

ELECTRONICS & Wireless World

MARCH 1984

85p

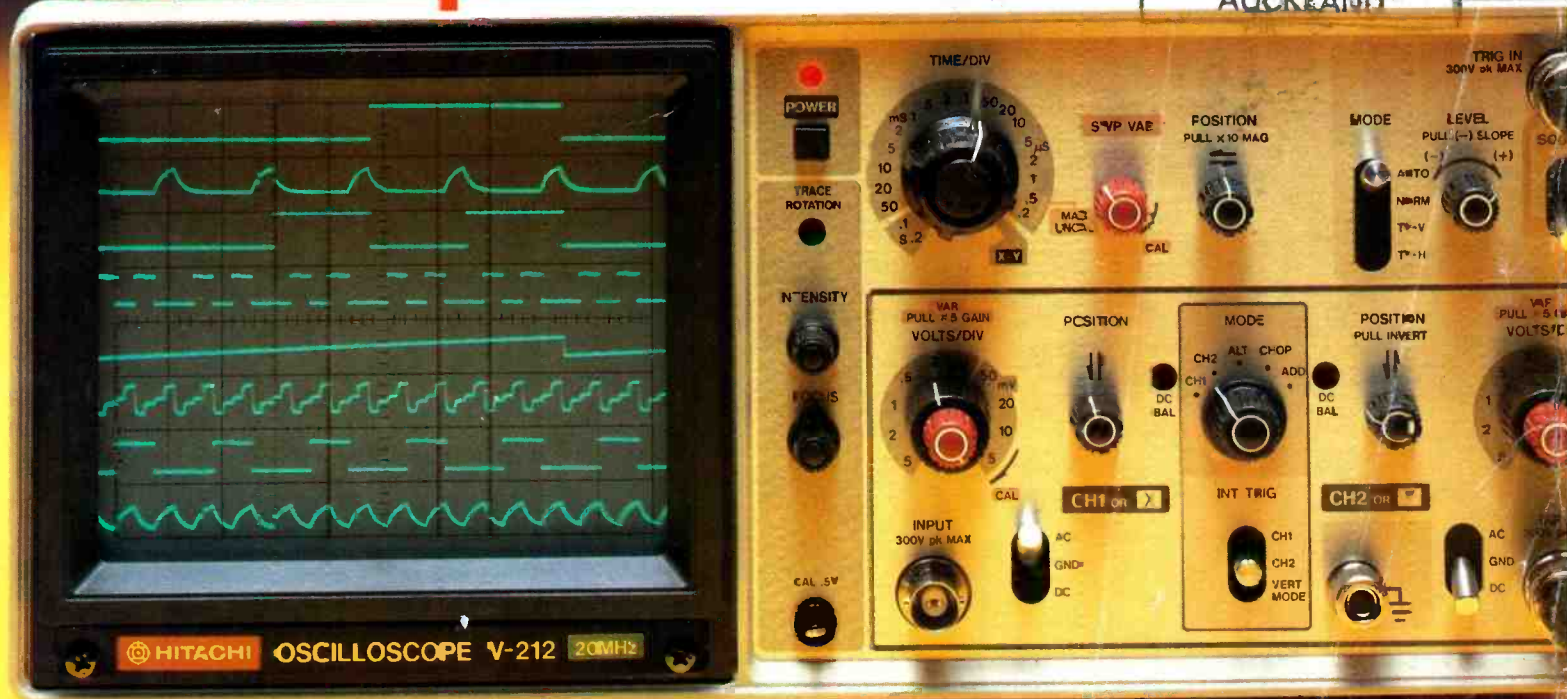


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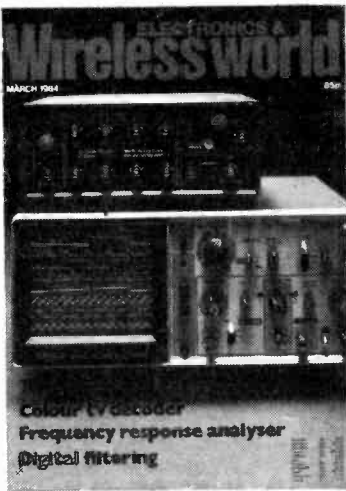
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ELECTRONICS & Wireless world

MARCH 1984

VOL 90 NO 1578



Front cover shows a Thurlby OM358 eight-trace multiplexer in use with a Hitachi V121 dual-trace oscilloscope to introduce our oscilloscope survey on page 57. Picture supplied by Thurlby.

NEXT MONTH

Bob Coates turns the Picotutor's 68705 microprocessor into a simple, low-cost interface for driving a teletypewriter from a microcomputer Centronics port.

As well as providing 5.5 and 6MHz sound, a synthesized tv modulator can be accurately switched to any u.h.f. channel.

Testing microprocessor systems is not so simple for the first-time builder without access to logic analysers or emulators. Carson gives some simple procedures that highlight hardware and software problems.

Surface wave, charge transfer and digital v.l.s.i. devices have enabled complex and powerful matched filters to be made. Geoffrey Robinson describes some examples that illustrate their different forms and uses.

Current issue price 85p, back issues (if available) £1.06, at Retail and Trade Counter, Units 1 & 2, Bankside Industrial Centre, Hopton Street, London SE1. Available on microfilm; please contact editor.

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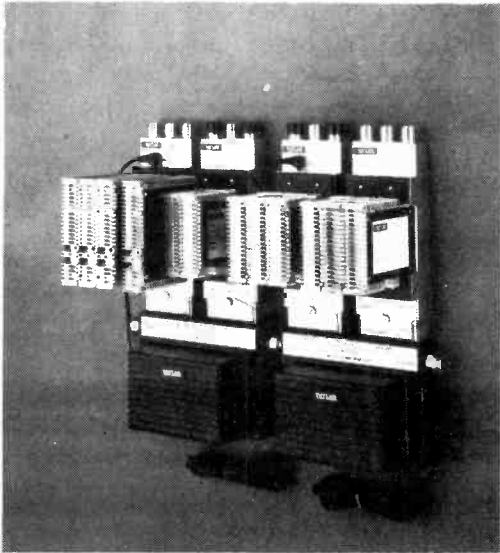
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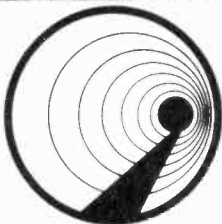
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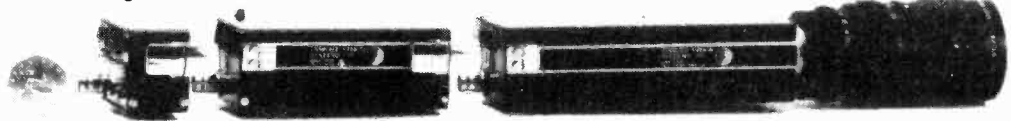
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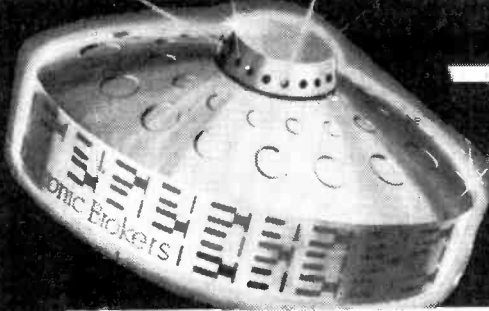
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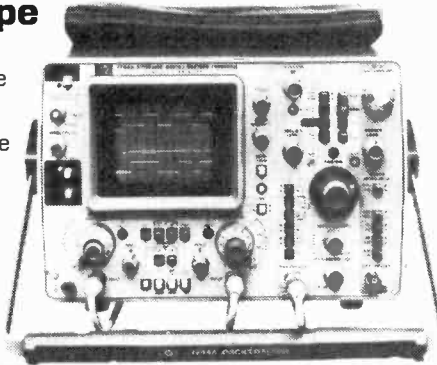
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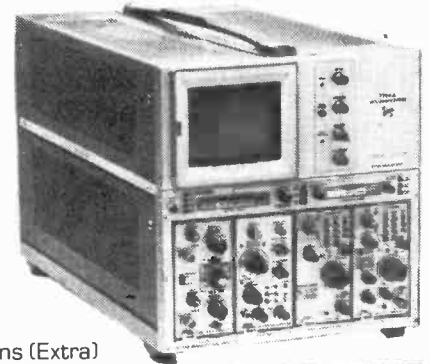
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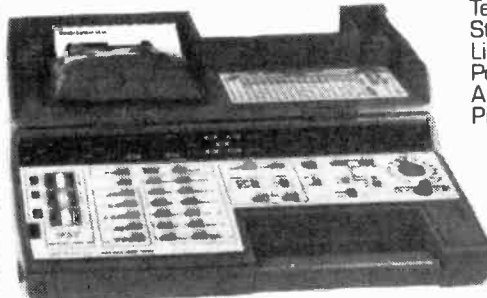
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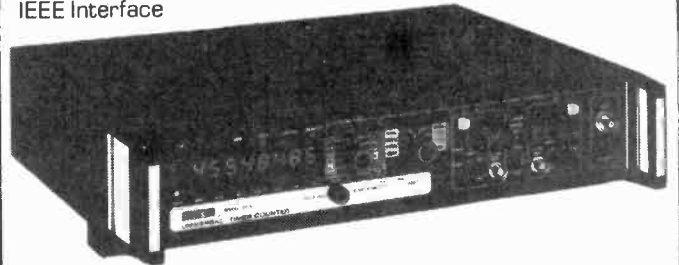
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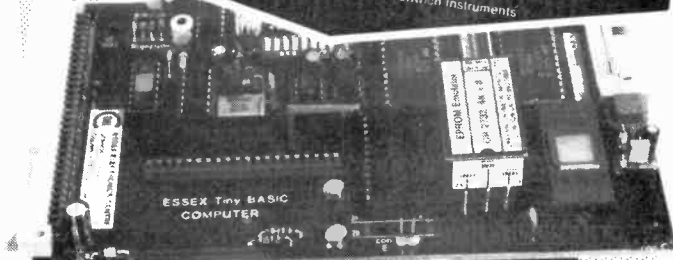
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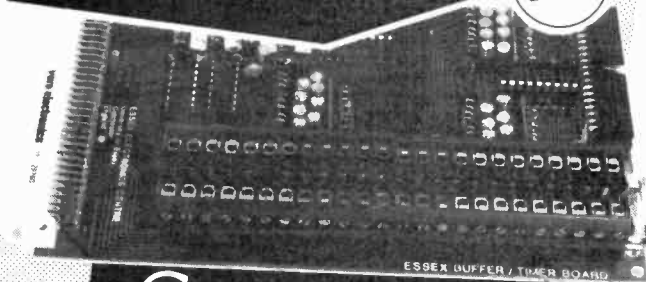
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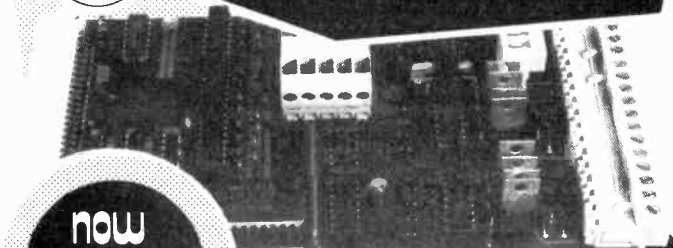
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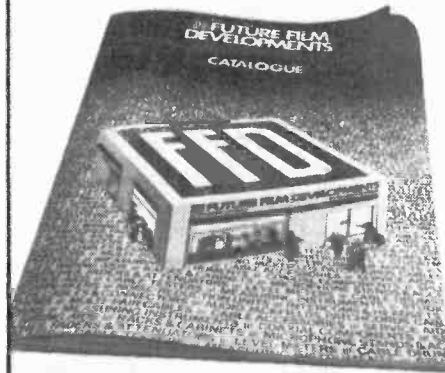
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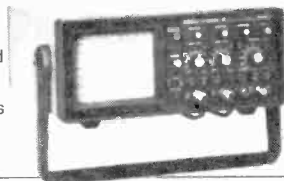
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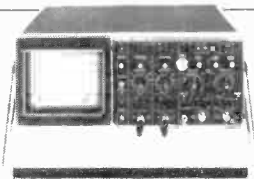
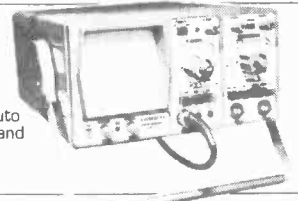
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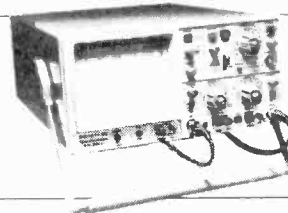
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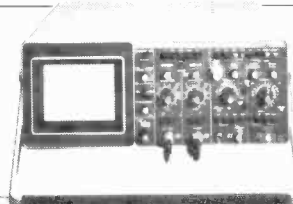


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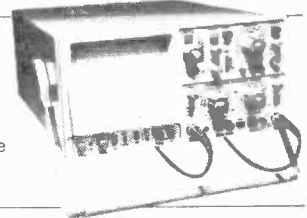


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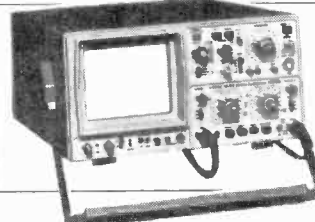
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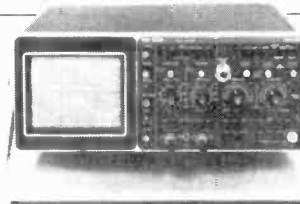


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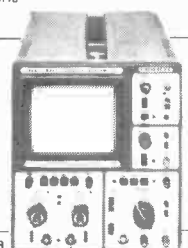


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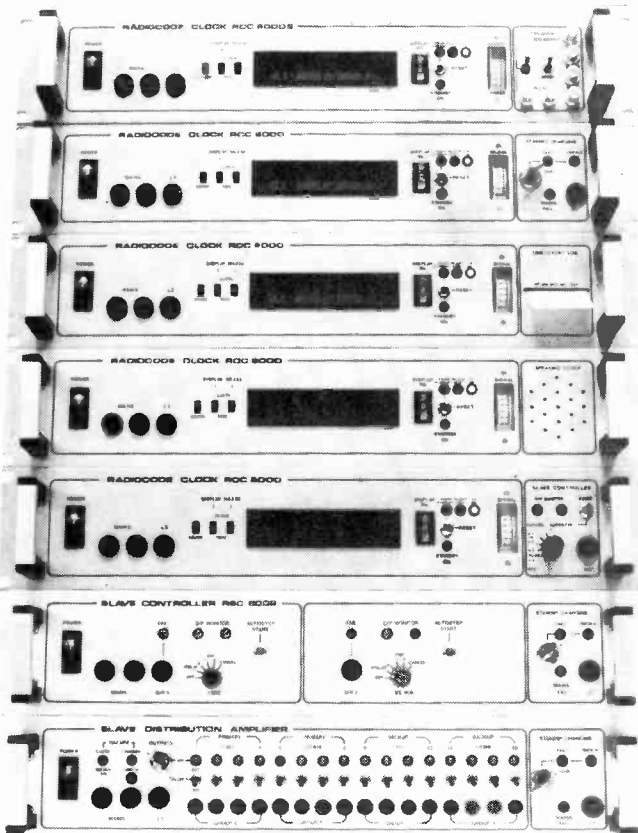


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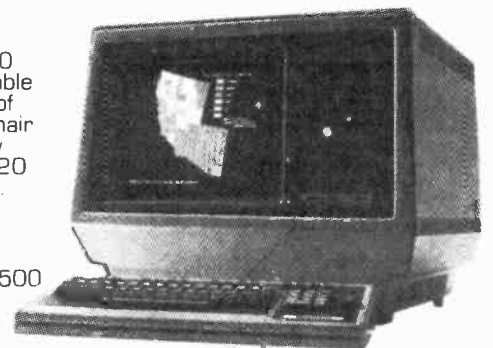
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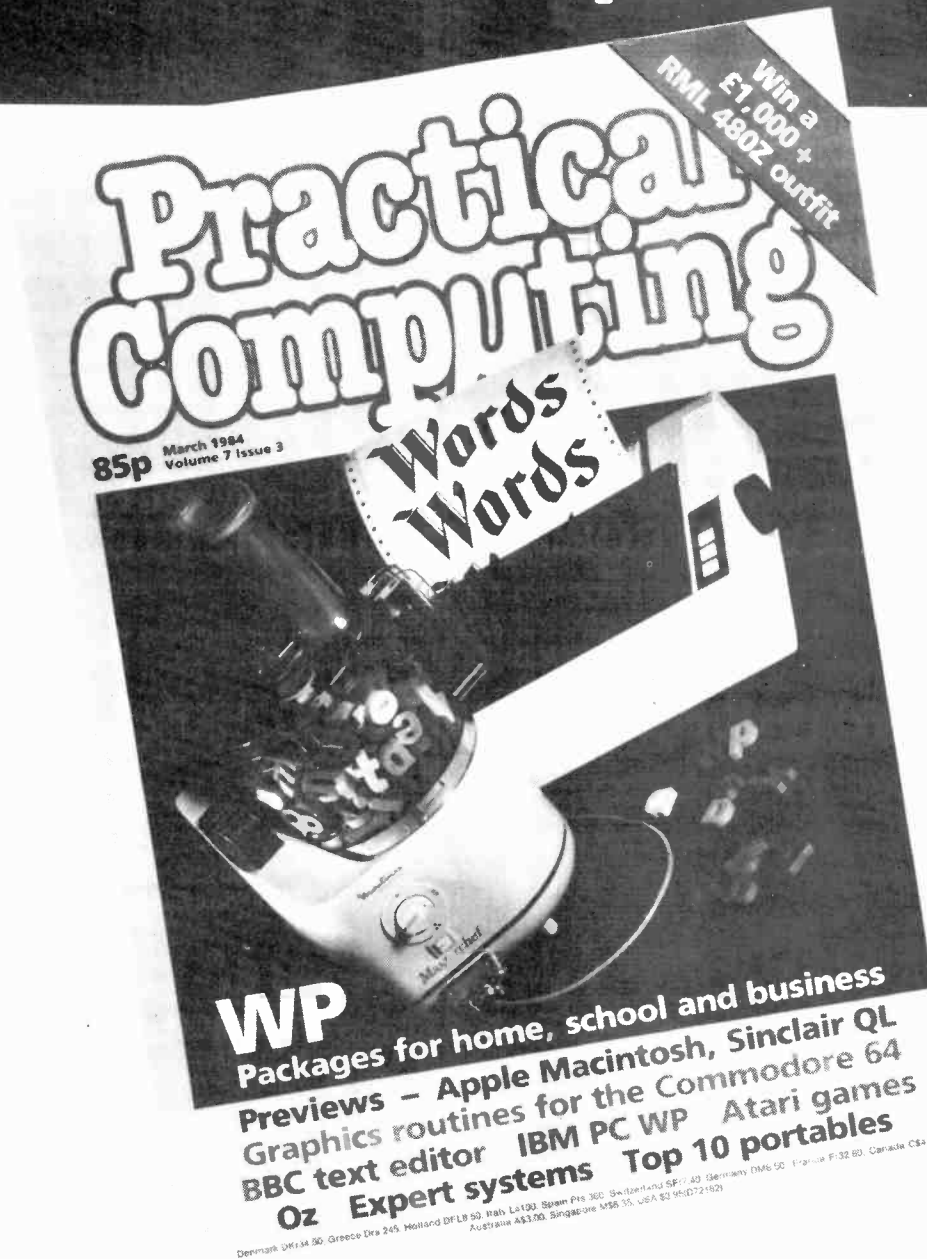
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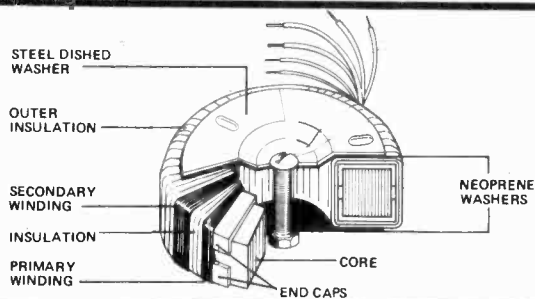
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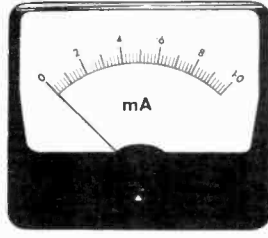
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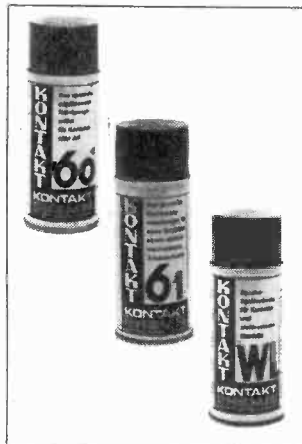
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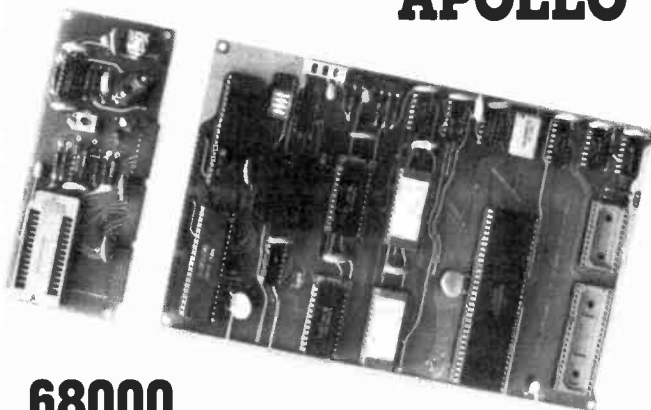
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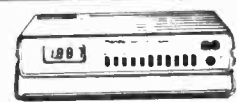
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KD25C 13 range 0.2A DC 2 meg ohm £28.95
KD30C 16 range 10A DC 2 meg ohm £27.95
KD30C 26 range 1A AC/DC 20 meg ohm £33.50
KD55C 28 range 10A AC/DC 20 meg ohm £38.95
METEX 3000 30 range 10A AC/DC 20 meg ohm £37.95
6010 28 range 10A AC/DC 20 meg ohm £37.95
7030 As 6010 but 0.1% basic £47.50
K0615 16 range 10A DC 2 meg plus Hfe tester £39.95
DM2350 21 range 10A AC/DC 20 meg ohm miniature hand held auto range with case £62.95
Beckman T100 34 range 10A AC/DC 20 meg ohm £56.35
Beckman T110 As T100 plus Cont. test etc £67.85
DM3350 19 range 10A AC/DC 2 meg ohm autorange £49.95

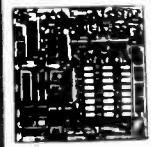
SK6330 24 range P-B autorange 10A AC/DC buzzer, with case £90.85
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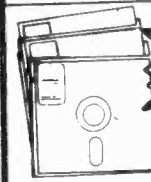


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I.T.T. 2020 CABINET

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600 600 MHz 3 ranges £132.35
1000 1 GHz 3 ranges £182.85
TFD40 8 digit LCO 40 MHz with batteries £138.00
TF200 8 digit LCO 200 MHz with batteries £186.75
Optional carry case £6.84 AC adaptor £7.90
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8610E 9 digit LED 600 MHz £125.35
8000B 8 digit LED 1 GHz £171.35
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SC110A Miniature 10 MHz battery portable Post free Nicads £12.50 AC adaptor £7.99
HM10310 MHz 2mV, 6 x 7 display plus component tester C/P £3.00
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HM203/4 Dual 20 MHz plus component tester £303.60
HM605 Dual 80 MHz, 1mV £580.00
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TMK500 23 ranges 30K/V 12A DC plus cont. buzzer £23.95 £11.95
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B30A 26 range 30K/V 10A AC/DC overload protection, etc £39.95
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All drives are supplied with manual, form disc and cables.

Single Drive: 100k £150; 200k £215*; 400k £235.
Single Drive with PSU: 100k £185; 200k £260; 400k £275.
Dual Drive with PSU: 2 x 100k £330; 2 x 200k £450*;
2 x 400k £495.

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

DISKETTES: Packet of 10
40 track SSSD £15 40 track DSDD £22
80 track SSDD £24 80 track DSDD £26
Carriage £2/box.

FLOPPICLENE Drive Head Cleaning Kit £14.50

Phone or send for our BBC leaflet

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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 Tale £135 + £2.50 carriage
HOBBIT Zero Memory Option £25 + £1 carriage
Computer Grade C12 cassette 50p each. £4.50 for 10 £1 carriage

MONITORS

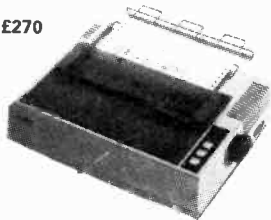
MICROVITEC 1431 14" RGB Std Res £215
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KAGA 12" GREEN Hi Res £106
SANYO DM8112CX 12" Green Hi Res £99
All leads included. Carriage £7

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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, an interactive business management game. Complete Package for £738 + £8 carr.

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EPSON FX80 £350. EPSON RX80 FT £270
EPSON FX-100 £555
NECPC80 23BE-N £310
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SEIKOSHA GP 250X £199
SEIKOSHA GP 700A Colour £375
JUKI 6100 Daisy Wheel £365
MCP 40 Col Printer/Plotter £129
Colour Graphics Plotter A3 size £270
GRAFPAD Graphics Tablet £120
Carriage £7



ACCESSORIES

Parallel Printer Lead £10 + £1 carriage
Serial Printer Lead £8 + £1 carriage
Epson Serial Interface 2K £60 + £1 carriage
Epson Serial Interface £50 + £1 carriage
NEC Serial Interface £42 + £1.50 carriage
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FX80 Tractor Attachment £37 + £1.50 carriage
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A low cost unit that opens up the full range of Real-Time applications. With its full battery backup, possibilities include an Electronic Diary, automatic document dating, precise timing and 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.

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.
★ Programming voltage selector switch is provided with a safe position.
★ Warning indicator to show programming in progress.
★ Programmer can read, blank check, program and verify at any address/addresses on the EPROM.
★ Simple menu driven software supplied on cassette (transferable to disc).
★ Full editor with ASCII disassembler.
★ Programmer complete with cables, software and operating instructions: £79.50 + £2 p. & p.

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Advanced User Guide (£2 p & p) £12.95
Assembly Lang Prog. for BBC £8.95
Assembly Lang programming on BBC
Micro by Ferguson and Shaw £7.95
Basic Prog. for BBC £5.95
BBC An Expert Guide £6.95
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Creating Adventure Programs £6.95
Discovering Machine Code £6.95
Structured Programming £6.50
The Friendly Computer Book BBC £4.50
Beyond Basic BBC £7.25

Large number of other titles stocked

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.

PRODUCTION PROGRAMMER: 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 ensures easy eprom selection and reliable programming in minimum programming times. £695 + £6 carriage.

★★ ATTENTION ★★

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

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 up to 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

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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(Speedblock Type)			
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20	145p	125p	195p
26	175p	150p	240p
34	200p	160p	320p
40	220p	190p	340p
50	235p	200p	390p

D CONNECTORS

	No. of ways			
	9	15	25	37
MALE				
Solder	80p	105p	160p	250p
Angled	150p	210p	250p	365p
FEMALE				
Solder	105p	160p	200p	335p
Angled	165p	215p	290p	440p
Hoods	90p	85p	90p	100p
IDC 15-way plug	340p	Socket 400p		
IDC 25-way plug	385p	Socket 450p		

TEXTPOOL ZIF

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

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4-way 70p	8-way 90p
6-way 85p	10-way 140p

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24" Ribbon Cable with Headers				
	14-pin	16-pin	24-pin	40-pin
1 end	145p	165p	240p	350p
2 ends	210p	230p	345p	540p

24" Ribbon Cable with Sockets				
	20-pin	26-pin	34-pin	40-pin
1 end	160p	200p	280p	300p
2 ends	290p	370p	480p	525p

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

RS 232 JUMPERS

(25-way D)		
24" Single end Male	.....	£5.00
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
	40p	100p	
14pin	40p	100p	
16pin	50p	110p	
24pin	100p	150p	
40pin	200p	225p	

AMPHENOL CONNECTORS

36-way plug Centronics Parallel Solder £5.25 IDC £4.95
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

RIBBON CABLE

(Grey/meter)	
10-way	40p
16-way	80p
20-way	85p
26-way	120p
34-way	180p
40-way	180p
50-way	200p
64-way	280p

EURO CONNECTORS

DIN 41617	Plug	Skt
21-way	160p	165p
31-way	170p	170p
DIN 41612		
2x32-way St. Pin	220p	275p
2x32-way Ang. Pin	275p	320p
3x32-way St. Pin	260p	300p
3x32-way Ang. Pin	375p	350p

EDGE CONNECTORS

		0.1"'	0.156"'
2x12-way (Vic)	350p	-	-
2x18-way	-	140p	-
2x22-way	190p	240p	-
2x23-way	175p	-	-
2x25-way	225p	220p	-
2x28-way	190p	-	-
1x43-way	260p	-	-
2x43-way	365p	-	-
1x77-way	600p	-	-
S100 Conn			600p

TEST CLIPS

14-pin 275p	40-pin £6	16-pin £3
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7404	25p	74279	55p
7405	25p	74283	50p
7406	25p	74285	160p
7407	25p	74286	180p
7408	25p	74289	90p
7409	25p	74298	120p
7410	25p	74351	150p
7411	25p	74365A	48p
7412	25p	74366A	48p
7413	40p	74367A	48p
7414	60p	74368A	48p
7415	60p	74370A	48p
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74LS06	20p	74LS293	50p
74LS07	20p	74LS297	90p
74LS08	20p	74LS298	90p
74LS09	20p	74LS299	200p
74LS10	20p	74LS321	240p
74LS11	20p	74LS322	240p
74LS12	20p	74LS323	240p
74LS13	20p	74LS324/624	403p
74LS14	20p	74LS348	150p
74LS15	20p	74LS348	150p
74LS16	20p	74LS352	70p
74LS17	20p	74LS353	70p
74LS18	20p	74LS356	175p
74LS19	20p	74LS363	180p
74LS20	20p	74LS364	180p
74LS21	20p	74LS366A	36p
74LS22	20p	74LS367A	36p
74LS23	20p	74LS368A	36p
74LS24	20p	74LS373	120p
74LS25	20p	74LS374	120p
74LS26	20p	74LS377	120p
74LS27	20p	74LS377	120p
74LS28	20p	74LS378	85p
74LS29	20p	74LS379	120p
74LS30	20p	74LS390	100p
74LS31	20p	74LS393	120p
74LS32	20p	74LS399	120p
74LS33	20p	74LS445	100p
74LS34	20p	74LS465	120p
74LS35	20p	74LS466	120p
74LS36	20p	74LS467	120p
74LS37	20p	74LS467	120p
74LS38	20p	74LS468	120p
74LS39	20p	74LS469	120p
74LS40	20p	74LS470	120p
74LS41	20p	74LS471	120p
74LS42	20p	74LS472	120p
74LS43	20p	74LS473	120p
74LS44	20p	74LS474	120p
74LS45	20p	74LS475	120p
74LS46	20p	74LS476	120p
74LS47	20p	74LS477	120p
74LS48	20p	74LS478	120p
74LS49	20p	74LS479	120p
74LS50	20p	74LS480	120p
74LS51	20p	74LS481	120p
74LS52	20p	74LS482	120p
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74LS58	20p	74LS488	120p
74LS59	20p	74LS489	120p
74LS60	20p	74LS490	120p
74LS61	20p	74LS491	120p
74LS62	20p	74LS492	120p
74LS63	20p	74LS493	120p
74LS64	20p	74LS494	120p
74LS65	20p	74LS495	120p
74LS66	20p	74LS496	120p
74LS67	20p	74LS497	120p
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74ALS05	20p	74ALS292	90p
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74ALS09	20p	74ALS299	200p
74ALS10	20p	74ALS321	240p
74ALS11	20p	74ALS322	240p
74ALS12	20p	74ALS323	240p
74ALS13	20p	74ALS324/624	403p
74ALS14	20p	74ALS348	150p
74ALS15	20p	74ALS348	150p
74ALS16	20p	74ALS352	70p
74ALS17	20p	74ALS353	70p
74ALS18	20p	74ALS356	175p
74ALS19	20p	74ALS363	180p
74ALS20	20p	74ALS364	180p
74ALS21	20p	74ALS366A	36p
74ALS22	20p	74ALS367A	36p
74ALS23	20p	74ALS368A	36p
74ALS24	20p	74ALS373	120p
74ALS25	20p	74ALS374	120p
74ALS26	20p	74ALS377	120p
74ALS27	20p	74ALS377	120p
74ALS28	20p	74ALS378	85p
74ALS29	20p	74ALS379	120p
74ALS30	20p	74ALS390	100p
74ALS31	20p	74ALS393	120p
74ALS32	20p	74ALS399	120p
74ALS33	20p	74ALS445	100p
74ALS34	20p	74ALS465	120p
74ALS35	20p	74ALS466	120p
74ALS36	20p	74ALS467	120p
74ALS37	20p	74ALS467	120p
74ALS38	20p	74ALS468	120p
74ALS39	20p	74ALS469	120p
74ALS40	20p	74ALS470	120p
74ALS41	20p	74ALS471	120p
74ALS42	20p	74ALS472	120p
74ALS43	20p	74ALS473	120p
74ALS44	20p	74ALS474	120p
74ALS45	20p	74ALS475	120p
74ALS46	20p	74ALS476	120p
74ALS47	20p	74ALS477	120p
74ALS48	20p	74ALS478	120p
74ALS49	20p	74ALS479	120p
74ALS50	20p	74ALS480	120p
74ALS51	20p	74ALS481	120p
74ALS52	20p	74ALS482	120p
74ALS53	20p	74ALS483	120p
74ALS54	20p	74ALS484	120p
74ALS55	20p	74ALS485	120p
74ALS56	20p	74ALS486	120p
74ALS57	20p	74ALS487	120p
74ALS58	20p	74ALS488	120p
74ALS59	20p	74ALS489	120p
74ALS60	20p	74ALS490	120p
74ALS61	20p	74ALS491	120p
74ALS62	20p	74ALS492	120p
74ALS63	20p	74ALS493	120p
74ALS64	20p	74ALS494	120p
74ALS65	20p	74ALS495	120p
74ALS66	20p	74ALS496	120p
74ALS67	20p	74ALS497	120p
74ALS68	20p	74ALS498	120p
74ALS69	20p	74ALS499	120p
74ALS70	20p	74ALS500	120p

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74ALS02	20p	74ALS280	46p
74ALS03	20p	74ALS283	50p
74ALS04	20p	74ALS290	55p
74ALS05	20p	74ALS292	90p
74ALS06	20p	74ALS293	50p
74ALS07	20p	74ALS297	90p
74ALS08	20p	74ALS298	90p
74ALS09	20p	74ALS299	200p
74ALS10	20p	74ALS321	240p
74ALS11	20p	74ALS322	240p
74ALS12	20p	74ALS323	240p
74ALS13	20p	74ALS324/624	403p
74ALS14	20p	74ALS348	150p
74ALS15	20p	74ALS348	150p
74ALS16	20p	74ALS352	70p
74ALS17	20p	74ALS353	70p
74ALS18	20p	74ALS356	175p
74ALS19	20p	74ALS363	180p
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74ALS21	20p	74ALS366A	36p
74ALS22	20p	74ALS367A	36p
74ALS23	20p	74ALS368A	36p
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74ALS25	20p	74ALS374	120p
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74ALS28	20p	74ALS378	85p
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74ALS30	20p	74ALS390	100p
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74ALS38	20p	74ALS468	120p
74ALS39	20p	74ALS469	120p
74ALS40	20p	74ALS470	120p
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74ALS42	20p	74ALS472	120p
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74ALS44	20p	74ALS474	120p
74ALS45	20p	74ALS475	120p
74ALS46	20p	74ALS476	120p
74ALS47	20p	74ALS477	120p
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74ALS51	20p	74ALS481	120p
74ALS52	20p	74ALS482	120p
74ALS53	20p	74ALS483	120p
74ALS54	20p	74ALS484	120p
74ALS55	20p	74ALS485	120p
74ALS56	20p	74ALS486	120p
74ALS57	20p	74ALS487	120p
74ALS58	20p	74ALS488	120p
74ALS59	20p	74ALS489	120p
74ALS60	20p	74ALS490	120p
74ALS61	20p	74ALS491	120p
74ALS62	20p	74ALS492	120p
74ALS63	20p	74ALS493	120p
74ALS64	20p	74ALS494	120p
74ALS65	20p	74ALS495	120p
74ALS66	20p	74ALS496	120p
74ALS67	20p	74ALS497	120p
74ALS68	20p	74ALS498	120p
74ALS69	20p	74ALS499	120p
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74VHC07	150p	74VHC297	90p
74VHC08	150p	74VHC298	90p
74VHC09	150p	74VHC299	200p
74VHC10	150p	74VHC321	240p
74VHC11	150p	74VHC322	240p
74VHC12	150p	74VHC323	240p
74VHC13	150p	74VHC324/624	403p
74VHC14	150p	74VHC348	150p
74VHC15	150p	74VHC348	150p
74VHC16	150p	74VHC352	70p
74VHC17	150p	74VHC353	70p
74VHC18	150p	74VHC356	175p
74VHC19	150p	74VHC363	180p
74VHC20	150p	74VHC364	180p
74VHC21	150p	74VHC366A	36p
74VHC22	150p	74VHC367A	36p
74VHC23	150p	74VHC368A	36p
74VHC24	150p	74VHC373	120p
74VHC25	150p	74VHC374	120p
74VHC26	150p	74VHC377	120p
74VHC27	150p	74VHC377	120p
74VHC28	150p	74VHC378	85p
74VHC29	150p	74VHC379	120p
74VHC30	150p	74VHC390	100p
74VHC31	150p	74VHC393	120p
74VHC32	150p	74VHC399	120p
74VHC33	150p	74VHC445	100p
74VHC34	150p	74VHC465	120p
74VHC35	150p	74VHC466	120p
74VHC36	150p	74VHC467	120p
74VHC37	150p	74VHC467	120p
74VHC38	150p	74VHC468	120p
74VHC39	150p	74VHC469	120p
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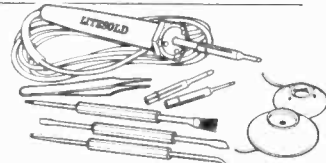


Features spike-free, solid state

proportional electronic temperature control inside the handle. Adjustable 280° to 400°C. Burn-proof 3-wire mains lead. Fitted 3.2mm Long-Life bit. 1.6, 2.4 and 4.7mm available. 240v a.c.

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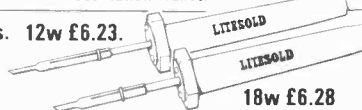


Possibly smallest mains iron in the world. Ideal for fine work. Slim

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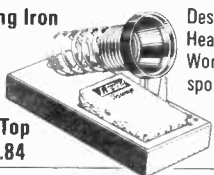


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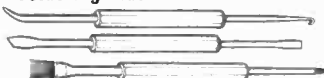
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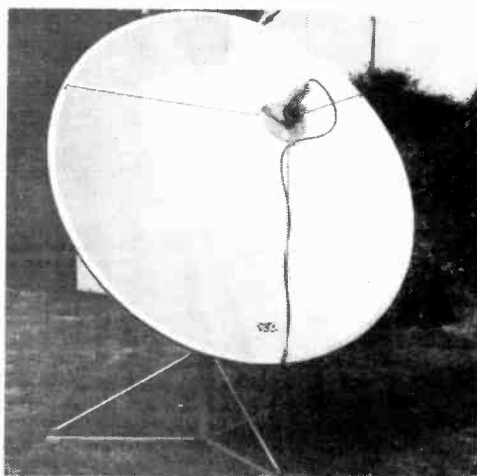


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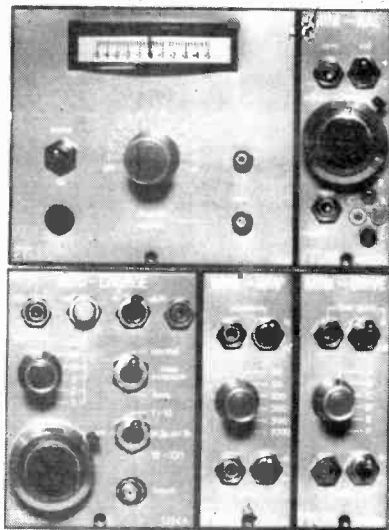
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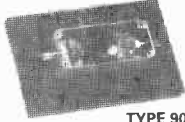
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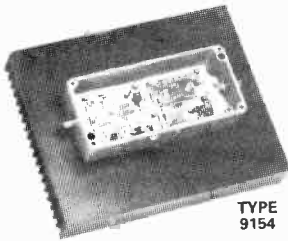
TYPE 9152



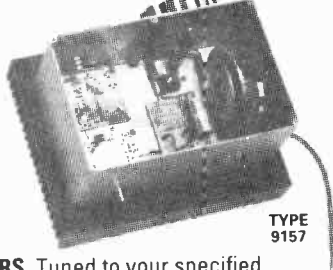
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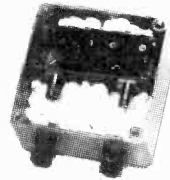
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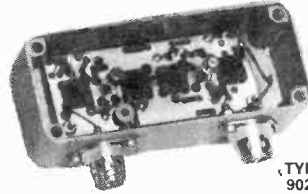
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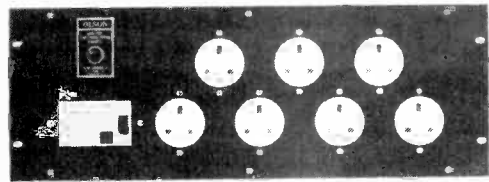
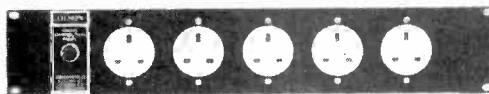
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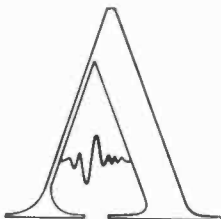
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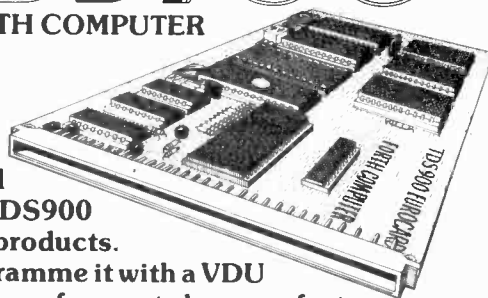
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No microprocessor development system is needed since the card contains a screen editor working with simple visual display units (VDUs). It also has the compiler for the FORTH source code. Debugging is inherent in the FORTH language and once the code is working, this can be output to a PROM programmer.

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AC107 0.55	AU110 3.00	BC184 0.11	BD144 2.00	BF361 0.20	MJE520 0.47	OC28 1.50	OC29 2.00	IN4002 0.06	2N2220 0.20	2N3906 0.17
AC126 0.25	BA145 0.13	BC212 0.11	BD181 1.20	BF398 0.20	MJE2955 1.70	OC32 2.00	OC35 1.50	R2010B 2.00	2N2221 0.20	2N4058 0.20
AC127 0.25	BA148 0.15	BC213 0.11	BD183 0.80	BF399 0.20	MJE3055 1.10	OC36 1.50	OC37 1.50	TIC226D 1.27	2N2222 0.20	2N4059 0.20
AC128 0.30	BA154 0.10	BC214 0.11	BD217 0.54	BF411 0.97	MPE102 0.35	OC41 1.50	OC42 0.90	TIC226D 1.27	2N2223 4.25	2N4060 0.16
AC128 0.30	BA155 0.11	BC237 0.11	BD238 0.54	BF438 0.46	MPE104 0.35	OC43 1.50	OC44 0.85	TIP299A 0.43	2N2368 0.25	2N4061 0.16
AC141 0.28	BA156 0.10	BC238 0.11	BDX10 0.91	BF485 0.30	MPE105 0.35	OC45 1.50	OC46 0.85	TIP300 0.45	2N2484 0.25	2N4062 0.16
AC141K 0.35	BAW62 0.05	BC303 0.34	BDX32 2.00	BF490 0.30	MPE106 0.26	OC47 1.50	OC48 0.85	TIP310 0.33	2N2646 0.50	2N4124 0.16
AC142 0.42	BAW62 0.05	BC307 0.11	BDY20 1.50	BF499 0.25	MPSA56 0.28	OC49 1.50	OC50 1.50	TIP32A 0.36	2N2904 0.32	2N4126 0.17
AC142K 0.35	BAX16 0.06	BC307 0.11	BDY60 2.75	BF520 0.25	MPSA56 0.28	OC51 1.50	OC52 1.50	TIP33A 0.54	2N2905 0.32	2N4286 0.15
AC176 0.30	BC107 0.16	BC308 0.11	BF115 0.35	BF521 0.25	MPSU01 0.53	OC53 1.50	OC54 1.50	TIP34A 0.67	2N2906 0.21	2N4288 0.18
AC176 0.30	BC108 0.16	BC327 0.12	BF152 0.16	BF522 0.25	MPSU06 0.65	OC55 1.50	OC56 1.50	TIP34A 0.67	2N2907 0.21	2N4289 0.18
AC176 0.30	BC109 0.16	BC328 0.12	BF153 0.16	BF523 0.25	MPSU06 0.65	OC57 1.50	OC58 1.50	TIP34A 0.67	2N2908 0.21	2N4400 0.11
AC176 0.30	BC110 0.16	BC329 0.12	BF154 0.17	BF524 0.25	MPSU06 0.65	OC59 1.50	OC60 1.50	TIP34A 0.67	2N2909 0.21	2N4401 0.11
AC176 0.30	BC111 0.16	BC330 0.12	BF155 0.17	BF525 0.25	MPSU06 0.65	OC61 1.50	OC62 1.50	TIP34A 0.67	2N2910 0.21	2N4402 0.11
AC176 0.30	BC112 0.16	BC331 0.12	BF156 0.17	BF526 0.25	MPSU06 0.65	OC63 1.50	OC64 1.50	TIP34A 0.67	2N2911 0.21	2N4403 0.11
AC176 0.30	BC113 0.16	BC332 0.12	BF157 0.17	BF527 0.25	MPSU06 0.65	OC65 1.50	OC66 1.50	TIP34A 0.67	2N2912 0.21	2N4404 0.11
AC176 0.30	BC114 0.15	BC333 0.12	BF158 0.17	BF528 0.25	MPSU06 0.65	OC67 1.50	OC68 1.50	TIP34A 0.67	2N2913 0.21	2N4405 0.11
AC176 0.30	BC115 0.18	BC334 0.12	BF159 0.17	BF529 0.25	MPSU06 0.65	OC69 1.50	OC70 1.50	TIP34A 0.67	2N2914 0.21	2N4406 0.11
AC176 0.30	BC116 0.19	BC335 0.12	BF160 0.17	BF530 0.25	MPSU06 0.65	OC71 1.50	OC72 1.50	TIP34A 0.67	2N2915 0.21	2N4407 0.11
AC176 0.30	BC117 0.23	BC336 0.12	BF161 0.17	BF531 0.25	MPSU06 0.65	OC73 1.50	OC74 1.50	TIP34A 0.67	2N2916 0.21	2N4408 0.11
AC176 0.30	BC118 0.18	BC337 0.12	BF162 0.17	BF532 0.25	MPSU06 0.65	OC75 1.50	OC76 1.50	TIP34A 0.67	2N2917 0.21	2N4409 0.11
AD149 0.75	BC125 0.18	BC338 0.12	BF163 0.17	BF533 0.25	MPSU06 0.65	OC77 1.50	OC78 1.50	TIP34A 0.67	2N2918 0.21	2N4410 0.11
AD161 0.35	BC126 0.18	BC339 0.12	BF164 0.17	BF534 0.25	MPSU06 0.65	OC79 1.50	OC80 1.50	TIP34A 0.67	2N2919 0.21	2N4411 0.11
AD162 0.35	BC127 0.18	BC340 0.12	BF165 0.17	BF535 0.25	MPSU06 0.65	OC81 1.50	OC82 1.50	TIP34A 0.67	2N2920 0.21	2N4412 0.11
AF106 0.35	BC136 0.19	BCY42 0.30	BF181 0.28	BF182 0.30	BY100 2.40	OC83 1.00	OC84 1.00	ZTX107 0.12	2N708 0.25	2N3053 0.25
AF114 0.75	BC137 0.19	BCY43 0.30	BF183 0.28	BF184 0.28	BY100 2.40	OC85 1.00	OC86 1.00	ZTX107 0.12	2N708 0.25	2N3054 0.25
AF115 0.75	BC147 0.12	BCY58 0.18	BF185 0.28	BF186 0.28	BY100 2.40	OC87 1.00	OC88 1.00	ZTX107 0.12	2N708 0.25	2N3055 0.25
AF116 0.75	BC148 0.12	BCY59 0.18	BF187 0.28	BF188 0.28	BY100 2.40	OC89 1.00	OC90 1.00	ZTX107 0.12	2N708 0.25	2N3056 0.25
AF117 0.75	BC149 0.12	BCY60 0.18	BF189 0.28	BF190 0.28	BY100 2.40	OC91 1.00	OC92 1.00	ZTX107 0.12	2N708 0.25	2N3057 0.25
AF118 0.75	BC150 0.12	BCY61 0.18	BF191 0.28	BF192 0.28	BY100 2.40	OC93 1.00	OC94 1.00	ZTX107 0.12	2N708 0.25	2N3058 0.25
AF119 0.75	BC151 0.12	BCY62 0.18	BF193 0.28	BF194 0.28	BY100 2.40	OC95 1.00	OC96 1.00	ZTX107 0.12	2N708 0.25	2N3059 0.25
AF186 1.00	BC158 0.13	BCZ11 0.17	BF195 0.14	BF196 0.14	Series 0.17	OC97 1.00	OC98 1.00	ZTX107 0.12	2N708 0.25	2N3060 0.25
AF239 0.39	BC159 0.13	BD115 0.42	BF197 0.14	BF198 0.14	Series 0.17	OC99 1.00	OC100 1.00	ZTX107 0.12	2N708 0.25	2N3061 0.25
AF211 4.00	BC167 0.11	BD121 1.70	BF199 0.17	BF200 0.17	CRS140 0.60	OC101 1.00	OC102 1.00	ZTX107 0.12	2N708 0.25	2N3062 0.25
AF212 4.00	BC170 0.11	BD123 2.80	BF201 0.17	BF202 0.17	CRS340 0.75	OC103 1.00	OC104 1.00	ZTX107 0.12	2N708 0.25	2N3063 0.25
ASV26 1.40	BC171 0.11	BD124 2.80	BF203 0.17	BF204 0.17	CRS340 0.75	OC105 1.00	OC106 1.00	ZTX107 0.12	2N708 0.25	2N3064 0.25
ASV27 0.90	BC172 0.11	BD131 0.44	BF244 0.48	GEX66 3.00	GEX66 3.00	OC107 1.00	OC108 1.00	ZTX107 0.12	2N708 0.25	2N3065 0.25

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A2087 13.50	E180C 10.50	EF86 1.75	GXU1 15.35	QZ4 3.50	QY3-125 66.50	UF42 2.10	4-400A 87.00	6CH6 13.00	12AY7A 4.00	6524 3.00
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A2293 16.00	E180C 10.50	EF92 6.37	GXU4 44.50	PC88 2.50	QY4-400 74.20	UF89 2.00	4C35 28.00	6CW4 8.00	12BA6 2.50	6570 4.50
A2426 27.50	E280C 12.00	EF93 1.50	GXU5 20.00	PC95 1.75	QY5-3000A 1.75	UL41 3.50	4X150A 60.00	6D2 1.50	12B6 3.00	6575 28.00
A2521 22.50	E280C 12.00	EF94 2.50	GY501 3.00	PC97 1.75	QY6-200 32.70	UL84 1.75	4X150D 36.00	6D2 1.50	12B7 2.75	6577 6.00
A2900 15.00	E280C 12.00	EF98 2.00	GY502 3.00	PC98 1.75	R10 6.00	UL84 1.75	4X250A 55.00	6D2 1.50	12B7 2.75	6578 6.00
A3343 45.00	E280C 12.00	EF183 2.00	GY503 3.00	PC98 1.75	R17 3.00	UL84 1.75	4X250A 55.00	6D2 1.50	12B7 2.75	6579 6.00
A3343 45.00	E280C 12.00	EF184 2.00	GY504 3.00	PC98 1.75	R17 3.00	UL84 1.75	4X250A 55.00	6D2 1.50	12B7 2.75	6580 6.00
A3343 45.00	E280C 12.00	EF185 2.00	GY505 3.00	PC98 1.75	R17 3.00	UL84 1.75	4X250A 55.00	6D2 1.50	12B7 2.75	6581 6.00
A3343 45.00	E280C 12.00	EF186 2.00	GY506 3.00	PC98 1.75	R17 3.00	UL84 1.75	4X250A 55.00	6D2 1.50	12B7 2.75	6582 6.00
A3343 45.00	E280C 12.00	EF187 2.00	GY507 3.00	PC98 1.75	R17 3.00	UL84 1.75	4X250A 55.00	6D2 1.50	12B7 2.75	6583 6.00
A3343 45.00	E280C 12.00	EF188 2.00	GY508 3.00	PC98 1.75	R17 3.00	UL84 1.75	4X250A 55.00	6D2 1.50	12B7 2.75	6584 6.00
A3343 45.00	E280C 12.00	EF189 2.00	GY509 3.00	PC98 1.75	R17 3.00	UL84 1.75	4X250A 55.00	6D2 1.50	12B7 2.75	6585 6.00
A3343 45.00	E280C 12.00	EF190 2.00	GY510 3.00	PC98 1.75	R17 3.00	UL84 1.75	4X250A 55.00	6D2 1.50	12B7 2.75	6586 6.00
A3343 45.00	E280C 12.00	EF191 2.00	GY511 3.00	PC98 1.75	R17 3.00	UL84 1.75	4X250A 55.00	6D2 1.50	12B7 2.75	6587 6.00
A3343 45.00	E280C 12.00	EF192 2.00	GY512 3.00	PC98 1.75	R17 3.00	UL84 1.75	4X250A 55.00	6D2 1.50	12B7 2.75	6588 6.00
A3343 45.00	E280C 12.00	EF193 2.00	GY513 3.00	PC98 1.75	R17 3.00	UL84 1.75	4X250A 55.00	6D2 1.50	12B7 2.75	6589 6.00
A3343 45.00	E280C 12.00	EF194 2.00	GY514 3.00	PC98 1.75	R17 3.00	UL84 1.75	4X250A 55.00	6D2 1.50	12B7 2.75	6590 6.00
A3343 45.00	E280C 12.00	EF195 2.00	GY515 3.00	PC98 1.75	R17 3.00	UL84 1.75	4X250A 55.00	6D2 1.50	12B7 2.75	6591 6.00
A3343 45.00	E280C 12.00	EF196 2.00	GY516 3.00	PC98 1.75	R17 3.00	UL84 1.75	4X250A 55.00	6D2 1.50	12B7 2.75	6592 6.00
A3343 45.00	E280C 12.00	EF197 2.00	GY517 3.00	PC98 1.75	R17 3.00	UL84 1.75	4X250A 55.00	6D2 1.50	12B7 2.75	6593 6.00
A3343 45.00	E280C 12.00	EF198 2.00	GY518 3.00	PC98 1.75	R17 3.00	UL84 1.75	4X250A 55.00	6D2 1.50	12B7 2.75	6594 6.00
A3343 45.00	E280C 12.00	EF199 2.00	GY519 3.00	PC98 1.75	R17 3.00	UL84 1.75	4X250A 55.00	6D2 1.50	12B7 2.75	6595 6.00
A3343 45.00	E280C 12.00	EF200 2.00	GY520 3.00	PC98 1.75	R17 3.00	UL84 1.75	4X250A 55.00	6D2 1.50	12B7 2.75	6596 6.00
A3343 45.00	E280C 12.00	EF201 2.00	GY521 3.00	PC98 1.75	R17 3.00	UL84 1.75	4X250A 55.00	6D2 1.50	12B7 2.75	6597 6.00
A3343 45.00	E280C 12.00	EF202 2.00	GY522 3.00	PC98 1.75	R17 3.00	UL84 1.75	4X250A 55.00	6D2 1.50	12B7 2.75	6598 6.00
A3343 45.00	E280C 12.00	EF203 2.00	GY523 3.00	PC98 1.75	R17 3.00	UL84 1.75	4X250A 55.00	6D2 1.50	12B7 2.75	6599 6.00
A3343 45.00	E280C 12.00	EF204 2.00	GY524 3.00	PC98 1.75	R17 3.00	UL84 1.75	4X250A 55.00	6D2 1.50	12B7 2.75	6600 6.00
A3343 45.00	E280C 12.00	EF205 2.00	GY525 3.00	PC98 1.75	R17 3.00	UL84 1.75	4X250A 55.00	6D2 1.50	12B7 2.75	6601 6.00
A3343 45.00	E280C 12.00	EF206 2.00	GY526 3.00	PC98 1.75	R17 3.00	UL84 1.75	4X250A 55.00	6D2 1.50	12B7 2.75	6602 6.00

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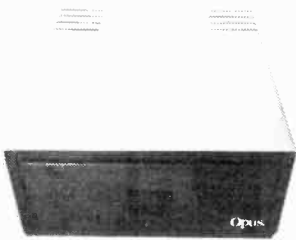
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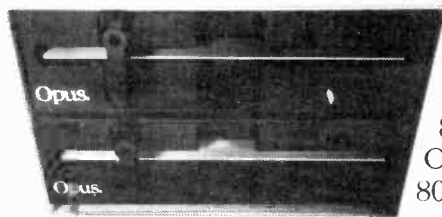
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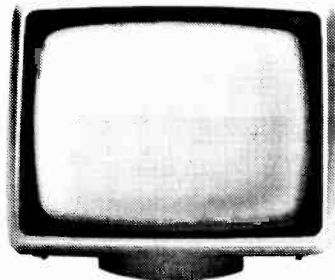


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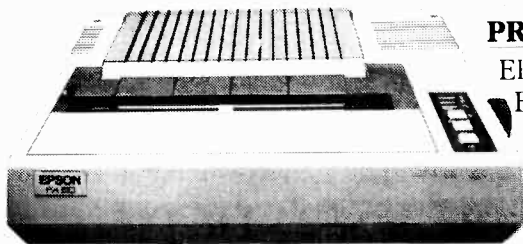


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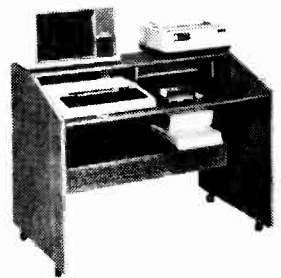
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There are two alternatives to ensure a proper return. Either every user must pay a fee to the inventor of the program, or the state must use the award-to-inventor system. Attempts have been made to shame users into the former course by writing on software packages the fact that the programmer must live and asking all users to buy their own expensive copy, for the fact is that popular material will always tend to be expensive, providing quite unjustified returns, like a best-selling book, while the minority-interest material will with the greatest difficulty recover costs. A book or program concerned with sewage cannot sell more copies than there are sewage works, yet may affect the lives

of every citizen. Thus authorship of all kinds is grossly ill-rewarded by the commercial system.

This problem is entirely new, because in the past technical authors might be reasonably expected to have academic jobs and programs be published free. There is no way that the cottage industry of software production can protect its copyright. It must rely on honourable treatment. If it doesn't get it and if as a nation we want this industry to continue we will have to pay the workers from central funds.

This will distress the computer retail industry who naturally want to sell information in a physical object with a limited life and accident prone condition, like a paperback book.

Anyone who wants to pirate a very valuable program need only buy enough battery backed-up ram to hold it, for there is no way anyone can argue that software can't be copied into ram: similarly it would be very hard to argue that paper tape cannot be cut from this ram.

If one uses selective-bit inversion no one could ever prove a tape was their program; it is foolish to contemplate it. In the end people will pay for convenience if the software creators aren't greedy and shops take reasonable mark-ups. Blatant commercial pirates ought to be prosecuted, but talk of prosecuting friends for exchanging one's own copies is nonsense.

COMMUNICATIONS

History in the making

Apart from those few radio and television pioneers who are regarded by the public as the great inventors – Marconi, Armstrong, Baird, Watson-Watt etc. – the bulk of engineers and scientists who have followed in their wake and contributed enormously to the technology have remained virtually unrecognised. Few engineers, let alone the public, associate the coaxial cable with Franklyn, the waveguide with Southworth, the optical fibre pipe with Kao . . . etc. Very few engineers write readable autobiographies, fewer still form the subject of in-depth studies by historians who can appreciate the precise value of the contributions they made to the state-of-art.

Occasionally one comes across exhortations to technologists such as “It isn’t enough in any science to do things. It is necessary to communicate what has been done . . . not only your scientific or engineering results but also talk about how they arose, who was involved, all those things that are too often unrecorded. People’s memories are not precise. But that does not matter because the essence of historical scholarship is to use memoirs and other primary sources with discretion. A person who has participated shouldn’t worry about that bias he has due to his participation. The historians will take care of that in due time by comparing sources and checking dates.”

Excellent advice – provided always that those later historians actually start digging, and manage to produce books that can be read with interest!

These thoughts have been generated by reading two recent exceptions to the general rule: Dr George Brown’s lively and outspoken recollections of his life as a research engineer “and part of which I was” (Angus Cupar Publishers) that covers not only his pioneer work on aerials, r.f. heating and colour television but the familiar problems of an engineer caught up in commercial and political struggles to gain acceptance for his ideas. The second book was Andrew Hodges’ excellent 600-page study of “Alan Turing – The Enigma” (Burnett Books, 1983) that provides a detailed study of the life and tragic early death of the brilliant mathematician who in 1936 first outlined the concept of the ‘universal machine’ from which was to spring the digital computer. He was a gifted member of that formidable team of cryptoanalysts who in the “creative anarchy” of Bletchley Park successfully tackled the difficult German naval enigma machine code; taught himself electronic and radio engineering in a couple of months at Hanslope Park; and struggled at NPL to get built the stored program computer ACE but found bureaucracy too strongly entrenched. In fairness to NPL, Turing was clearly not the easiest or most

diplomatic person to work in harness with, though capable of attracting intense loyalty from those who assisted him during wartime.

A few years ago I received a letter from a technician who had worked alongside Turing at Hanslope when, with Donald Bayley, he was developing the never-to-be-used Delilah speech encryption system. Alan Turing was then advising the whole laboratory on circuit calculations, he had picked up practical radio engineering in less than three months, claiming “When I first looked at radio I could see it was 100% mathematics anyway so it was no problem.”

Andrew Hodges has amassed an enormous amount of information on Turing, but the reason for his suicide in June 1954 remains a mystery. Hodges shows that the often-mentioned prosecution of Turing on homosexual charges was by then two years behind him. He speculates on the continued involvement of Turing with GCHQ in an era when the security investigations following the Burgess, MacLean, the third and fourth man scandals were still rumbling on, but provides no evidence of any link between these events and Turing’s untimely death. Certainly there can be no evidence that Turing, patriot that he was, was ever a real security risk.

NTSC, PAL and SECAM

Dr Brown is particularly revealing about the bitter struggle in the period 1945-1955 between RCA and CBS over the sequential and compatible colour television systems, and the subsequent struggle in Europe over NTSC (which was basically the RCA system), PAL and SECAM. He shows clearly, though from an American viewpoint, that politics rather than engineering dominated the CCIR meetings at Vienna and Oslo, and the similarity of Russian, American, French and British skulduggery in the form of overnight changes of policy, suppression of technical reports, rigging of delegations and the like. As one retired British television engineer put it to me, in recommending George Brown’s lively account of his struggles with RCA’s management, “Just change the name of the firm, and you have the story of my life”. For any young engineer who wishes to understand how things really happen, this is essential reading – though I noted that even the politically-conscious Dr Brown apparently failed to note one of the most astonishing events of the Oslo CCIR meeting in 1966. In April of that year, a member of the British delegation returned (unsuccessfully) to the UK during the event for the express purpose of trying to have the Post Office man in charge of the British delegation removed, leading later to an off-the-record press briefing in which the leader of the British team bitterly attacked the broadcasting delegates.

Data security

Presumably we shall never know whether Turing was under pressure from the security people in 1954 though one has no doubt that, as a wartime member of the Government School of Codes and Ciphers, he would have figured in those secret files that will remain inviolate under both the 30-year rule and the Data Protection Bill. Yet there is plenty of evidence that such files frequently contain information confused by mistaken identification etc. This might not matter so much were it not for the evidence that the Security Service advise outside organizations, including commercial firms, when recruiting engineers for sensitive posts. With such information now fully computerized, the effects on people’s careers can be far-reaching. Unlike many other countries not even the registrar, who will administer the British Act, will have power of inspection or supervision of either security or police files.

Clandestine war plans

Surprisingly one of the official files of 1953 now opened under the 30-year-rule details plans then proposed for clandestine activities in the event of war. The 1982 Falklands campaign showed that such activities still form an important part of British military planning. The 1953 proposals covered “stay-behind”, evader and coup-de-main activities. Sir John Sinclair, then head of the Special Intelligence Service, requested the use of 15 fast patrol boats, three trawlers, 42 fishing boats, 8 long-range aircraft, use of a submarine, and no less than 400 specially trained signals operators. Britain, France and the USA were each expected to provide 500 agents and 50 aircraft for the first three weeks following the outbreak of war. It was recognized that such activities were a gamble, possibly paying a high dividend or “next to none”. One wonders if the agents knew that they were to be part of a high risk gamble.

Costly clangers

Governments can and do make bad mistakes on their assessment of new electronics technology in addition to grossly underestimating the development costs. Now, the French Government and their nationalised Elf-Aquitaine oil company has been forced into revealing that they were “taken” to the tune of some £60million by the so-called Omega and Delta oil-sniffing systems that purported to reveal deeply buried geological strata to aircraft flying overhead, but was eventually shown to depend on prepared sketches fed into the machine. By surrounding the invention with an air of mystery, the Panamanian-registered company, Fisalma, was able to block all attempts to examine the costly prototypes. But it is not only the French

COMMENTARY

Government that has been known to back the wrong horse in electronics and telecommunications.

Recently Americans have become increasingly uneasy that the electronics equipment put into military aircraft, flight simulators etc can cost up to ten times its civilian counterpart. The electronics can cost many times more than basic aircraft. As one writer put it recently: "In the necessary secrecy that shrouds weapons development, a pipe dream can be pursued for years — and for billions of dollars — before someone catches on to its futility." The solution, it is suggested, would be to introduce independent technical monitoring of projects by a watchdog committee of top-notch engineers. But, one wonders, who would watch the watch-dogs? Engineers, as well as administrators, have been known to get it wrong.

The AM-stereo struggle

At the end of 1983 there was still no clear outcome to the "market-place" struggle in the USA between the four competing systems of a.m. stereo. In terms of transmitters, Harris had lost the lead to Kahn's independent sideband system used by some 80 stations including several major NBC music stations. Harris was stuck at about 65 stations, resulting from the FCC decision to restrain the company from marketing any more exciters until the type-acceptance dispute had been fully cleared up. Motorola was up to about 50 and their system has been endorsed by some large car radio firms. Trailing with single-figures was the Magnavox system, despite it being the original choice of FCC in 1979. Meanwhile Sony has marketed a \$90 combined a.m./f.m. portable that can receive any of the four a.m.-stereo systems and including a switch to widen the m.f. bandwidth to 12kHz. A multimode set has also been marketed by Sansui.

AMATEUR RADIO

50MHz extension

The Department of Trade and Industry has agreed to a substantial extension of the special research permits for 50MHz operation by British amateurs holding Class A licences. The number will go from 40 to 100. DTI have asked the RSGB to recommend additional names by March 31. With all British 405-line television broadcasting in bands 1 and 3 now due to end in the first week of January 1985, British amateurs are hoping that the DTI will make an early announcement about any plans to implement the recommendation in the interim Merriman Report in 1982 that an alloca-

tion in this part of the spectrum should be made available to all British amateurs. There remains the problem that this part of the frequency spectrum (except channel 1) is likely to remain in use for television in virtually all other European countries.

RTTY

Ian Wade, G3NRW, the current editor of the British Amateur Radio Teleprinter Group newsletter, estimates that about one half of BARTG members are still using mechanical teleprinters but many are in process of adopting computer-based electronic systems with over two-thirds of the membership owning home computers. Interest in the Amtor system with automatic correction of errors is also increasing rapidly and expected to really take off during 1984 with commercially manufactured units increasingly available. He also forecasts more amateur interest in digital data techniques including the "packet" systems. But there seems to be no end in sight to various problems of different technical standards, including the long standing problem of 45 versus 50 baud transmission, though some teleprinters, such as the Creed 444 will cope with both speeds. Bob Sayers, G8IYK is seeking contact with radio amateurs interested in adapting compact telephone-line facsimile equipments for h.f. transmission or for using such machines for other applications. He also points out that a special Met Office licence is needed to receive weather messages in r.t.t.y. format. Application forms for DTI licences can be obtained from Meteorological Office (Licensing) London Road, Bracknell, Berks, RG12 2SZ. Full title of the licence is "Receiving licence for the reception of meteorological information transmitted from special service stations".

During 1984 BARTG celebrates its Silver Jubilee having been founded in 1959. The group caters for those interested in most forms of data transmission, including r.t.t.y., Amtor, Fax, weather forecasting, satellites and telemetry. Current membership is about 1300. Membership details from John Beedie, G6MOK, 161 Tudor Road, Hayes, Middlesex UB3 2QG (telephone 01-561 0010). Apart from the quarterly newsletter BARTG publish "RTTY, the easy way".

Low power activity

Although extreme low-power operation is not an activity I would recommend to newcomers to the h.f. bands, it holds much interest for those with the necessary experience and patience. Indeed on some h.f. bands signals can come in at good strength from transmitters using power inputs of less than 5 watts over many thousands of miles. Low-power (QRP) operation in the UK has for a number of years been en-

couraged by the "G-QRP Club", formed in late-1974, and now having almost 2500 members. Rev George Dobbs, G3RJV, editor of its quarterly journal "Sprat" admits to being concerned that the fall-off of conditions on the h.f. bands due to the declining sunspot activity may make it more difficult to achieve good contacts on the higher of the h.f. bands but urges more activity on the "low-power calling frequencies" of 3560kHz and 7030kHz. He notes that low-power operation on these bands has not kept pace with the increasing number of members. He reports, however, an increasing interest in home construction of low power transmitters and compact direct-conversion receivers.

In brief . . .

George Stratton Loughton, founder in the 1920s of Eddystone Radio, died during December 1983. Eddystone was one of the first British firms to cater specifically for short-wave enthusiasts and radio amateurs with their "All World" series of receivers and components for home construction . . . RSGB membership has exceeded 35,000 for the first time . . . The RSGB National VHF convention is being held on March 24 at Sandown Park Racecourse, Esher, Surrey . . . A mobile rally is being held at the Carelon Community Centre by the Pontefract society on March 18 . . . An increasing number of amateurs in many parts of the world are now equipped for earth-moon-earth (moonbounce) contacts on the 1.3 and 2.3GHz band but Z25JJ, representing Africa, is closed for the time being while his equipment, including a massive 32ft dish reflector, is transported from Zimbabwe to South Africa . . . Much effort is being put into the rush building at the University of Surrey of its second spacecraft, UOSAT-B, which it hoped will be launched this Spring . . . Of the various Russian amateur satellites, RS6 and RS8 remain in operation. The problem on the L-band Oscar 10 transponder seems to have been successfully overcome . . . The IARU Region 1 Triennial Conference, bringing together the national IARU societies in Europe and Africa, is to be held in Sicily between April 7 and 14 . . . The installation of the RSGB's 50th President, R. G. Barrett, GW8HEZ, was at Cardiff Castle on January 14 . . . A number of changes affecting the British CB licence were introduced on February 1. No further licences are being issued to persons under 14 years of age but they can operate CB equipment under supervision. There is now an explicit ban on the playing of music and the re-transmission of radio and television broadcast material (both of which have always been illegal) and DTI draw attention to the CB Code of Practice in particular highlighting the recommendation that Channel 9 should be used for emergencies and assistance only.

PAT HAWKER, G3VA

Adaptable typewriter interface

Simple interface connects electronic typewriter to computer parallel output port. Self-documenting Pascal code facilitates translation into other languages that might be used in the target processor, and demonstrates how a printing routine is constructed rather than provides a rigid routine for only one situation.

Acquisition of a home-based computer requires a decision as to the type of printed output needed. The provision of a fully-formed letter printer allows a system to be used for word processing with a degree of professionalism that is absent from the usual low-definition dot-matrix machine. If an electronic typewriter is available then the simple interface described here enables it to be driven from a Centronics or other parallel output port.

The interface is in principle applicable to any typewriter mechanism that uses electronic-style switches to complete a circuit when a key is depressed. Virtually all daisy wheel printers use this type of mechanism. Since the majority of small computer systems do not have printer spooling (i.e. the system is dedicated to driving the printer whilst the printer is active) the computer is used to provide as much as possible of the intelligence of the interface.

Although the interface itself is simple it is necessary to do some investigation to determine the correct connection points for the various wires – and then further work to find the correct data for each printed character. The interface was actually connected to an Olivetti Praxis 35 and the specific data as to connection points and character data refer to this machine. Enough information is included to enable adaption to any other machine.

General considerations

In operation the printer sequentially grounds one of the lines marked A through H and reads the data appearing on all the lines a through h, Fig. 1. If no keys are closed then the data will be read as all high but otherwise the occurrence of a low will allow the closed key to be detected and decoded. Two points about this – first, a number of reads must give the same data for the printer to register the key closure and to avoid errors due to contact bounce. Second, not all possible crossing points on the matrix are used and so there are a number of possible data codes that may have no meaning to the printer as they should not be generated by the keyboard. Also there are two connections outside the matrix (I to i and J to j) used to tell the printer about keys that are pressed in conjunction with the main keyboard. Examples of this on the Praxis are Shift

by
C. M. Fortescue-Webb M.Sc.

and Keyboard 1 or Keyboard 2.

To simulate a key closure the circuit of Fig. 2 could be used. When the select key line is true then the low-going pulse on the input line be coupled through to the output. By using open collector gates there will be no interaction between the various keys. The difficulty of such a scheme is that a key select line is needed for every key and this requires a lot of hardware. By using a multiplexer and demultiplexer coupled with open collector drivers the final arrangement shown in Fig. 3 is realised. Now three lines are used to select the input row and a further three to select the output column. The remaining two lines on the eight-line computer output are used for the shift and keyboard 1/2 switches. Incidentally, if your computer will only output a seven-bit character on the parallel port then the keyboard 1/2 or equivalent line will have to be operated manually.

It is also necessary to prevent the computer passing data to the printer at a rate in excess of that at which it can accept the data. The interface shown here uses a software delay loop in the driving routine to ensure that the character rate is within specifications. A longer delay is used for those functions on the typewriter that take longest – carriage return (up to two seconds on the Praxis), fast return (timing as carriage return) and tab. The alternative is to use hardware consisting of something like a 555 timer with a variable current source depending on the character being printed, with the output from the timer being the busy line and used for character separation. To achieve a maximum transmission rate it would be necessary to find an internal (to the printer processor system) status line that will show if the printer can accept a character and then use this line for the BUSY/ACKnowledge reply to the computer.

When the computer outputs data on a Centronics interface the strobe line is made low for a short time (a few microseconds) to tell the printer that data is available.

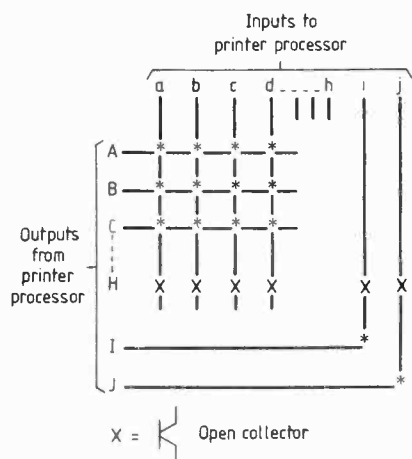


Fig. 1. Schematic of the matrix switching layout of typewriter keyboard. A keyswitch is present, normally open at intersections marked*. Pull-up resistors to V_{cc} are connected to lines a to j inclusive.

The printer responds by asserting BUSY and should pulse ACKnowledge low to signify that the character was accepted. When the printer is ready to accept another character it will drop BUSY. Many computer systems are content to ignore either BUSY or ACKnowledge but printers requiring line buffering (normally line printers) may use ACKnowledge to fill the line buffer and then assert BUSY whilst the characters are printing. Strictly the computer is not permitted to change the data on the Centronics port between the assertion of STROBE and the receipt

Charles Fortescue-Webb has been designing and producing microcomputer systems and electronic interfaces for eight years, with experience as chief engineer for a turnkey systems house in Ireland and as an independent consultant in microcomputer applications. His primary degree is in experimental physics and was followed by applied biological research for a M.Sc. degree. Application of minicomputers to the analysis and costing of civil engineering structures led onto work with microprocessor systems. His hobbies include sailing, bridge, woodworking and tinkering with cars and electronics.

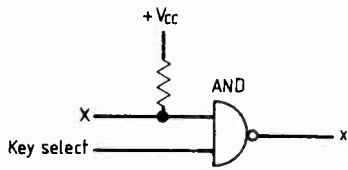


Fig. 2. Possible connection method to simulate a key switch connection when key-select is high. This circuit would be substituted at each * in Fig. 1, in which case a low on X will be coupled through to x via the open collector gate.

of an ACKnowledge, nor to assert STROBE whilst the printer is BUSY.

Circuit details

The functioning of the actual circuit is straightforward and the full schematic is shown in Fig. 4. The layout corresponds to that used in Fig. 3. The monostable between the strobe and busy lines is used to separate a multiple sequence of the same character into separate 'key depressions' by enabling the LS138 for a set time after each strobe pulse. The period of the monostable must be adjusted to be sufficient for the printer to recognise the character yet less than the intercharacter delay and the shown values provide a good starting point. The maximum R value is about 5kΩ due to limitations of the LS t.t.l. inputs.

The original was constructed on Vero d.i.p. breadboard using ribbon cable to couple the inputs and outputs. If a small system is being used then it may be more convenient to add on a eight-bit latch to the computer address/data lines rather than construct or purchase a specific parallel port.

If the keyboard uses greater than five volts then a small 5V supply will be needed for the logic and the inputs to the LS151 should be isolated using diodes connected in series with the lines to the LS151 from the keyboard with the anode connected to the interface. If a key is pressed on the keyboard whilst the interface is connected then the keyboard supply voltage can be coupled through to the multiplexer unless isolation from higher voltages is implemented.

The typewriter/printer lines are shown with the connection schematic for the Praxis. It is possible that your warranty on the typewriter could be effected by connecting this modification and so it is perhaps wise to wait until it is out of the warranty period. When making connections to this main board be aware that mos chips may be used internally and so static should be avoided (no nylon carpets, plastics worktops etc.). A soldering iron with low leakage or securely grounded would be a wise precaution if using soldered connections. If using a mains-powered wire-wrap tool then do not work on the interface whilst it is connected to the keyboard.

Detective work

One of the first operations is to examine the keyboard connections of the selected machine to ensure that it is possible to

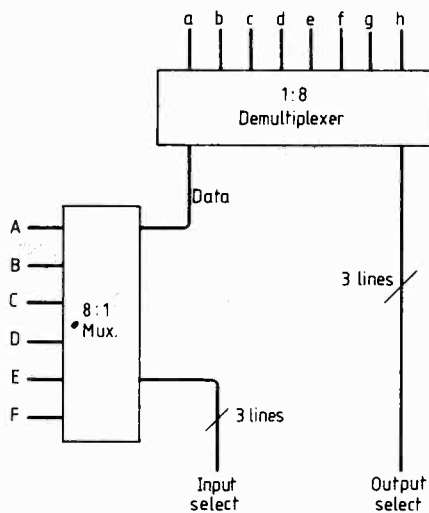


Fig. 3. Using a multiplexer and demultiplexer to replace a keyboard.

make the connections without having to, for instance, replace the complete case. First be quite sure that the mains cable is removed from the machine - a surprise jolt when you are probing inside the machine can do much damage to man and machine. On the Praxis after unscrewing the two platen knobs, without losing the small disc in the left hand one, four screws in the underneath of the case can be removed. Turning the case right side up again should enable the top section to be lifted off over the back of the machine. Be careful of the paper-holding bar. The keyboard can now be removed by undoing the two screws, one at either end, that hold the metal backing plate to the base of the typewriter case.

Lifting it off gently brings to light a number of connectors and these can be parted without putting any tension on the wires. At this stage the printer processor and electronics will be exposed to view along with three brass nuts positioned on the processor board that hold grounding straps and the processor board to the keyboard sub assembly. After noting the way in which the grounding straps are positioned the nuts can be undone and the keyboard and processor unfolded to show the printed circuit traces of the keyboard and processor connections. A drawing of the two boards opened out is shown at Fig. 5 with the connection points numbered to correspond with the schematic diagram Fig. 4.

Suppose that the typewriter is a different model from that used above. Then some investigation is necessary to find the connecting lines. Without the manufacturer's service manual the best method is to follow the printed circuit traces to the various keys. Keyboard switches may have either three connections (with the outer two commoned-check with a meter) or just two. The key connection traces should either end up on a chip with open collector drivers (in which case they are being driven from the printer processor) or else be connected to pull-up resistors if an input to the processor. If the keyboard processor combination can be 'powered up' whilst access is retained to the keyboard traces then processor output wire should have no or small voltages on them whilst processor input traces should be at 5V due to the pull-up resistors. In any event, provided that the keyboard is powered from five volts, an incorrect connection of the traces

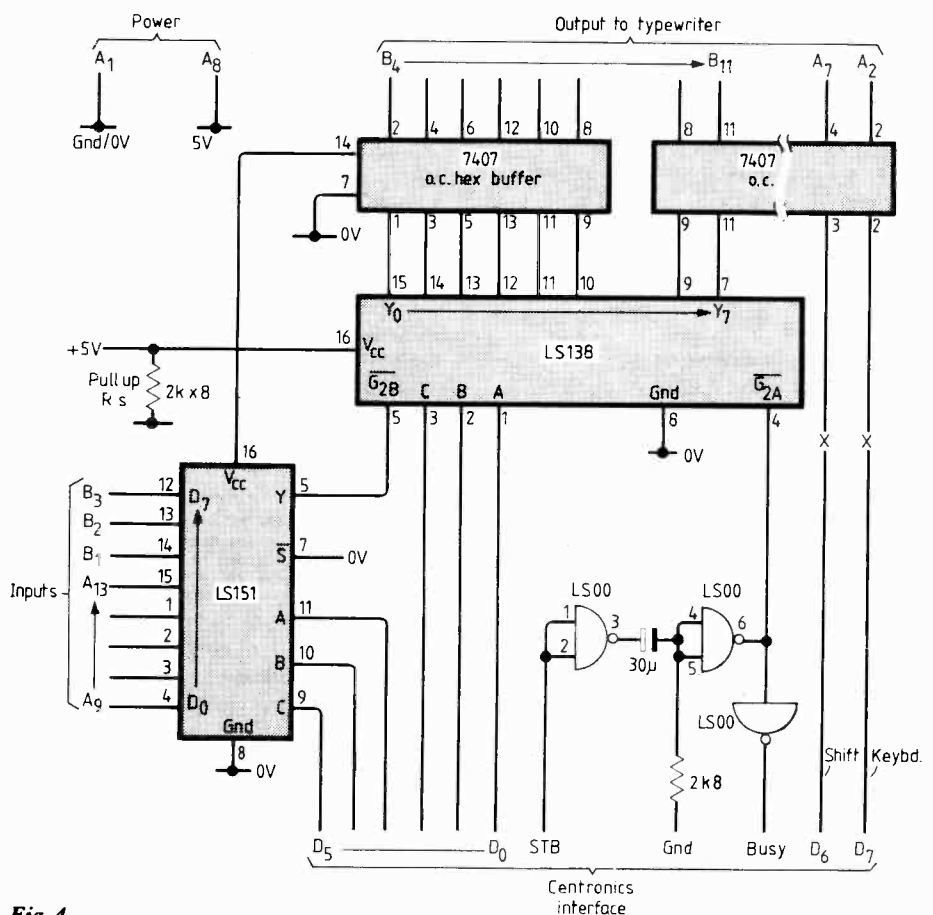


Fig. 4.

to the interface will not cause damage but prevent the interface and/or the typewriter working properly. There is no need to assign specific assignments to each of the input/output connections on the interface since a software routine is used later to determine the actual data required to

simulate a specific key closure.

The next stage is to determine the output data required for each simulated key closure. Connect up the computer-interface-typewriter combination and then run a program to output characters (with data values in the range of 0 to 255) and see

List 1. Program to produce a file 'Trans. text' of ascii character and corresponding code to operate printer.

```

Program Decode; (* Pascal under UCSD Version 4 *)

var Translation_file : text; (* data and character file *)
    Printer          : text; (* Treated as a file *)
    j                : integer; (* loop variable *)
    ch               : char; (* character read from vdu *)
Begin; (* program from hereon *)
Rewrite( Translation_file,'Trans.text'); (*Open Output file *)
Rewrite( Printer,'Printer:'); (*Open Printer*)

For j := 0 to 255 do begin; (* main loop *)
    Write(printer,chr(j)); (* data to printer *)
    Write(' Enter character printed ( ^ for non printing)');
    Read(ch); (* read character inputted from vdu *)
    writeln; (* new line on vdu *)
    writeln(Translation_file,j:5,ord(ch):5); (* write to file *)
end; (* end of main j loop *)

Close(Translation_file,Lock); (* keep the translation file *)
end.

```

List 2. Program to show how translation data can be used to run typewriter using codes from program in List 1.

```

Program Encode; (* Uses translation file to print on typewriter *)
Const cr = 13; (* carriage return ascii value *)
Var Printer : text;
    Decode : Array(0..255) of 0..255; (* holds printer codes *)
    k      : char; (* only used in demonstration program *)

Procedure PRINT_INIT; (* Initialises for the Printer *)

Var Translation_file : text; (* data setup in program DECODE *)
    data, code, j : integer;

Begin; (* procedure Print_init *)
Reset ( Translation_file, 'trans.text'); (* Open file *)
For j := 0 to 255 do Decode(j) := 0; (* initialise Decode array *)
For j := 0 to 255 do begin; (* file data to decode *)
    Read (translation_file, data, code ); (* read a line from file *)
    Decode(code) := Data; (* and put to decode *)
End; (* of the j loop *)
Close(Translation_file); (* no further need for this *)
Rewrite(Printer,'Printer:'); (* open printer for output *)
end; (* of procedure Print_init *)

procedure delay(ticks:integer); (* gives a 'ticks' milliseconds delay *)
var i,j,k:integer;
begin;
    For i := 1 to ticks do
        For j := 1 to 8 do k := k+1; (* 1 ms delay *)
        end;
end;

Procedure PRINT ( ch: Char ); (* accepts a character for printing *)

Var i : integer;

Begin; (* Procedure PRINT *)
i := ord(ch); (* find integer value of ascii character *)
i := decode(i); (* and use to get printer data *)
write(Printer,chr(i)); (* and output to Printer *)
if ch = chr(cr) then delay(1000) else delay(90); (* 11 c/sec *)
end;
End; (* of Procedure Print *)

Procedure PRINT_EXIT; (* called after finished with printer *)

Begin; (* start of Print_exit *)
print(chr(cr)); (* Carriage return to Printer *)
Write(Printer,chr(255)); (* Holds interface out of action to
enable all typewriter functions *)
Close(Printer); (* No further use for printer *)
End; (* of Procedure Print_Exit *)

BEGIN;

(* This is where your main routine would be. The following
is a short sample Program that can be used to test the
interface, and would not be present for normal use *)

Print_init; (* initialise the printer channel *)

For k := 'A' to 'z' do begin;
    write( k ); (* put out the character on vdu *)
    print ( k ); (* and on the printer to check correct action *)
end;

Print_Exit; (* and close up the channels *)
END.

```

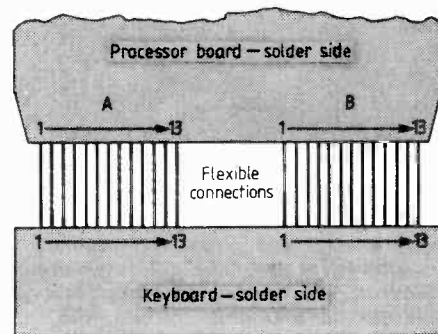


Fig. 5. Connection points on the opened out Praxis processor and keyboard.

what the response is from the typewriter. Be aware that some of the unused code can cause the typewriter to 'lock out' and not accept any more input. If this should happen the easiest way to recover is to turn the typewriter off then on again to reset the internal mechanism. Also some software driving parallel output ports will only output seven bits, the most significant bit being masked off as it is not used by many printers. If this is the case with your system then either the driving software can be altered or alternatively one of the dedicated lines (I...i, J...j) in Fig. 1) can be deleted.

In the case of the Praxis this would mean that keyboard 2 was not available but for many applications this would be quite acceptable. The program in Fig. 6 which is written in Pascal will provide you with a file of the data and corresponding characters printed. If you find that the interface is behaving badly, for instance by not printing all characters then check both the interface and connections to the keyboard traces. It is easy to have 95% functionality even though the shift line say is not connected.

Operation

The final step is to generate a small program that takes any character that you wish to output to the printer, translates this to the appropriate data code, and then outputs it on the parallel interface. The best method of implementing such a routine is in assembly language and then to incorporate it into the bios (basic input-output system) so that the operation is transparent to the host program. To give an idea of what is required and to provide a basis for further experimentation the small routine shown in Fig. 7 is written in Pascal and can be incorporated into an applications routine. The routine is broken up into three procedures: Print-init to open the printer channel, Print to actually translate and output the characters and Print-over to perform any closing tasks. Note that the main translation array TRANS must be declared in the main routine since Pascal cannot hold local variables from call to call of a sub routine. If you wish to use the printer for word processing then you will probably want to extend this program to enable such things as underlining and printing both £,p and \$,c.

continued on page 39

Improving colour television decoding

4 – Simple one-line comb decoder on a small single board can be added to existing receivers

Much of the background material and illustrations in these articles derives from the author's BBC work and that of his colleagues in the Research and Designs Departments. The particular proposal for a domestic receiver decoder described here is the author's own rather than a BBC concept.

Considering now the actual electronics, Fig. 34 shows a circuit diagram of the video path built to incorporate the

The full extent of picture improvement can only be achieved if the suggested modifications are incorporated into a receiver in which attention has been paid to a number of other aspects of performance, a similar experience to improving high quality audio. These would include the use of a 26in tube (preferably high resolution), an efficient aerial (possibly with a down-lead amplifier), a tuner and i.f. amplifier response flat to 5.5MHz and with the demodulated video group-delay equalized to give minimum phase errors. It would also be beneficial to receive the incoming r.f. signal from a transmitter of good performance.

The performance of the modifier used to comb chroma from the composite signal (to provide clean luminance) is degraded in the presence of phase errors. These errors are largely introduced by the video signal modulation and demodulation processes and mainly comprise poor group delay response across the chroma bandwidth ($f_{cc} \pm 1.3\text{MHz}$) and by differential phase (chroma phase shift with the change of luminance level).

Further information on transmitter performance and alternative circuits to place between the i.f. output and the PAL decoder will be given in a later article. These alternative circuits would be preferable for smaller screen sizes (assuming the standard tv receiver tube).

Some other developments which will be of relevance if the time delay for their introduction and cost are not too great are ITT's digital tv i.cs and the Philips n-mos memory chips. Philips also make a high resolution 26in tube (which will probably double the standard tube price) that can be operated at twice the normal line and field scanning rate. Memory chips store the incoming signal over a field or picture period; video information is thus available for scanning twice in the period of one input picture. This double scanning removes flicker and enables other decoding methods to be used, as outlined in the December and January articles. (See also the German Radio Show report, November 1983 issue pages 74, 75.)

by D. C. A. Read
B.Sc. (Eng), M.I.E.E.

foregoing principles (part 2, January issue). Composite video (1V pk-pk) is applied to the circuit to produce outputs that are suitable for the various decoder chips now readily available. Output pins can directly feed the decoder chips TDA3516A or 3560 from Mullard.

Transistors Tr_1 and Tr_2 are complementary emitter followers providing low-impedance drives, appropriate resistors being fitted to match the delay-line characteristic impedance and the chroma bandpass filter impedance. Also, a low-impedance feed is available for the sync filter which is an optional extra. The three coils and capacitors (L_{1-3} , C_{5-7}) form a symmetrical gaussian bandpass filter (described later) set up by adjusting all three inductors so that maximum subcarrier level occurs at the output, also with minimum 7.8kHz at chroma transitions.

The filtered chroma signal is fed out via Tr_{18} to provide low-impedance drive to the chroma input pin of the demodulator chip or chips. PAL decoding i.cs normally use a

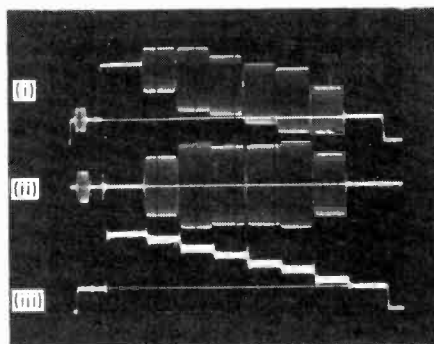


Fig. 35. Modifier comb-circuit waveforms. Top trace is the input composite PAL video signal, middle trace shows the chroma envelope after the Tr_1 , Tr_2 buffer and gaussian bandpass filter. After a further buffer this signal is fed out to pin 3 of the decoder TDA 3561A (or 3560) (if the one-chip decoder is used). Minimum 7.8kHz twitter at chroma transition indicates good group delay symmetry in the gaussian filter. Bottom trace is the luminance signal as fed to pin 10 of the one chip decoder.

chroma-length line (64 μ s–56ns) to provide delay-line PAL decoding for enhanced U/V separation in the chroma circuits. Colour prints 7, 8 and 9 are screen photographs with luminance off, showing, in print 7, the chroma demodulation performance using the field sweep skew test waveform for line-by-line decoding. Print 8 shows one chroma line in use i.e. combing the chroma over two lines; this is the standard method in most television sets. Using two-line delays, print 9 shows three-line combing in the ratio 1/4:1/2:1/4. The third line has no offset whereas the centre line has a 56ns offset. No further chroma work was felt necessary on this add-on card and this design will use one chroma line. This is a reasonable compromise which provides some comb filtering of the luminance, a 3-dB reduction of fine cross-colour, and, by adding and subtracting equal amplitude from the two lines, a 3dB reduction of random noise occurs. The slight loss of vertical resolution is only apparent when viewing computer graphics. Spatially, on horizontal transitions, the luminance and chroma are displaced by half a line in the field, but this is only seen on electronically generated signals.

In the circuit of Fig. 34, Tr_3 amplifies the signal from the chroma bandpass filter to provide a high level input for the DL60 delay line, which has a typical insertion loss of 11dB. The output transducer of this delay line is floating and can therefore provide a balanced push-pull drive to the MC1596 balanced modulator input with the d.c. supply bias provided by resistors

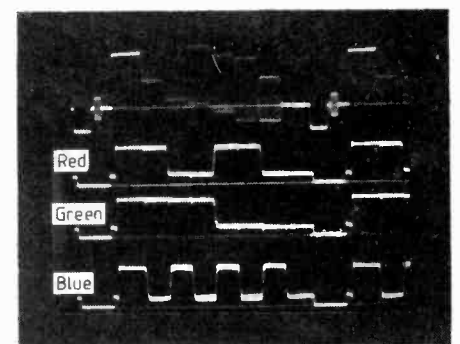
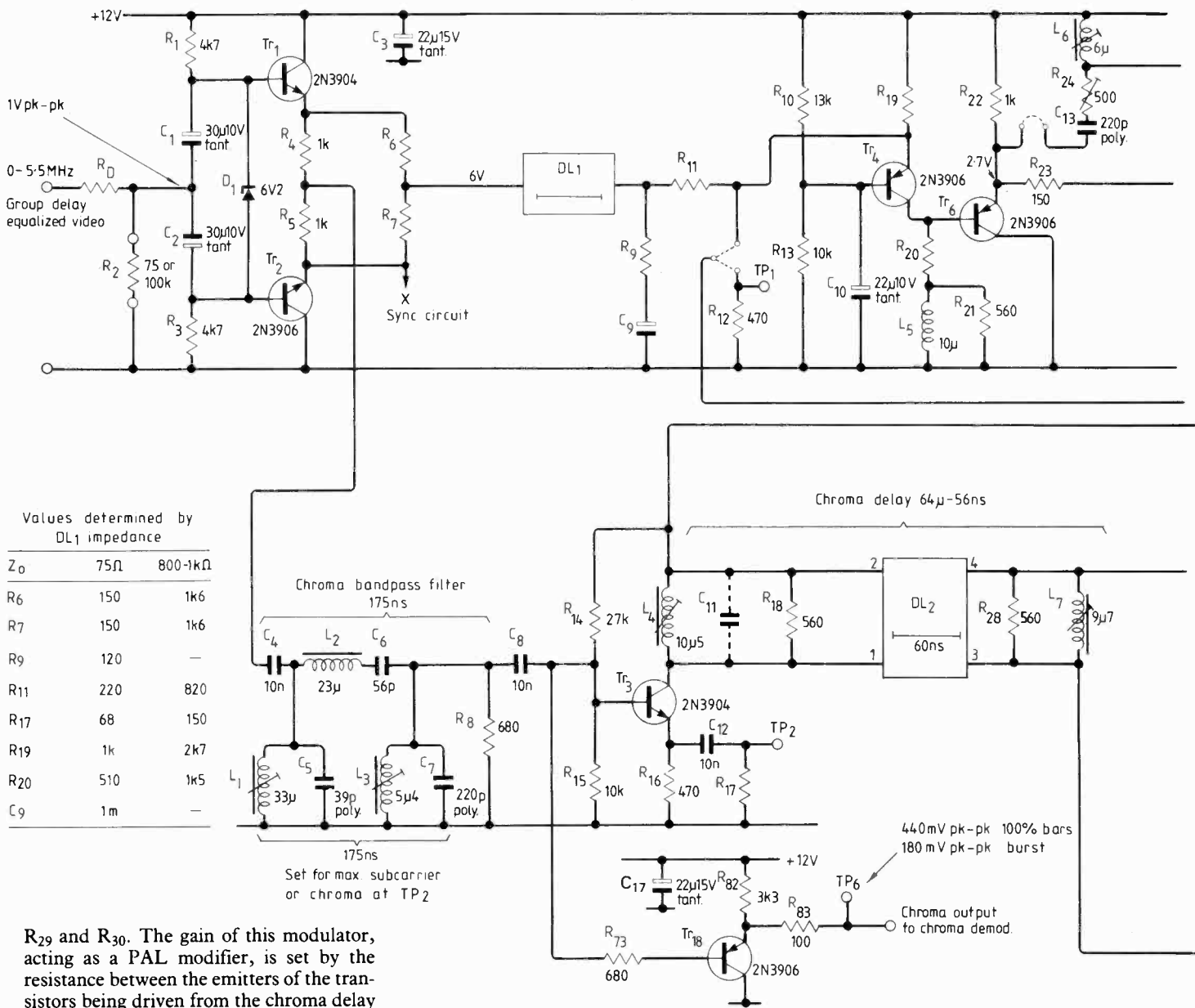


Fig. 37. Signal waveforms for the complete decoder. Top trace is 1V composite video input. The lower three traces are red, green and blue outputs from the modifier comb and TDA3516A (or TDA 3560) chroma chip.



R₂₉ and R₃₀. The gain of this modulator, acting as a PAL modifier, is set by the resistance between the emitters of the transistors being driven from the chroma delay line. Pins 7 and 8 have suitably phased and d.c. balanced (R₄₂, 5kΩ pot.) drives of 8.8MHz (twice colour subcarrier) taken from the chroma demodulator chips via buffer stages Tr₈, Tr₉ which also provides phase shift. The two phase shifters plus the changeover shown adjacent to C₂₈ and C₂₉ mean that the change in phase setting available to the modulator is in excess of 360°. Thus a setting will always be found, regardless of the decoder chips being used, to obtain the correct phase in the overall system. Pin 9, the demodulator output is fed directly to a grounded base stage via 10nF blocking capacitor (C₂₁). Therefore no signal can be seen at pin 9. Also summed at the grounded base stage is the composite PAL video from the luminance delay line. The delay of this, compared with the delay time through the gaussian bandpass filter plus the DL60 delay line and the modifier, is such that the two signals summing at the grounded-base stage are exactly 64µs apart.

The collector load of Tr₄, R₂₀, gives sufficient gain to provide a suitable level to the output filter, this being buffered by emitter follower Tr₆ and R₂₃ (150Ω) representing the characteristic impedance to the output filter.

The first sections L₈ and L₉, form a

phase/group delay equalizer as is L₁₀. The filter itself is formed by L₁₁ and L₁₂; the last element in the filter L₁₂ has an additional capacitor switched in by the f.e.t. to bring it to resonance at subcarrier frequency when the notch is needed, such as at a horizontal colour transition. As the notch switches in and L₁₂ becomes resonant, the input impedance to the filter rises. The small resulting increase in voltage available at Tr₆ emitter therefore drives Tr₅ harder and the notch 'snaps in' with a positive-feedback effect. Components L₆ and C₁₃, with variable resistor R₂₄ are in series resonance at subcarrier frequency; R₂₄ is adjusted to set the threshold of the notch. The notch will switch in very quickly with Tr₅ bottoming on the peaks of the 4.43MHz oscillations developed across L₆. With R₂₅ of 10MΩ the decay is slow, switching the f.e.t. off about half a line later.

If the voltage supplied to the gate of this f.e.t. is displayed on a black and white receiver with an external sync feed and viewed adjacent to the colour receiver, the amount of time the notch is in is shown to represent a very small proportion of the total picture area. The loss of resolution

can therefore be considered slight. It is also statistically unlikely that fine luminance detail will occur on horizontal colour transitions when the notch is switched in.

If luminance detail is continually present at 4.43MHz, the notch will be introduced and detail lost; it is as if the notch were always present. But the delay in operation of the adaptive notch switch will allow luminance edges through unscathed and this gives subjective improvement to the picture resolution.

It has been found in practice that with an input of test card F from a slide scanner, the threshold control resistor is best set so that the 4.5MHz gratings pass through with minimal degradation. Subcarrier from horizontal coloured edges will then cause the notch to switch in if the amplitude increases above the equivalent amplitude of this 4.5MHz grating. The 4.5MHz grating on the analogue test card (about to be replaced by a digital one) is well below the 0.7V black-to-white amplitude. However, switching to the electronically generated signal Channel 4 test card, the notch is permanently in during the 4.5MHz grating. But on pictures, the notch switches in when horizontal dot

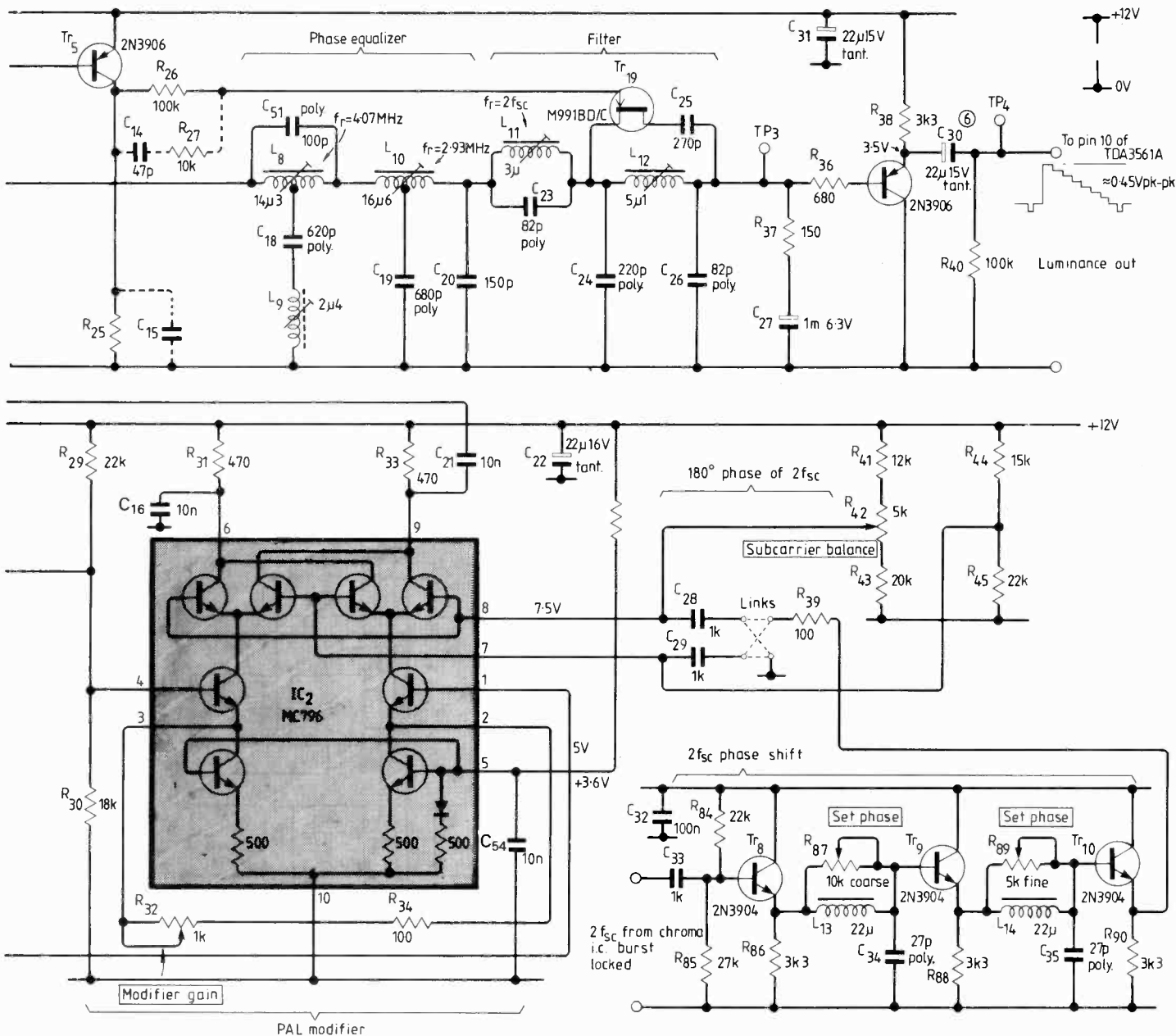


Fig. 34. Diagram of circuit that processes chroma and luminance signals.

Notes

- ① L₅ and R₂₁ can provide 1 to 3dB h.f. lift, normally shorted by link.
- ② R₂₅ 10MΩ for slow turn-off of adaptive notch, 100kΩ for fast turn-off
- ③ C₁₄, R₂₇ slightly speed-up switch-on but need not be fitted. Set for best 2T lobes
- ④ C₁₁ not fitted but can be used to trim phase
- ⑤ Poly = 2% polystyrene Cer = ceramic disc or Redcap/Bluecap
- ⑥ C₃₀ 100μ 12V Mullard for three-chip decoder. Lum. input has 2k7 in series & 22k to 12V. Remove R₄₀
- ⑦ Refer to next installment for filter adjustments
- ⑧ Inductors are wound with Sor6-strand 48s.w.g. Litz or 38s.w.g. (0.16 or 0.14mm dia.) enamelled copper wire

crawl becomes just visible at normal viewing distance, assuming $\leq 3.5 \times$ screen diameter. This seems a suitable criterion for determining the threshold of the notch. It may be considered that a slightly lower threshold which degrades 4.5MHz gratings on the test card will further reduce visibility of horizontal dot crawl. This is a setting which will be made subjectively to suit the individual.

At the output of the filter the signal is terminated (R₃₇, 150Ω) and buffered. Transistor Tr₇ provides a low-impedance drive output as many clamps in decoder

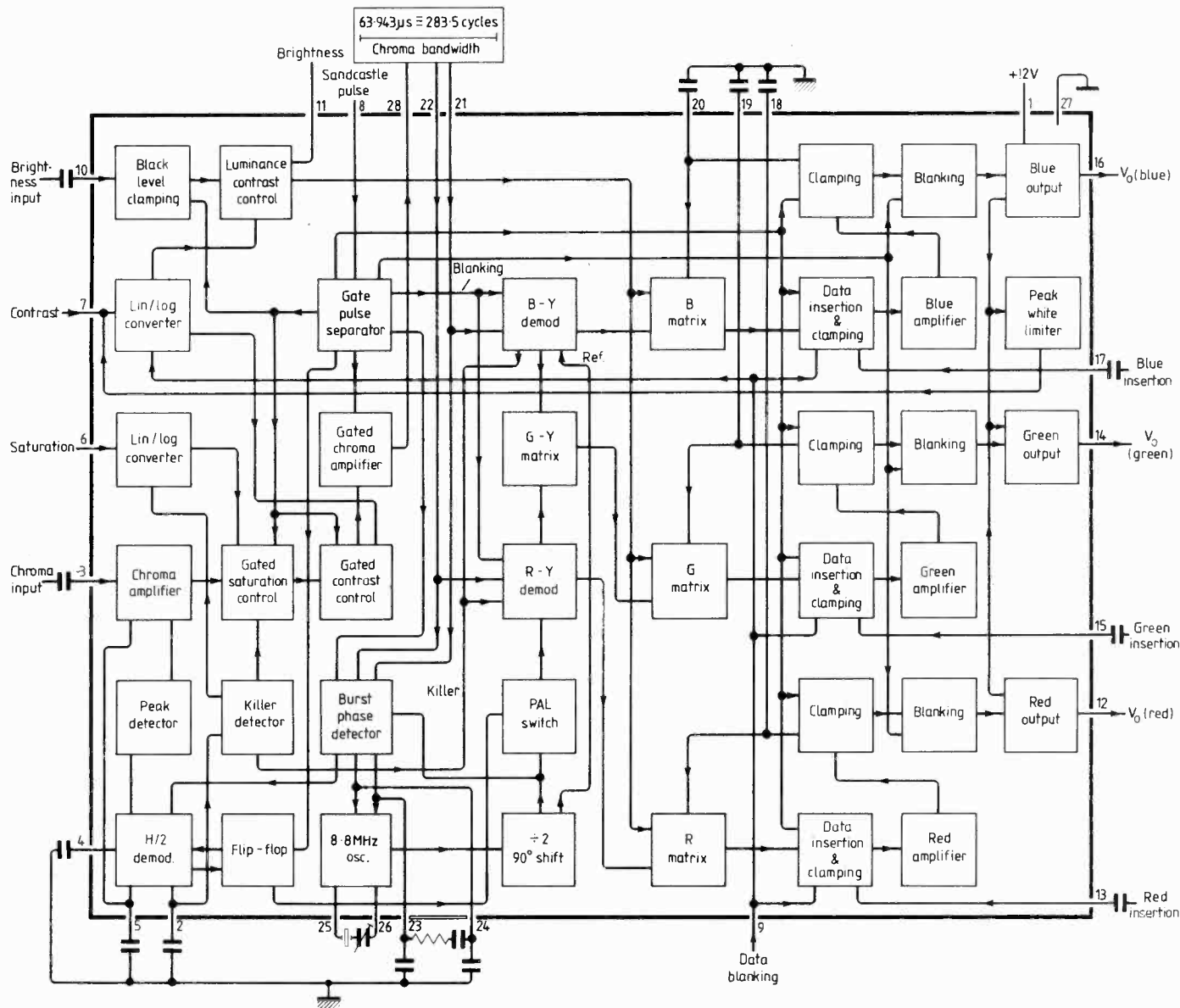
chips require a low-impedance point. The coupling capacitor may have to be changed to suit the time constant of such clamps, depending on whether the extra circuit board is fitted to a three, two or one-chip decoder.

Setting-up procedure (luminance)

In the first place, it is required to obtain a timing difference between the two signals summed at Tr₄ emitter of exactly 64μs. 100% colour bars are used as the test signal, although 95%, 75% or EBU bars would be suitable.

Inductor details

No.	Value (μH)	Turns	
		Neosid E2	Toko 10K
1	33	37	55
2	23	34	42
3	54	15	18
4	10.5	21	27
5	5	Painton or Sigma choke	
6	6	16	21
7	9.7 or 10	20.5 or 13+13	26 or Sigma choke
8	14.3	13+13	16 16
9	2.4	10	13
10	16.6	14+14	17+17
11	3.8	13.5	16
12	5.1	15	18
15	150	Painton or Sigma choke	

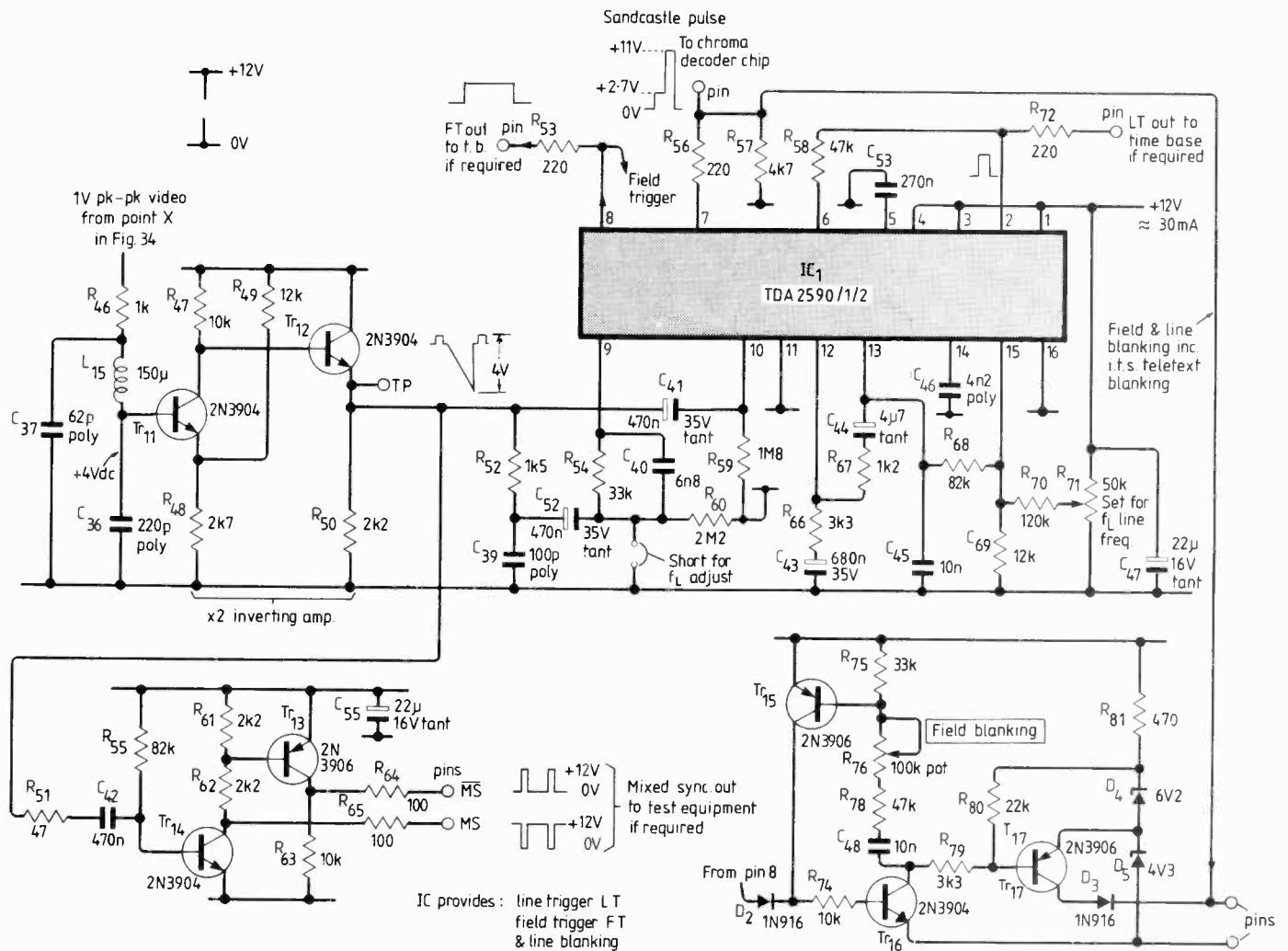


1. Disconnect either the input or output end of DL₁, and with the 2f_{sc} feed also disconnected (by removing the links adjacent to C₂₈ and C₂₉) unbalance the modifier pins 7 and 8 (R₄₂ turned to an end-stop).
2. With the output of the modifier linked to R₁₂, TP₁, the chrominance passing through the gaussian filter and DL60 delay line can be displayed on an oscilloscope and the signal path checked.
3. Reconnect the modifier Tr₄ emitter so that the chroma envelope can be seen at the output test point TP₄ (Fig. 34). The waveform appearance should be as shown in Fig. 35, middle trace. The green/magenta centre transition, will need to be expanded on the oscilloscope so that the signal is resolved down to 50ns (see Fig. 24, January).
4. The link at TP₁ is switched so that the modifier output is across R₁₂ and is not fed into Tr₄ emitter. Reconnect 2f_{sc}, put the oscilloscope probe on TP₁ and rebalance pins 7 and 8 on the modifier so that the carrier (2f_{sc}) is nulled to zero. This represents carrier balance of the modulator/modifier.
5. Again feed the direct composite PAL

The normal functions expected of a PAL decoder are adequately provided by the Mullard one-chip decoder TDA3561A. The chip requires separate chroma and luminance inputs - the circuit of Fig. 34 provides these in enhanced form. Pin 25 feeds PAL modifier via Tr₁₅ in Fig. 34.

6. Disconnect either the input or output lead of DL₁ as before, re-connect the modifier (link at Tr₄ emitter), adjust the gain of the modifier with R₃₂ (1kΩ pot.) to obtain the same chrominance amplitude as in preceding step.
7. Reconnect the luminance (link at DL₁), with the chrominance from the modifier also being summed at Tr₄ emitter, it only remains to adjust the phase of

- the modifier output. Using R₈₆ (10k pot.) and R₈₉ (5k pot.), the coarse and fine phase adjustments in the 2f_{sc} feed (and, possibly, the links adjacent to C₂₈ and C₂₉ for 180° change), a point will be reached where the phase of the chroma from the modifier will cancel the chroma of the composite PAL signal.
 8. The amplitude of the 2f_{sc} feed from the phase shifting stages Tr_{8,9,10} can be from 0.3 to 1.3V pk-pk and it may be necessary to adjust C₃₄ and/or C₃₅ to obtain reasonably constant amplitude as the appropriate 'set phase' controls are taken between end stops. Check at Tr₉ emitter first and adjust C₃₄ on test for constant amplitude over the full range of R₈₆. Repeat for C₃₅ and R₈₉.
 9. Finally to achieve the best null and to optimise the chroma cancellation on all levels (steps) of the resulting luminance, a small adjustment on the gain will be required. It is as well to use the gain pot (R₃₂ 1k) the phase pot (R₈₉ 5k) with the modifier balance pot (R₄₂ 10k) in a converging sequence to minimize residual subcarrier for all the steps in the luminance signal.
- The trace in Fig. 35 shows the composite PAL signal as measured across R₂ (input



terminating resistor), the middle trace is the chrominance at TP₂ which is being fed out to the chroma circuits of the demodulator (external to this additional circuitry), and the lower trace at TP₄ shows that the chroma from the modifier output is cancelling the composite PAL chroma to leave a clean luminance signal.

Fig. 36 shows some optional additional circuitry that may be used depending on the receiver to be modified. Point X is taken from the emitter of the input buffering pair in Fig. 34, Tr₂. This feeds a filter with a characteristic impedance of 1kΩ provided by R₄₆. The high-impedance terminated filter has a low-pass linear amplitude response which removes all the subcarrier and highband luminance energy but retains the sync risetimes with optimum shape. The filter design will be detailed later with group delay/phase and amplitude responses. Transistor Tr₁₁ amplifies the signal and Tr₁₂ emitter follower drives the sync separator chip IC₁, (TDA2590). There are other versions i.e. 2591, 2592, 2593 but in this application the available alternatives are not important. All the chips are capable of driving line output stages and field scan i.cs directly.

The chip has a sync-slicing system which is self-adjusting, according to the video amplitude, to maintain a 50% slice on sync edges. The line frequency can be set to approximately 15.625kHz using R₇₁ (50kΩ pot) with the input signal shorted at the points shown adjacent to C₅₂, R₆₀.

Fig. 36. Diagram of circuit of sync processor chip providing field blanking and other pulses.

When the short is removed, the phase locked loop is centralized. This chip also provides field triggers and line triggers. By feeding the line trigger output pulse back into the chip (on pin 6 via R₅₈) a 'sandcastle' pulse is generated which, if necessary, is then available for the chroma decoder chip. In most of the receivers, however a sandcastle pulse is already available and this circuitry would not be required.

The line and field trigger pulse trains could both be used to drive line and frame time bases if the whole receiver is being engineered. There is another optional circuit available. This widens field trigger pulses via the monostable (Tr₁₅/Tr₁₆) and thus provides blanking of the IFS (insertion test signal), and teletext (Ceefax and Oracle) and other data signals in the field block. See Fig. 38.

On the author's attic workroom receiver, the picture is underscanned so that all four corners can be seen and the 'business' at the top of the picture becomes unacceptable without widened blanking. The extra blanking circuit ensures that only active picture lines are displayed. The other optional extra, formed by Tr₁₃ and Tr₁₄, is solely used to drive test gear which needs to be locked to mixed syncs.

The luminance output of the board from Tr₇ can be coupled into the Mullard one-

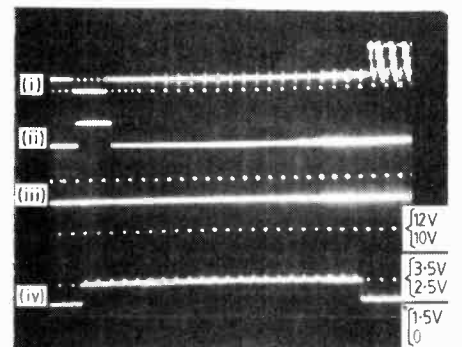


Fig. 36(b). Some of the waveforms occurring in Fig. 36 circuit. Trace (i) is video signal fed to pre-sync separator filter C₃₇, L₁₅ and C₃₆. (ii) is field trigger from pin 8 of TDA2592 and (iii) line trigger from pin 2. (iv) shows RGB clamping (top), output picture blanked (middle) and active picture - line and field blanking off (bottom).

chip TDA3561A (or 3560) which is mainly used as a colour decoder (see Fig. 20, January issue pages 54, 55). The coupling component feeding the luminance input, on pin 10 can be a 0.47μF non-polarized ceramic/polyester capacitor. The chrominance input on pin 3 fed from Tr₁₈ also requires d.c. blocking; 10nF is suitable. The d.c. on both pins 3 and 10 of the decoder chip are typically 2.2V and the output on Tr₇ is typically 3.5V. If a small tantalum capacitor is used, check for polarization particularly where other chips are employed.

Full amplitude levels in ITS and the high levels of teletext plus ICE signals (internal communications equipment) need to be fully blanked.

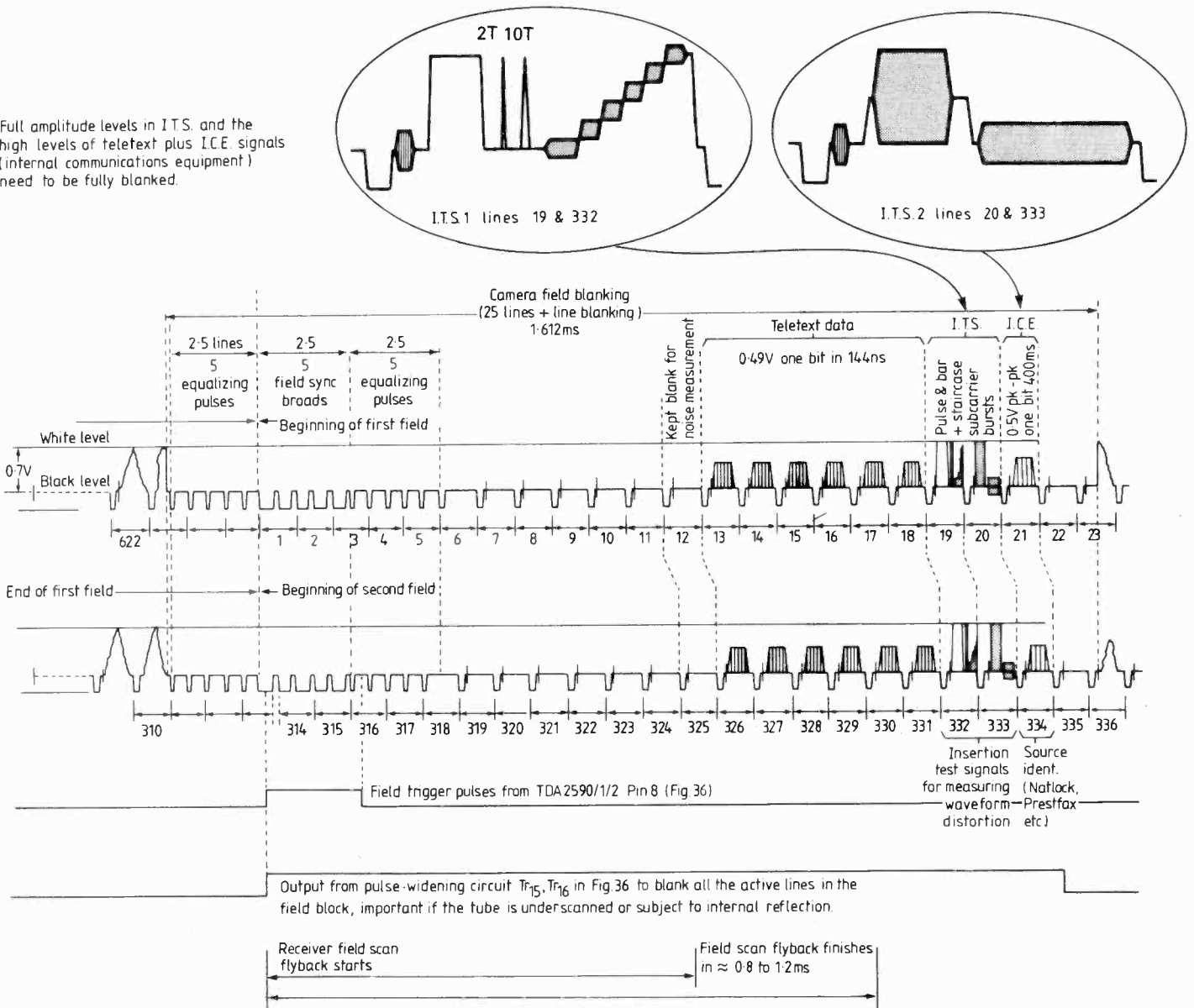


Fig. 38. Vertical synchronizing and blanking waveforms. As shown, field blanking interval lines are also used for teletext, ICE (internal communications equipment), ITS (insertion test signals), and clear lines for noise measurement. TDA2562A also uses lines 21, 22, 23 for RGB tube black-level stabilizing.

insertion test signal (two lines per field), teletext information (four lines per field or six lines on some channels), and the ICE signal (internal communications equipment coding line), will then all be blanked by the widened field pulse.

With the extra board (modifier etc.), set up, the picture will attain a horizontal resolution which is close to the vertical resolution. The equivalent vertical and horizontal resolutions can be calculated as follows. There are 625 lines transmitted in each picture period (40ms) but as 25 lines are blanked in each field (20ms) there are only 575 active lines in each picture or 287.5 active lines per field. These 287.5 lines determine the vertical resolution, i.e. the maximum number of cycles that can occur within the picture height. The transmitted pictures has a horizontal to vertical aspect ratio of 4:3, so 287.5 vertical cycles are equivalent to 383.3 horizontal cycles. Given that the active line period is 52μs (64μs less 12μs blanking), the period for each cycle of this maximum equivalent horizontal resolution then is 135.62ns (52/383.3). The frequency is to equivalent to 7.37MHz. This is the justification for improving the horizontal resolution.

WW

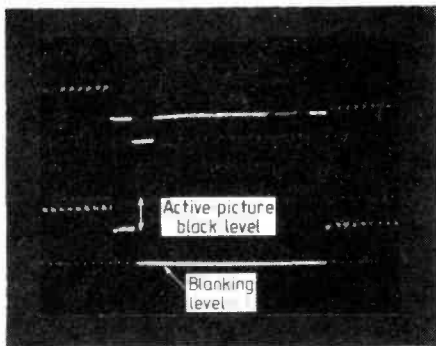
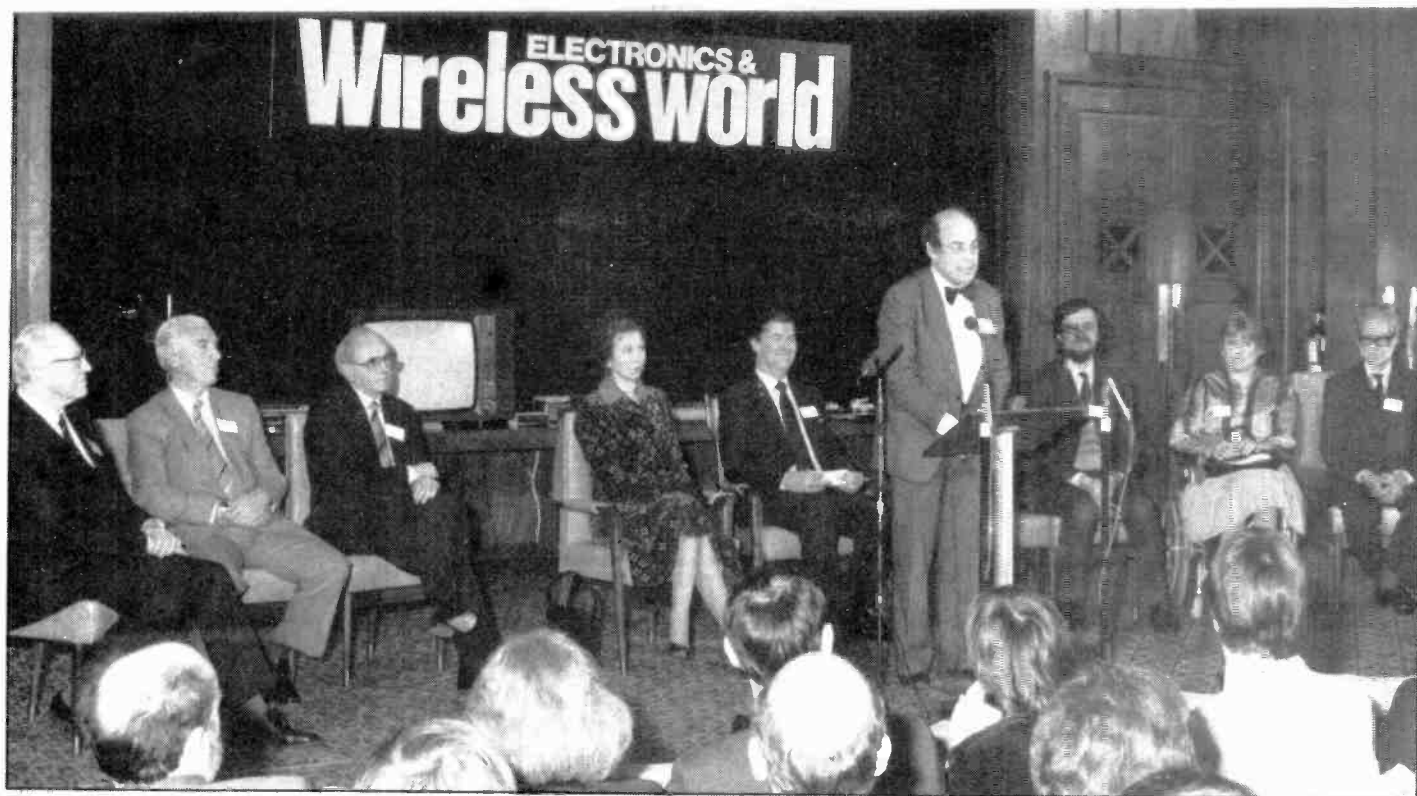


Fig. 38(b). Off-air video signal and extra blanking to prevent any adverse visibility at the picture top. Top trace shows some lines in use in the field blanking period. Bottom trace is final green drive to display tube, indicating line blanking and extra field blanking provided by the circuit of Fig. 36.

Provision was at one time made to adjust the chroma level output with a pair of resistors attenuating the feed to Tr₁₈ base. When adjusting the level feeding the decoder chip TDA3561A or the equivalent two and three-chip versions, it was found to be difficult to determine which chroma level suited the decoder to obtain maximum chroma linearity (the linearity being somewhat poor). Also the matrix which produces the red, green and blue signals

from the luminance and colour-difference signals can have up to 10% and amplitude errors. By optimizing the chroma level and averaging out the matrix errors across the RGB outputs a fairly good compromise can be achieved as is shown in the photograph, Fig. 37.

The blanking as generated by the extra circuitry Tr₁₆, Tr₁₇ and IC₁ (TDA 2590/1/2/3) is applied to the blanking input of the TDA3561A chroma demodulator chip. A line-rate trace of the blanking component is shown in Fig. 37 in which the fainter line represents the field blanking. Using this trace and with the oscilloscope timebase switched to field lock, the pot R₇₆ is adjusted so that the field blanking ends at the beginning of the first line in the active picture. The blanking should end half way through line 23 in the first (even) field, and at the beginning of line 336 on the second (odd) field; see Fig. 38. The



Left to right: Bill Bond (judge), David Gemmell (judge), Philip Darrington, H.R.H. Princess Anne, Sir Keith Skinner (chairman of Business Press International), Heinz Wolff (judge), Richard Lambley, Elizabeth Fanshawe (judge), Meredith Thring (judge).

Electronic devices for the disabled

First prize in *Wireless World's* recent competition was won by Tony Heyes of Nottingham University for his *Sonic Pathfinder*, a navigation aid for the blind. Dr Heyes received his award of £2,500 from Princess Anne at a presentation on January 30. Second prize, £1,500, went to Phil Pickersgill and Nic Stewart of Wokingham for a speech training device which they named *Pausaid*.

The four £1,000 prizes for runners-up went to

- David Battison and David Palmer of Cambridge, for their *Miaphone*, a speakback facility for blind, disabled typists.
- Michael Bolton and Alastair Taylor of Aberbeen, for their computer interface for the disabled.
- William McCarthy of Edinburgh, for his depth gauge for the visually handicapped.
- Ian Mitchell of Hull, for his *Talking Box*, a communication aid designed initially for speech-impaired children.

Judging and presentation of the awards took place on January 30th at the Institution of Electrical Engineers in London. Twelve entries selected for the final stage of the competition were demonstrated to the judges by their authors, who were Elizabeth Fanshawe of the Disabled Living Foundation, David Gemmell of Possum Controls Ltd, Bill Bond of the Polytechnic of the South Bank, Professor Heinz Wolff of the Brunel Institute for Bioengineering and Professor Meredith Thring, Queen Mary College, London University.

Princess Anne spent more than half an hour examining the devices and discussing them with their designers. In an address afterwards, she spoke of the ingenuity and inventiveness of those who had entered the competition. She said "Your enthusiasm and your efforts may not make you household names, but will certainly earn

you the sincere gratitude of a highly individual and progressively independent group of people". Princess Anne spoke also of those who had not reached the finals, whose entries might still warrant development and possible future production. "If they do that", she said, "they will have their own reward".

Speaking on behalf of the judges, Professor Wolff praised the designers for their cost-consciousness. They recognised that technical aids had to be paid for by someone. "A competition of this kind as a stimulus for technically knowledgeable people to exercise their compassion and think about people less fortunate than themselves is itself very valuable".

An article by Dr Heyes describing his prize-winning entry will appear in *Wireless World* shortly, and we plan to include details of other interesting entries during the next few months.



Dr Tony Heyes receives his prize from Princess Anne.



Philip Darrington (right), *Wireless World* editor, with Dr Heyes and a *Sonic Pathfinder*. Left is Richard Lambley, projects editor.

Dr Michael Bolton (right) shows Princess Anne his computer interface.



Differential temperature integrator

Battery-powered remote-reading integrating thermometer has application in energy-conservation schemes

As much as 25% of the UK's primary energy consumption is in domestic buildings, yet relatively little is known about the details of its use. Individual tastes vary wildly and variations of annual energy consumption of 3:1 or more between identical houses are quite common. Because of this, testing out some new insulation measure or heating system requires monitoring a large number of houses. This can be a very expensive business.

The traditional instrument for temperature recording has been the thermograph, a kind of clockwork chart recorder, still to be seen ticking away in the corners of art galleries and museums. More recently memory-based electronic recorders have appeared that can be read out into a computer.

For most housing work all that is re-

R. Everett

quired are weekly or monthly averages of temperature plus the opportunity to sample spot values, such as the evening living-room temperature. Most importantly, this must be done without disturbing the house occupants and without spending vast sums on cabling back to a central datalogger. The differential temperature integrator was specifically developed for the Pennyland field trial in Milton Keynes, one of many sponsored by the UK Departments of Environment and Energy in recent years, and involved monitoring 80 houses of varying insulation level and south-facing window area¹.

Why a 'differential' integrator?

The heating energy consumption of a house is roughly proportional to the average inside-outside temperature difference (ΔT), the constant of proportionality being an indication of the insulation level of the house. To evaluate the effectiveness of insulation, weekly heating energy consumption needs to be correlated with weekly ΔT . We can extend the process to include solar radiation to make an estimate of the 'passive' solar gains into a house. ('Passive' as opposed to the 'active' solar energy that you get from solar panels.)

As various zones of a house are at different temperatures, a weighted average of

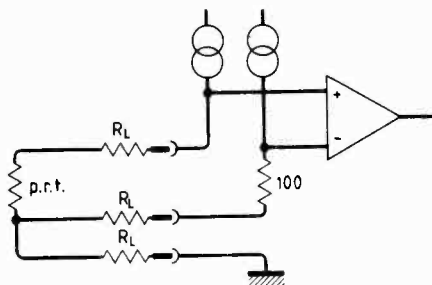
the different temperatures of different rooms is required. Thus the job of the d.t.i. is simply to generate cumulative integrals of the difference in temperature between each of three sensors inside the house, two downstairs and one upstairs, and a fourth on the outside, preferably on the north side out of the sun's rays. The temperatures are sampled every 8 minutes and the cumulative integrals are clocked up on three liquid-crystal displays, in units of degree-days (i.e. 1degC for one day, commonly used in building work). For the Pennyland field trial the integrator was mounted alongside the gas and electricity meters in an external meter cupboard where it could be read by the researchers without entering the house. The d.t.i. also has a hold mode allowing any of the four temperatures to be sampled on a test point with a d.v.m.

This device is a logical solution to a monitoring problem; I was not surprised therefore to find a paper proposing such a device after completing the prototype².

Circuit design

The temperature sensors used are thin-film platinum resistance types (such as RS 158-238), effectively precalibrated to $\pm 0.3\text{degC}$. This type of sensor has a resis-

Designed for temperature monitoring in energy conservation field trials at Milton Keynes this thermometer provides weekly average temperature differences between each of three zones of a house and the outside air temperature. Put crudely, heating energy consumption to a house is proportional to the temperature difference and the constant of proportionality is a measure of the quality of house insulation. The device requires three platinum resistance thermometers installed in the house, nominally one each in living room, kitchen and a bedroom, and an outside air temperature sensor. These four sensors are wired to the integrator box located in some convenient place, such as a meter or bin cupboard on the outside of the house, where it can be read weekly along with gas and electricity meters without disturbing the house occupants.



Note: Positions of heat meters may vary from house to house

Fig. 1. Three-wire bridge circuit puts equal lead resistance in each arm, with one lead in common.

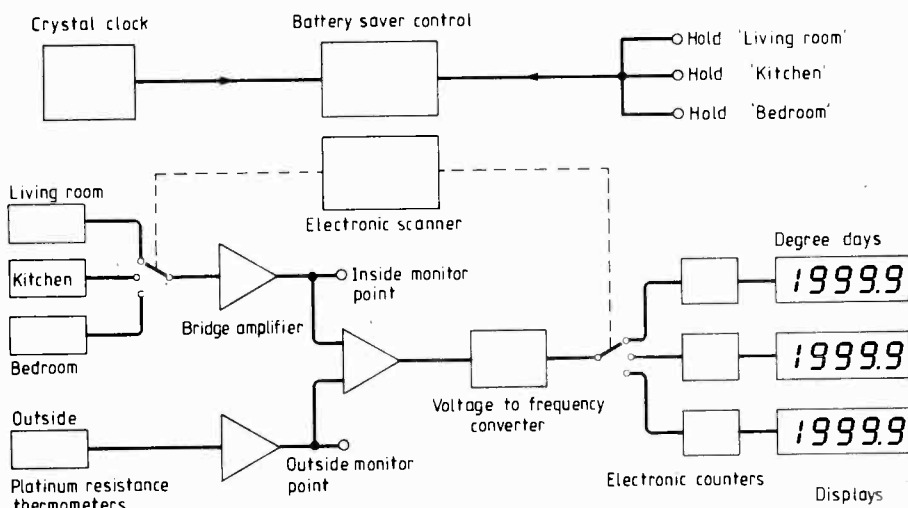
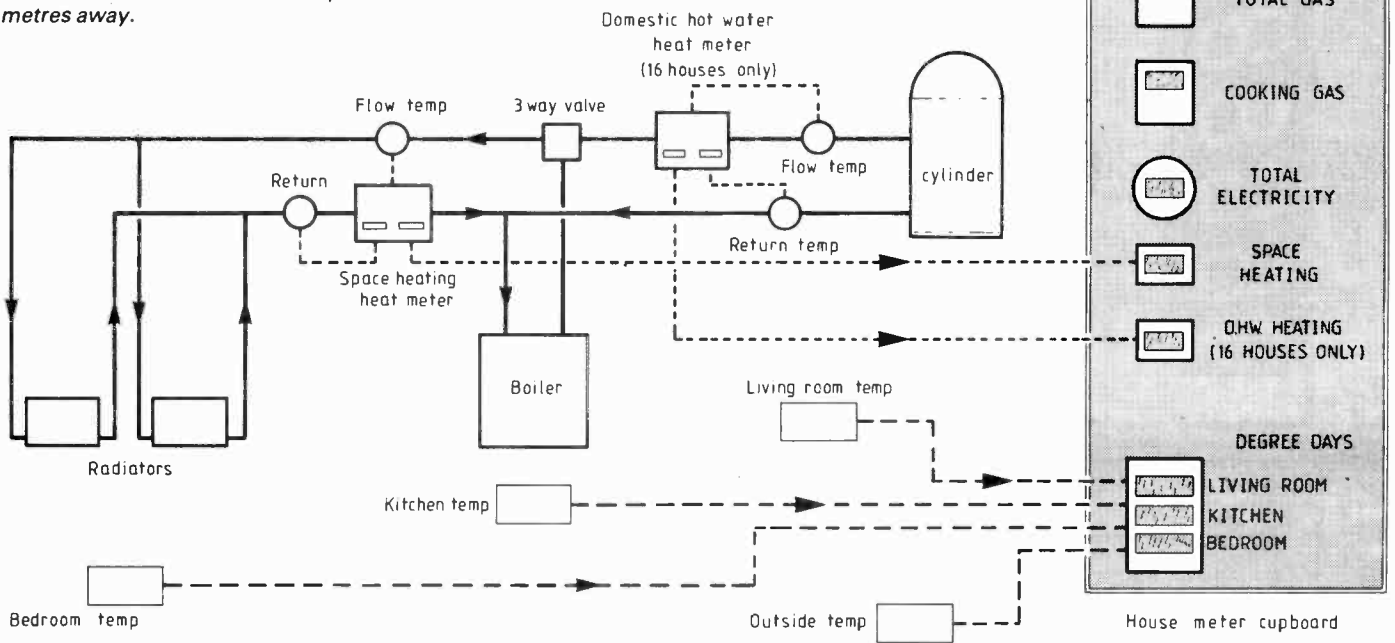


Fig. 2. Battery-saving circuitry samples temperatures every few minutes - the amplifier and v. to f. converter are multiplexed between sensors.

Fig. 3. Temperature integrator is mounted in the house external meter cupboard with other meters — the sensors are up to 10 metres away.



tance of 100 ohms at 0°C rising to 138.5 ohms at 100°C.

Because lead resistances are likely to be significant it is usual to use them in a bridge arrangement, as in Fig. 1. Here the p.r.t. is compared with a precision 100 ohm resistor (e.g. RS158-086) and the bridge ensures that equal lead resistances appear in each arm, with one resistance in common.

I wouldn't recommend the use of i.c.

constant-current sources in this type of bridge. Many have large temperature coefficients (read the fine print for long-term drift characteristics!) and more than one is sold as a dual-purpose constant-current source/temperature sensor! More recently, precalibrated thermistors have become available cheaply and these are now a better choice for temperature measurement than p.r.t.s because of their higher output.

The temperature integration process is

achieved by feeding the difference between the inside and outside temperatures to a voltage-to-frequency converter and then counting and displaying the resulting pulses. To minimize drift, the bridge amplifiers are ICL7600 commutating auto-zero types. To keep the component-count down the internal temperatures are multiplexed into a single bridge amplifier and v-to-f converter (see block diagram).

Much of the circuitry is devoted to battery saving. This allows four D-size and six AA-size alkaline cells to last up to six months.

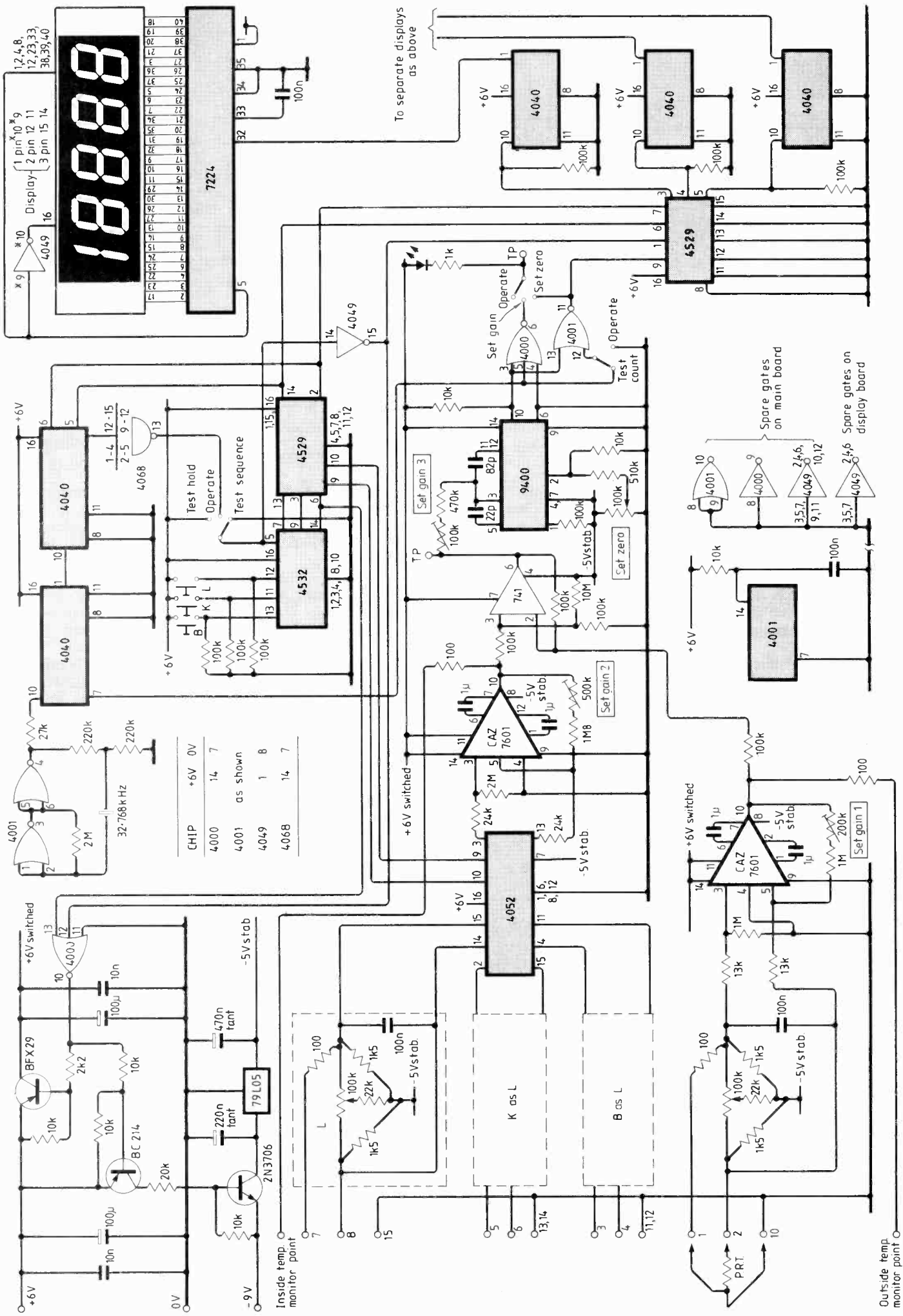
The 32.768kHz crystal oscillator is counted down by 4040 counters and decoded with the 4068 and gate to wake up the sleeping system for two seconds in 512 (about eight minutes). In the off state, battery consumption is essentially that of the three liquid crystal displays (about 300µA). The circuit cycles through four phases of 500ms each, starting with a settling period with the amplifier inputs grounded. Then each of the sensors in turn is routed through the input multiplexer and the bridge amplifier to the v-to-f converter. The resulting pulse train is routed to the appropriate 4040 counter and 7224 counter/display driver.

The v-to-f converter (Teledyne 7400 or RS307-070) requires a stabilized negative voltage rail as a reference, the stability of

Designed by Bob Everett and engineered by the OU Electronics Common Facility, 100 of these temperature integrators were made and installed in houses at Milton Keynes in the summer of 1981.



Bob Everett is currently a Research Fellow in the energy research group of the Open University. He studied mechanical and electrical engineering at Cambridge University, graduating in 1970, and subsequently worked on computer phototypesetting development for the (then) International Publishing Corporation. Since 1976 he has worked on the monitoring and computer analysis of a number of solar energy projects in Milton Keynes. He is embarrassingly fond of his ZX81.



◀ **Fig. 4.** Light-emitting diode and associated switches were included for production testing and could be omitted. The l.e.d. was an idea to set the v. to f. converter gain without an oscilloscope by beating the output against the crystal clock, but the 'scope is a lot easier in practice.

the positive rail being not nearly so critical. Hence the use of a 9V battery regulated to 5V to drive v-to-f converter, bridge amplifiers and the bridge.

Pressing any one of the individual hold buttons powers the system. The 4532 priority encoder selects the appropriate two-bit address and also allows the normal integration mode priority should the counter time out. The bridge amplifiers are powered and the appropriate temperature can be sampled on the two test points with a d.v.m. (1 volt=10degC).

Setting up


The design contains a rather confusing array of switch settings for testing and setting up, most of which turned out to be unnecessary. The bridge amplifier gains

and offsets can easily be set up in the hold mode using standard resistors (100Ω=0°C and 110Ω=26.0°C). The v-to-f offset is set to give a 5Hz tickover at zero ΔT (visible on the l.e.d. in the set-zero switch position). The v-to-f gain is set by adjusting the output to 8.192kHz at a ΔT of 16.9°C. The beat between the v-to-f output and the reference signal from the clock chain should be visible on the l.e.d. with the test switches set to set-gain. Alas, in practice it is far more visible on a 'scope.

One vital ingredient missing from the design is a way of detecting leaky c-mos chips. With complex battery powered equipment, one leaky chip or a floating gate can mean the difference between microamps and milliamps of battery consumption. But which chip is it? Desoldering them at random from a double-sided printed circuit board is a recipe for disaster, and yet a few 100ohm resistors in the power rails to localize the fault could have saved many boards from the bin.

This design dates from 1980. A production run of 100 were made in 1981 and have performed reliably since then. With

the close of the Pennyland field trial they are likely to be passed on to further trials. Although the design is a little dated, it is still difficult to get the same performance at the price from a micro design (the components excluding board and box come to about £120), but it is only a matter of time.

Members of the Open University Electronics Common Facility transformed the scruffy prototype into a production device. Funding for the Pennyland project came from the Department of Energy, through their Passive Solar Energy Programme, and the Department of Environment as an extension of their 'Better Insulated House' programme. 

References

1. Energy Projects in Milton Keynes, S. Fuller, J. Daggart & R. Everett, 1982. Available from Milton Keynes Development Corporation.
2. Simple data-logging instrumentation for monitoring the thermal performance of buildings, Charles Newcomb, Proc. 5th Passive Solar Conference, University of Massachusetts, 1980.

Adaptable typewriter interface continued from page 28

Table 1. Small sample of the output of program of List 1.

Data to printer	Ascii decimal equivalent
12	82
13	77
14	64
15	75
16	94
17	94
18	80
19	83
20	87

Table 2 shows the ascii code in binary for a character (written in left hand side of column) and decimal data representation of the binary code to be sent to the printer (right hand side). For example ascii code 1100100 is found from intersection of column 100 and row 1100 giving character 'd' translated to decimal code 123 for the printer. Non-printing characters are shown by blank entries.

Bits 7654	321							
	000	001	010	011	100	101	110	111
0000	nul							bel
0001	bs 114	ht 70	uf	vt	ff	cr 48	so 71	si 98
0010		dc1 68	dc2 67	dc3 65	dc4 66			
0011				esc 96			rs 69	
0100	sp 113	! 154	" 22	# 158	£ 54	% 29	& 52	' 40
0101	(8	) 56	* 30	+ 26	, 125	- 80	. 85	/ 62
0110	0 120	1 94	2 86	3 126	4 78	5 118	6 110	7 116
0111	8 104	9 72	: 23	; 87	(8	= 90	) 56	? 144
1000	@ 14	A 27	B 53	C 57	D 59	E 60	F 11	G 41
1001	H 55	I 10	J 47	K 15	L 63	M 13	N 45	O 58
1010	P 18	Q 28	R 12	S 19	T 44	U 42	V 9	W 20
1011	X 17	Y 43	Z 25	(8	) 56			46
1100	Y 40	a 91	b 117	c 121	d 123	e 124	f 75	g 105
1101	h 119	i 74	j 111	k 79	l 127	m 77	n 109	o 122
1110	p 82	q 92	r 76	s 83	t 108	u 106	v 73	w 84
1111	x 81	y 107	z 89	8	| 157	56		

Notes and limitations

Some residual problems exist such as the fact that the ascii code does not allow for characters such as half-space or ÷ which are available from the typewriter keyboard. One possible solution to this is to define characters in the code range 128 to 255 and then to use software to substitute these special codes when the alternate character set is required. A decision to include or discard such codes will have a bearing on the complexity of your final program as will, for instance, forcing your non-proportional spacing typewriter to right-margin justify text.


Note that the Praxis does not seem to read the keyboard 1/keyboard 2 status unless the character buffer is empty and so it is necessary to delay before changing the keyboard status if the printing rate is above about ten characters per second.

A more serious limitation is the amount of time that the printer can run continu-

ously until it needs a cooling off period. Typewriters are seldom driven by people who type virtually continuously and so they tend to overheat with this kind of use. For example the Praxis is not really up to printing more than 40 minutes continuously without say a 20 minute rest for the mechanism to cool down a bit. If the printer does get overheated it tends to skip characters and generally mess up the text, thus necessitating a reprint. A lot of printing can be done in 40 minutes but for really long and hard use it is probably more effective to purchase a heavy-duty daisy wheel printer in the first instance.

The problem of feeding single sheets of paper into the printer can be overcome

either by forcing a software delay (the simplest method) at the start of each new page or else detecting the form feed character, then setting a latch to hold BUSY high until manually reset.

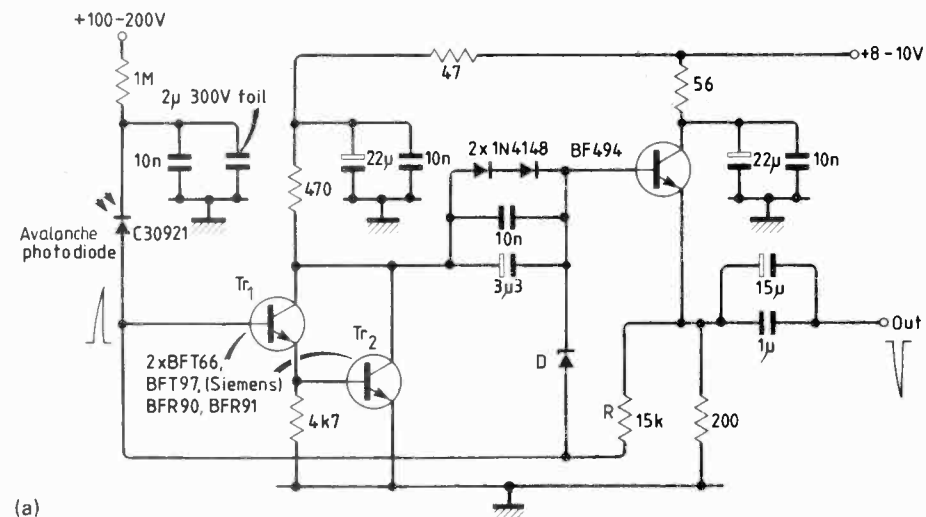
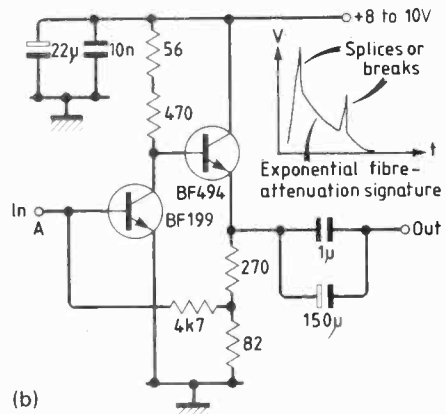
There are of course plenty of hardware options to add on if desired. A uart can be added to accept serial input but be careful about drawing too much current from the printer power supply. A preprogrammed eprom inserted into the data lines will enable the printer to accept straight ascii character data rather than the modified set used here. By this stage you are probably considering one of those single-chip eprom-based processors to produce an interface with all the 'bells and whistles'. 

CIRCUIT IDEAS

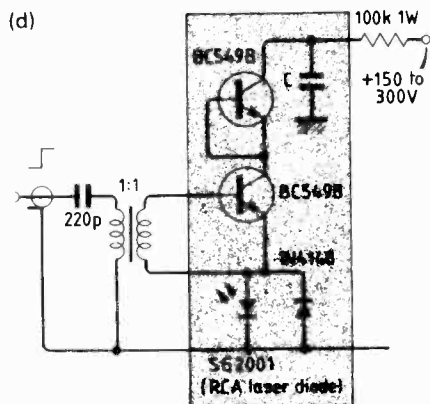
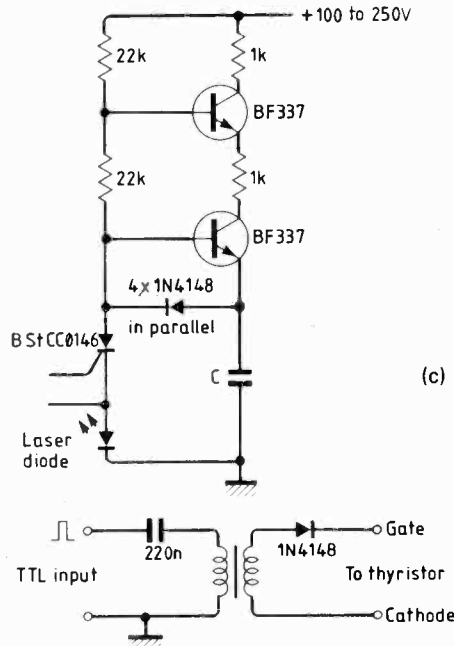
Optical-fibre measurements

Used with an optical-fibre directional coupler, these circuits allow backscatter measurements on fibres with >10dB one-way insertion loss. Light pulses of 50ns are used in the avalanche photodiode pre-amplifier which, when carefully constructed, has a 10-40MHz bandwidth. Small-signal Schottky diode D stops $Tr_{1,2}$ saturating when strong optical reflections occur. Resistor R should be as high as possible, depending on the required bandwidth. When displaying fibre backscatter curves on an oscilloscope, the second amplifier circuit may be useful (b). Oscilloscope bandwidth should be equal to or greater than 40MHz.

In the GaAs laser-diode pulse circuit, (c) capacitor C charges through the transistors and is discharged through the Siemens fast-recovery thyristor and the RCA SG2004/5/6 laser diode. These 904nm laser devices suit the C30921 avalanche photodiode. Capacitor C, chosen to give 50% light-on time, depends on the laser diode and supply voltage and is typically around 8nF. Pulse repetition rates higher than 10kHz are possible. Using a ferrite pulse transformer to drive the thyristor provides isolation (shown separately).



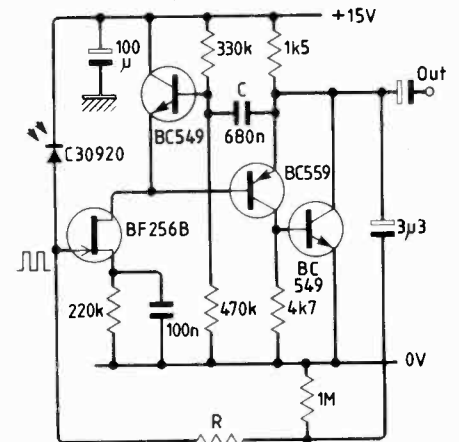
As an aid to optical-fibre bandwidth measurement, final circuit (d) can produce light pulses as short as 200ps with capacitor C at 45pF and using selected transistors in avalanche mode. Input pulse-repetition frequencies between 100Hz and 100kHz



are possible. Siemens BC549s showed avalanche effect at $V_{CEO} > 70V$ and $V_{BR(CES)} > 140V$ d.c. Each of the transistors must be above these limits and only small-signal devices may be used. Wiring within the boxed section should be as short as possible.

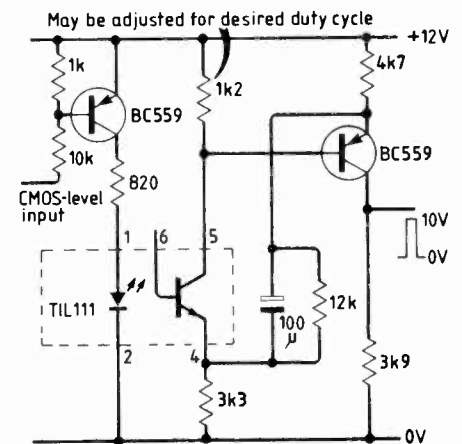
Chopped-light amplifier

Filtering the output of this amplifier to within 100Hz of the chopping frequency of say 1kHz allows light levels down to 10pW to be detected when $R = 10M\Omega$. A bipolar transistor fixes the fet drain voltage so



selection is not required; drain current may be altered by adjusting the source resistor. Voltage gain of the fet is high through inclusion of capacitor C which provides a high dynamic-load impedance. Amplifier noise is 0.04pA r.m.s./ \sqrt{Hz} and noise of the RCA C30920 p-i-n diode is 0.06pA r.m.s./ \sqrt{Hz} .

Schmitt-trigger opto-coupler

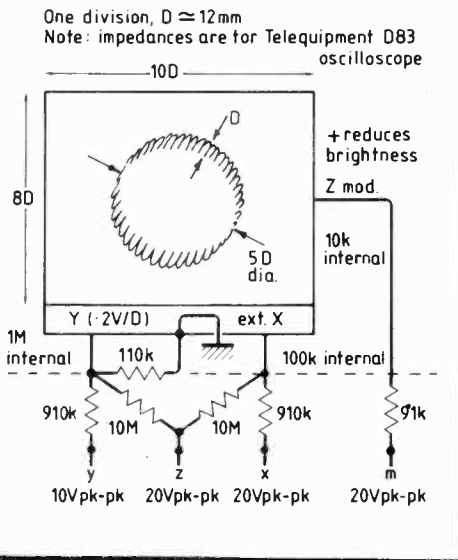


J. Vandeweghe
Ghent University
Belgium

Aligning four frequencies

Four a.c. signals may be compared on a four-channel oscilloscope, but a more graphic representation can be obtained using an oscilloscope in XY mode and adding pseudo-Z and Z modulation signals. This is particularly useful when testing phase-locked loops or tuning several signals simultaneously.

This arrangement, originally devised for a Telequipment D83 oscilloscope, was used to set up two 50Hz sinewaves in quadrature (at x and y) by means of a Lissajous circle. A 2.5kHz signal introduced at z causes the circle to take on a crown shape; this signal appears stationary when its frequency is an exact multiple of the



Programmable pulses with delay

On triggering, this programmable circuit produces a pulse after a delay. Accuracy of the pulse and delay periods is determined by the accuracy of the clock so the design doesn't suffer from drift associated with monostable circuits and works reliably at high frequencies.

The first counter determines delay and the second one pulse width. Counter Q_D outputs are used as these change synchronously with the clock and don't produce glitches at the output but it means that the maximum count is half of that possible using the ripple-carry output. Eight-bit counters are shown but any number of bits may be used by cascading more or fewer 74S163 i.cs. Delay D for a load value L is given by

$$D = (2^n - 1) - L$$

where n is the number of counter bits. In this case, n is seven.

A. D. Hackett
Salisbury
Wiltshire

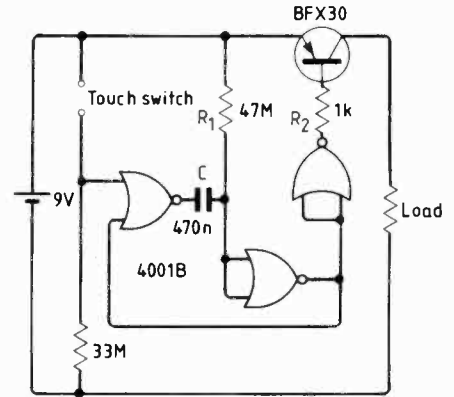
fundamental signal. The highest frequency, 5kHz in this instance, is applied at m to modulate brightness and results in a stationary stripe when synchronized.

With practice, z and m can be adjusted simultaneously. For lower multiples applied to z characteristic shapes are obtained, i.e., three lobes at 2f and four lobes at 3f. If frequencies at x and y are not the same, as usual, Lissajous figures are stationary when the frequencies are exact multiples of each other. For digital signals, sensitivity may be increased by reducing series-resistor values.

C. J. D. Catto
Cambridge

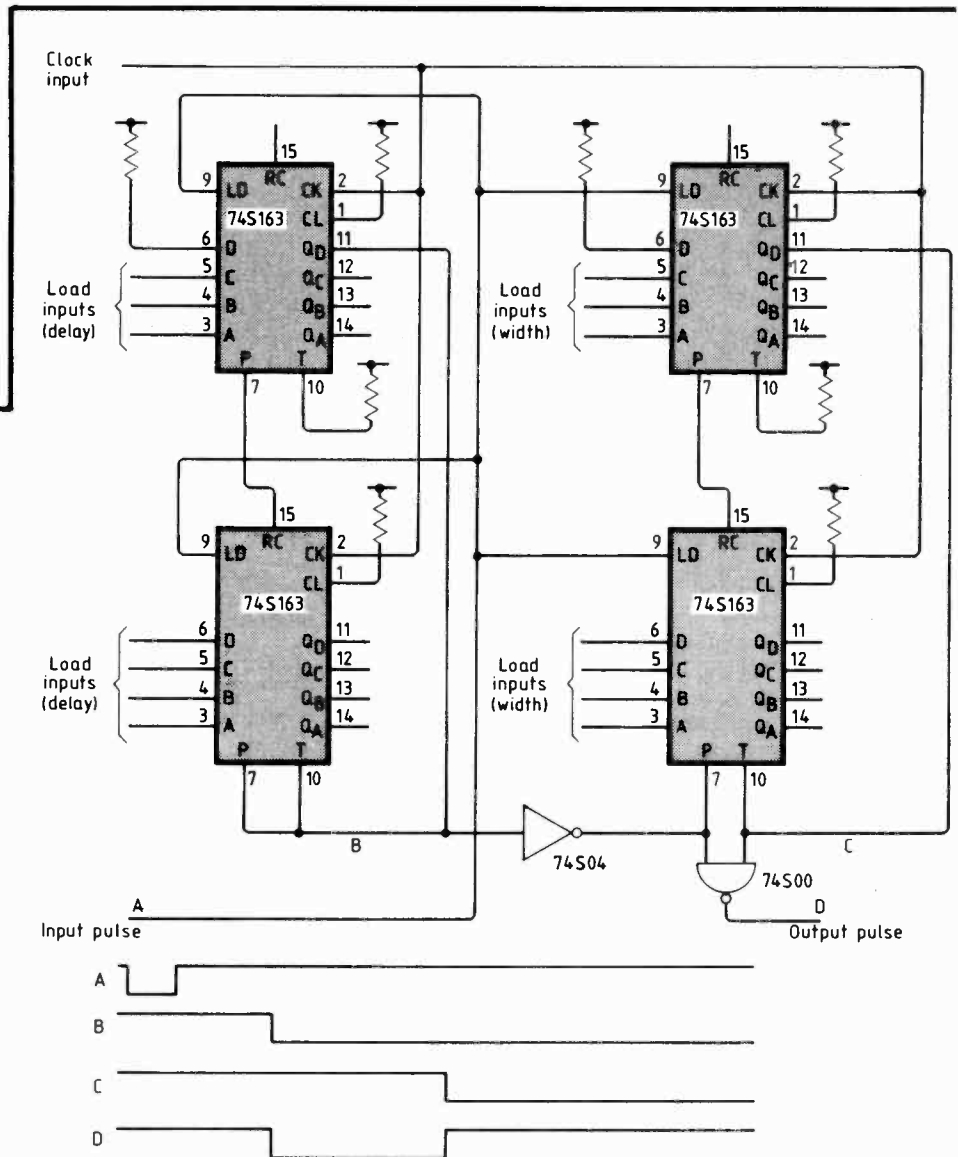
Simplified battery timeout

This contribution is a cheap and simple means of conserving battery power using only six components. After the touch switch is activated, power is applied to the

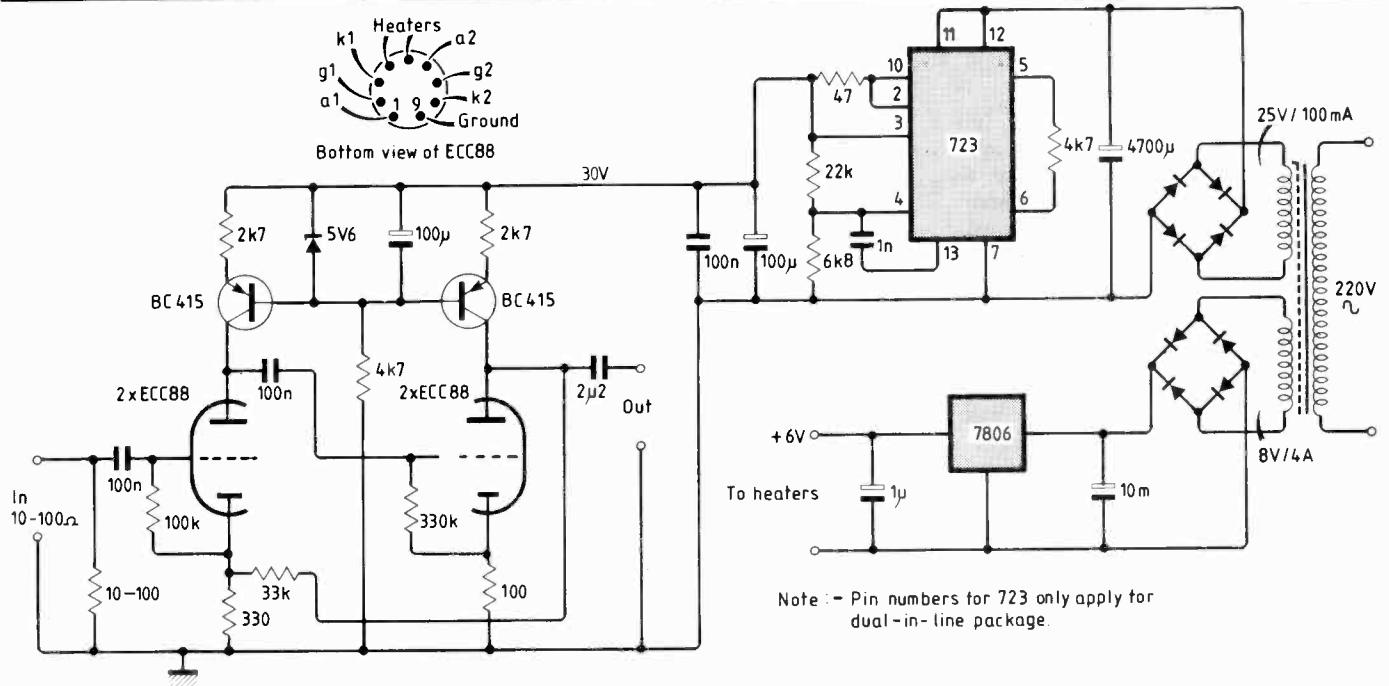


load for a period equal to $0.69CR_1$. Resistor R_2 determines current limiting and may be changed. Quiescent leakage current is less than 100nA and with values shown, the power-on period is 13s and current limiting is at about 450mA. At 200mA, voltage drop is only 200mV.

S. Whitt
Ipswich
Suffolk



CIRCUIT IDEAS



Moving-coil amplifier

I find that this moving-coil cartridge amplifier using valves gives a more natural sound than many circuits using transistors and it is easy to construct. Anode voltage rating of the ECC88 dual triode is only 90V but it may be taken as low as 10V so

power-supply design is simplified. The two sections of each ECC88 are connected in series and low-noise transistors connected as constant-current sources form anode loads for the two stages. Gain of each stage is about 30.

A 723 regulator is used for the main supply because signal-to-noise ratio of the

amplifier depends on noise, output impedance and ripple rejection of the supply. Popular 78-series regulators are not good enough. Valve heater supply must be regulated for the same reasons but in this case a 7806 suffices. Overall closed-loop gain of 100 is determined by the 33kΩ resistor, which may be lowered to reduce gain. Open-loop gain is 600. Loading required for different makes of cartridge varies but is usually between 10 and 100Ω. Capacitors are critical and high-quality polycarbonate or polypropylene types should be used throughout, except for power-supply smoothing.

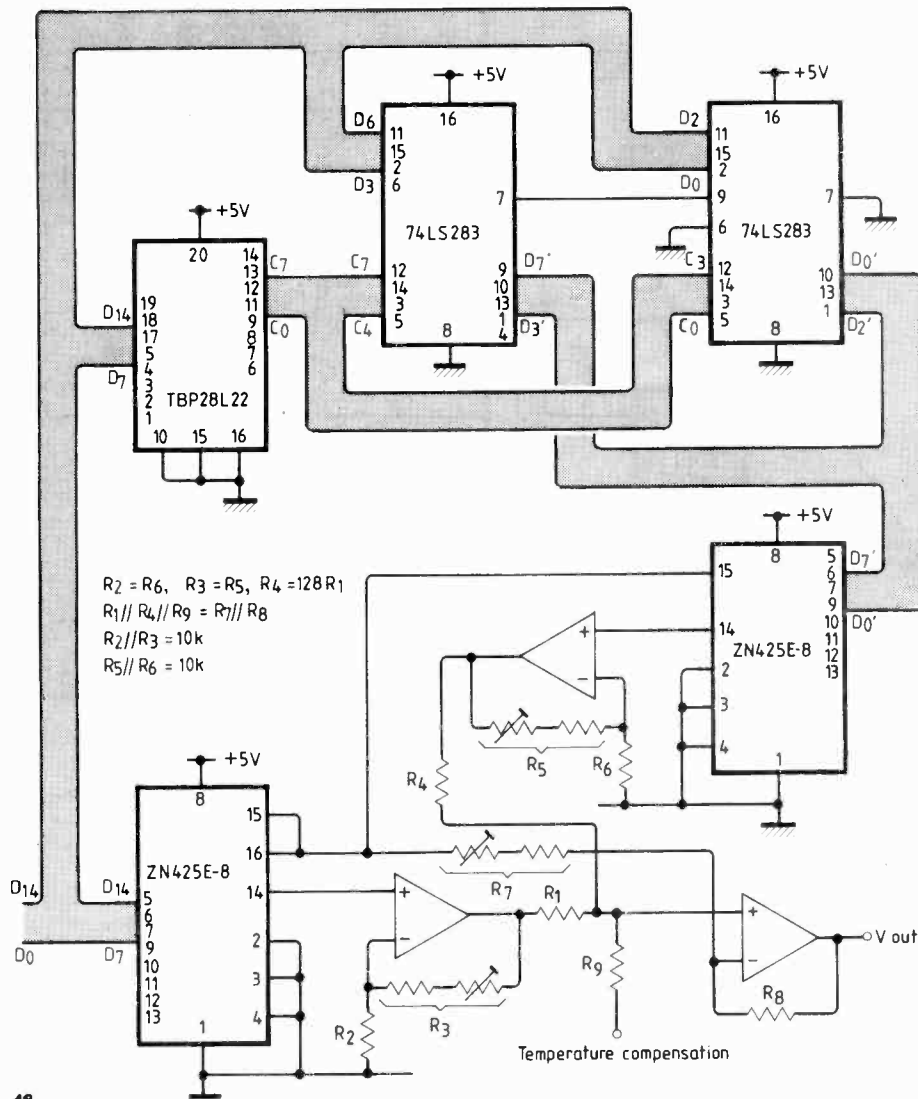
Per Hojlev
Copenhagen
Denmark

15-bit d-to-a using ZN425 converters

Two cheap eight-bit d-to-a converters are combined to form a 15-bit converter in this circuit. Output of the left-hand converter is calibrated for all input values (0 to 255) and a correction value is programmed into the 28L22 prom with 00 corresponding to -511/512 l.s.b. and FF₁₆ corresponding to +511/512 l.s.b. This correction is added to the seven least-significant bits of the input data to provide an eight-bit input to the second converter. Reference voltage for both converters is derived from one i.c. to reduce errors due to ageing and temperature fluctuations.

Resistors R_{3,5} are adjusted to give correct scaling factors for the two d-to-a converter outputs and R₇ corrects for output offset. Component values are not shown since these will depend on the application and output voltage range required. Temperature compensation can be applied through R₉ and by using an external reference voltage.

S. W. Beet
Merseyside



The parallel-fed voltage multiplier

Although any desired voltage may be obtained by stringing together a sufficient number of cells, a voltage converter has many advantages. Battery testing and replacement are simpler, and there is the option of using a single rechargeable device to power the whole of the circuitry.

Our particular need arose during the design of a portable muscle stimulator for biomedical use. The initial specification called for a unit to give output pulses at 10Hz, of 200 μ s duration and amplitude 15mA maximum into a load of approximately 8k Ω , representing the resistance of electrodes placed on skin over the muscle. The stimulator was to be carried about in a pocket or on a belt, and would be used for 6 to 12 hours per day. The power source was to be a single PP3 9V battery, and we hoped to keep the current drain below 1mA to ensure long battery life.

The specification evidently requires a voltage supply of at least 120V. As the output energy per pulse is 0.36mJ, the average power drawn from the supply is 3.6mW. If voltage conversion could be achieved with 100% efficiency, the current drain from the battery would be only 0.4mA. Thus the target value of 1mA seemed approachable. However at power levels below 10mW a conversion efficiency of even 50% is hard to achieve, as we found by examining a commercial stimulator with broadly similar specifications. It employed the conventional oscillator and step-up transformer, rectifier approach to voltage conversion, and its current drain was several milliamps. This poor efficiency, less than 20%, encouraged us to consider an alternative method.

Fig. 1 shows the well-known Cockroft-Walton cascade voltage multiplier in the form commonly used when an alternating voltage is available to drive it. A minor modification at (b) enables it to be driven by antiphase square waves which do not have to swing below 0V. These circuits are series-fed: the a.c. or square-wave driving voltage is applied to the end of a chain of capacitors in series. Design and analysis are notoriously difficult, because the current and voltage waveforms for each stage are different. It is known that with optimal allocation of resources the capacitor values should not all be equal, but should increase from C at the output end to NC at the driven end. Another disadvantage is that the additional output voltage per stage is not constant, but diminishes by one diode drop V_f for each stage in the circuit.

R. D. Purves and C. Prescott

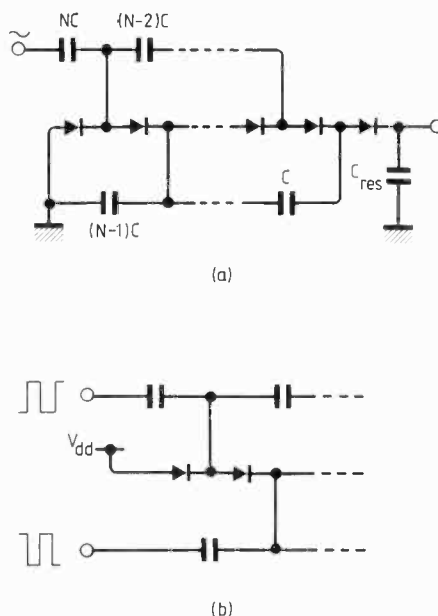


Fig. 1. In the Cockroft-Walton series-fed voltage multiplier the output reservoir capacitor C_{res} is chosen to have a reactance, that is much less than the load impedance at the working frequency. (a) is the single-ended version, while (b) is a modification for push-pull input where antiphase square waves do not have to swing below 0V.

Thus in Fig. 1 (b) with a driving swing from 0 to V_{dd} of 9V and V_f taken as 0.6V, one stage provides $9+8.4=17.4V$, two stages provide $9+8.4+7.8=25.2V$, and so on up to 14 stages which provide 72V. Beyond this limit extra stages contribute nothing.

While pondering these deficiencies we discovered that some remarkable improvements result if the configuration is changed to the parallel-driven form of Fig. 2. The N capacitors now all take the same

value, which simplifies construction. The open-circuit output voltage per stage has the constant value $V_{dd}-V_f$ and so the total output voltage $(N+1)(V_{dd}-V_f)$ can be increased without limit. Finally, the analysis is facilitated by the fact that apart from a step-wise increase in d.c. level, the current and voltage waveforms for each stage are identical (this is strictly true only if N is even, so that points X and Y see the same total capacitance).

The most important design parameter of a power supply, after its open-circuit output voltage, is the equivalent output resistance. The parallel-fed multiplier's output resistance can be derived directly as the ratio of open-circuit output voltage to short-circuit output current. For calculation only, it is convenient to return point Z of Fig. 2 to earth instead of to V_{dd} and to treat the diodes as having zero forward voltage drop. With these assumptions the output voltage becomes NV_{dd} . A further assumption, which will later be relaxed, is that square wave sources X and Y have negligible internal resistance and thus provide a full swing from 0 to V_{dd} regardless of the load. Now if the output terminal is earthed the diodes and capacitors act in 'bucket brigade' fashion to transfer a charge CV_{dd} from one stage to the next in each cycle. The average short-circuit current is therefore CV_{dd}/T where T is the square-wave period; it follows that the multiplier output resistance is NT/C .

A more general expression for output resistance, derived in the appendix, is

$$(NT/C) \coth(T/2NRC)$$

in which the hyperbolic term corrects for the finite resistance R of the square-wave

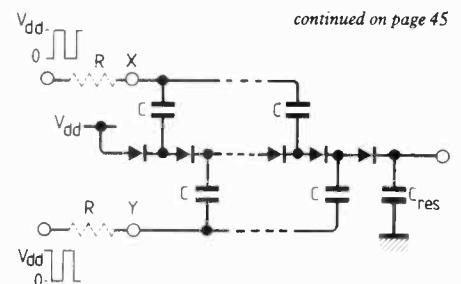


Fig. 2. Parallel-fed voltage multiplier. Resistors R represent the equivalent resistance of the square wave sources.

* Battery-powered instruments, by Ian Hickman, *Wireless World*, vol. 87, 1981, pp.57-61.

Dr Purves is with the department of pharmacology, University of Otago, New Zealand, and Mr Prescott is at the department of anatomy & embryology, University College, London.

Frequency response analyser

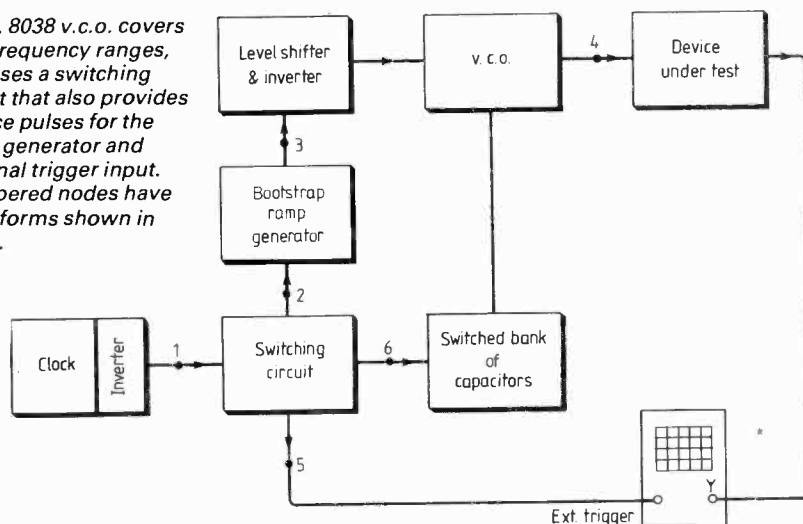
Using an oscilloscope to display response, this educational aid to understanding frequency response of amplifiers and tuned circuits covers the band 40Hz to 400kHz.

The heart of the analyser is a voltage-controlled oscillator, Fig. 1, whose ramp voltage varies the frequency. The v.c.o. used, the Intersil 8038, has a linear relationship between control voltage and frequency with the required range of 1:10,000 covered in four sweeps, each sweep causing a decade change in frequency. A given frequency range depends on external resistances and a capacitor. In our scheme, four different timing capacitors are used, one for each sweep range, switched in a repetitive sequence. The switching circuit shown in Fig. 1 is also used for providing retrace pulses for the bootstrap ramp generator and external trigger input for stabilized oscilloscope display. For a large frequency sweep, the v.c.o. requires a control voltage decreasing from V_{max} to V_{min} of V_{cc} to $2V_{cc}/3 + 2$. The level shifter with inversion after the ramp generator shown in Fig. 1 solves this problem.

The v.c.o. output is attenuated and fed to the input of the device under test (d.u.t.), say an RC-coupled amplifier. The frequency-dependent output of the device under test is passed to the oscilloscope Y-input.

K. Srivatsa, with a B.E. and M.Tech. in electronics, lectured at the University Visvesvaraya College of Engineering, Bangalore, before becoming senior engineer (software) at Processor Systems Pty Ltd, Bangalore. His co-authors graduated from UVCE in 1982 with B. E. (Electronics) and have taken up jobs in power electronics (Sridhara Murthy) and digital microwave communication (R. Partha).

Fig. 1. 8038 v.c.o. covers four frequency ranges, and uses a switching circuit that also provides retrace pulses for the ramp generator and external trigger input. Numbered nodes have waveforms shown in Fig. 2.



by K. Srivatsa, R. Partha and S. L. Sridharmurthy

Figure (2a) shows the clock input to the switching circuit, with a duty cycle of about 10%. Waveform (b) is derived from (a) with a period equal to four times the clock period. These pulses are passed to the bootstrap ramp generator circuit causing retrace.

The ramp at (c) has a frequency of

Fig. 2. Waveforms (a) to (f) are found at the nodes 1 to 6 in Fig. 1.

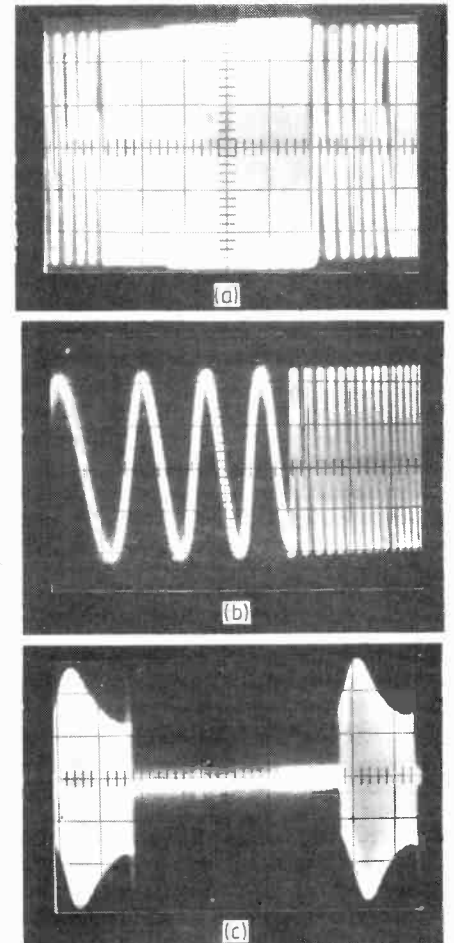
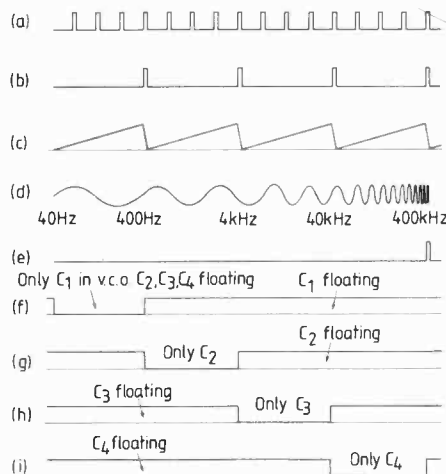


Fig. 3. Full range of analyser is shown at (a), with an expansion at (b). Lower trace shows typical output from a tuned amplifier.

400Hz. This waveform is inverted and level shifted before the v.c.o., whose output is shown in (d). Waveform at (e) has a period of four times the ramp period used for external sweep triggering to give a flicker-free display. Waveforms (f) to (i) switch the required capacitor into the v.c.o.

The performance of the analyser is demonstrated in Fig. 3. Photograph (a) shows the full range of v.c.o. and (b) is an expanded partial range. With this as the input to a tuned amplifier, the resulting output was as shown in (c). The detailed circuit is shown in Fig. 4. Design procedure is easily obtained from the data sheets¹.

Improvements

For higher resolution, as in a tuned amplifier which requires a part of the frequency

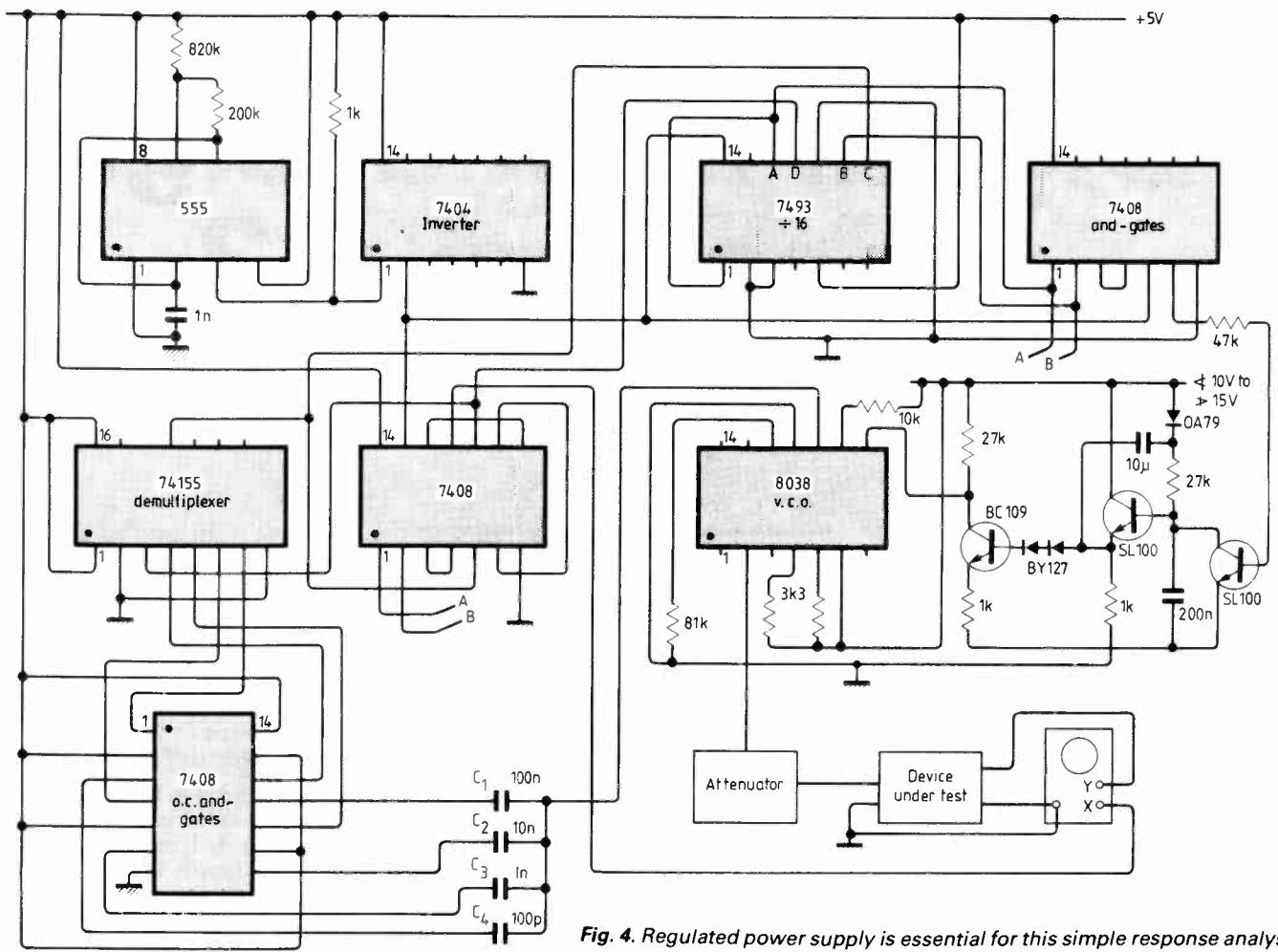


Fig. 4. Regulated power supply is essential for this simple response analyser.

range, it must be possible to divide the entire sweep range into programmable sub ranges, and the above multisweep technique repeated within each sub range.

In the analyser, the sinewave output of the d.u.t. is fed directly to the Y input. For a proper plot a direct voltage must be

given to the Y input. It will be necessary to use a wideband average detector with a switched filter for a d.c. output. Switching of filter capacitors is done using the waveforms for switching the v.c.o. capacitors. Other techniques for improving the display can be found in reference 2.

References

- 1 Intersil application note ICL 8038.
- 2 Logarithmic audio sweep generator, by A. C. Ainslie. *Wireless World* Sept. 1979.

Parallel-fed voltage multiplier continued from page 43

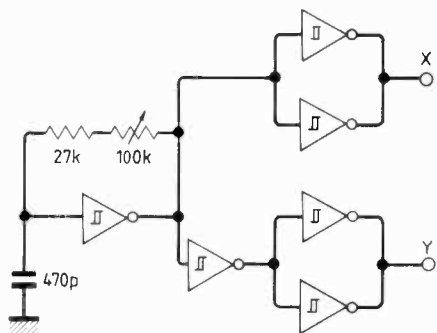


Fig. 3. A simple low power square wave source, using a CMOS hex Schmitt inverter (40106B or 74C14).

sources. For fixed R the output resistance falls with decreasing T or increasing C until $T \ll NCR$, when a limiting minimum value $2N^2R$ is reached. The actual value of capacitance used is largely immaterial, as a compensatory change in T can always be made.

In low power operation c-mos gates have sufficiently low output resistance (a few hundred ohms) to act as drivers, espe-

cially if two or more gates are paralleled, Fig. 3. More effective buffering is needed at power levels greater than about 10mW. A 15-stage multiplier driven by this circuit with $T=50\mu s$ and $C=10nF$ provided an open-circuit voltage of 137V with a battery drain of 0.27mA. The measured output resistance was 130k Ω . With 30 μA drawn from the output, total battery drain was 0.72mA. Overall conversion efficiency (load power/battery power) is 60%, a very satisfactory result in view of the low power level. If miniature polyester layer capacitors are used in the multiplier chain the entire circuit occupies little more volume than the 9V PP3 battery supplying it.

Appendix

When the resistance R of the square-wave sources is not negligible, the waveform at X or Y with the multiplier output short-circuited takes the shape indicated in Fig. 4, in which the amplitude of the swing $V_2 - V_1$ is less than its maximum value V_{dd} , owing to incomplete charging and discharging of the capacitors in

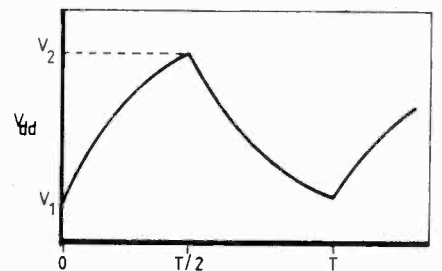


Fig. 4. The waveform seen at point X or Y of Fig 2 when R is not negligible.

each half cycle. The charge transferred from stage to stage in one cycle is $C(V_2 - V_1)$ and the average short-circuit current is therefore $C(V_2 - V_1)/T$. By inspection of Fig. 4:

$$V_1 = V_2 e^{-1/NRC}$$

$$V_2 = V_{dd} - V_1$$

$$\text{Hence } V_2 - V_1 = V_{dd}(1 - e^{-T/NRC}) / (1 + e^{-T/NRC}) = V_{dd} \tanh(T/2NRC)$$

With ideal diodes the open-circuit output voltage is NV_{dd} and so the output resistance is given by

$$NV_{dd} T / C(V_2 - V_1) = (NT/C) \coth(T/2NRC).$$

Digital filter design procedure – 3

Despite its limitations a high-pass digital filter is easily designed by 'inverting' its equivalent low-pass version (July issue). Except for sign changes, pole and zero parameters are the same.

Previous articles with this title were in the May and July 1983 issues, the first outlining how to design the digital equivalent of an analogue filter where the transfer function can be simply formulated. As an example, the article derived in detail the digital equivalent of a parallel tuned circuit, and one case had pole positions chosen with a simple microprocessor in mind. The second article covered the case where the z-plane transfer function had to be derived from an analogue filter using a bilinear transformation, and a fourth-order low-pass Butterworth filter was used as an example.

One can argue that even in the analogue world a high-pass filter cannot really exist as it is not possible for a circuit to pass signals of an infinite frequency. The Butterworth low-pass filter has a flat response from zero up to its cut-off, but the flat response of the equivalent high-pass filter cannot possibly extend from

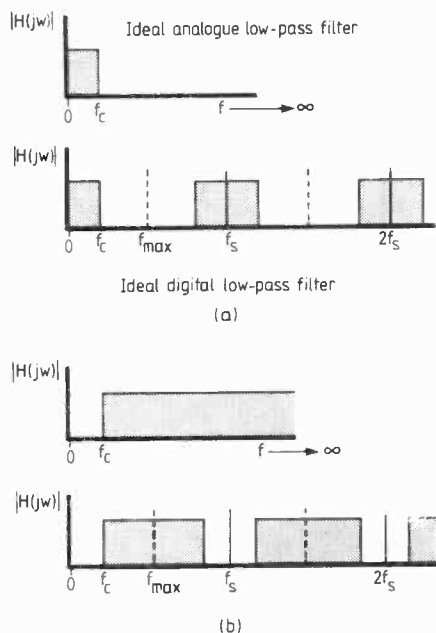


Fig. 1. Spectra of ideal analogue and digital low-pass filters compare as at top diagram (a), while ideal analogue and digital high-pass filters compare at bottom (b). Frequency f_{max} is the digital equivalent to an infinite analogue frequency.

by J. T. R.
Sylvester-Bradley M.A.

cut-off to infinity. However, as explained in the previous article, with the digital version of the Butterworth low-pass filter, the digital equivalent to an infinite frequency is the maximum frequency that the digital filter can handle, that is half the sampling frequency.

The same applies to the high-pass digital filter, and within this limitation it can have a flat response from its cut-off frequency up to the digital equivalent of an infinite frequency (f_{max}), see Fig. 1, where the spectra (or more precisely, the Fourier transforms of the impulse responses) of both low-pass and high-pass ideal analogue filters are compared with their digital equivalents. In the last mentioned the spectra are repeated at multiples (harmonics) of the sampling frequency.

Once the limitations of the high-pass filter are recognized, a filter which is the precise equivalent to its low-pass version is easily designed by inverting the position of the low-pass poles and zeros on the Z plane.

Figure 2 shows the spectrum and Z-plane diagram of the high-pass filter designed in this way to be an exact

equivalent of the low-pass filter designed in the previous article (Fig. 10 of that article).

Pole and zero positions

The pole positions for the low-pass filter were

$$\begin{aligned} \text{pole 1 } r_1/\omega_1 T &= 0.758 \angle 137.2^\circ \\ \text{pole 2 } r_2/\omega_2 T &= 0.458 \angle 159.1^\circ, \end{aligned}$$

with poles 3 & 4 as their conjugates. The four zeros were all located at $1.0 \angle 180^\circ$.

The pole and zero positions for the high-pass filter are found by adding 180° to the above positions, giving

$$\begin{aligned} \text{pole 1 } r_1/\omega_1 T &= 0.758 \angle 42.8^\circ \\ \text{pole 2 } r_2/\omega_2 T &= 0.458 \angle 20.9^\circ, \end{aligned}$$

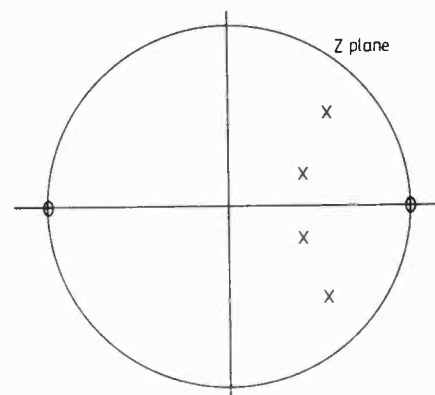
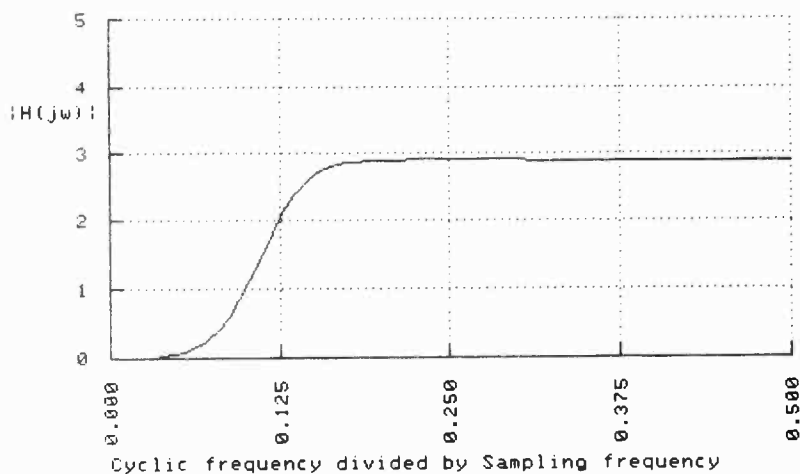


Fig. 2. Spectrum and Z-plane diagram and $|H(j\omega)|$ of digital equivalent of high-pass Butterworth filter.



with poles 3 & 4 as their conjugates, and with the four zeros located at $1.0 \angle 0^\circ$.

The spectrum of Fig. 2 shows a flat response from just above the cut-off frequency (f_c) up to f_{max} and

$$f_c = 1/8f_s = 1/4f_{max}$$

Transfer function

For the high-pass filter $H(z) = \frac{(z-1)^4}{(z-r_1e^{j\omega_1 T})(z-r_1e^{-j\omega_1 T})(z-r_2e^{j\omega_2 T})(z-r_2e^{-j\omega_2 T})}$

$$(z-r_1e^{j\omega_1 T})(z-r_1e^{-j\omega_1 T})(z-r_2e^{j\omega_2 T})(z-r_2e^{-j\omega_2 T}) \quad (1)$$

multiply the denominator to evaluate the pole parameters:

$$(z^2 - 2zr_1\cos\omega_1 T + r_1^2)(z^2 - 2zr_2\cos\omega_2 T + r_2^2) = z^4 - 2z^3r_1\cos\omega_1 T + z^2r_1^2 - 2z^3r_2\cos\omega_2 T + 4z^2r_1r_2\cos\omega_1 T\cos\omega_2 T - 2zr_1r_2\cos\omega_2 T + z^2r_2^2 - 2zr_1r_2^2\cos\omega_1 T + r_1^2r_2^2$$

Collect like terms:

z^4	z^3	z^2	z^1	z^0
1	$-2r_1\cos\omega_1 T$ $-2r_2\cos\omega_2 T$	r_1^2 $4r_1r_2\cos\omega_1 T\cos\omega_2 T$ r_2^2	$-2r_1r_2\cos\omega_2 T$ $-2r_1r_2^2\cos\omega_1 T$	$r_1^2r_2^2$

From the pole positions,

$$r_1 = 0.758$$

$$\omega_1 T = 42.8^\circ \quad \cos\omega_1 T = 0.7337$$

$$r_2 = 0.458$$

$$\omega_2 T = 20.9^\circ \quad \cos\omega_2 T = 0.9342$$

Therefore the pole parameters are

z^4	z^3	z^2	z	z^0
a_0	a_1	a_2	a_3	a_4
1	-1.1123	0.5746		
	-0.8557	0.9518	-0.4917	
		0.2098	-0.2333	0.1205
$\Sigma 1$	-1.968	1.7362	-0.725	0.1205

The pole parameters, a_n ($n=0$ to 4) for the high-pass filter above are the same, except for sign changes, as for the low-pass filter designed in the previous article. Some paperwork would therefore be avoidable if the high-pass filter is designed as the inverse of low-pass filter already designed.

The transfer function can now be written to include the pole parameters, and assuming unity gain, $H(z) =$

$$\frac{(z-1)^4}{z^4 - 1.968z^3 + 1.7362z^2 - 0.725z + 0.1205} = \frac{Y(z)}{X(z)} \quad (2)$$

In the numerator the zero parameters b_0 to b_4 can be found by expanding $(z-1)^4$ (or from Pascal's triangle):

$$(z-1)^4 = z^4 - 4z^3 + 6z^2 - 4z + 1$$

Values for b_n are the same as for the low-pass filter, except for sign changes in b_1

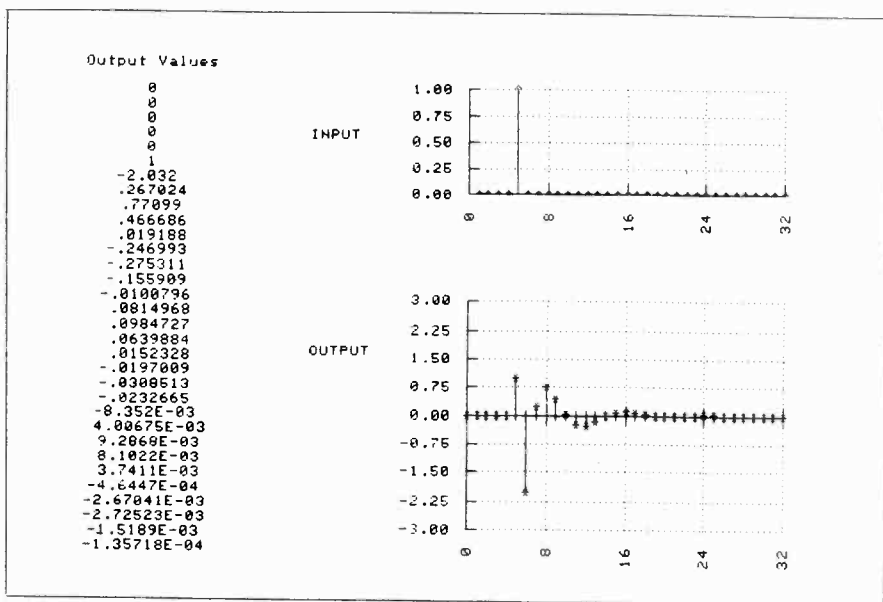


Fig. 4. Impulse response of high-pass digital filter showing "ringing" at $1/8f_s$ (top).

Fig. 5. Output of high-pass digital filter with a long (16 samples) input pulse (below).

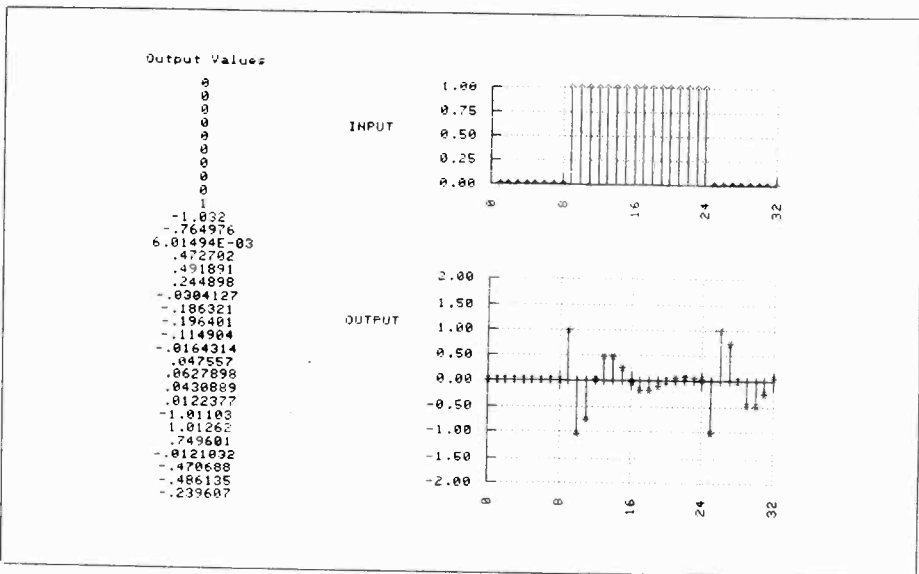
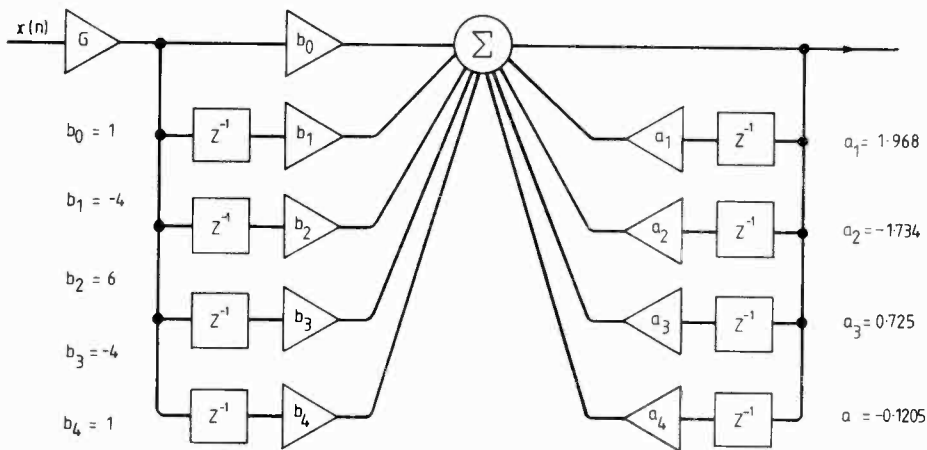


Fig. 3. Realization diagram for the 4th-order Butterworth high-pass digital filter (bottom).



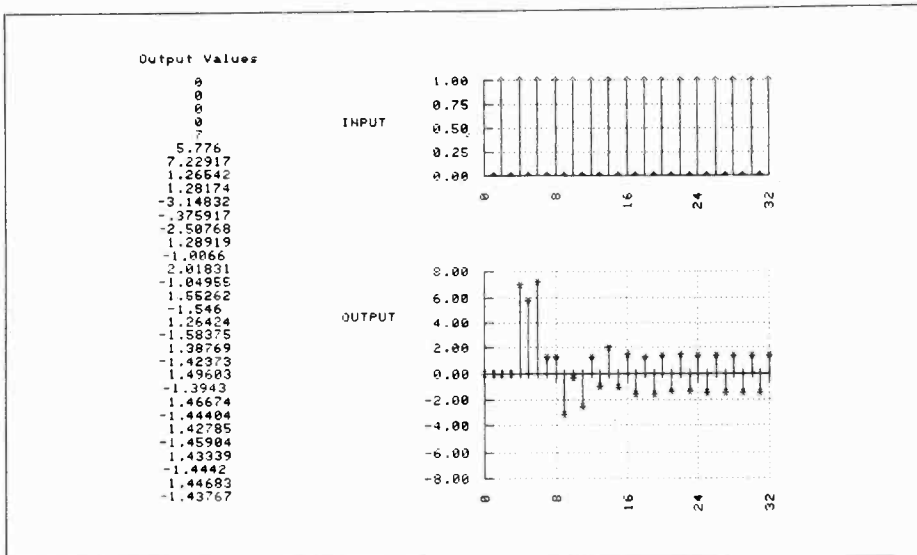


Fig. 6. After the switching transient, pulses are transmitted but with no d.c. component. Input is at f_{max} .

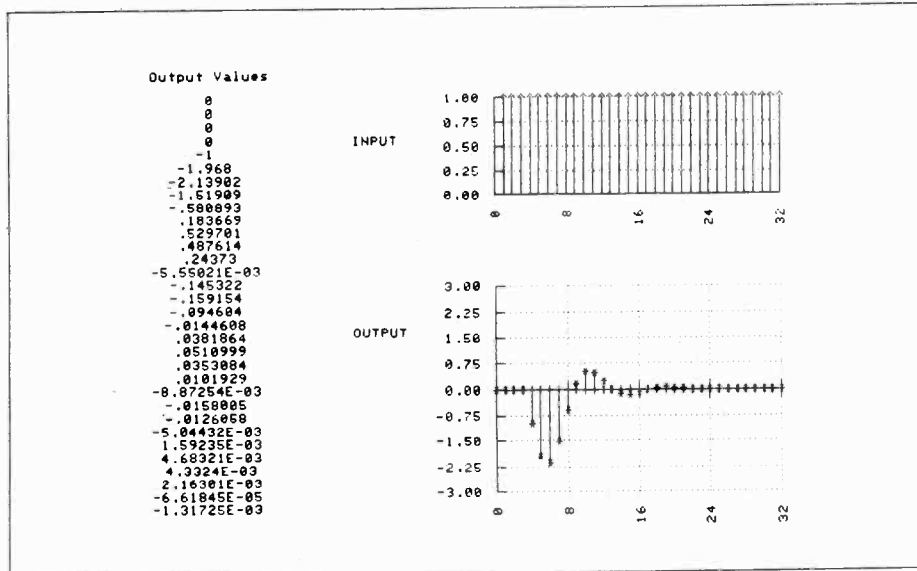
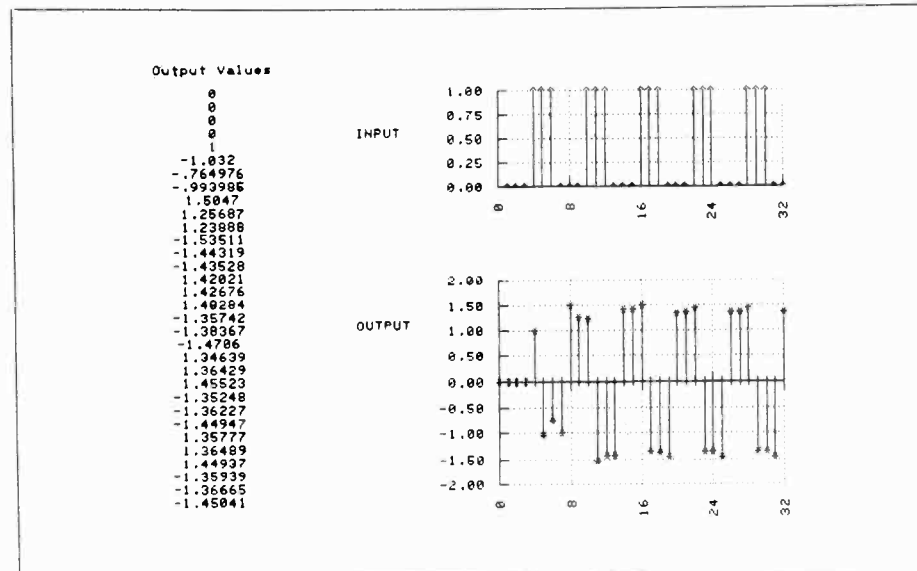


Fig. 7. In spite of being a "high-pass" filter, it cannot pass frequencies above f_{max} . Here the input is zero (after switching transient) with an input at the sampling frequency.

Fig. 8. Pulse train within the passband of the filter passed without distortion but with no d.c. component.



and b_3 . Cross multiplying in the equation for $H(z)$ and dividing by z^4 gives the expression for $Y(z)$:

$$Y(z) = 1.968Y(z)z^{-1} - 1.734Y(z)z^{-2} + 0.725Y(z)z^{-3} + 0.1205Y(z)z^{-4} + X(z) - 4X(z)z^{-1} + 6X(z)z^{-2} - 4X(z)z^{-3} + z^{-4}$$

The recurrence formula is therefore

$$y(n) = 1.968y(n-1) - 1.734y(n-2) + 0.725y(n-3) - 0.1205y(n-4) + x(n) - 4x(n-1) + 6x(n-2) - 4x(n-3) + x(n-4)$$

which can be written directly into a computer program to realize the filter. The realization diagram and impulse response are shown in Figs 3 and 4.

The output with a long rectangular input pulse, as in Fig. 5, clearly shows the differentiating effect of the filter, together with some ringing at the cut-off frequency.

With an input at f_{max} , (in Fig. 6 the on/off pulses are at half the sampling frequency) the output soon settles down to passing the pulses, but with their d.c. component removed. The output settles down after the ringing effect of the switching transient is over.

The filter is unable to pass a frequency equal to f_s , Fig. 7.

With a series of rectangular pulses three samples long their frequencies are well within the pass-band of the filter, and at Fig. 8 the pulse train is passed without much distortion (after the switching transient) but with the d.c. component removed. WWW

In the July 1983 article, a slip occurred on page 43, in which $X(z)$ was inadvertently repeated in the penultimate line.

If you read that article you will no doubt have spotted that the last two lines of text in column one on page 44 should have followed the recurrence formula. — dep. ed.

Who was Fessenden?

When J. D. Parker received the Fessenden Award from the National Marine Electronic Association, he had to confess that he did not know of Fessenden. So the NMEA provided him with an article from the January 1930 issue of *Radio-Craft*. Reginald A. Fessenden, it turned out, worked with Edison as an electrical engineer and as chief chemist. He later became professor of electrical engineering at Western University, Pittsburg and as early as 1895 began experimental work with radio waves. Through his knowledge of sound waves he conceived the idea of modulating a continuously oscillating radio wave and his was the first voice ever to be heard on radio. He invented the rectifying electrolytic detector, the successor to the coherer, and his other inventions included the r.f. alternator and the rotary spark-gap. He suggested the principle of heterodyning but was unable to go further until the development of suitable oscillator valves. He also spent a considerable time working on navigation and signalling at sea.

DSP, the next big step

Digital signal processing does the same things that are familiar to computer users. It executes algorithms. However in most computer applications relatively small batches of data are processed and they often do not require immediate processing. Many are familiar with the 'printout will be available next Tuesday' system. D.s.p. offers the ability to process great volumes of data with no observable delay, in 'real time'.

The technique is not particularly new. It has been used in specialized military and aerospace programmes where ultra-fast real-time computation is said to be needed, and used very expensive array processors. What is new is the production of integrated circuits that make it feasible to perform tasks previously too expensive for general use or only possible on analogue equipment.

An example of the use of d.s.p. is spectrum analysis of the vibrations in an engine on test. A d.s.p. spectrum analyser receives signals from transducers attached to the engine. It converts the analogue signals to digital signals, processed through filters to analyse the frequency content of the vibrations and provide an instant printout or display on the current state-of-health of the engine. Such equipment might now be the size of a personal computer but the new integrated circuits will reduce this to a handful of chips. A car, for example, might be fitted with a self-diagnosed module and a collision-avoidance system. Similarly small packages could be used for speech analysis, speech synthesis or for helping to compensate for hearing, speech or sight impairments.

All d.s.p. algorithms have similar structures. They typically require the multiplication and totalling of strings of numbers. This structure is similar to the totalling of a bill where data (e.g. quantities) and coefficients (e.g. prices) are multiplied together to give subtotals which are, in turn, all added to give a grand total.

Such multiplication of data and coefficients is known as array processing. Typical algorithms are digital filtering, which may be used for improving the signal-to-noise ratio; spectral analysis, which uses fast Fourier transforms to determine the frequency content of a signal; correlation, to compare signals; estimation, to decide on the validity of a signal that is incomplete or obscured by noise; and control.

A typical d.s.p. multiplier can complete a multiplication in 150ns, about 1000 times faster than a standard microprocessor. Multipliers are typical building blocks for d.s.p. hardware, others are arithmetic logic units and sequencers.

Belying their name, Analog Devices have launched a 16 by 16-bit multiplier accumulator (mac), the ADSP-1110. This c.mos device provides a 40-bit internal accumulator and yet fits onto a standard 28-pin dual in-line package. This is because it uses only a single port but operating from a 10MHz clock, the mac can alternately load x and y operands and, when instructed, output the result.

The mac can be used as a low-cost computational accelerator in graphics systems where matrix multiplications are used in image manipulation to translate, rotate or zoom the image. Under control of the system's processor, the mac can multiply a four-by-four matrix and a four-by-one vector, requiring 16 operations in less than 4µs. It operates on six-bit instruction words, there are two control lines and an overflow flag. In the event of an overflow there is an eight-bit accumulator overflow register. The ceramic version of the ADSP-1110 is available in sample quantities. It can operate over the temperature range -55 to 125°C. A plastics-housed version with a more modest temperature range, 0 to 75°C will be available soon. Prices are thought to be about £75 each if bought in quantities over 100. Analog Devices Ltd, East Molesey, Surrey KT8 0SN.

Electronic potato

If you have noticed that the potatoes you buy are less battered than before, this may be due to research carried out by the Scottish Institute for Agricultural Engineering (SIAE). They developed an electronic potato made out of plastic foam enclosing an Entran accelerometer, a transmitter and small rechargeable batteries. The transmitter sends out a v.h.f. radio signal, modulated when the transducer is activated. This potato is handled during harvesting and potato grading along with a batch of real potatoes and the stages when the is at

most risk from damage can be monitored. A battery operated receiver and tape recorder are used to record the signals transmitted from the potato and 'voice-over' commentary may be recorded at the same time to identify the stages actually taking place. Machine adjustments, modifications or alterations to the operating speed can all be assessed with the electronic spud. Moreover it can also disguise itself as an apple or an onion which are also subject to mechanical handling. A similar technique has been used to monitor raspberry harvesting with electronic raspberries.

Do you remember Baird tv?

If you do, the Royal Television Society would like to get in touch with you. They are planning an event to mark the 50 years that have passed since the 30-line service was terminated. They would like to identify as many of those 'pioneer viewers' as possible. The honorary secretary of the midland centre of the RTS is John Grant-ham, at BBC Network Production Centre, Pebble Mill Road, Birmingham, B5 7QQ.

Briton honoured

The tenth Marconi International Fellowship has been awarded to Professor Eric Ash. Dr Ash, Professor of Electronics at University College, London, has been made "in recognition of his outstanding leadership and pioneering work in the emerging technologies of acoustic surface wave device, optical fibre-based communications, acoustic optics and acoustic imaging".

Marconi International Fellowships were founded by Guglielmo Marconi's family and are awarded each year to further research by "a leading world scientist who has made a distinguished contribution to those areas of science and technology that improve the quality of life". Readers may recall that in 1982 the fellowship was awarded to Dr Arthur C. Clarke for first specifying the potentialities and technical requirements for the use of synchronous orbiting satellites for global communications.

High-Com stereo radio

A three month public trial of compressed f.m. broadcasts is under way in Federal Germany. The system had to offer no reduction in quality to the listener without an expander in the receiver and yet when an expander fitted there should be a noticeable difference. Not surprisingly, ARD chose a home-grown product - AEG-Telefunken's High-Com compander system. The system had to be modified to fit the requirements (see German radio show report, November 1983, page 75). After modification only two out of 13 'guinea pigs' could tell any difference between the compressed and uncompressed signal and then only in direct comparisons. Moreover, tests in cars showed that there was an audible improvement in v.h.f. reception of the compressed but unexpanded signals. It is thought that this was because the compressed signal increased the volume of quieter passages which were then more easily heard above the noise background.

Interface to be made in bulk

Swamped by the orders for the IEEE488 Procyon interface for the Acorn/BBC microcomputer, Cambridge Systems Technology have been forced to award an assembly contract for the unit to an outside manufacturer. The contract has gone to CVO Electronics of Stevenage.

The device has found a considerable number of customers in professional, scientific and educational users. A high proportion of scientific test instruments use 488 interfacing especially from such manufacturers as Hewlett Packard, CBM, Philips, and Tektronix, and therefore can be monitored or controlled through a BBC computer fitted with the Procyon unit.

TAT-8 will be optical

International agreement between 28 telecommunications authorities has given the go-ahead for TAT-8, which will use hair-thin glass fibres. Two pairs of fibres will be incorporated in the cable. Each pair will operate digitally at 280Mbit/s to give a total capacity of 8000 telephone circuits. This basic capacity can be increased by digital circuit multiplying equipment up to 40 000, although initially only a small proportion of this potential capacity will be used. Monomode transmission will give the cable this high capacity and allow a long spacing, 30 to 55km, between light regenerators, the equivalent of repeaters on wire cables which are needed every 5km.

The American end of the cable will start at Tuckerton, New Jersey and the main part, 5 800km will be provided by AT&T Communications. Near the European continental shelf, a junction box will allow the cable to be split two ways. 520km of cable will be laid by STC to join the junction box to Widemouth Bay, Cornwall, while another 310km will branch off to Penmarche on the Brittany coast of France. The French branch will be the responsibility of a French company, Submarcom.

Cables and satellites share about half each the total capacity of telecommunications across the ocean. At present, including TAT-7, the cable capacity is about 11 200 telephone circuits. TAT-8, expected to come into operation in 1988, will more than double this.

Home energy monitor

On page 36 of this issue is a project to build a differential temperature integrator to monitor temperature differences in a house. Designed by Bob Everett, a research fellow at the Open University, and engineered by the OU Electronics Com-



Amongst the facilities at the Daresbury Laboratory of the Science and Engineering Research Council are the world's largest tandem Van der Graaff accelerator and the world's first high energy electron accelerator dedicated to the production and use of synchrotron radiation. In experiments to study the details of atomic nuclei, ions are accelerated to energy levels up to 20MeV. Synchrotron radiation is emitted when electron have been accelerated to a peak level of 2GeV and then deflected by the fields of storage ring magnets. It is used in atomic and molecular spectroscopy, X-ray spectroscopy and surface science. Microprocessor monitoring and alarm systems are provided by Sattcontrol of Aldershot.

mon Facility, 100 of them were made and installed in houses in Milton Keynes in the summer of 1981 as part of a series of energy conservation field trials. The Building Research Establishment put the device on its list of equipment suitable for such monitoring.

The device has proved to be useful and reliable and the OU has had a continuous stream of letters from architects and research students who would like to borrow one or have the circuit. But the potential for making them commercially is small: "The design will surely be superseded within a year or so by a suitable c.mos processor," says Bob Everett. The current cost of the components for the integrator excluding the p.c.b. and the box is a little over £100, whereas current competitive commercial systems is mainly restricted to microprocessor systems for ten or single channel ram-based devices at £400. "Although the world is full of well-intentioned people who would like to monitor the energy performance of their houses," says Everett, "there are few who are prepared to fork out that much money or harness the i/o port of their home computers to temperature monitoring for six months solid.

"It would be nice if it were possible to get the integrator as a kit," he commented, "the Open University would have no problems in selling the two double-sided circuit boards required, and the whole thing

would have the blessing of the Department of Energy, though it could be of more interest to countries such as Denmark and France where energy conservation research is not quite as unfashionable as it is here."

In brief

Giotto, the space probe which is to intercept Halley's Comet in 1986, has undergone a comprehensive check-out on its electrical and electromagnetic characteristics. The tests, on this European Space Agency project, have been carried out by British Aerospace Dynamics group, Bristol. The circular test chamber is 14m in diameter and 12m high, where the vehicle has been subjected to r.f. tests from 0.1Hz to 18GHz.

The formation of a new computer company and a new computer has been announced. The first product of Compass Computers, of Tetbury, Gloucestershire, will be the Compass 32. This is a multi-user computer which will run CP/M, MS-Dos, or Unix under the DEC operating systems. Each user will have a Z80 or an 8088 processor and 64KBytes of ram. Winchester disc memory will be available. The company is also planning a variety of add-on devices for the DEC range of computers which will include communications boards, mass storage systems, etc.

LETTERS

AMATEUR BAND JAMMING

Under the heading "Moral persuasion" (Communications Commentary, August issue) the claim is made that China has ceased to operate broadcast stations in the 7000 to 7100kHz amateur band. Whilst it may well be true that Chinese broadcast stations in this band are not heard in Europe, it is completely incorrect to say that these stations have quit the so-called amateur-exclusive band at 7000-7100kHz.

As coordinator of the New Zealand Intruder Watch, and as coordinator for the Region 3 IARU Monitoring Service, I daily handle many complaints from amateurs regarding the use of this band by the Chinese broadcasting services – and others! My records for September and October show the following frequencies to be in current usage by the Chinese Service: 7010, 7025, 7030, 7035, 7040, 7045, 7050, 7055 and 7095kHz.

With reference to the 7010kHz frequency it appears that some rearrangement of schedules may have been made but the frequency is still used by China. The People's Liberation Army station on the nominal frequency of 7025kHz, and the regular Radio Beijing station on 7055kHz, hop around between the above noted frequencies depending on the degree of jamming they are being subjected to by the Russians.

The "hopping" from one frequency to another, without warning and often in the middle of an item, brings into question – at least in my mind – the value, if any, of this type of broadcasting.

Resolution 641 of WARC 1979 calls upon stations using this band to vacate it. To date this resolution has been ignored by China – using the "reservations" procedure of the ITU Convention, and simply ignored by Albania with its Radio Tirana on 7065, 7075 & 7090kHz.

Albania at least does have the excuse that it is not a signatory to the ITU Convention, not so China and the USSR, although we "down under" do wish somebody "up there" would show the Albanians how to operate their transmitters without the resultant daily high level 2nd harmonics on 20 metres.

The USSR at times re-broadcasts one of its Mayac (home service) programmes on top of Radio Beijing – grossly over modulated – as a jamming technique, and has the lower sideband of its 7100kHz transmissions in the amateur band. To say nothing of the intense jamming, with 2nd and 3rd harmonics appearing on other amateur bands.

The "footnoting" into the 7000-7050kHz portion of this band by the fixed services of 13 countries plus its unauthorized use by the Russian fixed service, and the broadcast service as noted above, brings into mockery the whole concept of an "exclusive" band for the amateur service.

A recent random check of this band by the WIA Intruder Watch, and later confirmed by the NZART Intruder Watch, showed that between the hours of 1900 to 1925 u.t.c. on the 13th July 1983 there were 11 broadcast stations present in this band plus seven jammers, and that the activities of these stations accounted for 70.7% of the available 100kHz. At this date (28-11-83) the situation has not changed appreciably!

We can only hope that the 1984 WARC for

h.f. broadcasters will go some way to alleviate the current situation on this band.

R. E. Knowles, ZL1BAD/ZL61W
Coordinator NZART Intruder Watch
Tuakau
New Zealand

RADIO SOFTWARE

With regard to your picture coverage of our Computer Programme, Datarama, and the subsequent reponse from our colleagues at BBC Radio Leeds claiming that they were the true pioneers of Radiosoftware, I should like to make a few salient points.

Firstly, we are not in the business of claiming firsts: we believe the true originators of Radiosoftware as a broadcasting fact to be The Dutch Hobby Scoop Programme,* which began doing it in 1978.

Secondly the Datarama team, unlike it would seem the BBC Leeds team and others who've followed suit, conducted its own 'experimental data transmissions' under controlled conditions and out of broadcasting hours, i.e. not during programme time. When the first series of Datarama went on air in March 1983, Radiosoftware, at least in our hands had passed beyond the stage of experiment and was a properly researched piece of broadcast material. Within the current series, Radiosoftware forms as natural a part of the programme, as does conversation. There is no more experimentation necessary. It is time to get on with it.

Thirdly, in conjunction with the IBA, we have produced outline specifications which we hope will form the basis of future technical specifications for any station wishing to broadcast Radiosoftware. These should be available from local IBA officers in all regions.

Datarama is broadcast weekly on Radio West (in the Avon area), and on Wiltshire Radio (Swindon/W. Wilts) and very shortly on CBC Radio (Cardiff). Since its inception, each programme has included Radiosoftware for at least one microcomputer.

On the RW transmission, Datarama is supplemented by longer programmes for more micros transmitted after the stations closedown. These 'Nightfile' tapes are repeated at ¼ hour intervals throughout the night, a technique copied by Barry Norman's excellent 'Chip shop take-away service,' except that ours are free, and theirs require you to spend £3.95 on a translator kit, which is still not available at the time of writing!

Tim Lyons
Chief Engineer
Radio West
Bristol

*See also News, November, 1982.

ENERGY SAVING

I read Mr MacHarg's article and the subsequent correspondence with interest. Several of my colleagues have an interest in optimizing heating systems, and many lunch-time conversations have taken place, during which useful exchanges of ideas occur. Many different ideas are aired; individuals rate different aspects of a system with varied importance. To my mind it is necessary to get back to basics if we are to make decisions which enable us to optimize a system.

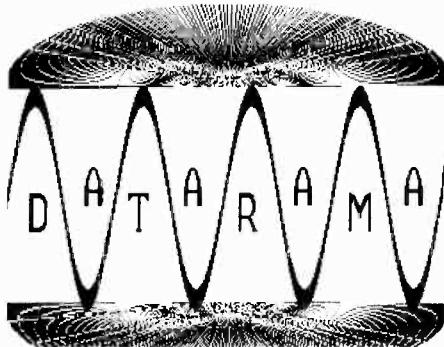
The object of a heating system is to burn fuel, thereby warming the house. A stable situation exists when heat input equals heat loss. Therefore the better insulated the property, the less energy we have to put in. This may seem very obvious, but is the first step.

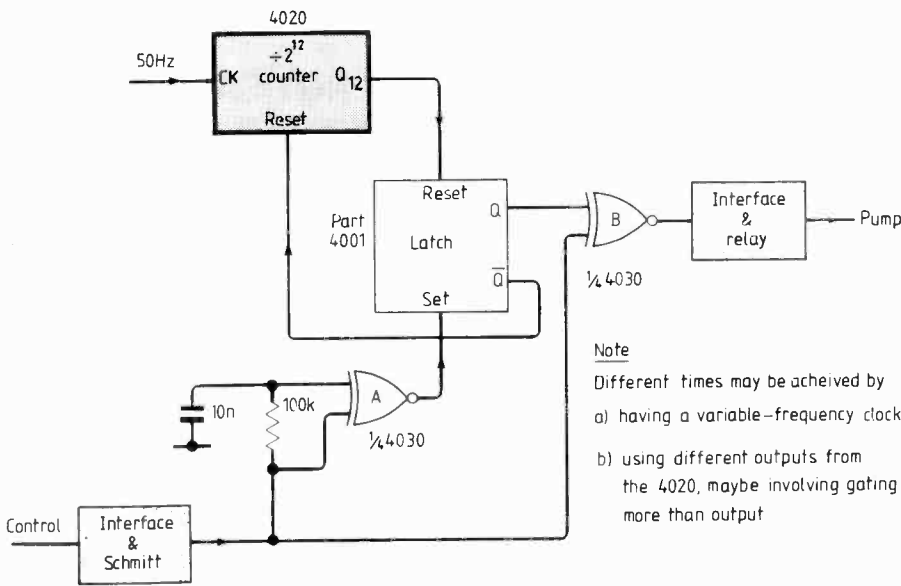
Assuming, for the moment, that boiler efficiency is not affected by flame height, then in theory we could adjust the flame height to provide water at a constant temperature, so that the heat lost by the radiators was equal to the heat lost by the house to the outside world.

The usual type of system does not work this way; we rely on a variable burner duty cycle followed by the integrating effect of large thermal masses to iron out the discontinuity. Having said this we next need to define the areas of waste. There is the basic loss of heat from the building, and there is heat loss up the boiler flue. If the boiler was 100% efficient, all the heat would go into the house. Because of the effects of integration, the temperature will rise before a control thermostat operates, but continue to do so afterwards. It is recognised that the thermal inertia is normally too great to allow a simple thermostat to be used, which is why the "accelerator" heating resistor is fitted into the majority of room thermostats.

Taken in isolation, this arrangement, if operating in a constant temperature, is a duty-cycle control device. By allowing a passage of air through this device the duty cycle is modified by ambient temperature as well as by manipulation of the control. Provided that the rate of heating by the accelerator resistor can be adjusted to suit the thermal inertia of the system, a simple means of optimization is available. Unfortunately, most proprietary items do not have such a facility, so a basically sound principle is nearly always subject to maladjustment in a particular installation.

I believe that it is undesirable to have a boiler cycle continuously, particularly when only the pump is controlled by a thermostat. Unfortunately Mr Ball, whose system employs a room thermostat to control both pump and boiler simultaneously, seems to have received short shrift from Mr MacHarg in the correspondence column. This is probably because Mr Ball has not gone into as much analysis of his simple system as is desirable. I have used a similar, but not identical, system for several years. The system operates successfully because not only does it avoid excessive cycling of the boiler, but also keeps the boiler temperature as low as possible consistent with providing adequate heat, as advocated by Mr Hargis. The less required, the shorter the duty cycle becomes (controlled by the thermostat with accelerator resistor) and consequently, the lower is the maximum water temperature attained throughout the cycle. Therefore the heating effect on the surrounding air is a function of both time and rising water temperature – a point which did not emerge in Mr Ball's letter.





The colder the weather, the greater the heat loss from the house, the longer will be the thermostat (and therefore, boiler) on duty cycle and the hotter the radiators become. To my mind, this is exactly what a sensible system should do. It is only under the most adverse conditions that I have known the boiler thermostat (set to 77°C) to operate. The system works well because I have taken care to "tune" the accelerator resistor as mentioned earlier, using a modified commercial thermostat, placed in a carefully chosen position.

Economies can be made by modifying simple systems as described. First, I have delayed the pump start and stop relative to the controlled boiler cycle. The boiler has a cast-iron heat exchanger, and a pump delay of about 82 seconds enables the boiler temperature to rise quickly, but without overshoot, after ignition and also enables a substantial amount of heat to be extracted from the iron after the flame is extinguished.

Another economy is made by designing the domestic hot water heating facility to latch up, so it is not defeated by the clock. This enables the water heating cycle to be completed before the boiler is turned off. The facility is particularly helpful in summer, when it prevents the need for re-ignition of the boiler at the start of the following day.

I should also point out that I heat the whole house consistently; radiator valves have been adjusted and are never normally touched. Furthermore I use no supplementary heating; this would upset the balance of the system. If supplementary heating is to be used, the subject of control becomes more complex and thermostatic radiator valves are likely to be needed. This would result in changes of heat output in other areas if the duty-cycle system I have described is used.

Finally, I believe long electrical time constants to be a potential problem because of the large values of resistance and capacitance needed. The diagram shows the bare bones of the 82 second delay referred to earlier. A $\div 2^{12}$ counter counts 50Hz mains pulses, but is normally held in the reset condition. The "go" control signal (which has also fired the boiler) causes the output from the interface and Schmitt to go high. A high or low excursion on this line results in a pulse emerging from 4030A, which sets the latch. Output goes high, maintaining a low at the output of B. Output Q goes low and removes the reset from the counter,

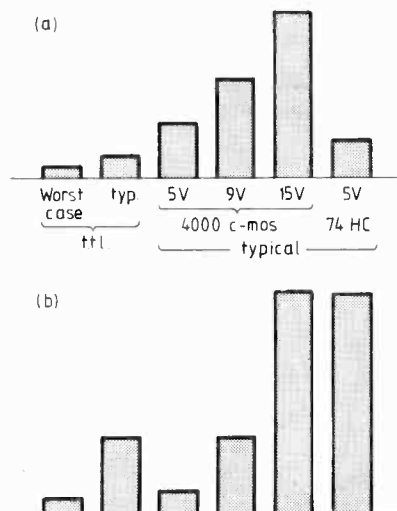
which then counts $2^{12} = 4096$ pulses at 50 per second; this takes 81.92 seconds. The output from Q12 goes high and resets the latch; B now has only one high on its inputs - its output goes high and the pump starts. Conversely, when the control input goes low, the counter is started again which sets Q high. As the other input to 4030B is now low, the pump keeps running until the circuit times out.

Keith Cummins
Southampton
Hampshire

LOGIC NOISE MARGINS

It is standard practice to talk of noise margins in terms of noise voltage. The meaning of this is, to say the least, vague, although it has its uses. For instance t.t.l. is quoted as having a noise margin of 0.9 volts, so it is obviously asking for trouble to use discrete diodes to expand the fan in, a reasonably common malpractice, because it reduces the margin to 0.2 volts.

The c-mos 4000 series is quoted as having a noise margin of 45% of the supply voltage - clearly superior as compared with t.t.l. - but this is only half the story. When signal lines are short as is desirable and likely within a piece of equipment, they take their impedance from the driving output according to the slogan "Low Z rules, OK?"



Short lines driven by t.t.l. are at an impedance of about 100 and the noise power necessary to overcome the noise voltage margin is $V^2/R = 0.9^2/100$ or about 8mW. The output resistance of 4000 series c-mos is 1.5kΩ to 2kΩ, so with a supply voltage of 5V the power needed to raise (or lower) the potential on the line by 45% is $2.25^2/2000 \approx 2.5$ mW. The noise power margin of t.t.l. is over three times as great at this supply voltage, see diagram.

It is worth noting that 54HC and 74HC logic has a much lower output resistance and a noise voltage margin of about 1.5 volts. Taking output resistance as 100Ω - it is in that parish though I have not seen it quoted - this requires a noise power of $1.5^2/100 = 22.5$ mW to overcome the noise voltage margin.

Using the same noise power concept, 4000 series c-mos requires a supply voltage of 9 volts to match the t.t.l. margin of 8mW, and only at a supply voltage of 15V does it achieve a noise power margin of 23mW, the equal in this respect of 74HCXX.

So far I have been considering short lines which take their impedance from the driving output. Long lines are a different matter. Correct termination is vital to establish the designed (low) impedance of the line and therefore confirm the designed noise power margin of the receiver device. It also performs its well known task of minimising reflection and radiation, two most potent causes of noise and crosstalk. Once again we are specifying and maximizing the noise power margin.

Our evaluation is not yet quite complete. An additional factor to be taken into account is the frequency response of the logic. 4000 c-mos just does not have time to propagate a noise spike of width 10ns, so its tardiness has considerable advantage if the system can be run at a frequency suitable to this logic family. The noise is effectively band limited and this is where 4000 c-mos really scores in noise immunity. The old 4049 buffer was particularly good in this respect, having a frequency limit of about 180kHz. Updated versions have a propagation delay of 60ns. Modern fast logic has a much greater bandwidth and is therefore vulnerable also to high frequency noise. So we are concerned with a balance of two factors; the noise power margin and the noise power bandwidth, both here defined by the characteristics of the logic. It is desirable to arrive at a figure of merit for noise immunity, taking both factors into account and expressed in terms which are, ideally, self-explanatory. I would welcome comments on the subject.

Tim Hartigan
Ballsbridge
Dublin

FORTH PROCESSORS

In his article and letter in November Wireless World Mr Woodroffe is less scrupulous than the Intel benchmark report that he obliquely criticises. This report, which compares the 68B09 with the 8088, can only really be faulted on the grounds that no allowance is made for code frequency in averaging out relative execution times and code sizes. It indicates, quite correctly, that re-entrancy is handled faster by the 6809.

By contrast, the table presented in his article by Mr Woodroffe can be faulted on several grounds. First, it omits the Texas 9995 processor, which competes in the same market sector as the 6809 (64k address, nonsegmented). I wonder why? The 9995 has a non-multiplexed bus and fast 16-bit parallel onboard ram; for 450ns access time its bus cycle is 670ns, versus

800 for the 8088 and 1000 for the 6809. It also makes use of prefetch.

Second, and more serious, some funny arithmetic occurs before the bottom line. The relative speeds for the 6809 and the 8088 are given as 4.11 and 3.19 respectively although the 8088 actually executes its code faster. This is derived from this "speed for 450 nanosecond access memory." I have news for Mr Woodroffe; in the real world it is not desirable to run a processor with a bus cycle allowing 695ns access at a speed which gives 450ns access. It tends not to work. In the real world the 8088 is faster by nearly 30%. Of course it would be perfectly practical to use a faster 6809 – the 68A or B 09 options – but then he should say so. If he is not actually using these faster devices in his own computer, he should tell us what access time his hardware actually requires, and recalculate his last line on that basis.

The third objection, however, is that in reality the 8088 programmer is unlikely to use the "JMP NEXT", as this requires that NEXT be within 127 bytes, necessitating numerous NEXTs scattered throughout the code rather like Underground stations (I nearly wrote public conveniences) in London. He or she will accept the 9-byte inline code (typical 6809 code is twice as long as typical 8088 code), losing 15 clocks and giving 8.6 microseconds. This execution time is slightly less than for the 6809 running at 1.5MHz with a comparable memory access time. The point, surely, is that the 8088 is the more expensive device, and the time and effort required to use features like segmentation mean that they are likely to be wasted in a small domestic microcomputer. There is no point in buying unused silicon.

The comments about code usage I agree with, except as regards the very arbitrary 80/20 ratio, seen quoted elsewhere as 75/25, $\frac{1}{3}/\frac{2}{3}$ – it is true that in most high level languages most of the time is spent pushing garbage to keep the system happy. This is why high level languages waste silicon and time while keeping programmers employed. However, the picture can change dramatically as soon as real arithmetic starts to happen, especially when trigonometry is involved. The makers of home computers assume, generally correctly, that most users will never stretch the resources of the mathematics. I would have thought, however, that electronic engineers differed in this respect; in the days when I was limited to a programmable calculator I remember calculations that exercised the poor little thing for hours on end, leading me to wish a bleeper had been fitted to announce the result. For this reason I would have thought that, again, the TMS9995 would have been a strong contender for a CPU because of its ability to handle 16 bit signed and unsigned multiplication and division in the instruction set.

Perhaps I should add that I am in no way connected with any semiconductor manufacturer.

Martin D. Bacon
Taunton
Somerset

WORLD TIMING

I am pleased that Dr J. D. H. Pilkington, head of the time department at Royal Greenwich Observatory, provided better background to the subject of "World Timing" than we were authorized to in our article on the subject; *WW* October 1983.

In our laboratory we make use of the special transmissions which disseminate UTC and CAT (co-ordinated atomic time) for calibrating and monitoring frequency sources and transmis-

sions. Therefore, one of the purposes of our article was to draw attention to the less tightly co-ordinated h.f. broadcast (and m.f.) frequencies by broadcasters since as we said, "errors of frequency can in fact be more of a nuisance than an error of time".

Indeed, in an European Broadcasting Union Report (SEBP66) entitled "A study of technical questions of interest to the WARC 1979", it was pointed out (paragraph 1.4) that the then frequency tolerance of l.f./m.f. and h.f. transmitters was unnecessarily generous, and that the stability of all carriers should be within 1Hz of the nominal assigned frequency by 31 December, 1984. It would appear from Dr Pilkington's letter that some broadcast authorities could have a busy year.

R. C. V. Macario
Department of Electrical and Electronic
Engineering
University College of Swansea

IMPLANT FOR BLADDER CONTROL

You may be interested to know that since the article on the electronic implant for bladder control was published (January issue) the device is continuing to be used to help paraplegic patients. The MRC workers who developed the implant tell me that 36 patients have now been fitted with this neurological prosthesis.

May I please correct a couple of small errors which came into the article during your preparation for publication? First, the article should have stated that the patient's hand-held transmitter (Fig. 8) was developed by T. A. Perkins of the MRC Neurological Prostheses Unit. Secondly, reference 3 should be to *Proc. IEE*, and not *IEEE*.

Tom Ivall
Staines
Middlesex

BEHIND THE MICRO

I've just read your articles 'Behind the micro' with interest, since I am thinking of expanding my interests in that direction.

Interesting . . . Well, yes, but I feel the writers haven't ever been in an actual shop to make enquiries!

The problem is, alas, compatibility. It's all very well to say that peripherals are available, but if I plug a device made by X into Y's computer, will it work – or will I get a cloud of smoke?

Don't tell me to 'consult the literature'!
So far as I can see, it is deliberately written in such a way as to discourage any such experiments!

I know what I want . . . but to do it I need to join together gadgets from SIX different makers! But can I, I just don't know!

Ronald G. Young
Peacehaven
East Sussex

DEAD WATCH TIMERS

To cope with just the sort of situation referred to by A. Roscoe under "Thunderstruck" (*Letters* February) we routinely include a "dead watch timer" in most of our new products. We also recommend our clients to use a power supply that outputs an advance warning of impending failure. These two hardware features when well integrated into the software enable

mains-related problems to be dramatically reduced, provided a third and equally vital facility is incorporated: an area of battery-backed ram to hold critical variables.

The basic idea of the dead watch timer is to have the software periodically trigger a, retriggerable monostable. As long as the software does this the monostable is prevented from reaching time out. If this happens a maskable interrupt is forced into the microprocessor. This causes activation of a special restart routine.

These facilities are essential when the system is required to "remember" long-term accumulating variables e.g. p-i-d controllers.

Steven Harris
Lodge Associates
Portslade
East Sussex

INDUCTANCE MEASUREMENT

I don't know whether the subtitle 'Simple practical method, hard to find in the textbooks' is due to the author, D. R. Fownes, or to you, but while I agree with the first half of it I think I have reason to be surprised by the second. From the sales and library loans, I venture to claim that the obvious textbook in which to look for simple practical methods of measuring inductance is my 'Radio & Electronic Laboratory Handbook', and Mr Fownes's method has been described in every edition of it from the first in 1938 (issued then by WW) to the 9th dated 1980. It was entitled 'The Three-voltages Method'.

I am obliged to Mr Fownes for deriving a simple formula for calculating the inductance. On the other hand most iron-cored inductors need to be measured with known variable amounts of d.c. flowing through them, and my measuring circuit has always shown this. Perhaps nowadays my stress on the voltmeter taking negligible current is no longer needed.

By the way, my letter in your October issue questioning the appropriateness of the term 'current dumping' having evoked no defence of it, I infer that there is no defence, and it is yet another misuse of a word in electronic terminology (e.g. 'slew rate', 'mixer' and 'attenuation distortion').

M. G. Scroggie
Bexhill
East Sussex

THE NEW BUREAUCRACY

Engineers will be regretful, but not surprised, that only one programmer in the country failed the von Neumann loyalty test. (*Wireless World* Letters, August and October 1983.)

However, D. W. Scott then writes,

"He – and MAPCON – still have not realised that machine architecture need have little to do with its technological implementation."

This statement beautifully illustrates the blocking position taken by programmers, preventing advances in the art. If, for instance, we can simulate a cam in a ram, then why should we ever want to build a cam? (If we can get there by horse and carriage, then why do we need a motor car?)

Ivor Catt
St. Albans
Hertfordshire

MICRO PRODUCTS

Apple Macintosh

The latest Apple computer is to be launched in the UK in April. Known as the Macintosh, it offers similar facilities to the Apple Lisa; it is menu driven from a display resembling a desk top where the facilities that a business executive may need can be pointed to with a cursor and selected for use by the push of a button. So notes may be scribbled on a pad, memos, expenses sheets, calculator, graph pad etc. are all available on the screen. They are selected by moving the cursor with a 'mouse', a small rolling box whose movements across the desk top are reproduced on the notional desk-top on the screen.

Macintosh uses a 16/32-bit Motorola MC68000 processor and includes 64K of rom and 128K of ram. A 512K version is due later in the year. The operating system is both rom and disc based and the computer includes a 3.5in disc drive. Each disk has a capacity of up to 400Kbytes. There is a port for an optional additional disc drive, two RS232C/422 serial ports for attaching printers or for communicating through a modem. Sound facilities give polyphonic sound over more than 12 octaves and are capable of reproducing human speech through the built-in speaker. Apple is developing a point-to-point interconnection bus and the interface is already built in to Macintosh. The integral 9in c.r.t display offers a bit-mapped 512 by 342 pixel resolution. There is a clock/calendar chip. Although not intended as a portable computer, it does have a carrying handle and at 7.7kg it weighs less than many so-called portables.

The price of Macintosh has not yet been fixed, though in the US it is likely to be about \$3,000.

Apple have produced two software packages for Macintosh; MacWrite word processing and MacDraw graphics. Lotus have developed a Macintosh version of 1-2-3, a spread-sheet and filing system and a number of software houses are preparing programs. Apple Computer (UK) Ltd, Eastman Way, Hemel Hempstead, Herts HP2 7HQ.

WW 303

Oric Atmos

The Oric 1 computer at the cheap home computer end of the market was never very successful. The



WW 303

makers made a mistake in providing prototypes rather than complete machines to the computer press who were very unkind to it. A cynical definition of the Oric 1 was "prototype for the Oric 2". The faults were compounded by the non-appearance of many promised additions and peripherals; a disc drive, a communications modem with a teletextdecoder, a rom cartridge with "super extended Basic as powerful as the BBC".

The principal difference between the Oric 1 and the Atmos is the new version of the rom operating system which has, according to Oric, not only ironed out the Oric bugs but also some others inherent in the Microsoft software. A number of additional commands have been added; especially to the cassette routines so that programs can now be verified after they have been saved. Arrays can now be stored and recalled without recourse to machine code.

The Basic is adequate and most of the commands that you would expect to find are there. We were surprised to note that there has been no attempt to improve on the abysmal line editing facility. In this respect many other computers also claiming to use 'extended Microsoft Basic' are much better (for example the Dragon and the Tandy Color Computer). Serial attributes, to change the colour or style of

characters on the screen, take some getting used to but have the advantage of taking up very little memory space.

Also provided is a cassette which has a graphics display program showing how good the display facilities are. Included is an animation of a flying duck which is very impressive especially as it is written in Basic. The program may be broken in to and listed to show how a particular effect is achieved. Also on the tape is a machine-code facility to overcome some of the frustrations of program loading mentioned above; it enables the user to override the error-checking routine. This overcomes the most common problems caused by errors in the 'header' and leading portion of the tape, which have no relevance to the actual program.

The specification for the Atmos includes a 6502A processor running at 1MHz, 48K ram, 16K rom, 57 keys and a concealed reset button for a 'warm' reset; i.e. one that does not lose any data. The screen format offers eight foreground and the same eight background colours for a text screen of 40 columns of 28 lines and a character set very similar to teletext (and BBC Mode 7) with standard ascii characters, double height and flashing characters and up to 80 user-defineable characters. High-resolution graphics offer 240 by 200

pixels in eight colours and there are line, circle and point facilities. Areas of the screen may be "filled" with a chosen colour. Three channels of sound over eight octaves with additional white noise and envelope control are output through a powerful internal speaker or may be output to a hi-fi system. There is an expansion port for the addition of some peripheral equipment, such as disc drives or a-to-d converters, a Centronics printer port, a modulated tv output as well as an RGB output for a colour monitor.

The Oric printer/plotter using four-coloured ball point pens has been re-styled to match the Atmos colour scheme and the long-promised 3in disc drive with 160Kbytes per side and a transfer rate of 250Kbit/s has been announced but at the time of writing we have not been able to get hold of one.

Those who already have an Oric 1 need not despair or throw it in the bin. Oric are looking "very seriously" at the possibility of providing an upgrade kit to turn an Oric 1 into an Atmos. This could cost about £50. 160 000 Oric 1s were sold so this could be a major operation. Oric Products International Ltd, Coworth Park, London Road, Ascot, Berks SL5 7SE.

WW 304

20MHz + 5mV/Division

TRIO

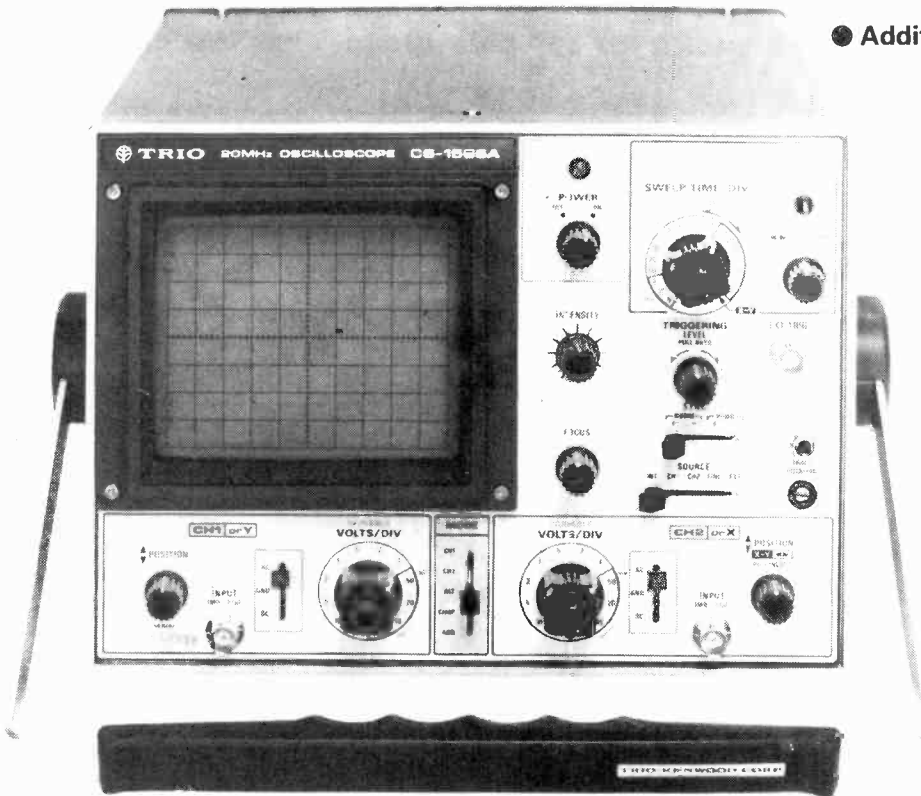
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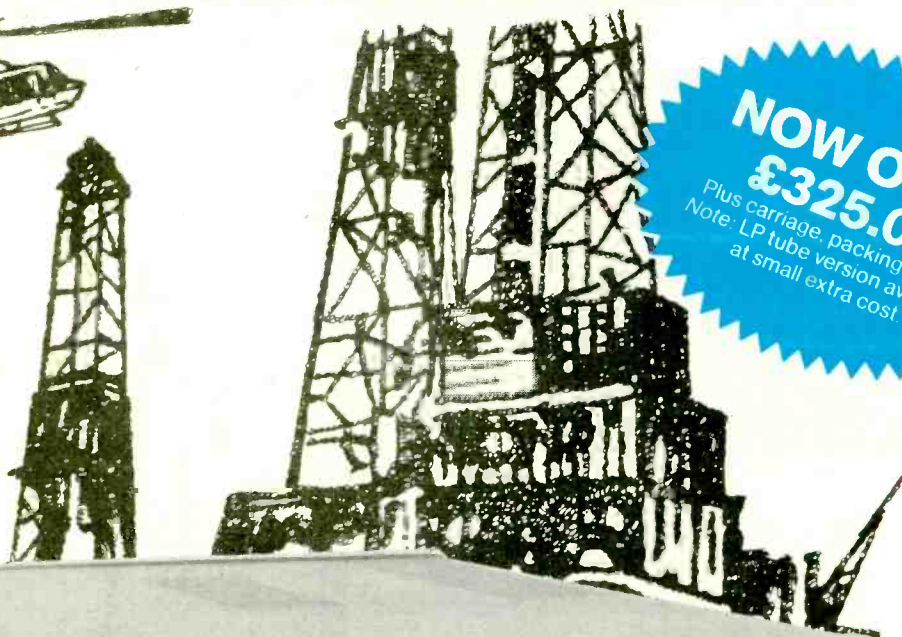
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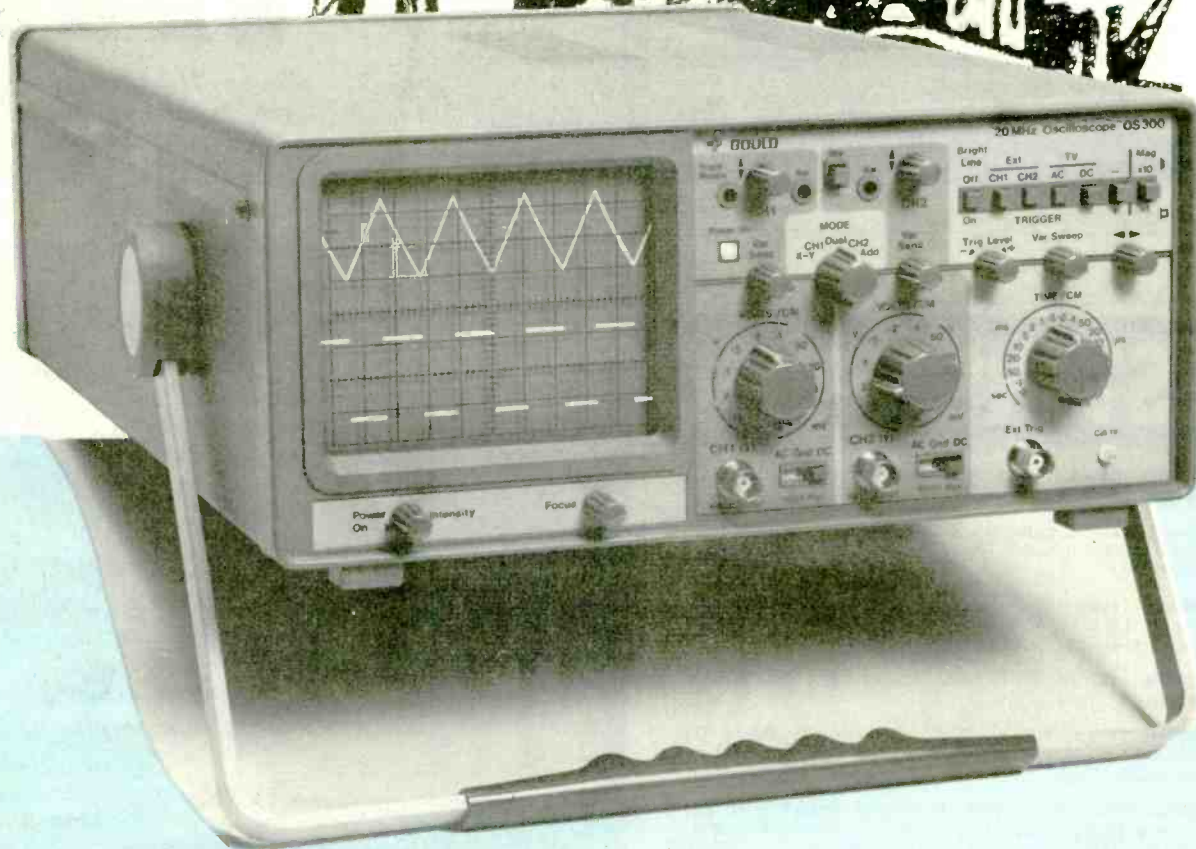


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GOULD
Electronics

Non-storage oscilloscopes up to 100MHz

Instruments currently available on the UK market

In the time since the last oscilloscope review appeared in *Wireless World* – a survey of portable types – it has become unnecessary to classify them in such a way, since the majority are now easily portable. Indeed, it is becoming increasingly difficult to classify oscilloscopes in any way at all: some of the functions of the more modern test instruments are those of an oscilloscope, but in some cases form only a small part of the instrument's repertoire. Logic analysis, spectrum analysis, waveform recording and even computing are now taken in hand by the latest, high-end equipment and the distinctions become blurred.

Not many instruments now exist of the type intended solely for displaying a trace. Very extensive measuring facilities in both axes are offered and, in the case of digital oscilloscopes, these can be made to an extremely high level of accuracy, sometimes with the result displayed on the screen.

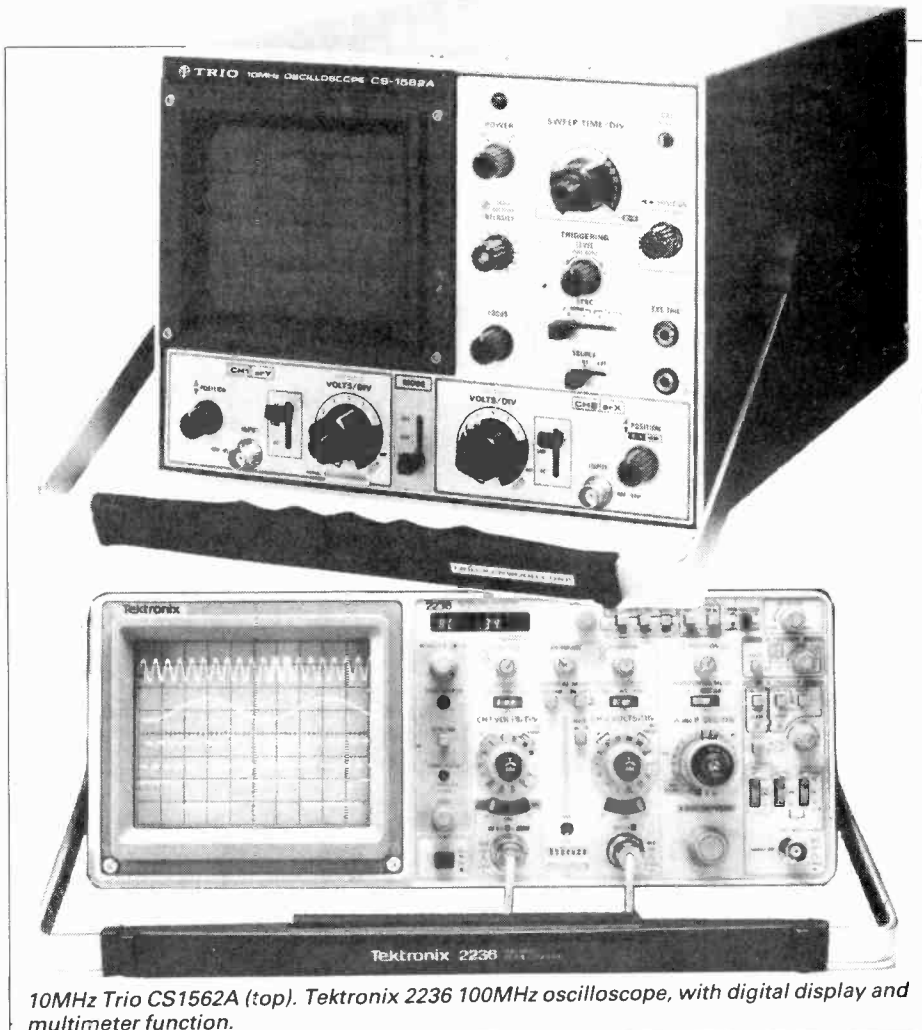
To enable readers who may be out of touch with modern oscilloscope design and the characteristics and facilities provided, the terms used in manufacturers' data sheets need explanation. The first part of this survey is therefore devoted to a glossary of terms.

Signal path

Bandwidth is the passband of the Y amplifier or amplifiers, measured at the -3dB points. Normally, oscilloscope amplifiers are directly coupled, so that the amplitude response extends to zero frequency: a capacitor can usually be switched in to allow small events on a large d.c. level to appear on the screen, the bandwidth then being limited to around 10Hz rather than zero.

In some cases, it is possible to offset the d.c. by means of a panel control to achieve the same effect without loss of low frequencies. The bandwidth of the Y amplifier is the characteristic used to indicate the kind of oscilloscope under consideration.

Rise-time is the response time of the Y amplifier to an infinitely steep step. If the amplifier's frequency/amplitude response has a smooth roll-off at high frequencies, as they all do, then the rise time in nanoseconds can be found from the bandwidth in megahertz by the expression $t_r = 350/f$. A



10MHz Trio CS1562A (top). Tektronix 2236 100MHz oscilloscope, with digital display and multimeter function.

bandwidth of 100MHz will give rise to an amplifier rise time of 3.5ns. Since, however, voltage steps are not infinitely steep, the displayed rise time (taken from 10% to 90% of the excursion) will always be longer than this, and is equal to $\sqrt{t_{ra}^2 + t_{rs}^2}$, where t_{ra} is the amplifier rise time and t_{rs} is that of the step itself.

Deflection factor is often termed Y sensitivity and is the amount of vertical deflection of the spot on the screen for a given input voltage to the amplifier. It is measured in millivolts per division of the graticule or per centimetre. A common figure is 5mV/div and may not be constant over the whole bandwidth of the amplifier: sometimes an increased sensitivity can be

obtained by sacrificing bandwidth and rise time. The sensitivity is controlled at the front panel by a switch, working in the 1, 2, 5 sequence, and often there is a two-position auxiliary switch to increase the sensitivity by a factor of 10. When a continuously variable gain control is fitted, the amplifier is not calibrated unless the control is at the end of its travel.

Display modes describe the way in which the input signals are presented on screen, in dual-trace oscilloscopes. A front-panel control selects for display channel 1, channel 2 (one of which can often be inverted), ch1 and ch2 alternately, ch1 and ch2 effectively simultaneously by chopping from one to the other at high speed so that

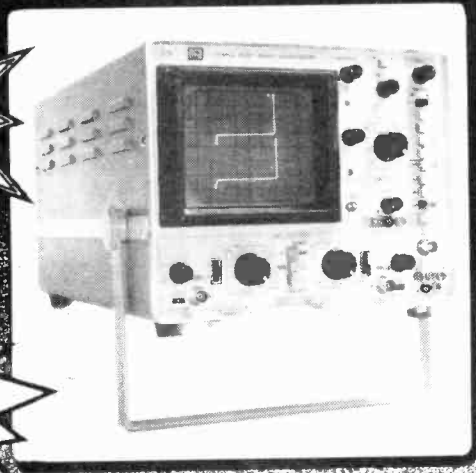
Model	Y bandwidth (MHz)	Y sensitivity (mV/div)	Channels	Max sweep rate (ns/div)	Dual sweep sweep delay Y delay line	TV sync	Screen	Acceleration potential	Price		Reply card number
BK/Dynascan											
1590	100	5 (x5)	4	20 (x10)	● ● ●		8x10cm	16kV	1780	V-mode trigger	WW501
1570	80	5 (x5)	4	50 (x10)	● ● ● ●		8x10cm	12kV	1285	V-mode trigger	
1560	60	1 (CH3-0.1)	3	500 (x10)	● ● ● ●		8x10cm	16kV	1139	Trig. holdoff. Auto focus. XY operation. V-mode	
1540	40	1	2	100 (x10)	● ● ● ●		8x10cm	12kV	941	XY. V-mode	
1522	20	1	2	200	● ● ● ●		8x10cm	6kV	670	XY. V-mode	
1466A	10	1	1	500 (x10)	● ● ● ●		8x10cm	2kV	380	XY	
1476A	10	1	2	500 (x10)	● ● ● ●		8x10cm	2kV	460	Dual-trace version of 1466A	
1535A	35	2	2	100 (x5)	● ● ● ●		8x10cm	6kV	745	Variable trigger hold off. Differential	
1479B	30	5	2	200 (x5)	● ● ● ●		8x10cm	6kV	700	XY. R.f. detector triggering	
1477	15	10	2	500 (x5)	● ● ● ●		8x10cm	2kV	453	XY	
1405	5	10	1	1000 aprx.					188	Free-running time base, synchronized	
1420	15	10	2	1000 (x10)			4x5cm	1kV	650	Mains/battery	
1435	15	2	2	500 (x5)	● ● ● ●		4.8x6cm	1.5kV	677		
Crotech											
3337	30	5	2	200 (x5)	● ● ● ●		8x10cm	10kV	405	XY	WW502
3132	20	2	2	500 (x5)	● ● ● ●		8x10cm		283	XY. Tester for passive and active components	
3034	15	5	2	500 (x2.5)	● ● ● ●		5.3x6.6cm	2kV	370	Battery. XY. Battery saver	
3033	15	5	1	500 (x2.5)	● ● ● ●		5.3x6.6cm	1kV	287	Battery saver	
3030	15	5	1	500 (x2.5)	● ● ● ●		5.3x6.6cm	1kV	154	Component tester	
3035	10	5	1	500 (x2.5)	● ● ● ●		8x10cm	2kV	174	Component tester	
Datacheck											
1200B	2.5	50	1	2000 (x10)			5x4.2cm	1.8kV	4223	Modular. Up to 7 units plugged into rack.	WW518
1200B(S)	2.5	50	1	20,000 (x10)			5x4.2cm	1.8kV	4545	Dual, selectable inputs	
Farnell											
DT12-5	12	5	2	500 (x5)	● ● ● ●		8x10cm	2kV	245	XY	WW503
DTV 12-14	12	5	2	500 (x5)	● ● ● ●		8x10cm	2kV	265	More flexible Y display options.	
DTC-12	12	5	2	500 (x5)	● ● ● ●		8x10cm	2kV	359	Fine X and Y controls	
DTS-12	12	5	2	500 (x5)	● ● ● ●		8x10cm	2kV	795	Component tester	
										Digital storage version of DT12-5. Max. event speed 100kHz. Max. sample rate 0.5MHz.	
Gould											
OS300	20	2	2	500 (x10)	● ● ● ●		8x10cm		325		WW504
OS8100	100	2	2	50	● ● ● ●		8x10cm	16kV	8400	Micro-controlled. Menu display. Auto calculations	
Hameg											
HM103	10	5 (x2.5)	1	500 (x2.5)	● ● ● ●		6x7cm	1.8kV	158	Component tester	WW505
HM203	20	5 (x2.5)	2	500 (x12.5)	● ● ● ●		8x10cm	2kV	264	Component Tester	
HM204	20	5 (x2.5)	2	500 (x2.5)	● ● ● ●		8x10cm	2kV	365	Trig. delay	
HM605	60	5 (x5)	2	50 (x10)	● ● ● ●		8x10cm	14kV	487	Trig. Delay. Trig. hold off	
HM705	70	5 (x2.5)	2	50 (x10)	● ● ● ●		8x10cm	14kV	588	Trig. delay	
Hewlett-Packard											
1980	100	2	2	5	● ● ● ●		10x12cm	22kV	8516	XY Trig-view. Trig delay. Auto-ranging trig-level, deflection factor and sweep speed	WW521
Hitachi											
V-212	20	5(x5)	2	200 (x10)	● ● ● ●		8x10cm	2kV	295	XY. V-mode	WW506
V-222	20	5(x5)	2	200 (x10)	● ● ● ●		8x10cm	2kV	340	D.c. offset for small signal viewing in presence of d.c. Avoids a.c. coupling. V-mode	
V-422	40	5 (x5)	2	200 (x10)	● ● ● ●		8x10cm	12kV	510		
V-203F	20	5 (x5)	2	200 (x10)	● ● ● ●		7.5x9.5cm	2kV	355	Trig. delay	
V-353F	35	5 (x5)	2	200 (x10)	● ● ● ●		7.5x9.5cm	5.2kV	495	Trig delay	
V-1050F	100	5 (x10)	4	20 (x10)	● ● ● ●		8x10cm	20kV	1200		
V-650F	50	5 (x5)	3	50 (x10)	● ● ● ●		8x10cm	10kV	750	A-trigger view on third channel	
V-509	50	5 (x5)	2	100 (x10)	● ● ● ●		5x6.3cm	12kV	995	A.c.-d.c. Trig. delay	
V-209	20	5 (x5)	2	500 (x5)	● ● ● ●		5x6.3cm	1.5kV	525	A.c.-d.c.	
Iwatsu											
SS5702	20	5(x5)	2	100 (x5)	● ● ● ●		8x10cm	2kV	290	XY. Ac/dc	WW519
SS3510	50	2 (x5)	2	100 (x10)	● ● ● ●		5x6.4cm	12kV	1250	Batt/mains, 8.25x4x11.875in. 8.6lb	
SS5710	100	1	4	20 (x10)	● ● ● ●		8x10cm	20kV	745		
SS5711	60	1	4	50 (x10)	● ● ● ●		8x10cm	15kV	1150		
Kikusui											
COS6100	100	5 (x5)	5	20 (x10)	● ● ● ●		8x10cm	20kV	1145	XY. Displays CH1, CH2, CH3, A trig, B trig. and add simultaneously. Trig. hold off	WW511
COS3010	15	5 (x5)	2	500 (x5)	● ● ● ●		7.6x6.4cm	1.5kV	395	Mains/battery. Trig. hold off. XY	
COS5060	60	5 (x5)	3	50 (x10)	● ● ● ●		6in rect.	12kV	735	8 traces. XY	
COS5041	40	5 (x5)	2	200 (x10)	● ● ● ●		6in rect.	12kV	535		
COS5040	40	5 (x5)	2	200 (x10)	● ● ● ●		6 in rect	12kV	445	XY. Trig. hold off	
COS5021	20	5 (x5)	2	200 (x10)	● ● ● ●		6in rect	2kV	395	Trig. hold off. XY	
COS5020	20	5 (x5)	2	200 (x10)	● ● ● ●		6in rect	2kV	280	XY	
Leader											
LBO514A	15	5 (x5)	2	500 (x5)	● ● ● ●		8x10cm	1.8kV	323		WW507
LBO522	20	5 (x10)	2	200 (x5)	● ● ● ●		8x10cm	2	349	Trig. hold off	
LBO523	35	5 (x10)	2	200 (x10)	● ● ● ●		8x10cm	7kV	501	XY	
LBO524	35	5 (x10)	2	200 (x10)	● ● ● ●		8x10cm	7kV	615	XY	
Non-Linear											
MS215	15	10	2	100			2.5x3.2cm	700V	445	Batt/mains (110V a.c.) Measures 2.9x6.4x8in.	WW520
MS230	30	10	2	50			2.5x3.2cm	700V	540	Batt/mains (110V a.c.)	
Philips											
PM3262	100	2	3	50 (x10)	● ● ● ●		8x10cm	17kV	1695	Trig. hold off. Trig. view	WW512
PM3267	100	2	3	50 (x10)	● ● ● ●		8x10cm	10kV	1250		
PM3264	100	2	4	50 (x10)	● ● ● ●		8x10cm	17kV	3550	Trig. view on fifth channel	
PM3263	100	2	2	50 (x10)	● ● ● ●		8x10cm	17kV	3030	Trig. view. Dual delay for time interval measurement	
PM3254	75	2	1	50 (x10)	● ● ● ●		8x10cm	10kV	1145	Trig. view on third channel	
PM3256			2						1245	As3254 with two channels	
PM3215	50	2	2	100 (x10)	● ● ● ●		8x10cm	10kV	695	XY. Trig. hold off	
PM3217	50	2	2	100 (x10)	● ● ● ●		8x10cm	10kV	850	As 3215 with delayed time base	
PM3233	10	2	2	200 (x5)	● ● ● ●		8x10cm	10kV	960	Dual beam	
PM3211	15	2	2	500	● ● ● ●		8x10cm	4kV	660		
PM3207	15	5	2	500 (x5)	● ● ● ●		8x10cm	2kV	325	X and Y sensitivity equal	continued on page 61

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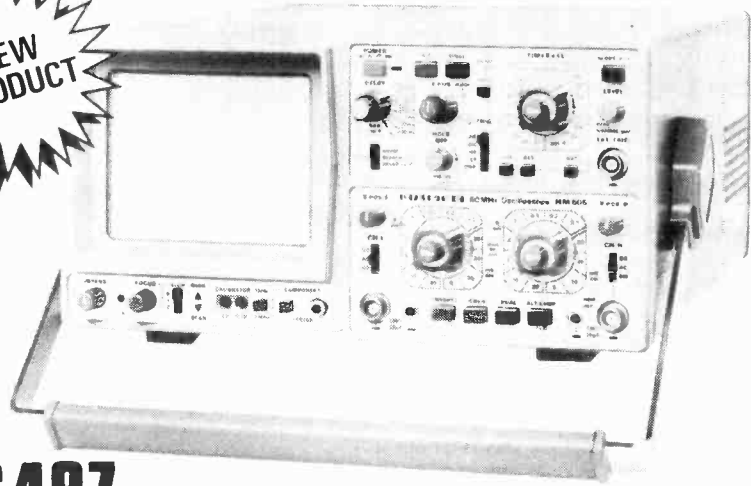
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WIRELESS WORLD MARCH 1984

Model	Y bandwidth (MHz)	Y sensitivity (mV/div)	Channels	Max sweep rate (ns/div)	Dual sweep sweep delay Y delay line	TV sync	Screen	Acceleration potential	Price	Reply card number
Rohde & Schwarz										WW508
BOP	30	5	2	200 (x10)	● ● ●		8x10cm	6kV		
BOL	100	5	4	20 (x10)	● ● ● ●		8x10cm	18kV	Displays eight traces, with trig. view	
Scopex										WW509
14D-10V	10	2	2	1000 (x5)		●	8x10cm		325 XY. Tv line delay. Tv & video servicing	
14D-15	15	5	2	1000 (x10)		●	8x10cm	2kV	285 XY	
Scopextra FC	15	5	2	1000 (x10)		●	8x10cm	2kV	365 As 14D-15 with add-on function generator	
Scopextra PS	15	5	2	1000 (x10)		●	8x10cm	2kV	385 As 14D-15 with add-on dual power supply	
Bridage SB121	5	50	1	1000			5x6cm		175	
DB242	5	50	2	1000			5x6cm		195 As SB121 but two channels	
Siemens										WW513
D1004	50	2	2	10	● ● ●		8x10cm	11kV	1150 XY	
Rest of Siemens range under revision										
Solartron										WW510
5220	100	5	2	50 (x10)	● ● ●		8x10cm	12kV	1545 Dig. time measurement	
5224	100	5	4	50 (x10)	● ● ● ●		8x10cm	12kV	1881 As 5220 but four channels	
5222	50	5	2	100 (x10)	● ● ●		8x10cm	10kV	1279 XY. Trig. delay	
5013	15	5	2	1000 (x5)		●	8x10cm	2kV	477 XY	
5023	15	5	2	1000 (x5)		●	8x10cm	2kV	448 As 5013, with fine gain adj. and A±B	
5024	10	5	4	1000 (x5)		●	8x10cm	2kV	988 A.c./d.c. XY	
5025	25	5	2	200 (x5)	● ● ●		8x10cm	4kV	778 XY	
5500					●		10x12.5cm	20kV	2633 XY. Mainframe with probe power. R version rack mount	
5522	175	5	2						1208 D.c. offset. 5500 plug-in	
5532	85	2 (x5)	2						895 5500 plug-in	
5523	1	0.02	2						778 Differential amp. for 5500. C.m.r.r. 100dB at 20µV and 100kHz	
5533	85	1	2						1416 Diff. comparator for 5500. C.m.r.r. 86dB at 1mV and 100kHz	
5546				20 (x10)	●				964 Dual time base for 5500	
5539	>1GHz	2 (x2.5)	2	0.02	●				2264 Sampling plug-in for 5500	
Tektronix										WW514
2337	100	5 (x2.5)	2	50 (x10)	● ● ●		6.4x8cm	18kV	2695 Trig. view. Trig. hold off. XY. D.v.m. Diff. time	
2336	100	5 (x2.5)	2	50 (x10)	● ● ●		6.4x8cm	18kV	2274 As 2337 without d.v.m.	
2235	100	5 (x2.5)	2	50 (x10)	● ● ●		6.4x8cm	18kV	2122 As 2336 without diff. time measurement	
2213	60	2	2	50 (x10)	● ● ● ●		8x10cm	10kV	880 Trig. hold off. Trig. delay	
2215	60	2	2	50 (x10)	● ● ● ●		8x10cm	10kV	1063	
335	35	10	2	200 (x10)	● ● ● ●		6.4x8cm	12kV	2796	
T422R	15	2	2	200 (x10)	● ● ● ●		8x10cm	12kV	765 XY. Rackmount	
308	5	5	2	1000 (x10)	● ● ● ●		5x6.3cm	2kV	333 D.v.m.	
221	5	5	1	1000 (x10)	● ● ● ●		3.1x5.2cm	1kV	1826 Mains/battery	
213	1	5	1	2000 (x5)	● ● ● ●		3.1x5.2cm	1kV	2327 D.v.m. display on screen. Mains/battery	
212	0.5	1	2	5000 (x5)	● ● ● ●		3.1x5.2cm	1kV	1645 Mains/battery	
7104	1GHz		2	0.2 max	●		6.8x8.5cm	12.5kV	19821 Mainframe. V and I calibrator	
Y plug-ins from 75 MHz to 1GHz, from 1m V/div.										
Y plug-ins from 0.2ns/div, delayed sweep, programmable										
5440	50 max		2	10max	●		9x12cm	15kV	2438 Mainframe	
5A38	35	10 (x2.5)	2						596 5440 Y plug-in	
5A48	50	1 (x2.5)	2						879 5440 Y plug-in	
5B40				100 (x10)	●				614 5440 X plug-in	
5B42				100 (x10)	●				1131 5440 X plug-in	
465	100	5	2	200 (x10)	● ●		8x10cm	18kV	2852 Trig. view	
Thandar										WW515
SC110A	10	10	1	100		●	3.2x2.6cm		D.c. or a.c. adaptor	
Trio										WW516
CS2110	100	5 (x5)	4	20(x10)	● ● ● ●		8x10cm	20kV	1499 Four channels, eight traces	
CS2070	70	5 (x5)	4	50 (x10)	● ● ● ●		8x10cm	12kV	949 V.c.r. and video disc work	
CS1577A	35	2	2	100 (x5)	● ● ● ●		140mm tube	6kV	499 Trig. hold off. XY	
CS1830	30	5 (x2.5)	2	200 (x5)	● ● ● ●		140mm tube	6kV	583 Trig. delay. Trig. hold off. XY	
CS1010	10	1	1	500 (x10)	● ● ● ●		8x10cm	2kV	269 V-mode	
CS1012	10	1	2	500 (x10)	● ● ● ●		8x10cm	2kV	289 As 1010, but two channels	
CS1020	20	1	1	200 (x10)	● ● ● ●		8x10cm	6kV	339	
CS1022	20	1	2	200 (x10)	● ● ● ●		8x10cm	6kV	359 As 1020, but two channels	
CS1566A	20	5	2	500 (x10)	● ● ● ●		140mm tube	2kV	349 XY	
CS1820	20	5 (x2.5)	2	200 (x5)	● ● ● ●		140mm tube	6kV	442 Trig. hold off. Trig. delay	
CS1720	20	2	2	200 (x5)	● ● ● ●		7.6x9.5cm	6kV	1674 Programmable functions	
CS1352	15	2	2	500 (x5)	● ● ● ●		75mm tube	1.5kV	431 Mains/batt. XY	
CS1560A	15	10	2	500 (x5)	● ● ● ●		130mm tube	2kV	325	
CS1562A	10	10	2	1000 (x5)	● ● ● ●		130mm tube	2kV	279	
CS1559A	10	10	1	1000 (x5)	● ● ● ●		130mm tube	2kV	265	
CS1575	5	10	2	500	● ● ● ●		130mm tube		358 Displays CH1, CH2, Lissajou and 0° phase simultaneously	
Vu-data										WW517
4100	100	5	2	50 (x10)	●		2x2.5cm	6kV	1850	

the chopping is invisible, ch1 minus ch2 and ch1 plus ch2.

The 'alternate' and 'chopped' presentations perform roughly the same function. At low and middle frequencies, chopping between channels occurs many times during the time-base sweep and is generally not phase-related: it cannot, therefore, be seen and the two traces appear simultaneously. At higher frequencies, the chopping may occur only a few times during a sweep and may become visible, so that each trace must then be triggered alternately to give once again an effective simultaneous display of the two signal channels.

Input impedance at the Y inputs is usually $1M\Omega$ with 20-30pF in parallel. In the event that the signal under inspection is from a high-impedance source and would be deformed by this input arrangement, most makers provide as an accessory a probe which, at the expense of a decrease in sensitivity by a factor of 10, gives $10M\Omega$ and 2pF at the probe tip. Even better performance is provided by probes with a field-effect transistor source-follower, which can give $1M\Omega$ and around 1pF even when the input of the oscilloscope is a 50Ω coupling – often found with high-frequency instruments.

Input coupling selects a coupling capacitor when the d.c. component of a signal is too high to allow inspection of small features which need a high sensitivity. It is usually marked AC, DC and GND, the latter earthing the input to provide a 0V reference on the display.

Delay line allows inspection of the leading edge of a transient. Since the signal itself normally triggers the time-base, and since the time-base takes a certain amount of time to fire after the trigger, the leading edge would have occurred before the sweep started, without the delay line.

With the line in the signal path, the signal is delayed by a fraction of a microsecond until the time-base is operative. The delay line does not deform the signal.

Time-base

Modern time-bases are of the triggered variety – they run when triggered by a pulse. The rate at which the spot sweeps across the screen is controlled from a front-panel switch, usually in a 1-2-5 sequence, and by an uncalibrated variable control. The fastest sweep provided must spread the rise-time of the Y amplifier over a useful part of the screen; for example, if the bandwidth is 100MHz, giving a rise time of 3.5ns, the highest sweep speed should be around 2 to 5ns per division or per centimetre. It may be that the fastest sweep on the control is ten times slower than this, at around 50ns per division, in which case there will probably be provision to magnify the sweep amplitude to overscan the screen by a factor of 10, effectively multiplying the sweep speed by 10. The result is roughly the same.

Horizontal modes

In dual-trace instruments, delayed sweeps with a number of display modes are commonplace. In essence, the main (A) sweep

traverses the whole area of investigation relatively slowly, small events being identifiable but not easily seen. By means of a delay control, the second (B) sweep is triggered just before the area of interest and, since it is set to run much faster than the A sweep, covers only that part. During this time the A sweep only is displayed, the part covered by the B sweep being brightened up.

When the delay and the duration of the B sweep are adjusted as required, the B sweep is displayed across the whole screen, the aforementioned small event now being magnified horizontally. The front-panel mode selector is labelled A, A intensified by B, B, or words to that effect. On some instruments, the delayed and delaying sweeps can be mixed to display both simultaneously. It might be possible to see the small occurrence in the normal way with sweep magnification, if it were near the trigger pulse, but a large magnification on a small trace would almost certainly result in a jittery display: the delaying method avoids this problem.

Triggering

A variety of triggering modes is usually provided. 'Normal' is the condition when the Y signal provides a trigger pulse for the time-base, which does not sweep unless the trigger is present. In the 'automatic' mode, the time-base free runs, providing a base-line on the screen in the absence of a Y signal, and locks to an applied signal: it is somewhat similar to the method used many years ago when free-running time-bases were synchronized with the Y signal. A 'single-sweep' facility is sometimes provided, when the timebase fires once on the next trigger after a front-panel button is pressed. Trigger hold-off is useful when, say, one cycle in a long train is to be viewed. It would normally not be easy to trigger the sweep just before the wanted cycle, since as far as the trigger circuit is concerned, all the cycles are identical. With trigger hold-off, pulses can be inhibited until the part to be investigated is reached, whereupon the next trigger fires the time-base, which can then run at the desired speed.

Since the Y signal itself normally provides the trigger, it is necessary to select the exact point on a waveform at which the trigger pulse is generated. The 'level' control sets this in the vertical direction and the 'slope' determines whether the trigger is taken from a positive or negative-going edge. It is usually possible to use an external trigger, selectable from the front panel. Vertical-mode triggering (V mode) enables two traces of differing frequencies to be viewed alternately – normally, triggering from one would give an unlocked display of the other.

In the table, sensitivity and sweep-speed figures are given without taking into account the multipliers shown in brackets. Prices quoted are exclusive of v.a.t.

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Datacheck. RMR Measurements, 138 Lime Crescent, Cumbernauld G67 3PQ. 02367 28170.

Farnell. Farnell Instruments Ltd, Sandbeck Way, Wetherby, West Yorks. LS22 4DH. 0937 61961.

Gould. Gould Instruments Division, Roebuck Road, Hainault, Essex IG6 3UE. 01-500 1000. Electroplan Ltd, P.O. Box 19, Orchard Road, Royston, Herts ST8 5HH. 0763 45145.

Hameg. Hameg Oscilloscopes Ltd, 74-78 Collingdon Street, Luton, Beds LU1 1RX. 0582 413174. Lawtronics Ltd, 139 High Street, Edenbridge, Kent TN8 5AX. 0732 865191.

Hewlett-Packard. H.P. Ltd, Nine Mile Ride, Easthampstead, Wokingham, Berks RG11 3LL. 03446 3100.

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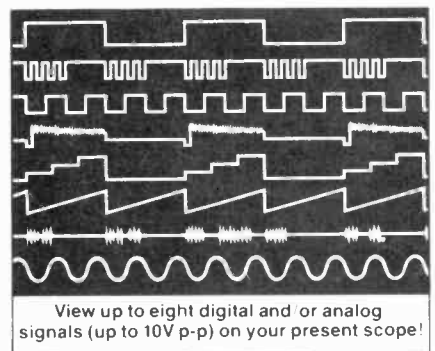
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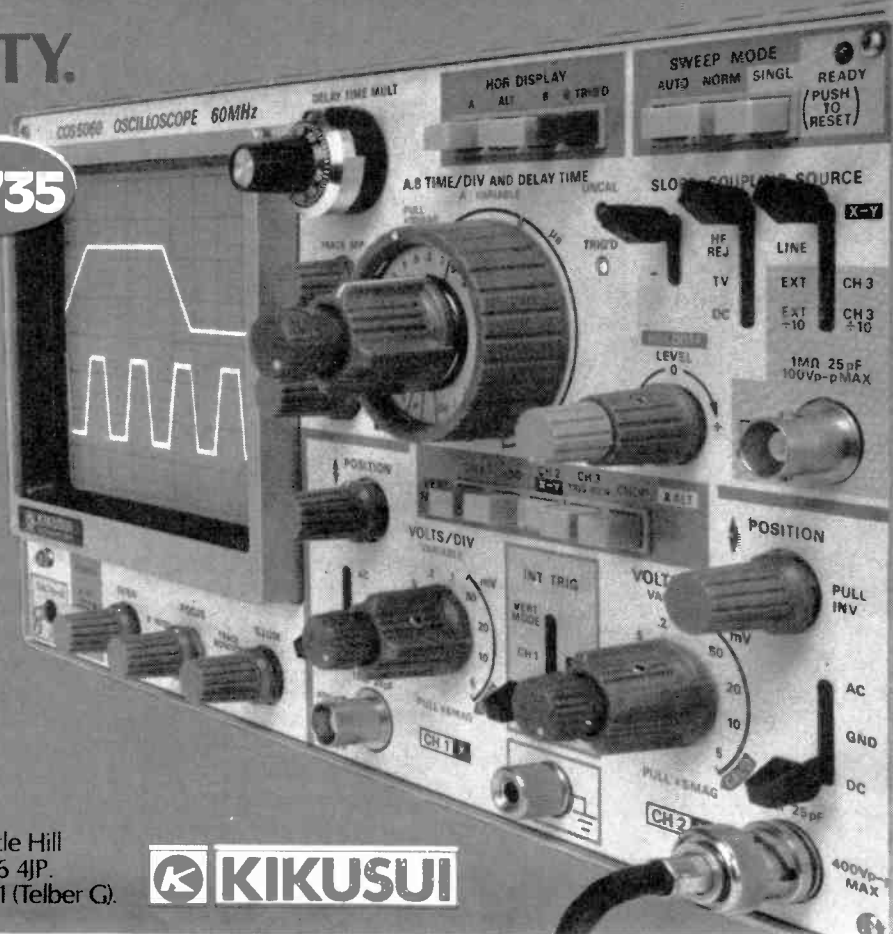
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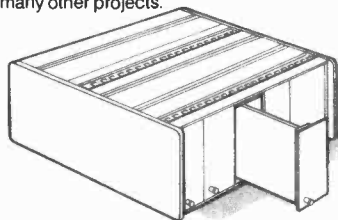


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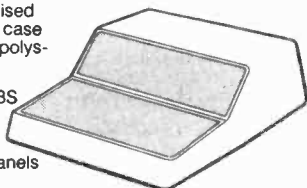
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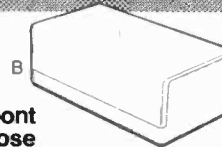
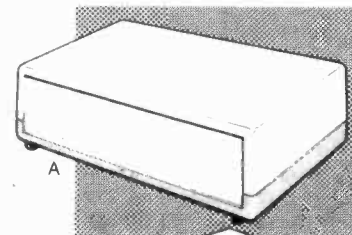
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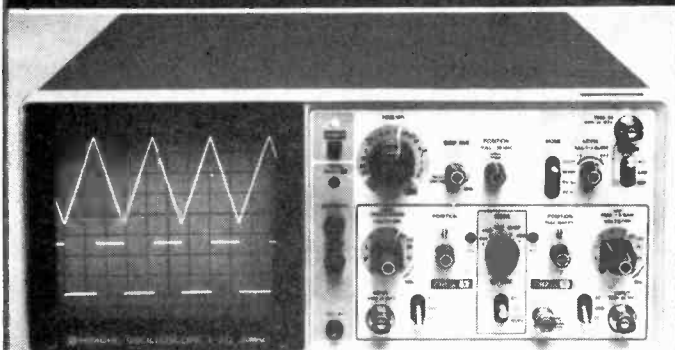
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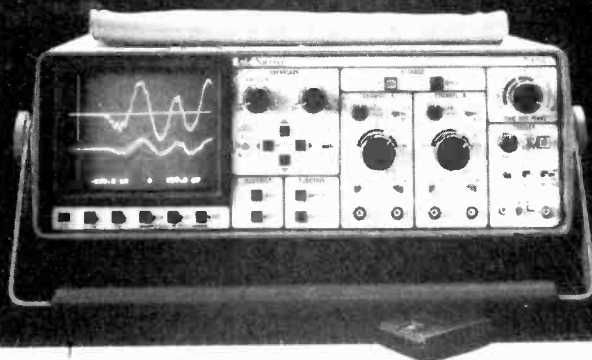
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Designing with the 68008 microprocessor

Ideal for use in low-cost, high-volume applications like personal computers and small business machines, the 68008 is an eight-bit microprocessor with a 32-bit architecture.

This two-part article describes its main features and how it's used with other microcomputer components like rom, ram and peripheral devices.

All of the microprocessors in the M68000 family of high-performance processors and peripherals, including the 68008, are based on the same 32-bit architecture. The 68008 has an eight-bit external data bus; others have 16 or 32-bit buses. The once-clear divisions between eight, 16 and 32-bit microprocessors are becoming blurred; with the 68008 the designer is now able to have a high-performance microprocessor with a 32-bit architecture in small cost-effective systems using eight-bit data buses.

The architecture of the 68008 is identical to the original member of the family, the 68000, a processor with a 16-bit external data bus. From the programmer's point of view the two processors look identical, so that the 68008 is completely code-compatible with the 68000. This means that any program developed for one processor will run on the other. This is true for object code as well as source code. Other 68000-family microprocessors such as the 68010, virtual memory version of the 68000, and the 68020, very high performance 32-bit mpu, have architectures which are upward-compatible with that of the 68008, making it easier to upgrade 68008-based systems. For example, any user program written for the 68008 will execute correctly on the 68000, 68010 and 68020 without need for modification.

Using standard rams and roms a smaller minimum-sized system can be constructed with the 68008 than with the 68000. Cost savings are made by producing the 68008 in a 48-pin dual-in-line package as opposed to the 64-pin version for the 68000. Eight pins are saved by halving the reduced data bus. Other minor hardware differences allow more pins to be shed (Fig. 1), for instance a few of the high-order address lines of the 68000 are not brought off-chip on the 68008. Even so, this still allows direct addressing of over one megabyte of memory — huge compared to that of conventional eight-bit microprocessors and more than enough for the low-end applications for which the 68008 is intended.

The 68008 is as fast as the 68000 when

by A. J. Barth

accessing byte-sized operands. However, because of its byte-sized data bus the 68008 needs to access 16-bit words as two successive bytes. As a result, the overall throughput of the 68008 is less than that of the 68000. For the same processor clock and for a typical mix of instructions, the 68008's performance is about 60% of that of the 68000. This is still a lot of raw processing power and will meet a need for low-end applications.

Because the architectures of the 68000-family microprocessors are so similar, knowing the 68008 means knowing much about the other processors. The 68008 is characterized by its 'clean', regular and consistent structure and in particular, emphasis was given to the architecture to make it regular with respect to the registers, instructions, addressing modes and data types.

Register set

The 68008 programming model has a large number of general-purpose 32-bit data and address registers, Fig. 2. There are eight

general-purpose 32-bit data registers, D₀-D₇, for byte (8-bit), word (16-bit), and long word (32-bit) operations. Seven address registers A₀-A₆ and two system stack pointers A₇, may be used as software stack pointers and base address registers. In addition these registers may be used for word and long-word address operations. All 17 registers may be used as index registers.

High-performance microprocessors are expected to rapidly handle complex functions having a large number of parameters. The 68008 can maintain most or all of these parameters in processor registers, which is both fast and makes the programs efficient and elegant. Microprocessors with only a few registers in such situations need to continuously swap parameters between registers and external memory.

As the 68008 has general-purpose registers, the programmer and not the microprocessor-chip designer decides which registers are used. It does not dictate that certain instructions use certain registers. This not only eases the task of the assembler language programmer but also makes high-level language compiler-generated code more efficient. Many of the instructions and addressing modes which

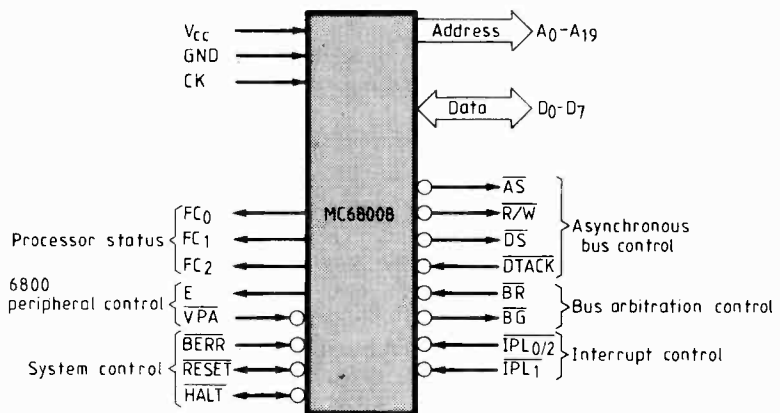


Fig. 1 68008 signal lines. The microprocessor has an internal 32-bit architecture and an eight-bit external data bus. Packaged in a 48-pin package the 68008 has non-multiplexed buses and a non-segmented 1 megabyte address space.

operate on the address registers may also be used with the 32-bit program counter. This makes it easy to write position-independent software that will execute correctly no matter where the code is loaded in memory.

The 68008 has a 16-bit status register which consists of two parts: a user byte and a system byte. The user byte is accessible by any program and contains the usual condition code flags associated with the execution of instructions, condition like Negative, Zero, Carry, Overflow, etc. The system byte of the status register is accessible only by a supervisory program (usually the operating system) and is used to control the operating mode.

Addressing range

The 68008 has a large linear addressing range. It can directly access one megabyte of external memory without paging or segmentation. Many microprocessors are able to access fairly large memory space but need to do so via a narrow window called a segment or page. This may be useful in a few applications, but in most situations it is an irritating handicap because the programmer is obliged to keep repositioning the window to access the desired location.

Like other Motorola microprocessors the 68008 has memory-mapped i/o. This enables the programmer to use the m.p.u's sophisticated instructions and addressing modes to operate on i/o as well as memory.

Instruction set

The 68008 has a powerful, flexible and easy-to-use instruction set. There are 56 basic instructions (Table 1). This is actually less than the ten-year-old 6800 microprocessor. However because of the regularity of the 68008 architecture, those instructions which use registers may use any register with almost any addressing mode and data type. These permutations yield many thousands of useful operations, compared to less than 100 for the 6800; the 68000 family philosophy being to provide a small number of easy-to-remember and flexible general-purpose instructions.

The instruction set covers the following classes of operations:

- data movement
- integer arithmetic
- logic
- shift and rotate
- bit manipulation
- binary-coded decimal
- high-level language support
- program control and
- system control.

Operations on data in registers and memory are independent of the data size and usually involve a source and a destination operand. The programmer need only remember one mnemonic for each type of operation and then specify data size and addressing modes for both the source and destination operands. Consistency is maintained as all data registers and memory locations may be a source or destination for most operations on integer data.

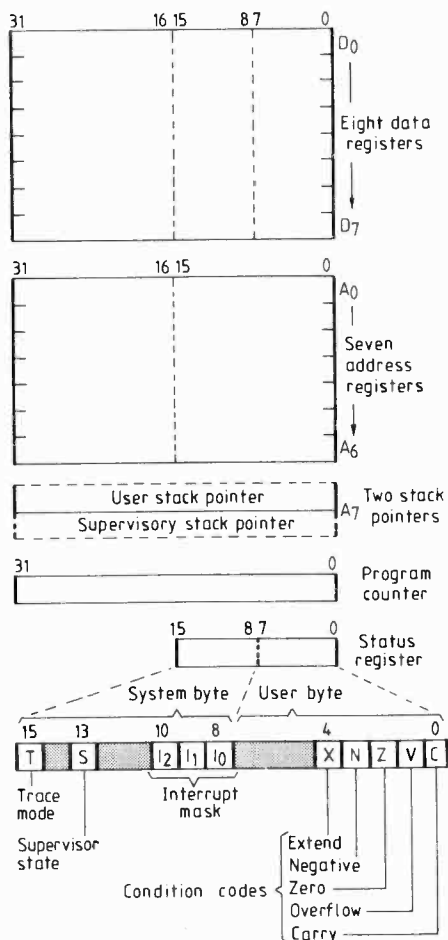


Fig. 2 68008 programming model: eight general-purpose data registers for 8, 16 and 32-bit operations, seven address registers, and two system stack pointers for software stack pointers and base address register. All 17 maybe used as index registers.

Like all M68000 microprocessors the 68008 instructions are implemented by microcode rather than random logic, so that, for example, the execution of undefined instructions no longer leads to unpredictable results.

Data types

The 68008 operates on five main data types. Operations may be on bits, b.c.d. digits, bytes, words and long-words. For integer arithmetic the programmer need not remember different instructions for different data sizes. The required data size is simply appended to the instruction as the program is written.

Addressing modes

An addressing mode is the method by which the data or other operand is accessed by the processor. The availability of powerful and flexible modes usually means performing an operation with just one instruction which would otherwise take many. This results in programs executing faster, being smaller, easier to read and to maintain. The 68008 has 14 powerful addressing modes (See Table 2). They operate consistently and are independent of the instruction itself.

Program privilege scheme

A two-level program privilege scheme

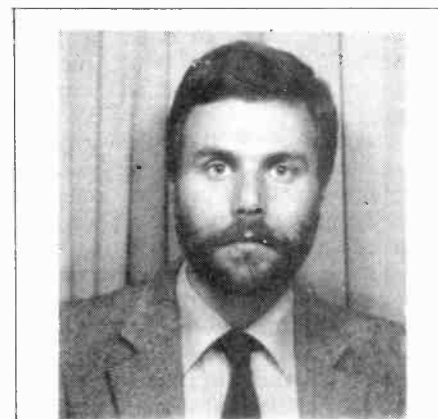
provides security and high reliability. Programs should access only their own code and data areas, and ought to be restricted from accessing the information which they do not need and must not modify. Such a scheme not only prevents the deliberate tampering with data but also guards against a faulty program running wild and altering other programs.

The 68008 operates at one of two privilege levels, the supervisor level or at the user level. At the supervisor level programs have access to all processor resources and can execute any instruction or access any register. Normally, only the controlling operating system or its kernel runs at this level. This code is normally relatively small, well-tested and therefore reliable. All the rest of the software, which includes both the utility and application programs, executes at the user level and has access only to a subset of the total processor unit resources, the resources governing control of the system being protected from these programs. If a user-level program attempts to execute a 'privileged' instruction or to access a supervisor register, control is immediately taken away and given to the controlling supervisor program which can take some corrective action.

Interrupt structure

In most applications, programs are seldom executed instruction-after-instruction without a break. The need frequently arises to respond to an event or exception. Such exceptions may be the hardware interrupts caused by external logic, or the software interrupts caused by the recognition of some condition internal to the processor unit. High-performance microprocessors must be able to respond rapidly to a large variety of exceptions with varying degrees of priority.

Three levels of priority are provided for external hardware interrupts. By use of the three-bit interrupt mask in the 68008 status register (Fig. 2) the supervisor program may postpone handling external interrupts with priorities less than that contained in the mask. When an interrupt



Andrew Barth is a senior staff engineer with Motorola's systems engineering group in East Kilbride. He graduated in physics from Leeds University and since 1976 has worked in microprocessor systems design in Germany and the USA, as well as in the UK.

Table 1. 68008 instruction set

Mnemonic	Description
ADBC	add decimal with extend
ADD	add
AND	logical and
ASL	arithmetic shift left
ASR	arithmetic shift right
B _{CC}	branch conditionally
BCHQ	bit test and change
BCLR	bit test and clear
BRA	branch always
BSET	bit test and set
BSR	branch to subroutine
BTST	bit test
CHK	check register against bounds
CLR	clear operand
CMP	compare
DB _{CC}	test condition, decrement & branch
DIVS	signed divide
DIVU	unsigned divide
EOR	exclusive or
EXG	exchange registers
EXT	sign extend
JMP	jump
JSR	jump to subroutine
LEA	load to effective address
LINK	link stack
LSL	logical shift left
LSR	logical shift right
MOVE	move

is recognised the processor performs an interrupt acknowledgement sequence (IACK). During IACK the peripheral being acknowledged may indicate that program control should be given to any one of 256 interrupt service routines (vectored interrupt method), or to one of three service routines corresponding with the hardware interrupt priority level (autovector interrupt method). Most of the M68000-family peripherals use the vectored interrupt method in which the peripheral provides an eight-bit vector number on the data bus. The 68008 uses this vector number to determine which of the 256 interrupt routine addresses in its interrupt vector table to use. The less sophisticated peripherals use the autovector interrupt method which have seven vectors reserved for them. In either case the external hardware needed to interface both kinds of peripherals to the 68008 is minimal.

Some 68008 instructions are designed to cause internal interrupts, some always and others only upon detection of certain conditions. An example of the last is the execution of a 'privileged' instruction. If a supervisor-level program executes such an instruction, the instruction will execute normally and no exception will occur. However, if a user-level program attempts to execute it, a privilege violation exception occurs and program control is given immediately to the appropriate interrupt service routine.

A number of exceptions correspond to error conditions, either those detected by external hardware or by the processor itself. For example, the Bus Error input (BERR) may be used by external hardware to cause the 68008 to abandon the current bus cycle and give program control to the Bus Error interrupt routine, or, by the simultaneous use of BERR and HALT, to retry the current bus cycle.

A very useful feature is the trace exception, which enables a supervisor-level program to step through a target program on an instruction-by-instruction

Mnemonic	Description
MOVEM	move multiple registers
MOVEP	move peripheral data
MULS	signed multiply
MULU	unsigned multiply
NBCD	negate decimal with extend
NEG	negate
NOP	no operation
NOT	one's complement
OR	logical or
PEA	push effective address
RESET	reset external devices
ROL	rotate left without extend
ROR	rotate right without extend
ROXL	rotate left with extend
ROXR	rotate right with extend
RTE	return from exception
RTR	return and restore
RTS	return from subroutine
SBCD	subtract decimal with extend
S _{CC}	set conditional
STOP	stop
SUB	subtract
SWAP	swap data register halves
TAS	test and set operand
TRAP	trap
TRAPV	trap on overflow
TST	test
UNLK	unlink

basis. Each time the target program executes an instruction, no matter which instruction it may be, control is returned to the supervisory program. No external hardware is required to implement the program tracing as it is part of the processor architecture.

Asynchronous data bus

Like most of the other Motorola microprocessors, the 68008 data bus is not multiplexed – the m.p.u. pins used for the data bus are not shared with other signals. Some microprocessors multiplex the data and address buses onto the same pins to reduce the total number of pins. Non-multiplexed microprocessors such as the 68008 require more pins and sometimes a more expensive package. However, non-multiplexed buses have many advantages: they can operate much

faster, dissipate less chip power, and do not require external demultiplexing hardware. Analysis shows that multiplexed microprocessor systems are more costly than non-multiplexed systems because the microprocessor and demultiplexing i.c.s together cost more, occupy more board space and have more pins overall.

The 68008 has an asynchronous data bus. The time taken to transfer data to or from a memory or peripheral device via the data bus is variable. The memory or peripheral device signals the processor when it is ready to make the data transfer by use of a special handshake line called data transfer acknowledge (DTACK). The advantage of this asynchronous scheme is that each bus cycle can be fine-tuned to the speed of the particular device being accessed. If the device is rather slow, the processor simply marks time until the device is ready. In this way the 68008 runs at the fastest rate that memory and peripherals can go, which maximizes system throughput.

Most M68000-family peripherals have a pin for the DTACK handshake signal, and interfacing such parts to the 68008 microprocessor is simple. Even those peripherals originally designed to work with synchronous processors, like the 6800 or 6809 microprocessor units, may be interfaced to the 68008 with minimal hardware. This is because the 68008 has several signal pins specially for this purpose. By use of these signals, the M6800-type peripheral device signals the processor to perform the current bus cycle synchronously, making the 68008 behave like a synchronous microprocessor for this one bus cycle.

The 68008 m.p.u. uses a two-line bus arbitration scheme which enables the data bus to be shared efficiently with other microprocessors units in a multiprocessor system and with other bus masters such as d.m.a. controllers.

To be continued with interfacing details.

Table 2. 68008 addressing modes

Mode	Generation
Register direct addressing	
Data register direct	EA=D _n
Address register direct	EA=A _n
Absolute data addressing	
Absolute short	EA=(next word)
Absolute long	EA=(next two words)
Program counter relative addressing	
Relative with offset	EA=(PC)+d ₁₆
Relative with index and offset	EA=(PC)+(X _n)+d ₈
Register indirect addressing	
Register indirect	EA=(A _n)
Postincrement register indirect	EA=(A _n), A _n ←A _n +N
Predecrement register indirect	A _n ←A _n -N, EA=(A _n)
Register indirect with offset	EA=(A _n)+d ₁₆
Indexed register indirect with offset	EA=(A _n)+(X _n)+d ₈
Immediate data addressing	
Immediate	Data=next word(s)
Quick immediate	Inherent data
Implied addressing	
Implied register	EA=SR, USP, SP, PC

EA effective address
 A_n address register
 D_n data register
 X_n address or data register used as index register
 SR status register PC program counter
 d₈ eight-bit offset (displacement)
 d₁₆ sixteen-bit offset (displacement)
 N=1 for byte 2 for words and 4 for long words
 () contents of
 ← replaces

16-line p.a.b.x with options

Hints on construction complete Jaap Kuiper's description of a versatile electronic/electromechanical exchange

Current passing through the telephones has to be kept within acceptable limits. Having used 700Ω relays throughout the O relay requires a 470Ω, 1W series resistor (at 45V supply). As relays O, G, II, EI and R are all controlled from the individual stations they must switch positively. Typical values for limiting resistors turned out to be 390Ω, 1W for II, EI and R, and 1kΩ, 1W for G relays and others working off the 45V supply. Relays using the 12V rail don't need series resistors and so operate economically and reliably. The limiting resistor for G relays, if required fits between the G-bus and contacts gh₂/gi₂ in the external control section.

Most Continental telephones include a ground key but where not, momentary push-buttons may be fitted and connected directly to the set's a-line. The original switches, if available, may be fitted in the space provided on top of UK sets in front of the cradle. Holes for the leds have to be drilled or melted in a suitable position and are also connected directly to the a-line. Previous diagrams gave details for both Continental and UK sets.

Special mounting plates (RS Components RS349-119) are available for fitting Siemens/Varley type relays. Each plate holds six relays. Joining these plates together allows daisy-chain wiring of the bussed contacts. The mounting plates have each station's O, T and G relays grouped together for ease of wiring with ribbon cables running to the T-drivers. Terminator, oscillators and line interface were constructed on home-made p.c.bs and 30-way connectors were used to plug in the various telephones.

Resistors in the ground-key toggle have to be approximately the same value as the relay coil and must be capable of dissipating the full power during switching (1kΩ, 5W). The muting i.c. is an LM311 which is rated at 36V maximum, so a voltage divider was included to reduce the supply. These are resistors ra and rb. The reference point is connected through a 1MΩ

resistor so as not to affect proper operation of EI which has to follow dial pulses. At 700Ω EI coil value and a telephone presenting 300Ω when operating, the reference voltage will be approximately 31.5V. Therefore divider rc/rd has to be adjusted to provide around 35V. As soon as the dial is moved the reference point goes to the full supply voltage; the 1MΩ resistor protects the i.c. The LM311 will switch up

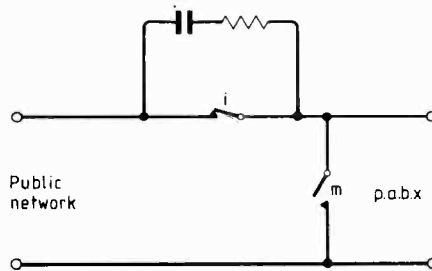
by J. H. Kuiper

to 40V so the additional transistor was included for protection.

With the introduction of more and more d.t.m.f. (system X) exchanges it is sensible to construct the line interface on a separate p.c.b. so that when change-over is required only the line interface needs replacing. A dual tone circuit (Exar application note AN-08) then feeds the 4514 latch. Wiring to the individual sets is by standard four-core cable as each station's b and

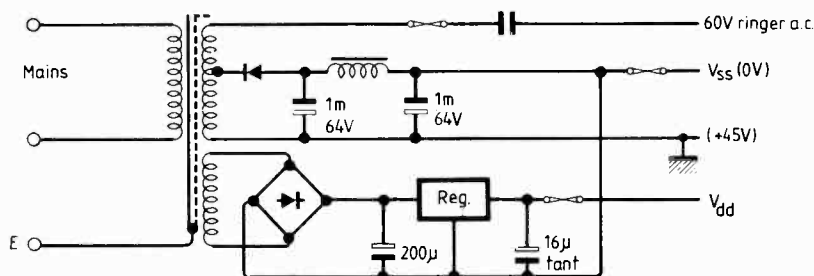


Born in Friesland in 1949 and having lived in Holland since 1960, Jaap Kuiper completed his study of electrical engineering and electronics at Alkmaar Polytechnic in 1970 after which he worked as a buyer re-exporting equipment to Indonesia and Singapore. Since 1977 he has run a small import/wholesale business specialising in audio accessories and computer peripherals.



Automatic dialling by computer requires two buffered output ports each driving a relay. Additional hardware requirements are minimal as shown here.

Power supply diagram. Current of the 33V secondary producing 45V direct is 1.5A. Using higher impedance coils will reduce this. Current from the 9V secondary is 100mA; a 12V regulator is used on this supply. The 1μF, 250V ringer-line capacitor is not needed for UK sets.



ground-key wire have to be discrete throughout. This largely applies to the a-wire as well to avoid speech induction to unwanted sets. Led-lines may, however, be joined together at convenient places to reduce the number of leads.

The line isolating and matching transformer is available from RS Components (RS217-826). The RC shunt across the interruptor contact consists of a 1μF, 250V capacitor and a 560Ω, 1W resistor on the Continent and 2μF, 250V and 600Ω, 1W in the UK. In view of interface requirements relays EI and M should be new types as they must have a contact bounce of less than 4ms and contact resistance of less than 200mΩ. All other relays may be surplus types. Diodes are general-purpose high-speed silicon types. Many diodes used combine or separate switching actions to reduce the number of relay contacts; these are rated at 100mA (BA155). Diodes used in the oscillator circuits and sections working at 12V may be rated lower.

Note that in stations not requiring the muting-inhibit action the g₄ contact becomes redundant. Since relays usually come with two or four contacts, a component can be reduced by omitting the diode between contact t₂ and the G coil and connecting spare contact g₄ directly from t₂ to ground (marked with asterisk on page 63 of November issue).



NEW PRODUCTS



WW 305

Micro-floppy

Following other Japanese manufacturers, Teac have announced the availability of FD-30A, a 3in floppy disc drive that has all the same characteristics as their 5.25in drives; capacity, format, density, disc rotation speed, transfer rate and power and data interface connections are all identical. This makes it fully compatible and a direct replacement for its larger cousin. With a brushless d.c. direct-drive motor, the drive is claimed to be very durable and electrical noise is eliminated. Available in the UK through Tekdata Electronics, Federation Road, Burslem, Stoke-on-Trent ST6 4HY. WW 305

Transistor tester

An addition to their range of hand-held test units is the Osgorne 4500 transistor tester. Completely self-contained, it can be used easily to check p-n junctions of discrete semiconductors whether in or out of circuit. It features a series of leds which indicate the junction status; p-n-p or n-p-n, open or short circuit can be instantly identified and it will work reliably even when parallel circuits have values approaching 270 ohms or 33 microfarads. Osborne Electronics, Binstead Road, Ryde, Isle-of-Wight. WW 306

Voice digitizer

A voice digitizer may be used to enable the transmission of voice and data down the same telephone line. An American model, the Switchco TSP series 1000 works at a very low data rate of 2400bit/s which makes it easy to use with data modems or, by using a multi-

port modem it can transmit four voice conversations over the same line. It is distributed by Vanderhoff Communications Ltd, Haunchwood Estate, Bermuda Road, Nuneaton, Warwicks CV10 7QF. WW 307

Conduct heat — not current

Another American product is a thermally-conductive dry filled silicone rubber that provides 2000V isolation between power semiconductors and heat sinks. The low-cost Aarvid Rubber-Duc pads are vulcanised onto the heatsinks in the factory and eliminate mica washers and grease or silicone rubber pads and adhesives, while offering better thermal conductivity than either. Configurations suitable for TO-3, TO-66 and plastic power devices as well as DO-4 and DO-5 diode washers. Warth International Ltd, Oxted, Surrey. WW 308

Shaft cutter

The cutting of shafts on potentiometers, rotary switches and variable capacitors has been made much easier by the introduction of the Telpro shaft shear. This guillotine-type tool will cut copper, aluminium, mild and stainless steel, and plastics rods of diameters up to 0.25in or 6mm. It does not transmit any shock or vibration and may be used on such delicate components as helical trimmers, providing a clean cut

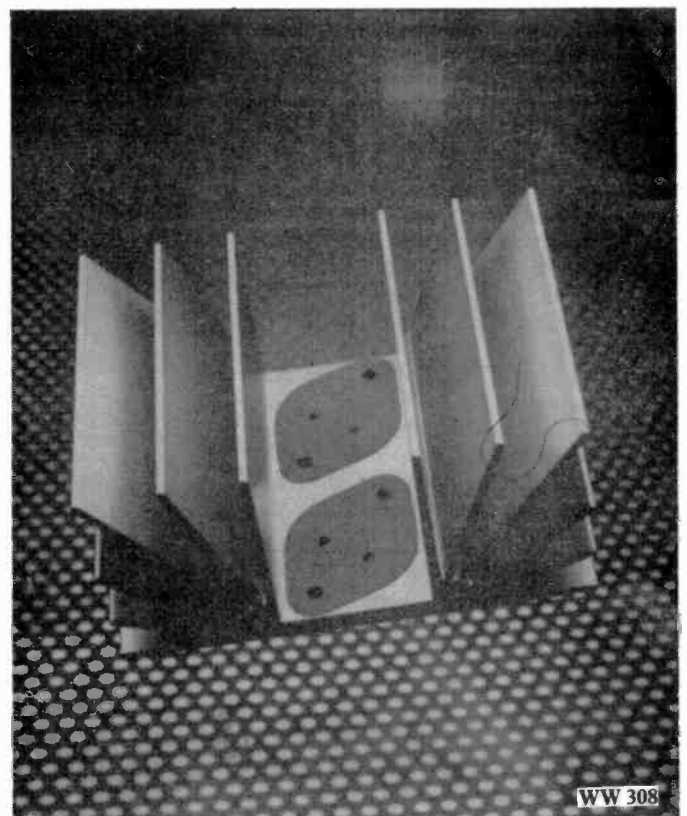
with no need for further filing or finishing. It is claimed that the tool will pay for itself by cutting as few as half-a-dozen shafts because of the reduction in time and damage to components. Electronic and Computer Workshop Ltd., 171 Broomfield Road, Chelmsford, Essex CM1 1RY. WW 309

Laser for communication

A new high-frequency GaAlAs diode laser with a modulation bandwidth of 6GHz is mounted in an impedance matched high frequency module which includes an integral power-monitoring photodiode for the automatic control of carrier wave output power. The laser diode can be used for the transmission of analogue or digital signals from d.c. up to microwave frequencies over long or short optical links. For a complete high-speed link, there is a matching photodiode with a 7GHz detection bandwidth. The small size, light weight and very low power consumption of the laser make it suitable for airborne or remotely powered system use. Typical applications include multi-channel communications, phased array antennae, or radar signal transmission. Walmore Electronics Ltd, 11 Betterton Street, London WC2H 9BS. WW 310

Polyester capacitors

An alternative to the multi-layered ceramic capacitor in decoupling application is offered by the Suflex range of metallized polyester capacitors. The SUF168 is a sub-miniature device that allows for high packing density and is printed on the top to allow identification of values when closely mounted. Values range from 1000pF to 1 μ F with ratings of 50, 60 and 100V d.c. Suflex Ltd, Risca, Newport, Gwent NP1 6YD. WW 311



WW 308

Sinclair goes into business

No modesty has been exercised by Sinclair Research in the naming of their latest computer which they have called the QL for Quantum Leap. It certainly is a leap into an entirely different world from that occupied by the ZX81 or the Spectrum. The QL is being promoted as a purely business machine and is provided with four business-oriented software packages; a word processor, a database, a spreadsheet and a graphics program for the production of graphs and charts.

The computer is based on Motorola MC68000 processor which Sinclair claim is a 32-bit processor. The 68000 has 32-bit internal architecture but uses 16-bits externally and the 68008 version used in the QL has an 8-bit data bus. So it's really an 8/16/32-bit processor depending from where you look at it. A second processor, Intel 8049, is used to control the keyboard, generate the sound and act as an RS232C receiver. QL has 128K of ram and there will be a 0.5Mbyte plug-in ram module as an optional extra. Program storage is on Sinclair Microdrive, a tape cartridge medium with 100Kbytes of storage on each of the two built-in drives. There is an expansion slot for up to six further drives.

Sinclair have designed their own operating system, called QDOS, although no discs are involved. QDOS is a single user, multi-tasking system which has the ability to run several programmes concurrently and to display the result simultaneously in different windows on the screen. The operating system uses a new version of Sinclair Basic, called SuperBasic, which is claimed to be so superior to 'normal' Basic as to constitute a different language. It has the ability to define procedures written in individual blocks. A 'constant execution speed' is claimed, that does not get slower if a program is longer.

The computer has a full typewriter-pitch keyboard with 'real' keys, 65 of them, including cursor-control keys and five programmable function keys.

The display facilities are from a wide choice of character sets with a normal format of 84 columns by 25 lines. Two modes of high-resolution graphics are offered; 512 by 256 pixels with four-colour (red, green, black and white) display, and 256 by 256 with an eight-colour display. A 'stipple' command allows the mixing of foreground and background colours to add to the palette. In both modes a varying grey scale is produced on a monochrome monitor. The quality



WW 301

of the display is such that a high-resolution monitor is necessary to take full advantage of the system. Much would be lost by using a tv receiver even though a tv modulated output is provided.

A number of interfaces are built in; two RS232C interfaces, two analogue joystick ports, a rom-cartridge slot, a u.h.f modulated tv output as well as an RGB monitor output. There is a general-purpose expansion slot which may be used to plug in a ram module, or other peripherals as they become available. There are also two local area network ports and up to 64QLs and/or ZX Spectrums may be daisy-chained together sharing such facilities as a printer or a data base. Data may be transmitted along the QLAN at 100K baud and there is a handshake protocol to ensure that a receiver station is 'listening'.

The QL is due to be issued to customers toward the end of February. As is usual with Sinclair new products, it will be available on mail-order only and may appear in retail shop after about six months. There is a £7.95 charge for postage and packing and users are invited to join a users' group or QLUB, for an additional £35 a year. Members will get software up-dates and news of all additions.

Planned enhancements already under development include a C compiler, 6800 assembler, emulation of a main-frame terminal, a-to-d converter, a hard disc interface, a modem, a parallel printer interface, and an IEEE-488 interface.

Sinclair Research Ltd, Computer Division, Stanhope Road, Camberley, Surrey GU15 3PS.

WW 301

Wren for £1,000

Designed by Transam for Prism Business Systems, the Wren computer is based around a Z80B processor running at 6MHz. It has 64K or ram expandable to 256K, with a diagnostics rom of 8K. A real-time clock is included as is a 50byte c.mos ram, both with battery back-up. It includes a 7in monochrome amber display c.r.t with 36K of screen memory, three selectable screen formats; 80 columns by 24 lines, 40 columns by 24 lines Prestel format, or 512 by 256 elements high-resolution graphics. Although the internal display is monochrome, full colour graphics are supported and there is an RGB output to a colour monitor. The keyboard, which is not detachable, has 67 full size qwerty keys with separate cursor keys and five function keys which allow up to 15 different programmable operations. Two 5.25in disc drives are included with 200Kbyte storage for each drive.

There are a number of interfaces; an RS232 serial port, a Centronics parallel printer port, two analogue inputs for paddle cursor controls, a hard disc interface, and a built in autodial modem which is Prestel and CCITT compatible. Software may be downloaded from Micronet 800 through the inbuilt download facility. For transport, the screen and disc drives in the upper section slide forward over the keyboard, revealing a sturdy carrying handle at the back, it weighs "under 20 lb" (9kg).

The software includes a Z80 version of BBC Basic, a desk-top facility which includes a diary, an address file, a system for creating simple documents such as memos, or expense forms, a filing system, a calculator and it may be used in conjunction with a printer as a typewriter. Perfect Writer, Perfect Calc and Perfect Filer are included along with CP/M 3. Prism Business Systems Ltd, 18 Mora Street, London EC1V 8BT. WW 302



WW 302

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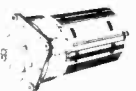


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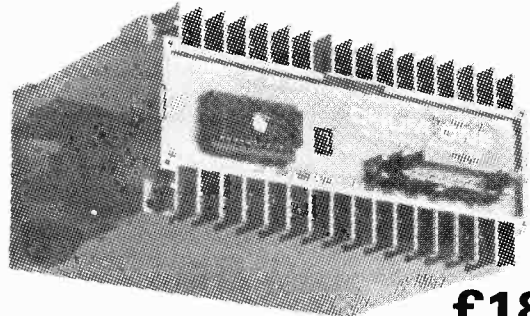
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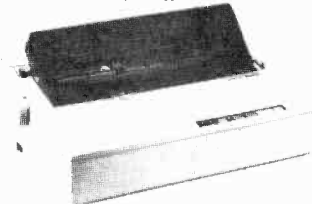
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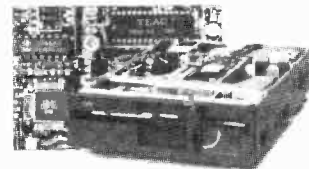
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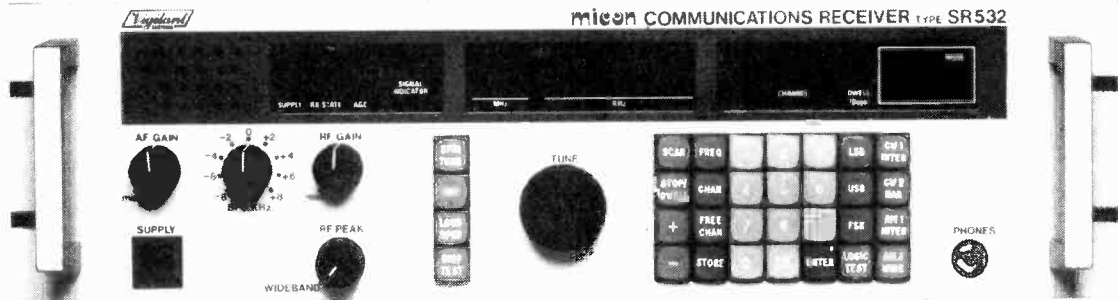
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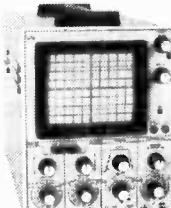
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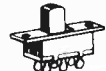
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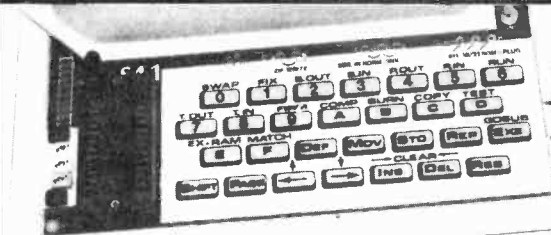
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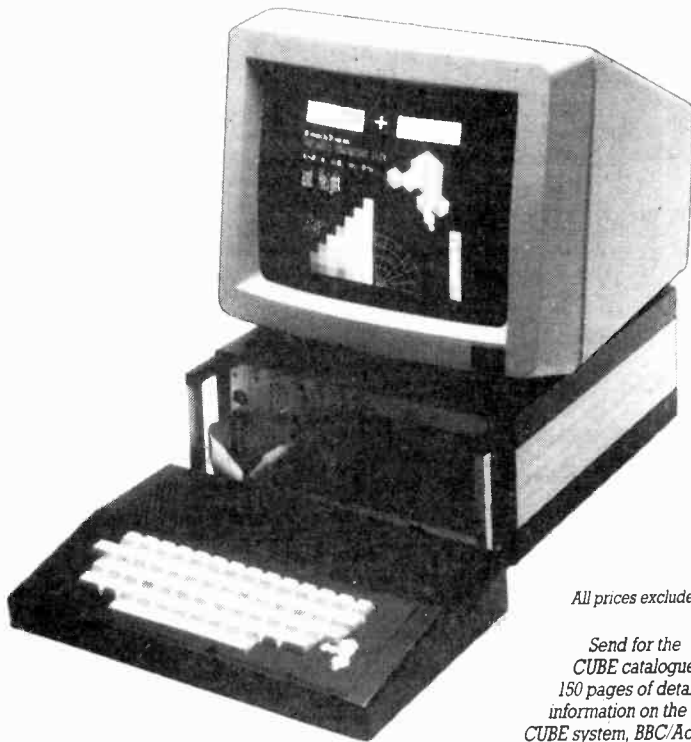
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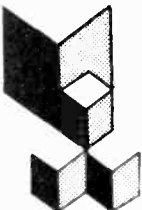
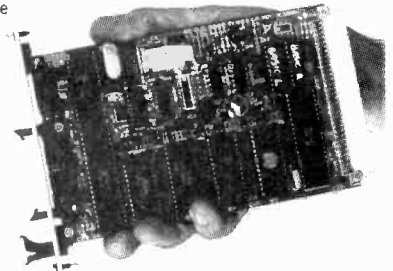
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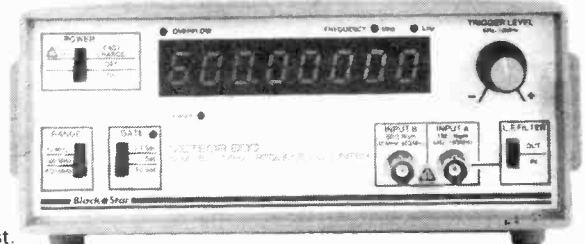
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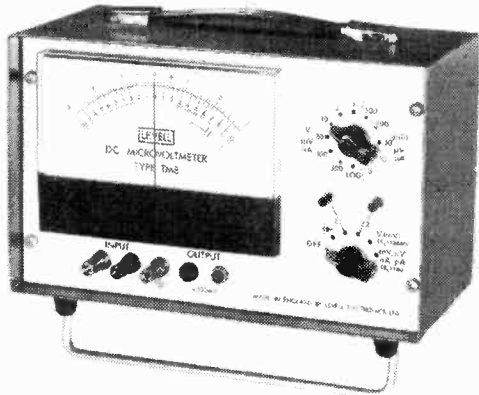
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ALUMINIUM BOXES. 4x4x1 1/2 £1.20, 4x2 1/2x2 £1.20, 3x2x1 £1.20, 6x4x2 £1.90, 7x5x3 £2.90, 8x6x3 £3, 10x7x3 £3.60, 12x5x3 £3.60, 12x8x3 £4.30; 9x4x4 £3.
POTENTIOMETERS 5k/2meg. LOG or LIN. L/S 50p. DP 90p. Stereo L/S £1.10. DP £1.30. Edge Pot 5L SP 45p.

MINI-MULTI TESTER £7.50 Post 65p
Pocket size moving coil instrument. 4000 o.p.v. 11 ranges. DC volts 5.25, 250, 500. AC volts 10, 50, 500, 1000. DC amps 0-250µA, 0-250mA. Resistance 0 to 600K

De Luxe Range Doubler MULTI-METER £19.50
50,000 o.p.v. 7x5x2in. 50 Micro Amp
43 Ranges, 1,000V, AC-DC, 20 MEG 10 amp DC Post £1

PANEL METERS 50µA, 100µA, 500µA, 1mA, 5mA, 50mA, 100mA, 500mA, 1 amp, 2 amp, 25 volt, VU 2 1/4x2x1 1/4. Stereo VU 3 1/4x1 1/2x1in. £5. p.p. 50p

RCS SOUND TO LIGHT CONTROL BOX £27 Post £1
Complete ready to use with cabinet size 9x3x5in.
3 channel, 1000 watt each. For home hi-fi or disco
OR KIT OF PARTS £19.50

BATTERY ELIMINATOR Mains to 9 volt DC. 400MA.
Stabilised, safety cutout, 5x3 1/4x2 1/2in. £5. Post £1.

DISCO GRAPHIC MIXER EQUALISER £108. Post £2.
4 channel stereo, 5 band graphic, red + green LED. VU display, headphone monitor, or Deluxe Model, 5 channel 7 band graphic. £119.

FAMOUS LOUDSPEAKERS

MAKE	MODEL	SIZE	WATTS	OHMS	PRICE	POST
AUDAX	WOOFER	5in	25	8	£10.50	£1
GOODMANS	HIFAX	7 1/2x4 1/4	100	4/8/16	£30	£2
GOODMANS	HB WOOFER	8in	60	8	£12.50	£1
WHARFEDALE	WOOFER	8in	30	8	£9.50	£2
CELESTION	DISCO/GROUP	10in	50	8/16	£21	£2
GOODMANS	HPG/GROUP	12in	120	8/15	£29.50	£2
GOODMANS	HPD/DISCO	12in	120	8/15	£29.50	£2
GOODMANS	HP/BASS	15in	250	8	£72	£3
GOODMANS	HPO/BASS	18in	230	8	£84	£4

RCS STEREO PRE-AMP KIT. To build. Inputs for high, medium or low imp volume control and PC Board. Can be ganged for mono-channel £3.50 Post 65p

MAINS TRANSFORMERS Post
250-0-250V 80mA, 6.3V 3.5A, 6.3V 1A £7.00 £2
350-0-350V 250mA, 6.3V 6A CT £14.00 £2
220V 25ma 6V lamp £3.00 220V 45ma 6V 2 Amp £4.00 £1
250V 60mA, 6V 2A £5 £1

Step-Down 115v to 240V 150W £9. 250W £12. 500W £14 £2

GENERAL PURPOSE LOW VOLTAGE			Price Post		
Tapped outputs available					
2 amp	3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 25 and 30V		£5.00	£2	
1 amp	6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60		£6.00	£2	
2 amp	6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60		£10.50	£2	
3 amp	6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60		£12.50	£2	
5.8-10-16V	1/2 amp	£2.50 £1	0-8-12V 5 amp	£5.00 £1	
6V 1/2 amp	£2.80 £1	15-0-15V 1 amp	£4.00 £1		
6-0-6V 1 1/2 amp	£3.50 £1	15-0-15V 2 amp	£5.00 £1		
9V 400ma	£1.50 £1	20V 1 amp	£4.00 £1		
9V 3 amp	£5.00 £1	20-0-20V 1 amp	£4.50 £1		
9-0-9V 50ma	£1.50 £1	0-12-27V 1 amp	£5.00 £1		
9-0-9V 1 amp	£3.50 £1	20-40-60V 1 amp	£4.50 £2		
10-0-10V 2 amp	£4.00 £1	25-0-25V 2 amp	£5.50 £1		
10-30-40V 2 amp	£5.50 £1	28V 1 amp twice	£7.00 £2		
12V 100mA	£1.50 £1	30V 1 1/2 amp	£5.00 £1		
12V 750 ma	£2.50 £1	30V 5 amp and			
12V 3 amp	£4.50 £1	17-0-17 2a	£5.50 £2		
12-0-12V 2 amp	£5.50 £1	35V 2 amp	£5.00 £1		

500mF 12V 15p; 25V 20p; 50V 30p. 1200mF 76V 80p.
1000mF 12V 20p; 25V 35p; 50V 50p; 100V 120p.
2000mF 30V 42p; 40V 60p; 100V £1.40; 1500mF 100V £1.20.
2250mF 50V 70p; 3000mF 50V 65p; 4700mF 40V £1.

CAPACITORS WIRE END High Voltage
.001, .002, .003 .005, .01, .02, .03, .05 mfd 400V 10p.
.1MF 400V 14p. 600V 15p. 1000V 25p.
22MF 350V 12p. 600V 20p. 1000V 30p. 1750V 60p.
47MF 150V 10p. 400V 25p. 630V 30p.

HIGH VOLTAGE ELECTROLYTICS			
2/500V	45p	32+32+16/350V	90p
16/450V	45p	100+100/275V	50p
20/500V	75p	150+200/275V	50p
32/350V	45p	32+32+32/450V	95p
32/500V	95p	50+50+50/350V	95p
125/500V	£2	8+8/500V	£1
		8+16/450V	75p
		16+16/350V	80p
		32+32/350V	85p
		32+32/500V	£2
		50+50/300V	50p
		50+50/350V	80p

BAKER AMPLIFIERS BRITISH MADE

PA150 Watt MICROPHONE VOCAL AMPLIFIER £129
4 channel mixing, 8 inputs, dual impedance, 50K-600 ohm, volume, treble, bass. Presence controls on each channel. Master volume control, echo send return socket. Slave sockets. Post £3.
150 Watt MIXER AMPLIFIER 4 Inputs £99
Discotheque, Vocal, Public Address. Speaker outlets for 4, 8 or 16 ohms. Four inputs, 20 mv, 50K ohm. Individual volume controls "Four channel" mixing. Slave output. 16" x 8" x 5 1/2". Wt - 14lb. Master volume control. British made. 12 months' guarantee. 240V A.C. 120V to order. All transistor and solid state. Post £2.
100 Volt Line Model, 150 watt £114. MONO SLAVE, 150 watt £80. Baker Stereo Slave 150 + 150 watt 300 watt Mono £125. Post £4.

BAKER MOBILE PA AMPLIFIER. All transistor. 60 watt RMS, 12V DC & 240V AC, 4 inputs 50k. Aux + 2 mics + 1 phono. Output 4-8-16 ohm + 100 volt line. **£89 Post £2**

BAKER PORTABLE DISCO 150 watt. Twin console + amplifier + mike and headphones + twin speakers £330, 300 watt £399. Carr. £30. Console + decks + pre-amp £95. Carr. £12.

PA CABINET SPEAKERS. Complete. 8 ohm 60 watt 17x15x9in. £27. Post £4. 4 or 8 or 16 ohm 75 watt 23x15x11in. £52. 90 watt 32x15x11in. £71. 150 watt £80. Carr. £10. Black vinyl covered.

BAKER LOUDSPEAKERS

MODEL	INCHES	OHMS	WATTS	TYPE	PRICE	POST
MAJOR	12	4-8-16	30	HI-FI	£16	£2
SUPERB	12	8-16	30	HI-FI	£26	£2
AUDITORIUM	12	8-16	45	HI-FI	£24	£2
AUDITORIUM	15	8-16	60	Woofer	£37	£2
GROUP 45	12	4-8-16	45	PA	£16	£2
DG 75	12	4-8-16	75	PA	£20	£2
GRUP 100	12	8-16	100	PA	£26	£2
DISCO 100	12	8-16	100	Disco	£26	£2
GROUP 100	15	8-16	100	PA	£35	£2
DISCO 100	15	8-16	100	Disco	£35	£2

REPAIR service available to most Baker loudspeakers.
SPEAKER COVERING MATERIALS. Samples Large S A E
B.A.F. LOUDSPEAKER CABINET WADDING 18in wide 35p ft.

MOTOROLA PIEZO ELECTRIC HORN TWEETER, 3 3/4in. square £5
100 watts. No crossover required. 4-8-16 ohm, 7 3/4x3 3/8in. £10
HORN BOXES, complete 200 watt £30. 300 watt £35. Size 16x6x6in. Black vinyl covered with handle Post £4

CROSSOVERS. TWO-WAY 3000 cps 30 watt £3. 100W £4.
THREE-WAY 950 cps/3000 cps. 40 watt rating. £4. 60 watt £6. 100W £8.
LOUDSPEAKER BARGAINS. Please enquire, many others in stock.
4 ohm, 5in. 7x4in. £2.50; 6 1/2in, 8x5in, £3; 8in, £3.50. 6 1/2in 20W £7.50.
8 ohm, 2 3/8in, 3in, £2; 5x3in, 6x4in, 7x4in, 5in, £2.50; 3in, 10W £4.
8x5in, £3; 8in, £4.50; 10in, £5; 12in, £6. 8in 25W £6.50. 60W £12.50.
15 ohm, 2 1/4in, 3 1/2in, 5x3in, 6x4in, £2.50. 6 1/2in 10W £5. 8in £4. 10in £7.
25 ohm, 3in, £2; 5x3in, 6x4in, 7x4in, £2.50. 120 ohm, 3 1/4in dia. £1.
EMI 13 1/2x8in. Bass & Tweeter 4 or 8 ohm 10 watt £8 pp. £1

RADIO COMPONENT SPECIALISTS

Books and Components Lists 32p stamps. (Minimum post/packing charge 65p.) Access or Barclaycard Visa. Tel: 01-684 1665 for SAME DAY DESPATCH. Cash prices include VAT. WWW-7

HART

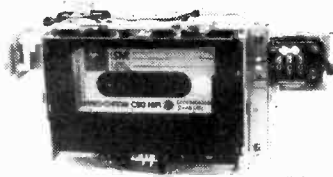
LINSLEY-HOOD 300 SERIES AMPLIFIERS

- 30 Watt Complete Kit £72
- 35 Watt Complete Kit MosFet O/P £79.50
- 45 Watt Complete Kit MosFet O/P £83.50
- Reprints of 30 Watt Article from 'Hi-Fi News' 50p
- Reprints of MosFet Postscript to above 30p

LINSLEY-HOOD 100-WATT MOSFET POWER AMPLIFIER

The very latest amplifier design, published in 'Wireless World' by the renowned John Linsley-Hood. This may now be taken as the standard by which the rest are judged! Our kit, approved by the designer, has massive heat sinks and power supply and includes all components needed to build. Case size 412mm wide, 254mm deep and 145mm high. Automatic switched speaker protection is included as standard. Cost of all parts is over £120. Our complete stereo kit price £105.50.

SOLENOID CONTROLLED HI FI/DIGITAL CASSETTE MECHANISM



Front loading deck with full solenoid control of all functions including optional read in fast wind modes. 12 volt operation. Fitted 3-digit memory counter and Hall IC Motion Sensor. Standard erase and stereo R/P Heads. Cheapest price ever for all these features. Only £38.90 plus VAT. Full technical specification included.

THIS MONTH'S SPECIAL OFFERS

HIGH-SPEED DIGITAL CASSETTE RECORDER

A really super buy for the computer enthusiast. These decks, made by Burroughs, use a capacitorless cassette mechanism to record and replay data at 10 and 30 inches per second. The read after write head uses an NRZ system with separate tracks for clock and data. Power supplies of 5v, -12v and +12v are required. Front panel is 137mm square and the unit is 200mm deep including rear connector. Offered in good export condition at a fraction of original cost, ONLY £44.50 inc. VAT and postage. Data inc. circuits and layouts of PCBs £3.50.

DOLBY 'B' NOISE REDUCTION IC LM1011

Magnificent opportunity for home experimenters, build your own noise reduction system. Supplied complete with circuit showing typical application. Absolute knockout price only £3.50 for two inc. VAT and post.

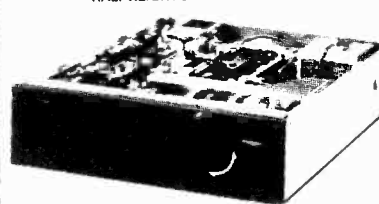
COMPLETE STEREO CASSETTE DECK

Brand new high quality top-loading Cassette Deck complete with Record/Play electronics. Supplied with connection data and circuit diagram. Automatic chrome/ferrie switching. Only needs 9v DC supply. Total price only £18.34 inc. VAT and post.

COMPLETE STEREO TUNER MODULE

Three band LW/MW/FM Stereo Tuner fully assembled on PCB 165 x 85mm. Supplied with Ferrite rod aerial and band switch fully wired. Facility provided to drive tuning meter and stereo LED. Only needs 12v DC supply. FM sensitivity. 2.5uV. Price only £7.99 inc. VAT and post.

HALF HEIGHT 5 1/4" FLOPPY DISK



Latest MPU controlled 80 Track Drives, support single or double density. Fully compatible with Teac, Shugart and many other full and half height drives. £179 80 Track, Single side £225 80 Track, Double side Full manual for each type £14.50. No VAT.

HIGH QUALITY REPLACEMENT CASSETTE HEADS



Do your tapes lack treble? A worn head could be the problem. Fitting one of our replacement heads could restore performance to better than new! Standard mountings make fitting easy and our TC1 Test Cassette helps you set the azimuth spot-on. We are the actual importers which means you get the benefit of lower prices for prime parts. Compare us with other suppliers and see! The following is a list of our most popular heads, all are suitable for use on Dolby machines and are ex-stock.

- HC20 Permalloy Stereo Head. This is the standard head fitted as original equipment on most decks £5.11
 - HM50 High Beta Permalloy Head. A hard-wearing, higher performance head with metal capability £8.06
 - HS16 Sendust Alloy Super Head. The best head we can find. Longer life than Permalloy, higher output than Ferrite, fantastic frequency response £9.91
 - HO551 4-Track Head for auto-reverse or quadrophonic use. Full specification record and playback head £9.73
- Please consult our list for technical data on these and other Special Purpose Heads.

HART TRIPLE-PURPOSE TEST CASSETTE TC1

One inexpensive test cassette enables you to set up VU level, head azimuth and tape speed. Invaluable when fitting new heads. Only £4.66 plus VAT and 50p postage.

Tape Head De-magnetiser. Handy size mains operated unit prevents build-up of residual head magnetisation causing noise on playback £4.54

Curved Pole Type for inaccessible heads £4.85

COMPONENTS

We now list a wide range of individual components many of which are not available elsewhere. Send for your copy of our latest list which also gives further information on our Kits.

Please add part cost of post, packing and insurance as follows:

INLAND
Orders up to £10 - 50p
Orders £10 to £49 - £1
Orders over £50 - £1.50

OVERSEAS
Please send sufficient to cover Surface or Air Post as required.

ALL PRICES EXCLUDE VAT UNLESS STATED



Personal callers are always very welcome but please note that we are closed all day Saturday (0691) 652894

AA117	0.090	BC140	0.130	BD138	0.200	BF244	0.200	BW200	0.200	BY200	0.200	ZZ200	0.200	AAA117	0.090	BB117	0.130	CC117	0.130	DD117	0.130	EE117	0.130	FF117	0.130	GG117	0.130	HH117	0.130	II117	0.130	JJ117	0.130	KK117	0.130	LL117	0.130	MM117	0.130	NN117	0.130	OO117	0.130	PP117	0.130	QQ117	0.130	RR117	0.130	SS117	0.130	TT117	0.130	UU117	0.130	VV117	0.130	WW117	0.130	XX117	0.130	YY117	0.130	ZZ117	0.130	AAA222	0.090	BB222	0.130	CC222	0.130	DD222	0.130	EE222	0.130	FF222	0.130	GG222	0.130	HH222	0.130	II222	0.130	JJ222	0.130	KK222	0.130	LL222	0.130	MM222	0.130	NN222	0.130	OO222	0.130	PP222	0.130	QQ222	0.130	RR222	0.130	SS222	0.130	TT222	0.130	UU222	0.130	VV222	0.130	WW222	0.130	XX222	0.130	YY222	0.130	ZZ222	0.130	AAA333	0.090	BB333	0.130	CC333	0.130	DD333	0.130	EE333	0.130	FF333	0.130	GG333	0.130	HH333	0.130	II333	0.130	JJ333	0.130	KK333	0.130	LL333	0.130	MM333	0.130	NN333	0.130	OO333	0.130	PP333	0.130	QQ333	0.130	RR333	0.130	SS333	0.130	TT333	0.130	UU333	0.130	VV333	0.130	WW333	0.130	XX333	0.130	YY333	0.130	ZZ333	0.130	AAA444	0.090	BB444	0.130	CC444	0.130	DD444	0.130	EE444	0.130	FF444	0.130	GG444	0.130	HH444	0.130	II444	0.130	JJ444	0.130	KK444	0.130	LL444	0.130	MM444	0.130	NN444	0.130	OO444	0.130	PP444	0.130	QQ444	0.130	RR444	0.130	SS444	0.130	TT444	0.130	UU444	0.130	VV444	0.130	WW444	0.130	XX444	0.130	YY444	0.130	ZZ444	0.130	AAA555	0.090	BB555	0.130	CC555	0.130	DD555	0.130	EE555	0.130	FF555	0.130	GG555	0.130	HH555	0.130	II555	0.130	JJ555	0.130	KK555	0.130	LL555	0.130	MM555	0.130	NN555	0.130	OO555	0.130	PP555	0.130	QQ555	0.130	RR555	0.130	SS555	0.130	TT555	0.130	UU555	0.130	VV555	0.130	WW555	0.130	XX555	0.130	YY555	0.130	ZZ555	0.130	AAA666	0.090	BB666	0.130	CC666	0.130	DD666	0.130	EE666	0.130	FF666	0.130	GG666	0.130	HH666	0.130	II666	0.130	JJ666	0.130	KK666	0.130	LL666	0.130	MM666	0.130	NN666	0.130	OO666	0.130	PP666	0.130	QQ666	0.130	RR666	0.130	SS666	0.130	TT666	0.130	UU666	0.130	VV666	0.130	WW666	0.130	XX666	0.130	YY666	0.130	ZZ666	0.130	AAA777	0.090	BB777	0.130	CC777	0.130	DD777	0.130	EE777	0.130	FF777	0.130	GG777	0.130	HH777	0.130	II777	0.130	JJ777	0.130	KK777	0.130	LL777	0.130	MM777	0.130	NN777	0.130	OO777	0.130	PP777	0.130	QQ777	0.130	RR777	0.130	SS777	0.130	TT777	0.130	UU777	0.130	VV777	0.130	WW777	0.130	XX777	0.130	YY777	0.130	ZZ777	0.130	AAA888	0.090	BB888	0.130	CC888	0.130	DD888	0.130	EE888	0.130	FF888	0.130	GG888	0.130	HH888	0.130	II888	0.130	JJ888	0.130	KK888	0.130	LL888	0.130	MM888	0.130	NN888	0.130	OO888	0.130	PP888	0.130	QQ888	0.130	RR888	0.130	SS888	0.130	TT888	0.130	UU888	0.130	VV888	0.130	WW888	0.130	XX888	0.130	YY888	0.130	ZZ888	0.130	AAA999	0.090	BB999	0.130	CC999	0.130	DD999	0.130	EE999	0.130	FF999	0.130	GG999	0.130	HH999	0.130	II999	0.130	JJ999	0.130	KK999	0.130	LL999	0.130	MM999	0.130	NN999	0.130	OO999	0.130	PP999	0.130	QQ999	0.130	RR999	0.130	SS999	0.130	TT999	0.130	UU999	0.130	VV999	0.130	WW999	0.130	XX999	0.130	YY999	0.130	ZZ999	0.130	AAA000	0.090	BB000	0.130	CC000	0.130	DD000	0.130	EE000	0.130	FF000	0.130	GG000	0.130	HH000	0.130	II000	0.130	JJ000	0.130	KK000	0.130	LL000	0.130	MM000	0.130	NN000	0.130	OO000	0.130	PP000	0.130	QQ000	0.130	RR000	0.130	SS000	0.130	TT000	0.130	UU000	0.130	VV000	0.130	WW000	0.130	XX000	0.130	YY000	0.130	ZZ000	0.130
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PHILIPS P2000 DAISY WHEEL PRINTER. RS232	£375 ea	44 HP SWEEP OSC H01-694B. 7-12.4gHz.	£350
SHUGART 801 FLOPPY DISK DRIVES 8"	£100 ea	45 JP VHF SIG GEN 608D 10-480MHz	£150
TRANSELT DOT MATRIX PRINTER Compact Serial Interface 230V. With info	£65 ea	48 HP WAVE ANALYSER 302A. 20Hz-50kHz	£35
TELETYPE ASR33 (Printer, Keyboard, Punch and Reader) RS232	£50 ea	49 B&K BEAT FREQ OSC 1022 20Hz-20kHz	£400
CREDO 75 TELEPRINTER. Very good condition	£25 ea	51 B&K LEVEL RECORDER 2305. Solid state	£200
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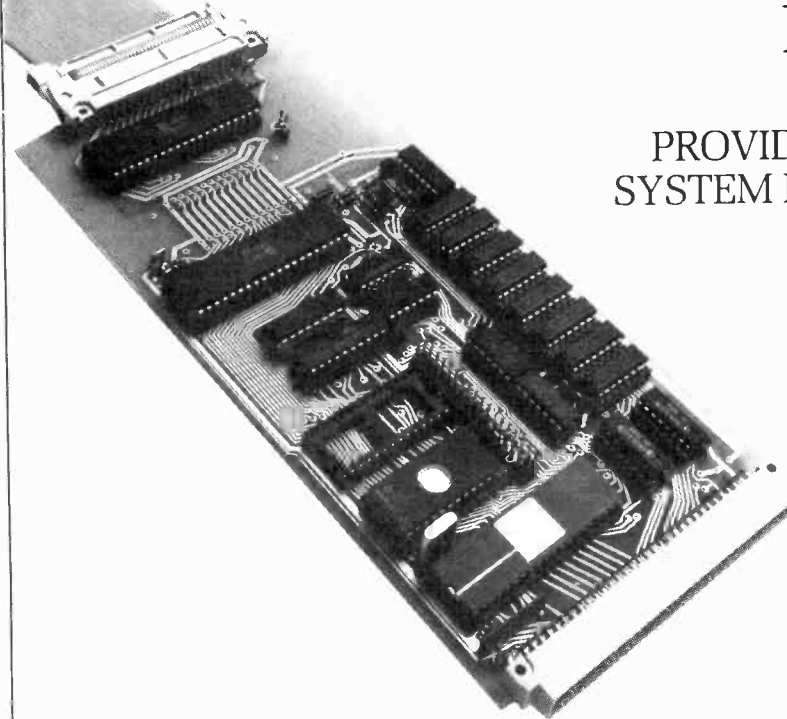
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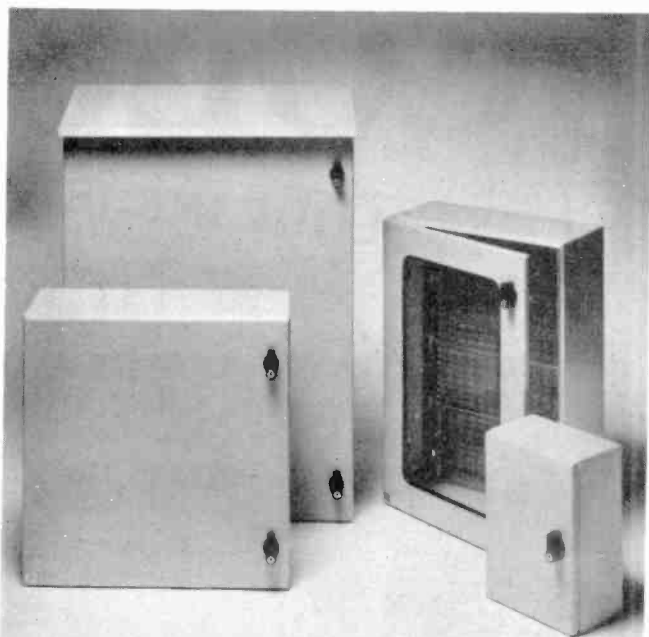
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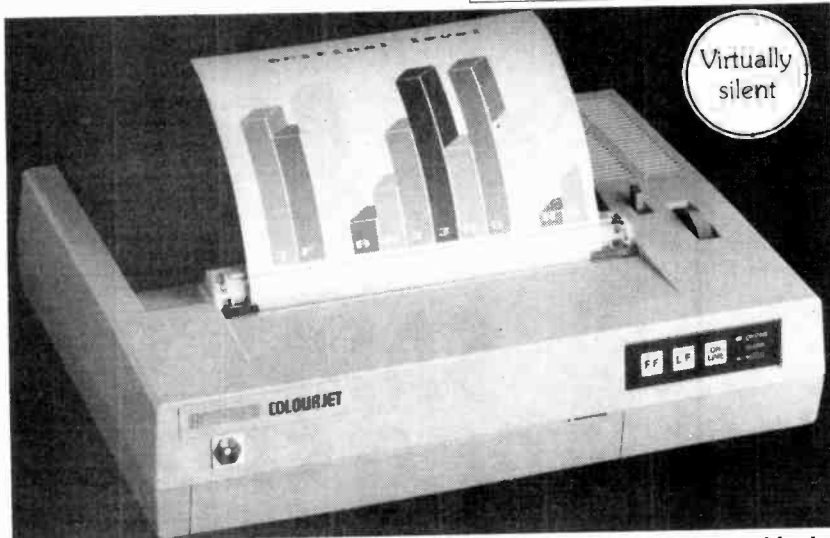
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1. make sure it is safe to approach
The cable has it. If this is not possible stand on any insulating material such as a mat, newspaper or a rubber mat and use the pencil or pen to disconnect the casualty from the contact using a brush or stick. Do not touch the casualty with bare hands but if nothing else is available then you may have to touch them under the armpits and get the casualty away from the source.

2. check for signs of breathing
Place a casualty in the recovery position and call medical aid.
if NOT breathing
Get someone to call medical aid while you begin mouth-to-mouth ventilation.

3. mouth to mouth ventilation—Speed is essential
Open the airway by tilting the head and lifting the neck. Place the heel of your hand on the forehead and the back of your hand on the chin and push upwards. Breathing should be restored.

4. if AFTER FOUR VENTILATIONS the casualty does not respond, start external chest compression
Kneel alongside the casualty facing the head. Place the heel of your hand on the centre of the lower part of the breastbone. Press down with the heel of your other hand and lock the fingers together. With arms straight press vertically down on the lower part of the breastbone to depress chest about 1.5 in. Do this 15 times at the rate of 80 per minute. Repeat the arms and give two ventilations. Repeat this 15 compressions and two ventilations for one minute and check for a pulse. If a pulse is restored, continue until normal breathing is restored.

● manual artificial ventilation method
If mouth-to-mouth ventilation is not possible or if there are several casualties the manual resuscitator should be used. Place the hands placed under the head. Turn the

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phone
ambulance
phone
hospital
phone
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phone

Prepare with the assistance of the British Red Cross Society

Enclose with your name or a vertical one for your name. Pack backwards allowing for name and full address. The casualty's name just above the name of the person to be contacted. Have the name and full address written on the envelope. Repeat this for each casualty. After the exercise continue for 15 minutes.

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RESISTORS	AXIALS (wires each/ind)	7491 7492 7493	7494 7495 7496	7497 7498 7499	7500 7501 7502	7503 7504 7505	7506 7507 7508	7509 7510 7511	7512 7513 7514	7515 7516 7517	7518 7519 7520	7521 7522 7523	7524 7525 7526	7527 7528 7529	7530 7531 7532	7533 7534 7535	7536 7537 7538	7539 7540 7541	7542 7543 7544	7545 7546 7547	7548 7549 7550	7551 7552 7553	7554 7555 7556	7557 7558 7559	7560 7561 7562	7563 7564 7565	7566 7567 7568	7569 7570 7571	7572 7573 7574	7575 7576 7577	7578 7579 7580	7581 7582 7583	7584 7585 7586	7587 7588 7589	7590 7591 7592	7593 7594 7595	7596 7597 7598	7599 7600 7601	7602 7603 7604	7605 7606 7607	7608 7609 7610	7611 7612 7613	7614 7615 7616	7617 7618 7619	7620 7621 7622	7623 7624 7625	7626 7627 7628	7629 7630 7631	7632 7633 7634	7635 7636 7637	7638 7639 7640	7641 7642 7643	7644 7645 7646	7647 7648 7649	7650 7651 7652	7653 7654 7655	7656 7657 7658	7659 7660 7661	7662 7663 7664	7665 7666 7667	7668 7669 7670	7671 7672 7673	7674 7675 7676	7677 7678 7679	7680 7681 7682	7683 7684 7685	7686 7687 7688	7689 7690 7691	7692 7693 7694	7695 7696 7697	7698 7699 7700	7701 7702 7703	7704 7705 7706	7707 7708 7709	7710 7711 7712	7713 7714 7715	7716 7717 7718	7719 7720 7721	7722 7723 7724	7725 7726 7727	7728 7729 7730	7731 7732 7733	7734 7735 7736	7737 7738 7739	7740 7741 7742	7743 7744 7745	7746 7747 7748	7749 7750 7751	7752 7753 7754	7755 7756 7757	7758 7759 7760	7761 7762 7763	7764 7765 7766	7767 7768 7769	7770 7771 7772	7773 7774 7775	7776 7777 7778	7779 7780 7781	7782 7783 7784	7785 7786 7787	7788 7789 7790	7791 7792 7793	7794 7795 7796	7797 7798 7799	7800 7801 7802	7803 7804 7805	7806 7807 7808	7809 7810 7811	7812 7813 7814	7815 7816 7817	7818 7819 7820	7821 7822 7823	7824 7825 7826	7827 7828 7829	7830 7831 7832	7833 7834 7835	7836 7837 7838	7839 7840 7841	7842 7843 7844	7845 7846 7847	7848 7849 7850	7851 7852 7853	7854 7855 7856	7857 7858 7859	7860 7861 7862	7863 7864 7865	7866 7867 7868	7869 7870 7871	7872 7873 7874	7875 7876 7877	7878 7879 7880	7881 7882 7883	7884 7885 7886	7887 7888 7889	7890 7891 7892	7893 7894 7895	7896 7897 7898	7899 7900 7901	7902 7903 7904	7905 7906 7907	7908 7909 7910	7911 7912 7913	7914 7915 7916	7917 7918 7919	7920 7921 7922	7923 7924 7925	7926 7927 7928	7929 7930 7931	7932 7933 7934	7935 7936 7937	7938 7939 7940	7941 7942 7943	7944 7945 7946	7947 7948 7949	7950 7951 7952	7953 7954 7955	7956 7957 7958	7959 7960 7961	7962 7963 7964	7965 7966 7967	7968 7969 7970	7971 7972 7973	7974 7975 7976	7977 7978 7979	7980 7981 7982	7983 7984 7985	7986 7987 7988	7989 7990 7991	7992 7993 7994	7995 7996 7997	7998 7999 8000
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IMMEDIATE DELIVERY - PHONE FOR LATEST PRICES

IMMEDIATE DELIVERY - PHONE FOR LATEST PRICES

4072	19p	10mp	40412	70p	BC338	15p	BFY50	23p	6amp type	SL480	2.99	Single sided
4073	19p	790957	40873	70p	BC440	32p	BFY51	23p	Square with hole	SL490	3.47	100 x 180 2.10
4074	19p	79121	40874	70p	BC441	32p	BFY52	23p	PW06 1000 95p	SN76003	2.95	100 x 220 2.50
4075	45p	79157	40875	70p	BC460	32p	BFY53	23p	PW02 1200 99p	SN76013	2.95	203 x 114 2.40
4076	45p	79247	40876	70p	BC461	32p	BFY54	23p	PW04 4000 130p	SN76023	2.95	233 x 220 2.50
4077	19p		40877	70p	BC462	32p	BFY55	23p	PW06 6000 139p	SN76033	2.95	Double Sided
4078	19p		40878	70p	BC516	40p	BSX21	40p	25amp type	TA7220	2.95	150 x 160 2.20
4079	19p		40879	70p	BC546E	15p	BU014	22p	Metal clad with hole	TA7221	2.95	100 x 200 2.80
4080	19p		40880	70p	BC547	15p	BU015	22p	RO11100 2.62	TA7222	2.95	203 x 114 2.90
4081	49p		40881	70p	BC556B	15p	BU018	3.95	K02 1200 2.75	TA7223	2.95	233 x 220 5.90
4082	19p		40882	70p	BC548	12p	BU020	1.75	NB21	TBA5000	3.1	1 above ldn
4083	49p		40883	70p	BC549	12p	BU021	1.75	NB22	TBA5010	3.1	use Sodium
4084	60p		40884	70p	BC548B	14p	BU022	1.75	NB23	TBA5100	3.05	Hydrexel
4085	49p		40885	70p	BC548C	14p	BU023	1.75	NB24	TBA5200	2.75	500ml
4086	49p		40886	70p	BC548D	14p	BU024	1.75	NB25	TBA5300	2.56	
4087	19p		40887	70p	BC548E	14p	BU025	1.75	NB26	TBA5500	2.77	
4088	19p		40888	70p	BC548F	14p	BU026	1.75	NB27	TBA5600	2.87	
4089	19p		40889	70p	BC548G	14p	BU027	1.75	NB28	TBA5700	2.74	
4090	19p		40890	70p	BC548H	14p	BU028	1.75	NB29	TBA5800	2.74	
4091	19p		40891	70p	BC548I	14p	BU029	1.75	NB30	TBA5900	2.74	
4092	19p		40892	70p	BC548J	14p	BU030	1.75	NB31	TBA6000	2.74	
4093	19p		40893	70p	BC548K	14p	BU031	1.75	NB32	TBA6100	2.74	
4094	69p		40894	70p	BC548L	14p	BU032	1.75	NB33	TBA6200	2.74	
4095	71p		40895	70p	BC548M	14p	BU033	1.75	NB34	TBA6300	2.74	
4096	71p		40896	70p	BC548N	14p	BU034	1.75	NB35	TBA6400	2.74	
4097	2.88p		40897	70p	BC548O	14p	BU035	1.75	NB36	TBA6500	2.74	
4098	74p		40898	70p	BC548P	14p	BU036	1.75	NB37	TBA6600	2.74	
4099	89p		40899	70p	BC548Q	14p	BU037	1.75	NB38	TBA6700	2.74	
4502	39p		4502	39p	BC548R	14p	BU038	1.75	NB39	TBA6800	2.74	
4503	39p		4503	39p	BC548S	14p	BU039	1.75	NB40	TBA6900	2.74	
4507	33p		4507	33p	BC548T	14p	BU040	1.75	NB41	TBA7000	2.74	
4508	1.26		4508	1.26	BC548U	14p	BU041	1.75	NB42	TBA7100	2.74	
4510	4.4p		4510	4.4p	BC548V	14p	BU042	1.75	NB43	TBA7200	2.74	
4511	4.4p		4511	4.4p	BC548W	14p	BU043	1.75	NB44	TBA7300	2.74	
4512	4.4p		4512	4.4p	BC548X	14p	BU044	1.75	NB45	TBA7400	2.74	
4513	1.3		4513	1.3	BC548Y	14p	BU045	1.75	NB46	TBA7500	2.74	
4514	1.3		4514	1.3	BC548Z	14p	BU046	1.75	NB47	TBA7600	2.74	
4515	1.3		4515	1.3	BC548AA	14p	BU047	1.75	NB48	TBA7700	2.74	
4516	5.5p		4516	5.5p	BC548AB	14p	BU048	1.75	NB49	TBA7800	2.74	
4518	3.9p		4518	3.9p	BC548AC	14p	BU049	1.75	NB50	TBA7900	2.74	
4519	2.9p		4519	2.9p	BC548AD	14p	BU050	1.75	NB51	TBA8000	2.74	
4520	4.8p		4520	4.8p	BC548AE	14p	BU051	1.75	NB52	TBA8100	2.74	
4521	6.8p		4521	6.8p	BC548AF	14p	BU052	1.75	NB53	TBA8200	2.74	
4526	6.8p		4526	6.8p	BC548AG	14p	BU053	1.75	NB54	TBA8300	2.74	
4527	6.2p		4527	6.2p	BC548AH	14p	BU054	1.75	NB55	TBA8400	2.74	
4528	74p		4528	74p	BC548AJ	14p	BU055	1.75	NB56	TBA8500	2.74	
4529	6.8p		4529	6.8p	BC548AK	14p	BU056	1.75	NB57	TBA8600	2.74	
4534	3.9p		4534	3.9p	BC548AL	14p	BU057	1.75	NB58	TBA8700	2.74	
4536	2.9p		4536	2.9p	BC548AM	14p	BU058	1.75	NB59	TBA8800	2.74	
4538	7.8p		4538	7.8p	BC548AN	14p	BU059	1.75	NB60	TBA8900	2.74	
4539	8.9p		4539	8.9p	BC548AO	14p	BU060	1.75	NB61	TBA9000	2.74	
4543	6.8p		4543	6.8p	BC548AP	14p	BU061	1.75	NB62	TBA9100	2.74	
4545	2.25		4545	2.25	BC548AQ	14p	BU062	1.75	NB63	TBA9200	2.74	
4555	3.5p		4555	3.5p	BC548AR	14p	BU063	1.75	NB64	TBA9300	2.74	
4556	3.5p		4556	3.5p	BC548AS	14p	BU064	1.75	NB65	TBA9400	2.74	
4560	1.9p		4560	1.9p	BC548AT	14p	BU065	1.75	NB66	TBA9500	2.74	
4566	1.4p		4566	1.4p	BC548AU	14p	BU066	1.75	NB67	TBA9600	2.74	
4569	1.65		4569	1.65	BC548AV	14p	BU067	1.75	NB68	TBA9700	2.74	
4570	3.9p		4570	3.9p	BC548AW	14p	BU068	1.75	NB69	TBA9800	2.74	
4585	5.5p		4585	5.5p	BC548AX	14p	BU069	1.75	NB70	TBA9900	2.74	

40412	70p	BC338	15p	BFY50	23p	6amp type	SL480	2.99	Single sided
40873	70p	BC440	32p	BFY51	23p	Square with hole	SL490	3.47	100 x 180 2.10
40874	70p	BC441	32p	BFY52	23				

CIRCUIT MODELLER for CP/M

by Harcourt Systems

An engineering package for CP/M* and MS DOS* microcomputers to carry out accurate, fast designs of linear circuits.

CIRCUIT MODELLER can find voltage gain, phase shift, Z_{in} and Z_{out} for most linear electrical and electronic circuits. The limits of capacity are set by the microcomputer RAM, which must be at least 60 KBytes. This gives a capacity of 32 nodes, 101 resistors, 101 capacitors, 101 inductors, 31 mutual inductors, 31 simple operational amplifiers and 31 controlled sources.

Features include:

- ADD & EDIT** to construct and alter circuit
- LOAD & SAVE** to save and recover circuit from disk
- GAIN** to display gain and phase
- ZIN** to display input and output impedances
- BW** to find centre frequency and $-3dB$ Av points of circuit
- SEARCH** to find frequency corresponding to given gain
- PRINT** to print synopsis of circuit diagram sufficient for its precise reproduction.

Operating Speed

CIRCUIT MODELLER is an all-compiled package with seven overlays in which the inner two loops of pivotal condensation are written in Z80 assembler. This means that whereas microcomputer CAD is usually slow, **CIRCUIT MODELLER** can solve a four hybrid-pi amplifier in a few seconds.

Graphics

PLOT is an extension to **CIRCUIT MODELLER** enabling an ordinary 132 column printer to plot both dB gain and phase angle against frequency for the circuit. A log/log plot is obtained with automatic axis scaling.

Themselves designers of high performance electronic equipment, Seasim Controls have recognised the importance of **CIRCUIT MODELLER** which they are making available in association with Harcourt Systems. **CIRCUIT MODELLER** is priced at £160+VAT. Prices for MS DOS on application. Order, or send for more details from

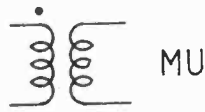
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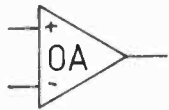
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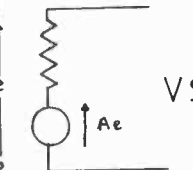
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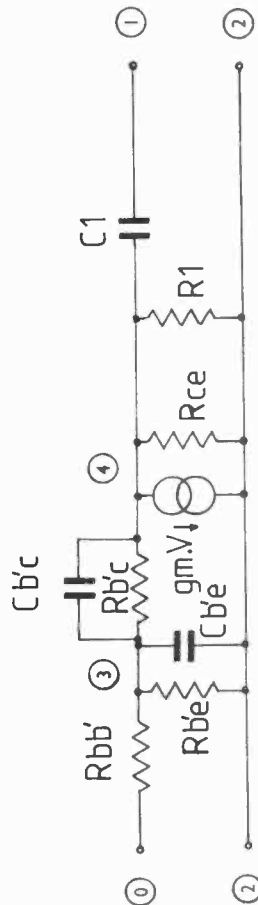
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CS



VS



BULK PURCHASE BARGAINS CAPACITORS

AXIAL		Price each per 100	Price each per 1K	Price each per 10K	RADIAL		Price each per 100	Price each per 1K	Price each per 10K
Value/Volts	Qty.				Value/Volts	Qty.			
100/10	89000	0.07	0.04	.025	47/10	3600	0.04	0.03	
220/10	5000	0.08	0.05		330/10	69500	0.05	0.03	0.02
2200/10	10000	0.19	0.10	0.07	1000/10	7400	0.08	0.05	
4700/10	4000	0.32	0.20		33/16	47000	0.04	0.03	0.02
100/16	4000	0.07	0.04		33/25	19600	0.04	0.025	0.02
470/16	400	0.11			330/25	3000	0.07	0.05	
47/40	9000	0.09	0.05		100/40	9200	0.06	0.04	
100/40	2500	0.11	0.07		47/40	3000	0.05	0.03	
150/40	7000	0.11	0.07		100/63	23400	0.11	0.07	0.05
4700/40	400	0.55			2.2/100	2800	0.03	0.02	
4.7/50	2800	0.05	0.03		330/40	850	0.09	0.05	
3.3/63	1400	0.06	0.04		22/100	1900	0.05	0.03	
4.7/63	300	0.06	0.04		220/100	8400	0.18	0.11	
.47/63	6000	0.04	0.025		47/160	1000	0.12	0.07	
1000/63	450	0.32			10/200	1000	0.04	0.025	
100/100	450	0.15			47/250	1500	0.05	0.03	
1/160	2000	0.05	0.025		4.7/450	550	0.03		
10/160	18000	0.08	0.05	0.04	CERAMICS				
4.7/450	4000	0.07	0.045		10pf	24000	All one price		
22/500	1500	0.05	0.04		39pf	56000			
4.7/500	350	0.06			47pf	118000	£10 per 100		
470/6.3	900	0.11			20pf	16000	£25 per 10K		
1/250	1000	0.07			51pf	100000	£125 per 100K		
CERAMIC FILTERS					33pf	48000			
10.7 Mhz	15000	0.15	0.10	0.05	120pf	16000	Any mix		
INDUCTORS					12pf	16000			
82µH	35000	0.15	0.10	0.05	6800pf	36500			
33µH	16000	0.15	0.10	0.05	4700pf	6000			
					120pf	1800			
					150pf	75000			
					15pf	40000			
					12pf	16000			
					68pf	20000			
					22pf	2000			
					39pf	5000			
					47pf	14000			

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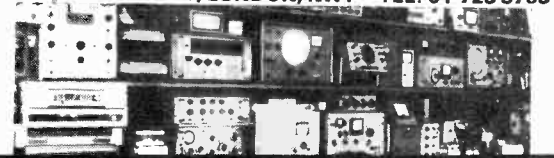
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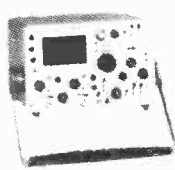
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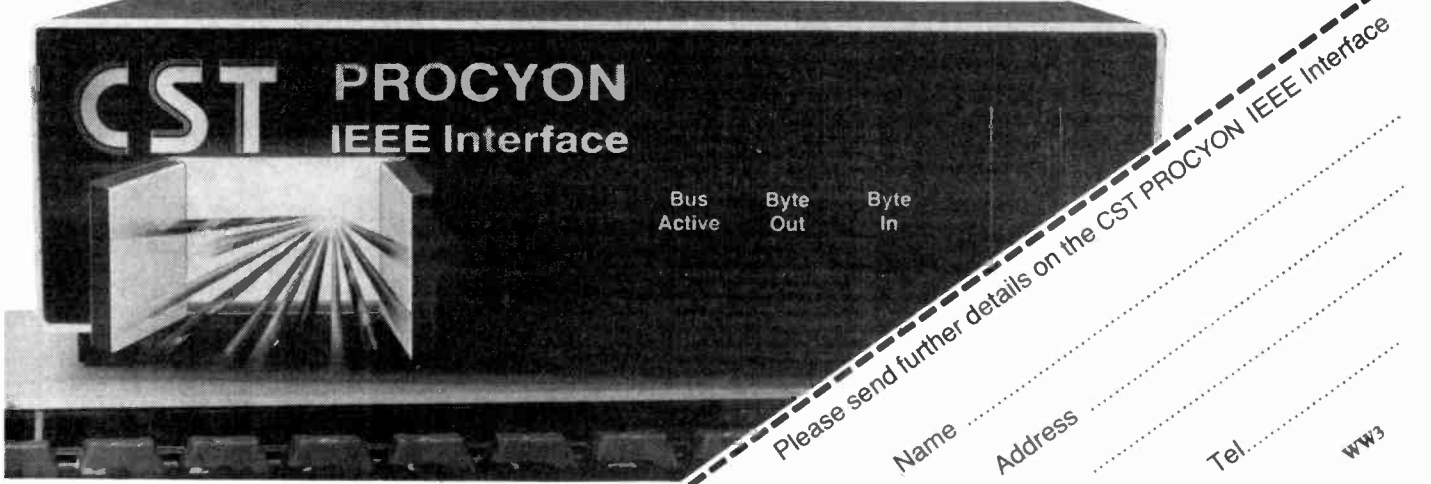
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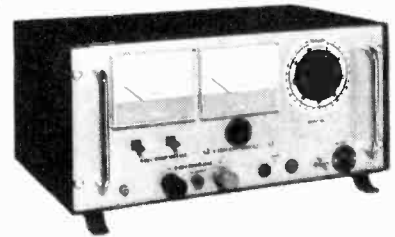
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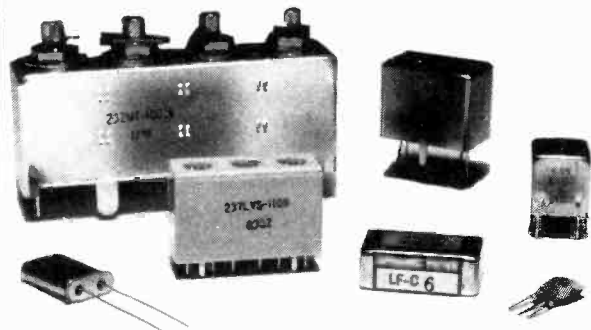
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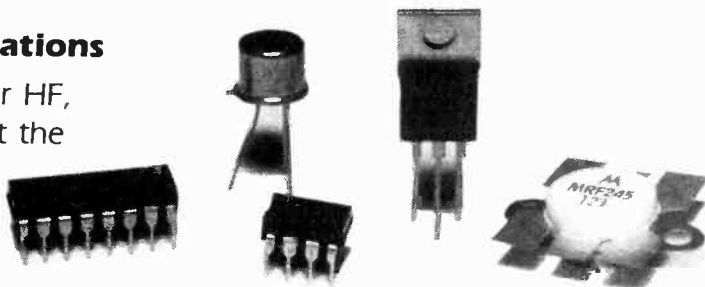


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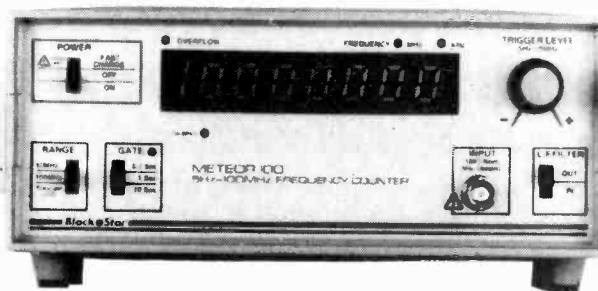
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For further details please write to the address given below. As our careful selection process takes some time, it would be particularly helpful if you could detail your qualifications, your personal fields of interest and practical experience, and describe the type of working environment most suited to your career plans.

The Recruitment Officer, HMGCC, Hanslope Park, Buckinghamshire MK19 7BH.

(2448)

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The Superintendent will institute test runs and be responsible for range personnel, test procedures, safety, the integrity of test equipments, and will also contribute to the development of the test range facility. Applicants should have an HNC as a minimum qualification and at least 5 years experience of R.F. and antenna testing utilising computer based systems.

The Supervisor will be responsible to the Range Superintendent for the implementation of test runs and generally contribute as a member of the range test team. Applicants for this should possess ONC in electronics plus at least 3 years computer based test experience of R.F. equipments.

Appropriate salaries and other attractive benefits form a first-class package anticipated from a large market-leader employer.

Telephone Portsmouth (0705) 674019 for an application form or write direct to Derek Withers, Marconi Space and Defence Systems Limited, Browns Lane, The Airport, Portsmouth, Hants PO3 5PQ quoting reference BL 152.

(All posts are open to men and women)

Marconi
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(2458)

WANDSWORTH HEALTH AUTHORITY

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Hospital: Department
of Medical Physics

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The starting salary will be £8,009, with increments up to a maximum of £9,835 including London Weighting. Post available from April 1984.

For further information please contact Ian Eversden, Principal Physicist.

Application form and job description available from:

Hospital Administrator
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Copse Hill, Wimbledon
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ELECTRONIC ENGINEERS

Due to promotion, two Electronic Engineers, qualified to a minimum of HNC level, are required for our Electronic Maintenance Department.

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One opportunity is to join the section responsible for repair to component level of studio broadcast equipment, including Video Switching and Processor Systems, Field Synchronisers, Telecine and Cameras. Applicants should be familiar with colour television technology and have experience in fault finding on analogue, digital or microprocessor based hardware.

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Personnel Officer (Recruitment)
Yorkshire Television Limited
The Television Centre, Leeds LS3 1JS

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Recruitment Office, Government Communications Headquarters,
Oakley, Priors Road, Cheltenham,
Gloucestershire, GL52 5AJ. (2452)

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Applicants write with full C.V. to:

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To apply, please write to, or telephone, Chris Burns at:

CASE Computer and Systems, Engineering plc, Caxton Way, Watford Business Park, Watford WD1 8XH. Hertfordshire. Tel: Watford 33500.

(2488)

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The appointment will be on the Medical Physics Technician Grade 3 scale.

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Application forms are available from the Personnel Department, Guy's Hospital, London SE1 9RT. Tel: 01-407 7600, Ext. 3471. Please quote Ref: P/2. Closing date for completed application forms, March 30, 1984.

(2482)

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Salary £5,517-£8,316 plus £1,284 London Weighting

Further details and application form from EO/Estab 1b, Inner London Education Authority, Room 365, The County Hall, London SE1 7PB.

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This vacancy is suitable for job sharing.

All applicants will be given equal consideration irrespective of sex, age, disabilities, race, colour, ethnic or national origins, marital status, sexual orientation, family responsibility, trade union activity or political belief.

(2456)

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The Survey's vessels re-supply Antarctic land stations, support scientific parties in the field and in addition undertake shipborne research.

Candidates should possess valid certificates of proficiency recognised by the Department of Trade and have served the necessary sea time to work a single-handed station.

Starting salary in a scale up to £8,640, rising to £10,917 per annum. In addition an allowance of £1,200 per annum is payable for periods of service spent south of Montevideo.

For further details and an application form, please write, stating full qualifications and experience, to: The Establishment Officer, British Antarctic Survey, High Cross, Madingley Road, Cambridge CB3 0ET. Please quote ref: BAS 5. Closing date: March 14, 1984.

NATURAL ENVIRONMENT RESEARCH COUNCIL

(2492)

Cameron Communications, an expanding division of C W Cameron Ltd, is a well established leader in the Visual Communications market, with high quality products for the professional and industrial users, including — Colour Graphic Displays — Interactive Video Systems — Video Projection — Videotex Terminals — Broadcast and Industrial Video Equipment — Touch Screen Displays — Computer Graphics Projectors.

The continuing growth and success of the company has resulted in the creation of further career opportunities based in our new Reading Office.

SENIOR ENGINEER

Video/Computer Products (Ref: RE1)

Salary: £ Negotiable Based: Reading Plus: Car

A Senior Engineer is required to head a team of engineers operating in a modern well equipped department providing technical assistance to the Sales Group, OEM Customers, Dealer Network and End Users. Key activities will include the organisation of documentation system to cope with the expanding product line and installed equipment base. Provide and maintain a technical interface with the company's suppliers and its customers and introduce equipment training and acceptance facilities.

EUROPEAN SERVICE ENGINEER

(Ref: RE2)

Interactive Video — Computer Products

Salary: £ Negotiable Based: Reading Plus: Car

An adaptable and self motivated person is required to provide service support and practical training on the above display systems at our distributors and customers premises in the UK, Europe and certain other countries.

Formal qualifications in electronics are required and service experience on video displays and some knowledge of personal computers or microprocessor based equipment would be a distinct advantage as would a foreign language.

TEST/SERVICE TECHNICIAN

(Ref: RE3)

Interactive Video — Computer Products

Salary: £ Negotiable Based: Reading Plus: Car

An interesting position is offered which will involve carrying out regular quality control checks on pre-manufactured 'Interact' systems passing through our Reading distribution and service depot. The post will also involve service and update of display units returned from the field and the preparation of fault investigation reports. Formal qualifications in electronics would be an advantage.

A small amount of UK and overseas travel may also be required.

We offer an attractive remuneration package with competitive salaries and company profit sharing scheme. All replies will be dealt with in the strictest confidence.



Cameron

Write for an Application Form quoting the position reference number to: —
Mr J F Cowan
Personnel Department at
Company Head Office
C W Cameron Ltd
Communications Division
Burnfield Road
Glasgow G46 7TH
Tel: 041-633 0077

(2460)

TECHNICAL MANAGER

Laser Sporting Products Limited are looking for an Electronics Engineer based at their office in North Yorkshire. The company is about to launch a new product and package on to the Game Shooting scene.

The applicant should have a sound knowledge of electronic and sonic technology together with a flare for innovation. An interest in fire-arms and shooting would also be a great advantage.

Please send applications together with curriculum vitae to:

The Managing Director, Laser Sporting Products Ltd
Manor Farm House
Garriston
Leyburn
N. Yorkshire DL8 5JT

(2467)

TEST EQUIPMENT DESIGN ENGINEERS

Rediffusion Consumer Manufacturing design and manufacture a full range of advanced specification colour television receivers and monitors.

We are looking for experienced Electronic Design Engineers to help us maintain our industry lead in sophisticated computer controlled test gear for production testing of our products. Future test equipment will be an interesting mix of digital and analogue circuitry aimed at increasing the automation of the production testing operation.

If you are able to conceive, design and implement production test equipment with minimal supervision, we'd like to hear from you.

These positions are based in our Chessington Engineering Centre but some visits to our factories in the North East and Lancashire will be required at infrequent intervals. Salaries are obviously dependent on qualifications and experience, but will reflect the importance of future test gear projects to the Company's long term development.

Interested ? ... Then write or phone :

Harry Brearley,
Rediffusion Consumer Manufacturing Ltd.,
Fullers Way South,
Chessington, Surrey. KT9 1HJ.
Telephone: 01-397-5411.



REDIFFUSION

(2408)

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SOFTWARE ENGINEER — GROUND-FLOOR OPPORTUNITY

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Location:

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Tempo House, 30 Fairfield Street, London SW18 1DW
Telephone: 01-870 4504

(2453)

Appointments

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As world leaders in the supply of communications, navigation and entertainment equipment to the mercantile marine and offshore industry, we need additional professional men and women to help us meet the demand for our expanding product range.

SYSTEMS PLANNING/ PROJECT ENGINEER

Would you like to be technically involved with the planning of communication systems to meet specific marketing requirements? If so this position has good prospects with an ultimate objective to engineer and manage major projects. You should be aged 30 to 40, a good organiser, of graduate level or equivalent, with a sound knowledge of communication systems both in a practical and theoretical sense.

DEVELOPMENT ENGINEERS

Radio Communications

You will need to be a degree level/HNC or equivalent engineer with experience of radio communication development work, with particular regard to transmitters, modems, ancillary units, control and RF circuitry. Experience of digital and microprocessor work is highly desirable.

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A graduate with sound industrial experience, preferably including digital circuit design, is needed for the design of marine electronics equipment, initially radar. Your tasks would involve the detailed design of analogue and digital circuits over a wide range of speeds and power levels, together with associated software, overall systems design and equipment evaluation including sea trials.

The preferred age range for both these positions is 23-40.

We offer good working conditions, attractive salaries and other benefits usual within the thriving Marconi group of companies.

Please send full personal and career details, indicating which position interests you, to John Ellis, Marconi International Marine Company Limited, Elettra House, Westway, Chelmsford, Essex. Telephone: Chelmsford 261701.

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(2486)

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(1935)

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We offer an excellent benefits package including an attractive salary, Company car, free private medical cover and a Company Pension/Life Assurance Scheme.

If you are interested please write to, or telephone:

David Parry, Assistant Personnel Officer, Sony Broadcast Limited, City Wall House, Basing View, Basingstoke, Hants RG21 2LA. Tel: (0256) 55011

SONY
Broadcast



Sony Broadcast Ltd.

City Wall House
Basing View, Basingstoke
Hampshire RG21 2LA
United Kingdom
Telephone (0256) 550 11

(2469)

SENIOR ELECTRONICS DESIGN ENGINEER

THE JOB: Electronics and Instrumentation design for the rehabilitation and medical markets: signal processing, digital circuits, microprocessors, small servo systems.

THE REWARDS: An opportunity to be involved from conception to production in a company with a good working atmosphere. Salary £9,000-£12,500 depending on ability.

THE PERSON: Age: Preferably 26-40 years. Qualification: Degree or equivalent. Experience: At least three or four years of relevant design work needing a creative approach.

THE COMPANY: The post is in our Roehampton Research Department which is part of a company which has supplied rehabilitation services to the disabled for over 60 years.

Apply with full c.v. to:

Mr D. Hawkins
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(2472)

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Lansdowne Appointments Register,
Park House, 207-211 The Vale,
London W3 7QB.
Please send me a Lansdowne
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JOB TITLE _____

ADDRESS _____

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(1640)

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For further information contact:

Dr R. N. McBurney
MRC Neuroendocrinology Unit
Newcastle General Hospital
Westgate Road
Newcastle upon Tyne NE4 6BE
Telephone (0632) 735251

(2464)

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Application form and job description available from the Personnel Dept., Royal Free Hospital, Pond Street, Hampstead NW3 2QG. Quote ref. 0758

Closing date - 2nd March 1984

HAMPSTEAD HEALTH AUTHORITY (2459)

University of Leeds

An

Electronics Technician Grade 7

is required to take charge of the electronics workshop that jointly serves three departments. He/she would be assisted by a Grade 5 Technician already in post. The duties include the construction of new instruments for the research and teaching activities of the department, together with the maintenance of existing instruments. It is essential that the person appointed should be familiar with, and keep abreast of, the latest developments in electronic circuitry (including microprocessors) and that he should also be prepared to keep going older equipment. There is a very interesting wide spread of applications. Applicants should be qualified to at least HNC or equivalent level and have had a minimum of ten years' relevant experience. Salary is in the range £8,385 - £9,418pa.

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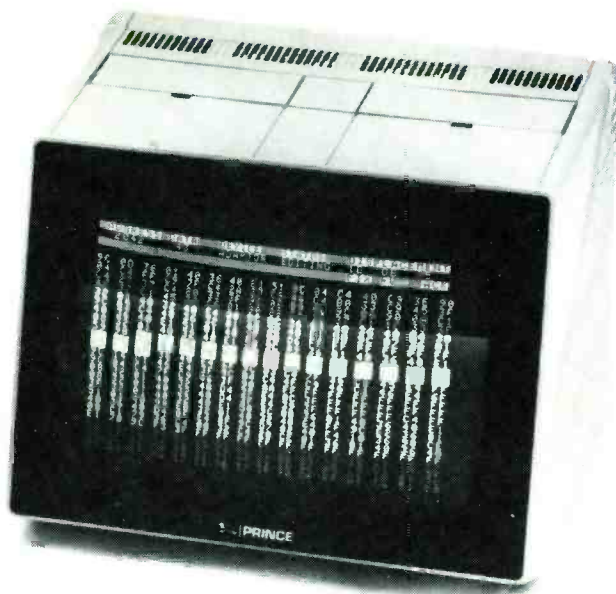
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