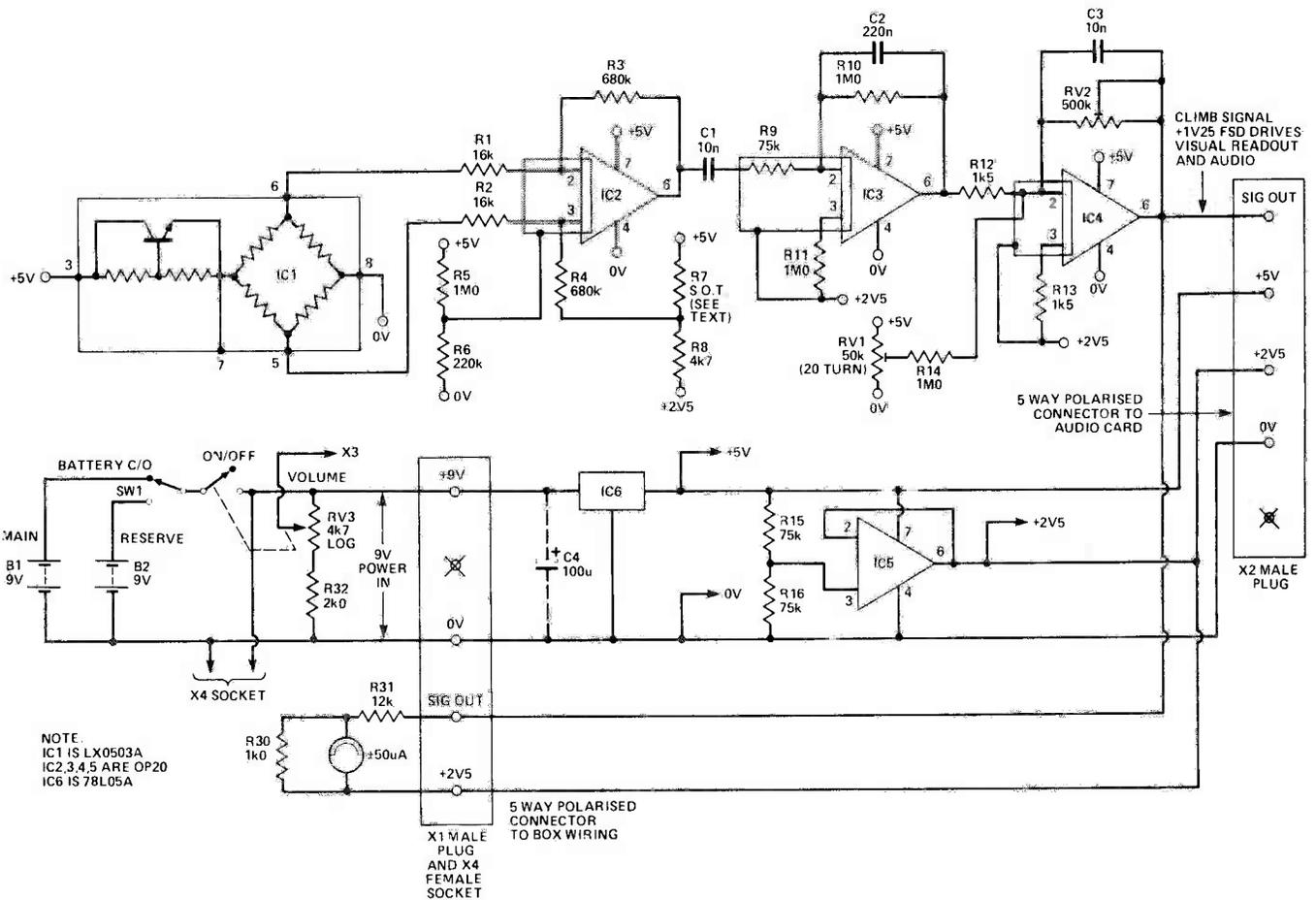


Fig. 4 Circuit diagram of the vario.

HOW IT

The LX0503A is a semiconductor piezo-resistive strain gauge manufactured using integrated circuit technology. A hollow is etched in a single crystalline (and therefore perfectly elastic) silicon chip about 2mm square, forming a diaphragm. This chip is then bonded to another chip acting as a backing plate, the pair forming a closed vacuum cell. Four strain gauge resistors making up a Wheatstone bridge are diffused into the diaphragm, two in areas of compression and two in areas of tension. Since the resistors are diffused in, the bonding to the diaphragm is perfect. The semiconductor material of which the bridge resistors are made has an enormous temperature coefficient. The gauge factor (sensitivity to stress) also changes with temperature. To compensate for this the LX0503A has an internal V_{be} multiplier.

In this application, the bridge and the compensation network are wired in series and connected across 5V. Wired this way, pins 5 and 6 of the transducer sit at about a volt above the negative supply and the swing between sea level (SL) and 20,000 feet (14.7 psi to 6.75 psi) is typically 16 to 20mV.

The first op-amp (IC2), converts the transducer differential output to a single ended output, with a gain of 680/16. The resistor marked SOT (Select On Test) is adjusted to bring the op-amp output to 0.25V below the +2.5V signal ground rail (assuming the altitude of your workshop is $SL \pm 1000'$). Not only does this procedure make sure that the op-amp does not saturate at the positive end at altitudes up to 20,000 feet, it also makes certain that the voltage across the 10uF capacitor, C1, is never more than $\pm 0.25V$ at switch on. Too large a voltage across this capacitor at switch on would cause too much dielectric absorption and hence too long a warm up time. The resistors in this stage are all best quality metal film in keeping with the low flicker noise requirement.

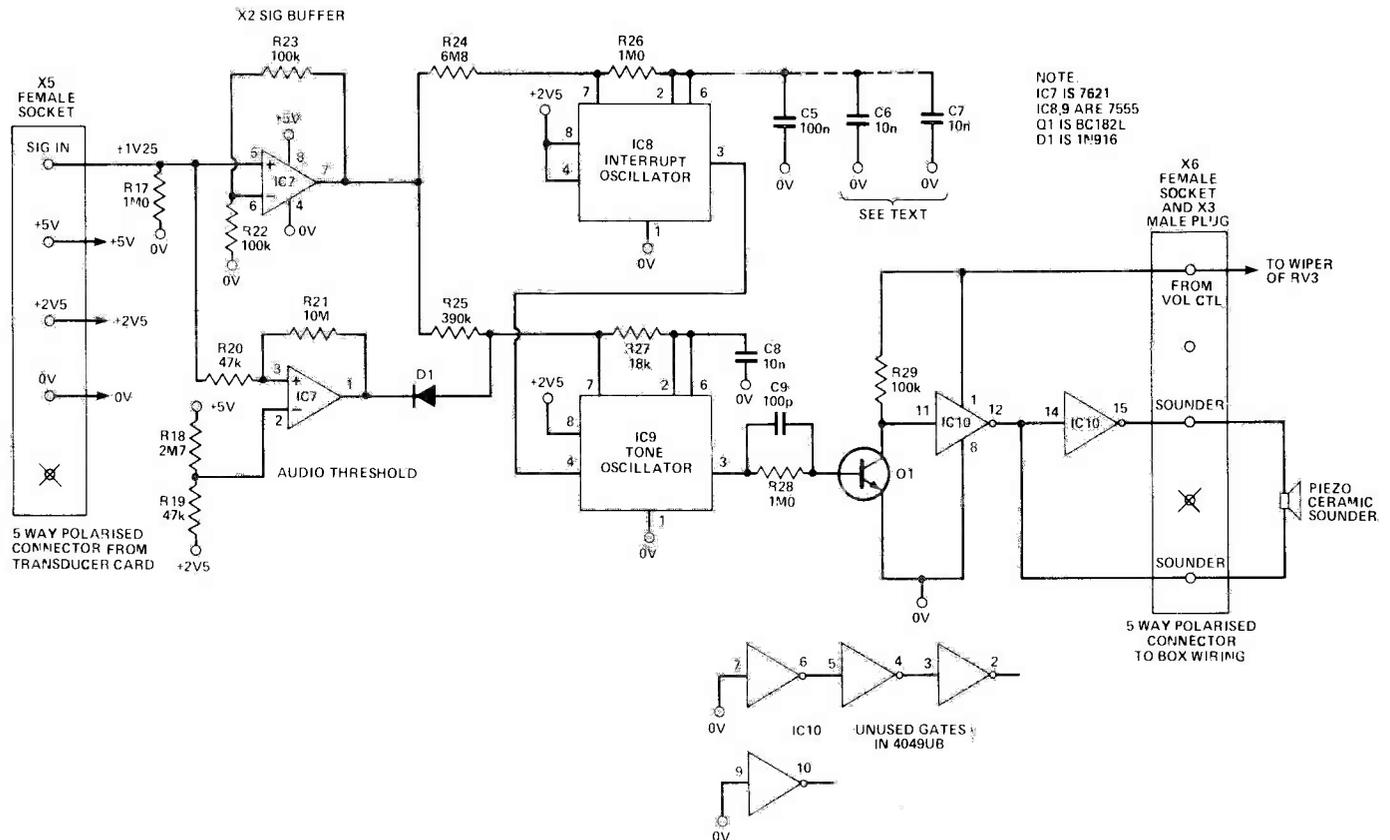
A crude guard track is used around the input pins of the op-amp. The principle of a guard track is that sensitive high impedance points or tracks in a circuit can be surrounded by a low impedance guard track at the same potential. Because there is no potential difference across the PCB surface, no leakage takes place and hence noise caused by leakage is reduced. Here, the potential on

the guard track is set by the divider chain R5, R6 at about 1V, approximately the same potential as that on the inputs.

IC3 is configured as a differentiator. The effective gain of the stage is set by the product of C1 and R10, which is why both are as large as practicable. Both C1 and C2 must have polyester dielectric or better. A guard track is run around IC3 inputs and also around R9, and since the voltage at the inputs never exceeds a few millivolts, a track connected to signal ground is very effective. The 75k resistor R9 and the 0.22uF integrating capacitor C2 fix the response time of the vario. This is also referred to as damping. Using the values given the response is quite fast.

The final amplifier, IC4, is an inverting amplifier providing a gain of typically X200 to bring the climb signal up to the $\pm 1.25V$ output. RV2 adjusts the gain between X100 and X330 to enable scale calibration to be set. RV1 sets the zero, nulling the offsets from both IC3 and IC4, and also has sufficient adjustment range to swing the output plus or minus full scale when testing the audio section. A guard track connected to the signal

PROJECT : Vertical Speed Indicator



WORKS

ground is run around IC4 inputs. C3 quiets any noise picked up after the differentiator which would otherwise cause a ragged turn on of the audio.

The output of IC4 drives a $\pm 50\mu\text{A}$ panel meter as well as the audio. The 1k resistance in parallel with the meter coil (which also has a resistance of 1k) is necessary to add damping to the meter movement itself. A gain of X2 is provided by the first half of IC7, an Intersil 7621 CMOS op-amp whose output will swing all the way between its supply rails. The other half of IC7 is wired as a non inverting Schmitt trigger switching at a threshold equivalent to 33 feet per minute, which is set by R18 and R19. R20 and R21 provide positive feedback to implement the Schmitt trigger action with a small amount of hysteresis. The output, again switching fully between the supply rails, is routed via D1 to inhibit the tone oscillator unless the climb signal is above the threshold.

Two CMOS 555s configured as VCOs are used, one for the interrupt running at 2 to 4Hz and the other for the tone running at 330 to 660Hz. Both are voltage controlled over an octave. C5 charges through R24 and R26 and C8 through

R25 and R27 until pins 2 and 6 reach two thirds of the 555 supply voltage (2.5V). Pin 7 then discharges C5 through R26 and C8 through R27 until pins 2 and 6 drop to one third of the 555 supply, when the IC removes the discharge through pin 7 and allows the capacitor voltages to rise again, continuing the cycle. The VCO action arises because the higher the voltage to which R24 and R25 are returned, the faster will be the charging rate on the long cycle.

The output of the interrupt oscillator IC8 drives into the RESET pin of the tone oscillator IC9. More tone than interrupt is allowed through by making the interrupt oscillator mark/space ratio uneven. Provision has been made for padding the interrupt oscillator VCO capacitor C5 with C6 and C7. This is important as the interrupt frequency must be 2Hz or a little less to sound right to the ear.

Q1 acts as a level changer to bring the signal level up to 9V. Because the base drive resistance is high, a small capacitor (C9) helps Q1 turn off more quickly by dumping a charge into the base when the drive switches from a high to a low state. Reasonably fast rise and fall times remove the risk of oscillation in the

CMOS 4049 buffer. The risk is further reduced by specifying a suffix UB part. Volume control is provided by supplying both the buffer IC10 and Q1 from a 4k7 log pot across the 9V supply.

The very efficient piezoceramic sounder used gives maximum volume at around a few kHz. To get the loudest sound, IC9, the tone oscillator, generates a very uneven mark/space ratio signal running at a fairly low frequency, but which is very rich in harmonics. Although the oscillator runs from 330 to 660Hz, its output consists of pulses only 250 μs wide. The sounder is connected between the input and the output of the second inverter in IC10. It is thus driven in a complementary mode which effectively doubles the battery supply voltage and significantly increases the sound power.

Alkaline PP3 sized 9V batteries are used in the Vario giving about 40 hours of life. The 9V is regulated to 5V with a 78L05A regulator IC6, while IC5 provides a split rail to act as signal ground. A 100 μF capacitor (C4) decouples the 9V input lead if necessary.

PROJECT : Vertical Speed Indicator

We want to resolve to ± 20 fpm or $\pm 2\%$ of FSD. In other words, the random flicker observable on the pointer due to noise should be hardly noticeable. Bearing in mind the bandwidth of DC to 1 Hz, total noise referred to the transducer output must be kept to a fraction of a microvolt. If the working frequency band was in the audio or RF spectrum, this would be quite easy. There we would only have thermal and shot noise to deal with and over a 1 Hz bandwidth these would be insignificant. However, down at the bottom end of the spectrum, below a few Hz, the lesser known phenomenon of flicker or $1/f$ noise dominates. ' $1/f$ noise' is so called because its amplitude is inversely proportional to frequency; it seems to be caused by discrete jumps in conductivity but very little information is available. Experiments showed that PCB surface leakage contributed very large pulses of this noise but at intervals of one or two minutes.

Noise in the vario originates from the regulator, the transducer, the first op-amp, the resistors in the first amplifier, and from PCB surface leakage around the differentiator. Attention must be paid to all of these as noise from any one can be sufficient to swamp the others. A number of different parts from various manufacturers have been tried in the circuit and the regulator, transducer and op-amps specified in the parts list have been found to give the best noise performance. Similarly, several different types of resistor

were tried but metal film proved the most appropriate, offering less noise in this band than the supposedly less noisy thick film types, for example. Finally, the problem of noise caused by PCB leakage has been tackled by placing guard tracks around sensitive points on the PCB.

Damping (or what is often mistakenly called 'sensitivity') is a damping down of the speed of response by limiting the circuit bandwidth. Sailplane pilots seem content with quite heavy damping and consequent sluggish response. Hang glider pilots like a fairly light damping, but again, too little damping can be very annoying. Every little bump of lift and bit of turbulence in the air causes the vario response to be all over the place and the reading is very difficult to interpret. Accordingly, the damping used in this design has been set at a value as light as is consistent with a reasonably satisfactory integration of the irrelevant bumps and turbulence. Or, to put it another way, damping is added until the point just before a lag becomes noticeable in the vario response. As it happens, this coincides quite neatly with the bandwidth constraint imposed by circuit noise.

The last requirement, for a stable zero, is probably the most important. It does not matter so much if one is climbing at an indicated 400 fpm when the real climb rate is 600 fpm. The 200 fpm difference could be due to a calibration scaling error of 30%, a

zero shift of plus 200 fpm. If the former, then a true 100 fpm sink will show as 60 fpm sink on the vario. Again, not too bad. But if the error is due to a shift in the zero, then a true 100 fpm sink will show as 100 fpm lift on the vario for the same 200 fpm difference — a totally different and unacceptable situation. Drift of the zero can be considered in two parts — drift originating before the differentiator and drift originating after the differentiator. Clearly drift originating before the differentiator only shows through to the output while the drifting is actually taking place. Therefore an advantage is gained by placing as much gain as possible before the differentiator, the limit being set by the allowable swing at the transducer buffer op-amp output. Further, since the differentiator op-amp gain is X1 so far as offset drift is concerned, regardless of the effective gain in the differentiator circuit, a further advantage is gained by making the differentiator gain as large as is practicable. The limit is set by the maximum physical size of polyester dielectric capacitor which can be accommodated and the maximum differentiator feedback resistor which is considered acceptable. The gain of the last stage is then the figure by which the offset drifts in both the differentiator and final amplifier op-amps should be multiplied. In this circuit, the final stage gain is 250. The sources of drift before the differentiator are the op-amp and the transducer. The op-amps used have been chosen for their low offset drift as well as their low noise performance, and the transducer specified has an internal V_{be} multiplier which provides at least coarse nullification of the temperature drift in the measuring bridge. This still leaves some non-linear drift in the transducer, but correcting this would require far more complex circuitry and a lengthy setting-up procedure, and in practice the level of drift remaining is quite acceptable.

Next month's concluding article will contain full constructional details and an extended Buylines giving advice on where to purchase the components.

Device	Manufacturer	Comments
LX0503A	Sensym	Cheapest 0-15 psi transducer available. Used to be manufactured by National Semiconductor
MPX100A	Motorola	Very variable quality
134PC15A1	Honeywell	
1800-01-33-00B-0	Foxboro	
PTQ-H-360 A	Kulite	Top quality, very expensive.
PAA-2-1	H.W. Keller-Druck	

Table 1 Basic 0-15 psi pressure transducers available in this country.

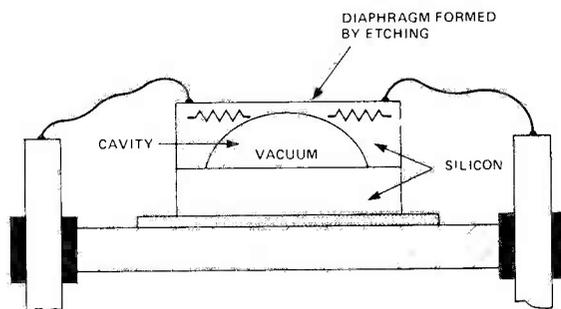


Fig. 5 Internal construction of the transducer element.

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DESIGNER'S NOTEBOOK

Signals come and go, but sometimes you want to hang on to them for a while. Joe Pritchard shows how it can be done.

Let us start this article with a definition: a sample and hold circuit is used to obtain a discrete value that represents an analogue signal at a particular instant in time. It samples the signal, and then, on a given command, holds the value that the signal possessed at the instant of interest. These circuits have found use in many different areas of electronics where it is necessary to take a "snapshot" of a signal at a particular instant.

We'll first look at these circuits from a theoretical point of view, examining an ideal circuit. At its simplest, a sample and hold circuit consists of some means of holding the voltage, and some means of connecting this storage element to the signal of interest when we want to sample the signal. Figure 1 shows us an ideal sample and hold circuit, in which we have an electronically-controlled switch to connect the capacitor, our storage element, to the input signal when we wish to sample the input. On opening the switch, the capacitor holds the voltage that was present at the input the instant the switch was opened. We shall call the input voltage V_{in} , and the impedance of the source R_{out} . The **sample period** is the length of time for which the switch is closed and the **hold period** is the length of time the switch is open.

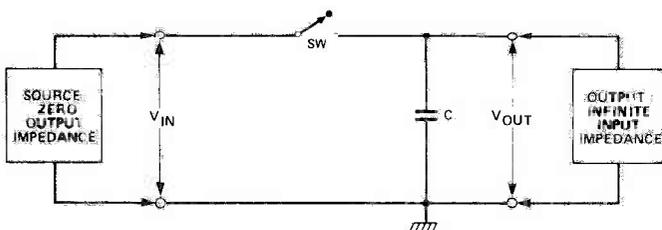


Fig. 1 Ideal sample and hold.

When we initiate a sampling period by closing the switch, the following happens. After the switch is closed, ignoring the on resistance of the switch, the circuit approximates to that in Fig. 2. As you can see, we now have a simple RC circuit in which the capacitor is charged up via the source impedance R_{out} . The output voltage, V_o will rise as an exponential with a time constant of $R_{out}C$; mathematically, this is:

$$V_o = V_{in} (1 - \exp(-t/R_{out}C)) \dots \dots \text{Eq. 1}$$

where t is the time between the start of sampling and the instant at which we are measuring V_o . The practical significance of this is that we allow the sampling period to get longer and longer, then V_o becomes closer and closer in value to the input voltage.

If we allow the sampling period to carry on for five time constants, V_o attains a value that is within 1% of the

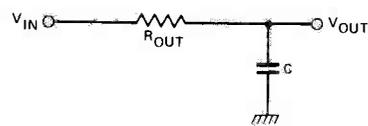


Fig. 2 The effect of the source impedance.

value of V_{in} ; this is shown in Fig. 3. Obviously, extending the sampling period leads to the value of V_o becoming even closer to V_{in} , and after nine time constants the output voltage is within 0.01% of the input voltage.

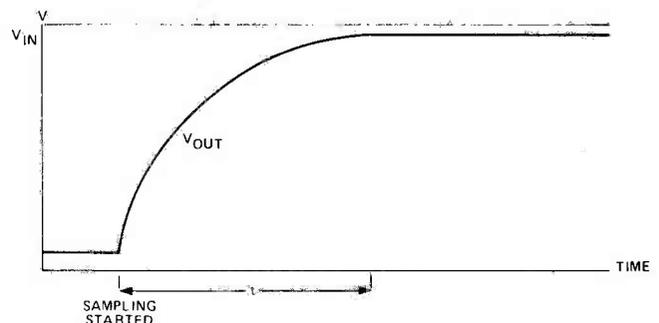


Fig. 3 The effect of the source impedance.

The time required for the output to approximate to the input to within a given percentage accuracy is called the **acquisition time** for that particular accuracy and that particular sample and hold circuit. In the above example, the acquisition time for 1% accuracy is five time constants, and nine time constants for 0.01% accuracy.

So, to recap on the sampling state. While the switch is closed and sampling is occurring, V_o will follow V_{in} to a certain degree of accuracy after the acquisition time has expired: this state of affairs is shown in Fig. 4. We'll now go on to examine what happens when the switch is opened and the circuit performs the hold function.

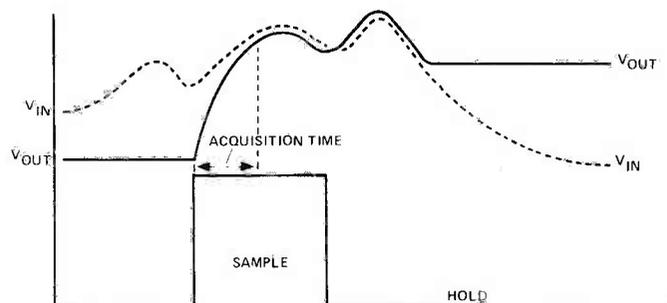


Fig. 4 The acquisition time.

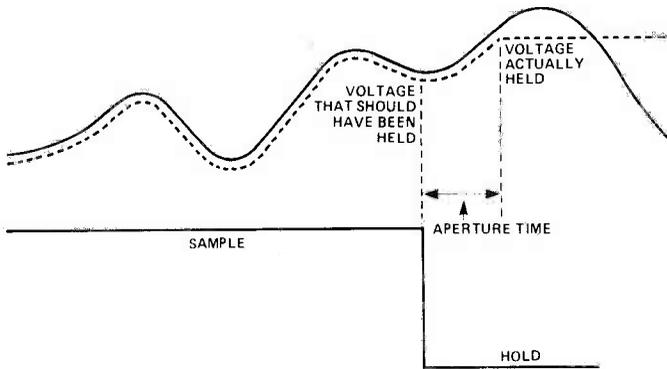


Fig. 5 Aperture time.

Holding On

The first thing to note is that the input voltage, and its impedance, in theory no longer have any effect on the capacitor, due to the switch being open. In reality there is a slight delay in between the hold condition being initiated and the switch actually opening. This time is called the **aperture time** and during the output voltage will still follow the input: this is shown in Fig. 5. The aperture time is a function of the circuitry used to perform the switching and we'll look at it in greater detail when we go on to look at the practical implementations of these circuits.

In addition to the aperture time there is the **settling time**, which is the time taken for the output to attain a value approximating the input voltage at the instant that the hold was initiated. The settling time also depends upon the the degree of accuracy needed.

Once the hold state has been set up, with the capacitor isolated from the input voltage, then in the ideal situation with a perfect capacitor, the capacitor would retain the charge indefinitely. However, as nothing is truly perfect, the charge stored on the capacitor gradually leaks away and the held voltage falls. This decay is prosaically known as the **droop rate** and depends upon the capacitor value and the current that leaks through it. Mathematically,

$$\frac{dV_o}{dt} = \frac{I}{C} \dots \dots \dots \text{Eq. 2}$$

where I is the leakage current, C is the capacitor value and dV_o/dt is the rate of change of the output voltage.

The leakage current in the circuit under consideration would be purely due to the leakage through the capacitor itself. However, in practical circuits, this current can leak away through other circuit elements. So, the output voltage will be constantly falling, at the droop rate, during the hold period.

Building Blocks

Let's now look at some of the basic building blocks that we'll use to build a sample and hold circuit out of discrete components. The first circuit element that we'll consider is fundamental to the whole operation — the electronically controlled switch.

FET Switches: field effect transistors are obvious candidates for the job of an electronic switch due to their high resistance when they are not turned on, and their low on resistance of between 30 and 200 ohms. MOSFET's are also used in this role (Fig. 6). However, these devices have drawbacks at high frequencies due to the capacitance that is inherent in them due to their construction. This stray capacitance, which is often between 20 and 50pF, reacts with the on resistance of the switch to give a low pass filter, thus limiting the input frequency

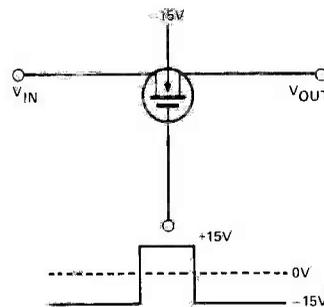


Fig. 6 (left) N-channel MOSFET as a switch.

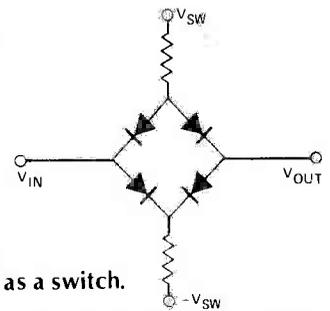


Fig. 7 (right) Diode switch.

that the switch can handle. If we do the sums, it turns out that the top limit of these FET switches is around 20 MHz. This is ample for most cases, however. The aperture time of these switches is about 100 ns.

Diode array switches: diode arrays can be employed to give fast switching combined with short aperture times. The capacitance of these arrangements tends to be lower than that for the FET switches. A typical diode array switch is shown in Fig. 7. A voltage applied across the V_{SW} terminals will lead to the diode array switching.

CMOS switches: these use the sort of switches found in the 4016 package. They have a low on resistance of between 30 and 50 Ω and have the advantage that they can be driven directly from CMOS chips used to implement the control logic of the sample and hold circuit. Other switching devices, such as relays, have been used in this role, but their obvious limitation is their low speed and high aperture time. Both of these parameters are due to the fact that these devices are mechanical.

We'll now go on to look at how we might implement sample and hold functions, firstly by using 'standard' devices, such as operational amplifiers, and then by using integrated circuit packages designed specifically for the purpose. Figure 8 shows what is almost a classical design for a sample and hold circuit utilising op-amps. This circuit still has the essential components of the ideal system but we now introduce the additional components to do some signal conditioning on the input voltage and some isolation of the capacitor from the circuitry connected to the output.

The amplifier IC1 is connected as a unity gain amplifier, and it serves to take the input signal and provide a copy at the input to the switch that is identical but with a lower impedance. This impedance is the parameter R_{out} in the first system we considered and we saw there how it is desirable to minimise this value. The switch in this circuit could be one of those found in a 4016 package.

The capacitor used here is a compromise value, as there are conflicting design factors. From the equation describing the droop rate, Eq. 2, a large value capacitor will minimise droop. However, if the capacitor is too large, it will reduce the maximum frequency at which the sample and hold circuit can operate, by acting as a low-

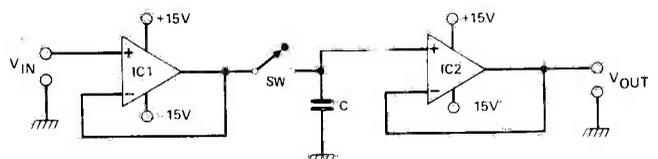


Fig. 8 A basic sample and hold circuit.

pass filter in conjunction with R_{out} and the on resistance of the switch, and a large capacitor here will increase the acquisition time for a given percentage accuracy by increasing the value of the time constant of $R_{out}C$. Thus for the circuit to be able to follow high frequency signals it is necessary that the capacitor should be fairly small.

An alternative to a large value of capacitance to minimise droop is to use some means of reducing the leakage current, I . It is best to stay clear of using aluminium electrolytic units in this role, as they have a very poor performance due to their relatively high leakage. Polyester, polypropylene and tantalum units can be employed here, depending upon the value of capacitance chosen.

Another source of leakage across the capacitor comes from whatever circuit element the capacitor 'looks into' when the switch is open. In this case, it is the input of an operational amplifier in a configuration that offers a high input impedance and so a low leakage. By putting this amplifier in the circuit, we give the capacitor a standard output to which any circuitry may be connected without increasing the droop rate. The op-amp used for IC2 should thus have a low input bias current, and this parameter is always given in the data sheets for such a device. The input bias current is the minimum required by the operational amplifier for correct operation. If the figure quoted is large, then the droop rate will increase. Thus we must have a good quality amplifier at this point in the circuit and operational amplifiers with JFET inputs are often used here due to their low input bias currents. This makes it possible to choose the value of the capacitor to suit the frequency requirements of the circuit rather than the droop rate requirements.

A final consideration that we must make is the amplifier IC1. It must be able to follow the input signal that is applied to it, and supply a copy of this input to the switch. The frequency characteristics of the circuit are thus dependant upon the characteristics of IC1 as well as the capacitor. The first parameter of the operational amplifier that we must look at here is the slew rate of the amplifier, a value that determines the frequency response of the device. This is best described in Fig. 9, which shows what happens when an input of sufficient magnitude to drive the output of the amplifier into saturation is applied very suddenly. Note how the output takes a finite time to assume the final output voltage level. The slew rate is rate at which the output rises, usually quoted in volts per microsecond.

Obviously, if this parameter is fairly small, the output voltage will take a longer time to stabilise than if it were quite large. High speed amplifiers have high slew rates, such as $100 \text{ V}/\mu\text{s}$. The unit we choose for IC1 should have a slew rate that is appropriate for the signals under consideration.

Another parameter of IC1 that is important for satisfactory operation of the circuit is the ability of the output to provide current. In charging the capacitor during the sampling period, the amplifier will have to provide a charging current of

$$I = C_1 \frac{dV}{dt} \dots \dots \dots \text{Eq. 3}$$

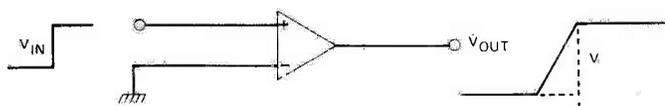


Fig. 9 Op-amp slew rate.

If the rate of change of voltage is quite large, a state of affairs that is not rare when we have a rapid sampling rate or a rapidly changing input signal, the current required can be considerable. Amplifiers used in this position in the circuit can suffer a rise in temperature.

It is often the current sourcing ability that limits the slew rate of the system as a whole. Consider an amplifier driving a signal changing a $10 \text{ V}/\mu\text{s}$ into a 100 nF capacitor; the current it must supply is 10 mA .

It is the lower of the two slew rate parameters (op-amp slew rate and current supply capability) that limits the frequency operation of the circuit. The maximum current that an operational amplifier can source can be found in data sheets for the device in question.

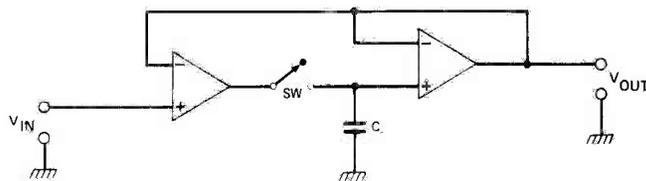


Fig. 10 Alternative sample and hold circuit.

Figure 10 shows an alternative connection of the operational amplifiers, but the principles outlined above still hold; however, this alternative connection minimises the effects of the op-amp's offset voltages.

Before we go on to see some general rules of thumb about op-amp based sample and hold circuits, a few words about the rate of and length of sampling. The first point to make is that the sampling period should be longer than the acquisition time of the system, so that when sampling takes place, for most of the sampling period the output voltage into the capacitor follows the input voltage with reasonable accuracy. If the sample period is shorter than the acquisition time then the output at hold will not be an accurate representation of the input. With regard to the rate of sampling, if the aperture time is longer than the time interval between separate samples being taken, then again inaccurate results will be obtained. To be quite safe, you should allow a good deal longer than the aperture time between samples.

Choosing Devices

First of all, which amplifiers should we use? For IC1 in the circuit we have considered, the main requirements, as we've seen, are high slew rate and good current sourcing ability. The LM318 and the LF351 are both possible choices here. The ubiquitous 741 is not usually useful in this role as it has a low slew rate. The equally popular LM324 suffers from the same problem, but both of these devices can be used in low frequency applications as they have good current sourcing ability.

With regard to the switch used, this really depends on the speed of sampling that is to be used. For many applications, CMOS switches are quite adequate. The rate of sampling and the sample period can both be controlled by suitable astable and bistable circuits, or via signals from a microprocessor.

The value of the capacitor used should be chosen for the acquisition time required, as we can minimise droop effects by careful choice of the final op-amp. If a small acquisition time is needed, which would be the case if we were sampling a rapidly changing signal, then the capacitor should be small.

The main requirement of the final op-amp is that it should have a low input bias current. Devices that come

into this category are the LF356 and the LM308. The more common op-amps such as the 741 could be disappointing due to their relatively high bias current.

Some Practicalities

Figures 11 and 12 show practical versions of Figs. 8 and 10 due to Texas Instruments which is why they both use TI devices. Figure 11 uses two P-channel enhancement FETs to produce a very high degree of isolation between the capacitor and the input buffer IC1. Obviously, PCB lay-out can enhance the isolation still further, and conversely poor lay-out can degrade it. If the value of C1 is chosen to be $1\mu\text{F}$, then the maximum drift should be around 0.2 mV per second.

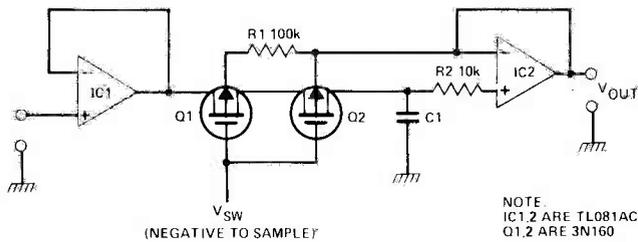


Fig. 11 (above) Practical sample and hold circuit.
Fig. 12 (below) Low offset sample and hold circuit.

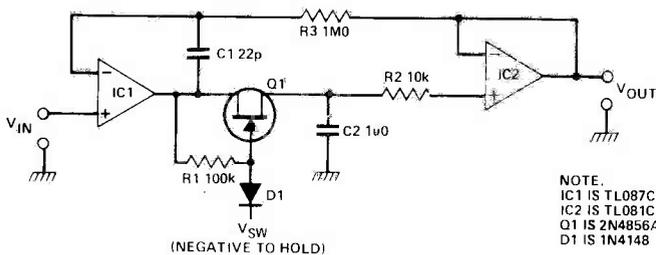


Fig. 12 is a high-accuracy sample and hold; since IC2 is within a closed loop, the effect of its offset voltage is negligible. IC1 is chosen to be a type with a very low offset voltage, maximum 0.5 mV at 25 degrees centigrade. Components C1 and R3 are to improve loop gain in the sampling mode. The one problem with this circuit is that during hold, DC feedback to IC1 is removed and it will saturate. It is therefore important to choose Q1 to withstand this possibility. Alternatively, a second FET could be put in parallel with C1 so as to provide feedback when Q1 is off.

The LM398 is a ready-made unit and its internal circuitry is very similar to the configuration that we have looked at in this article, with the difference that the capacitor is an external component to the chip. This device makes the construction of a simple sample and hold circuit much more straight forward. A typical configuration is shown in Fig. 13. The signal that is being sampled is put in to pin 3 of the device, and the output is taken from pin 5. C₁ is the capacitor that stores the voltage at hold, and the value of this capacitor is best

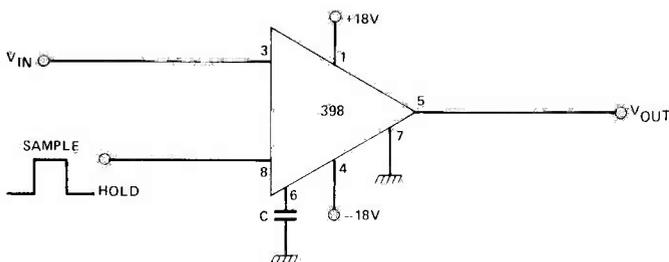


Fig. 13 A ready-made unit, the LM398.

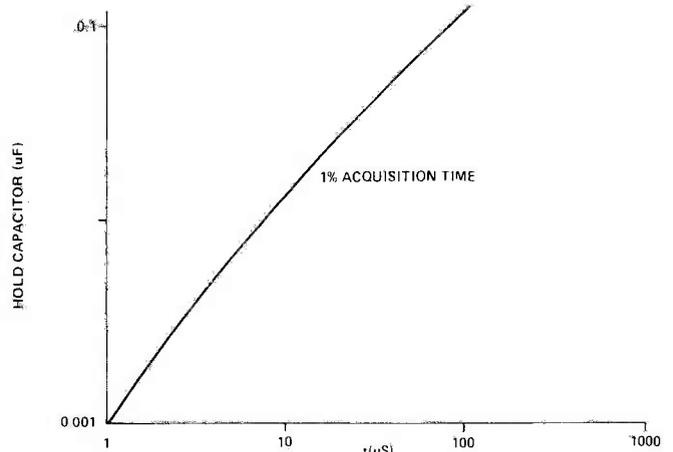


Fig. 14 Choosing the capacitor value for Fig. 13.

estimated from the graph in Fig. 14. Taking pin 8 to a logic 1, say 5 volts, will cause sampling to take place, and restoring it to a logic 0 will cause a hold state to ensue.

A capacitor of a value of 1nF will give a settling time of around $5\mu\text{s}$, indicating that after this time after sampling has started a voltage will be available at the output. Thus after this time you can hold and get an accurate result. This device has found use in analogue to digital conversion systems where it is used to hold a typical value of a rapidly varying analogue signal long enough for digitisation to occur to the desired degree of accuracy.

Uses

With regards to applications, the field of computer interfacing is the most obvious. In an analogue to digital conversion system, the circuit would sample the input and then hold it until conversion had occurred. Obviously, the device used would need to be fast enough to follow the input, but would also require a droop rate which was low enough to allow the conversion to occur before the voltage held on the capacitor had decayed substantially. In this type of application we would be using the sample and hold circuit to make it possible for a relatively slow analogue to digital converter provide values of a fast moving waveform at regular intervals. Without the sample and hold circuit, the input waveform would have changed before conversion was complete, thus giving an inaccurate reading.

Digital instrumentation is a similar field of application. Electronic synthesisers also utilise them, enabling complex electrical signals to be used to control voltage controlled amplifiers, filters and oscillators.

Slightly modified sample and hold circuits are also used in circuits known as "peak pickers". These circuits continuously sample the input signal but have as their output a value representing the highest signal that they've experienced within a given time. The output voltage shows droop, but these circuits find use in estimating rapid transients that have occurred in circuits. Figure 15 shows one peak picker, due to TI.

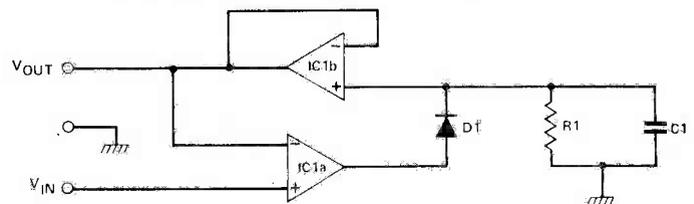


Fig. 15 A simple 'peak picker' circuit.

I hope that this article has given you some insight into the sample and hold circuit — a circuit that is finding new applications in the field of data conversion.

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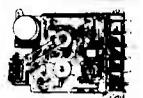
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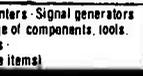
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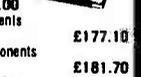
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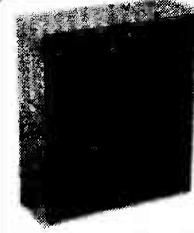


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UNIVERSAL EPROM PROGRAMMER THE SEQUEL TO THE SEQUEL

Some projects just won't lie down — and the EPROM programmer published last year was one of them!

One inevitable fact about projects published in electronics magazines is that although they are believed to be 100% functional at the time they are printed, it is obviously not possible to test them as extensively as if they were developed in a true commercial environment. This fact explains how a particular device may often be built as an ETI project for a fraction of the cost of a similar commercial product. For this reason, we very much appreciate feedback from readers about any difficulties they are experiencing with published

projects.

In particular we would like to express our gratitude to Graham Davies for the helpful comments he has made with regard to some problems he was having with the EPROM programmer. As a result of this correspondence we are now able to publish the following amendment to the assembler routine which appeared in January 84.

The 50mS programming pulse required to program EPROMs is initiated by lines 138 to 142 of the assembler routine and the code on lines 122 to 130 is relied upon to

turn it off by re-setting up the initial conditions after executing the delay loops and jumping back to LOOPP.

The problem with this method is that part of the initialisation code resets IC1PIA to zero on lines 125,126. Since this register contains some high order address bits as well as control lines and on some EPROM types this zeroing takes place before turning off the pulse there is a short time when the programming condition still exists and yet the address has been modified to a value in the range 00 to FFH. Although the duration of this condition is nowhere near the 50mS required to program a location it has been found that the cumulative effect of this happening a number of times can be to overwrite the first 255 bytes of the device.

Although this could probably be cured by changing the order of some of the instructions in lines 122-130, it was considered that a 'play it safe' approach of ensuring that the programming pulse is turned off before jumping back to LOOPP should be adopted. This is done by duplicating lines 138-142 between lines 148 and 149. The modified section of assembler program is shown below together with a new hex dump.

A different problem has been mentioned in connection with using the programmer on machines other than the Microtan. The BBC machine and some others, especially those with disc operating systems, generate

```

1C00 4C 4C 1C 00 00 00 00 00 00 00 00 00 00 3C 3C 3C
1C10 3C 3C 3C 34 34 34 18 18 18 10 10 18 12 10 12 3C
1C20 3C 3C 34 34 3C 3C 3C 08 08 08 05 25 08 22 00
1C30 22 01 01 01 01 01 08 02 08 02 06 06 06 06 05
1C40 06 05 06 01 01 01 01 01 00 01 00 01 20 96 1D AD
1C50 0B 1C C9 02 D0 03 4C BC 1C A9 30 8D 25 BC A9 00
1C60 8D 24 BC A9 34 8D 25 BC AE 0C 1C BD 0D 1C 8D 23
1C70 BC A9 00 8D 20 BC A9 3C 8D 25 BC BD 16 1C 8D 26
1C80 BC 20 AB 1D 20 71 1D D0 03 4C 22 1D 20 26 1D AD
1C90 25 BC 49 08 8D 25 BC 20 AB 1D AD 24 BC 8D 0A 1C
1CA0 A2 00 AC 0B 1C F0 10 30 07 C9 FF F0 BB 4C 22 1D
1CB0 C1 35 F0 B4 4C 22 1D 81 35 4C 68 1C A9 30 8D 25
1CC0 BC A9 FF 8D 24 BC A9 34 8D 25 BC AE 0C 1C BD 0D
1CD0 1C 8D 23 BC A9 00 8D 20 BC BD 1F 1C 8D 25 BC BD
1CE0 28 1C 8D 26 BC 20 AB 1D 20 71 1D F0 35 20 26 1D
1CF0 A2 00 A1 35 8D 24 BC AE 0C 1C BC 3A 1C B9 20 BC
1D00 5D 31 1C 99 20 BC A0 1D A2 FF CA D0 FD 88 D0 FA
1D10 AE 0C 1C BC 3A 1C B9 20 BC 5D 31 1C 99 20 BC 4C
1D20 CB 1C 20 96 1D 60 AD 05 1C 8D 22 BC BD 43 1C F0
1D30 09 AD 06 1C 8D 20 BC 4C 61 1D AD 20 BC 0D 09 1C
1D40 8D 20 BC AD 06 1C 29 10 F0 08 AD 20 BC 09 08 8D
1D50 20 BC AD 06 1C 29 08 F0 08 AD 26 BC 09 01 8D 26
1D60 BC AD 06 1C 29 20 F0 08 AD 23 BC 09 08 8D 23 BC
1D70 60 E6 35 D0 02 E6 36 EE 05 1C D0 03 EE 06 1C AD
1D80 06 1C 29 E7 8D 09 1C AD 05 1C CD 07 1C D0 06 AD
1D90 06 1C CD 08 1C 60 A6 35 A4 36 AD 03 1C 85 35 AD
1DA0 04 1C 85 36 8E 03 1C 8C 04 1C 60 A0 80 88 D0 FD
1DB0 60
    
```

Fig. 1 The modified hex dump.

UPDATE : EPROM Programmer

regular interrupts in which zero page locations may be overwritten. Since the software presented for use with the programmer uses two zero page locations, 35H and 36H, if either of these were to be accessed in an interrupt routine, then things will obviously go wrong.

The solution here is to re-write portions of the assembler routine to access the data RAM area by some addressing mode which does not require zero page locations. One possible method is to use self-modifying code, or in

other words, arrange for the reads and writes to the data RAM area to be made by absolute addressing, altering the op-codes of the instructions to access the next location each time the INCADD routine is executed.

In practice this would involve the following:

1. Remove all references to ZPLOAD, ZPHIAD and the ZPSWAP routine.
2. Change line 108 to VV: CPM VV
111 to RR: STA RR
136 to PP: LDA PP

3. Insert the following code at the start of the routine i.e. line 66.

```
LDA  LOADR
STA  VV+1
STA  RR+1
STA  PP+1
LDA  HIADR
STA  VV+22
STA  RR+22
STA  PP+22
```

4. Change the start of the INCADD routine to the following:

```
INCADD: INC  VV+1
        INC  RR+1
        INC  PP+1
        INC  RR+1
        BNE INCROM
        INC  VV+2
        INC  RR+2
        INC  PP+2
```

INCROM: (as before...)

As a final point, although this doesn't affect the operation of the program, two comments are incorrect in the assembler listing published in January 1984. The following are the correct versions of the comments:

line 44 : ;0-R, 80H-V, 1-T, 2-P
line 105 : ;MUST BE TEST - FF?

Fig. 2 The modified section of the assembler program.

138	1CF7	AEOCIC	LDX	TYPE	‡EPROM TYPE
139	1CFA	BC3A1C	LDY	PTBYTE,X	‡BYTE TO TOGGLE
140	1CFD	B920BC	LDA	ICIPIA,Y	‡LOAD IT
141	1D00	5D311C	EOR	PTBIT,X	‡TOGGLE BIT
142	1D03	9920BC	STA	ICIPIA,Y	‡PUT IT BACK AGAIN
143	1D06	A01D	LDY	E1DH	‡CARRY
144	1D08	A2FF	LDX	E0FFH	‡OUT
145	1D0A	CA	DEX		‡50 MS
146	1D0B	DOFD	BNE	DEL	‡DELAY
147	1D0D	8B	DEY		‡FOR
148	1D0E	DOFA	BNE	DEL	‡PROGRAMME
149	1D10	AEOCIC	LDX	TYPE	‡TOGGLE BIT BACK
150	1D13	BC3A1C	LDY	PTBYTE,X	‡
151	1D16	B920BC	LDA	ICIPIA,Y	‡
152	1D19	5D311C	EOR	PTBIT,X	‡
153	1D1C	9920BC	STA	ICIPIA,Y	‡
154	1D1F	4CCB1C	JMP	LOOPP	‡ROUND AGAIN
155					

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BASS FOR BEGINNERS

Looking for a way to save money on hi-fi? One way that is still open to the home constructor is to build your own loudspeakers. But what if you haven't seen a design you like? Simple, design it yourself! Barry Porter tells us how to get the bass right.

When it comes to bass loading, most loudspeakers fall into one or two categories — reflex or closed box (often referred to as 'infinite baffle' by optimists, and 'acoustic suspension' by Americans). Although these configurations have been in use for many years, the design processes involved have become clouded with an air of mystery and black magic (no, not the fattening type!) so that many DIY speaker builders believe that they cannot compete with commercial designs unless they have a 10,000 ft³ anechoic chamber at their disposal, and, B&K equipment sprouting from every cupboard.

This need not be the case, and by devoting a modest amount of brain power to the following procedures, anyone with access to a scientific calculator will be able to produce speakers of all shapes and sizes which, as far as bass response goes, will equal similar, manufactured items. Whereas it is not possible to design a complete speaker system without taking frequency response measurements, the intelligent application of manufacturers' information can often lead to a perfectly acceptable result, especially if due allowance is made for it being all your own work (which is good for at least a 6dB error to go unheard!). As this article is purely about bass loading, the whole subject of crossover networks will be left until another time, and preferably another author.

Reflex Or Closed Box?

You will probably have noticed that some loudspeakers have a hole in their front panels while others do not. One theory says that reflex speakers are produced by those who know how to work out how big the hole should be, whereas those who don't know use closed boxes. While this may have been true a few years ago, some of the most capable, present-day manufacturers base their designs on closed boxes, and some of the most awful speakers available are wrongly aligned reflex systems. So, what are the advantages of one method over the other?

In simple terms, for a given cabinet size and drive unit, reflex loading will give extended bass response with a roll-off slope that is steeper than that obtained with a closed box. Figure 1 shows superimposed low-frequency response curves for reflex and closed box loading of the same bass driver. At first sight, the reflex response appears to be the more attractive, and this would be the case if the normal listening environment were an anechoic chamber or a ten acre field — arguably not the ideal places for soft lights, sweet music and

whatever else is appropriate to the occasion.

Average sized living rooms tend to be ideally proportioned to reflect a considerable percentage of the low frequency output of a loudspeaker, which interacts in a rather haphazard way with the direct output of the bass unit. As most of this interaction is additive, the effect is to increase the perceived low frequency level, often leading to complaints about larger speakers having LF colouration when used in rooms that are too small for them. In practise, the rather unattractive response of a closed box system may well be modified by the listening room to have a very flat effective output, which is part of the reason that such diminutive speakers as the Celestion SL6 can appear to have a bass output that is out of all proportion to their size.

An important factor in low frequency reproduction is phase shift, which needs to be minimized in order to maintain a good, tight bass sound. The response plots show that a reflex speaker rolls off at 24dB per octave — twice the rate of a closed box. This higher order of attenuation is accompanied by increased phase shift and its associated transient overshoot and ringing.

A combination of these factors often means that a relatively small closed box unit will exhibit a much better

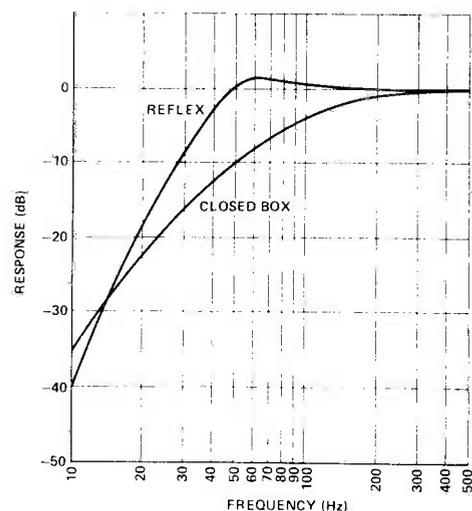


Fig. 1 Comparison of reflex and closed box responses for similar sized speakers.

bass sound than a much larger reflex design. Of course, this does not mean that reflex speakers should be condemned out of hand, as many superb examples do exist, but those that have proved successful under normal, domestic conditions, have usually been of moderate size — the Spendor BC1 being a classic specimen.

So, it really is a case of "suck it and see", but as a 'do-it-yourselfer', you have the advantage that you can tailor your speakers to meet your individual requirements, even to the point of introducing a reflex vent to a closed box, or of filling one in, with no infringement of anyone's guarantee. As a guide, the best sized units for a typical 1500-2000 ft³ living room appear to be based on a 200 mm bass driver in a 20-40 litre closed box. Larger rooms or a liking for music with plenty of bass content is when 300 mm drivers in 100 litre reflex cabinets come into their own.

There are several directions from which speaker design can be approached. A manufacturer can decide upon a cabinet size then design a bass unit to meet the system requirements. This is obviously out for the home constructor unless he has taken up unit construction so the design process has been based on the drive unit parameters being fixed while the enclosure dimensions are variable.

Choosing A Drive Unit

Having decided upon a bass driver size, the main factors governing the actual units to use are likely to be:

- 1 price;
- 2 availability;
- 3 continuity of supply (in case you damage a unit in 1987);
- 4 availability of technical information;
- 5 electrical & mechanical parameters, cone material, etc;
- 6 manufacturer's reputation;
- 7 maximum power handling;
- 8 appearance;
- 9 performance of available systems using the unit.

Most of these points are self-explanatory, and most drive units supplied by reputable manufacturers should be worthy of consideration. Whether you settle on a particular unit or decide to produce theoretical designs for a number of contenders, the following parameters must be obtained from the manufacturer:

- f_s : Free air resonance of driver (Hz)
- Q_{TS} : Total Q of driver at f_s
- V_{AS} : Suspension compliance of driver (litres)

With this information at hand, you can claim your rightful ownership of the ZX81 (remind your offspring who paid for it) and design either a reflex or closed box enclosure, calculating the frequency response to an accuracy of about 1dB, by following the simple procedures detailed here. In order to help you check your calculations, examples based on a typical 200 mm bass unit will be given at each stage. This unit will be assumed to have the following specification:

- f_s = 27 Hz
- Q_{TS} = 0.37
- V_{AS} = 90 litres

Reflex Design

Each drive unit has an optimum reflex cabinet internal volume given by:

$$V_B = 20 V_{AS} Q_{TS}^3 = 67.66 \text{ litres.}$$

Just to make life more interesting, we will assume that threat of the introduction of speakers of this size into

your love nest leads to the instant purchase of a one-way ticket back to mother, to you compromise on something smaller — say 40 litres. This will have a -3dB point of:

$$f_3 = f_s \left(\frac{V_{AS}}{V_B} \right)^{0.44} = 38.6 \text{ Hz.}$$

which will be obtained by tuning the box to:

$$f_5 \left(\frac{V_{AS}}{V_B} \right)^{0.31} = 34.7 \text{ Hz.}$$

It is now possible to plot the frequency response of this unit-box combination. First of all, calculate the following parameters:

$$A = \left(\frac{f_B}{f_s} \right)^2 = 1.6517$$

$$B = \frac{A}{Q_{TS}} + \frac{f_B}{7f_s} = 4.6477$$

$$C = 1 + A + \frac{V_{AS}}{V_B} + \frac{f_B}{7f_s Q_{TS}} = 5.3979$$

$$D = \frac{1}{Q_{TS}} + \frac{f_B}{7f_s} = 2.8863$$

For each frequency of interest, define "normalised" frequency, f_N as $\frac{f}{f_s}$ (in our example at 20 Hz $f_N = 0.7407$ and at 50 Hz $f_N = 1.8519$). The relative response may now be calculated from:

$$R(\text{dB}) = 20 \log \left(\frac{f_N^4}{\sqrt{(f_N^4 - C f_N^2 + A)^2 + f_N^2 (D f_N^2 - B)^2}} \right)$$

Our example gives the following response:

Hz	dB	Hz	dB
20	-18.33	60	+1.15
25	-12.25	70	+1.13
30	-7.68	100	+0.70
40	-1.81	200	+0.19
50	+0.60	300	+0.09

With a programmable calculator or home computer, the above steps may be repeated for different combinations of drive unit and cabinet volume until one is found that has the required response.

Having settled on a final design, the vent size required to tune the cabinet to f_B may be worked out. In case you haven't yet discovered it, plastic rainwater, or 'down' pipe is an ideal material for making tuning vents, as it is available in several sizes, and is easily cut and glued into place. It should be obtainable from your friendly local hardware store, but don't arrive on your bicycle and expect to buy a foot of it, as it is normally sold in 6 or 8 foot lengths. (A colleague discovered this, and the accident that ensued when the string holding a length to his crossbar decided to part company with itself was a fair imitation of the morning after at Pearl Harbour.) Tubing with an internal diameter of 75mm is usually the most useful.

For a given internal diameter ($D_V = 75$ mm) the length (L_V) is given by:

$$L_V = \frac{2340}{f_B^2 V_B} \cdot D_V^2 - 0.731 D_V = 218.5 \text{ mm}$$

FEATURE : Bass for Beginners

This is a realistic length, but if the result calls for a vent that is less than 50 mm or longer than, say, 250 mm, it will be necessary to change the tube diameter to obtain a more convenient length. For example, if D_V had been 100 mm, L_V would be 412.7 mm, which could just cause embarrassment at the cabinet back panel.

This is not the place to go into the details of cabinet construction, but as a general rule, choose three dimensions that differ by at least 20%, keep the width as narrow as possible to minimise diffraction problems and mount the drive units in line vertically and as close together as is reasonably possible. Our 40 litre example could have internal dimensions of: 250 mm wide, 550 mm high and 320 mm deep, giving a total volume of 44 litres. This will be reduced to approximately 40 litres by the internal filling, bracing pieces, etc.

Closed Box Design

For any bass unit, the closed box volume primarily controls the Q of the system, one of 0.707 giving the flattest response without a peak prior to the low frequency roll-off. Some designers tend to aim for a system Q (Q_{TC}) of about 0.5, as this gives improved transient response and a better phase characteristic. For our example, a Q_{TC} of 0.55 will be the objective.

The total enclosure volume is given by:

$$V_B = \frac{V_{AS}}{\left(\left(\frac{1}{Q_{TC}} - 0.2 \right) \cdot \frac{1}{Q_{TS}} \right) - 1} = 50.3 \text{ litres}$$

We now hit a slight problem. The resonant frequency (f_s) of the drive unit is considerably altered by the existence of a cabinet, so until you have built a unit and carried out some measurements, it is not possible to predict its performance. Luckily, speaker design is not a particularly precise art, so a certain amount of guesswork is likely to pass unnoticed. As a starting point, assume that a cabinet giving a Q_{TC} of 0.5 to 0.7 will double the free air resonance (f_s) of your drive unit ($f_{SB} = 2f_s$). The unit used as an example had an f_{SB} of 48 Hz in a 46 litre enclosure, which is close enough to the assumed 54 Hz for the purpose.

Using this approximation, it is possible to calculate a provisional response curve which will have sufficient accuracy to indicate whether or not the unit-box combination meets your requirements. Once the cabinets are built, it is possible to measure f_{SB} and Q_{TC} , which will enable more accurate results to be plotted.

The necessary test set-up is shown in Fig. 2. The drive unit impedance is calculated from:

$$Z = \frac{R}{\left(\frac{V_{IN}}{V_L} \right) - 1}$$

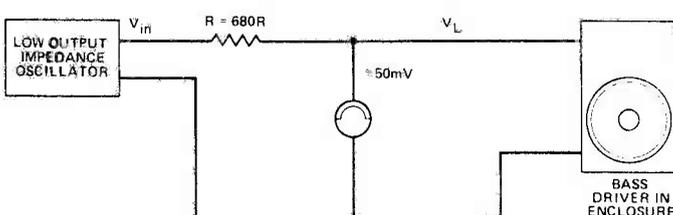


Fig. 2 Test set up for f_{SB} and Q_{TC} measurements.

and should be plotted over a range of frequencies to produce a curve similar to the one shown in Fig. 3, which was obtained from the driver being used as an example mounted in a 40 litre enclosure. One point to note is that the surround material of many units is very temperature sensitive, so make sure that your unit is at 20 degrees centigrade or slightly above before making any measurements. The resonant frequency may be read directly from the graph, or more accurately calculated as:

$$f_{SB} = \sqrt{f_1 f_2} = 47.6 \text{ Hz}$$

(f_1 and f_2 are shown in Fig. 3). The system Q is given by:

$$Q_{TC} = \sqrt{\frac{R_{DC}}{R_{MAX}} \cdot \frac{f_{SB}}{f_2 - f_1}} = 0.505$$

which is quite close to the original calculated value, but was probably influenced by the measurements being made at 25 degrees centigrade.

It is now possible to estimate the -3dB frequency from:

$$f_3 = f_{SB} \left(\frac{1}{\frac{1}{Q_{TC}} - 0.2} \right) \cdot \frac{1}{Q_{TS}} \sqrt{\frac{K + \sqrt{K^2 + 4}}{2}} = 110.7 \text{ Hz.}$$

$$\text{where } K = \frac{1}{Q_{TC}^2} - 2 = 1.9212$$

Now for the frequency response plot, calculated by:

$$R = 10 \log \left(\frac{f_N^4}{f_N^4 + K f_N^2 + 1} \right)$$

where f_N is defined as:

(see over page)

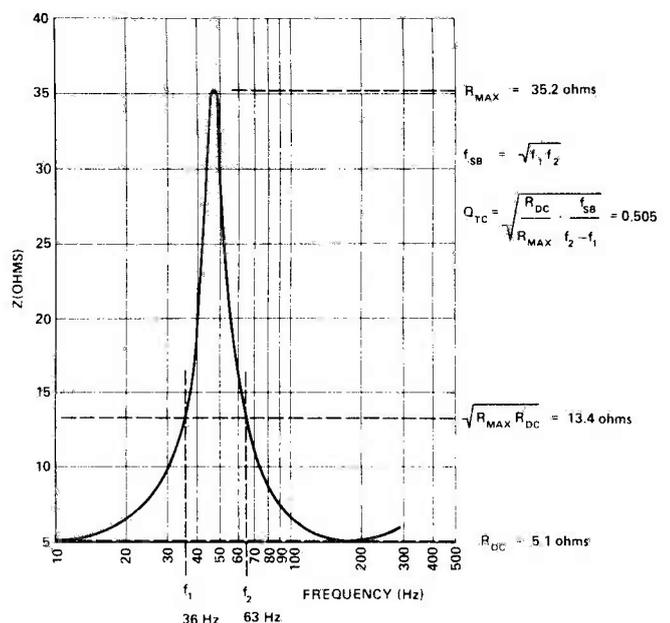


Fig. 3 Impedance curve used to measure f_{SB} and Q_{TC} .

SUPER-SELECTIVE MUSIC FILTER

Paul Wollover explains how it is possible to electronically preselect what you listen to on the radio.

Most people have distinct preferences as to what sort of music they wish to listen to and probably more so about what they wish to avoid. With this in mind the designer of this project has set out to assist us to be much more selective about our auditory intake with little or no extra effort. In this first part we shall cover the principles of operation and their application to the task in hand.

The main task of this unit is to detect, by some means, when the input signal contains a certain class of sound, in this case a certain type of music. If and when this is found and verified, the module must then take appropriate action, ie, switch over to the alternate source if the input is not desirable

or switch from the alternate source to the main channel if it is desired. How quickly this should happen is a matter for personal choice but the timing inherent in this design should be suited to most needs.

The circuit as shown in the block diagram Fig. 1 illustrates the dual detection units available and how they interact to get the desired results. The first detection path examines the input signal for multiple glissandos which occur at regular intervals in certain types of 'popular' music. The circuit basically examines the input and triggers when an instrument slides from note to note over an extended period. When triggered, this initiates two gated timed pulse generators and some logic to switch the audio pathways. At the

same time this signal also starts a starts a time out circuit which eventually activates the permanent muting trigger control solenoid.

The second detection path examines the input signal for repeated sequences of sub-phrases in which minimal information changes occur. This is performed by a phase-locked loop, to extract the duo-decimal frame reference, and a synchronised digital pitch extractor. The resulting data is stored in a small memory and is compared is obtained, indicating the minimal information syndrome of this type of programme material, then the following coincidence timer will activate the programme switch via the mode switch and gate.

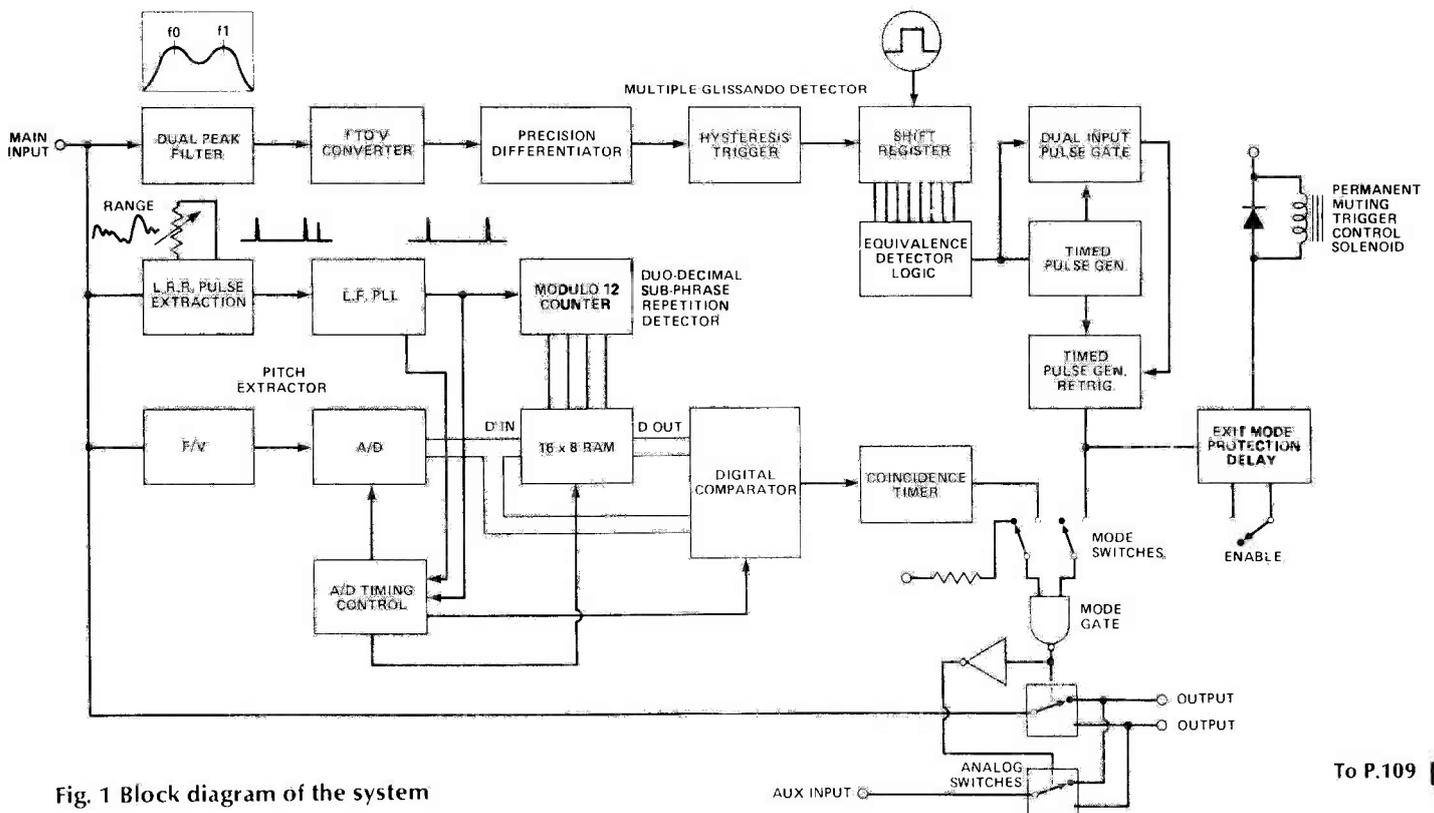
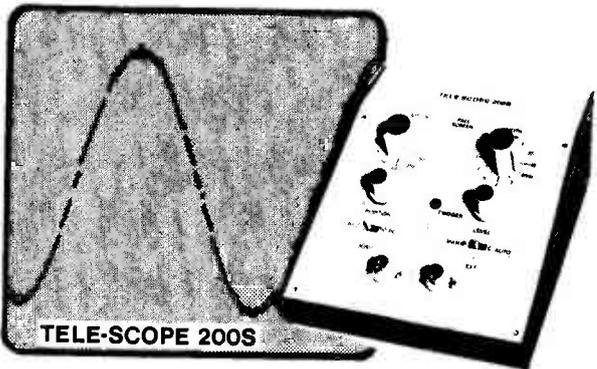


Fig. 1 Block diagram of the system



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ADDING COLOUR TO THE ACE

Black and white is boring, so add a little colour (or a lot, if you want) to your computer's life with this project from John Wike. Additional material by Phil Walker.

The two facilities that really enhance the output of a microcomputer are sound and colour. The Jupiter Ace already has sound of sorts and this project provides a means of adding colour to its monochrome display. Eight colours including white and black are available, any of

which may be selected as foreground (ink) or background (paper). The circuit is active from switch-on and requires no special software for monochrome operation. Thus programs may be listed, edited and run without the need to keep swapping over aerial leads or operating systems. The board uses the smaller edge connector and contains a RAM (addressed in parallel with the Ace video RAM) to hold the colour information for each of the 768 locations on the screen.

paper. The attribute number is obtained by adding the ink value to the paper value and adding 128 (80h).

Colour	Ink	Paper
Black	0	0
Blue	1	16 (10h)
Red	2	32 (20h)
Purple	3	48 (30h)
Green	4	64 (40h)
Cyan	5	80 (50h)
Yellow	6	96 (60h)
White	7	112 (70h)

EDITORIAL COMMENT

It may seem a little strange to publish a project for the Jupiter Ace several months after the manufacturer has gone into liquidation. However, there will be a number of readers around who have Aces, and, moreover, we think that there is a lot to be learned from the techniques and systems described here. We think you will agree with us once you've read this article.

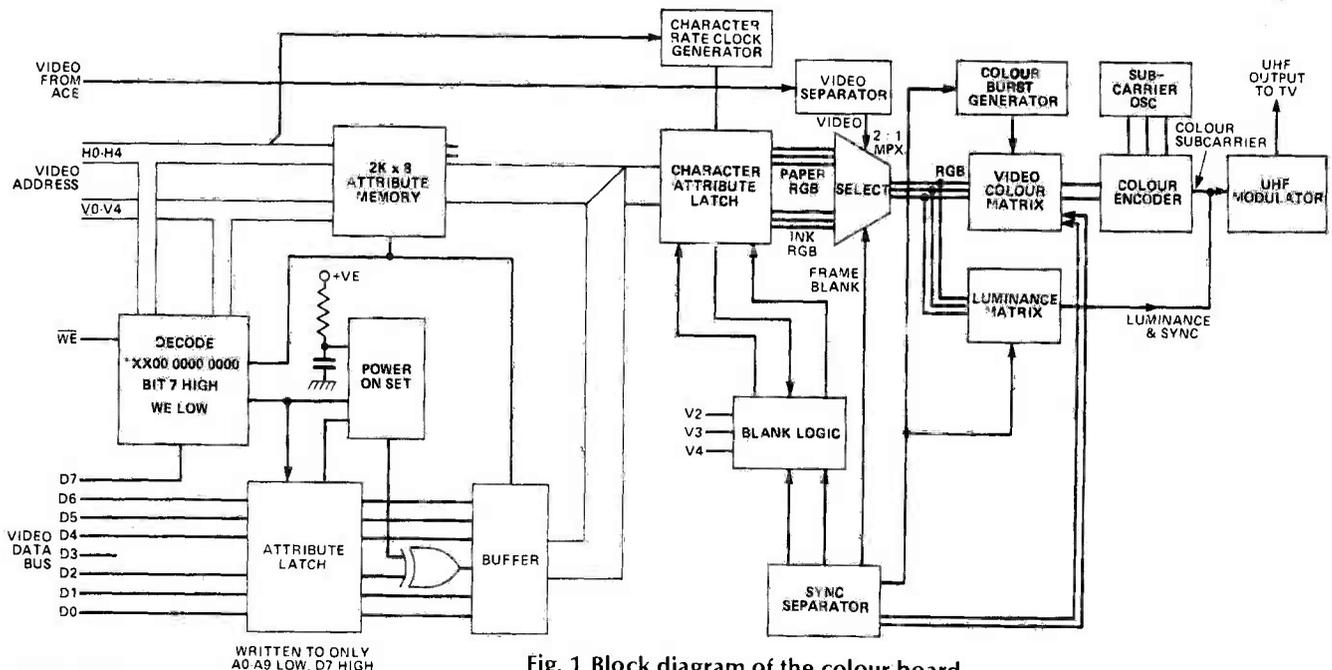
Attributes

Each character written on the screen will have associated with it the current attribute describing its ink and paper colours. To print anything with different colours the current attribute must first be updated. This is easy to implement and software for doing so is given later. The default colours at switch-on are green ink and black

About The Ace

The Jupiter Ace video display consists of 24 rows of 32 characters, each of which is selected by storing the required code at the appropriate location in the video RAM. There are 128 character shapes (plus their inverses) available and these are re-definable by the user.

At the rear of the computer



WRITTEN TO ONLY A0-A9 LOW, D7 HIGH

Fig. 1 Block diagram of the colour board.

Painting In Colours

To produce on a suitable TV set while still being able to get a good black and white picture from the same input signal, the broadcast authorities have adopted the PAL system for use in the UK. This system operates by retaining a simple amplitude modulated brightness (or luminance) signal which can be used by both colour and monochrome receivers. The colour information is added on to this in a rather complex manner such that it produces a minimum amount of interaction on the screen.

As far as our eyes are concerned, the colour information can be represented by the sum of three 'primary' colours — red, green and blue — in various mixtures. The total brightness effect of the combination is the luminance signal and this is transmitted as such.

The colour information is coded differently. The luminance signal is the weighted sum of all the colour signals and the colour information can be sent in two further difference signals obtained by subtracting the luminance signal from the red and the blue

colour signals. In order to combine these signals with the luminance signal, they are modulated onto sub-carrier signals. The frequency of the two sub-carriers is the same and has a carefully chosen relationship to the line frequency. The difference between the sub-carriers is that they are 90° out of phase with each other. This phase difference is +90° on one line and -90° on the next to reduce the visible effects of phase distortion during transmission. These modulated sub-carriers are then combined with the luminance signal to form the composite video signal. This, together with a separate frequency-modulated sound sub-carrier, is then used to modulate the UHF transmitter.

This, then, is what the colour board project is doing (with the exception of the sound part). Incidentally, there are a few other such as synchronising and blanking signals which have not been mentioned but are necessary and are provided by the circuitry on the PCB.

A Typical Video System

For those of our readers not yet thoroughly steeped in the inner

workings of micros from the hardware side, we present a short description of a typical black and white TV style video display.

As far as we can tell from a surreptitious peek inside the case of a Jupiter Ace borrowed for the occasion, there is nothing unusual about the video system used. Fig. 3 shows in block diagram form the main components of such a system.

The first major part to consider is the 1K of RAM which stores one 8-bit byte for each character location on the screen. This memory can be written into and read by the processor. By this means information can be updated as necessary.

The next part to consider is the video address generator. This normally consists of a crystal controlled clock oscillator driving a counter chain. The frequency of the oscillator and the division ratio of the counter chain are matched together such that they also provide information at the correct time for line and frame synchronising pulses and for the blanking signals necessary to prevent us seeing the line and frame fly-back traces.

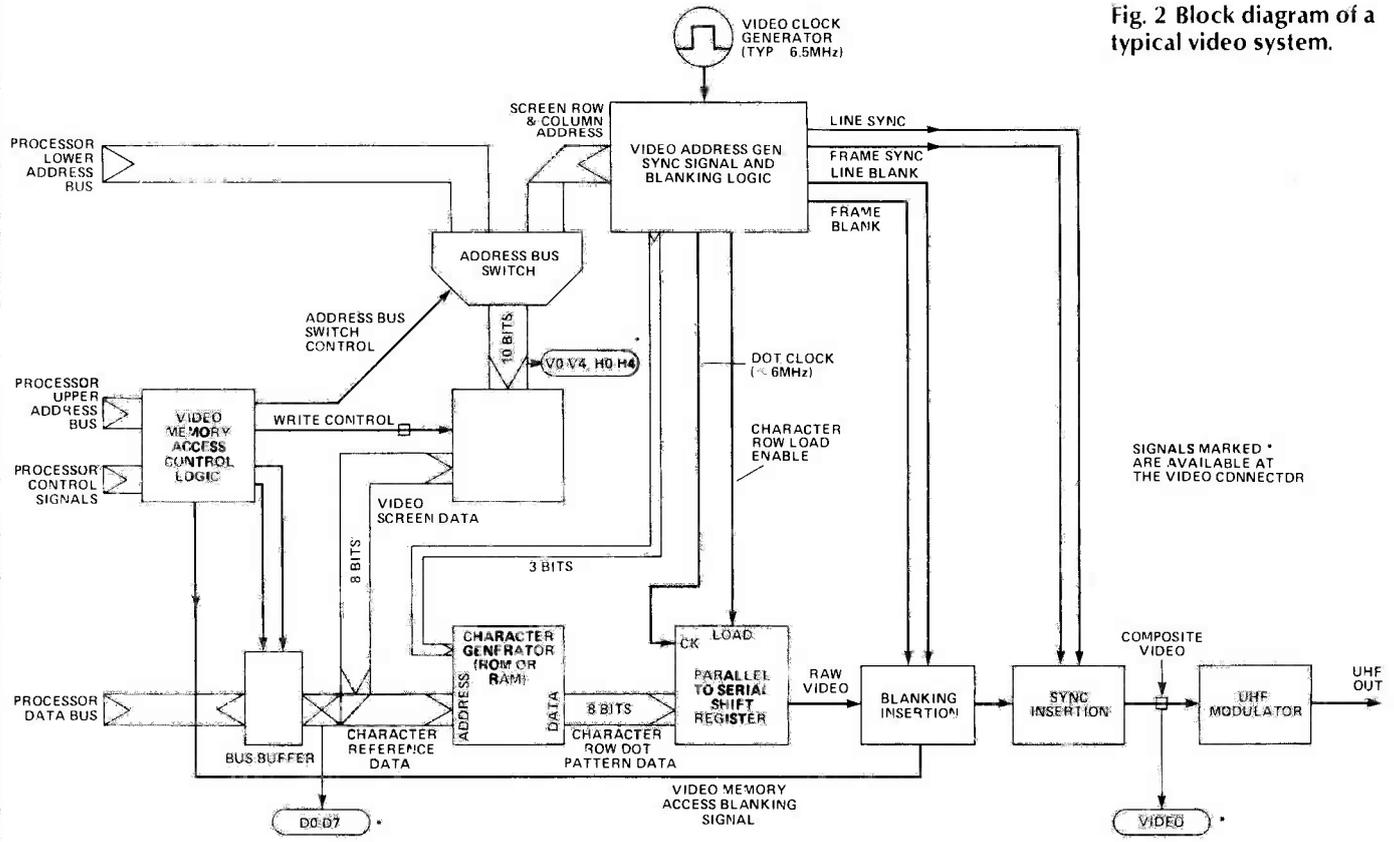


Fig. 2 Block diagram of a typical video system.

For operation in the UK and several European countries, the line period is $64\mu\text{s}$ (15.625 kHz) while the frame period is 20ms (50 Hz). The line blanking period is nominally $12\mu\text{s}$ while the frame blanking lasts about 4ms.

The video address generator in the Ace provides 5 address lines in the horizontal direction and 5 more for the vertical direction. This gives a possible 32×32 screen of which only 32×24 are actually used. In addition to these 10 address lines there are three more (sometimes four in other machines) which go directly to the character generator — of which more later.

When the video system is displaying the data in the video RAM at any time the address generator supplies 10 address bits to the RAM which then supplies its eight data bits on its output pins. These are taken to the character generator device. The character generator can be either ROM or RAM and in the case of the Ace it is RAM.

In the Ace, seven of the data bits from the video RAM are used as address bits for the character generator and point to a group of eight locations in it. These locations store the dot pattern for each horizontal line of the character specified by the seven bits from the video RAM. The actual line to be displayed is selected by the three extra address lines coming from the video address generator.

The dot pattern for the line of the character to be displayed passes from the output of the character generator to a parallel input shift register. At a suitable time the data is loaded into this device and then shifted out one bit at a time to give the raw video signal. In the Ace there is an extra bit available from the video RAM which is used to invert the polarity of the raw video when it is set.

The raw video signal from the shift register is combined with the blanking signals and then the sync signals to form the composite video signal which drives the UHF modulator.

If, as in the Ace, the character generator is not a ROM, then there must be a way for the processor to load it with the correct dot patterns when the machine is first switched on. Note that this is not shown on the block diagram.

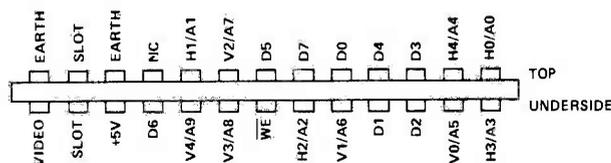


Fig. 3 Edge connector details that aren't in the manual!

there are two edge connectors, the larger of which is documented in the manual and brings out the processor busses for memory and peripheral expansion. The smaller connector is not documented, but it is intended for expansion of the video circuits and carries the video RAM address, data and WE lines as well as the composite video signal from the input to the UHF modulator.

The 1K video RAM appears twice in the Ace memory map, at 2000h-23FFh and at 2400h-27FFh. When addressed in the lower range the processor has priority over the video circuits and accesses can occur during the display period. In the higher range the video circuits have priority and processor accesses are confined to the blanking periods. The latter is the preferred situation so only the range 2400h-27FFh will be considered here.

Of this space the 768 bytes at 2400h-26FFh hold the screen data and the 255 bytes at 2701h-27FFh are used as a scratchpad by the system. According to the ACE manual, the one remaining byte at 2700h should always be zero, but this is in fact used only by the input command interpreter to mark the end of the input buffer on the screen. Therefore when a program is running, the byte can be any value provided it returns to zero before the next operation of the command interpreter. Thus the current colour attribute is held in a latch at 2700h. As a zero written to this address must not affect the contents of the latch, the most significant data bit D7 is set to 1 (by adding 128) to indicate that an attribute is to be stored.

The Circuit

The circuit consists of a six-bit current attribute latch, a 1K by 6 screen attributable RAM, a blanking section, ink/paper selector, colour encoder and UHF modulator. Both the latch and RAM are write only so it will be necessary to maintain separate variables or arrays to keep a check on their contents. In most situations, however, the value required in a particular RAM location can be derived from either its address or

the contents of the video RAM at that location.

As there is no blanking signal from the edge connector, it must be re-constituted from the RAM address counters. This can be done provided processor accesses are confined to the blanking periods by using addresses 2400h-27FFh as described earlier.

The selection of ink or paper is determined by the Ace video signal. Areas of the display that are normally white are taken to be ink and black areas to be paper.

The colour encoder is based on a National Semiconductor LM1889 colour modulator chip. Although designed to work at the American colour subcarrier frequency of 3.58MHz, it will work at the UK's 4.4336MHz with suitable changes of component values. This IC requires a supply voltage of 10 to 15 volts, for which the author used a spare computer power pack which actually came with a Sinclair printer. Obviously any alternative voltage source could be used. The 5 volt supply for the UHF modulator was derived from the 12 volt line to avoid problems with noise on the logic supply.

Construction

Construction of this project is straightforward but we recommend that you do it in the following order using a fine tipped soldering iron.

Firstly, since this is a double sided PCB and is not plated through, some links must be inserted and soldered on **both** sides of the board; note especially the ten underneath IC8. Also, some component leads must be soldered on both sides.

Next fit the recommended IC sockets for IC8 and IC4. Now fit the other ICs and remember to solder the leads on the top, bottom or both sides of the board as necessary. Check this part carefully as mistakes here will be very difficult to locate. Make very sure you put ICs in the right way round as well.

Now fit the resistors, capacitors, variable resistors, variable capacitor, diodes, transistors, crystal, edge connector and UHF modulator in this order. Don't forget

The address inputs of RAM IC8, the colour attribute store, are connected to the address inputs of the Ace video RAM, H0 to H4 and V0 to V4. These lines normally carry the display horizontal and vertical character position counters, but during a processor access to the video RAM (2400h — 27Ffh) they are equal to the processor address lines A0 to A9.

If the access is a write operation then the decoded write enable signal WE will go low and data from latch IC4 (via tri-state buffer IC1) will be written into IC8. The WE signal is further decoded by gates IC2 and IC3 so that data written to address 2700h will be latched in IC4 if the most significant bit D7 is high. At switch-on, IC4 is cleared by R3/C5, but as this would give a colour attribute of black on black, gate IC6a (controlled by latch IC5b) inverts the green ink signal to give the default condition of green on black. Latch IC5b will be cleared when IC4 is written to, and the green ink signal will then be passed normally by IC6a.

During the display period, gates IC6b

and c in conjunction with output Q2 of latch IC11 produce a short clock pulse for IC11 every time address line H0 changes. As the RAM outputs change very quickly, timings here are critical so H0 is buffered by IC1b and H1 is delayed slightly by C2.

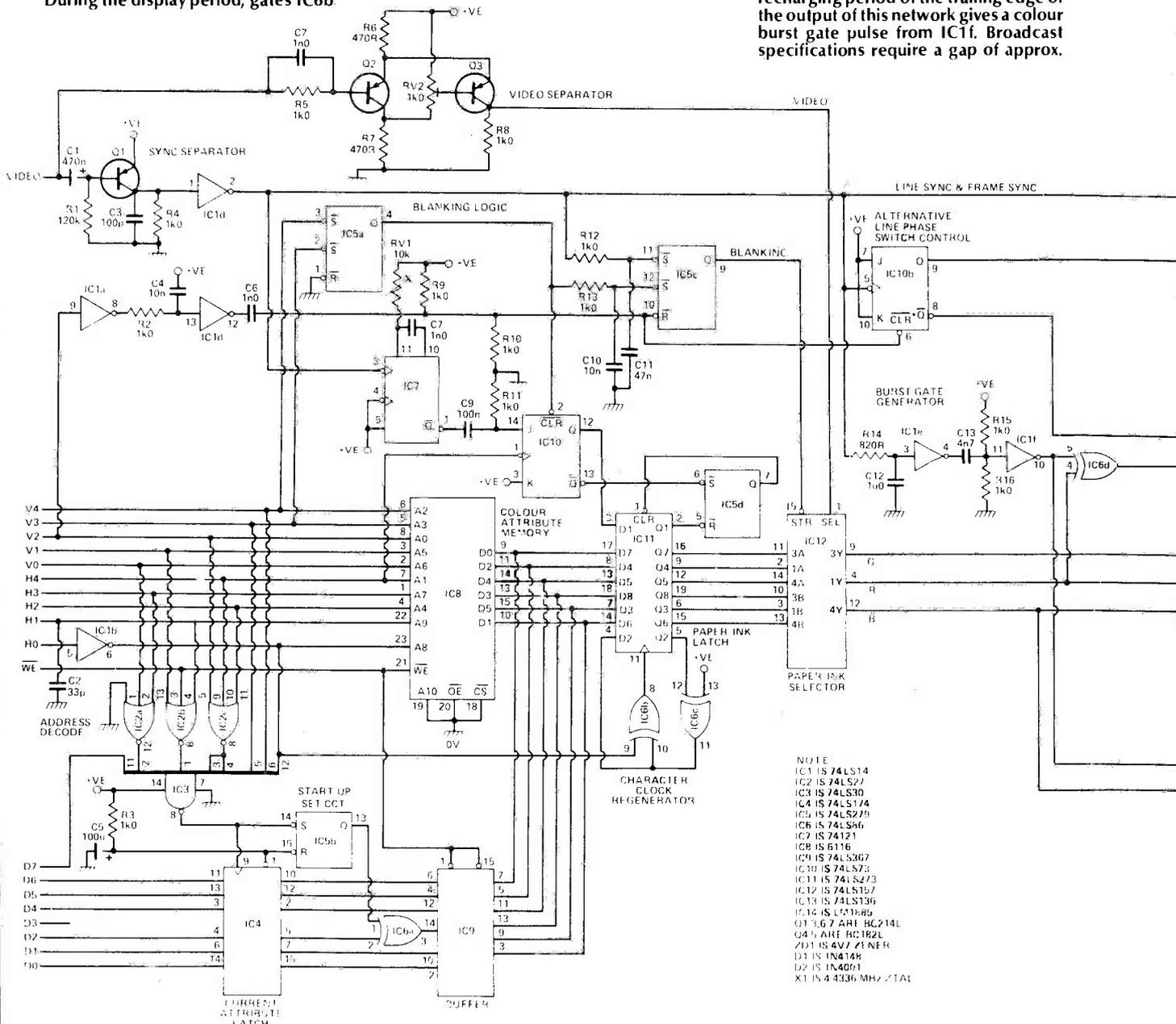
The outputs of IC11 consist of three ink bits and three paper bits for the character currently being displayed by the Ace character generator. Selection of ink or paper bits in data selector IC12 is controlled by Schmidt trigger Q2/3 from the Ace composite video signal. White areas select ink colours and black areas select paper colours. The outputs of IC12 are the red, green and blue video signals.

The most significant horizontal address line H4 clocks bistable IC10a on and off to provide line blanking. To ensure that any processor accesses of the video RAM during the blanking period do not lead to incorrect trigger-

ing of IC10a, monostable IC7 and differentiator R11/C9 give a short window for triggering to occur. Latch IC5d and output Q1 of IC11 serve to delay the blanking signal for the same period that the data from the RAM is delayed.

Sync separator Q1/IC1d provides the line sync for the board from the Ace composite video signal. The sync is integrated by R12/C11 to give a field sync input to set latch IC5c, the field blanking generator. The latch is reset by a short pulse produced by differentiator C9/R9/R10 at the end of one cycle of address line V2. This allows the field display period, which ends when address lines V3 and V4 (combined in IC5a wired as a NAND gate) are both high and sets IC5c again. Integrating networks R13/C10 and R2/C4 prevent their respective signals responding to changes caused by processor accesses, as these last only about 1µs.

The line sync pulse is applied via R1d to differentiator C13/R15/R16. The recharging period of the trailing edge of the output of this network gives a colour burst gate pulse from IC1f. Broadcast specifications require a gap of approx.



- NOTE
- IC1 IS 74LS14
 - IC2 IS 74LS27
 - IC3 IS 74LS30
 - IC4 IS 74LS174
 - IC5 IS 74LS279
 - IC6 IS 74LS96
 - IC7 IS 74121
 - IC8 IS 6116
 - IC9 IS 74LS367
 - IC10 IS 74LS73
 - IC11 IS 74LS273
 - IC12 IS 74LS157
 - IC13 IS 74LS136
 - IC14 IS LS7189
 - Q1, 6, 7 ARE BC1214L
 - Q4, 5 ARE BC182L
 - ZD1 IS 4V7 ZENER
 - D1 IS 1N4148
 - D2 IS 1N4001
 - X1 IS 4.4336 MHz XTAL

the flying leads for the 12 volt supply.

Lastly, insert IC8 and IC14 in their sockets and all should be ready.

At this stage, **check again** carefully for shorted tracks, etc, before setting up.

If you do not get a polarising key with your piece of edge connector, either bend the contacts at the slot position in towards each other or alternatively, break the pins off very close to the rear of the connector at the correct position and pull the contact part out of the front.

Cut a small piece of PCB material or similar board and having made sure that it fits the slot in the Ace connector, glue it, preferably with a fast-acting cyanoacrylate adhesive, into the front of the edge connector. This will allow positive location of the connector into the Ace.

Setting Up

After checking the board (again!) very carefully for shorted tracks, etc plug it into the Ace, connect it to a 12 volt supply (that is switched off!), connect the TV aerial to the board and switch on all supplies. Tune in the television and a blank flickering raster should be present.

Now proceed as follows: Turn RV1 fully clockwise. Adjust RV3 so that the blank raster is locked. Adjust RV2 until the whole display area brights up and set it at the mid point of its bright-up range. It may be necessary to adjust RV3 to keep the display steady. The central area of the screen should now be green. If not try re-tuning the TV. Adjust RV1 until the cursor is visible at the bottom left. Enter VLIST and adjust RV1 to give the boldest lettering with no streaking. Any colour dot crawl can be tuned out with CV1. Produce colour bars by entering and running the following:

```
16 base c!
: colourbars
2700 2400
do
  i 4 / 8 mod
  10 * 80 or
  2700 c! 20 i c!
loop
87 2700 c!
0 2700 c!
```

Adjust RV3 to give the best range of colours.

PARTS LIST

RESISTORS (all 1/4W 5% unless stated)

R1	120k
R2-5, 8-13, 15-21	
23, 27, 32-34	1k0 (22 off)
R6, 7	470
R14	820
R22, 24	10k
R25	2k7
R26	1k2
R28	3k9
R29	6k8
R30, 36	15k
R31	33k
R35	3k3
R37, 38	2k2
R39	1k8
R40	3k6
R41	220, 1/2W
RV1	10k 10-turn preset
RV2, 3	1k0 preset

CAPACITORS

C1, 22, 25	470n 35V tant
C2, 16	33p
C3	100p
C4, 10, 15, 17, 23, 24	10n
C5	100µ 6V3 electrolytic
C6, 7, 12	1n0
C8, 11, 14	47n
C9, 18, 21	100n
C13	4n7
C19	100µ 25V electrolytic

C20	220n
CV1	5-65p

SEMICONDUCTORS

IC1	74LS14
IC2	74LS27
IC3	74LS30
IC4	74LS174
IC5	74LS279
IC6	74LS86
IC7	74121
IC8	6116
IC9	74LS367
IC10	74LS73
IC11	74LS273
IC12	74LS157
IC13	74LS136
IC14	LM1889
Q1-3, 6, 7	BC214L
Q4, 5	BC182L
ZD1	4V7 zener, 500 mW
D1	1N4148
D2	1N4001

MISCELLANEOUS

X1	4.4336 MHz crystal
UM1233	UHF modulator; 13-way 0.1" double-sided edge connector; 24-pin DIL socket; 18-pin DIL socket; PCB; pins for link-throughs (if preferred); wire, etc

Software

In order to use the colour facilities within FORTH programs, it is necessary to define the following words:

```
decimal 16 base c!
2700 constant attriblatch
0 constant black
1 constant blue
2 constant red
3 constant purple
4 constant green
5 constant cyan
6 constant yellow
7 constant white
87 variable attrib
: combine
  attrib c@ and or dup
  attrib c! attriblatch c!
  0 attriblatch c!
```

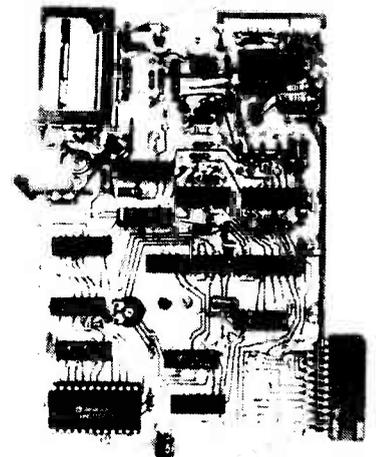
```
: ink
  £0 combine
```

```
: paper
  10 * 87 combine
```

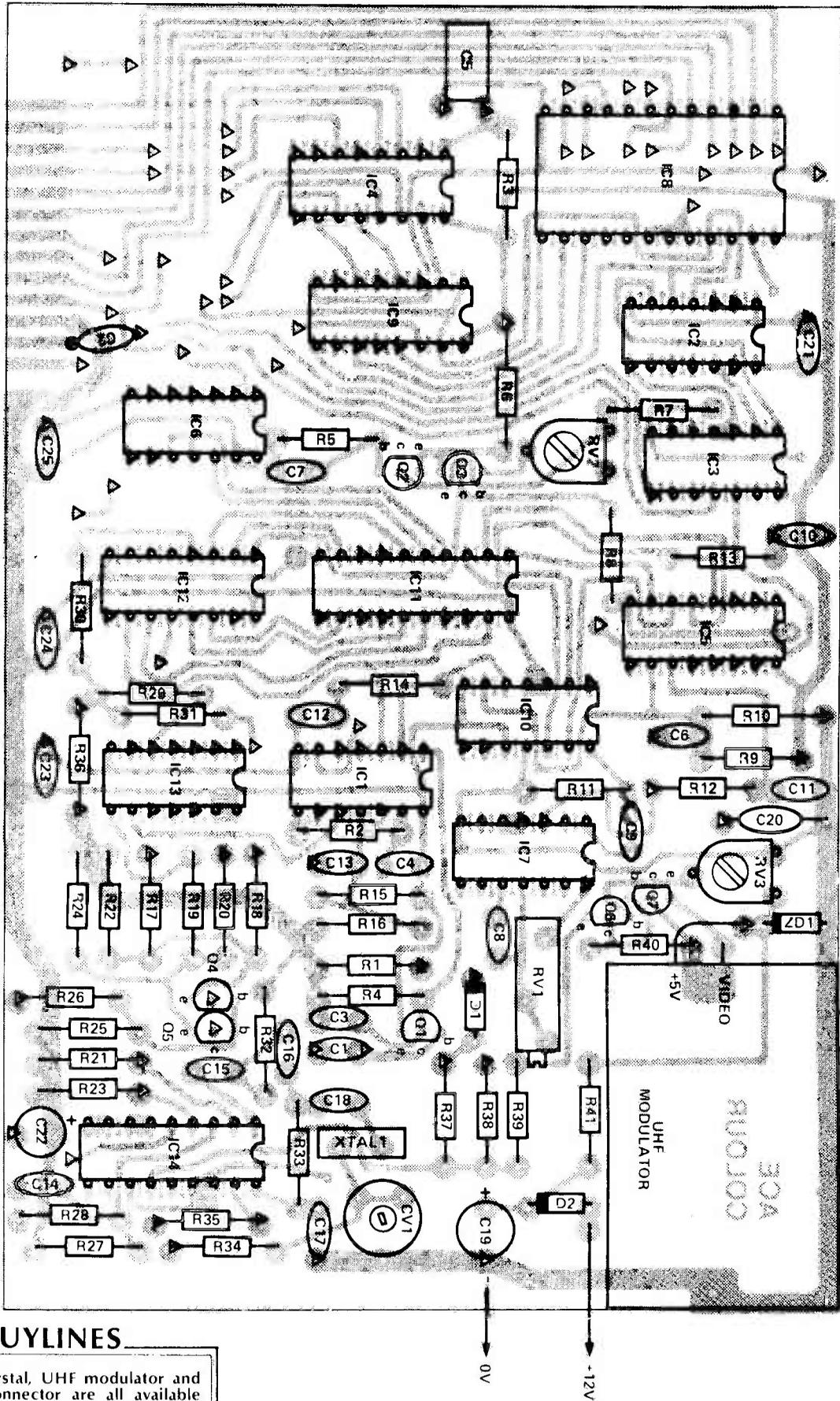
By way of explanation, INK and PAPER both expect a colour number on the stack. They pass this and a mask value to COMBINE which masks out the old colour and adds the new one. This is stored in the variable ATTRIB and also in the latch. Zero is then written to the latch for the reasons given earlier.

These words can now be used directly by entering for example white paper blue ink, or they can be liberally sprinkled at the required points in applications programs.

If when you first turn on the screen is full of random colour blocks, do a CLS. This will write the current attribute (green on black) over the whole screen. Beware when you cause or allow a scroll operation to take place as this will also cause the current attribute to be written over the whole screen, wiping out all the pretty colours and giving a uniform foreground and background.



PROJECT : Adding Colour



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B.32510 7.5mm PCM 10% tolerance 100V min. In 7 values from 0.0047 to 0.47µF
B.32512 15mm PCM 10% tolerance 100V 1µF, 2.2µF
B.32560 7.5mm PCM 26 types 10% tolerance 400V 0.001 to 0.0068µF
5% tolerance from 0.0082 to 0.68µF in 400, 250 & 100V

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TEXAS INSTRUMENTS

MACHINE CODE PROGRAMMING

So you've bought this wonderful, marvelous heap of computer electronics: now how do you talk to it? I/O, I/O, it's off to work Bob Bennett goes . . . (The staff of the magazine wish to dissociate themselves from that pun.)

Every computer, no matter what its pedigree, is just a handful of electronic components connected together. This constitutes the world of that particular computer and anything else belongs to the outside world. And every computer, to justify its existence, has to be able to communicate with the outside world — how else would you get information to a screen, or some other display, or to a printer, or from a keyboard?, not to mention the program going out to, or coming in from your tape recorder.

Although the method of this two-way communication may differ according to which CPU the computer has, the principle is essentially the same for every computer. An I/O port is just another name for an I/O address, and the principle is to use a register as an intermediary between the computer and the peripheral via an address. In some computer systems the method is to reserve a few addresses for I/O ports and, by using load or move instructions, transfer either the contents of the register to the port or vice versa.

In both cases the contents of the register is known as a data byte, and the above method is usually called memory-mapped I/O.

Because the Z80 set has quite a number of I/O instructions, and because the method used is slightly different, I will give examples from the Z80 set, and for the Spectrum in particular. To illustrate input port usage, let's pretend that we have just written a machine code game which places a graphics character on the screen. Whatever the object of this game is doesn't matter, but we do require to move the character about the screen using the keyboard to control the movements up, down, left and right. Page 160 of the Spectrum BASIC handbook gives a list of the eight addresses which are concerned with the keyboard input. These addresses range from 65278 to 32766, which is not surprising, because, in theory, 65,536 addresses could be used as I/O ports in the Z80 system.

The ideal keys to use for movement of our character would be the cursor control keys, but reference to page 160 shows that keys 6, 7, and 8 are input at address 61438 and key 5 is at address 63486. It would make for easier programming if all four keys were accessed at the same address so I'm going to plump for keys Y, U, I and O for up, down, left and right respectively, as these are all at address 57342. There is a misprint in the handbook which gives this address as keys P to 7, but should read P to Y. Figure 1 gives a listing in hex for the program to read the keys from input port address 57342 but I will explain what is happening. I would urge those of you who are fairly new to machine code programming to write the instructions down the side of a large ruled note pad (A4

size), with the addresses, and use appendix A of the Spectrum handbook to convert the hex to the Z80 assembler mnemonic.

The program I have given is only a small portion of our mythical program; it can be at any address, even in the printer buffer, and is called from the first address as RANDOMISE USR address. The object of this small routine is to 'capture' one of four keypresses and move the character on the screen in the direction that the key represents. However, all this program will do at present is print onto the screen the character of the key pressed.

CODE	EFFECT
3E	Load A
02	with 2
CD	Call address in ROM
01	to open stream to
16	upper 22 lines of screen
3E	Load A with high byte
DF	of port address
DB	IN A,(nn)
FE	nn = low byte of port address
CB	use instruction after CB
67	Bit 4 A, if reset then Y has been pressed
28	if Y pressed zero flag set so jump
18	forwards to print Y
CB	
5F	Bit 3,A then if Y not pressed
28	if U pressed then jump
10	to print U
CB	
57	Bit 2,A then if U not pressed
28	if I pressed then jump
08	to print I
CB	
4F	Bit 1,A then if I not pressed
20	0 has not been pressed so jump
EC	backwards to load A with high byte again
3E	Load A with code for letter 0
4F	because 0 must have been pressed to get here
D7	Print 0
C9	Return
93E	Load A with code for letter I
49	because I must have pressed to get here
D7	Print it
C9	return
3E	Load A with code for
55	letter U
D7	Print it
C9	Return
3E	Load A with code for
59	letter Y
D7	Print it
C9	
	end of program

Fig. 1 A routine to read certain keys.

Earlier I said that the data coming in, or going out, was a data byte, and we are going to test certain bits of the data. There are five keys at this particular port and bits D0 to D4 represent five keys with bit D0 for key P and working inwards on the keyboard to bit D4 for key Y (the D stands for data), so the bits we want are D4 to D1.

The first five bytes of the program open the stream to print to the first 22 line of the screen; if you want to print to the bottom two lines then load A with 1 instead of 2. Next the high byte of the port address is loaded into register A, then the instruction DB FE — IN A,(nn) where nn is the low byte of the port address, which in this case is FEh. Now the computer has the information — the port address is 57342 (keys P to Y) — and the data byte has to come into register A.

The next two bytes are CB67 — BIT 4,A. These together mean that we are going to test the current status of bit 4 in the A register and put the result into the zero flag bit of the status register. (Z flag = 1 if bit 4 of A register = 0). The following instruction 28 18 — JR Z,e, will cause a jump forward by the displacement 18h if the Z flag is set (ie. if bit 4 of the A register was 0 indicating that the 'Y' key was pressed) and print the letter 'Y'. If, however, the 'Y' key was not pressed, the jump will not take place and the next instruction executed will be CB 5F — BIT 3,A and so on until BIT 1,A.

Note well the last conditional jump instruction, 20h — JR NZ,e, which jumps back to 3E DF to start again; this means that if none of the 4 keys are pressed the computer will wait until one is.

This program is not the most elegant of programs, and is certainly not the only way to 'read' the keyboard. The instruction DBh nn — IN A,(nn) is the first of 8 simple IN instructions, but the other seven have a slightly different form, and there are also eight simple OUT instructions which follow the same pattern of the IN instructions.

Covering the rest of the IN instructions first, they take the form IN register,(register). This means that the first register will receive the data byte, and the port address is formed from the low byte in the register in brackets, and the high byte in the other register of the register pair. To explain that, the instruction ED 78 — IN A,(C) could have been used in my program, with C loaded with FE, and B register loaded with DF, and the A register still tested for bits D4 to D1.

The first of the simple OUT instructions is D3 nn — OUT (nn),A; the other seven are of the form OUT (register), register with the register in brackets again holding the low byte, and the other one of the pair holding the high byte, the other register in the instruction being used for the data byte.

There are four fully automatic I/O instructions, two IN and two OUT, and all four are of similar pattern. The instruction ED B2h — IN IR means IN (C) from address (HL) with register B holding the number of times the instruction is repeated; the address is then incremented, and B decremented, and repeated until B reaches zero. The second IN automatic instruction ED BAh — IN DR which uses the same register format but with (HL) being decremented, which is what the D stands for.

Automatic OUT instructions are the same except that register C holds the data to go out to address (HL). There are two non automatic IN instructions, and two non automatic OUT instructions which follow the same pattern as the automatic instructions but the increment, or decrement (HL) is only done once, that is, the R, for Repeat, is left off, as in ED A2h — INI.

By the way, for those of you who have never met the instruction D7h — RST 10h used in the example program, it is an instruction to print the contents of the A register to the next PRINT position on the screen. ETI

MIDWICH

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4118-15	D1 3.75	7805	0.33
4164-15	D2 4.33	7812	0.33
4164-20	D2 3.95	7815	0.33
4418-20	D2 6.60	7905	0.46
4564-15	5.25	7912	0.46
5516-25	7.73	7915	0.46
6116-LP3	D1 3.72	LM339K	0.58
2532-45	D2 3.50	LM337K	0.92
2708-45	D2 3.25	LM338K	4.58
2716-35	D1 4.50	78HGASC	8.13
2716-45	D1 3.50	78H05SC	6.28
2716-3	D1 4.50	78H12ASC	7.40
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2732-45	D1 3.75	78540PC	2.50
2764-30	D1 3.92		
2764-250NS T	3.92		
2764-250NS BBC	5.95		
2564-30	D2 6.00		
27128-30	D2 24.50		

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6800	D7 2.87
6802	D5 2.61
6803C	D6 7.12
6809	D6 7.12
6810	D1 1.25
6811	D3 1.31
6840	D4 3.92
6843L	20.88
6845	D5 5.88
6850	D2 1.31
6862	0.00
6871-AI	14.17
68488	D7 5.78
6875	D2 7.13
6880	D3 1.99
68B09	D6 9.96
68B21	D3 1.88
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UPD7002	D1 4.65
ZN425E-8	D1 3.13
ZN425E-8	D1 1.97
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8212	1.50
8216	1.37
8224	1.92
8226	3.25
8251A	D5 2.60
8253	3.33
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6502A	D3 4.67
6520	D1 2.67
6520A	D1 2.80
6522	D5 3.47
6522A	D5 4.40
6532	D2 5.33
6532A	D2 5.87

6500 Family

SN75458BP	0.24
SN75468N	1.08
SN75491AN	0.46
SN75492AN	0.61
TL010CP	0.38
TL061CLP	0.28
TL062CP	0.47
TL064CN	0.89
TL066CP	0.28
TL071CP	0.28
TL072CP	0.47
TL074CN	0.91
TL081CP	0.24
TL082CP	0.41
TL084CN	0.85
TL091CP	0.41
TL092CP	0.60
TL094CN	1.37
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SN751078N	0.58
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SN75150P	0.72
SN75154N	0.87
SN75158N	1.19
SN75160N	2.15
SN75161AN	2.35
SN75162AN	3.31
SN75172NG	1.64
SN75173N	1.21
SN75174	1.64
SN75175	1.21
SN75182	0.62
SN75183	0.62
SN75188	0.44
SN75189	0.44
SN75451BP	0.24
SN75452BP	0.24
SN75453BP	0.24

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18	0.16	0.32	0.86
20	0.17	0.41	1.23
22	0.17	0.46	1.31
24	0.20	0.63	1.44
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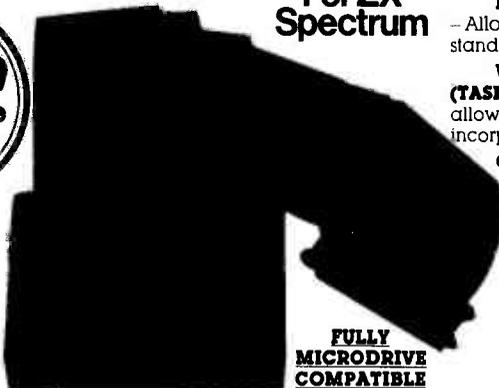
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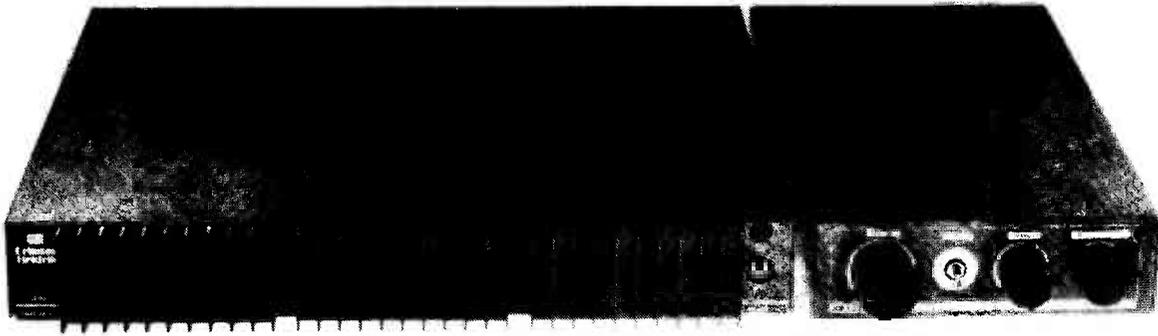
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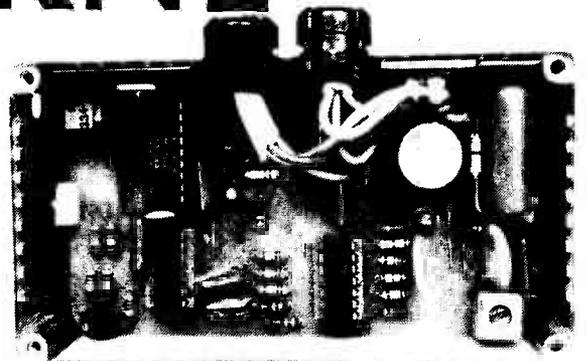
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Microcomputers offer some fascinating possibilities to the experimenter when used as intelligent controllers, for example, the careful control of heating, lighting, and other services in a house, which can result in enormous savings in energy and labour. The use of this type of controller is increasing both in the home and in the factory, but a major source of expense and inconvenience is the apparent need for wiring between the controller and the various devices scattered throughout a

building. It has been realised for some time, that nearly every home, office and factory has a ready installed 'data bus' in the form of the mains wiring. To prove that nothing is new, the first patent suggesting this possibility was taken out in 1897. However, it is only in the last few years that the electronic devices needed to reliably and economically send and receive control signals over the mains wiring have become available.

The ETI MainsCom offers an inexpensive but reliable remote

control facility, allowing a central microcomputer controller to switch mains-powered equipment on and off using only the mains wiring itself as a communications medium. The system comprises two distinct units, the transmitter and the receiver. The transmitter is interfaced to the controlling microcomputer, from which it also draws its power, and the output plugs directly into a 13A mains socket. The receiver also plugs into a 13A socket, is mains-powered, and has a 13A output socket which can be switched on and off by appropriate commands from the controlling microcomputer.

This first article discusses the operation of the system and describes the construction of the receiver unit only. Next month's concluding article will describe the transmitter, the procedure for interfacing with a microcomputer, and the alignment and operation of the completed system.

As with cordless intercoms, which also rely on the mains wiring for their interconnections, the MainsCom uses a frequency modulated carrier to convey the controlling data stream. The well known tolerance of FM signalling to noise and to signal level variation comes in useful in this application. The control data is generated and decoded by standard remote control ICs, manufactured by Plessey, which incorporate error detection logic to minimise the possibility of spurious switching occurring as a result of noise.

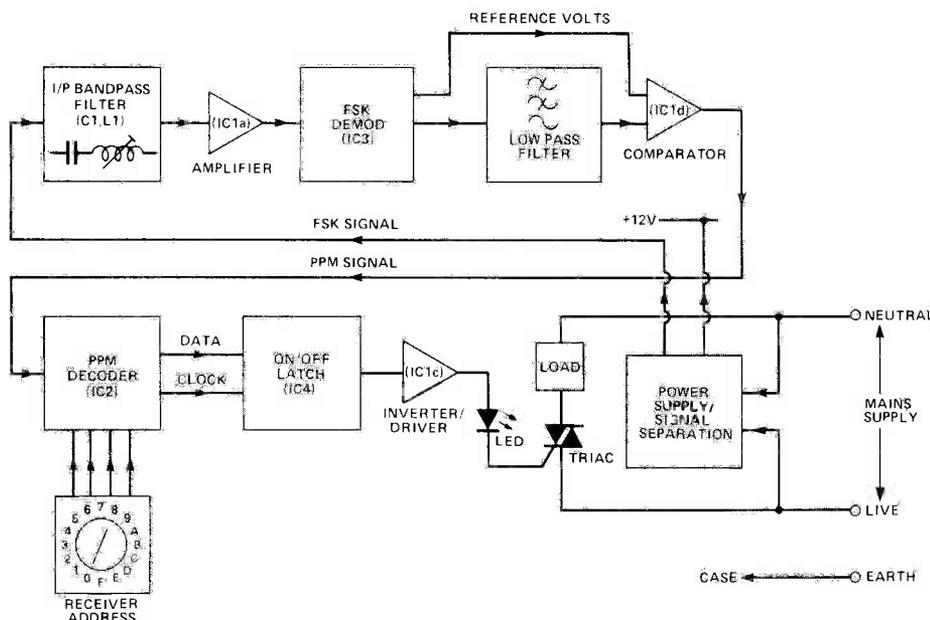


Fig. 1 Block diagram of the receiver unit.

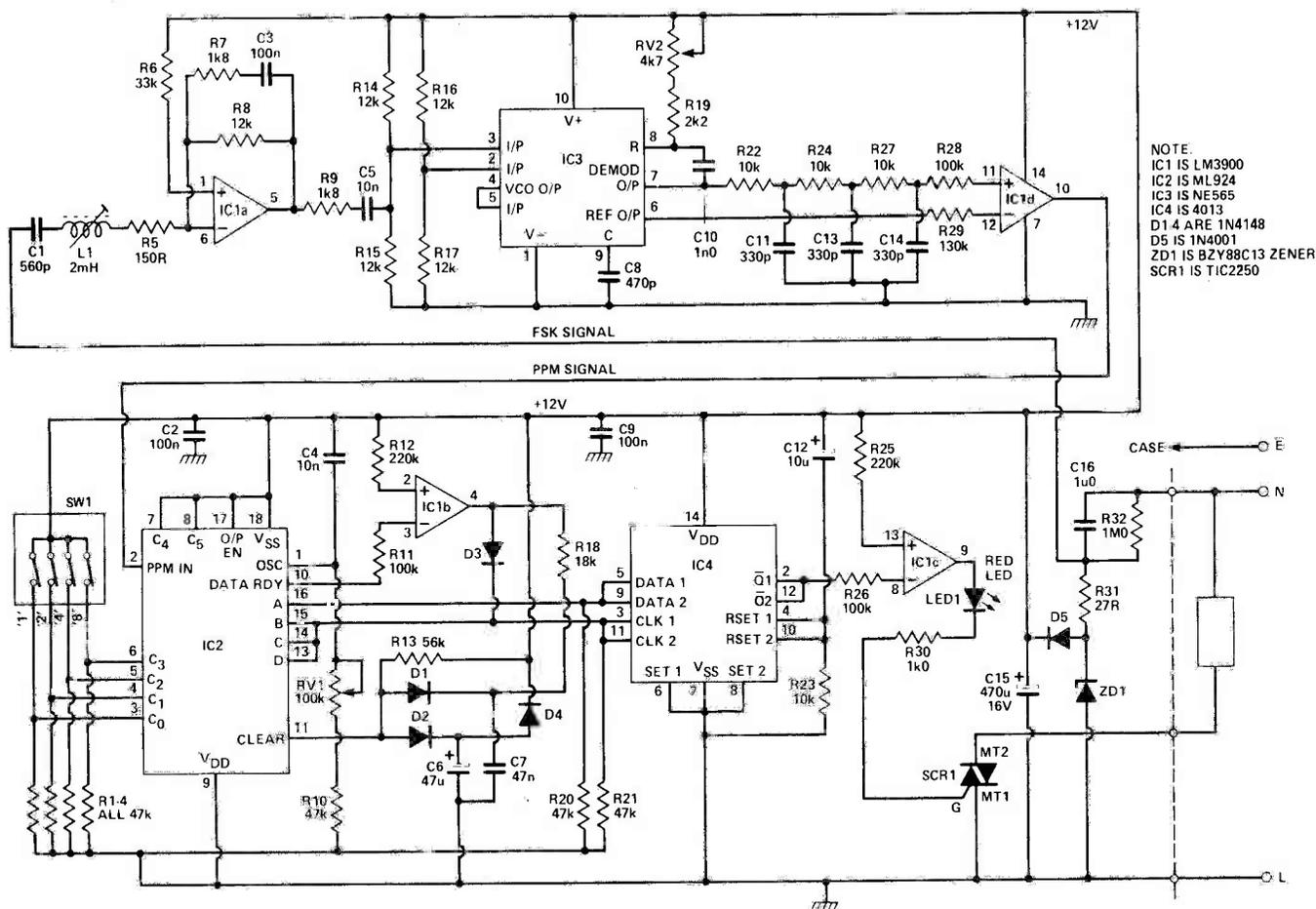


Fig. 2 Circuit diagram of the receiver.

The System

The only desirable features of mains wiring as a transmission channel are that it already exists and that it will serve most areas of a home, office or factory. Electronically it is a low impedance transmission line with unpredictable and varying loss, and which is subject to high levels of broadband noise. Frequency Shift Keying (the digital equivalent of FM) is used in the MainsCom system because of its resilience under these conditions of varying signal level and impulsive noise.

A carrier frequency of approximately 130 KHz is employed as this is outside the range of most sources of interference, such as harmonics of the mains frequency below and the LF and MF radio transmissions above. The upper range of frequencies must also be avoided so that MainsCom does not cause interference to these services. The chosen frequency is also within the band (125-140 KHz) proposed by the Control Equipment Manufacturers Association for use in this type of application. A deviation of about 10KHz is used, which is relatively wide compared with the bandwidth of the

data signal. However, this does provide the high level of noise protection associated with broadband FM.

The system design is simplified by the use of a pair of ICs specifically designed for remote control applications, the Plessey SL490 PPM (Pulse Position Modulation) transmitter and the ML924 receiver. The transmitter uses the SL490 device as a PPM encoder. This device, which employs I^2L bipolar logic, is designed to be connected directly to a cross point matrix keyboard. Interface logic is therefore required to enable the use of a parallel binary signal from a microcomputer port, and the devices used to perform this function are two CMOS analogue switches. These accept logic level inputs and appear to the SL490 as a switch closure. The apparent position of the switch in the matrix is determined by the binary number fed into the inputs of the CMOS switches. The PPM output of the SL490 drives the frequency shift modulator. This is an NE565, more commonly encountered as a Phase Locked Loop decoder, but which can also be persuaded to act as a frequency modulator.

The frequency keyed carrier need only be of a relatively low power to be effective. About 1 watt is sufficient and a higher level would risk interference to other services, such as MF and HF radio broadcasts. A power amplifier stage is needed to amplify the output of the frequency shift keyer and to match this to the low impedance of the mains wiring. At the frequency used, this is in the region of 10 ohms. The power amplifier uses a pair of VMOS transistors, operating in class C push-pull, and matched to the mains wiring by a tuned output transformer. This is an efficient and rugged output configuration which can withstand the large transients sometimes coupled into this stage from the mains wiring. The output state is interfaced with the frequency shift keyer by some CMOS gates. These provide carrier on/off switching and correctly timed pulses to drive the output transistors.

The MainsCom receiver uses four ICs to provide the functions of input amplifier, FSK demodulator, PPM decoder and on/off latch. The latched on/off signal within the receiver is used to drive

HOW IT WORKS — THE RECEIVER

The MainsCom receiver is powered by a 'wattless' dropper arrangement, comprising C16, R31 and ZD1. The reactive current flowing through C16 results in 13 volts appearing across ZD1 during every other half cycle of current flow. This pulse train is converted into a steady supply voltage of about 12 Volts by D6 and C15. The advantage of this type of power supply is that it is an efficient way of obtaining a small amount of low voltage power, without the expense and bulk of a mains transformer, and is probably more efficient than the latter. Efficiency and low power consumption are important considerations in a piece of equipment which is likely to be running continuously over long periods. R31 serves as a surge suppression resistor and also as a fuse in case of the failure of C16. It is important that only the stated wattage of resistor is used in this position. R32 discharges C16 when the unit is disconnected from the mains supply and prevents the possibility of minor, but unpleasant, shocks from the mains plug. The power supply in this unit also serves two less obvious functions. It acts firstly as a snubber network to reduce mains borne transients, which could damage the triac. Its other role is as a high-pass filter to extract the FM carrier from the incoming mains.

The filtered high frequency signals, which appear across line and neutral, contain the FM control signal as well as a lot of noise. These are fed to the input of IC1a via a series tuned LC filter, L1 and C1. This filter is tuned to the centre frequency of the FM signal and separates this signal from HF noise. IC1a amplifies this signal before passing it on to IC3, a standard phase locked loop FM demodulator. The centre frequency of the demodulator is set by C8 and R19 with RV2. The differential output of IC3 is fed through a low pass filter network to the input of IC1d. This section of IC1 acts as a comparator, and converts the low level differential output of IC3 into a 12 volt

digital signal, which is the transmitted data stream.

This PPM data stream forms the input to IC2, the PPM decoder. The 'C4' and 'C5' inputs of this IC are strapped to logic high in order to select the desired operating mode and the 4 bit address of the receiver is set up on the 'CO', 'C1', 'C2', and 'C3' inputs by means of SW1, or by hard-wired links. When it has received a valid sequence of address and data messages, IC2 will pulse the DATA READY output high and place the bit pattern from the data message onto the outputs A to D. The internal clock frequency used to time the reception of the PPM data is set by C4 and R10/RV1.

The DATA READY pulse from IC2 is inverted by IC1b to produce a low going clock pulse. The output of IC1b is combined with the B, C, and D outputs of IC2 by wired-OR logic, via D3. This ensures that the clock pulse to IC4 will not occur unless these data outputs are all simultaneously logic 0. This clock pulse is used to latch the logic level appearing on the A output of IC2 into IC4, IC4 is a dual D-type latch with both halves connected in parallel.

The output of IC1b will also reset IC2, a short interval after the receipt of the DATA READY signal, by pulling the CLEAR input low. This ensures that the receiver will require another address message before responding to other data messages. D1, D2, and C6 form a circuit that resets IC2 at power up. A similar function is carried out by C12 and R13 which clear IC4 on power up. This ensures that the MainsCom receiver always comes on in the 'off' state.

The NOT Q outputs of IC4 provide the input to IC1c, which is used as an inverter and driver. The output of IC1b has sufficient current source capability in the high state to light the indicator LED and to switch on the high sensitivity triac, SCR1. The triac, in turn, controls the flow of power to the load attached to the MainsCom system.

Pulse Position Modulation

In a PPM transmission, a 1 or 0 is transmitted not by the presence of absence of a pulse as would be the case with more conventional digital coding, but by the use of two different lengths of interpulse time to indicate the binary states. The ICs used in this system employ codes based on 5 bit words, so that each word requires the transmission of 6 pulses to generate the 5 interpulse periods

(Fig. 3). A short interpulse gap signals a logic 1, and a longer gap a logic 0. To enable a receiver to correctly 'frame' the incoming stream of bits into 5 bit words, an even longer gap is used to signal the gap between words.

The ICs used to receive the PPM data stream use an internal oscillator and a counter to time the periods between pulses. Inside the receiving IC, the leading edge of each PPM pulse resets the counter. The state of the counter, when the leading edge of the next pulse comes along, is used to set the timing windows which determine the difference between 1s, 0s and interword markers. Any pulse appearing before the counter has reached 20 is ignored as this is likely to be the result of external noise or multipath reception with some types of remote control. A pulse appearing whilst the count is between 20 and 32 is taken to represent a logic 1, and if it is between 32 and 60, it represents a logic 0. An interpulse period of over 60 clock periods is seen as an interword gap and the receiver logic resets the counter and internal error detection logic if the count reaches 1220 without the appearance of a pulse.

The frequency of the receive IC's internal oscillator is set by an external RC network which should be adjusted so that 40 cycles of its output occur in the period used to represent a logic 0. A logic 1 interpulse period will then equal 26.6 cycles. This setting will place the incoming pulses generally in the receiver's timing window and provide an allowance for frequency drift in the PPM transmitter and receiver devices.

The receiver ICs in this family of devices use a simple and effective method of error checking. The last PPM word received is stored and compared with the one currently being decoded. If the words are the same, only then is the word accepted as a valid message. This does mean that any message must consist of a PPM word transmitted at least twice, so that two consecutive and identical words can be seen by the receiver.

The ML924, which is used in the MainsCom receivers, can be used

a triac which can be used to control an external mains load. Alternatively, the on/off signal can be used directly as a logic level for remote control purposes. The receiver employs a reactive power supply, resulting in a lightweight unit with low power consumptions that can be built into a small diecast box.

Each receiver can be allocated a four bit address code that allows up to 16 'addresses' to be selectively switched on or off. The address code in each receiver can be set permanently by wire links, or can be reset if hexadecimal coded switches are fitted. Several receivers can share an address code, to form a group that can be switched simultaneously.

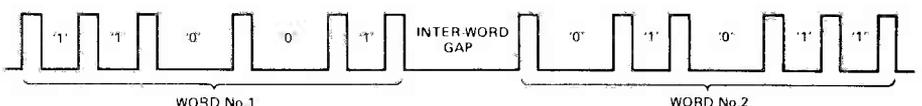


Fig. 3 Data format used in Pulse Position Modulation (PPM).

in several modes, one of which is this simple mode where the receipt of a valid message consisting of two indential words will result in the 5 bit data pattern apperaring on its A, B, C, and D outputs and the Data Ready output being pulse high. In the MainsCom receiver, a more complex mode of operation is used, in which the IC must be activated by the receipt of an 'address' message before it can accept one or more 'data' messages. As with the simpler mode of operation, each of these messages must be at least two consecutive, identical PPM words. An address message is distinguished by having a most significant bit of 0, and data messages by having a most significant bit of 1.

The addressable mode gives additional security against unwanted messages being generated by noise, since two valid messages in the correct order are necessary. The second advantage of using this mode is that individual receivers or groups of receivers can be selected to receive the message code. The address messages must have a 0 for their most significant bit, but the remaining four bits form an address code which must match the four bits set up on the C0 to C3 inputs of the ML924. An ML924, in the addressed state, will be deactivated if it receives an address message with the wrong address code.

In the MainsCom receiver, additional logic external to the ML924 resets this devices a short while after the receipt of any data message. This is done so that the receiver is not left in an active addressed state where there would be a remote possibility that it could respond to random noise or garbled message and spuriously switch on or off.

Construction

The receiver is built on a small printed circuit board, and this is mounted in a suitably sized die-cast box. The diecast box forms a robust enclosure for this unit, an important factor in an item of equipment which could end up in odd corners of the home or office and suffer indignities such as being trodden on. The box acts also as an electrical shield for the unit within, which is connected directly to the mains supply. For this reason the box should always be earthed.

The printed circuit board is held in place at each end by a pair

of plastic clip-type support pillars. These provide ample spacing between the printed circuit board assembly and the bottom of the box. The clearance between the edges of the PCB and the sides of the box is very small and to prevent the possibility of short circuits between them, two suitably

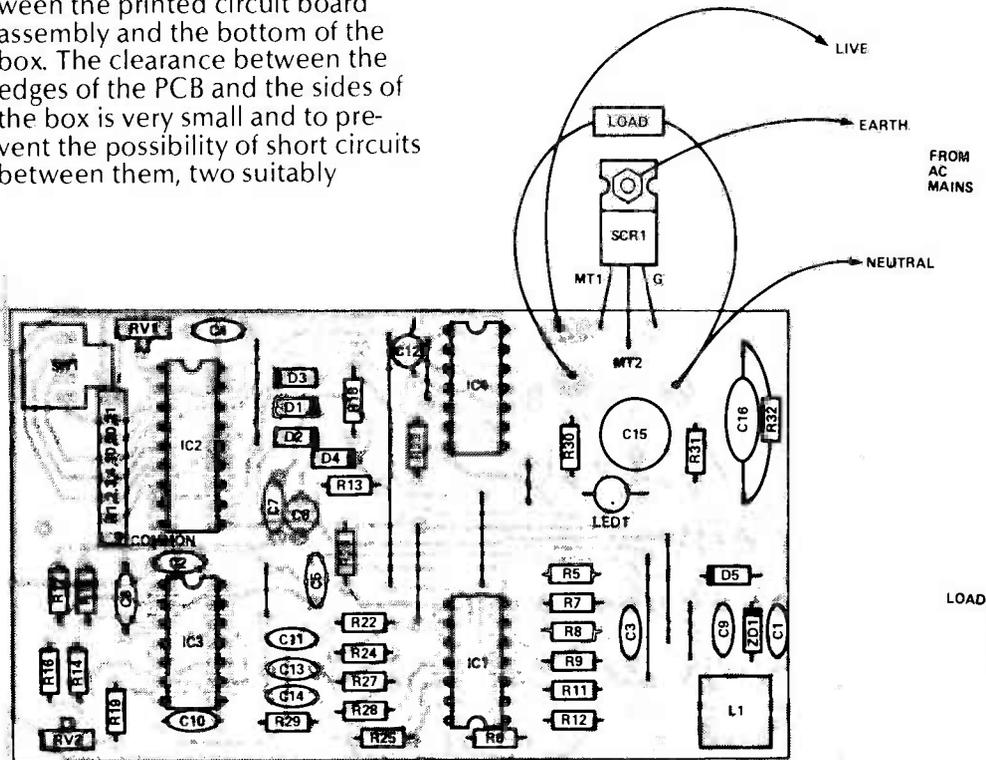


Fig. 4 Component overlay of the receiver PCB.

PARTS LIST — THE RECEIVER

RESISTORS

(All resistors 1/4 W, 5% unless otherwise stated)

R1-4,10,20,21	7 x 47k SIL resistor pack
R5	150R
R6	33k
R7,9	1k8
R8,14-17	12k
R11,26,28	100k
R13	56k
R18	18k
R19	2k2
R22-24,27	10k
R12,25	220k
R29	130k
R30	1k
R31	27R 0.5 watt metal film
R32	1M0
RV1	100k vertical preset
RV2	4k7 vertical preset

CAPACITORS

C1	560pF 2% silver mica or polystyrene
C2,3,9	100n 100V ceramic
C4,5	10n 100V ceramic
C6	4.7u 10V tantalum
C7	47n 100V ceramic
C8	470pF 2% silver mica or polystyrene
C10	1n0 100V ceramic
C11,13,14	330pF 2% silver mica or polystyrene

C12	10u 10V tantalum
C15	470u 16V radial electrolytic
C16	1u0 400V DC polyester or paper

SEMICONDUCTORS

IC1	LM3900
IC2	ML924
IC3	NE565
IC4	4013
D1-4	1N4148
D5	1N4001
ZD1	BZY88-C13
LED1	0.2" red LED
SCR1	TIC-225D (for alternatives, see text)

MISCELLANEOUS

SW1	Vertical hexadecimal coded rotary switch (RS Components 334-959)
L1	2mH variable inductor TOKO P/No. YXNS30450NK

IC sockets (high quality turned pin type); diecast box, Bimbox 5004/14 or Verospeed P/No. 86-20102B; 13A free socket; 13A mains plug; 3 core mains cable; strain relief bushes; PCB clips; mylar film; triac mounting kit, nut, bolt, etc.

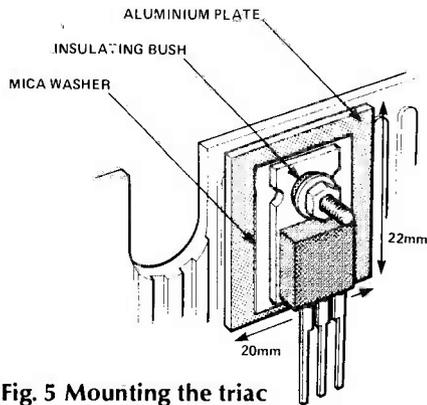


Fig. 5 Mounting the triac using a small aluminium plate.

shaped strips of mylar film are slipped between the PCB and the box. This type of film has a high dielectric strength and is easily obtainable in the form of PCB draughting material.

The triac, SCR1, is situated at the edge of the PCB and uses the diecast box as a convenient heat sink. The type of box recommended has a ridged internal surface to facilitate the vertical mounting of printed circuit boards. This is a nuisance in this instance as it prevents close contact between the triac and the box and will not permit efficient heat transfer, a small rectangle of aluminium sheet, drilled to take the triac mounting bolt and placed between the triac mounting tab and the box, will overcome the problem of heat transfer. The usual mica washer and insulating bush must also be used in mounting the triac to provide electrical isolation (see Fig. 5).

Assembly of components on the PCB should pose few problems if the points listed below are noted. The ICs can be soldered directly to the board, but test and maintenance of the unit is much easier if sockets are employed. If these sockets are of a high quality type, their use will have little

effect on the reliability of the unit. Note that IC1 is mounted in the opposite direction to the other three ICs.

Two components have critical lead lengths. LED 1 must have its leads dressed so that it protrudes through the hole in the lid of the box; the top part of a plastic LED mounting clip, secured to the lid with a drop of instant adhesive, will hold the LED tidily in place when the lid is fitted. The leads of SCR1 should be carefully dressed so that the hole in the triac's mounting tab coincides with the hole drilled in the side of the box. The leads should be bent in an S-shape in order to cushion the triac from any vibration of the PCB.

Veropins, or something similar, are used to provide the live and neutral terminals on the PCB for the incoming and outgoing mains connections. The mains cable connections should be soldered to these pins prior to fitting the PCB into the box. If not done in this order, access to the pins is difficult. For the same reason, test and adjustment of the receiver unit should be completed prior to the fitting of the PCB.

The earth connections of the input and output mains cables are soldered to a tag. This tag is secured under the nut used to mount the triac tab and the electrical connection via the bolt serves to earth the box. The two mains cables coming to the receiver unit are led into the box through cable clamps held in U-shaped cut-outs in the side of the box. The clamps are compressed onto the cable and are themselves held in place by the lid of the box being screwed down.

If a hexadecimal switch has been fitted to set the receiver address, then a small hole, just large enough to take a screwdriver, can be drilled in the end of the box to allow the address to be changed without opening the box.

The current available from the capacitive dropper power supply used in this unit cannot produce sufficient gate current to guarantee triggering of all TIC225D triacs. A small proportion of this type of device will not trigger reliably. The usual symptom of this will be that the triac conducts on alternate half cycles only. The fitting of another triac of the same type will, unless you are unlucky, remove this problem. If the load to be controlled draws less than 4 Amps RMS, a TIC206D triac can be substituted as SCR1. This has a lower gate current threshold than the

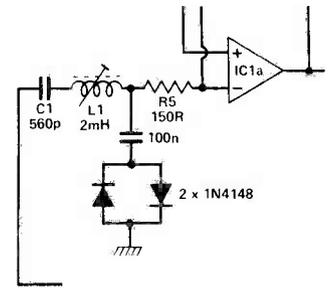


Fig. 7 A modification which will reduce the risk of spurious switching.

TIC225D and all devices of this type should operate satisfactorily in this circuit.

If the receiver is required to control loads drawing more than the 8 amps RMS, which is the maximum that a TIC225D can control, then a variation on the basic receiver circuit may be used. This is shown in Fig. 6. The limitation on the size of power triac that can be used is the gate current required to switch it on. This should be less than 300 milliamps. Therefore, a second low power triac, SCR2, is added to trigger a high power triac, such as a TIC246D which can control up to 16 amps RMS. The additional triac can be a very low power device in a small package, such as a TAG 93D, or a TR1 400-0.35.

If a direct digital output is required from the receiver, rather than the switching of a mains supply, SCR1 can be omitted and an opto-isolator connected between R30 and common. The output of the opto-isolator can then be used as a remotely controlled digital signal. The type of opto-isolator employed should be a high sensitivity type, as the current available to drive it is only of the order of 10 milliamps.

A problem arose in the prototypes of this unit when certain brands of LM3900 were used for IC1. The problem was that the receiver would spurious switch off the load when large surges occurred in the connected mains wiring. In one instance, this resulted in a television receiver being switched on by the Mains-Com receiver, and then a fraction of a second later being switched off again. The most reliable cure for this was found to be the addition of a second later being switched off again. The most reliable cure for this was found to be the addition of the components shown in Fig. 7. The capacitor is a 100n, 100V ceramic and the diodes are 1N4148. These can easily be soldered onto the track side of the PCB, but must be kept well clear of the bottom of the box.

Next month, transmitter details and Buylines.

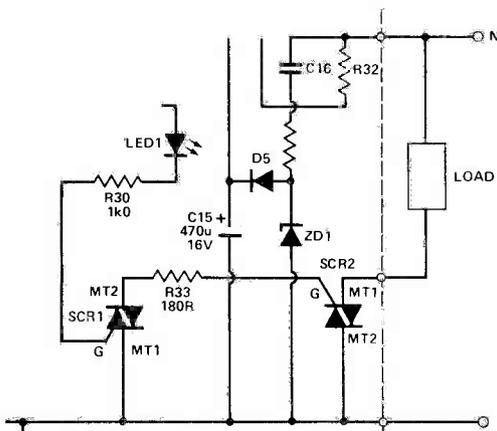
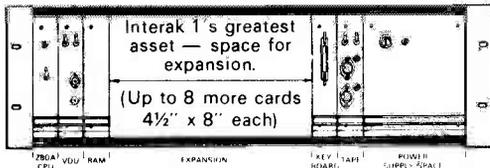


Fig. 6 The modification required to drive high power triacs.

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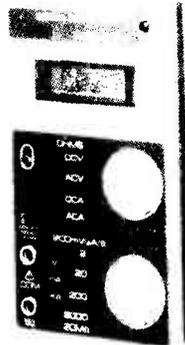
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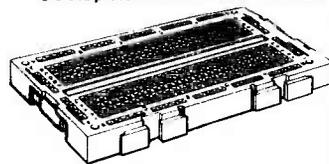
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Timer circuits and projects are not particularly unusual, but this one was designed in response to a request and for a specific purpose.

It was required for a training school to time the speaking assignments of the students, and also those of the instructors. In the case of the students, an audible signal was required at the end of the assigned time which would sound for about two seconds and then stop. For the instructors, the timing signal had to be less obvious, and took the form of a light which could be seen from the rostrum but was not generally visible to the class. The light would remain on until cancelled by the operator. In addition, a warning light was required. This would come on 2 minutes from the end of the set time and remain on until the time had expired, whereupon it would go out and the 'time up' light come on.

At first, the cheap, plentiful and reliable 555 timer was considered for the basic timing circuit, but rejected due to the long interval required to be timed. Instead, the ZN1034E precision timer was used. This IC is well suited to applications requiring long time delays because it incorporates a

12 stage binary divider. The divider output changes state only after 4095 oscillator cycles, allowing a higher oscillator frequency and hence smaller timing components to be used than would be the case were a 555 used to provide a similar delay. The ZN1034E also has an internal shunt regulator which removes the need for external supply regulation, a further regulator giving a 2.5V output to feed the RC timing network, and TTL compatible complementary outputs.

In order to obtain the two minute warning facility required in this application, two separate timing circuits are employed each based on a ZN1034E. The first circuit has a delay which can be varied from five minutes to forty-four minutes in steps of 1 minute. The delay is selected on two rotary switches, one having increments of 1 minute and the other having increments of 10 minutes. In fact, the switching is so arranged that the delay is always two minutes less than that selected. At the end of the timing period, a warning light is switched on and the second timing circuit triggered. The second circuit is similar but has a fixed delay of two minutes. At the end of this time, the warn-

ing light is extinguished and a 'time up' light comes on. Alternatively, the lights can be switched out of circuit and an audible alarm substituted. In this case there is no two minute warning, the first timing circuit merely triggering the second.

Construction

Everything assembles onto the PCB except the loudspeaker, the range setting resistors, the indicator lamps, the LEDs, the transformer and the switches. Nothing on the PCB should cause any problems, but take the usual care with ICs, the electrolytic capacitors, the transistors and the diodes, all of which must be inserted the right way around. We recommend that you use sockets for the ICs, but this is not essential. No case has been described since the original was built as a module only and was mounted in the PA desk.

The timing range resistors should be soldered directly to the two rotary switches. We have specified ordinary carbon resistors in the parts list but if a high level of timing accuracy is required you would do better to use 1% types, preferably metal film since these have a low temperature coefficient. The design exceeds the original requirements slightly in providing for delays of up to forty-four minutes rather than thirty, but it is quite easy to extend the timing range further should you wish to. Further resistance can be introduced between pins 13 and 14 of IC1, but note that the total should not exceed 5 Mohm or the circuit operation may become unreliable. As the circuit stands, the total is a little over 1.6 Mohm. If even longer timing periods are required, you could try increasing the value of C1. The formula for calculating the required values is $RC = 21.94T$, where R is resistance in k ohms, C is capacitance in uF, and T is time in minutes. This formula

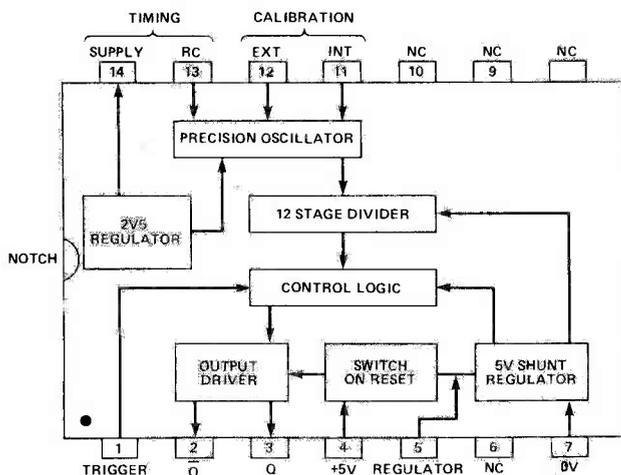


Fig. 1 Internal block diagram of the ZN1034E.

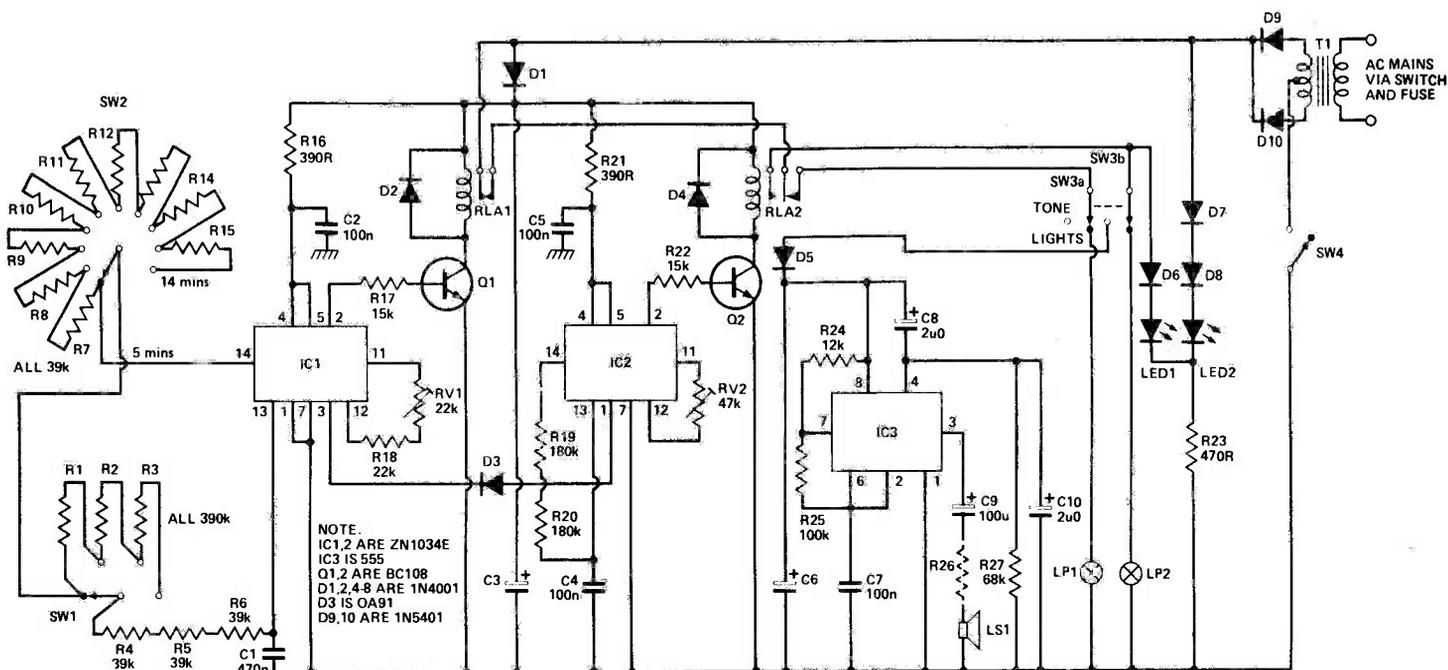


Fig. 2 Circuit diagram of the School Timer.

only applies when the calibration resistance, ie, the resistance between pins 11 and 12 or RV1 and R18 in the circuit, is approximately 47k.

The lamps used in the prototype were a combination indicator/stop/tail lamp set intended for use on caravans and purchased from a motor accessory shop. The amber indicator lamp was used for the two-minute warning and the red combined stop and tail lamp was used for the 'time up' indication. The unit came ready fitted with bulbs, a 21 watt bulb in the indicator section and a 21 + 5 watt bulb in the stop and tail section. The 5 watt section was simply left unconnected.

The loudspeaker should ideally have an impedance of 70 ohms, but an 80 ohm type will work quite satisfactorily. A lower impedance speaker could be used provided a series resistance was added to raise the overall impedance to about 70 ohm, but this would result in less power being available for the loudspeaker. Provision has been made on the PCB for such a resistance to be used (R26) and if it is not needed you should insert a link in this position.

Setting Up

When the construction is complete and the board has been tested and found to work approximately to time, the two presets can be adjusted to set the timing accurately. Start with RV1 and set

the five minute range, timing three minutes until the warning lamp comes on. Then set SW2 to fourteen minutes and time the delay for twelve minutes until the warning light comes on. Readjust RV1 if necessary and then check the five minute range again. Some compromise may be required depending upon the accuracy of the range-setting resistors used. The preset affects the fourteen minute setting more than the five minute setting, so make the last adjust-

ment on this range.

The required 47k calibration resistance is split into two parts for this IC, RV1 itself which is 22k and a fixed 22k resistor, R18. If it is found that the required setting is too near one end of the preset or is not on the preset at all, the preset and the fixed resistance can be exchanged for other values.

Having got the five to fourteen minute range working correctly, set SW2 back to five minutes and set SW1 to ten minutes. Start the

PARTS LIST

RESISTORS (all 1/4 W 5% unless otherwise stated)

R1, 2, 3	390k (see text)
R4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15	39k (see text)
R16, 21	390R
R17, 22	15k
R18	22k
R19, 20	180k (see text)
R23	470R
R24	12k
R25	100k
R26	see text
R27	68k
RV1	22k horizontal skeleton preset 47k horizontal skeleton preset

CAPACITORS

C1	470n polycarbonate
C2, 5, 7	100n
C3	2200u 25v radial electrolytic
C6	2u0 16V radial electrolytic
C8, 10	2u0 16V radial electrolytic
C9	100u 16v radial electrolytic

SEMICONDUCTORS

IC1, 2	ZN1034E
IC3	555
Q1, 2	BC108
D1, 2, 4, 5, 6, 7, 8	1N4001
D3	0A91
D9, 10	1N5401
LED1	0.2" red LED
LED2	0.2" green LED

MISCELLANEOUS

SW1	1 pole, 4 way rotary switch
SW2	1 pole, 10 way rotary switch
SW3	DPDT switch, any type
SW4	SPST switch, any type
T1	9-0-9V, 2A mains transformer
LS1	Eagle type TP26G or any speaker of 30 - 80 ohms
RLA1, 2	miniature PC mounting relay, 12V 400R coil

PCB; combination indicator/stop/tail lamp assembly, Sedan Car Accessories type CL845-S00 or similar; 2 off 14 pin and one off 8 pin DIL sockets; knobs for SW1, 2.

HOW IT WORKS

The output from the secondary of T1 is full-wave rectified by D9 and D10 to give a pulsed DC supply of about 12-13V peak. This is then passed via D1 to the reservoir capacitor, C3, to give a smoothed supply of about 12V. The pulsed DC is used to power the two 21W indicator lamps while the smoothed supply feeds the ICs, the use of two separate rails ensuring that the heavy surge currents drawn by the lamps do not upset the timing circuits. ICs 1 and 2 contain internal 5V shunt regulators, and the supply to these is dropped by R16 and R21 and decoupled by C2 and C5.

IC1 is a ZN1034E precision timer. Pin 4 is the switch-on reset and this coupled to pin 5, the regulator input, so that it is held high while timing is in progress. A second internal regulator provides 2.5V via pin 14 to feed the RC network, comprising C1 and resistors R1 to R15. The RC network sets the frequency of the internal oscillator, and 39k and 390k values used here correspond to 1 minute and 10 minutes respectively with the given value of C1, 470nF. R4, 5 and 6 are always in circuit, giving a period of three minutes when SW2 is at its lowest setting, 5 minutes. SW1 and SW2 are so arranged that the timing period is always two minutes less than the period selected. The oscillator frequency is also controlled by an internal resistor so as to ensure temperature stability, but this is trimmed by RV1 to provide fine adjustment.

The oscillator output is fed to a 12 stage binary counter, also on the chip,

which triggers the output stage via control logic after 4095 counts. Both active low and active high outputs are provided; pin 2 goes high at the end of the timing period and drives Q1 via R17, thus activating relay RLA1 which connects LP1 to the pulsed DC supply rail. Pin 3 goes low at the end of the timing period, triggering IC2 via D3. D4 prevents back EMF damaging the transistor.

IC2 is also a ZN1034E and functions in exactly the same manner as IC1, except that here the timing period is fixed at two minutes by R19, R20 and C4. RV2 allows for fine adjustment of the oscillator frequency and hence the timing period. Pin 2 of IC2 goes high at the end of the timing period and drives Q2 via R22, activating RLA2. RLA2 switches over, breaking the connection to LP1 and connecting the pulsed DC supply to LP2 and circuit comprising D5, LED1 and R23. LP2 and LED1 light up to show that the timing period is over and LP1, the warning light, goes out. LED2 is fed from the pulsed DC supply via D7 and D8 and is therefore illuminated throughout the timing process, but when the time is up and LED1 lights up, LED2 goes out. This happens because red LEDs have a lower forward voltage than green LEDs, so that, since both LEDs share the same series resistor, when LED1 is conducting there is not enough voltage across LED2 for it to conduct. D6 is included to prevent reverse voltage appearing on LED1 via LP2 when the supply to these two is not connected. Since D6 contributes a further voltage drop in series with LED1, it is necessary

to include a diode in series with LED2 also if the LED switching described above is to take place. However, the inclusion of one diode in series with each LED makes the extinguishing of the green LED less certain, and so two diodes have been inserted in series with the green LED, D7 and D8, which makes the switching action quite positive.

SW3 selects either the visual indication of timing as described or an audible alarm which sounds only at the end of the complete timing sequence. If SW3 is switched to the Tone position, the circuit operates as before except that the output from IC1 at the end of its timing period is used only to trigger IC2; there is no two minute warning. When IC2 reaches the end of its timing period it activates RLA2 as before, supplying pulsed DC to the circuitry around IC3. The pulsed supply is passed via D5 to the smoothing capacitor, C6, and then applied to C8 and the V_{CC} connection of IC3, a 555 timer. The 555 oscillates at a frequency determined by R24, R25 and C7, and its output is fed via C9 to the loudspeaker, LS1. The voltage supplied to C8 will at first appear mostly across R27, but as C8 charges the voltage on R27 will fall to zero. Thus the voltage on IC3's reset pin will fall, causing it to cease oscillating after several seconds. C10 is fitted to give a sharper cut-off; without it the tone will tail off, dropping in volume and frequency rather than just stopping.

timing and check that the warning light comes on after thirteen minutes. If the warning light is early or late, try substituting another 390k resistance. If you have a sufficiently accurate ohmmeter you could try selecting a suitable resistance with that, remembering that a higher resistance

will be needed to increase the time delay and vice versa. The other possibility is to add further small resistances at the rate of 650 ohms per second of error or to substitute a 330k resistance with some smaller values in series if the initial resistance is too high.

When the ten minute range is

working correctly, repeat the procedure for the twenty and thirty minute ranges. Bear in mind that the period you are looking for in each case is the period of the range selected plus the five minutes set up on SW2 and less the two minute warning period, ie, twenty-three minutes on the twenty minute range and thirty-three minutes on the thirty minute range. Finally, adjust the two minute period of IC2 using RV2. To avoid waiting while IC1 times its delay period, trigger IC2 by momentarily shorting pin 1 to earth. When RV2 has been set, the completed unit is ready for use.

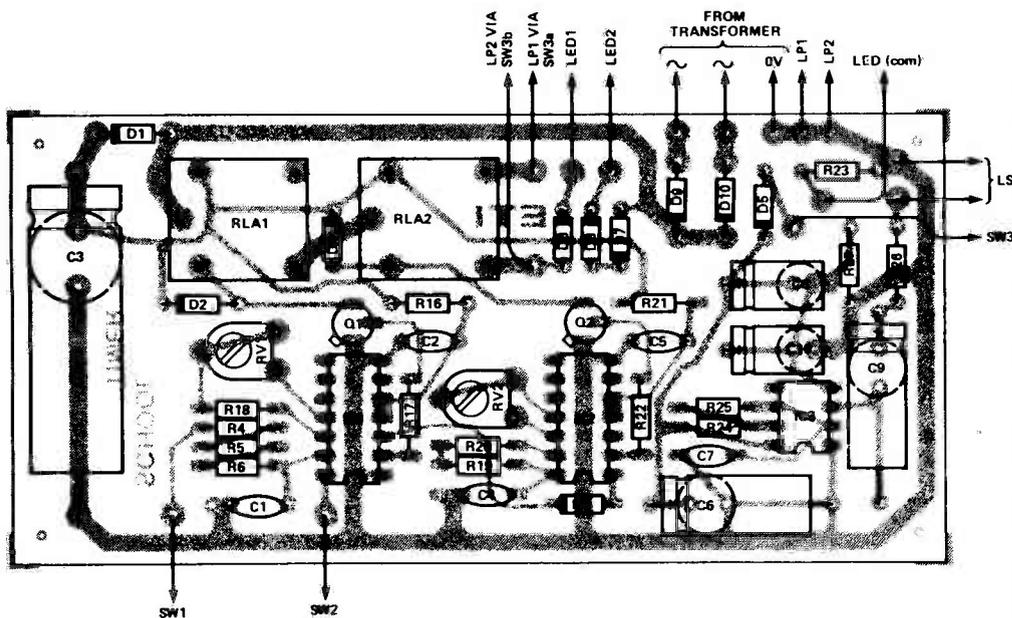


Fig. 3 Overlay diagram of the PCB.

BUYLINES

The ZN1034E is available from several suppliers, as are all the other semiconductors and the general components. The relay is available from Maplin, type no. YX96E. Suitable transformers are available from a number of suppliers but it pays to shop around here as prices vary enormously; a glance through the smaller ads for surplus and end-of-line items would not go amiss. 1% 0.4W metal film resistors, should you wish to use these for the range-setting network, are available from Maplin. The PCB is available from our PCB service, see page 67.

SERVICE SHEET

Enquiries

We receive a very large number of enquiries. Would prospective enquirers please note the following points:

- We undertake to do our best to answer enquiries relating to difficulties with ETI projects, in particular non-working projects, difficulties in obtaining components, and errors that you think we may have made. We do not have the resources to adapt or design projects for readers (other than for publication), nor can we predict the outcome if our projects are used beyond their specifications:
- Where a project has apparently been constructed correctly but does not work, we will need a description of its behaviour and some sensible test readings and drawings of oscillograms if appropriate. With a bit of luck, by taking these measurements you'll discover what's wrong yourself. Please do not send us any hardware (except as a gift!):
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- Be brief and to the point in your enquiries. Much as we enjoy reading your opinions on world affairs, the state of the electronics industry, and so on, it doesn't help our already overloaded enquiries service to have to plough through several pages to find exactly what information you want.

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ETI should be available through newsagents, and if readers have difficulty in obtaining issues, we'd like to hear about it.

Backnumbers

Below we list the backnumbers that are available from our backnumbers department. Please note that this list will be out of date if you use an old copy of the magazine. Backnumbers cost £1.50 (UK or overseas by surface mail) and are available from: ETI Backnumbers Department, P.O. Box 35, Wolsey House, Wolsey Road, Hemel Hempstead, Herts, HP2 4SS (cheques should be made payable to ASP Ltd).

Even if the copy of ETI you need is not listed, all may not be lost, because we run a photocopying service. For £1.50 (UK and overseas) we will photocopy an entire article (note that parts of a series of articles count as separate articles). Your request should clearly state what article you require and the month and year in which it appeared (the index for 1980 and 1981 was published in January 1982, the index for

1982 appeared in December 1982, and the index for 1983 in January 1984). Send your request to ETI Photocopies, Argus Specialist Publications Ltd, 1 Golden Square, London W1R 3AB (cheques should be made out to ASP Ltd).

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Write For ETI

We are always looking for new contributors to the magazine, and we pay a competitive page rate. If you have built a project or you would like to write a feature on a topic that would interest ETI readers, let us have a description of your proposal, and we'll get back to you to say whether or not we're interested and give you all the boring details. (Don't forget to give us your telephone number).

We don't bother with the bureaucracy for Tech Tips — all you do is to send in your idea, stating clearly if you want an acknowledgement of receipt. If possible, please *type* your explanation of why the circuit is different, what it does and how it works, on a separate sheet from the circuit diagram: both sheets should carry your name, address and the circuit title. We'll let you know (within a month or so) if we want to use your Tech Tip.

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OOPS!

We have in the past published small corrections to projects on the letters page, and major corrections separately. From now on corrections will appear on this page, and will be repeated for several months (just to increase our embarrassment). If a correction is too large to fit on here, we will publish it just once, but will note the fact that a correction does exist, and that copies of it can be obtained from us provided you send in an SAE. But please — request copies only if you really do need them; if this service is abused, we may be forced to withdraw it.

Universal EPROM Programmer (August 1983)
Corrections to this project are listed in the article "Universal EPROM Programmer Revisited" which appeared in the January '84 issue.

Z80 Controller Computer (August 1983)
On the overlay, SW1 is the rectangle beside ICs 5 and 6. C6 should be shown between ICs 3 and 7, and a link through has been missed — to the right of pin 18, IC11.

Typewriter Interface (October 1983)
An update article on this project appears on page 25 of this issue.

Car Alarm (October 1983)

In the semiconductors section of the parts list, Q1, 2, 5, and 7 should be BC212L, Q3 should be BC182L, and Q4, 6 should be TIP31 or BD131. There was also another (inconsequential) silly but we bet you've already spotted that one!

Tech Tips (October 1983)

Ramped Pulse Generator For Stepper Motors — pin 1 of IC2 should be grounded, the Ramp Up and Ramp Down inputs accept negative, not positive, going pulses, and IC7 should be a 4011 rather than a 4001.

Active Loudspeaker (November 1983)

Gremlins attacked the parts list on page 72 leaving a trail of 00's in their wake. The ceramic tiles should be 150 mm (6") square and you need six of them. The BAF wadding needs to be about as wide as the enclosure's internal height, i.e., about 21", and long enough to loosely fill the space when rolled up with a bit left over to cover the back of the bass unit. The thinner the wadding you use, the greater the length you will require.

Mini Drum Synth (November 1983)

On the overlay diagram on page 37, RV2 has been shown as RV3 and vice-versa; the circuit diagram is correct.

Programmable Speech Board — Mini Mynah (February 1984)

The PCB for this project is double sided but only the underside pattern appears on the overlay drawing on page 26 and on the Foil Patterns page. The component side pattern appears on the PCB Foil Patterns page in this issue. The error does not affect PCBs supplied by our PCB service.

THE SAGA OF SILLY-COW VALLEY

Vivian Capel tells a tale from the dawn of the electronic age.

In the days when buffalo roamed freely over the American Praries an Indian village nestled in the hollow known as Silly-Cow Valley. No-one knew how it had acquired the name, whether it was due to a rampaging female buffalo or half-witted Indian squaw, the origin was lost in antiquity.

The white man was rarely seen in those parts, so, unspoiled by 'civilisation', the Indians lived in comparative peace except for occasional skirmishes with nearby tribes. All this was soon to change, for one day a stranger appeared in their valley. His visage and attire was like no other white man they had ever seen. His strange blue straight-sided wigwam perched on a rock overlooking the encampment; but no-one had seen it arrive, it had just appeared as though from nothing.

Being more inquisitive than hostile, the Indians made him welcome to their village, especially as he brought a seemingly inexhaustible supply of gifts. There were large numbers of multi-coloured baubles, insect-like beads with long springy legs that delighted the children, and much more.

For the wives of the chief there were special gifts, fine buffalo hides dyed in bright colours, and for the favourite wife, a real rarity for those parts, a hippopotamus skin. In return all he asked was to be allowed to come and go as he pleased, and to observe and talk to the people.

Chief Sitting-Bull readily agreed, so for many moons the stranger became a familiar visitor to the camp. Often he would be invited to a camp-fire pow-wow and entertainment with the Chief, and they became firm friends. Always though he carried a notebook, and wrote down carefully anything he heard which seemed to interest him.

One evening while they were relaxing after a particularly good meal at the camp fire, the Chief asked him about his book. "What are these marks you keep making in this thing?" he said. "White man's writing," came the reply, "I put down here anything I wish to remember, then later I can read it and recall all I have seen and heard."

The Chief took the book, turned it this way and that, but could make nothing of it. "Why you do this?" he asked.

The stranger paused, looking intently into the burning embers. "I am a traveller," he said at length, "I have travelled far in search of the Eternal Truth, the Great Principle, and I must continue on until it is found."

"Then why you come here?" grunted the Chief.

"I am drawn to this place, I have been here before and seen so many miracles that you could never understand that I know it is here I will find what I seek."

"We've not seen you before, when you come?" demanded the Chief.

A faint smile crossed the strangers visage, "Not of this time," he said, "but far into the future, beyond the days of your sons' sons."

"I nounderstand what you talk about," growled Chief Sitting-Bull as he handed the notebook back, "pale-face brother speak with forked tongued like snake-in-the-grass." He had a faint suspicion that the stranger was making a fool of him. However, those nearby who heard, seized on the description, and because he had given no other, he was henceforth called by the name Pythonograss, 'snake' seeming somewhat disrespectful.

"This writing though," the Chief added, "it interests me, could paleface brother teach Chief to read?" Having little alternative, Pythonograss agreed.

The Chief proved a quick and adept pupil, and as his ability improved, an avid reader. Poor Pythonograss was kept busy fetching books, papers and periodicals from his wigwam on the rock. Not wishing to keep the benefits of literacy to himself, Chief Sitting-bull taught first his family, then his braves the art of reading, and commanded that they in turn should teach their squaws and young ones.

Next he decided to produce his own newspaper, the *Daily Squawk* which he dedicated to a group of braves who wrote and copied. Soon, specialist periodicals began to appear such as *Scalp-Collectors Weekly*, and *Practical Witch-Doctor*.

One day, when Pythonograss entered the village he sensed a difference. The squaws were not wearing their coloured ornaments nor were the children playing with their 'insects'. On approaching the Chief's wigwam he saw tables piled high with them, while at others braves sat working, trying to piece different items together.

The Chief stood nearby with a periodical in his hand taken from the last pile Pythonograss had brought; it was ETI.

"How," he greeted, "these things you give the squaws, they 'lectronics — we know, we read." He tapped the magazine.

"Well, yes," admitted Pythonograss, "they're bits from my old guidance computer and time displacement unit. I though the squaws would like the colours. But what are you doing with them?"

"We makeum circuit, like it says here," the Chief replied tapping the magazine again, "only we design our own."

"So what exactly are you trying to make?"

"Sound generator to give us the mating call of the buffalo, then they come to us instead of we hunting them," returned the Chief with a look of satisfaction in his face. "You think good idea, yes?"

"We-ell," responded Pythonograss dubiously, "it sounds alright but it could wipe out the buffalo, make them extinct."

"No!" declared the Chief emphatically, "plenty buffalo on the plains, we huntem plenty, but always more."

Pythonograss left them to it and thoughtfully returned to his rock. So, the future of Silly-Cow Valley was already taking shape, but he was as far off as ever in completing

his quest. Surrounding tribes soon got to hear of the village with the Pale-face learning and came to investigate. Sitting-Bull shrewdly encouraged their interest, then sold them as many components and back issues of ETI that he could get out of Pythonograss, at an inflated barter rate. Yes, capitalism had come to Silly-Cow Valley too.

The Chief even set up a special row of wigwams to conduct the trade. At one end he erected a pole with the inscription Totenum Pole Road. Experiments and project building now was the regular pastime at most of the encampments in the area. This could be seen from the frequent puffs of smoke that appeared over them. A small one meant: "should have used a wire-wound for the surge limiter," while a large one declared: "oops, connected the reservoir round the wrong way."

These would be viewed with trepidation by travellers in distant caravan trains with mutterings that "those doggone injuns on the warpath again." Which often was true, as some of the more warlike tribes would ride out and take it out on whoever happened to be around, whenever a project didn't work — which was more often than not.

Meanwhile the village squaws were growing more discontented. Their ornaments had gone, and they hardly ever saw their men who spent their time using arrows for screwdrivers and spears for soldering irons (well everything is big in America).

So they just sat around the camp fire on their own talking squaw talk and looking enviously at the three who still had their gifts, the hides on which they sat. But two of these were even more jealous of the favourite

who flaunted her rare hippopotamus skin at every opportunity.

Finally, being able to stand it no longer, they plotted to steal the hide. Each had a son, and these they persuaded to do the deed, disguised as the braves of another tribe. So as she returned to her wigwam one night, the favourite was set upon by these two who tried to wrest the skin from her grasp. Now it so happened she had just read a book on karate, so in minutes her assailants were laid out cold.

The next day, Pythonograss wandered wearily into the village. Things had not gone as he hoped, he had broken the first law about interfering with local cultures and he was no nearer the great Truth that he sought. Casually, he glanced at the copy of the *Daily Squawk* pinned to the totem pole; it consisted mostly of an account of the previous night's fracas.

Suddenly, his eyes widened and clicked back to the headline. "This is it!, this is it!" he shouted throwing his hat in the air and cavorting around the pole. "I've found it, I've found it!" Then he made off as fast as he could back to his wigwam which after a few moments, melted into nothing with a soft whirring noise.

Chief Sitting-Bull who had observed all this from the entrance of his wigwam, pushed back his head-dress and scratched his head in amazement. Then he went over to the paper to discover just what had produced such an astonishing reaction. He could see nothing unusual at all, the headline just read:

"THE SQUAW ON THE HIPPOPOTAMUS IS EQUAL TO THE SON OF THE SQUAWS ON THE OTHER TWO HIDES."

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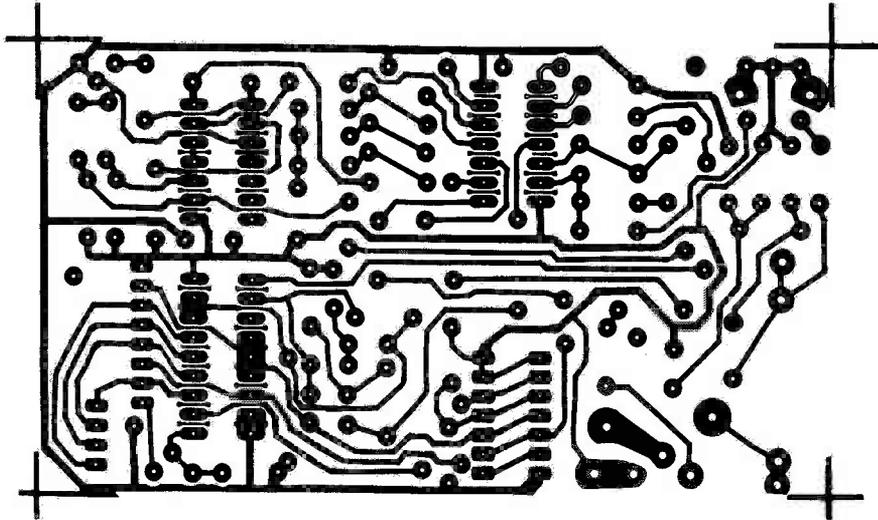
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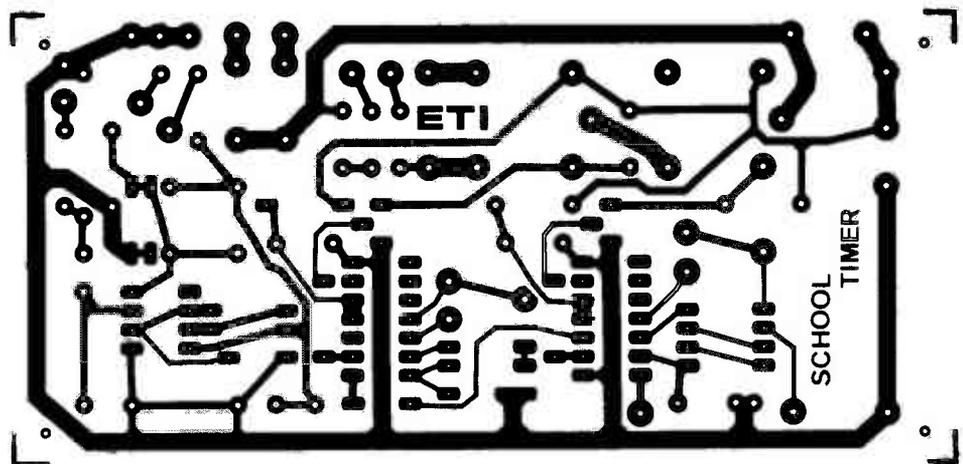
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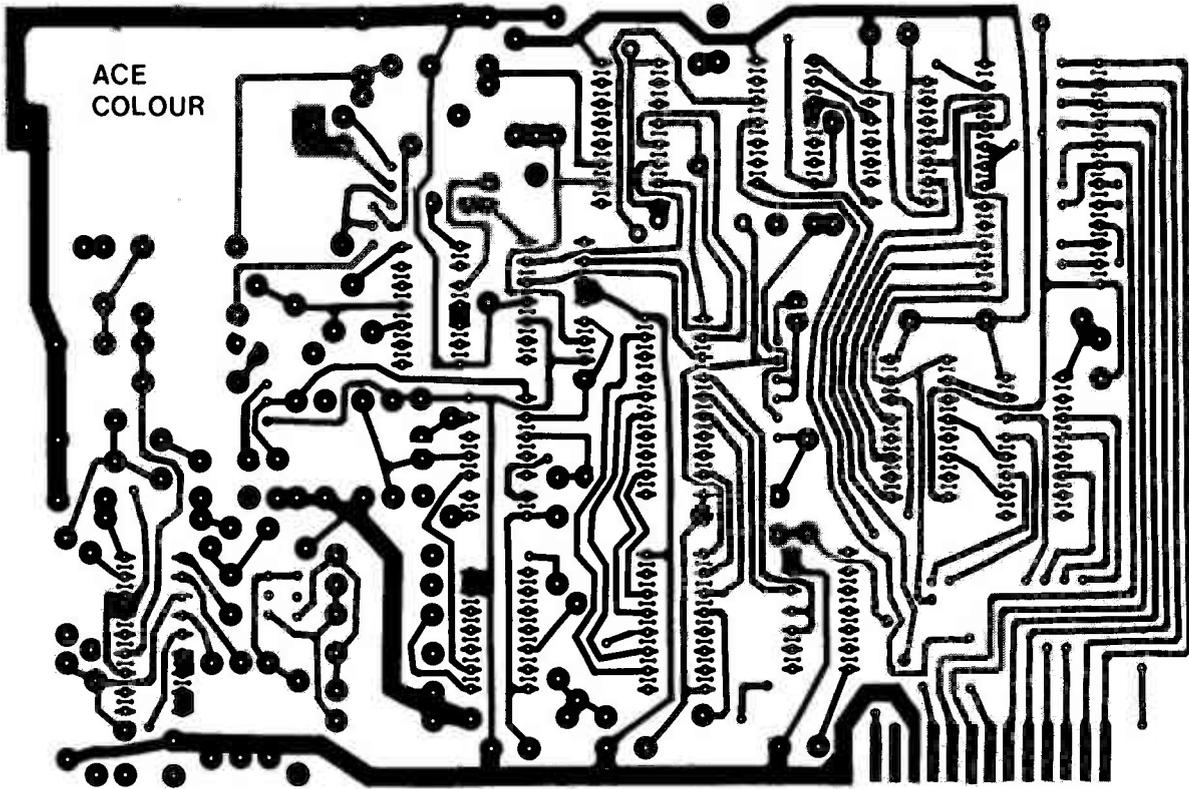
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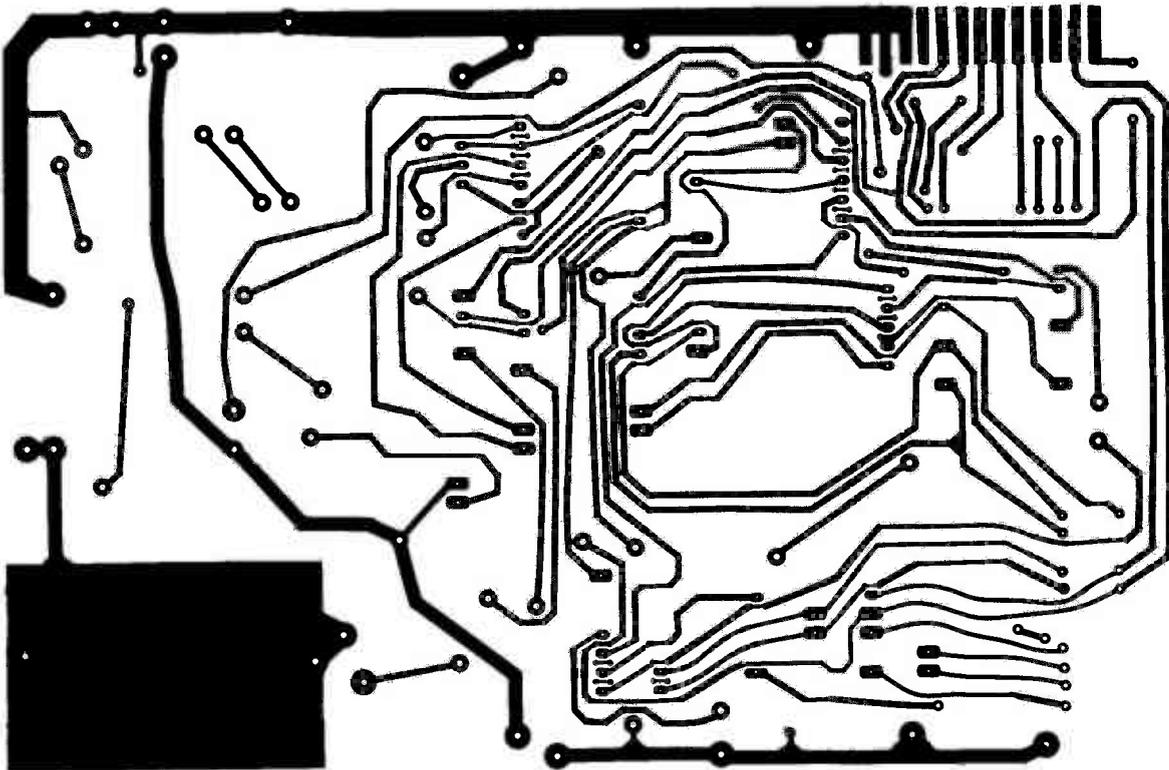
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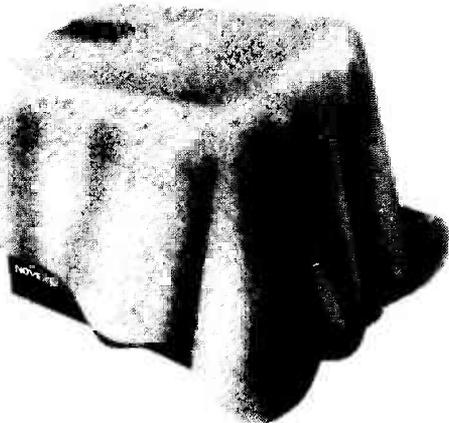
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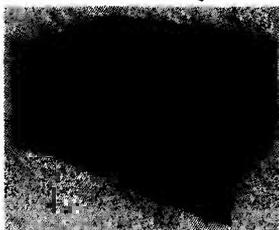
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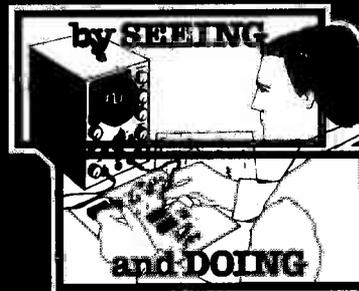
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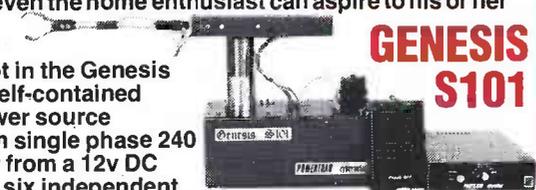
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Low-price robots from POWERTRAN

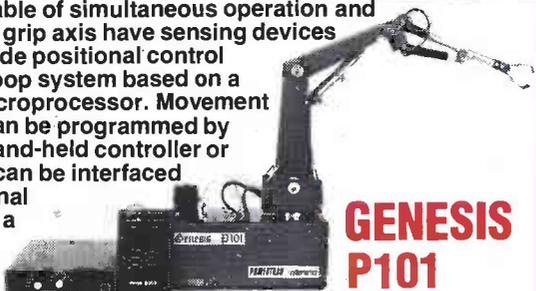
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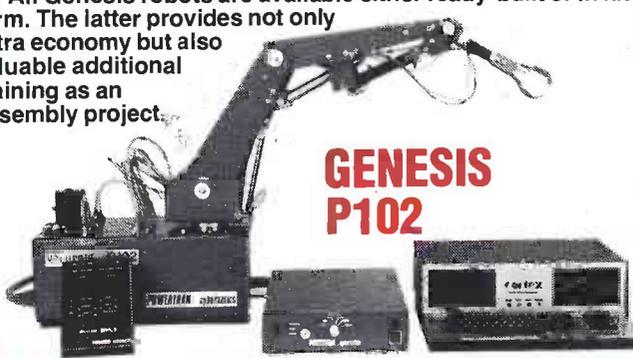
GENESIS S101



GENESIS P101

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GENESIS P102

Cortex 16 bit microcomputer



HEBOT II Turtle-type robot

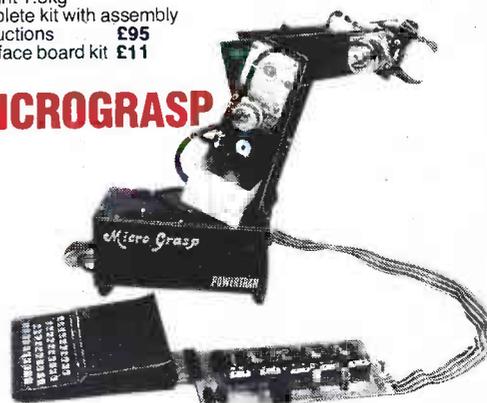
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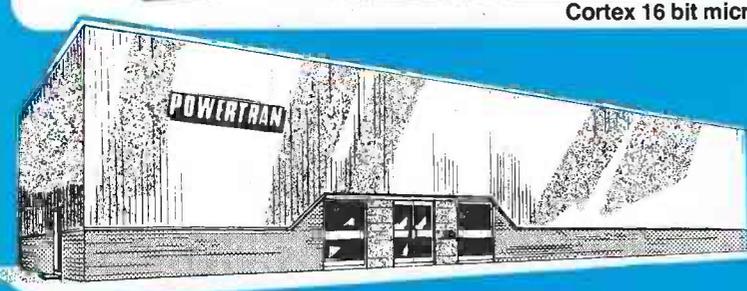
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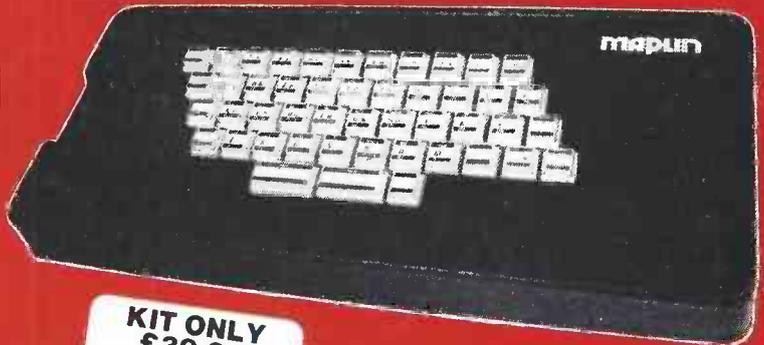


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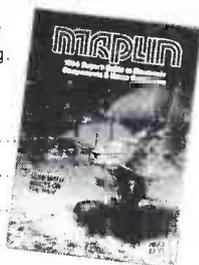
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