ELECTRONICS & Wireless world

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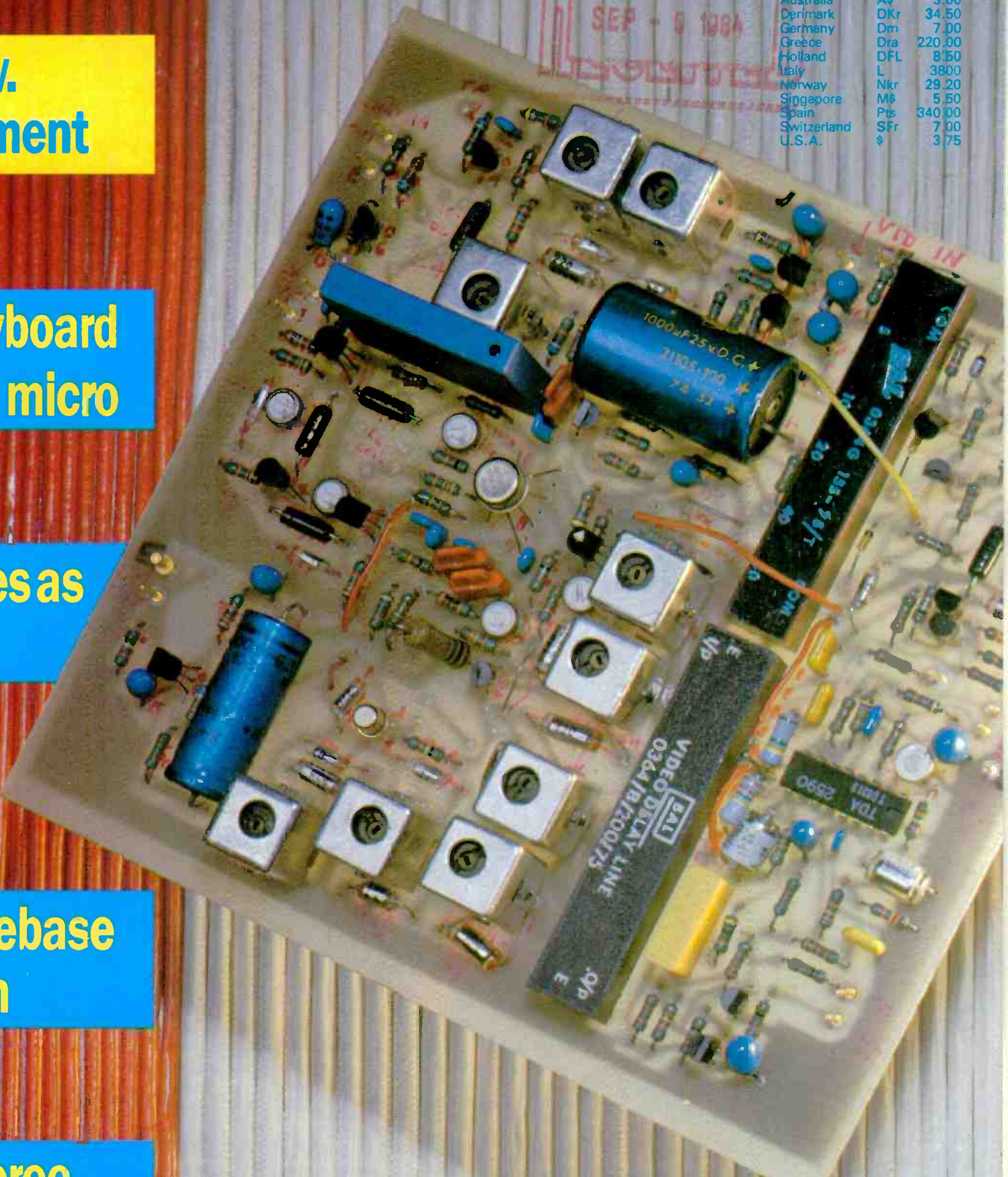
Colour t.v. enhancement

Music keyboard interface micro

Using trees as tv aerials

Video timebase correction

Digital stereo television sound



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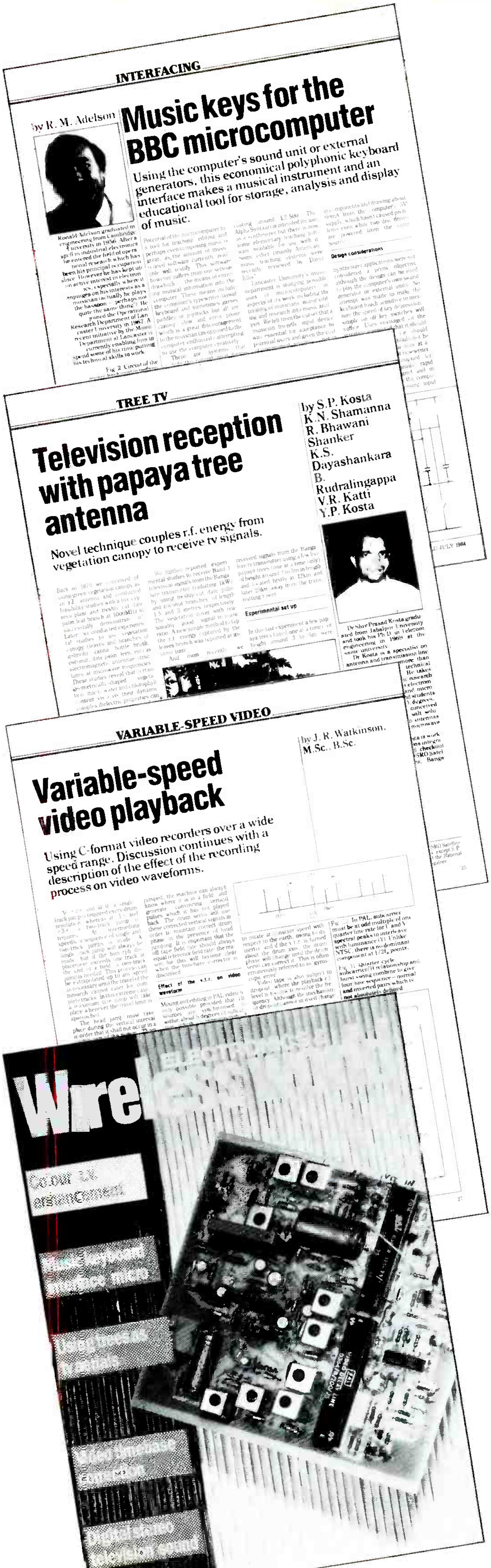
ELECTRONICS &
Wireless world
over 70 years in independent electronics publishing

July 1984 Volume 90 number 1582

FEATURES

REGULARS

This issue has been affected by the continuing dispute between members of the National Union of Journalists and Reed International. We apologise to readers and advertisers for its late appearance. The next issue of Electronics and Wireless World, cover dated August/September should be published on 15 August.



Front cover pictures David Read's PAL colour tv enhancement board, also pictured on page 37, comprising PAL modifier and comb filter decoder.

NEXT MONTH

Laboratory equipment for measurement in linear motion includes a computer-to-air interface. Detection of rider position enables RML computer to carry out experiments and display results.

In Stage Lighting System, forty 1 kilowatt circuits are remotely controlled with one cable linking desk and dimmers. A Z80 multiplexes data from the controls.

Dr Ken Smith of Kent University contributes a short series on power supply design, concentrating on the switched-mode variety. And John Adam's SC84 switch-regulated power supply is suitable for any application requiring an efficient, simple and economical power unit with either fixed or variable output. John also gives some SC84 construction tips.

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TORCH Z80 DISC PACK

The proven upgrade for the BBC Micro. Comprising 2 × 400K disc drive, Z80 processor with 64K of memory, and a CP/M compatible operating system, it opens up the vast range of CP/M software, including advance languages, scientific and business applications. The system is supplied with the PERFECT software range including PERFECT WRITER, PERFECT SPELLER, PERFECT CALC, and PERFECT FILE. Full TORCHNET software is also supplied allowing sophisticated networking between other units. This will allow access to information, and communication, between up to 254 suitably upgraded BBCs.

NEW TORCH Z80 PACK PRICE £699. SOFTWARE PACKAGE INCLUDES Z80 BASIC

Phone for details about the 20Mbyte Hard Disc Pack, and the 68000 Hard Disc Pack with UNIX Operating System.

NOW AVAILABLE — The TORCH Z80 SECOND PROCESSOR CARD — for those who already have suitable disc drives. The card is supplied with all th free perfect software and Z80 basic, as detailed above, presenting a very attractive package. £299.
Torch ZH0 240 Mbyte Hard Disc + 400K Flopy. £1995 (a)

ACORN IEEE INTERFACE

A full implementation of the IEEE-488 standard, providing computer control of compatible scientific & technical equipment, at a lower price than other systems. Typical applications are in experimental work in academic and industrial laboratories. The interface can support a network of up to 14 other compatible devices, and would typically link several items of test equipment allowing them to run with the optimum of efficiency. The IEEE Filing System ROM is supplied. **£282.**

BUZZ BOX A full spec pocket size direct connect modem with both Originate and Answer modes. this BT approved modem conforms to CCITT V21 300/300 Baud Standard. Battery/Mains powered plugs directly into telephone line. Modem Z69 head Z3:50 Ext PSU Z8:00

BOOKS

We have a large selection of books on the BBC and other titles. Please ask for details. No VAT on books.

'TIME-WARP' REAL-TIME-CLOCK/CALENDAR

A low cost unit that opens up the total range of Real-Time applications. With its full battery backup, possibilities include an Electronic Diary, continuous display of 'on-screen' time and date information automatic document dating, precise timing & control in scientific applications, recreational use in games etc — its uses are endless and are simply limited by one's imagination. Simply plugs into the user port — no specialist installation required — No ROMS. Supplied with extensive applications software. **Please phone for details. £29.00 + £2.50 carriage.**

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

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EPSON FX-80	£325.00a
EPSON RX-80 FT	£250.00a
EPSON FX-100	£480.00a
EPSON DX-100	£375.00a
Printer Sharer + Cable Set	£88.00c
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MCP40 Col. Printer/Plotter	£110.00a
Grafpad Graphics Tablet	£125.00c

ACCESSORIES

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Ribbon MX80/RX80/FX80	£6.50c

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Microvitec 1431 14" RGB Std Res	£179.00a
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Microvitec 1451 14" RGBB Med Res	£295.00a
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SANYO DM8112CX 12" Green Hi Res	£99.00a

CASSETTE RECORDERS

SANYO DR 101 Data Recorder	£30.00b
Datex Slim Line	£20.00c
BBC Tape Recorder	£28.50b
Cassette Lead	£3.00d
Computer Grade C-12 cassette	£0.45d
Computer Grade Cassette 10 off	£4.00c
Phillips Mini-data cassette	£3.00d

SOFTY II

This low cast intelligent eprom programmer can program 2716, 2516, 2532, 2732, and with an adaptor, 2564 and 2764. Displays 512 byte page on TV — has a serial and parallel I/O routines. Can be used as an emulator, cassette interface. Softy II £169 (b) Adaptor for 2764/2564 £25.00 (c).

SMARTMOUTH:

The original 'infinite speech'. Still the best.

A ready built totally self contained speech synthesiser unit, attractively packaged with built-in speaker, AUX output socket etc. — no installation problems! It allows the creation of any English word, with both ease and simplicity, while, at the same time being very economical in memory usage. You can easily add speech to most existing programs. Due to its remarkable infinite vocabulary, its uses spread throughout the whole spectrum of computer applications — these include industrial, commercial, educational, scientific, recreational etc. No specialist installation — no need to open your computer, simply plugs into the user port — and due to the simple software, no ROMS are needed. SMARTMOUTH is supplied with demo and development programs on cassette, and full software instruction. **£37 + £2.50 carriage.**

UV ERASERS

UV1T Eraser with 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.** For Industrial Users, we offer UV140 & UV141 erasers with handling capacity of 14 eproms. UV141 has a built-in timer. Both offer full built-in safety features UV140 **£61,** UV141 **£79, p&p £2.50.**

PRODUCTION PROGRAMMER:

P8000

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

EP 8000

This CPU controlled Emulator Programmer is a powerful tool for both Eprom programming and development work. EP 8000 can emulate and program all eproms up to 8K × 8 bytes, can be used as stand-alone unit for editing and duplicating EPROMS, as a slave programmer or as an eprom emulator **£695 (a).**

BBC EPROM PROGRAMMER:

A fully self-contained mains-powered eprom programmer housed in an attractive finished case. It is able to program 2716, 2732/32A, 2764 & 27128's in a single pass. It is supplied with vastly superior software when compared to any currently available similar programmer. In addition to normal eprom programming, you are now able to load your favourite basic programs onto eprom.

*** Menu Driven Software provides user friendly options for programming the eprom with:**
a) Basic programs
b) Ram resident programs.
c) Any other program.

***Programmer can read, blank-check, program & verify at any address/addresses on the Eprom.**
*** Personality selection is simplified by a single rotary switch.**
*** Programming voltage selector switch.**
*** Full Editor with ASCII Disassembler, allowing direct modification data in HEX or ASCII.**
*** Continuous display of time left for completion of programming.**
*** Continuous display of current addresses as they are being programmed.**

The programmer comes complete with cables, software & operating manual.
£89 + £2.50 carriage. Software on disc £2 extra.

CONNECTOR SYSTEMS

I.D. CONNECTORS

(Speedblock Type)

No of ways	Header Plug	Receptacle	Edge Conn.
10	90p	85p	120p
20	145p	125p	195p
26	175p	150p	240p
34	200p	160p	320p
40	220p	190p	340p
50	235p	200p	390p

JUMPER LEADS

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.
25-way Male **500p** Female **550p**

AMPHENOL CONNECTORS

	Solder	IDC
36-way plug Centronics	£5.25	£5.25
36-way socket Centronics	£5.50	£5.50
24-way plug IEEE	£5.00	£4.75
24-way socket IEEE	£5.00	£4.75

PCB Mtg Skt Ang pin
24-way **£6.00.** 36-way **£6.50**

RIBBON CABLE

(Grey/meter)

10-way	40p
16-way	60p
20-way	85p
26-way	120p
34-way	160p
40-way	180p
50-way	200p
64-way	280p

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**

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

EURO CONNECTORS

	Plug	Skt.
DIN 41617		
21-way	160p	165p
31-way	170p	170p
DIN 41612		
2×32-way St. Pin	230p	275p
2×32-way Ang. Pin	275p	320p
3×32-way St. Pin	260p	300p
3×32-way Ang. Pin	375p	400p
1 DC Skt	A + B 275p	A + C 350p

For 2 x 32-way please specify spacing (A + B, A + C)

EDGE CONNECTORS

	0.1"	0.156"
2x6-way (Commodore)	—	300p
2x10-way (Commodore)	150	—
2×12-way (Vic 20)	—	350p
2×18-way	—	140p
2×23-way (ZX81)	175p	220p
2×25-way	225p	220p
2×28-way (Spectrum)	200p	—
2x36-way	250p	—
1×43-way	260p	—
2x22-way	190p	—
2×43-way	395p	—
1×77-way	400p	500p
2x50-way (S100conn)	600p	—

TEXTOOL ZIF

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

DIL SWITCHES

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

DIL HEADERS

	Solder Type	IDC Type
14pin	40p	100p
16pin	50p	110p
24pin	100p	150p
28pin	200p	225p
40pin	200p	—

TEST CLIPS

14-pin **375p** 16-pin **400p** 40-pin **£10.30**

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7409 60p
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7412 50p
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7414 90p
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7417 POA200p
7420 60p
7421 100p
7422 60p
7423 60p
7425 75p
7426 60p
7427 60p
7428 60p
7430 60p
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7433 60p
7437 60p
7438 100p
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7440 60p
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7480 80p
7481 220p
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7484A 250p
7485 120p
7486 70p
7489 300p
7490A 75p
7491 70p
7492A 90p
7493A 75p
7494 150p
7495A 90p
7496 100p
7497 250p
74100 220p
74107 75p
74109 75p
74110 90p
74111 55p
74116 220p
74118 200p
74119 300p
74120 180p
74121 90p
74122 100p
74123 150p
74125 100p
74126 100p
74128 120p
74132 100p
74136 90p
74141 180p
74142 450p
74143 480p
74144 480p
74145 140p
74147 225p
74148 180p
74150 225p
74151A 100p
74153 100p
74154 250p
74155 100p
74156 110p
74157 110p
74159 320p
74160 120p
74161 75p
74162 90p
74163 90p
74164 90p
74165 100p
74166 120p
74167 400p
74170 250p
74172 750p
74173 180p
74174 120p
74175 120p
74176 150p
74177 150p
74178 250p
74179 250p
74180 150p
74181 380p
74182 200p
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74185A 300p
74190 140p
74191 140p
74192 140p
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74195 100p
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74198 250p
74199 250p
74221 150p
74251 150p
74259 250p
74265 100p
74273 270p
74276 350p
74278 370p
74279 150p
74283 170p
74285 350p
74290 140p
74293 140p
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74LS15 60p
74LS20 60p
74LS21 60p
74LS22 70p
74LS26 70p
74LS27 70p
74LS28 70p
74LS30 60p
74LS32 POA100p
74LS33 60p
74LS37 60p
74LS38 100p
74LS40 60p
74LS42 100p
74LS47 140p
74LS48 140p
74LS51 60p
74LS54 60p
74LS55 60p
74LS73A 75p
74LS74A 100p
74LS75 90p
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74LS83A 120p
74LS85 150p
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74LS91 110p
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74LS93 90p
74LS95B 100p
74LS96 160p
74LS107 75p
74LS109 75p
74LS112 90p
74LS113 75p
74LS114 75p
74LS122 100p
74LS123 200p
74LS124/629 300p
74LS125 90p
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74LS133 90p
74LS136 75p
74LS138 120p
74LS139 120p
74LS145 150p
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74LS148 220p
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74LS153 100p
74LS154 300p
74LS155 140p
74LS156 125p
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74LS197 130p
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74LS240 250p
74LS241 250p
74LS242 140p
74LS243 140p
74LS244 300p
74LS245 350p
74LS247 120p
74LS248 120p
74LS249 120p
74LS251 100p
74LS253 100p
74LS256 200p
74LS257A 120p
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74LS259 200p
74LS260 90p
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74LS273 240p
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74LS279 120p
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74LS290 110p
74LS292 900p
74LS293 120p
74LS295 140p
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74LS356 220p
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74LS364 180p
74LS365 100p
74LS366 100p
74LS367 100p
74LS368 100p
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74LS374 POA300p
74LS375 100p
74LS377 180p
74LS378 150p
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74LS390 140p
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74S112 150p
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4025 30p
4026 100p
4027 50p
4028 60p
4029 90p
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4039 250p
4040 80p
4041 60p
4042 75p
4043 75p
4044 75p
4046 90p
4047 85p
4048 60p
4049 48p
4050 48p
4051 80p
4052 80p
4053 80p
4054 90p
4055 90p
4056 100p
4059 450p
4060 90p
4063 90p
4066 45p
4067 290p
4068 30p
4069 30p
4070 30p
4071 30p
4072 30p
4073 30p
4075 30p
4076 90p
4077 30p
4078 30p
4081 30p
4082 30p
4085 60p
4086 70p
4089 125p
4093 48p
4094 100p
4095 90p
4096 90p
4097 290p
4098 90p
4099 90p
4501 40p
4502 60p
4503 60p
4504 90p
4505 400p
4506 120p
4507 45p
4508 160p
4510 75p
4511 75p
4512 75p
4513 140p
4514 130p
4515 130p
4516 75p
4517 200p
4518 75p
4519 75p
4520 75p
4521 125p
4522 90p
4526 90p
4527 90p
4528 75p
4529 90p
4531 75p
4532 80p
4534 400p
4536 220p
4538 90p
4539 90p
4541 90p
4543 100p
4551 250p
4553 220p
4555 60p
4556 70p
4557 250p
4560 120p
4566 200p
4568 300p
4569 200p
4572 50p
4583 75p
4584 48p
4585 65p
4724 150p
14411 900p
14412 850p
14416 300p
14419 300p
14490 550p
14495 450p
14500 700p
14599 350p
22100 350p
22101 700p
22102 700p
40014 48p
40085 90p
40097 60p
40098 60p
40100 120p
40101 120p
40102 140p
40103 170p
40104 120p

COUNTERS

74C925 £4
74C926 £5
74C928 £6
72168 £22
ZN1040 670p

LINEAR ICs

AD7581 £15
ADC0808 1190p
AN103 200p
AY1-5050 99p
AY3-1270 750p
AY3-1350 350p
AY3-8910 400p
AY3-8912 500p
CA3019A 100p
CA3028A 150p
CA3046 70p
CA3059 350p
CA3060 350p
CA3080E 80p
CA3086 60p
CA3089E 250p
CA3090AQ 375p
CA3130E 90p
CA3130T 110p
CA3140E 60p
CA3140T 110p
CA3160E 100p
CA3161E 150p
CA3162E 450p
CA3189E 300p
CA3240E 120p
CA3280G 225p
D7002 600p
DAC0800 200p
DAC0808 200p
DG308 300p
HA1366 190p
HA1388 250p
ICL7106 700p
ICL7611 95p
ICL7650 400p
ICL7660 250p
ICL8038 300p
ICM7216B 2400p
ICM7217 300p
ICM7555 100p
ICM7556 140p
LC7120 300p
LC7130 325p
LC7137 350p
LF347 150p
LF351 60p
LF353 100p
LF355 100p
LF356F 100p
LF357 130p
LF13331 350p
LM10C 325p
LM301A 25p
LM307 45p
LM308CN 75p
LM310 120p
LM311 70p
LM318 150p
LM319 160p
LM324 50p
LM334Z 90p
LM335Z 140p
LM339 40p
LM348 65p
LM358P 60p
LM377 225p
LM380 75p
LM381AN 180p
LM382 180p
LM386 90p
LM387 120p
LM389 180p
LM391 180p
LM392N 60p
LM393 100p
LM394CH 350p
LM709 50p
LM710 50p
LM711 70p
LM725C 300p
LM733 75p
LM741 20p
LM747 70p
LM748 40p
LM1011 480p
LM1014 150p
LM1801 300p
LM1830 250p
LM1871 300p
LM1872 300p
LM1886 500p
LM1889 350p
LM2917 250p
LM3302 75p
LM3900 50p
LM3909 120p
LM3911 160p
LM3914 350p
LM3915 350p
LM3916 350p
LM13600 110p
M51513L 230p
M51516L 500p
MB3712 200p
MB3730 400p
MC1310P 150p
MC1413 130p
MC1458 40p
MC1493 100p
MC1495L 350p
MC1496 70p
MC3340P 200p
MC3401 50p
MC3403 65p
MF10CN 360p
MK50240 900p
MK50398 790p
ML920 500p
MM6221A 300p
NE531 150p
NE544 190p
NE555 22p
NE556 50p
NE564 400p
NE565 150p
NE566 150p
NE567 140p
NE570 400p
NE571 400p
NE592 75p
NE5532P 200p
NE5533 160p
NE5534P 120p
NE5534AP 200p
PLL02A 500p
RC4136 60p
S566B 300p
SAA1900 £16
SAD1024A 1150p
SFF96364 800p
SN76477 600p
SN76489 400p
SN76495 400p
SP0256AL2 800p
TA7120 150p
TA7130 160p
TA7204 150p
TA7205 90p
TA7222 150p
TA7310 150p
TBA231 120p
TBA800 80p
TBA810 100p
TBA820 80p
TBA950 225p
TC9109 500p
TCA210 350p
TCA220 350p
TCA270 350p
TCA940 175p
TDA1004A 500p
TDA1010 250p
TDA1022 500p
TDA1024 120p
TDA1170 300p
TDA2002 325p
TDA2003 325p
TDA2004 300p
TDA2006 350p
TDA2020 320p
TDA2030 250p
TDA2541 400p
TDA3560 990p
TDA7000 350p
TL061CP 50p
TL062 75p
TL064 110p
TL071 45p
TL072 60p
TL074 110p
TL081 45p
TL082 55p
TL083 75p
TL084 100p
TL094 200p
TL170 50p
TL430C 120p
UA1003-3 935p
UA2240 120p
UAA170 200p
UCN4801A 350p
ULN2001A 130p
ULN2002A 130p
ULN2003A 130p
ULN2004A 130p
ULN2068 350p
ULN2802 250p
ULN2803 250p
ULN2804 250p
UPC575 275p
UPC592H 200p
UPC1156H £3
UPC1185H 350p
XR210 400p
XR2206 400p
XR2211 575p
XR2240 120p
ZN414 80p
ZN419C 190p
ZN423E 130p
ZN424E 130p
ZN425E 350p
ZN426E 300p
ZN427E 600p
ZN428E 450p
ZN429E 210p
ZN450E 750p
ZN459CP 300p
ZN1034E 200p
ZN1040E 200p
ZNA134J £23
ZNA234E 950p

VOLTAGE REGULATORS

FIXED PLASTIC

	-ve		+ve	
1A				
5V	7805	50p	7905	45p
6V	7806	60p	7906	45p
8V	7808	60p	7908	50p
12V	7812	50p	7912	45p
15V	7815	50p	7915	45p
18V	7818	60p	7918	50p
24V	7824	60p	7924	45p
5V 100mA	78L05	30p	79L05	45p
6V 100mA	78L06	30p		
8V 100mA	78L08	30p		
12V 100mA	78L12	30p	79L12	50p
15V 100mA	78L15	30p	79L15	50p

OTHER REGULATORS

LM309K 1A 5V 140p
LM317K T03 250p
LM317T 150p
LM337T 225p
LM323K 3A 5V 450p
LM3501 350p
LM723N 50p
TL494 300p
TL497 300p
78S40 250p
78P05 900p
78H12 850p
78HGKC 600p
78HO5KC 650p
78GUIC 225p
79GUIC 250p
79HGKC 700p
ICL 7660 250p
LM305AH 250p
SG3524 300p

OPTO-ELECTRONICS

2N5777 43p
OCP71 180p
ORP12 120p
ORP60 120p
ORP61 120p
TIL32 55p
TIL78 55p
TIL31A 120p
TIL81 120p
TIL100 75p

OPTO ISOLATORS

ILD74 130p
MCT26 100p
MCS2400 190p
MOC3020 150p
ILQ74 180p
TIL111 70p
TIL112 70p
TIL113 70p
TIL116 70p
6N137 400p

LEDS

0.125
TIL209 Red 10p
TIL211 Gr 12p
TIL212 Yel 15p
0.2
TIL220 Red 10p
TIL222 Gr 12p
TIL228 Yel 15p
Rectangular LEDs (R,G,Y) 30p
FND357 120p
MAN72 140p
MAN74 140p
MAN4640 200p
MAN8910 250p
TIC729 140p
TIC730 140p
NSB5881 570p
TIL311 600p
TIL321/3 130p
TIL330 140p
7750/60 200p
Bargraph 225p

DISPLAYS

DL704 140p
DL707 Red 140p

COMPUTER COMPONENTS

CPUs

1802CE 650p
2650A £12
6502 400p
6502A 650p
6800 290p
6802 300p
6809 650p
68B09 £12
6809E £12
68B09E £16
6800L8 £48
8035 550p
8039 550p
8080A 350p
8085A 1800p
8086 £22
8088 2200p
8748 3600p
TMS1601 £12
TMS9980 1200p
TMS9995 £12
WD55 1450p
Z8 £24
Z80 300p
Z80A 400p
Z80B 950p
8288 £11
8755A 1800p
9901 £3
9902 £3
TMS9901 350p
TMS9902 350p
Z80P10 300p
Z80AP10 350p
Z80CTC 300p
Z80ACTC 350p
Z80ADART 850p
Z80ADMA £10
Z80SI 0/1/2 £9

SUPPORT DEVICES

2651 £12
3242 800p
3245 450p
6520 300p
6522 350p
6522A 550p
6532 650p
6551 650p
6821 200p
68B21 250p
6829 £12.50
6840 375p
68B40 600p
6850 200p
68B50 250p
6852 250p
6854 850p
68B54 1200p
6875 750p
8154 950p
8155 1100p
8156 750p
8205 225p
8212 300p
8216 200p
8224 200p
8226 250p
8228 250p
8243 400p
8250 1400p
8251A 1800p
8253C-5 1800p
8255AC-5 1900p
8256 £36
8257C-5 750p
8259C-5 750p
8279 750p
8284 600p

MEMORIES

2102 250p
2107B 500p
2111A-35 400p
2114-2L 500p
2114-4L 400p
2147 450p
4027-3 300p
4116-15 200p
4116-20 150p
4118-3 500p
4164-2 450p
4164-15 500p
4416-15 500p
4532-20 250p
4816AP-3 475p
5101/5501 450p
5516 1000p
6116P-3 850p
6116LP-3 950p
6264-15 3500p
6514-45 650p
6810 180p
74S189 225p
74S201 350p
74S289 225p
93415 600p
93425 600p
93L422 950p
X2210 TBA

ROMs/PROMs

74S188 180p
74S287 200p
74S288 180p
74S387 225p
74S473 475p

EPROMs

2532 450p
2532-30 700p
2564 700p
2708 400p
2716 350p
2732 450p
2732A-2 900p
2732A-35 550p
2764-25 900p
27128-25 2500p
27128-30 2200p

CRT CONTROLLER

CRT6545 900p
CRT5027 £18
CRT5037 £18
EF9365 £36
EF9366 £36
MC6845 650p
MC6845SP 750p
MC6847 650p
P8275 £27
SFF96364 £8
TMS9918 300p
TMS9927 £18
TMS9928 £20
TMS9929 £16

INTERFACE ICs

AD558CJ 775p
AD561J £20
AM25S10 350p
AM25LS2521 350p
AM26LS31 160p
AM26LS32 160p
D7002 600p
DAC80 £28
DM8131 325p
DP8304 300p
DS3691 350p
DS8830 140p
DS8831 150p
DS8832 150p
DS8833 225p
DS8836 150p
DS8838 225p
DS8880 170p
LF13201 450p
MC1488 100p
MC1489 100p
MC3418 950p
MC3446 250p
MC3459 450p
MC3470 650p
MC3480 850p
MC3486 500p
MC3487 300p
MC4024 325p
MC4044 325p
MC14412 750p
75107 90p
75110/12 160p
75114/15 160p
75121/22 140p
75150P 120p
75154 140p
75159 220p
75365 150p
75451/2 72p
75453/4 72p
75491/2 65p
8T26 120p
8T28 120p
8T95/6 90p
8T97/8 90p
81LS95 220p
81LS96 220p
81LS97 220p
81LS98 220p
88LS120 400p
9602 220p
9637AP 160p
ZN425E-8 350p
ZN426E-8 350p
ZN427E 600p
ZN428E-8 450p

DISC CONTROL ICs

8271 £45
8272 £20
FD1771 £20
FD1791 £22
FD1793 £23
FD1795 £28
FD1797 £28
TMS9909 £12
WD2793 4200p
WD2797 4200p
WD1691 1500p
WD2143 800p

CHARACTER GENERATORS

RO3-2513
U.C. 750p
L.C. 700p
DM86S64 £12
MC66760 750p

KEYBOARD ENCODER

AY 5 2376 1150p
74C922 480p
74C923N 500p

BAUD RATE GENERATORS

MC14411 900p
COM8116 800p
4702B 750p

UARTs

AY-3-1015P 300p
AY-5-1013P 300p
COM8017 300p
IM6402 360p
TR1602 300p

ZIF SKTS

(TEXTOOL)
24 pin 575p
28 pin 800p
40 pin 975p

MODULATORS

6MHz UHF 375p
8MHz UHF 450p

CRYSTALS

32.768KHz 100p
100KHZ 400p
200KHZ 400p
Freq in MHz
1.0 325p
1.8432 300p
2.00 250p
2.45760(L) 210p
2.45760(S) 275p
2.5 250p
2.662 250p
3.276 150p
3.5795 120p
4.0 150p
4.194 200p
4.43 125p
4.608 250p
4.9152 250p
5.0 175p
6.0 150p
6.144 175p
7.0 150p
7.168 175p
8.0 175p
8.867 175p
10.0 175p
10.50 250p
10.70 200p
11.0 300p
12.0 150p
14.0 175p
14.318 175p
14.756 250p
15.0 200p
16.0 200p
18.0 200p
18.432 150p
19.969 150p
20.0 450p
24.0 300p
48.0 175p
116 300p
PX0 1000 1200p

REAL TIME CLOCK

MC6818P 550p
MM58174AN 800p
MSM5832RS 350p

TELETEXT DECODER

SAA5020 600p
SAA5030 700p
SAA5041 £16
SAA5050 900p

LOW PROFILE SOCKETS BY TI

8 pin	9p	18 pin	16p	24 pin	24p
14 pin	10p	20 pin	18p	28 pin	26p
16 pin	11p	22 pin	22p	40 pin	30p

WIRE WRAP SOCKETS BY TI

8 pin	30p	18 pin	50p	24 pin	75p
14 pin	42p	20 pin	66p	28 pin	100p
16 pin	45p	22 pin	75p	40 pin	130p

TRANSISTORS

AD161/2 45p
BC107/8 18p
BC109C 20p
BC169C 16p
BC172 18p
BC177/8 30p
BC179 30p
BC182/3 15p
BC184 16p
BC187 30p
BC212/3 16p
BC214 18p
BC237 16p
BC327 16p
BC337 16p
BC338 16p
BC461 40p
BC477/8 36p
BC516/7 50p
BC548C 12p
BC549C 16p
BC557B 14p
BC559C 24p
BCY70 30p
BCY71 36p
BD131 75p
BD132 80p
BD135/6 40p
BD139 40p
BD140 40p
BD189 60p
BD232 60p
BD233 75p
BD235 85p
BD241 60p
BD242 60p
BD379 60p
BD380 60p
BD677 40p
BF244B 40p
BF256B 50p
BF257/8 40p
BF337 30p
BFR39 32p
BFR40/1 32p
BFR79 32p
BFR80/1 32p
BFR96 180p
BFX29 45p
BFX30 45p
BFX84/5 30p
BFX86/7 30p
BFX88 40p
BFX89 180p
BFY50 30p
BFY51/2 40p
BFY56 33p
BFY90 90p
BRY39 45p
BSX19/20 30p
BU104 225p
BU105 190p
BU108 250p
BU109 225p
BU126 150p
BU180A 120p
BU205 200p
BU208 200p
BU406 145p
BUX80 600p
BUY69C 350p
E310 50p
MJ413 250p
MJ802 400p
MJ2501 225p
MJ2955 90p
MJ3001 225p
MJ4502 400p
MJE340 60p
MJE2955 150p
MJE3055 120p
MPF102 40p
MPF103/4 40p
MPF105 40p
MPSA06 30p
MPSA12 50p
MPSA13 50p
MPSA20 50p
MPSA42 50p
MPSA43 50p
MPSA56 30p
MPSA70 50p
MPSA93 40p
MPSU06 63p
MPSU07 60p
MPSU45 90p
MPSU65 78p
TIP29A 35p
TIP29C 40p
TIP30A 35p
TIP30C 40p
TIP31A 40p
TIP31C 45p
TIP32A 45p
TIP32C 40p
TIP33A 70p
TIP33C 80p
TIP34A 90p
TIP34C 120p
TIP35A 120p
TIP35C 140p
TIP36A 140p
TIP36C 150p
TIP41A 50p
TIP41C 55p
TIP42A 60p
TIP42C 65p
TIP54 160p
TIP55 180p
TIP120 75p
TIP121 75p
TIP122 80p
TIP125 75p
TIP126 80p
TIP142 120p
TIP147 120p
TIP2955 90p
TIP3055 70p
TIS93 30p
VN10KM 50p
VN66AF 90p
VN88AF 100p
ZTX108 16p
ZTX300 18p
ZTX452 45p
ZTX500 20p
ZTX502 20p
ZTX504 22p
ZTX552 55p
ZTX652 60p
ZTX752 70p
2N697 35p
2N698 45p
2N706A 36p
2N708 36p
2N918 45p
2N930 30p
2N1131/2 50p
2N1613 36p
2N1711 36p
2N2102 70p
2N2160 350p
2N2219A 30p
2N2222A 30p
2N2369A 30p
2N2484 30p
2N2645 50p
2N2904/5 30p
2N2906A 30p
2N2907A 30p
2N2926 12p
2N3053 40p
2N3054 60p
2N3055 55p
2N3442 140p
2N3553 240p
2N3584 250p
2N3643/4 48p
2N3702/3 16p
2N3704/5 16p
2N3706/7 16p
2N3708 16p
2N3773 200p
2N3819 45p
2N3823 30p
2N3866 120p
2N3902 700p
2N3904 22p
2N3905 22p
2N3906 24p
2N4036 65p
2N4037 65p
2N4123/4 27p
2N4125/6 27p
2N4401/3 25p
2N4427 120p
2N4871 50p
2N5087 30p
2N5089 30p
2N5172 27p
2N5191 90p
2N5245 40p
2N5401 60p
2N5459 30p
2N5460 36p
2N5485 36p
2N5875 250p
2N5883 375p
2N6027 30p
2N6052 300p
2N6059 325p
2N6107 65p
2N6247 190p
22N6254 130p
2N6290 65p
2SC1306 100p
2SC1307 150p
2SC1957 90p
2SC1969 150p
2SC2028 80p
2SC2029 200p
2SC2076 160p
2SC2335 200p
2SC2612 200p
3N128 200p
3N140 200p
3N141 200p
3N201 200p
3N204 200p
40290 250p

DIODES

BY127 12p
BYX36300 20p
OA47 10p
OA90/91 9p
OA95 9p
OA200 9p
OA202 10p
1N914 4p
1N916 7p
1N4148 4p
1N4001/2 5p
1N4003/4 6p
1N4005 6p
1N4006/7 7p
1N5401/2 12p
1N5403/4 14p
1N5404/5 14p
1N5406/7 19p
IS920 9p

BRIDGE RECTIFIERS

1A 50V 19p
1A 100V 20p
1A 400V 25p
1A 600V 30p
2A 50V 30p
2A 100V 35p
2A 400V 45p
3A 200V 60p
3A 600V 72p
4A 100V 95p
4A 400V 100p
6A 50V 80p
6A 100V 100p
6A 400V 120p
10A 400V 200p
25A 400V 400p

DIL SWITCHES

4-way 90p
8-way 120p
6-way 105p
10-way 150p

TURNED PIN LOW PROFILE SOCKETS

8 pin 25p
14 pin 40p
16 pin 45p
18 pin 50p
20 pin 56p
24 pin 75p
28 pin 90p
40 pin 120p

TRIACS PLASTIC

3A 400V 60p
6A 400V 70p
6A 500V 88p
8A 400V 75p
8A 500V 95p
12A 400V 85p
12A 500V 105p
16A 400V 110p
16A 500V 130p
T2800D 130p
TIC 206D 60p
TIC 226D 75p
TIC 246D 110p

THYRISTORS

3A 400V 45p
8A 600V 180p
12A 400V 160p
16A 100V 180p
16A 400V 220p
C106D 45p
MCR101 36p
2N3525 130p
2N4444 180p
2N5060 30p
2N5061 32p
2N5064 35p

ZENERS

2.7V-33V
400mW 9p
1W 15p

WW-5

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Hyperthermia progress

Much attention in recent years has been focused on radiation hazards very close to high-power radio transmitters. Less notice has been taken of the advances being made in the medical use of r.f. heating by h.f., v.h.f. and microwave transmitters, particularly for hyperthermia treatment of malignant cancer tumours. Although hospitals have used heating by r.f. power (diathermy) for about 50 years, recent work has concentrated on the development of more effective coupling of the r.f. power into the affected part of the body by means of improved 'applicators'.

A recent report from the Biomedical Engineering and Instrumentation Branch of the American National Institutes of Health in Bethesda, Maryland, notes that while hyperthermia offers promise as an adjuvant to cancer therapy, so far little success has been achieved in heating deep-seated tumours. A new design of helical coil applicator has been developed which in tests under simulated conditions of the fat-muscle-bone of a human arm or thigh appears to be both practically and theoretically capable of producing deep heating (*IEEE Trans* 1984 vol.BME-31, pp.98-106, and *Electronics Letters*, 1984, vol.20, April 12, pp.337-8). Hyperthermia uses r.f. power to raise the temperature of tumours to around 43-45°C instead of the normal body temperature of about 37°C. It has been known for over a century that some malignant tumours respond to localized but small elevation of temperature. The difficulty has been to heat the affected organ without overheating other parts of the body. The Bethesda work has used the industrial, scientific and medical frequencies of 13.56, 27.12 and 40.69MHz. Other workers have concentrated on microwave hyperthermia on 2450 and 915MHz despite its limited depth of penetration of roughly 1cm for loads of high water content, such as muscle, brain and organs. Design of applicators that can improve the heating of tumours deep within layers of fat or bone, with minimum absorption of energy elsewhere has proved difficult and the Bethesda work on helical coil applicators appears to be in the nature of a breakthrough.

A number of British hospitals are involved in hyperthermia experiments, some making use of obsolete 405-line v.h.f. television transmitters which can be modified for this type of work. IBA have already donated several Band III equipments to hospitals in Aberdeen, Bristol and Cambridge and have earmarked further equipments for this purpose when Band III television is finally phased out in January 1985.

Telecommunications Act

The Telecommunications Act, 1984 received Royal Assent on 12 April, 1984 and Part VI – provisions relating to wireless telegraphy, incuding amendment and enforcement of the Wireless Telegraphy Acts—will shortly become law. The new Act appears to provide the DTI with the means of stamping out unauthorized and illegal use of transmitters of all types, provided always that sufficient effort is put into tracing them.

Manufacturing, selling, offering for sale or hire of 'restricted' apparatus becomes for the first time an offence. Having 'without reasonable excuse' such equipment in one's custody or control, or importing it, will also be an offence. Manufacturing includes assembly of component parts.

Immediate seizure of equipment under a search warrant becomes possible; if there is any doubt as to identity or address not even a warrant is necessary. Where such seizure is later confirmed by the Court, the Secretary of State can, as at present, dispose of it as he thinks fit.

The Act also makes provision for payment of the radio Interference Service from money provided by Parliament and operational responsibility for this service will be transferred from British Telecom to DTI.

The Act abolishes the advisory committee of the 1949 Act and strengthens the powers of the licensing authority in a number of ways including the ability at any time to revoke or vary the terms of any broadcasting or communications licence 'in the interests of national security or relations with the government of a country or territory outside the UK'.

Sending of false or misleading messages becomes an indictable offence. DTI have the right to prescribe technical requirements for services.

It remains to be seen how strictly the Courts will interpret the amended Wireless Telegraphy Acts and the effort that will be put into enforcing them. On the face of it it would seem to be an instrument capable of quickly putting off-air the broadcasting 'pirates' and the more numerous pseudo-amateurs such as the 'International C.B.' around 6.6MHz. Less easy to suppress will be the unlicensed 'amateurs' and 'c.b.' operators who may still find it possible to pass unnoticed for a time by operating in accordance with the licences they have omitted to obtain.

It seems likely that concessions will be made soon to small-time broadcasters by the introduction of some form of 'community radio' or 'special event' radio licence involving for example low-power transmitters at major outdoor and sports events. This may however be deferred until the end of the second session of the ITU Regional Administrative Conference at Geneva next October to December, when frequency assignments between 100-108MHz are expected to be agreed for the European region.

Vienna Convention

The events during April surrounding the 'siege' of the Libyan People's Bureau were calculated to re-inforce the very worst fears of signals intelligence people. The American ABS network started the ball rolling by claiming that Libyan messages to London had been intercepted, deciphered but then not passed on to the police in time for them to take greater precautions during the morning of April 17. Such a 'leak' apparently from American sources, if true, must rank alongside the three classic occasions in the 1920s when it was openly revealed in the British Parliament that Russian diplomatic traffic was being read. This led inevitably to the USSR introducing secure ciphers and the loss of a valuable source of information. As a result British Intelligence became very wary of passing sigint even to the Cabinet.

Today diplomatic traffic can be unconditionally secure (truly random :one-time' keys) or more often-'computationally secure' requiring excessive computer time to crack. Clearly some of what can be plucked form the air can still be read, if only with difficulty, or signals intelligence would not have retained its importance. But the idea that almost all diplomatic traffic can be read immediately on receipt can serve only to encourage the Libyans (who *know* whether they sent such a message) and other countries to change to more secure ciphers.

The leak furthermore served no useful purpose. WPC Fletcher was already dead. If NSA or GCHQ are able to decipher such messages virtually without dealy, it may indeed have been blame-worthy that a warning did not reach the Metropolitan Police before the shooting. But finding a scapegoat is a doubtful advantage if in the process a source is blown.

Diplomatic radio communications form one of the fixed services not entirely transferred to satellite. A stroll though Belgravia or other embassy districts of London reveals many h.f. aerials ranging from very large log-periodics to the barely visible compact transmitting loop aerial on the roof of the US embassy in Grosvenor Square. Diplomatic communicatons remain an important market for h.f. equipment.

Foreign embassies, however, do not have an automatic right to set up radio links. Paragraph 1 of Article 27 of the Vienna Convention on Diplomatic Relations, 1961 reads: 'The receiving state shall permit and protect free communication on the part of the mission for all official purposes. In communicating with the Government and the other missions and consulates of the sending State, wherever situated, the mission may employ all appropriate means, including diplomatic couriers and messages in code or cipher. However the mission may install and use a wireless transmitter only with the consent of the receiving State.'

CCD camera

At NAB, RCA introduced a solid-state portable broadcast camera based on charged-coupled device sensors and a 'frame transfer' process. Priced $37,000 the camera is claimed to provide a signal/noise ratio of 62dB with high sensitivity and absence of smear on moving objects. C.c.d. cameras have been under development for at least ten years, but many difficulties have had to be overcome for broadcast-quality units, and studio cameras may still be some way off. Largest exhibit at NAB was mounted by Sony Corporation at a cost of over $1-million. They featured their ½-in Betacam integrated camera/recorder and a complete high-definition system....NBC have begun distributing network programmes to 22 affiliate stations via satellite and plan to increase this to 150 stations by early 1985... About 17-million US homes (19% of tv homes) now have v.c.r. machines, still significantly below UK penetration.

Amateur Radio

Moonbounced TV?

Andrew Emmerson, G8PTH, has passed along news from Maurice Clot, F1FVX, of what promises to be a remarkable and unique experiment aimed at gaining a 'world first' in amateur television. French amateurs are to attempt moonbounce of television signals transmitted on 1255MHz using an aerial with a calculated gain of the order of 90dB!

To make this possible, the French electricity authorities have granted permission for F9CH and F6BGR to use the 10,000 square-meter plane metal reflectors of the French experimental solar oven near Fontromue, East Pyrenees as an aerial, with a dipole element replacing the normal crucible and with the computer programmed to follow the moon instead of the sun.

It is planned to use frequency-modulated vision signals with a transmitter power of 140 watts during tests between July 9 and July 13 when the moon will be low enough on the horizon (20 to 24° at the meridian) to allow receiving stations to aim their aerials without the need for an elevation rotor. Further information on these experiments is to be distributed through French stations on 144.170MHz ± 10kHz and 3670 ± 10kHz.

Here and there

The Australian society, WIA, has succeeded in persuading their Government to re-establish the special low import tariff (2%) on amateur transmitters and transceivers. This concession was lost in June 1983 when an Australian manufacturer of marine communications equipment complained that some imported amateur radio equipment had been modified and illegally sold for use in the maritime service. The low import tariff was granted on the basis that there is no Australian production of amateur h.f. transceivers.

The Olympic Games torch run that starts on the East Coast of the USA and will pass through all the 48 contiguous States before it ends at the Los Angeles venue on July 28 is being co-ordinated by amateur radio communicators travelling in the fleet of support vehicles, under the aegis of AT&T.

Several Australian amateurs have been granted experimental permits permitting transmission on 196kHz (1830 meters) on condition that only 'backyard' aerials are used. With output powers of about 100 watts and fairly short aerials about 10m high, resulting in effective radiated powers of less than 0.5-watt, telegraphy contacts are being made over distances of several hundred miles.

A successful meeting of Dutch amateurs interested in narrow-band mechanical television was held last March in Eindhoven, attracting 50 to 60 visitors. Historic 30-line equipment was displayed by Kees Sanders, PAoDXY. A camera monitor by P. Wakker was made from small lenses taken from a broken road sign and driven by a bicyle dynamo. Several British NBTV enthusiasts have been using silicon solar cells as pick-up devices for low-definition systems. A 96-mile mechanical system being developed by J.A. Short uses the old Baird techniques of obtaining sync signals by blanking off part of the picture (i.e. no blacker-than-black pulses) but uses a much more sophisticated form of sync-separator discriminator. Apparently it works, which is more than could always be said of the Baird phonic-wheel technique!

Wayne Green, W2NSD, editor of *73 Magazine*, in a petition for rule-making submitted to the FCC has proposed that all American radio amateurs should be re-examined for morse proficiency every two years with a requirement that they achieve a five word-per-minute up-grading each time, to a final level of 35 word/min. Failure to improve speed, he suggests, should result in loss of licence. However it seems highly unlikely that FCC will impose such a rule.

Region 1 Conference

At the 1984 IARU Region 1 Conference held at Cefalu, Sicily, Dr John Allaway, G3FKM, was elected as secretary of the Region 1 Executive Committee, the post held until his death in 1981 by Roy Stevens, G2BVN and since then by Eric Godsmark, G5CO. Region 1 conferences are held once every three years. At this year's conference, member-societies were urged to seek from their national adminstrations a 50MHz amateur allocation and the removal of Syledis pulse transmissions from the 430MHz band. The conference also recommended that no f.m. repeaters should operate between 144.8 and 145MHz and rejected proposals to allocate channels and repeater channels for narrow-band f.m. transmissions in the 29MHz band. It endorsed a provisional band-plan for 1296MHz and a new world-wide locator-squares system (from January 1, 1985). The IARU Medal was awarded to the Russian amateur N. Kazansky, UA3AF. The conference also discussed the proposed new constitution for the International Amateur Radio Union.

Rather more success in dealing with interference from Syledis-type transmissions in the 430MHz band is reported from California where pulse transmitters on 433 and 437MHz have now been turned off.

In brief

A major solar flare, possibly the largest in Solar Cycle 21, was recorded at the end of April.... The RSGB 1984 National Convention at NEC Birmingham attracted over 6000 people on Saturday 28 April and some 5000 on the Sunday. The 1985 Convention is to be held at the National Exhibition Centre on 13 and 14 April 1985... A postage stamp featuring the amateur radio station, H44SI, of the Solomon Island amateur radio society was issued last December as one of a set of three stamps forming a World Communications Year set ... During early June, French amateurs operated a special station, TK6JUN, at Ste Marie-du-Mont (Utah Beach) to mark the 6 June, 1944 D-Day landings by Allied forces. On this side of the Channel, GB4BLC operated from the Royal British Legion centre at Nettley, Southampton as part of an 'Operation Overlord' project during the D-Day anniversary week ... RSGB annual subscription is being increased by £2 to £16.50 from July 1 ... In a recent prosecution for the illegal use of 6.6MHz transmitter, Robert Burwell was fined £250 with £50 costs. It was stated that French air traffic control had complained of interference to its operations caused by the transmitter ... July mobile rallies include: Worcester club at Droitwich High School, Ombersley Road on July 1; West Manchester club at Burtonwood Motorway Service Area near the junction of M6 and M62 on 8 July; Cornish club at Camborne Technical College, Pool on 15 July; West Kent Radio and Electronics Fair at Royal Victoria Hall, Southborough on 21 July; Anglian rally at Stanway School, Colchester and McMichael rally at Bells Hill, Stoke Poges both on July 22; Rolls Royce rally at Sports & Social Club, Barnoldswick and Scarborough rally at The Spa, Scarborough both on July 29 -

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225	3v-30v	0-120	11.50	2.50	2.10	16.10
300	3v-30v	0-120	13.50	2.50	2.40	18.40
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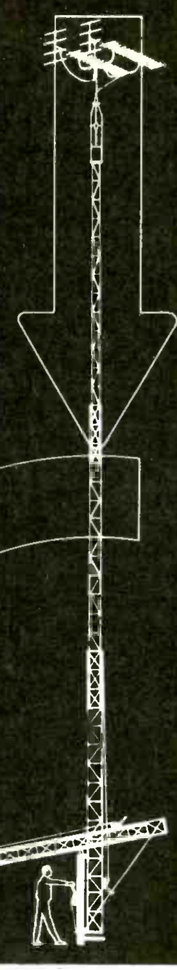

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Computer crashes

No less than three different computer companies ceased trading in one week: Dragon Data, Tycom and Camputers. The chief executive of Tycom is Sir John Clark, Conservative Members of the European Parliament. His major customer has been the Conservative party, who have installed the Microframe computer in a large number of constituency offices. The party is now looking for ways to provide services and hardware support to those constituences. Brian More of Dragon Data feels that the bouancy of the home computer market has been overestimated and that most people who get home computers do it purely and play games or because they are curious about computers. He is looking for a buyer, and one may be at hand. Tandy Corporation, whose Color Computer is very similar internally to the Dragon 32, has expressed an interest, initially in taking over the servicing and repair of the Dragon but possibly in continuing the manufacture as well. Camputers, manufacturers of the Lynx computer which never really got off the ground, having sold only some 10 000 units, are also looking for a buyer.

The business computer market is now greatly influenced by the coming of the IBM personal computer. Such large corporations can use their capital and their marketing expertise to produce a machine that is easy to mass produce, and can provide full documentation and support in both hardware and software. The smaller companies such as Tycom find it difficult to compete with such powers.

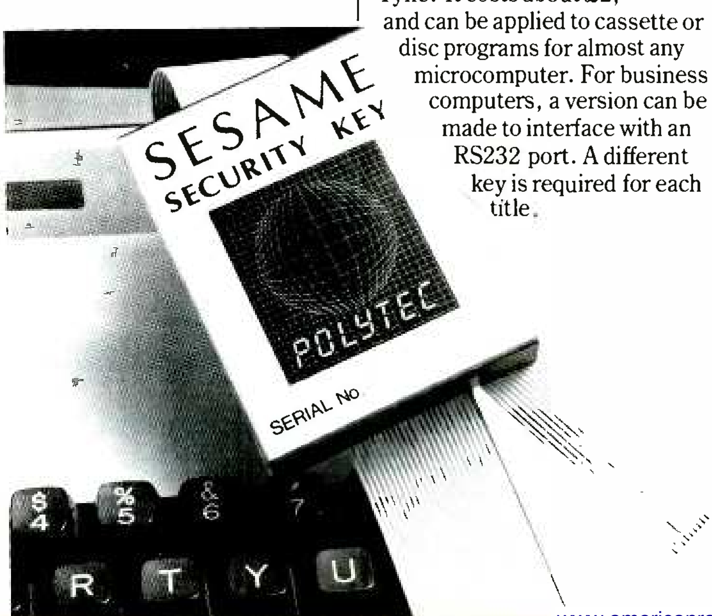
Software Key

A fresh attempt to counter home software piracy has been launched by the Cornish company Microdeal, with the inclusion of the protection device with one of their latest computer games.

Buzzard Bait, a game for the Dragon 32, comes with a small resin-encapsulated module which plugs into one of the computer's joystick ports. This software key, as Microdeal call it, must be in place to enable the cassette to load properly. The company hopes the device will put an end to unauthoried tape-to-tape copying, since without it the cassette is useless. And Microdeal believe that copying the module itself would call for resources beyond those of the home user. The key, or dongle, was developed to Microdeal's specification by Northern Software Consultants of Newcastle-upon-Tyne. It costs about £2, and can be applied to cassette or disc programs for almost any microcomputer. For business computers, a version can be made to interface with an RS232 port. A different key is required for each title.

Microdeal will be adding the key to several new programs on their Tom Mix Software label. They hope to discover whether increased sales to frustrated pirates will outweigh those lost to schoolchildren who might otherwise have bought the game by pooling their pocket-money.

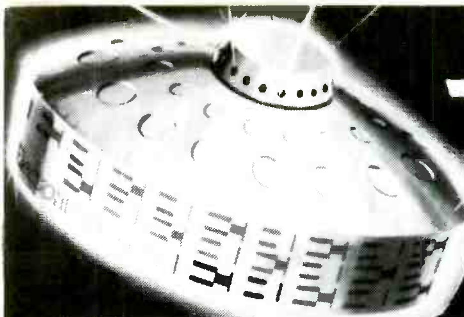
- Also fitting in to the RS232 port of a computer is the Sesame security key from Polytech Engineering Services Ltd. Without inhibiting the use of the port, any software used with the system interrogates the key which responds only if the correct password is used. Any copy of the software will only work on a computer fitted with the same key and as there are approximately 100 million possible codes, made up out of ASCII control characters, in effect this means only one computer can use it. Each device is supplied with a randomly selected code, together with notes and a flow-chart on how to incorporate the interrogation routine into a program. It has been estimated that it would take a fast computer about 20 years to 'crack' the code. WW230



Cell news

Trials for Racal's cellular radio-telephone system, to be known as Vodafone, are to start in December 1984, ahead of the original schedule, over a 150 square-mile area of London. The service will also start up before its schedule date of March 1985, initially covering London, cities in the south, Wales and the midlands, and along several motorways. The second phase is to be an expansion into the north of England — plans for Scotland and Northern Ireland are to be announced later this year. Racal have also launched a new company, Racal-Vodac, to distribute, install and service subscriber equipment. Another company was necessary as the licencee for the system is not permitted under the terms of the licence from marketing the consumer equipment.

Consumer equipment for the BT/Securicor Cellnet system is to be manufactured in Japan by NEC. After a world-wide search for a manufacturer to these products, BT decided that NEC were the only people with the facilities and expertise to provide the system. The equipment will include both car-mounted mobile radiophones and hand-held portables. The mobile sets will be available in December this year with the portables following later in 1985. If the cellular system is as successful and popular as both BT and NEC think it will be then there is a chance of manufacturing facilities being transferred to the UK. The first working pilot system of Cellnet was to be demonstrated in London early in June to cover 3 000 square miles and give continuous coverage over central London, extending to Heathrow and Gatwick Airports.



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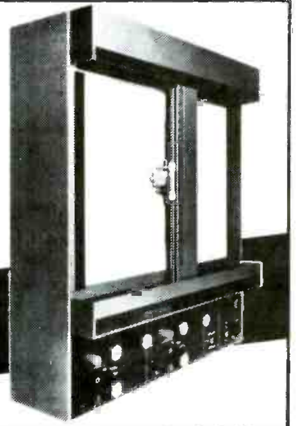

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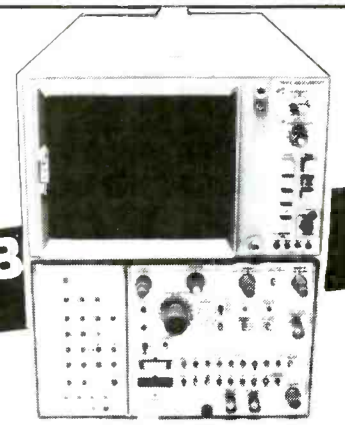

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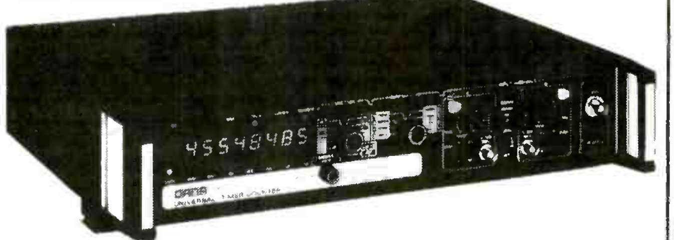

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CIRCLE 203 FOR FURTHER DETAILS.

Uosat 2 not dead but poorly

Uosat-2, the Surrey University satellite which ceased to transmit beacon signals after the first three orbits, has now been traced. (Communications Commentary, last month) The giant SRI dish in Greenland managed to detect the 1.2GHz local oscillator which pin-pointed the exact orbit of the craft. Surrey engineers were gratified to have confirmed that the satellite was where they expected it to be. They managed to turn on the 2MHz beacon to discover that the satellite was undergoing a weekly temperature cycle and that there were major problems with the 2MHz beacon system. Now they have managed to bypass the problem by using the on-board computer and have been able to send commands on the command uplink. It is still necessary to stabilize the craft to prevent the temperature cycling and to get the main antenna pointing earthwards. Then it will be possible to have a complete system check-out and find out how many of Uosat-2's functions are still working. Even if everything else functions propertly, it will not all be able to be used because of the use of the computer to bypass the 2MHz problems.

OED on computer

The compilers of the new edition of the Oxford English Dictionary have decided to commit it to a computer. This will enable the original 13 volumes to be expanded by the four supplement volumes and any new words can be easily inserted right up to the moment that the edition is prepared for printing. There are over half-a-million entries which include over two million illustrative quotations giving a total of over 80 million characters. In addition there is a variety of typefaces including Greek, phonetic characters, mathematical symbols and scientific formulae.

The system is to be based around an IBM 4341 central processor with both tape and disc storage, printers and over 20 v.d.us. Under IBM's scheme for support for academic institutions they are sending two data-processing specialists to the OUP to assist the dictionary editors with the task of updating.

One network not two in UK

Britain is urged not to follow the American example and have separate telephone and tv networks. In an article in the *Sunday Times* of June 4th, Warren Partridge an American lawyer and telecommunications business consultant, points out that with the denationalization of British Telecom, Britain is heading toward the same system that the US has developed in the 70s: one that has a private telephone monopoly, underfunded cable tv and unnecessary investment in all sorts of services to be carried into homes on several wires. Now is the time, he maintains, for all these services to be combined into one network.

The American experience is the development of two separate, and inadequate, systems. The telephone network is neither designed for local transmission of high-speed data nor tv pictures; the other, a cable tv system is not designed to provide telephone services. Both systems suffer from not getting the income that could accrue from the services provided by the other.

Mr Partridge suggests that Britain's cable tv franchising process could be used as the mechanism for privatizing BT. Britain could be divided into a few large combined telephone and cable services. The condition attached to awarding a franchise should be the aquisition of BTs present telephone system assets. This would privatize BT geographically, piece by piece, with the licensee operating a single system for telephones and tv. Those awarded franchises should offer a common carrier service only and lease capacity for tv channels or other services to programming and marketing companies. Control of such entertainment channels could be through the proposed cable authority.

These proposals would counter the problems found in the US, where it has been found that cable tv only provides more channels and if those channels are also available over the air then the cable systems begin to founder. Only in Washington DC has the telephone company proposed that they provide the cable system to be leased to cable tv companies. That should be the way forward for Britain, says Mr Partridge, if it wants to learn from US mistakes and take its telecoms into the futue.

Communications in the air

British Telecom persuaded British Caledonian to run part of its Gatwick operation from Birmingham at Communications 84. They did this to demonstrate the capabilities of Touchdown, a communications link between the aircraft, controllers and groundstaff which allows for the arrangement of schedules for re-fuelling and repairs, check destination and arrival times, book crews and aircraft, check passenger loads and the provision of on-flight catering. All this is done from a touch-screen terminal. By touching squares on the screen operators can answer incoming calls, call up background information, make internal and external calls (all regular numbers are stored and dialled automatically), and send or receive telexes. The link from Gatwick to Birmingham was for two of the 12 terminals in use at Gatwick.

Another communications system, installed by BT at Gatwick, is for the air traffic controllers. Through ADEKS, Advanced Design Electronic Key System, allows controllers to get in instant touch with other controllers and with telephone lines. Mike Morris, a director of BT National Networks, expressed his pleasure at receiving the order from the Civil Aviation Authority. He hoped that similar organizations in other countries would follow suit. The system combines 'sophisticated features and high reliability, at an extremely competitive price. ADEKS was designed specifically for installations such as this and is the result of cooperation between BT and CAA communications engineers.'

ADEKS keyboards are small units incorporated into the air traffic controller's desks. At the touch of a button users have instant access to all kinds of internal, public and emergency telephone lines. Incoming calls are indicated according to their priority.

The control system is designed to minimize disruptions and uses multiple processors and back-up cable routes to ensure high integrity. Any components failure can effect a maximum of one console or two lines. Self-checking routines and battery back-up are also provided. Cables are smoke and fire resistant and special immunity to radar and radio interference has been built in. One system can handle up to 116 lines to 60 consoles and systems may be linked for larger installations. ADEKS can also be interfaced to radio circuits. ADEKS is installed in the new stalk-mounted control tower at Gatwick.

Expanding American teletext

National Association of Broadcasters has joined the FCC in its proposals to authorise American tv stations to provide paging and a variety of data transmission services in the tv signal vertical blanking interval. The services should include video games and computer programs, and other 'interactive' services. The decision to provide these services should be left to the market place. In its submission, the NAB said that the system was technically sound, promoted competition and conductive to spectrum efficiency. It also said that the services should not be subject to common carrier regulation. Cable services which are obliged to carry certain network services should not be permitted to 'strip' the new offerings from the tv signals.

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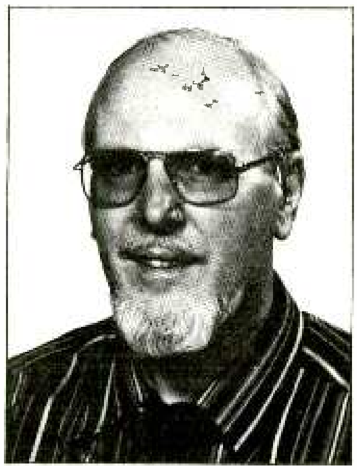
Digital stereophony with television

by E. H. Hartwell BBC Research Department



Ted Hartwell joined the BBC in 1963 after serving four years as a design and development engineer in industry. Most of his time in the BBC has been spent in the studio engineering department at the Television Centre in West London where he worked as an engineer and, more recently, as a technical writer. He became Research Author at the BBC's Research Department last year.

Tests on digital four-phase d.p.s.k. technique of transmitting additional sound information for tv stereophoney show the system to be more rugged than for either teletext or colour television pictures.

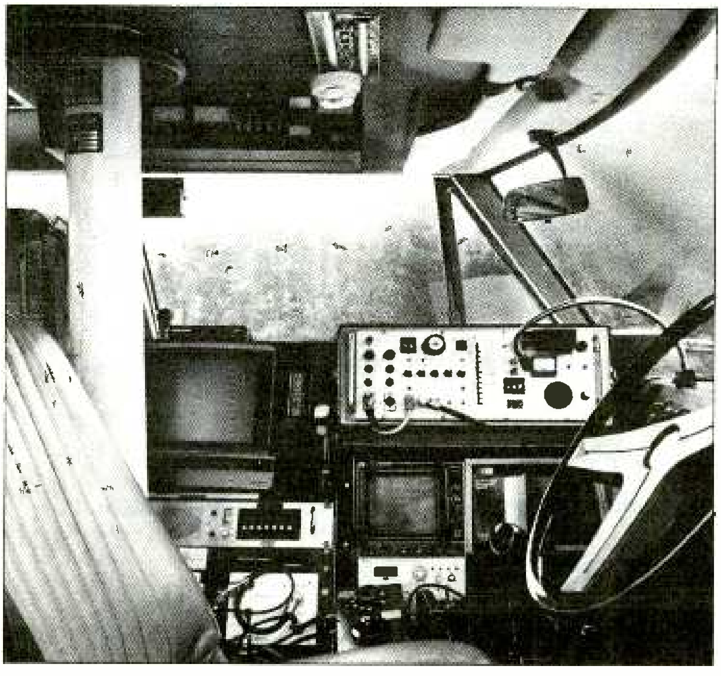
A single high-quality broadcast audio channel requires a bandwidth of at least 15kHz. Simple linear quantization of an audio signal requires at least 13 bits per sample for acceptable broadcast quality. Near-instantaneous digital companding*, however, enables the number of transmitted bits per sample to be reduced to ten with negligible degradation in quality. Assuming a 15kHz audio bandwidth, a sampling rate of about 32kHz is required to satisfy the Nyquist criterion** and thus avoid unwanted alias effects. The minimum bit-rate for a single high-quality audio channel is therefore about 320kbit/s. To this must be added the bit-rate needed to transmit additional data such as framing words, parity bits for error detection, and the scale factor words associated with near-instantaneous companding. Two such channels, therefore require a bit-rate of something in excess of 640kbit/s.

*In near-instantaneous digital companding the analogue input signal is sampled and digitally coded to an accuracy of 14 bits per sample. Only ten of these 14 bits are actually transmitted, the ten-bit 'window' moving up and down the 14-bit range according to the peak signal level occurring during a block of 32 samples. The receiver decoder is instructed on the correct placement of the 'window' by a three-bit scale factor word sent with each successive 32-sample block. By this method, low-level programme signals are transmitted with 14-bit accuracy. The accuracy progressively decreases down to ten bits per sample for the higher signal levels, but the consequently increased quantization noise is masked by the higher level of programme.
**The sampling frequency must be at least twice the highest modulating frequency.

A system has been devised based on earlier work at the BBC Research Department[2] and its outline parameters are given in Table 1. The proposed system, which is still under development, was not used in the South Wales tests, a pseudo-random binary sequence generator being used instead. However, the important factor was to test the modulation system employed and this is discussed next. The proposed system employs a bit-rate of 704kbit/s, chosen because it is a multiple (22) of the sampling frequency which could lead to simplification of the decoder, and it provides a few kbit/s spare data capacity for supplementary purposes.

Choice of modulation techniques

The choice of a modulation technique for any digital transmission system results from a compromise between the required bandwidth, the signal-to-noise ratio required to achieve an acceptably low received bit-error rate (this



Receiving, demodulating and measuring equipment inside a BBC survey vehicle.

Table 1. Proposed baseband coding for experimental digital stereo sound with terrestrial television.

Audio bandwidth	15kHz
Pre-emphasis	CCITT
Audio sampling rate	32kHz
Samples per block	32
Audio coding	14/10-bit near-instantaneous commpanding 640kbit/s
Scale factor bits	3 per block per Channel 6kbit/s
Error protection for sample words	32kbit/s
Error protection for scale factor bits	4kbit/s
Framing	8kbit/s
Available for further development	14kbit/s
Overall bit rate	704kbit/s

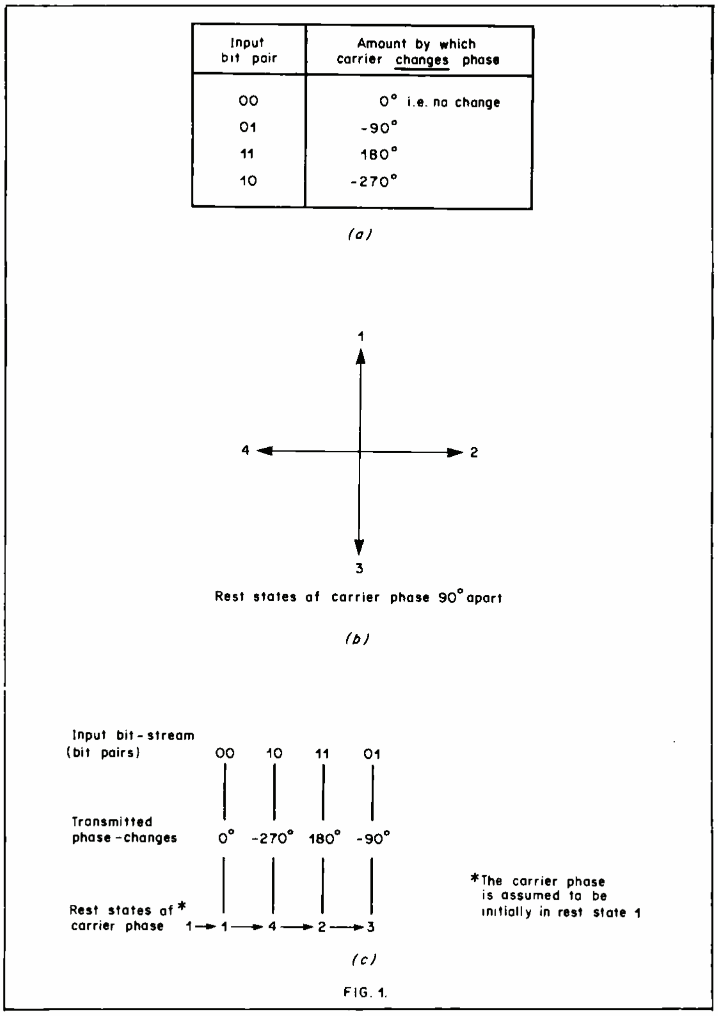


Fig.1. In the differential coding process four bit-pair combinations which modulate the carrier cause it to change phase by the amount shown in the table (a). Carrier has four possible rests state 90 apart (b). An example of carrier rest states adopted for the input bit-pair sequence 00, 10, 11 and 01 is shown in (c).

usually determines the carrier power required), and cost. The last item is particularly important here because it is highly desirable to minimize the cost of the decoder required in domestic receivers.

The broad family of four-phase-shift keying systems offers the best compromise between the requirements above, and a particular variant known as four-phase differential or quadrature phase shift keying was chosen for the experimental system. Four-phase d.p.s.k. had been successfully used by the BBC in earlier contexts[3] so experience had already been gained in the use of this method.

Four-phase p.s.k. is a digital modulation technique in which the carrier adopts one of four possible phase states dependent on the two-bit pattern occurring at any instant, i.e. 00, 01, 11 and 10. Carrier amplitude remains constant except during phase transitions.

Simple four-phase p.s.k. requires the transmission of an additional phase reference signal for correct decoding and this can only be achieved at the expense of increased carrier power or bandwidth, neither of which is desirable. However, if the p.s.k. signal is *differentially* coded (d.p.s.k.), no additional information is required. Instead, the transmitted message is coded into carrier phase *changes* between one bit pair and the next, which the decoder does not need a phase reference to detect, Fig.1. Briefly, the modulation system works as follows.

The changes of carrier phase which correspond to the four possible bit pairs 00, 01, 11 and 10 are respectively 0, —90, 180 and —270°, Fig.1(a). The carrier phase itself can dwell in one of four rest states 90° apart, as depicted in (b). An input bit-pair shifts the carrier phase into a different rest state by the amount assigned to that particular pair. The transmitted phase changes and subsequent carrier rest states for the input bit-pair sequence 00, 10, 11 and 01 are illustrated in (c).

Choice of second sound carrier

The relative levels of the vision and sound carriers, and the frequency-spacing between the main and second sound carriers, have to be chosen to give good compatibility with existing receivers, whereby interference to the picture or main sound channel is kept to a minimum. The frequency and level of the second sound carrier must also be chosen so that the digital system works reliably throughout the service area of normal television reception. A third requirement is that the second sound carrier must not interfer with transmitters operating on adjacent television channels. The first and third requirements have been investigated in the laboratory, and the second during the field tests in South Wales. Inevitably, these requirements conflict and a compromise has had to be sought.

Theory and laboratory tests indicate that, to avoid interference to or from the main frequency-modulated sound signal, the additional digitally-modulated sound carrier woudl need to be spaces 6.5MHz or more above the vision carier (i.e. 0.5MHz above the rest frequency of the main sound signal), and at an amplitude of between 20 to 25dB below it.* This is a larger frequency spacing than that used in the earlier BBC tests on the analogue two-carrier system, where a spacing of about 6.3MHz was best, because of the greater bandwidth (about 700kHz) of the digitally modulated signal compared with that of the f.m. signal.

The upper limit on the spacing of the second carrier from the vision carier was determined by adjacent-channel interference, both from the viewpoint of interference from the digitally modulated signal into the vestigial sideband of the upper adjacent channel, and vice versa.

Laboratory tests indicate that with the second sound carrier at a level of 20dB below the vision carrier level, interference from the digitally modulated second sound carrier into the upper adjacent channel is not a problem and complies with the CCIR recommended protection ratio. In fact the main sound carrier is the limiting factor for interference into the upper adjacent channel; this remains true even when the main sound carrier is reduced by 3 to 10dB below the vision carrier. Interference from the upper adjacent channel into the digital sound channel seems more likely because the CCIR recommended protection ratio in this direction is much more tolerant.

Any interference to the digital sound channel from the vestigal sidebands of the upper adjacent channel vision signal is picture dependent, which meant detailed

Table 2. Modulation system for experimental digital stereo sound with terrestrial television.

Frequency of second sound carrier	**6.55MHz above vision carrier**
Level of second sound carrier	**—20dB with respect to peak vision carrier**
Modulation of the second sound carrier	**4-phase d.p.s.k. at 704kbit/s**
Overall bandwidth (to —30dB) of transmitted d.p.s.k. signal	**700kHz**
Level of main sound carrier	**—10dB with respect to peak vision carrier**

studies of the power-density spectrum with a variety of picture signals. As expected from the vestigial sideband shaping, the power density spectrum falling into the digital channel is triangular, power-density decreasing with increasing spacing from the interfering vision carrier. This indicates that the frequency of the second sound carrier should be kept as close as possible to that of its parent vision carrier.

These conflicting requirements lead to a frequency spacing for the digital sound channel of 6.55MHz above the wanted vision carrier, i.e. 0.55MHz above the main f.m. sound carrier, Fig.2.

Parameters of the modulation system adopted fo the experimental equipment are given in Table 2.

Conclusions

The South Wales tests show that the experimental digital system is adequately resistant to impairments to digital sound signal reception arising from low field strength, multipath propagation, ignition interference, and distortions in a long chain of transposers.

The results clearly show that when receiving low field-strength signals directly from the main transmitter (at Wenvoe) the digital sound signal will not, on average, fail before the picture became unacceptably noisy; when receiving signals via a rebroadcast relay station (transposer) the average failure point occurring at a field strength well below the nominal service area limits for Band IV and V transmissions. The system is more rugged than either colour television pictures or teletext with regard to multipath propagation effects (ghosting).

In March, with Home Office agreement, the BBC conducted similar tests from the BBC2 transmitter at Crystal Palace, to confirm that the experimental system is compatible with the widest possible range of domestic receivers. In May, test transmissions were made of a television programme with stereophonic sound using the experimental system described. The results of both series of tests are very encouraging; the BBC is presently having discussions with the IBA and the receiver industry to establish an agreed UK Standard.

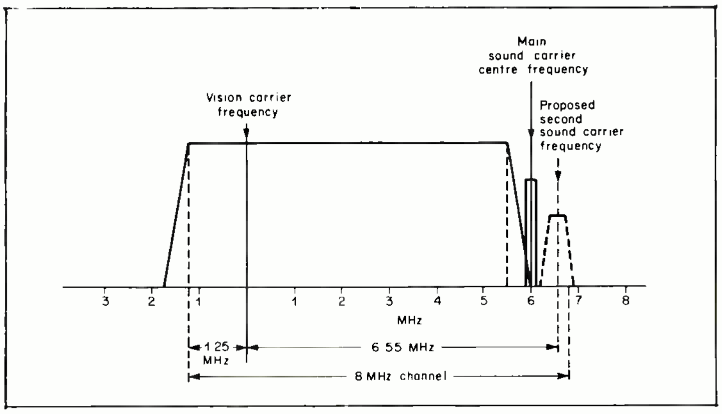


Fig.2. **Frequency bands occupied by the colour picture components and sound signal of one television channel with the proposed digital sound signal added.**

Background to BBC experiments

For many years there has been interest in the possibility of adding stereophonic sound to existing television services and the BBC has investigated a number of possible methods. In all cases an additional sound signal is required to carry the stereo information and, in some cases, the additional signal is suitable for the transmission of two independent sound signals as may be required, for example, to provide a bilingual service. Methods investigated include the pilot-tone system as used for stereo radio broadcasting in the UK, the Japanese f.m.-f.m. system and the German two-carrier system, all of which employ an analogue second sound signal; and digital sound similar to that proposed for direct broadcasting by satellite television.

The first two methods have certain limitations in this context and were not pursued as serious contenders. The German method, (*WW* November 1981, Page 40) in use on a limited basis in that country, appeared more promising and engineers at the BBC Research Department devised a variant of this method adapted to the PAL System I as used in the UK.

Toward the end of 1982, the BBC conducted over-air compatibility tests of this variant from the BBC transmitter at Crystal Palace outside normal broadcasting hours. The tests indicated that the system was only marginally compatible; interference between the additional sound carrier and the main sound carrier gave rise to picture patterning, which, to avoid, required reduction of the main sound carrier. However, reduction of the main sound carier to 13dB below the vision carrier as in Germany caused increased buzz-on-sound in some existing receivers.

During the period that various options for analogue stereo sound with television were being assessed, the status of digital techniques in domestic equipment had changed considerably and consumer products, such as the digital audio disc with its attendant high quality sound, had become available. Also, the BBC proposes using an internationally agreed system of digitally coded sound for d.b.s. These advances led to the consideration of a digitally modulated second sound carrier to convey the stereo signal.

A digitally-coded signal is more rugged than its analogue counterpart and may therefore be transmitted at a lower level. This reduces the level of any interference between the main sound carrier and the added digitally-modulated carrier. Also, because of the more noise-like nature of a digital signal, the visibility of any interference patterns is reduced further, which enables the main sound carrier to be maintained at or near its full level, avoiding the increased buzz-on-sound problem found with the analogue two-carrier system.

A thorough investigation of the digital option carried out at the Research Department led to over-air tests of an experimental system, conducted outside normal broadcasting hours from the BBC2 transmitter at Wenvoe in South Wales and its associated rebroadcast relay stations during the autumn of 1983 [ref.1]. This particular area was chosen because the terrain is hilly and multipath propagation of normal television signals very evident. The area contains a large concentration of rebroadcast relay stations which enabled assessment of the digital sound signal when subjected to the cumulative effects of distortions in a long chain of such stations.

This article discusses the reasons behind the choice of parameters used for the experimental systems, together with a summary of the test results.

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*The vision carrier level is taken as the peak vision carrier power at the tips of the sync pulses, and the levels of the main and second sound carriers refer to the respective levels of the unmodulated carriers.

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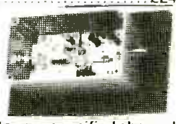

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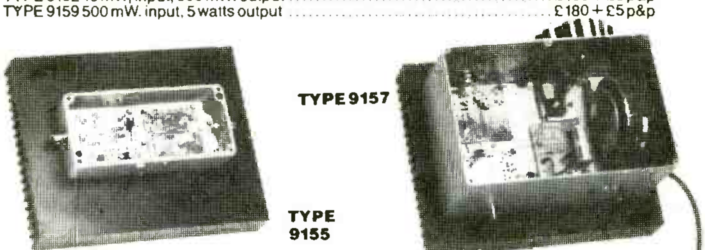

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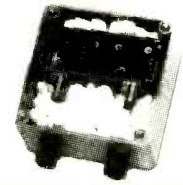

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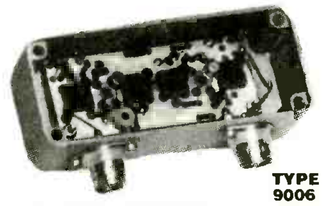

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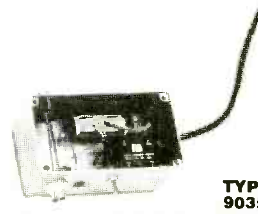

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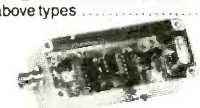

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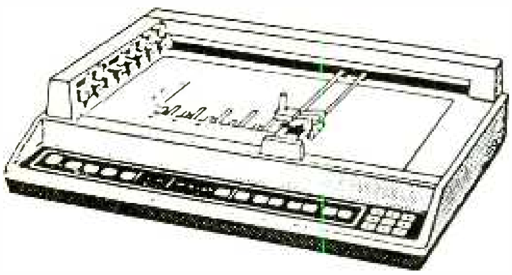
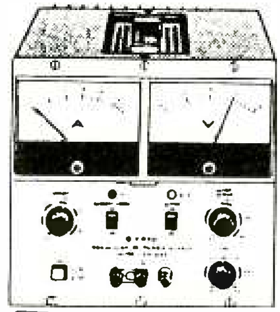
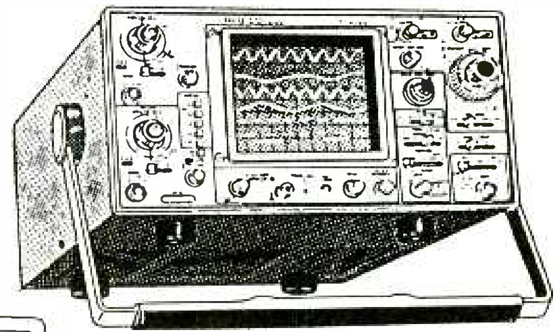
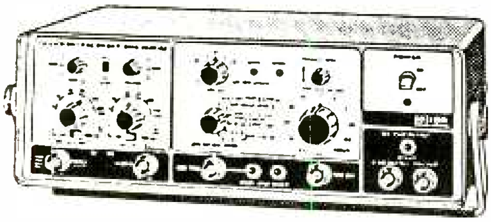
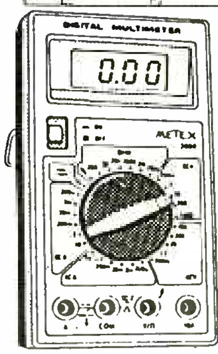
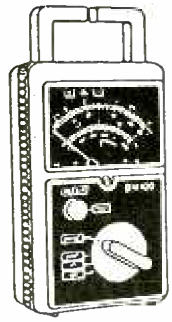
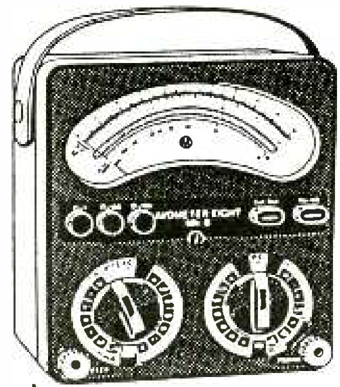

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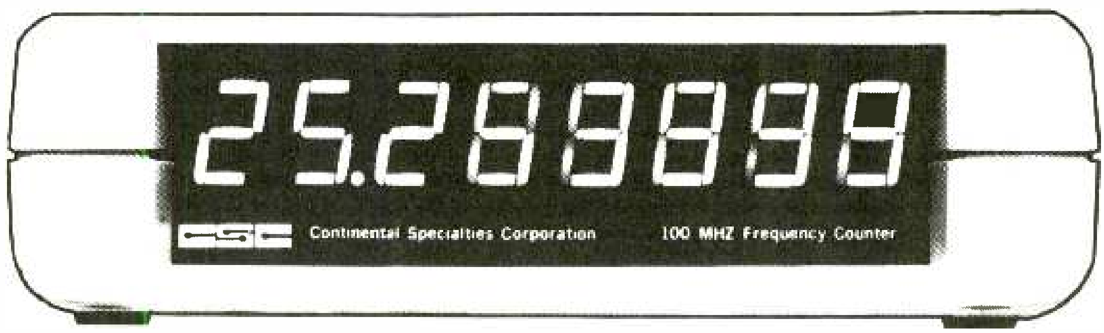

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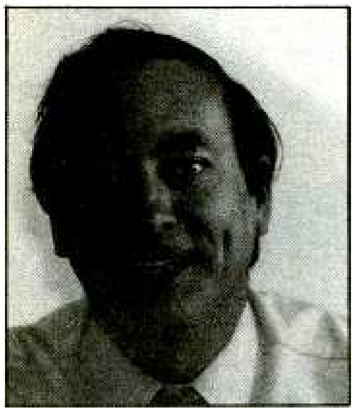
Music keys for the BBC microcomputer

Using the computer's sound unit or external generators, this economical polyphonic keyboard interface makes a musical instrument and an educational tool for storage, analysis and display of music.

by R. M. Adelson



Ronald Adelson graduated in engineering from Cambridge University in 1956. After a spell in industrial electronics he entered the field of operational research which has been his principal occupation since. However he has kept up an active interest in electronics, especially where it impinges on his interests as a musician (actually he plays the bassoon — perhaps not quite the same thing!). He joined the Operational Research Department of Lancaster University in 1967. A recent initiative by the Music Department at Lancaster is currently enabling him to spend some of his time putting his technical skills to work.

Potential of the microcomputer as a tool for teaching, editing and perhaps even composing music is great, as the amount of music-related software currently available will testify. This software however suffers from one serious drawback — the means of entering musical information into the computer. These means include the computer's typewriter-layout keyboard and sometimes games paddles or joysticks but all are clumsy, slow and error prone which is a great discouragement to the musician (as opposed to the computer enthusiast) attempting to use the computer creatively.

There are systems that include the natural input device for a musician — a music keyboard — but they are mainly intended for computer-based synthesizer applications. Best known of these are probably the Fairlight Computer Musical Instrument costing around £20 000 and the Alpha Syntauri add-on for the Apple computer costing around £2 500. The Alpha Syntauri is intended for use as a synthesizer but there is now some elementary teaching software available for use with it. Some other (mainly American) music teaching systems were recently reviewed by David Ellis*.

Lancaster University's music department is studying possible uses of microcomputers in aspects of its work including the training of musicians, music editing and research into music analysis. We felt from the outset that a 'musician friendly' input device was essential for acceptance by potential users and given the cost of commercial systems — not to mention their shortcomings — we decided to develop a straightforward and cheap keyboard interface for the BBC microcomputer. The outcome is a keyboard and interface costing around £50 in components and drawing about 60mA from the computer's 5V supply, which hasn't caused problems even while two disc drives are powered from the same source.

*David Ellis, CAMI — Some educational music programs. *Electronics and Music Maker*, Oct. 1983.

Design considerations

Synthesizer applications were not considered a prime objective although the design can be used to play the computer's own sound generator or external units. No attempt was made to make the keyboard touch sensitive to measure the speed of key depression; simple on/off key switches will suffice. Uses envisaged for the interface suggested that it should be fully polyphonic, i.e. should accept chords and should not be restricted to the one-note-at-a-time characteristic of typewriter-style keyboards designed for computer input. Finally, rapid response was required and in some circumstances the computer might be processing input

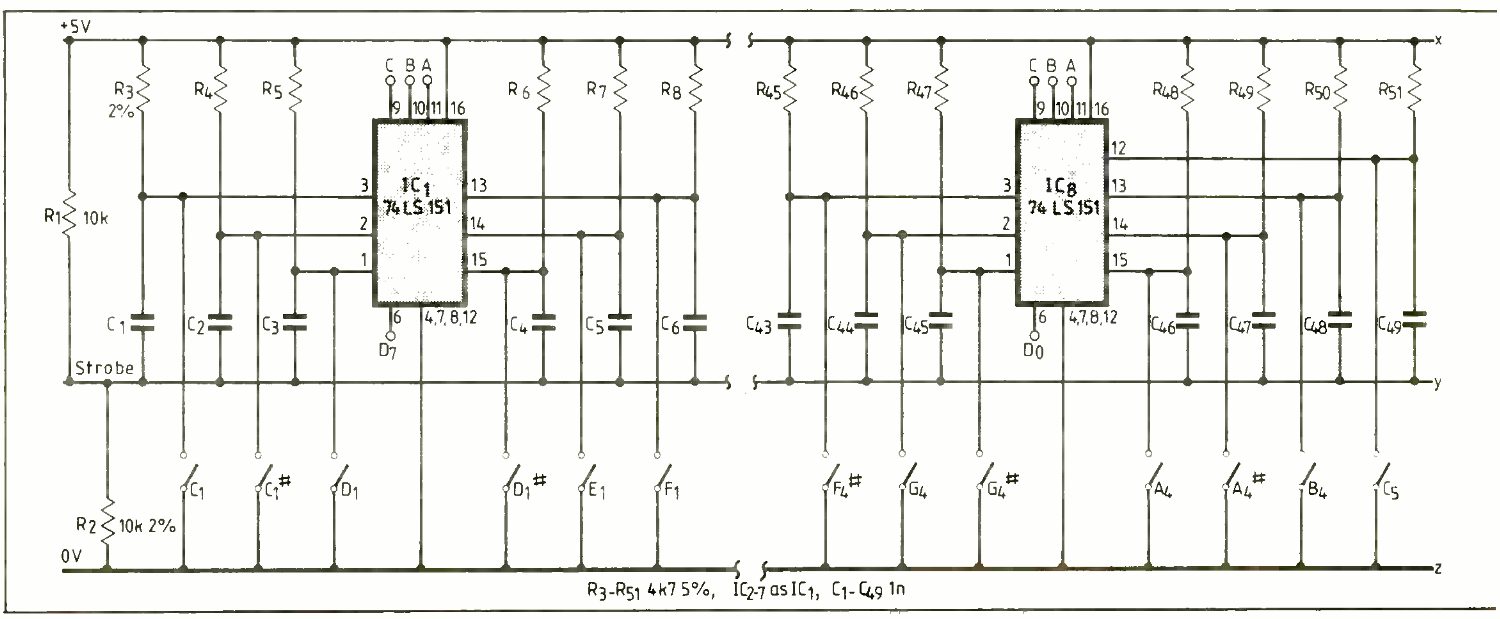


Fig. 2. Circuit of the music-keyboard interface. Whenever strobe voltage goes outside the narrow window defined by R_{54-56}, dual comparator IC_9 generates an interrupt at CB_1. The computer then responds by reading the inputs of IC_{1-8}, then clocking them on using CB_2 on IC_{10} until the whole keyboard status has been read.

information in real time, suggesting that time should not be wasted by scanning the keyboard unnecessarily.

These conditions were met by making the system interrupt driven and bit mapped. This means that any change in keyboard status due to a key being pressed or released produces an interrupt signal causing the computer to read the status of all the notes on the keyboard. On reading the keyboard, the computer stores a bit-mapped image (zero for an unpressed key, one for a pressed key) of the current keyboard status for subsequent analysis, display, sound generation, etc.

Hardware

A four octave C-C (49 note) keyboard is used. Initially, the 49th note proved a minor nuisance since 48 notes can be neatly mapped into six bytes. However, in the final design it turned out to be convenient to read the keyboard in eight bytes so the system can accommodate a five-octave keyboard. One byte is used to check that spurious noise pulses have not sent the interface byte counter out of step with the reading software.

Keyboard and key switches used are those sold by Maplin Electronic Supplies as the basis of their 'Spectrum Synthesizer' (no connection with the well known microcomputer). The key switches are unusual in that they are simply coiled springs soldered to a p.c.b. at one end and touching a bus bar on the p.c.b. at the other end when the key is pressed (the p.c.b. is also supplied). This seemingly effective keyboard is easy to assemble and much cheaper than using conventional organ key switches. Some initial problems were experienced due to key bounce caused by spring vibration but these were solved by inserting lengths of soft foam plastic at the edge of the p.c.b. where the switches are soldered to damp the vibrations.

The BBC microcomputer user port is connected to the B lines of a 6522 versatile interface adaptor, v.i.a. It carries eight data lines, D_{0-7}, two handshake lines, $CB_{1,2}$, a number of ground lines and the computer 5V supply. Through programming, the v.i.a. can be made to generate an interrupt signal when CB_1 changes from high to low or alternatively low to high — but not both. For the keyboard, a response is required when any key is pressed, or released, and even if a number of other keys are already held down, so a means producing a suitable interrupt signal is needed.

Figure 1 shows basic key connections in which two equal resistors, $R_{1,2}$, establish a steady-state voltage of 2.5 on the strobe rail. Each key switch is conncted to a network made up of R_x and C_x. Initially, C_x has a potential difference of 2.5V across it (lower plate 5V, upper plate 2.5V). When the switch is closed, the lower plate potential falls initially by 5V and as the capacitor's charge cannot change instantaneously, so does the upper plate's potential i.e., the strobe potential drops to -2.5V.

In due course, C_x discharges through R_2 then recharges with reverse polarity through R_1 and the strobe returns to 2.5V. When the switch is opened, C_x tries to discharge through $R_{1,2}$ and R_x and in doing so pulls the strobe line above 2.5V by an amount depending on the values of the resistors. The capacitor now discharges and recharges to the original steady-state voltage through R_1 and R_x, so key status can be read at point S.

If several keys are connected to the strobe rail each with their own RC networks, their behaviour will be similar but step magnitudes and associated time constants will depend on how many keys are pressed. For example, if 48 keys are pressed — a tricky feat even using arms instead of hands — pressing the 49th key places the last C_x in parallel with the 48 others and limits the step size to about 100mV. However, as long as the system can detect the smallest possible step and react to the minimum time constant while the maximum time constant is short enough to ensure that recovery occurs before one has a chance to press the next key, all is well. Component values shown allow the keyboard to respond to chords of any number of notes that I have managed to reach over and to trills and glissandi without problem.

Negative-going interrupts can be produced by taking the strobe line to the non-inverting input of a comparator whose input is biased just below 2.5V so that it responds only to negative-going pulses, and to the inverting input of a further comparator, whose non-inverting input is at just above 2.5V, which responds only to positive-going pulses. The LM393 dual comparator is ideal for this purpose since it works with a 5V supply and has open-collector outputs which can be wired together to produce OR gating.

Figure 2 is the final circuit. Resistors $R_{1,2}$ provide bias for the strobe rail and R_{3-51} and C_{1-49} are R_x and C_x for each key, Fig.1. Resistors R_{54-56} provide bias for the comparators, IC_9. Resistor R_{59} forms collector load and resistors $R_{57,58}$ provide some hysteresis — usually a good policy when using comparators to improve noise immunity and switching times and to reduce tendency to spurious oscillations. The input voltage on IC_9 must not be allowed to fall below ground and it can be seen from Fig.1 that the strobe rail can do this — hence

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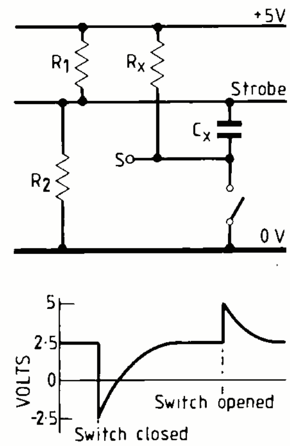
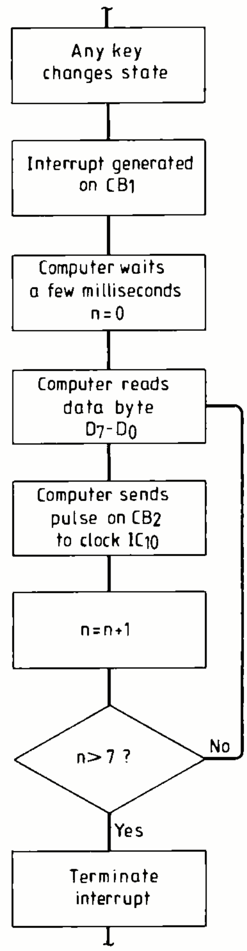
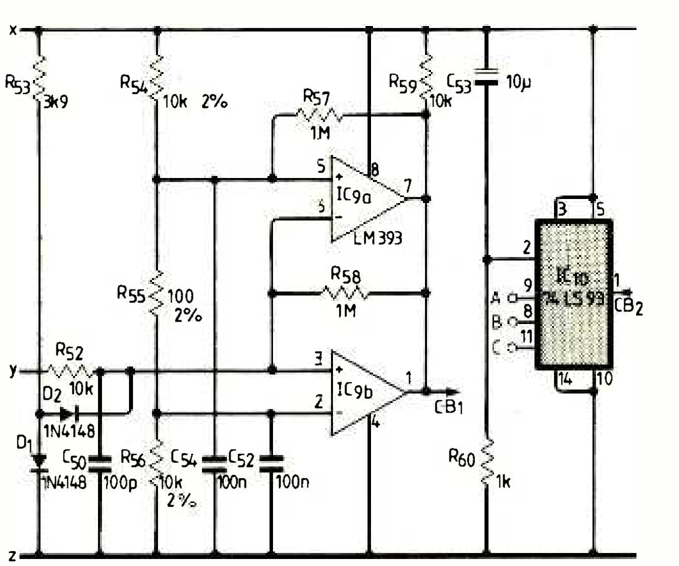


Fig. 1. Outline of the keyboard's interrupt generator. Closing or opening the switch causes the voltage on the strobe rail to act as shown. Each pulse causes an interrupt.



At switch on, the counter is set to zero and its synchronism is checked each time the keyboard is read. The delay allows for key bounce and for the fact that is impossible to play all the notes of a chord simultaneously.



Television reception with papaya tree antenna

by S.P. Kosta
K.N. Shamanna
R. Bhawani Shanker
K.S. Dayashankara
B. Rudralingappa
V.R. Katti
Y.P. Kosta

Novel technique couples r.f. energy from vegetation canopy to receive tv signals.

Back in 1979 we conceived of using green vegetation canopy as an r.f. antenna and conducted feasibility studies with a live cypress plant and freshly cut date palm leaf branch at 1000MHz to successfully demonstrate it[1]. Later[2], we conducted experimental studies to use vegetation canopy (leaves and branches of gulmohr, canna, bottle brush, coconut, date palm, fern, etc) as electromagnetic antennae structures at microwave frequencies. These studies reveal that certain geometrically-shaped vegetation, due to water and chlorophyll content vis-a-vis their dynamic complex dielectric properties can sustain, propagate and radiate electromagnetic waves from their structure if suitably excited. A gain varying from 2 to 5dB over an exciter probe antenna from selected vegetation canopies at 1000, 3000 and 4000MHz has been achieved with satisfactory impedance-matching characteristics. (The radiation pattern of the exciter probe antenna be shaped with increased its gain axially when it excited an e.m. wave on vegetation cover structure.) A range of branches from a single tree branch to a bunch of a few branches (kept in a plastics cone to maintain a dielectric-rod antenna configuration of the bunch) were used to achieve better radiation pattern characteristics with a gain of around 5dB over that of the exciter probe antenna.

In all these studies a probe helix at the end of a vegetation branch was used to excite an e.m. wave on the vegetation structure. The radiation characteristics so observed were found to remain so long as the vegetation structure is fresh, and start to deteriorate with increase in dryness.

We further reported[3] experimental studies to receive Band 3 television signals from the Bangalore transmitter (radiating 1kW) by using freshly-cut date palm and coconut branches, of length 1.5 and 3 metres respectively. The vegetation cover with reasonably good signal-to-noise ratio. A new simple method to tap the r.f. energy captured by the leaves branch was reported at the same time.

And most recently, we received signals from the Bangalore tv transmitter using a few live papaya trees (one at a time only) of height around 3 to 5m in length and located firstly at 12km and later 25km away from the transmitting tower.

Experimental set up

In this last experiment a few papaya trees (used one at a time), of height around 3 to 5m were

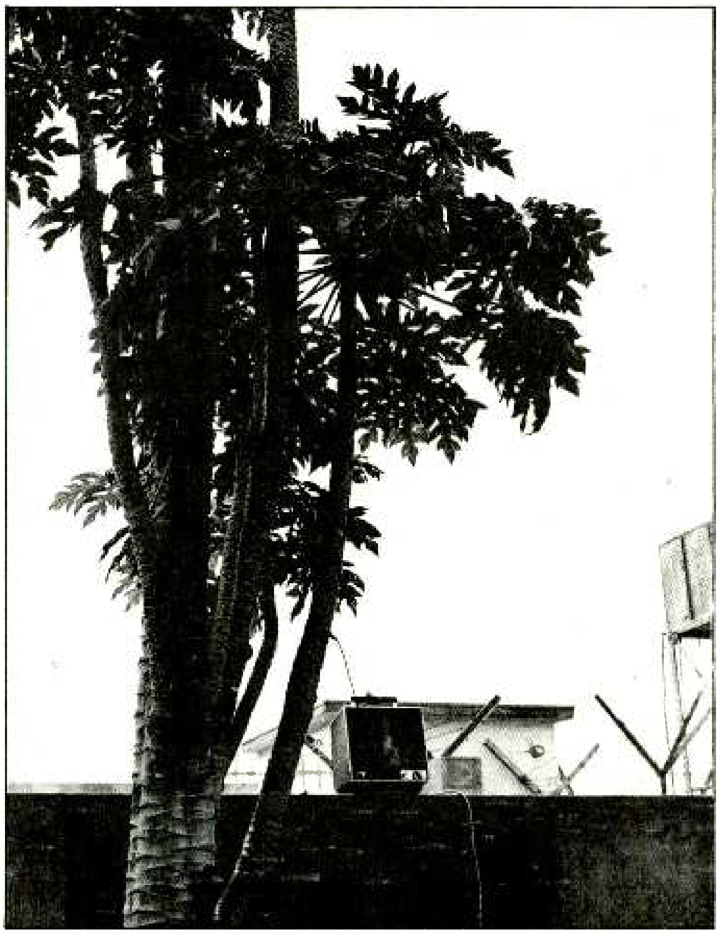


Fig.1. **Field receiving site**

Dr Shiv Prasad Kosta graduated from Jabalpur University and took his Ph.D. in Telecom engineering in 1969 at the same university.

Dr Kosta is a specialist on antenna and transmission line systems and has more than 120 research and technical papers to his credit. He takes keen interest in basic research problems relating to electromagnetics, antenna and microwaves and has guided students for M.Tech and Ph.D. degrees. Recently, Dr Kosta conceived of using trees and salt solutions as tv and radio antennas for very high and microwave frequencies.

Presently, Dr Kosta is working as head of systems integration, at the ground checkout and test division of ISRO Satellite Centre, Pennya, Bangalore.

The authors are with ISRO Satellite Centre, Bangalore, India, except S.P. Kosta who is studying at the National College, Jayanagar, Bangalore.

Fig.2. **Probe coupling configuration**

located to receive line-of-sight signals at a distance varying from 12 to 25km from radiating tv tower were used to receive colour, as well as black & white signals. A flexible coaxial cable (RG-58A/U) tapped r.f. energy from the appropriately selected places of the tree. The inner conductor of the BNC connector (EMRI-506, projecting by around 3mm) was pierced through first into the trunk and then at the end point of the stem supporting the green leaf of the tree (Fig. 1).

The maximum signal tapping point was found after many trials, from which we found that the piercing end of the inner conductor should touch the moist/wet portions of the tree (xylem, phloem, chloren chyma, etc). The other end of the coaxial cable was connected to a Sony portable receiver model CVM-111E. The BNC connector is not necessary to tap the r.f. energy, Fig. 2. A bare sharpened inner conductor end of RG-58A/U cable itself should be used in practice to economically receive television signals.

Observations

The signal received with the probe antenna alone at the height of the tapping point was very hazy (unreadable) at 12km distance and, practically, identification of the picture wasn't possible, Fig. 3. Further, no signal was received by the probe alone at 25km distance.

The signals received from the papaya tree trunk, its one green leaf and the dipole antenna at 12km and 25km distance, were of good readable quality. The v.s.w.r. under best conditions of reception was around 1.5. Only the leaves pointing clearly toward the tv transmitting tower without obstruction received good television pictures. To achieve higher gain (better s/n ratio of the received tv picture), standard antenna array techniques using a few suitably located Papaya trees or a few suitably oriented leaves need to be studied in depth.

Under average conditions (slow breeze and feeble rain) the observed tv picture quality was fairly satisfactory.

Theoretical model

To a first order of approximation one may simulate either

— suitable symmetrical and geometrically-shaped freshly-cut or live vegetation branch or a bunch of branches (like fern, date palm, bottle brush) as a standard well-known dielectric rod antenna configuration; or

— papaya, coconut, banana-type live branch leaf as a thin dielectric sheet aperture antenna.

The exact constitutive parameters of a green leaf are not well-known[4]. Because of the very large static dielectric constant of water one can well expect that the moisture content of the leaf will have a predominating influence. A reasonable estimate of the complex dielectric constant of green foliage (Du and Peake[4]) can be made from the following equation:

$$\epsilon - j\frac{g}{\omega\epsilon_0} = G\left(5 + \frac{75}{1+\frac{f}{f_0}}\right) + G\frac{g_e}{j\omega\epsilon_0}$$

where g_e the ionic conductivity due to dissolved salts of the fluid in the leaf, G is the fraction of water content, f_0 is 16GHz, and ϵ_0 have the usual meanings, and the conductivity of the dissolved salt may vary widely but is assumed here to be 0.2 to 0.4×10^{-4}mho/m. Further, the effective relative dielectric constant of the medium can also be written as

$$\epsilon_x = \epsilon_j + \frac{g_j}{j\omega\epsilon_0}$$

where ϵ_x is the effective dielectric constant, and g_j the effective conductivity.

Du and Peake[4] measured values of the relative dielectric constant ($\epsilon \approx$ 1.01 to 1.04) and effective conductivity ($g_j \approx$ 0.2 to 0.4×10^{-4}mho/m) of the green leaves with varying percentage of water content (10 to 50%) and the volume concentration of the leaves (in the range of 0.0003 to 0.001) at v.h.f. They have also found that dielectric constant is nearly independent of frequency in the v.h.f. band. Spence and Heisler[5] have reported dielectric constant of jungle environment as ϵ_j = 1.02 and conductivity $g_j \approx 10^{-4}$mho/m. It is also known that

Continued on page 29

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Variable-speed video playback

by J. R. Watkinson, M.Sc., B.Sc.

Using C-format video recorders over a wide speed range. Discussion continues with a description of the effect of the recording process on video waveforms.

At +2× and at 0, a single-track jump is required every drum revolution, whereas at -1× and +3×, a two-track jump is required. At intermediate speeds, a sequence of single and two-track jumps is made. A single-track jump will always be made, but if the bimorph displacement exceeds one track at the end of a field, a two-track jump is needed. This process can be extrapolated up to any speed as necessary until the travel of the bimorph cannot cater for complete tracks. In this extreme case, a maximum size jump will take place whenever the travel limit is approached.

The head jump must take place during the vertical interval in order that it shall not occur in a visible part of the picture. There is, however, a further difficulty. In C-format, vertical-interval storage is optional and vertical detection is done by locating the equalising pulses which are at the end of the main field track. These pulses are relatively narrow, and could be missed in the case of dropout. They are thus predicted and validated by counting lines along the field track. The 3½ line timing shift between adjacent fields has been mentioned: if a jump takes place, this shift has to be taken into account in order to locate the equalising pulses correctly.

When the tape speed is varied, the head-to-tape speed changes, causing the off-tape H sync. pulses to change frequency. As the tape-head contact is not continuous, the machine has to maintain sync. from track to track by counting extrapolated H sync. pulses at the same frequency as they are coming off the tape. A circuit is incorporated which measures the off-tape line period in cycles of a reference clock, and which can generate H pulses separated by that period during the vertical interval. By counting these H pulses, and modifying the count by 3½ lines for every track jumped, the machine can always know where it is in a field, and generate convincing vertical pulses which it has not played back. The drum servo will use these corrected vertical signals in order to maintain correct drum phase in the presence of head jumping. It is important that the off-tape field rate should always equal reference field rate: the reason for this will become clear when the timebase corrector is discussed.

Effect of the v.t.r. on video waveform

Mixing and editing in PAL video is only possible provided that all sources are synchronised to within about 5 degrees of subcarrier, which is approximately 3 nano seconds. A field in PAL has a duration of 20 milliseconds, so the stability demanded is:

$$\frac{3\times10^{-9}}{20\times10^{-3}} \times 100\% = 0.000015\%$$

As no mechanism can approach such a tolerance, timebase correction is mandatory even at normal speed.

Video tape, like all magnetic tape, has a plastics backing, which has a relatively high temperature-coefficient of linear expansion, and can also change its dimensions as a function of ambient humidity. It is also flexible. The length of a field track on the tape can be altered by temperature, humidity or tension changes, and timing errors will be caused.

When tapes are interchanged between machines, mechanical tolerances on drum diameter and tape tension will change playback timing. The impact of the rotating heads striking the tape and leaving again creates shock waves which travel along the tape, causing jitter.

Where portable recorders are carried whilst recording, inertial effects can cause timing shifts of several lines. The drum attempts to rotate at constant speed with respect to the earth, owing to its inertia, and if the v.t.r. is turned about the drum axis, the drum phase will change until the drum servo can correct it. This is often erroneously referred to as 'gyroscopic error'.

Video tape is also subject to dropout, where the playback r.f. level is too low to resolve the frequency. Although the mechanism of dropout cannot in itself change

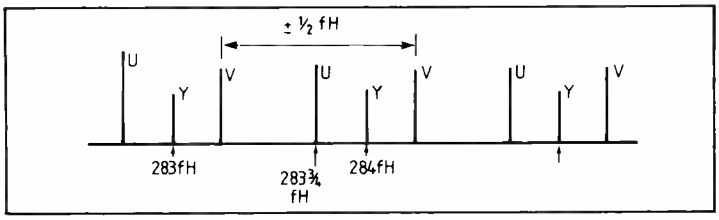


Fig. 10. In PAL, subcarrier must be at odd multiple of one quarter line rate for U and V spectral peaks to interleave with luminance (Y). Unlike NTSC, there is no dominant component at $1/2f_H$ points.

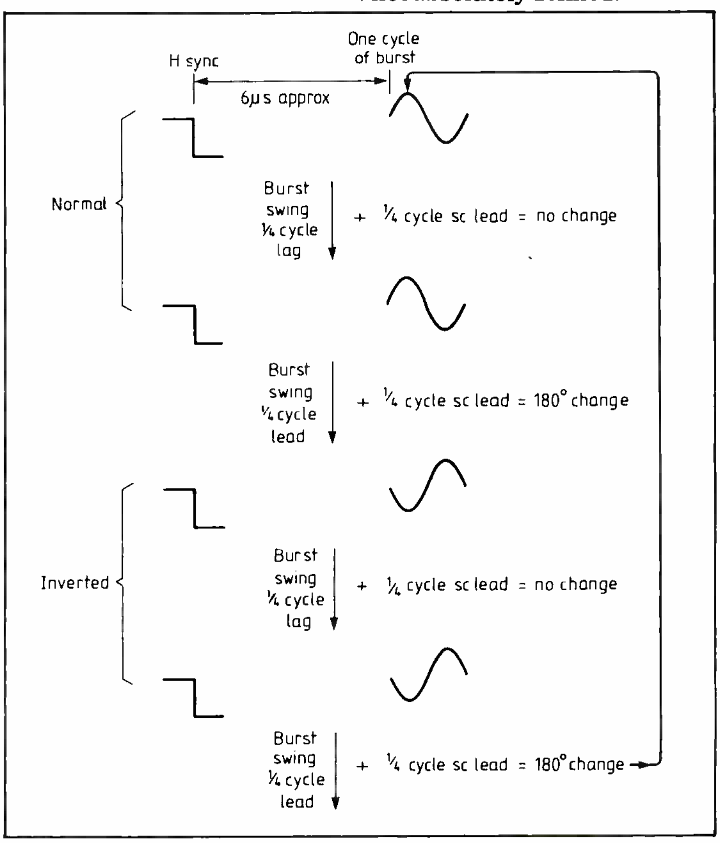


Fig. 11. Quarter-cycle subcarrier/H relationship and burst swing combine to give four-line sequence – normal and inverted pairs which is not absolutely defined.

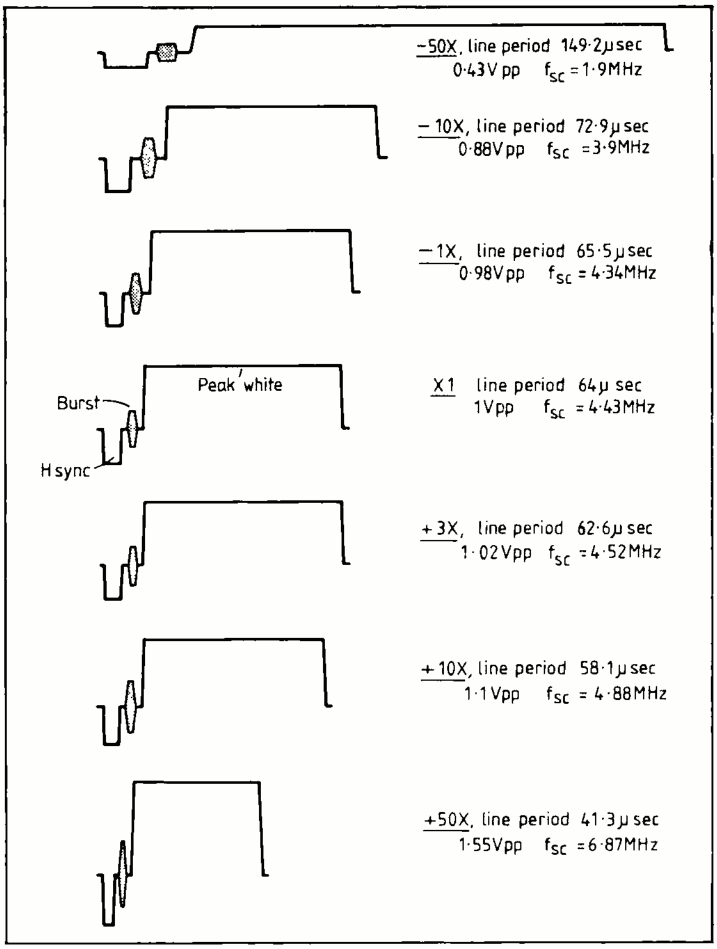


Table 1

video timing, the consequence of dropout can. For example, the destruction of a burst by dropout renders the following chroma information meaningless, since the timing of the suppressed carrier is lost. Dropout compensation is thus a major function of timebase correctors.

If the variable-speed playback is employed, the effect is to change the line period from the standard 64 microseconds. It is possible to calculate the line period for any speed. As the track angle in C-format is so small, the error caused by assuming it is zero is of the order of 0.1%, which can be neglected. The line period in inversely proportional to the head/tape speed. At ×1 forward, the tape speed is 239. 8mm/s, and the head to tape speed is 21.39m/s. If the tape is run at +2× normal speed, the head/tape speed will now be 21.39 + 0.2398m/s and the line period will be

$$t_H = \frac{64 \times 21.39}{21.39 + 0.2398}\ \mu s = 63.29\ \mu s$$

a change of about 1.1%.

It is important to remember that, although the line period becomes smaller, the field rate remains constant owing to the constant drum speed. The visible part of the picture is thus time-compressed into a shorter part of the field period, and the interval where the head is between tracks will be extended. Owing to the horizontal alignment condition, this extension will be $3\frac{1}{2}$ off-tape lines at +2X as there is a one-track jump at every drum revolution. There are normally $312\frac{1}{2}$ lines in a field, but at +2× speed, an extra $3\frac{1}{2}$ can be fitted into the same field period. This holds the key to a much simpler way of calculating the line period, which is

$$t_H = \frac{64 \times 312.5}{312.5 + 3.5} = 63.29\ \mu s$$

This can easily be generalised if the specific speed S is unity at normal speed.

$$t_H = \frac{64 \times 312.5}{312.5 + (S-1) \times 3.5}\ \mu s$$

This equation is to be preferred, since no approximation has been made, and no knowledge of drum dimensions or tape format is needed except the size of the video offset of $3\frac{1}{2}$H. It is very easy to arrive at the equation for other standards. For example, in 525/60 NTSC C-format, the video offset is $2\frac{1}{2}$H. The equation follows from that. Table 1 shows the effect of applying a variety of speeds to the equation. Interestingly, in reverse, the field tracks are stretched in time, the backwards head jumps lose $3\frac{1}{2}$H for each track jumped and the vertical interval is encroached upon.

The change in head/tape speed also changes the apparent frequency range of the f.m. carrier, and consequently the levels and amplitude of the playback video. The percentage change can be derived from the equation for change in line rate, since both are controlled by the same phenomenon.

Jumping performed in variable speed causes fields to be omitted or repeated, which destroys the eight-field sequence of PAL. The recreation of the eight-field sequence, the correction of the time compression or expansion of fields, and restoration of video levels are the major additional actions of a variable speed timebase corrector.

Appendix
PAL structure

The broadcasting of colour television is done in such a way that the bandwidth of the signal is no greater than that of a monochrome signal of equal resolution, and that a monochrome receiver can display a good picture from a colour broadcast without modification. Without these constraints, NTSC could never have been introduced, since every monochrome tv set in the United States would have been made obsolete overnight by a non-compatible system.

The bandwidth constraint was achieved by choosing a subcarrier whose sidebands interleaved with those of the monochrome signal, and monochrome compatibility was achieved by encoding colour difference signals into the subcarrier which a colour receiver could use to convert the monochrome signal into a colour picture. The subcarrier would be virtually invisible to a monochrome receiver. The only problem was that the original designers of the 525/60 monochrome system had very wisely placed the sound carrier at an odd multiple of half line rate, to give maximum immunity to video sidebands. This became, however, precisely the frequency of subcarrier sidebands. A solution involving a change of sound carrier frequency would have meant re-aligning the coils in every tv set in the United States, so the only alternative was to shift the video/subcarrier spectrum by changing the entire picture rate. NTSC field rate is thus 59.94 Hz, a change of 0.1%. A direct consequence of this was the development of a drop-frame time code to permit synchronisation of this strange frequency with real time.

Experience of broadcasting NTSC led the PAL system, whose well known characteristic of reversing the sense of one of the colour-difference signals on alternate lines had some far reaching consequences. The first, and intended, consequence is that by line averaging, hue errors caused by phase errors under difficult reception conditions were converted to saturation errors, much more acceptable subjectively, and the hue control was eliminated from the receiver.

Choice of subcarrier frequency in PAL is, however, more complex than in NTSC because of the V switch. the effect of the V switch is to shift the V spectrum up and down by $\pm 1/2f_H$ at half-line rate. The unswitched U signal is at the centre of the $\pm 1/2f_H$ swing of the V energy.

If the subcarrier (U) frequency were chosen at an odd multiple of half line rate, this would make V sidebands coincide with luminance. To interleave Y, U and V, it is mandatory that the subcarrier frequency is an odd multiple of *one quarter* line rate. The odd multiple chosen is 1135, but 1133 or 1137 would have worked just as well. Figure 10 shows that, using this frequency, perfect interleaving of Y, U and V is achieved. Note also that there is no spectral component at half line frequencies, a fundamental difference from NTSC.

The subcarrier frequency in PAL is thus fixed at $283\frac{3}{4}$ times line rate, but with offset of 25Hz, which causes residual subcarrier on luminance signals to be out of phase on alternate fields, helping to make the subcarrier invisible to the viewer.

Subcarrier frequency is defined as

$$283\tfrac{3}{4}f_H + \tfrac{1}{2}f_V = 283\tfrac{3}{4} \times 312\tfrac{1}{2}f_V + \tfrac{1}{2}f_V = 88672.375f_V = 4.43361875\,\text{MHz}$$

The V signal can only be decoded properly if the receiver knows the sense of the switch. This information is conveyed by swinging the burst phase, relative to continuous subcarrier, from line to line. A well damped phase-locked loop in the receiver will run at the average phase of successive bursts, but the sense of the phase error in the loop wil follow the burst swing and will reveal the sense of the V switch to the decoder. The swing could not be ±90°, because there would be ambiguity about the average phase. A swing of ±135° corresponds to 90° between the lines.

Spectrum interleaving demands a quarter cycle offset between subcarrier and line frequencies, a direct result of PAL V switch. Burst swing is another direct result of using V switch. The combination of these two gives some interesting results.

The quarter-cycle shift means that subcarrier phase advances by 90° from the start of one line to the next. Burst swing is also 90° from line to line, but alternately avanced and retarded. On some lines then, the 90° advance of the subcarrier cancels the 90° retarded burst, giving no change, whereas on others, the 90° subcarrier advance adds to the 90° advanced burst, causing a 180° change. The result of this is a four-line sequence, containing, relative to H pulses, two identically phased bursts, and two identically inverted bursts. Figure 11 shows these effects.

The two burst phases, normal and inverted, are determined by the state of a squarewave of 1/4 line rate. As 625 will not divide by four, it takes four frames before a given relationship between the burst phase control signal and the vertical pulse repeats. The 25Hz offset is negligible within the four-line sequence described, but it causes the four-frame sequence to contain 2500 unique lines.

This extremely long sequence must never be broken if the signal is to be broadcast, and this adds to the complexity of videotape editors and timebase correctors.

Fig.3A. **Received TV picture by probe antenna**

Fig.3B. **Received TV picture by coconut tree branch**

TREE TV

continued from page 26

the relative permitivity of water alone, which is the dominant content of the green vegetation foliage, is around 80 at microwave frequencies.

In the literature, low-loss dielectric-loaded aperture antennas and dielectric rod antennas are well-known for their directional beam-mode antenna radiation pattern. Low-loss dielectric rods have been used in practice, with Teflon, polystyrene ($\varepsilon \approx 2.5$).

Thus after carrying out indepth studies of the dielectric data cited above, and the works of Zucker, King, Ulaby, Anderson, James et al, weconceived, intuitively, of the idea to use the green vegetation canopy as an antenna structure.

We concluded that a suitably located Papaya tree of height 3 to 5 metres (at 10 to 25km distance) has the properties to pick up Band 3 tv signals from the tv tower, which can be easily tapped by a suitable feeder line probe to the tv set.

However, no attempt was made to optimize the quality of tv picture received by the organic tree antenna structure, either by developing more efficient antenna probes or by adopting antenna arraying techniques. Indepth studies are called for to overcome the effects of hostile environments (wind, rain, snow) and to improve the s/n ratio of the received tv signals before any commercial venture can be thought of.

Continued from page 23

inclusion of $R_{52,53}$, $D_{1,2}$ forming a clamp at zero volts. Capacitors $C_{50,51}$ and C_{52} are bypass capacitors to reduce interference from switching spikes, r.f., etc. Switch-sense points at the junctions of R_x and C_x (S in Fig.1) are each taken to an input of a group of eight-to-one-bit multiplexers (IC_{1-8}) whose inverting outputs D_{7-0} provide a byte which can be read by the computer through the v.i.a. Control inputs of the multiplexers (A, B and C) are taken to a three-bit counter whose clock input is connected to CB_2 (programmed as an output) of the v.i.a. Capacitor C_{53} and R_{60} provide a reset to zero on switch on so that the counter always starts from a known position (see flow diagram).

Thus the whole keyboard is read in eight bytes. This gives a complete bit-map of the state of the keyboard, and some redundancy. After receiving eight clock pulses, the counter is back in its original state. The delay at the third operation in the flow diagram is introduced to allow for any residual key-bounce and for the fact that it is impossible to play all the notes of a chord simultaneously.

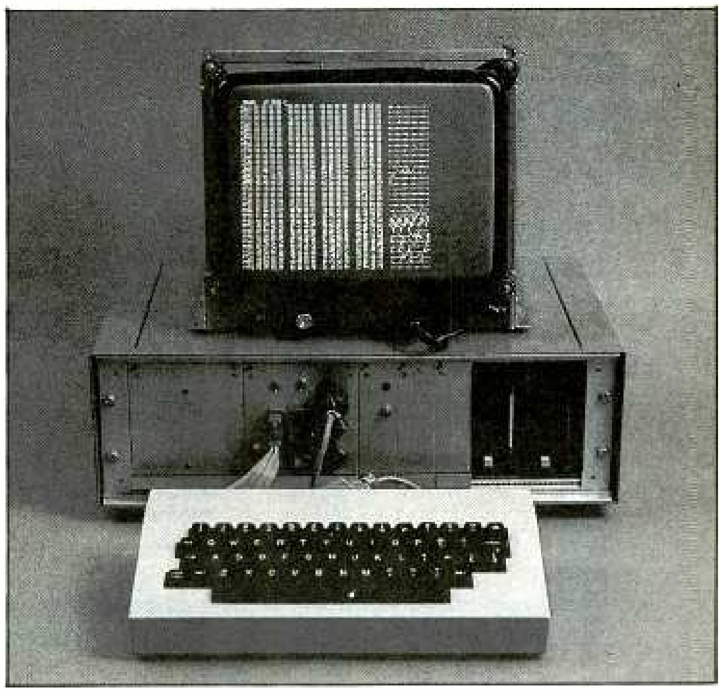
Figure 2 shows that only six of the eight inputs of IC_{1-7} are used, and only seven of IC_8. It would be possible to fit a 48-note keyboard using all the inputs of six multiplexers and it would not be necessary to provide an additional one for the extra note. However this would lead to reading only six bits per byte, causing either wasted memory if the inputs are to be stored or a complex software repacking procedure. Further, unless complicated wiring was used to connect keys to multiplexers (which would not lend itself well to p.c.b. layout), the bit-mapping involved would need extra software. The small additional cost of two extra multiplexers used offers two advantages.

— By taking six keys to each multiplexer (seven on the last one) an octave of 12 notes fits into two multiplexers. This makes it much easier to keep track of which bit represents which note.

— Bit zero (pin four) of all the multiplexers is grounded. Thus the first byte read should be FF (hexadecimal) since the outputs are inverting.

Keyboard software and control are outlined in a second article.

SC84 Micro–computer



The third module of John Adams' disc-based professional microcomputer for engineers and enthusiasts provides a c.r.t. display of more than 3000 text characters, 36000 picture elements, or a mixture of text and graphics.

by J. H. Adams

A visual-display unit, v.d.u., passes information from a computer to its operator. It consists of a display device — a monitor or a tv — and digital circuits to control an area of memory holding a representation of the image to be displayed. Data written into this memory from the computer is read out for processing and combination with control signals to produce the necessary monitor input signals. This being a vital part of a computer, large-scale integrated circuits of varying complexity have been produced to simplify the design of v.d.u digital circuits. There are two fundamental types of v.d.u. circuit, memory-mapped and i/o-mapped.

In a memory-mapped system, memory storing characters to be displayed on the screen is part of the system's addressable memory. The advantage of memory mapping is that the processor can make rapid transfers to and from the v.d.u. — as fast as its own memory cycle — which for a Z80B means 300 000 characters per second. Also, as the memory is under processor control, it is relatively easy to implement unusual screen features such as scrolling the display left or down. The main disadvantage is that the v.d.u. memory takes up memory available for programs unless paging is used and, as the screen resolution and hence the amount of memory required for a display increases, less and less of the addressable memory remains for the program.

Paging is a technique where a block of memory can be temporarily switched in place of another. Use of paging means that v.d.u. memory doesn't appear to take up any space in the main memory map, with the proviso that software that sends information to the v.d.u. mustn't be in the memory segment switched out when the v.d.u. is switched in, and the penalty that v.d.u. access is slowed down by extra switching software. Other problems with memory-mapped v.d.us are the extra circuits required to switch address lines to the v.d.u. memory, the arbitration needed and the screen disturbance which can occur when the c.p.u. accesses the memory. The problem of arbitration is most relevant when dynamic memory, with its need for orderly memory access, is used. As dynamic memory is cheaper and as higher resolution requires more and more memory, this can lead to extra complexity or expense. With static memory it is simply a matter of giving the c.p.u., which will after all control the arbitration process, priority in addressing and accessing v.d.u. memory. The disturbance occurs when the c.p.u. gains control during an active-display period. The v.d.u. control circuits take bytes from memory in an orderly manner and pass them on for processing into video information. When a c.p.u. cycle occurs this is interrupted, the location addressed and the data on the bus lines being different from that planned by the v.d.u. controller. The result is speckling on the screen which, particularly during scrolling can almost obliterate the wanted information. Common solutions to this are to force the video output to the 'black' state during c.p.u. accesses or to only allow access to the v.d.u. during flyback periods — i.e. when the video is naturally suppressed. Unless done carefully, selective blacking can noticeably reduce display intensity; the second solution reduces the rate at which characters can be passed to the screen.

Terminal-type or i/o-mapped v.d.us appear to the c.p.u. as input/output channels, so their advantage is in not occupying any system memory. Their disadvantage is in circuit complexity. Circuits must be provided for receiving and interpreting commands as well as data. For example the i/o-mapped v.d.u. must recognize a request for the character at a particular screen location (including transfer of the screen coordinates — information implicit in a memory-mapped access), or the need to clear the rest of the current display line and return the cursor or next-screen-location pointer to the left-hand margin on receiving the carriage return control character. It is common practice to pass data to

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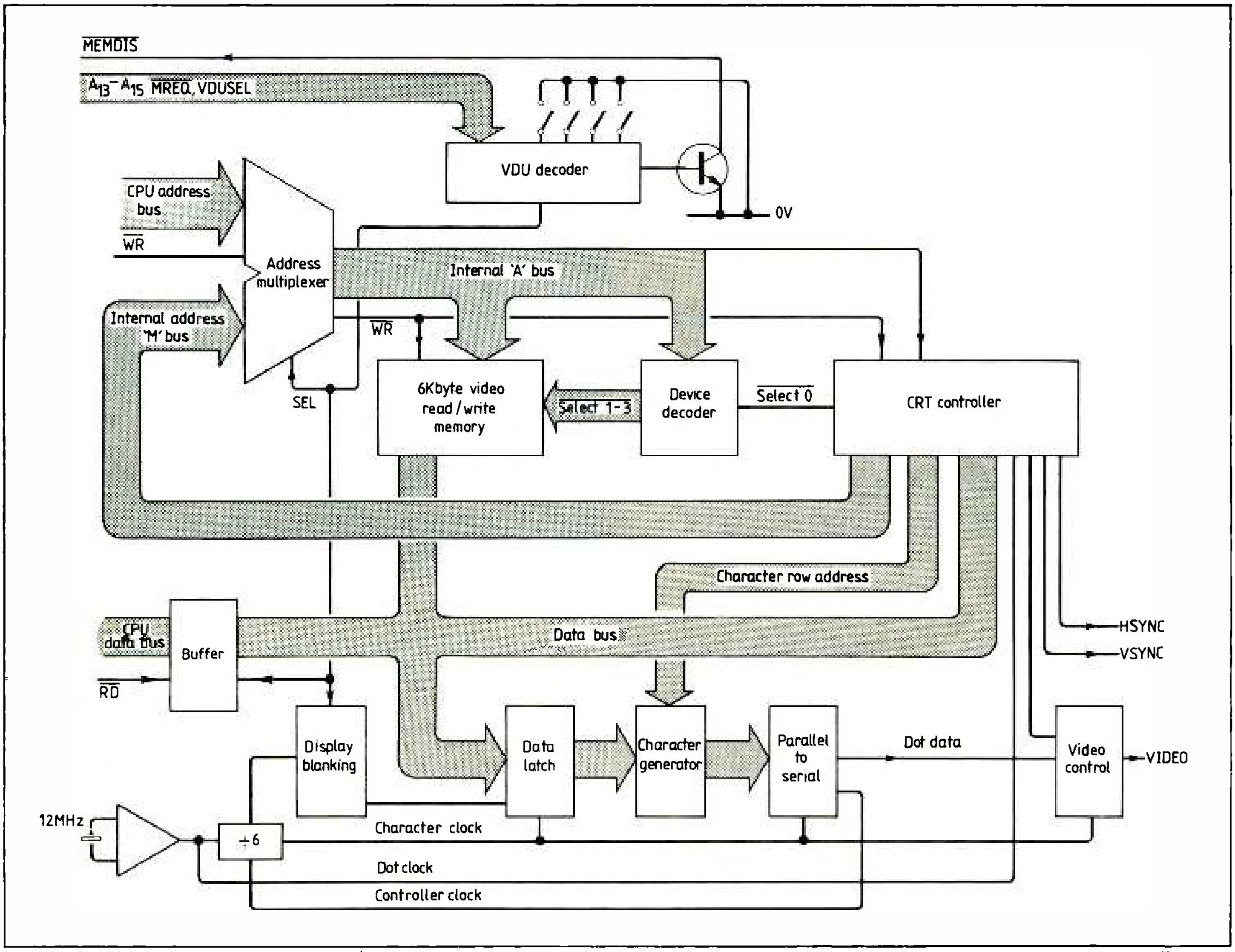


Designed chiefly for fast clear high-density text display, the monochrome v.d.u. section of SC84 is memory mapped and uses the pipelining technique. Output is separete video and sync. signals in either polarity.

Fig.1. SC84's monochrome v.d.u. circuit, right, uses an enhanced version of the 6845 c.r.t. controller with light-pen register and interlaced video facility to give 32 lines of 96 characters and up to 192 by 192 pixels for graphics. Using an eprom character generator is cheaper than using a proprietary rom and allows reprogramming. Switching is included to relocate the v.d.u. section for experimentation.

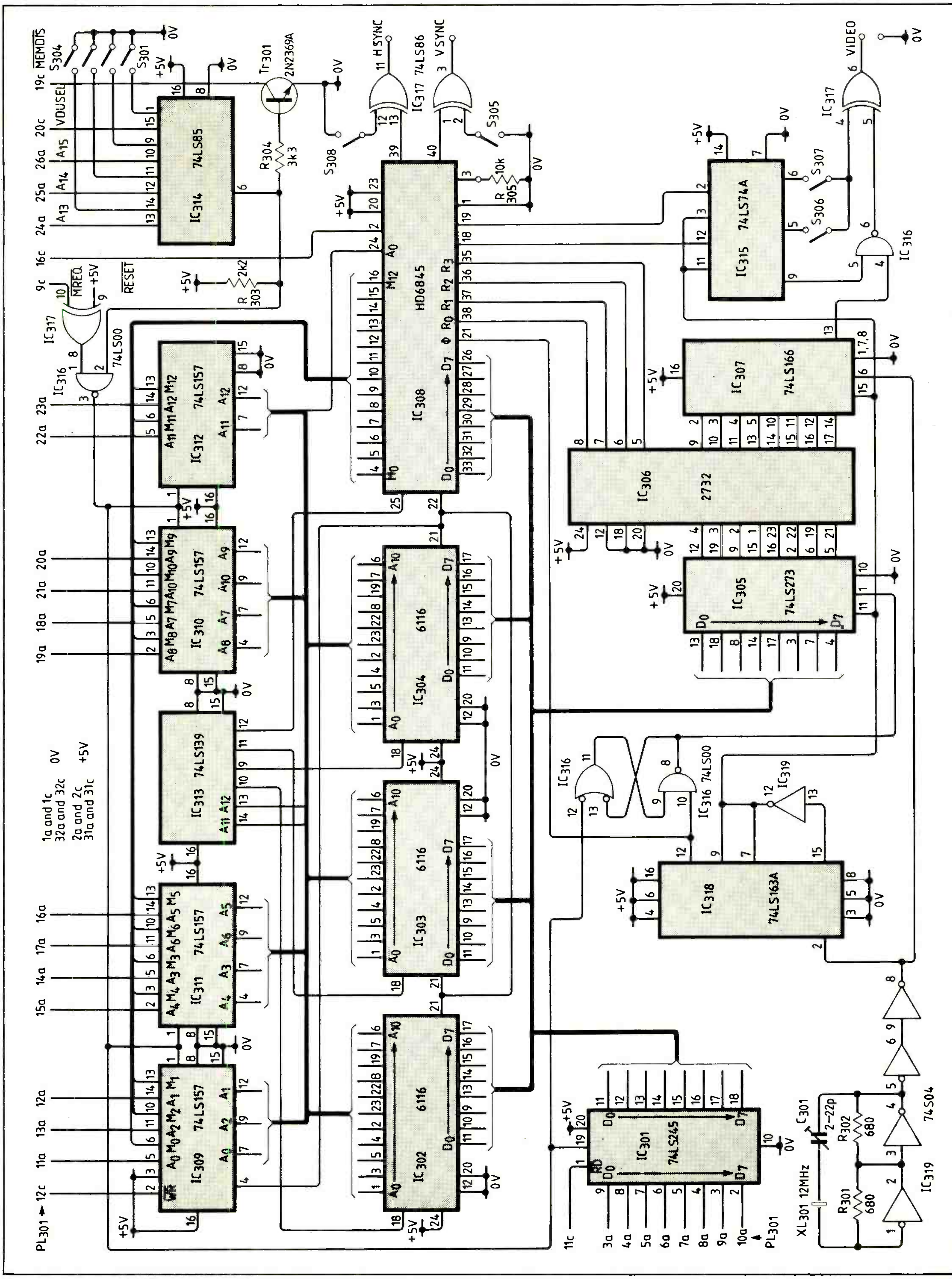
an i/o mapped v.d.u. in serial form, which restricts the character rate to about 1000/s. Processor i/o operations are not so various or fast as memory ones, making something of a bottleneck of the i/o channel, however the possible division of processing between the main c.p.u. and the v.d.u. circuits can lead to a reasonably fast system. Also, as v.d.u. memory only has one controller it can be dynamic without any problems arising.

It should now be apparent that there are pros and con's to both methods. There are further reasons affecting the choice. Wordstar, a popular word-processing program, is an example of software which can work well with either system but which shows off its best features when modified for use with a memory-mapped v.d.u. My solution is to use both systems — a memory-mapped display for monochrome characters and medium resolution graphics and an i/o system for high-resolution colour graphics*. This prompts use of two monitors — a monochrome one for dense character display, where typically close-up use renders a colour monitor tiresome to read unless perfectly adjusted, and a full colour output with the option of character formation.

Controllers

The Hitatchi HD6845S used in this design (until recently numbered HD46505S) is a developed form of the popular 6845 v.d.u. controller. Its advantage to the computer designer is flexibility, virtually all design parameters (e.g. characters per line, lines per screen, sync. pulse length etc.) being stored in registers loaded by the c.p.u. rather than being fixed. In the Hitatchi version capabilities of these registers are extended; these capabilities are used in this design so it is important to use the specified device. While it can be used for graphic displays, its primary intent is as a character-display controller and to this end it has control lines which can be fed to a character generator (a rom which produces dot patterns corresponding to characters placed in the v.d.u. memory), and skewed video control lines, i.e. signals which can be delayed internally by one or two characters periods to allow a technique called 'pipelining' to be used. 'Pipelining' is a technique used in complex v.d.us whereby v.d.u. memory and character generator outputs are latched in synchronism with the character display rate. Whatever the speed of memory accesses, providing they are each shorter than one character display period (500ns in this system), data passes, or is 'piped' synchronously through the v.d.u. Being able to skew the display and cursor enabling systems means that it is easier to ensure that control and data information appear together at the end of the 'pipeline' (see the timing diagram). The controller provides a register for positioning a cursor which can be made to flash, a register for use with a light pen and a facility for interlaced video. Together with multi-

* John Adams is currently working on the high-resolution colour system which we plan to describe in a future article - Ed.


IC314 74LS85
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IC310 74LS157
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IC308 HD6845
IC304 6116
IC303 6116
IC302 6116
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74S04

plexers selecting memory, c.p.u. or controller lines, some high-speed logic too fast to build into the nmos controller, and memory it forms the character v.d.u.

The NEC μPD7220 is one of a new generation of graphics controller designed for i/o mapping but offering a degree of internal complexity which overcomes many of the objections to i/o mapping. Designed to control up to 256K words (1 word = 16 bits) of dynamic memory, it appears to the c.p.u. as two i/o ports and optionally a d.m.a. channel. Using i/o ports for commands and d.m.a. for data, rapid access to v.d.u. memory is possible. For graphic functions such as shape drawing or filling areas, the 7220 can be given parameters and then commanded to draw - which it can do at over one million picture elements (pixels) per second without further c.p.u. involvement. Other internal features are full refresh, zooming (expansion of one part of the display to fill the entire screen) and the option of flash-free memory update (i.e. memory access during flyback period only). Details of the graphics display and of programming techniques for both controllers will appear in a later article.

Figure 1 shows the character v.d.u. circuit. As most c.r.t. controllers, the HD6845S is designed for use in raster-scanning systems, i.e. with a normal, television-like display where the cathode-ray tube spot writes lines across the screen from left to right while being progressively swept down the screen. This means that one character is not completely drawn on the screen before the next. As the spot moves across the screen, successive character codes are taken from v.d.u. memory and just one row of dots from each of the corresponding character pattern is taken from the character generator rom and displayed on the v.d.u. At the start of the next c.r.t. line the v.d.u. memory address reverts to the same value as that of the start of the line but a different row of dots is selected from the character generator. Only when the last dot row has been drawn is the memory address allowed to step to the next area of v.d.u. memory. The number of characters on line and the number of dot rows, or rasters, is set by loading values into the controller when the Z80 is initializing the system. These factors control v.d.u. memory address lines $M_{0\text{-}12}$ and row-address lines $R_{0\text{-}3}$.

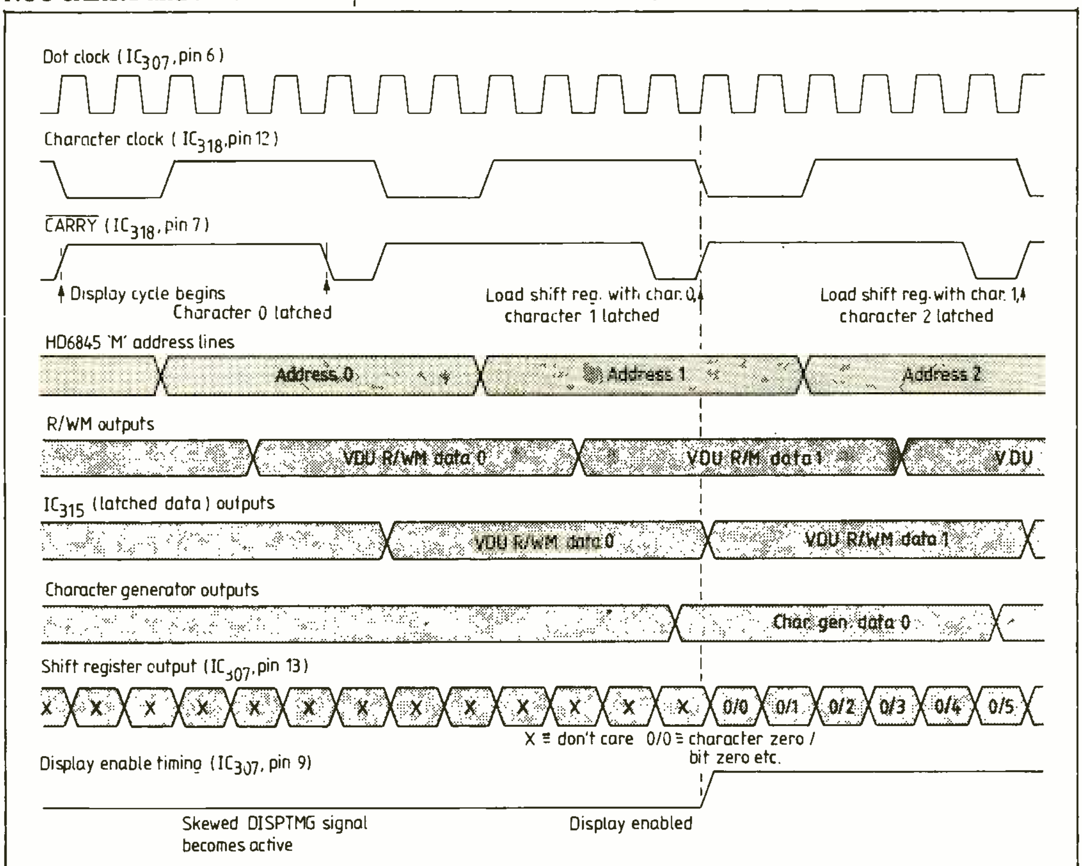
In this system displayed characters are six dots wide by nine dots high; this pattern includes the space (one dot column) between adjacent characters and the space (two dot rows) between adjacent display lines. The two-dot horizontal space is used by lower-case letters with descenders (g, p, q, etc.). The fastest event in the v.d.u. is sending of a pixel to the display and a signal at this frequency is generated by the 12MHz dot-clock oscillator, (IC_{319}). This signal is divided by six in a programmable divider to give a signal running at the character-display frequency, the character clock. This division, and all operations at the dot frequency, is done outside the controller as the frequencies involved are too high for most technology used in the HD6845S. Note that the character generator is an eprom. Not only are they cheaper than proprietary character generator roms but they allow you to change the character set to suit your own requirements. Even the number of dots making up a character can be altered, up to an eight-by-16 matrix, but this is rather advanced work.

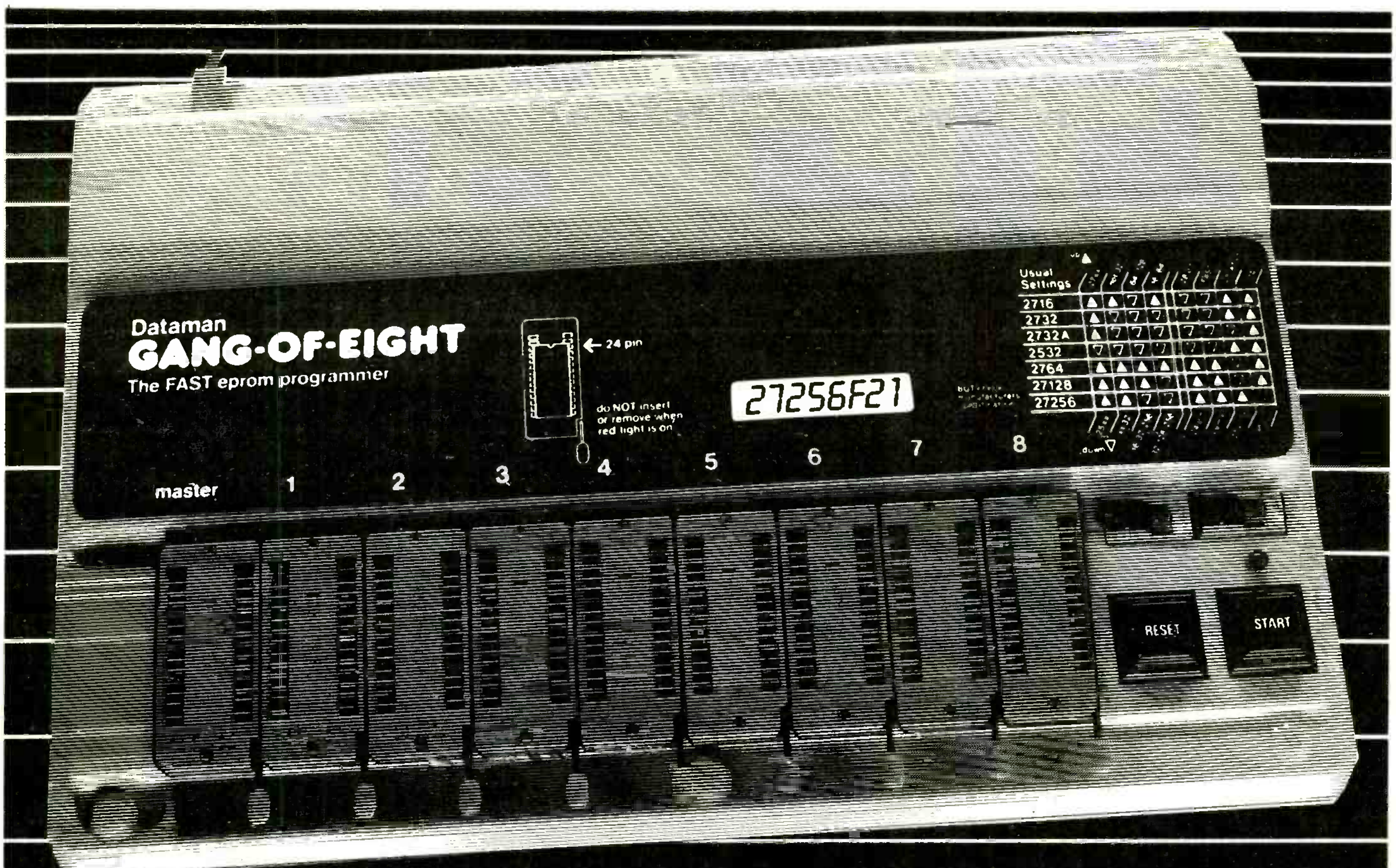
Circuit IC_{318} is a four-bit programmable counter. It provides a 'carry' pulse at pin 15 as it passes through its maximum count value - binary 1111 - and this signal loads the binary value on pins six to three instead of allowing the counter to count on to zero on the next dot clock pulse. This value is binary 1010 - denary 10 - so the counter counts through six states, binary 1010 to 1111, before repeating. Divider output C provides the character clock signal fed to the controller. An inverted carry pulse is used to provide a clocking and/or loading signal throughout the logic outside the controller.

Synchronization is extremely important. As one can see from the timing diagram there are many delays between the rising edge of the character clock initiating the addressing sequence and the production of a dot pattern at the output of the character generator, and between this point and the coming of those dots and control signals for display blanking, etc., from the controller. The timing diagram is to scale and incorporates the worst-case delays specified for the i.cs. Two signals used to synchronize the system are rising edges of dot clock and carry signal. To cope with delays between the controller generating an M-line address and the output of v.d.u. memory settling - a process which might take up to two-thirds of a character period - memory

Continued on page 64

VDU timing. Synchronization in this v.d.u. using 'pipelining' (see text) is critical and depends on two signals — NOT CARRY and the dot clock.





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Improving colour television decoding

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

Viewing tv pictures at work and at home over several years using various decoding methods, David Read found the comb filter method an undoubted improvement with a 26in screen. But inprovements to other video processing blocks are needed to fully appreciate the picture. This postscript recommends an acoustic surface wave filter for i.f. use and discusses other picture enhancement techniques.

Most of the signal-processing improvements that the home viewer can make — to PAL decoding, RGB drive, and wide-band comb filtering — have been covered in this series of articles. One remaining area for investigation is the tuner/i.f. strip. Although the ten-years old design originally described in these pages (1975, Oct-Dec) is still in use and gives good results, particularly with extended comb filter methods of PAL decoding, it is felt that the design and circuit board cannot be recommended for building today — with discrete inductors providing all the i.f. bandwidth shaping and post-demodulator group-delay equalization. It has been remarked that the board looks more like a Manhattan sky line! There is also a daunting setting-up procedure.

Recently, both Signal Technology and Mullard have been manufacturing some excellent surface acoustic wave i.f. filters. The SD155 from signal Technology is flat at frequencies above f_{sc} and has a sound shelf of —16dB though probably not sufficiently down for a single-chip demodulator e.g. TDA 3541, though an LC trap to provide an extra 10dB could readily be added. Over the retailers' counter this could cost £40 to £50 currently, but it is hoped that cable-head companies and set manufacturers will start to use these better quality filters and the price will reduce.

Some of the better filters, for example Signal Technology's SY155 and RW153P have the sub-carrier equivalent frequency (vision carrier minus subcarrier, 35.07mHz), only 0.5 to 2dB down. These will provide the best overall performance with modified LC filters used before the chroma decoder. However, the performance is not good enough to justify the Fig.34 comb filter circuit approach although a much improved picture can be obtained with the alternative LC networks shown last month. This is achieved by using the Fig.77 circuit for the luminance path (Figs 74 and 76 show amplitude and group-delay performance) and the Fig.81 circuit for the chroma path (Figs 79 and 80 give amplitude and delay performance). The chroma circuit can be modified to advantage as shown in Fig.93 (See Figs 94 and 95 for amplitude and delay performance). The modified chroma filter will offer a better chroma bandwidth and reduced 7.8kHz twitter at the chroma transitions if it is adjusted to match the s.a.w. filter response (chroma sideband symmetry optimized), as was similarly indicated in Fig.82.

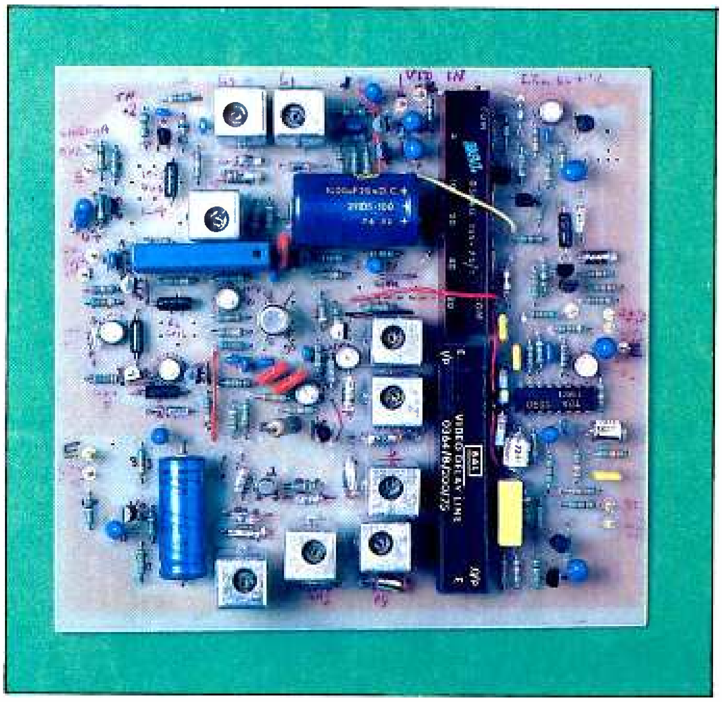
When the s.a.w. filter with the performance of Fig.96 is in use, e.g. the SD155, the best chroma filter is the gaussian band-pass filter of Fig.34. For this Fig.52 shows the amplitude response and Fig.53 the group delay performance, with Fig.52(b) indicating the clean chroma transitions that can be obtained.

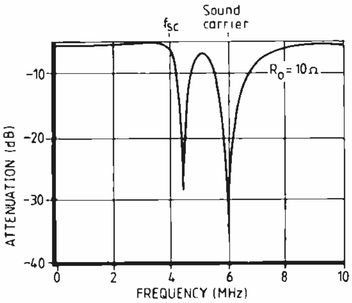
Mullard are expected to introduce two new tuners later this year, the U343 for potentiometer tuning and the U344 for use with a frequency synthesizer. These use low noise, high dynamic range mosfet stages and include the first i.f. bandpass coupling stage and driver amplifier for the s.a.w. filter. The tuner i.f. board then need only comprise a front-end tuner, s.a.w. filter and the integrated i.f. amplifier demodulator TDA3541 together with a few discrete components (ref.11).

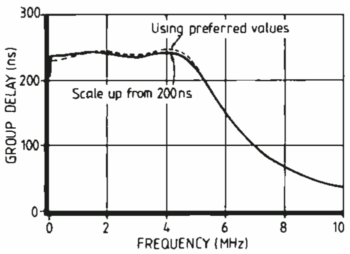
Design of high-grade receiver

For really high quality sound and vision to feed into a comb-type decode, the B.B.C. have designed a u.h.f. tv receiver type RCI/511, being manufactured under licence by SPT Video

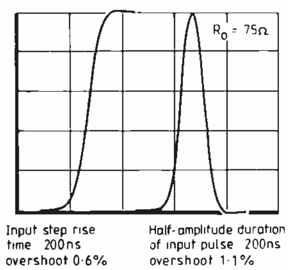
Fig.90. **Board contains PAL modifier and comb luminance filter of Fig.34 together with the optional sync separator sandcastle pulse generator and extra field blanking of Fig.36.**







Errors caused by rounding components of Fig.87 (bottom circuit) to preferred values are shown by the group delay response above (Fig.88).



Group delay ripple and other losses in performance caused by using preferred capicitor values are shown in these pulse-and-step test results (Fig.89).

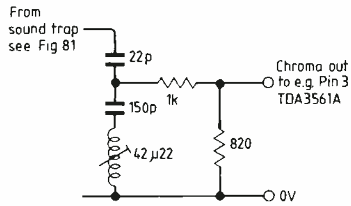


Fig.93. **Circuit of modified chroma-path filter when using the better i.f. s.a.w. filter. Subcarrier (equivalent frequency 35.067MHz) is only 0.5 to 2dB down.**

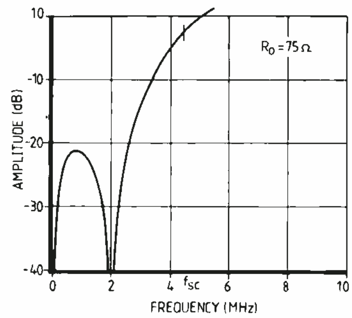


Fig.94. **Amplitude performance of the chroma path filter.**

Limited. This unit has a performance specification of

- Two video outputs at 75Ω: amplitude response ±1dB to 5.5MHz.
- balanced and unbalanced sound outputs: harmonic distortion 0.5% MAX.
- u.h.f. coverage: channels 20-70
- differential phase and gain: 4° and 4% max, 2° and 2% typically.

Physically, it is a 2U high, full bay width unit. Channel setting (tuning) is by front-panel thumbwheel switches which control a synthesiser; a rear D-plug enables remote control. Details of the internal operation are shown in Fig.97; the notes on this block diagram explain the functions.

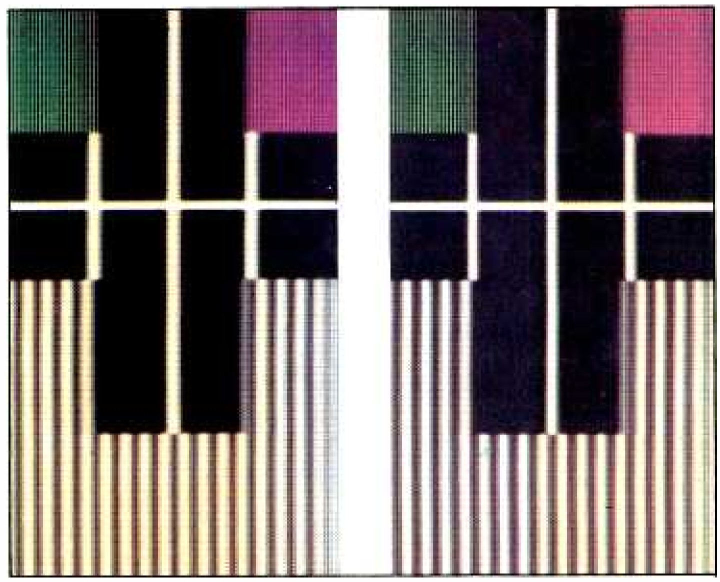


Fig.100. **Resulting picture improvement with scan-velocity off and on (screen photographs taken from a Mullard report).**

Other methods of picture enchancement

There are excellent picture enhancers that rely on picture storage and can provide both horizontal and vertical aperture correction. By recycling the information taken from the picture store with new pictures as they arrive, noise reduction is achieved. But on movement, zonal adaptive techniques are needed to stop cumulative recycling and thus prevent excessive blur.

For the domestic receiver, a simple enhancement technique is to modulate the line scan velocity

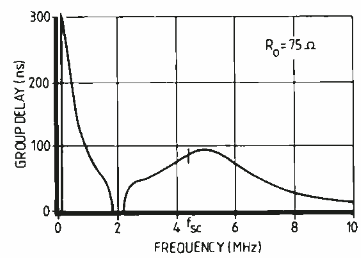


Fig.95. **Group delay response of the high-pass chromafilter.**

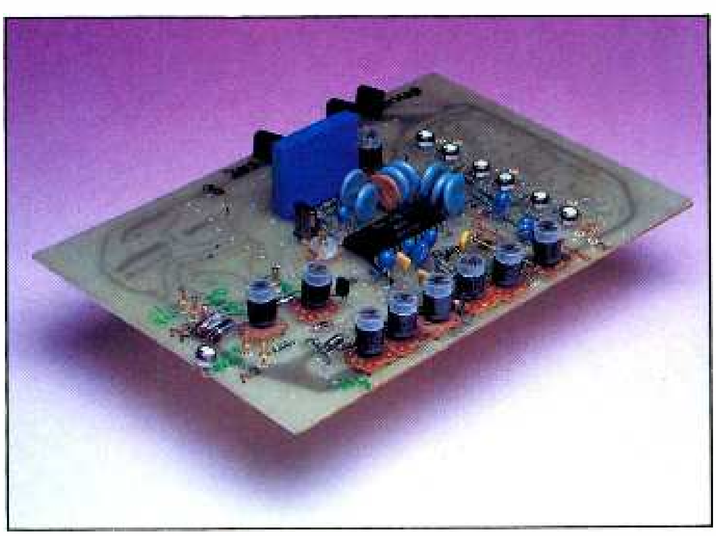


Fig.91. **Alternative self-contained decoder board (Fig. 34 & 36 circuits not used) incorporates TDA3561A with the luminance notch filter of Fig.77 and the chroma high-pass filter of Fig.81, hard-wired at the p.c. board edges. Board also has copper tracks laid out for RGB output stages, if needed for video processing improvement, similar to that in the TX10 receiver (Fig. 41, May issue). Boards available from?**

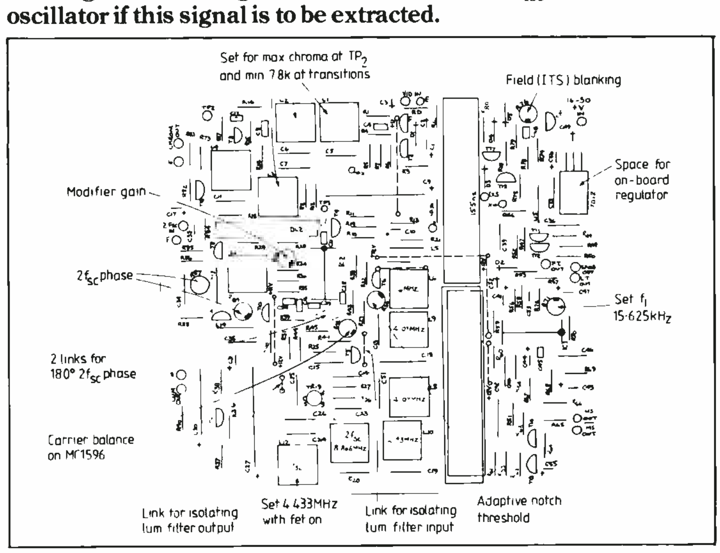
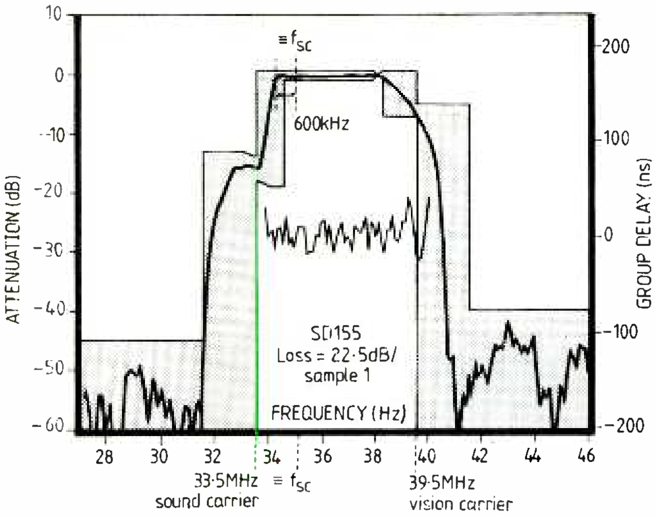


Fig.92. **Component location for PAL modifier comb filter board. It is useful to check the coil bases with the board before winding any coils, particularly the center-tapped ones. Chip provides additionally the 2_{fsc} feed required by the PAL modifier in Fig.34. The sandcastle pulse to the TDA3561A can be supplied from the TDA2591/2/3. These two signals may already be available in existing receiver designs, but check that it is a 2_{fsc} locked oscillator if this signal is to be extracted.**



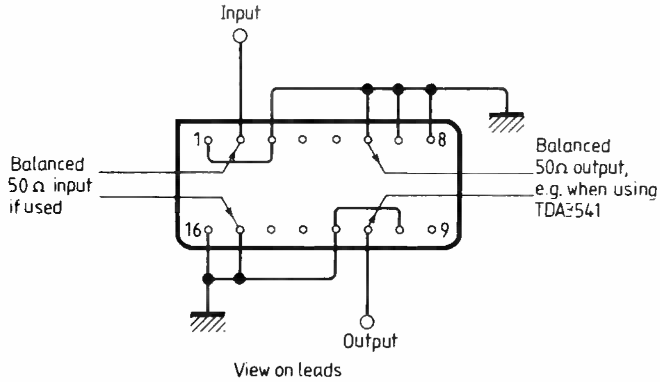
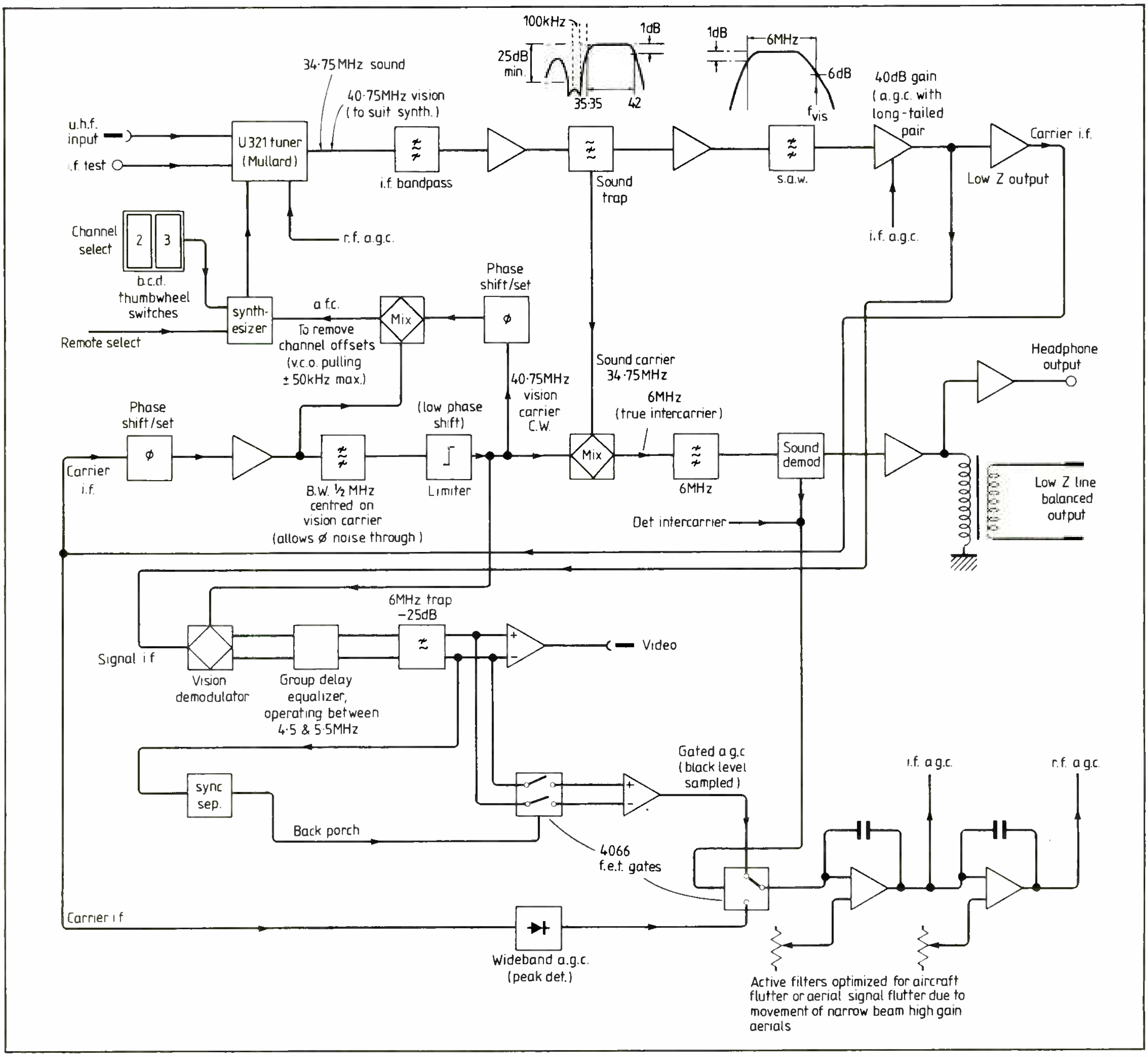


Fig. 96. Amplitude and group delay performance of s.a.w. filter recently introduced by Signal Technology.

Fig. 97. Block diagram of the BBC-designed u.h.f. tv receiver, RC1/511, giving outputs of 1 volt composite video and good quality sound.



Readers of this series puzzled by the numbering of component references on page 33 of the May installment may be reassured to know that it originated from the maker's service sheet and were not shown on the circuit diagram. The BC337s of Fig.41 are transistors 653, 652 & 651 in the text, the BF392s are 659, 658 & 657, and resistors 665, 664 & 663 are the 22k pull-up components at the BF392 bases. Also on that page, the resistor referred to in line three, column three, should be 2.7k and not 2.7Ω In Fig.42, the annotation 'Fig.34' should have read Fig.41. The author also asks us to point out that in Fig.40 the chroma input burst should be 150mV rather than the 250mV shown at pin3 of the i.c. The right-hand ordinate on Fig.86 (page 62, June) was inadvertently cropped, and should of course be labelled with attenuation in dB. Observant readers will have noticed that Fig.60 was a repeat of Fig.69; the correct figure appears in this article. In Fig.24 (page 56 January) please substitute 200ns for the 200μs shown.

Component suppliers

1. Surface wave filters
Signal Technology Ltd, Crompton Road, Groundwell Industrial Estate, Swindon. Wilts.
Tel: 0793-726666 ex. 230.

Mullard Ltd,
Torrington Place, London WC2.
Tel: 580-6633.

Delay lines.
Manor Supplies, 172 West End Lane, London NW3.
Tel: 794-8751.

Future Films
Leamington Street, London W1.
Tel: 437-1892.

Coil formers
Cirkit (Ambit), 200 N.Service Road, Brentwood, Essex.
Tel: 0277 231616.

Parts list for Fig.34,36 one-line comb filter circuits.

Capacitors. Polystyrene ±2% 125V (Suflex, Salford, Lemco)

Value (F)	Circuit reference
220p	13, 7, 24, 36
39p	5
56p	6
620p	18
100p	51, 39
680p	19
150p	20
82p	26, 23
270p	25
27p	34, 35
62p	37
4.2n	46

Disc ceramic or red/blue cap.

10n	4, 8, 12, 16, 21, 45, 48
1n	28, 29, 33
100n	32

Polyester metallized ±10% 100 or 250V (Mullard type 344)

6.8n	40
470n	42
270n	53

Tantalum ±20% (Union Carbide or RS components)

30μ10V	1, 2
22μ15V	3, 17, 31, 30, 22, 47, 55
22μ10V	10
4.7μ25V	44

Electrolytic (Eire, Mullard or equivalent)

1m6.3V 27

Transistors

Type	Circuit reference
2N3904 BG239	1, 3, 8, 9, 10, 11, 12
2N3906 or BC309	2, 4, 6, 18, 5, 18 (reference missing from the circuit: transistor with R36, 38), 13, 14, 15, 16, 17
or VN0610L, or VN2222L, or M991BD/C, or 1167BD	TR19 (f.e.t.)

Integrated circuits

MC796, MC1496 or MC1596 IC_2
TDA2590/1/2/3 IC_1
TDA2593 in the current I.C.
If used +12V regulator μA7812

Diodes

BZY88C6V2	D_1, D_4
BZY88 C4V3	D_5
1N916	D_3

Delay lines

DL_1 Best to make the descrete LC network $Z_0$220Ω or see text for alterations.
DL_2 DL60 or DL700 not critical. Observe R_{18} and R_{28} suit Z_0 of line. See table

Resistors. Mullard MR25 metal film ±2% 0.4W or equivalent metal film ±5% 0.2W.

Value(Ω)	Circuit reference
4.7k	1, 3, 57
470Ω	12, 16, 31, 33, 81
13kΩ	10
10kΩ	13, 15, 47, 63, 74
560Ω	21, 18, 28
150Ω	23, 37
1k	22, 4, 5, 46
680Ω	8, 73, 36
27k	14, 85
100Ω	83, 34, 64, 65
3.3k	82, 38, 86, 88, 90, 66, 79
100k	26, 40
33k	29, 30, 54, 75 (note R_{29} was 22k, R_{30} was 18k using 33k improves modifier balance)
22k	84, 45, 80
12k	41, 49, 69
20k	43 (use 2×10k or 18k if necessary)
15k	44
2.7k	48
2.2k	50, 61, 62
1.5k	52
2.2M*	60 Eire carbon ±5% 0.33W
1.8M*	59 Eire carbon ±5% 0.33W
1.2k	67
82k	68, 55
120k*	70 Mullard MR30 metal film or equivalent ±5% 0.25W
220Ω	53, 56
47k	58, 78
220Ω	72
47	51
1.6k	to pin 5 MC796 (Fig.34) from ±12V rail (component ref. omitted from circuit)
R_D	R_2 and R_D can be set as a potential divider to suit higher video input levels. If high Z in required omit R_2 and set R_D to 470Ω (parasitic oscillation stopper)

Potentiometers (Cermet)

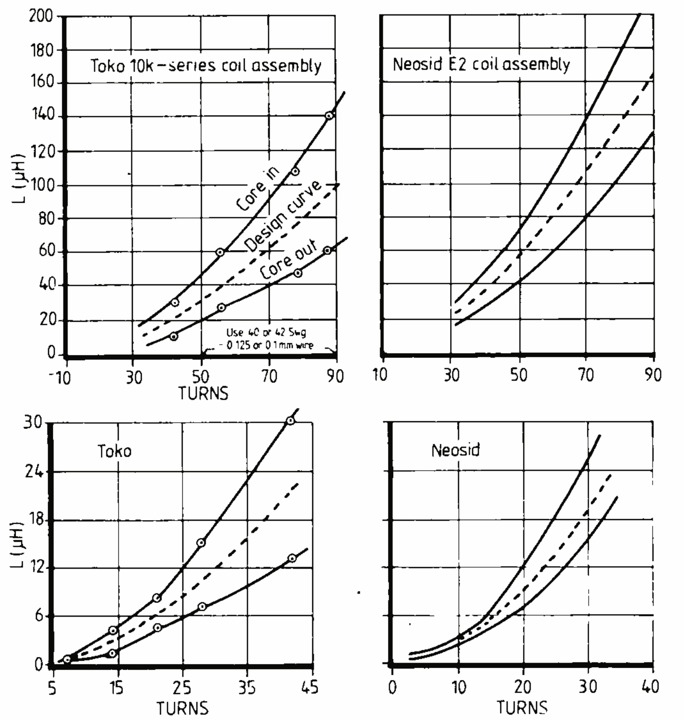
Value	Circuit reference
500Ω	24
1k	32
5k	42, 89
10k	87
100k	76
50k	71

Values determined by DL_1 impedance

Zo	75Ω	800-1kΩ	using LC network 220Ω
R_6	150Ω	1.6kΩ	440Ω (2×220)
R_7	150Ω	1.6kΩ	440Ω (2×220)
R_9	120Ω	—	—
R_{11}	220Ω	820Ω	220Ω
R_{17}	68Ω	150Ω	68Ω
R_{19}	1kΩ	2.7kΩ	1kΩ
R_{20}	510Ω	1.5kΩ	510Ω
C_9	1mF	—	—

Circuit reference	Value		Turns Neosid E2	Toko
1	33μ	Set for max, chroma &	37	55
2	23μ	min. 7.8kHz at transitions	34	42
3	5.4μ		15	18
4	10.5μ	Set for max. chroma, not critical	21	27
5	10μ	Painton or Sigma choke		
6	6μ	Set to notch fsc.	16	21
7	9.7 or 10μ	Painton or Sigma choke	20½	26
8*	14.3μ	resonate top L_8 to 4.07MHz one	13TBIFILOR (13.0.13)	16TBIFILOR (16.0.16)
9*	2μ4μ	end of C_{18} removed. Resonate L_9 with C_{18} connected & short the outer pins of L_8 together.	10	13
10*	16.6μ	Disconnect output end of L_{10}, series resonate the remaining half-coil with the 680pF at 2.93MHz (or use wider signal-bar corner on i.t.s.).	14BIFILOR (14.0.14)	18TBIFILOR (17.0.17)
11	3.8μ	not 3μH as shown in circuit. Resonate at $2f_{sc}$.	13½	16
12	5μ1μ	Set for filter cut-off. — Not critical.	15	18
13, 14	22μ	Painton or Sigma choke		
15	150μ	150μ Painton or Sigma choke		

*It is best to set up A and B group-delay equalizer sections in isolation, i.e. no other equalizer or filter component in the circuit; thus check each stage of the filter and equalizer one section at a time.
L_8 and L_{10} measured across outer pin i.e. total inductance.



in relation to transitions in the increasing video signal. A pair of four-turn coils built into the scanning yoke and placed in the line-scan coil plane provides line aperture modulation of the scanning field. A restricted spectrum of the luminance signal (in the range 2 to 3.5MHz) is amplified, amplitude-limited and used to drive the extra coils in the scan yoke. The block diagram is shown in Fig.98. The additional circuit feeding these coils need only consist of a simple CR differentiator, back-to-back diode limiter and class B output amplifying transistors. The waveforms of the system are as shown in Fig.99 and the display picture shown in Fig.100 illustrates 'before and after' the application (screen photograph taken from a Mullard publication).

Picture enhancement with colour-transient improvement circuit

It is possible to improve the R G B signal where the chroma bandwidth has been restricted to suppress crosscolour, resulting in risetimes in excess of 500ms. On improving (speeding up) the risetimes, care has to be taken not to exaggerate the crosstalk (e.g. increased U/V 12.5Hz flicker).

By using a switched equalizer under the control of the differentiated luminance signal (to minimize cross-colour increase), the U and V i.e. B—Y and R—Y chrominance steps can be improved. This is possible because of the good correlation between the luminance and chrominance picture information. An i.c. to improve colour transients is the Mullard TDA4560, shown in Fig.101. This uses the differentiated input R—Y and B—Y chroma to control and chroma delay switching. The effect of using such techniques is for a chroma positive-going transition as seen in Fig.102.

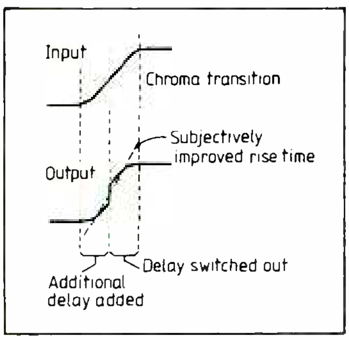


Fig.102. **Waveforms showing chroma edge enhancement by delay switching.**

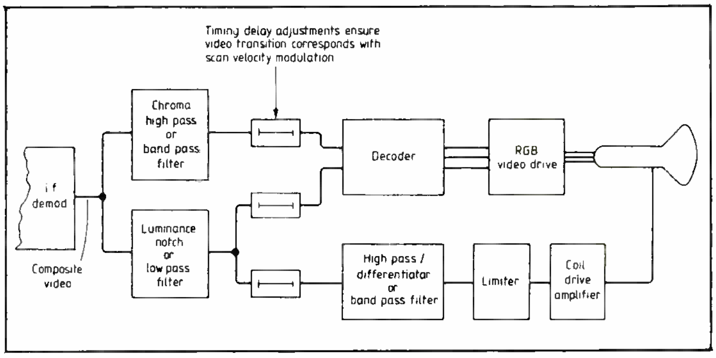


Fig. 98. **Block diagram describing a method of scan-velocity modulation to improve picture sharpness.**

Picture enhancement techniques and various methods of aperture correction can have adverse effects - multiple images and movement blur - viewers have said that the picture appears as if looked at through speckled glass. Also if the noise spectrum lies in the 2-3MHz region, noise on the final picture can be increased. After viewing many live programmes it was concluded that it is better to get back more of the signal as originally generated at source.

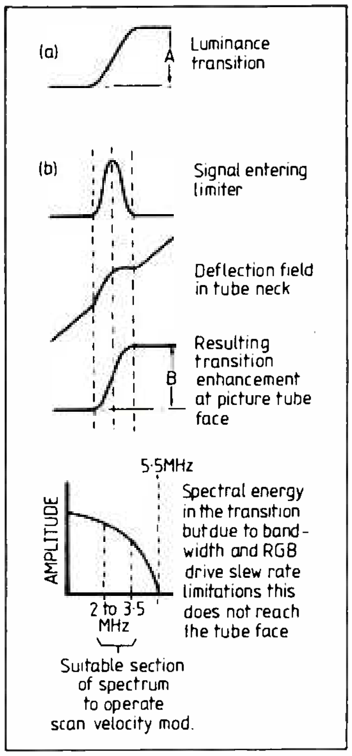


Fig.99. **Example of waveforms occurring in a scan-velocity modulation circuit.**

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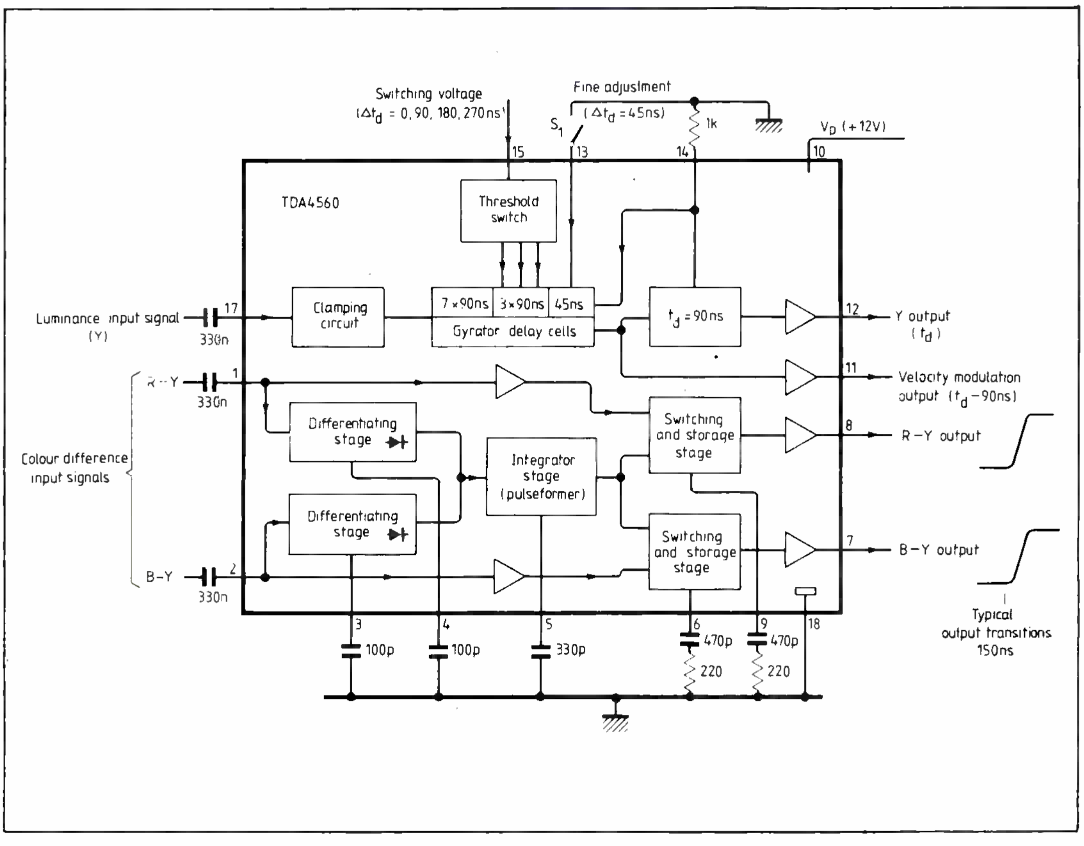
10. P.G.J. Barten and J. Kaashoek. 30AX Self-aligning 110° In-line Colour TV Display. Mullard Technical Note 119.
11. P.J.M. Sijbers and J. Zeelen (Philips Technical). One i.c. and a SAW-filter in a high-performance vision i.f. channel. *Electronic Components and Applications.* vol.5, no.1. Nov.1982.
12. A. Oliphant, 1982. Weston Clean PAL BBC Research Department Report. 1980/1.

Fig.101. **Functional block diagram of an available i.c. for colour transient improvement (taken from the data sheets for the TDA4560).**



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2000	82.27	5.00
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2		1	4.25	1.20
4		2	4.91	1.60
6		3	7.69	1.60
8	A	4	8.98	1.60
10	M	5	9.82	1.80
12	P	6	10.89	1.90
16	S	8	12.97	2.12
20		10	17.46	2.44
30		15	21.69	2.64
60		30	44.45	OA
83		41	51.20	4.50

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72/96-V		36/48V	Price	P&P
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2	A	4	14.69	2.20
3	M	6	17.79	2.40
5	P	10	32.23	3.20
6	S	12	40.36	3.50
8		16	44.03	3.75

50/25V or 25-0-25V
2×25V Tap Secs. 5, 7, 8, 10, 13, 15, 17, 20, 25, 30, 33, 40, 20-0-20 or 25 0-25V

50V		25V	Price	P&P
0.5		1	4.13	1.40
1		2	5.03	1.50
2	A	4	8.69	1.84
3	M	6	10.36	1.90
4	P	8	14.10	2.12
6	S	12	18.01	2.20
8		16	24.52	2.70
10		20	30.23	3.00
12		24	36.18	3.20

60/30V or 30-0-30V
Pri 2x120V. 2×30V Tap Secs 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60, 24-0-24 or 30-0-30V.

60V		30V	Price	P&P
0.5		1	4.70	1.50
1		2	7.15	1.50
2	A	4	9.20	1.90
3	M	6	13.31	2.00
4	P	8	15.15	2.20
5	S	10	19.16	2.20
6		12	21.86	2.65
8		16	30.72	3.00
10		20	35.76	3.30
12		24	41.22	3.50

MINIATURES

Sec V	A	Pri	P&P
3-0-3	.2A	3.11	.90
6×2	1A×2	3.45	1.20
9-0-9	.1	2.59	.90
9×2	.33×2	2.41	.90
8,9×2	.5×2	3.36	1.20
8,9×2	1A×2	4.27	1.40
15×2	.2A×2	2.41	.90
12-0-12	.05	3.11	.90
20×2	.3×2	3.39	1.20
20×2	.15×2	1.50	.50
20,12,0			
12,20	.9	4.13	1.30
15,20-2	1A×2	5.60	1.60
15,27×2	.5×2	4.83	1.40
15,27×2	1A×2	7.30	1.60

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2	A	4	6.99	1.60
3	M	6	8.10	1.85
4	P	8	9.67	1.90
5	S	10	11.95	2.00
6		12	13.52	2.00
8		16	18.10	2.26
10		20	20.88	2.26
12		24	23.20	2.50
15		30	26.60	3.00
20		40	35.64	4.83

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500	13.30	2.24
1000	24.14	2.80
1500	28.17	3.20
2000	42.14	4.00
3000	71.64	4.80
5000	108.30	OA

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80	9.35	1.60
150	12.10	1.90
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1000	33.74	2.80
2000	60.47	4.50

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6KVA	£1743.00
7.5KVA	£2073.00
10KVA	£3347.00

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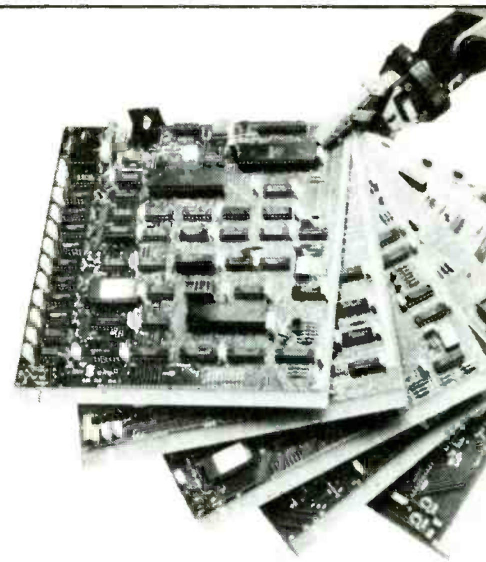

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HENRYS RADIO
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Multi-standard modem

by Richard Lambley

Details of the line interface and software requirements, plus some telephone numbers to dial

The line interface follows the pattern shown in Fig.3 of the article in the May issue. In the direct-connect version of the modem, op-amp IC_{10} duplexes the transmitted and received carriers. Resistor R_{44} is the terminating resistor for the telephone line. A cmos analogue switch IC_9 provides loopback of the transmitted signal to the receiver input when S_2 is in test position; but in a direct-connect modem, this i.c. and its associated components (Tr_2 and Tr_3 etc.) should be omitted, since there will be sufficient coupling around the duplexer. If IC_9 is not fitted, a link must be wired between pins 8 and 9 of its location on the p.c.b.

When a call is in progress, the modem holds the telephone line by means of the gyrator network around Tr_5 and Tr_6. This arrangement is taken from a Mullard circuit* widely used in commercial modems. No heat-sink is required for Tr_5. The capacitors in the line interface may have to withstand ringing voltages and transients on the line, and so it is important to fit suitably rated types: for the prototypes, 250V metallized film capacitors were chosen.

If the constructor does not intend to add an auto-dialler, there is no need for RL_2, RL_3 or their associated components R_{49}, R_{51} and C_2; but a wire link should be added in place of the contacts of RL_2.

The spark gap across the telephone line is included for safety, although some commercial modems do without. It should be able to withstand the voltages developed during ringing without breaking down. Suitable types are available from Electrovalue Ltd.

*LSI circuits for teletext and viewdata: the Lucy generation. Mullard Technical Publication M81-0001, June 1981.

The auto-answer circuit is isolated from the line by an opto-coupler IC_{11}. The zener diodes are to protect IC_{11} against damage by over-voltages and to define a threshold level below which it will not respond. An a.c. ringing voltage causes the level on pin 3 of the inverter (IC_{16}) to fall, triggering the monostable. The telephone will continue to ring for a few seconds until the second monostable is triggered by the rising edge at IC_{16} pin 4.

At this point, pin 1 of the Am7910 is pulled low, causing it to begin its answering sequence, and the line-seize relay RL_1 closes. The time constant of the second monostable is about 30 seconds, which should allow enough time for the calling modem to establish communication. Control of RL_1 then passes to the CD or BCD outputs of IC_8: if the incoming carrier is lost the relay will be released and the call terminated.

To enable auto-answering, it is necessary to disable RTS until the answer sequence of IC_8 is complete. For this reason the amendments shown in Fig.3 should be made to the computer interface section of the modem. The additional connection to pin 16 of IC_8 is to ensure that the DTR signal is removed briefly between auto-answered calls. Without this, the modem will not generate its burst of answer tone.

However, a problem may arise if a large transient occurs on the line as S_3 is moved. The first monostable in IC_{12} may be triggered, removing DTR temporarily. If this happens, a way of dealing with it is to inhibit the monostable except when auto-answering is enabled. Omit C_{40} and R_{58}, but connect pin 6 of IC_{16} to pins 3 and 11 of IC_{12}.

If the components of the auto-answer section are ommitted entirely, a 47kΩ resistor must be inserted between pins 12 and 16 of the IC_{12} position to ensure that pin 1 of the Am7910 is tied high.

Note also that the dotted links LK_{10} and LK_{12} in last month's circuit diagram are shown reversed: if a full RS232 interface is required, the RTS input of IC_8 should be linked to pin 11 of IC_5 and the BRTS input to pin 8 of IC_5.

Components

The Am7910 integrated circuit is stocked by AMD distributors, including Quarndon Electronics and Hawke Electronics; the unit price is £32.80 excluding v.a.t. This and other semiconductor devices for the project together with the crystal, the relays and the connectors are available from Technomatic Ltd (see address list). The Am7910 is also stocked by Maplin Electronics.

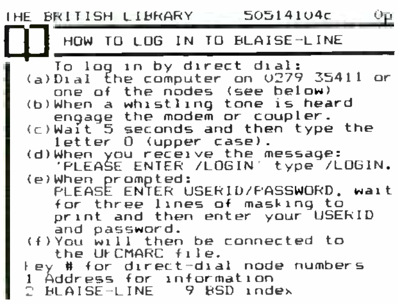
The two transformers can be supplied for £5.70 the pair, including inland postage and v.a.t., by Barrie Electronics.

A printed circuit measuring 160 by 200mm will be available from July 10 from Combe Martin Electronics, for £16 inclusive. The board, a prototype of which was shown in last month's article, is double sided with plated-through holes.

Software

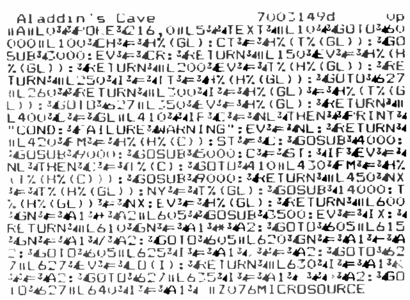
To control the modem, a suitable communications program is needed. In its simplest form, this would configure the serial port to transmit and receive at the required rate. It would then route data arriving from the modem to the screen, and direct data from the keyboard to the modem.

In a practical program there would also be facilities for selecting the data word length, parity and stop bits, for controlling the display format and for transferring disc or cassette files to and from the modem.



Logging on, or in: like Prestel and many commercial databases, the British Library's BLAISE system asks for passwords.

The start of a program in Apple Basic, in Prestel telesoftware format. With the help of suitable communications software, a complete program can be down loaded automatically in about the time it would take to load from tape.



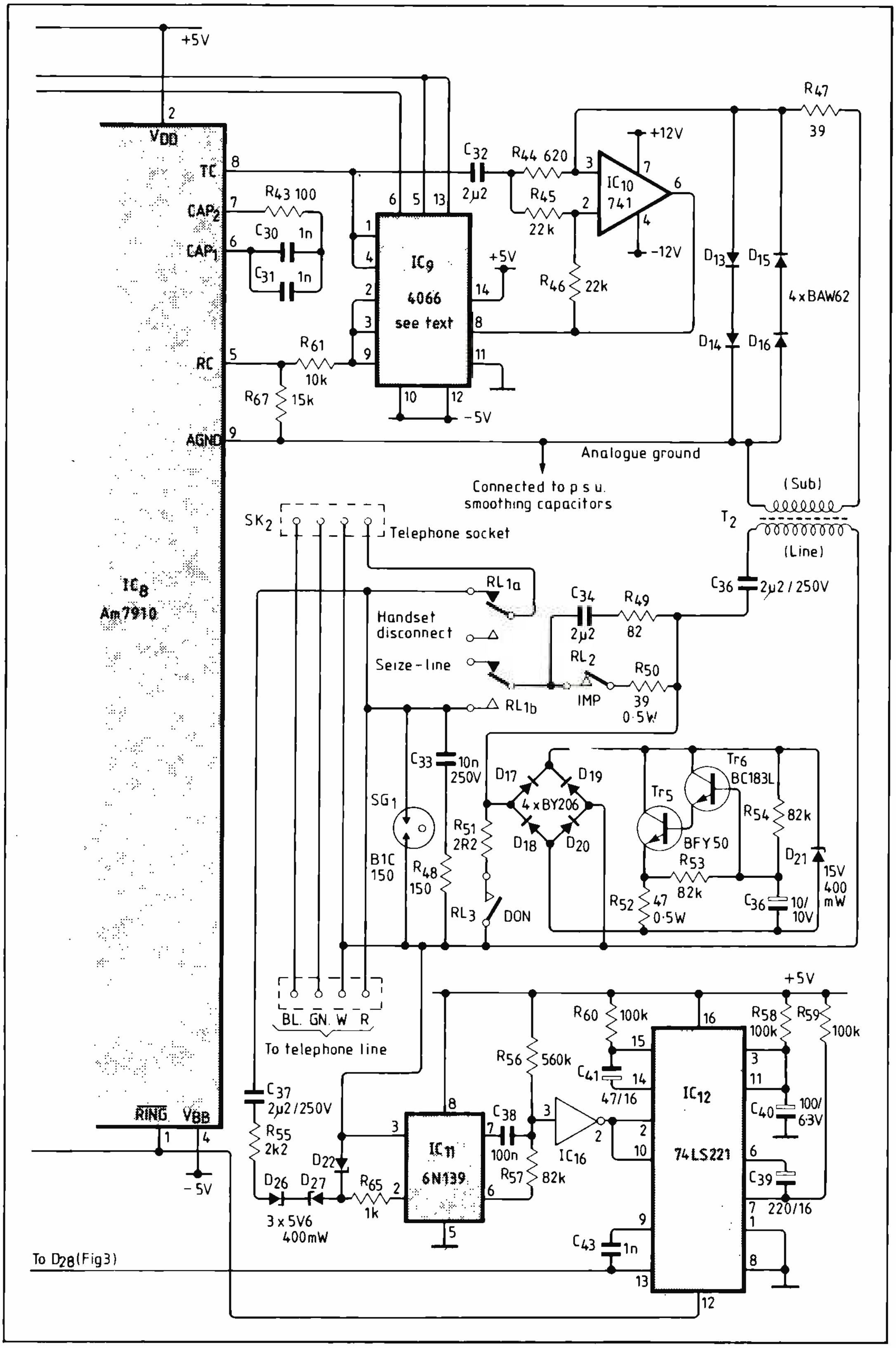


Fig.1. Line interface, and auto-answer section. Isolation from the line is via a transformer and, for the ring detection circuit, an opto-coupler. An auto-dialler could be added by the user if required.

Other useful options include the ability to send Xon and Xoff commands to halt temporarily the output from the distant computer, and to echo incoming characters back to it: this allows the other operator to see what he is typing. There may be some advantage too in redefining the output of certain keys on the keyboard. In particular, the effect of the delete key seems to vary from one computer to another. For Viewdata systems such as Prestel it is convenient to have the return key send a # character.

Some of the bulletin board systems listed here have adopted the so-called Christensen or Xmodem protocol for file handling. This protocol allows virtually error-free transfer of Ascii text or program files over event the poorest lines. The file to be sent is transmitted in 128-byte blocks, with error-checking on each block. If an error arises, the receiving computer asks for the block to be sent once more. Error-checking is used also in viewdata terminal programs for telesoftware file downloading.

Viewdata software for a variety of home and business computers is available from Micronet 800. For the 300 baud modes, Maplin Electronics can provide modem interfaces and software for the ZX81, Spectrum, Dragon, Oric, VIC 20 and Commodore 64.

For the BBC Microcomputer there is a wide choice of software, including packages in eprom. Computer Concepts' communicator (16Kbyte) provides emulation of a DEC VT100 terminal. It gives very extensive control of transmission mode and display format and includes such features as storage of telephone numbers for an auto-dialler. Communicator costs £59.

A rom of especial interest to bulletin-board users is Pace Software's Commstar (8Kbyte). This provides software handshaking, file transfer facilities using the Christensen Xmodem protocols and numerous other features. Current versions have a Prestel mode which supports colour Viewdata graphics (including double-height characters) and can download telesoftware. The price is £34 including v.a.t.

Software for the TRS-80 is available from Molimerx Ltd, who offer two communications packages: Smart Terminal at £25.30 and Modem 80 at £30.48.

A communications program to run under CP/M-80 is available to members of the CP/M User's Group. Details, in return for a stamped addressed envelope, from the group at 72 Mill Road, Hawley, Dartford, Kent. Individual membership costs £7.50 per year.

Logging on

First select the appropriate signalling standard and mode using S_1 and S_2. At this stage S_3 should be in the centre off-line position. Dial up the computer of interest; and when its answering tone is heard move S_3 to the on-line position. This will establish communication, disconnecting the telephone handset at the same time. With some of the bulletin board systems listed in the box, it may then be necessary to type a few carriage returns to start things off.

At the end of the call, S_3 should be moved back to the centre position to break the connection. In the Viewdata mode, disconnection occurs automatically when the Prestel computer drops its carrier. This may happen prematurely if the RTS signal is removed: as this may occur momentarily while files are being saved to cassette or disc, it may be best to fix RTS permanently on in the modem. This can be done by linking pins 13 and 14 of IC_5; it may then be wise to cut the track between pin 13 and the 25-way socket to avoid contention when the full RS232 interface is used.

The third position of S_3 allows the modem to auto-answer calls from other computers. This facility is allowed only in the 300 baud 'answer' modes and in V.23 mode with S_2 set to 'reverse'.

Acquisition of a carrier in the back channel is indicated by LED_1, and in the main channel by LED_2. LED_3 lights when the circuit is powered and flickers during transmission of outgoing data. When a call is auto-answered, LED_4 lights; and LED_5 comes on when the modem is holding a line.

To test the modem off-line, set S_2 to the test position. The modem should then echo characters typed at the keyboard back to the screen. Note that this test may not work in the V.23 mode, since the Viewdata terminal software will set the RS232 driver and receiver to different data rates.

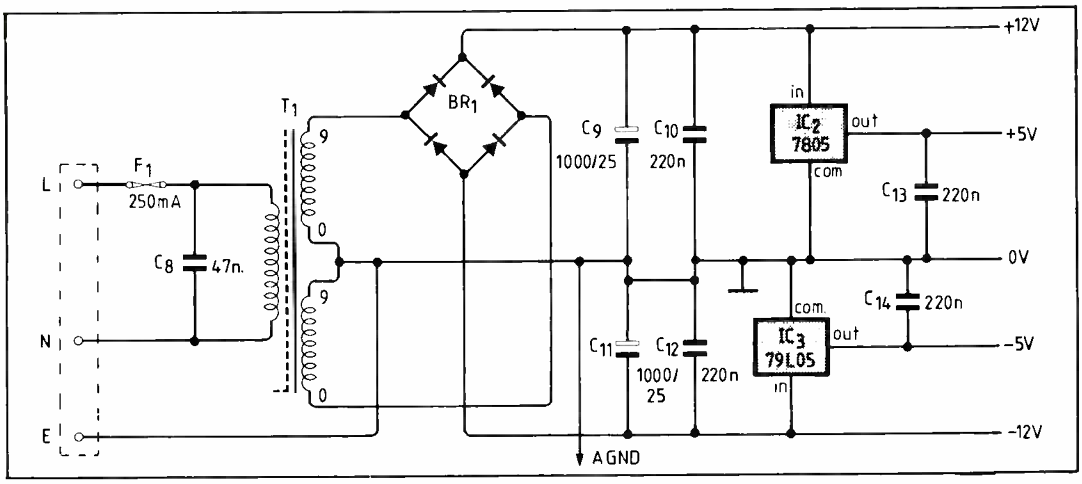
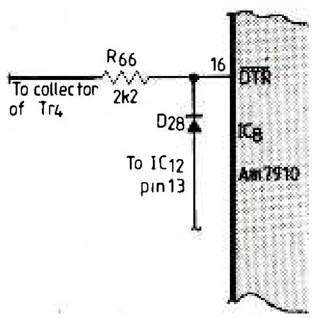


Fig.2. **Space for this power supply is provided on the p.c.b.**



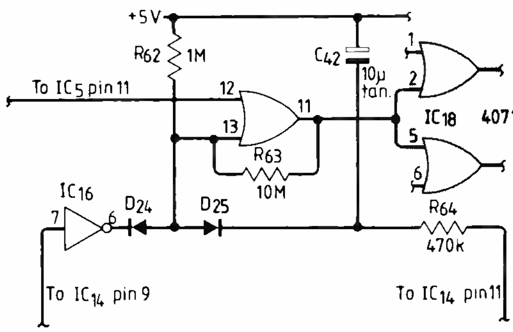


Fig.3. Disabling RTS and DTR during the auto-answer sequence. This addition has been incorporated in the p.c.b. for this project.

Some databases to try

The following 'bulletin board' systems are run by private individuals on a voluntary basis. No charges are made for use of their facilities, which include message handling, software downloading and news. Forum-80 systems use a seven-bit word with even parity and one stop bit; others have an eight-bit word with one stop bit and no parity bit.

Beware of 1200/75 systems: some use the same data format as on their 300 baud modems, and may not be compatible with Prestel terminal software.

CBBS Chiltern: 07073-28723, 07073-39241, 18.30-22.30h, Monday and Wednesday.
CBBS Cumbria: 069-92314*, 1800-2200h daily. V.21, Bell 103 and 1200/75 baud V.23.
CBBS Southwest: 0626-890014, 24 hours, V.21 and 1200/75 baud V.23.
CBBS Surrey (Woking): 04862-25174, 24 hours.
MG-NET CBBS (London): 01-399 2136, Sunday only, 17.00-22.00h.
CABB, *Computer Answers* bulletin board (London): 01-631 3076, 24 hours. Also weekdays on 1200/75 baud V.23.
Forum-80 (Hull): 0482-859169. Tuesday and Thursday, 19.00-22.00h; Saturday and Sunday, 13.00-22.00h. Night-time service for U.S.A. using Bell 103 tones, 00.00-08.00h.
Forum-80 (London): 01-902 2546, evenings and weekends.
Mailbox-80 (Liverpool): 051-428 8924, 24 hours.
Mailbox-83 (West Midlands): 0384-635336*, 17.30-08.30h daily and all day Sunday.
Manchester BB: 061-427 3711, Sunday-Thursday 22.30-00.0h, Friday 13.30-02.00h, Saturday 22.30-02.00h.
Microweb (Stockport): 061-456 4157, 24 hours. For users of the BBC Micro.
TBBS City (London): 01-606 4194, 24 hours. 1200/75 on Wednesdays.
TBBS London: 01-348 9400, 09.00-01.00h with CCITT V.21 tones, 01.00-09.00h with Bell 103 tones.
TBBS Southampton: 0703-437200, 17.00-08.00h weekdays, all day at weekends.
North Birmingham BBS: 0827 288810*, 24 hours.
Blandford Board: 0258-54494, 24 hours.
Stoke ITEC BB: 0728-265078, 24 hours.
Southern Bulletin Board: 0243-511077, 24 hours.
BASUG (British Apple Systems User Group board): 0742-667983, 24 hours.

The following commercial systems, operated by electronic component suppliers make no charge to users except where shown:

Distel (Display Electronics Ltd, London SE19): 01-679 1888 (V.21). A 1200/75 baud service is to be added: test port on 01-679 6183.
Estelle (STC Electronic Services, Harlow, Essex): 0279-443511 (V.21), 0279-442288 (V.23), business hours.
Rewtel (Cirkit, formerly Ambit International, Brentwood, Essex): 0277-232628. Some facilities are available only to subscribers.
Maptel (Maplin Electronics Ltd, Southend-on-Sea): 0702-552941.

Viewdata

Prestel Microcomputing: details from Micronet 800, Scriptor Court, 155 Farringdon Road, London EC1R 3AD. Enquiries, 01-278 3143. The quarterly subscription of £13 (for domestic users) gives access to Micronet 800, Viewfax 258 and all sections of Prestel not restricted to other closed user groups.
Prestel: for information ask the operator for Freefone 2296.
*'Ring back' systems: dial the number, let it ring once, replace the handset and then dial again.

Addresses

Barrie Electronics Ltd, Unit 211, Stratford Workshops, Burford Road, London E15 2SP; 01-555 0228.
Combe Martin Electronics, King Street, Combe Martin, Devon EX34 0AD.
Computer Concepts, 16 Wayside, Chipperfield, Hertfordshire WD4 9JJ; 09277-69727.
Electrovalue Ltd, 28 St Jude's Road, Englefield Green, Egham, Surrey TW20 0HB; 0784-33603.
Maplin Electronic Supplies Ltd, P.O. Box 3, Rayleigh, Essex SS6 8LR; 0702-554155.
Molimerx Ltd, 1 Buckhurst Road, Town Hall Square, Bexhill-on-Sea, East Sussex; 0424-220391.
Pace Software Supplies Ltd, 92 New Cross Street, Bardford BD5 8BS; 0274-729306.
Technomatic Ltd, 17 Burnley Road, London NW10 1ED; 01-452 1500.

CIRCLE 09 FOR FURTHER DETAILS.

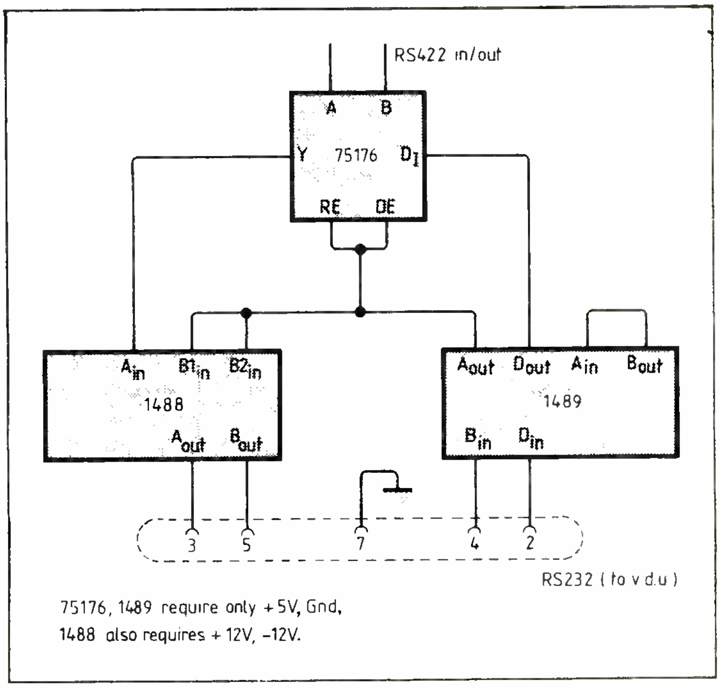
CIRCLE 14 FOR FURTHER DETAILS.

CIRCLE 68 FOR FURTHER DETAILS.

RS422/RS232 converter

RS422 is a half-duplex data-link standard and, being balanced, allows greater distances to be covered and higher data rates than are possible using RS232. It can also be used with one transmitter and several receivers ('multi-drop'). This circuit provides RS422 and line monitoring using an RS232 v.d.u. or computer.

Normally, the circuit is in receive mode and the v.d.u. monitors the line. When a key is pressed, line four on the RS232 interface is inverted and the 75176 transmits the character. Receive mode is resumed on key release. Line five provides information on the direction of the line and may be omitted. Essentially, the circuit is a level converter and therefore independent of data rates. Note that direction reversal time on an RS422 line can be far shorter than that of a simple v.d.u., which can lead to apparent loss of characters. A twisted pair should be used for the 422 line as the 75176 is very sensitive, and care should be taken with layout.



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Perthshire

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We prefer circuit ideas with neat drawings and widely-spaced typescripts, but we would rather have scribbles on "the back of an envelope" than let good ideas be wasted. Submissions are judged on originality or usefulness — not excluding imaginative modifications to existing circuits so these points should be brought to the fore, preferably in the first sentence. Minimum payment of £30 is made for published circuits, normally early in the month following publication.

Isolated video driver

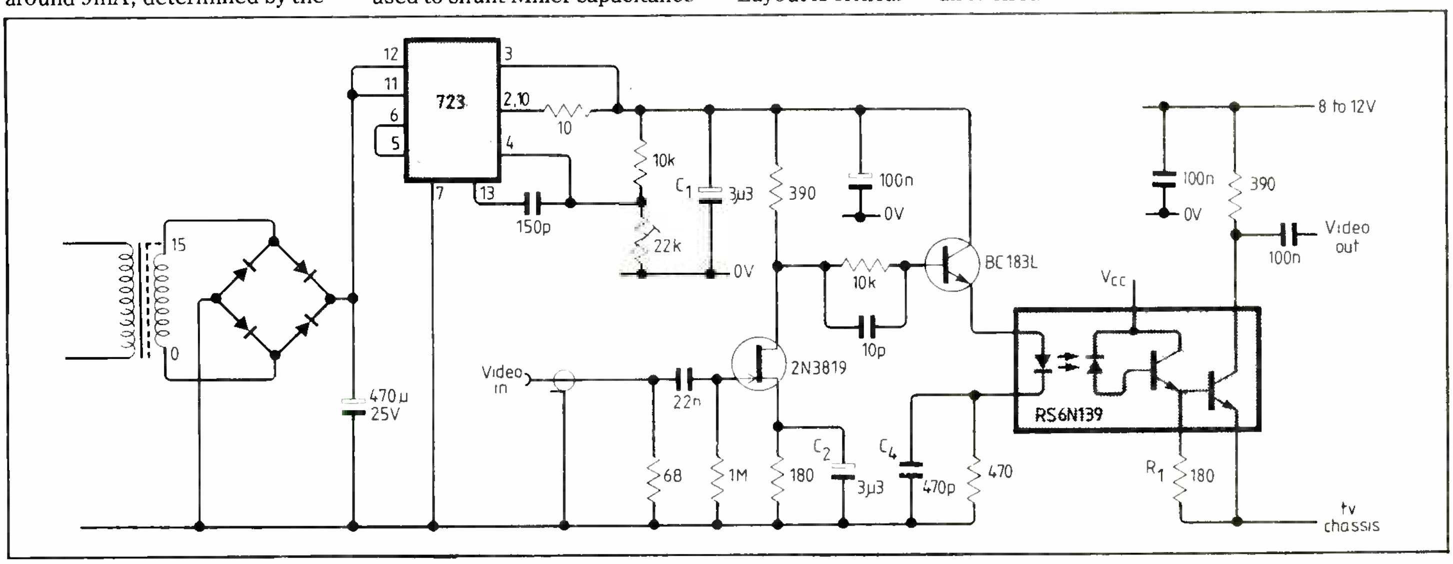
Designed for connecting computer video output to a non-isolated domestic tv, this circuit uses a readily available 6N139 optical coupler (RS Components) operating at 1:1 current-transfer ratio. Positive video modulation is assumed and, for the UK, a composite video-signal bandwidth requirement of 6MHz.

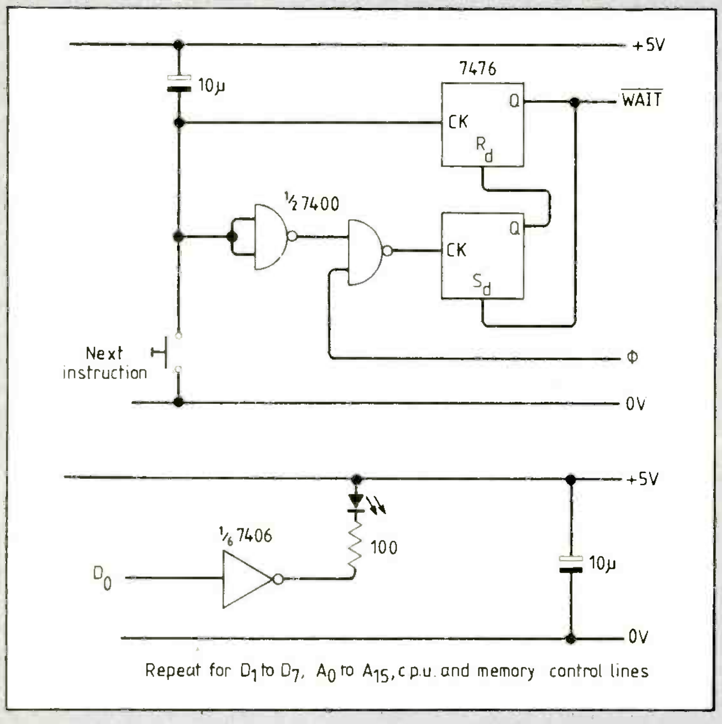
Voltage gain of the fet stage is about four. The source is directly coupled to the next stage which approximates a current drive for the coupler led. Bias current of around 9mA, determined by the fet drain/source resistors and supply voltage, keeps the optical-coupler transfer characteristic in its linear region. Capacitor C_3 negates the effect of Miller capacitance in the driver transistor and C_4 extends frequency response to above about 800kHz by quickly removing stored charge in the transistor emitter during voltage transitions. Resistor R_7 is set for optimum rise and fall times.

Collector current in the opto-coupler is about 7mA, allowing low resistor values to be used to shunt Miller capacitance so that the transistors can operate at maximum speed. Direct-current supply for this stage may come from the tv; in valve sets, the sound output-valve cathode might be used.

The prototype gave rise and fall times of 200ns corresponding to a bandwidth of 5MHz which should be sufficient for most home computers. Bandwidth is mainly limited by the opto-coupler and faster devices should work with only minor modifications since the driver bandwidth is about 20MHz. Layout is critical — all tv circuit tracks should be separated from the grounded side by at least 4mm for insulation, and signal paths should have minimum stray capacitance. Video signal from 75Ω coaxial cable is terminated and should be about 1V pk at the input and large values of $C_{1,2}$ are required for faithful reproduction of frame-sync. pulses. Output is about 4V pk and may need to be divided for some sets.

J. A. McLay
Ballincollig
Co. Cork
Ireland



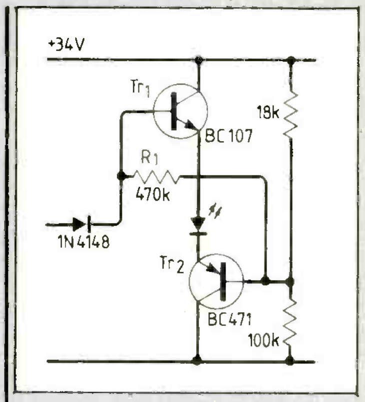


Microprocessor teaching aid

Using the WAIT command, the Z80 microprocessor can be made to execute one instruction at a time under control of a manual switch. If all the address, data and control lines are monitored, the processor can be seen fetching/storing information and carrying out commands.

While the switch is open, WAIT is low. When the switch is closed, the upper bistable device is clocked and WAIT goes high. Simultaneously, pulses from the processor clock feed the lower bistable i.c. and after two rising edges, the output of the lower device goes low and resets the upper one. Thus WAIT returns low after one or two clock cycles and sets the lower bistable i.c. Note that dynamic memory content will be lost since the memory-refresh circuit cannot operate. The circuit has been used with a ZX81 (no ram expansion), connected through the 23-row connector to make internal soldering unnecessary. A binary-to-hexadecimal converter and display on the data lines is a useful addition.

Peter Hall
University College London



Simple clipping detector

No setting up is required on this simple clipping detector for audio power amplifiers. When positive output swing exceeds

$$V_{b1}+V_{eb1}+V_{led}+V_{be2}+V_{D1}$$

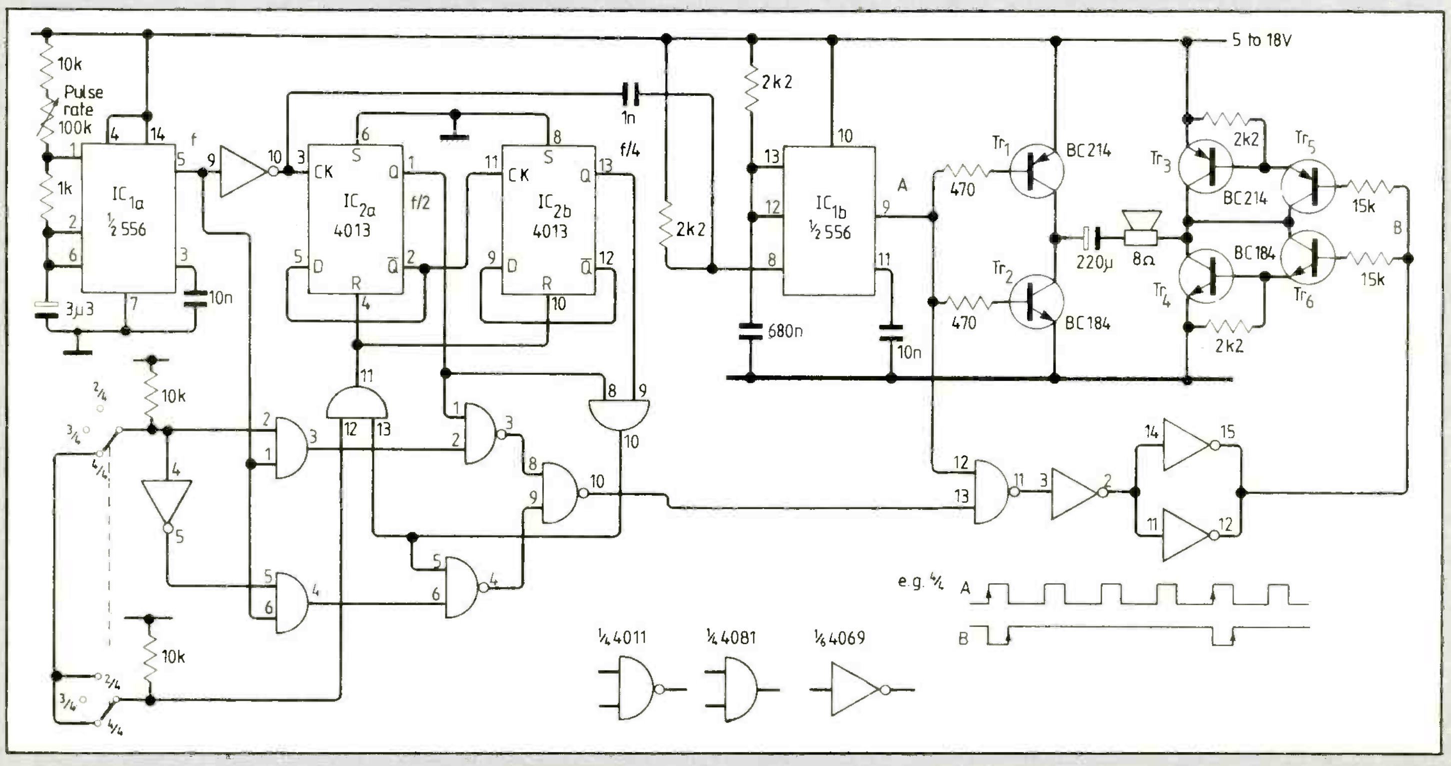
the led lights. Values shown are for a 34-0-34V supply and switch the led on at 64V pk-pk, but they may be altered to suit any single or dual-rail power amplifier. Tolerance on the switching point is about 0.5V due to junction effects. Resistor R_1 and the diode protect Tr_2 during negative swing.

M. J. Conduit
Farnham
Surrey

Accentuated metronome

Loud regular pips — clearly audible even above my attempts to master the guitar — are generated by this metronome. Each pulse from IC_{1a} triggers a fixed-duration pulse from IC_{1b} which drives the loudspeaker through $Tr_{1,2}$. Normally, common collectors of Tr_{3-6} are approximately at ground potential but counting and decoding circuits around IC_2 cause Tr_{3-6} to be driven in opposition to $Tr_{1,2}$ on the first beat of each bar to give an accentuated pip. Time signatures of 2/4, 3/4 or 4/4 are selected by a switch. Supplies of between 5 and 18V may be used. I used two PP3 batteries to give 18V in the prototype.

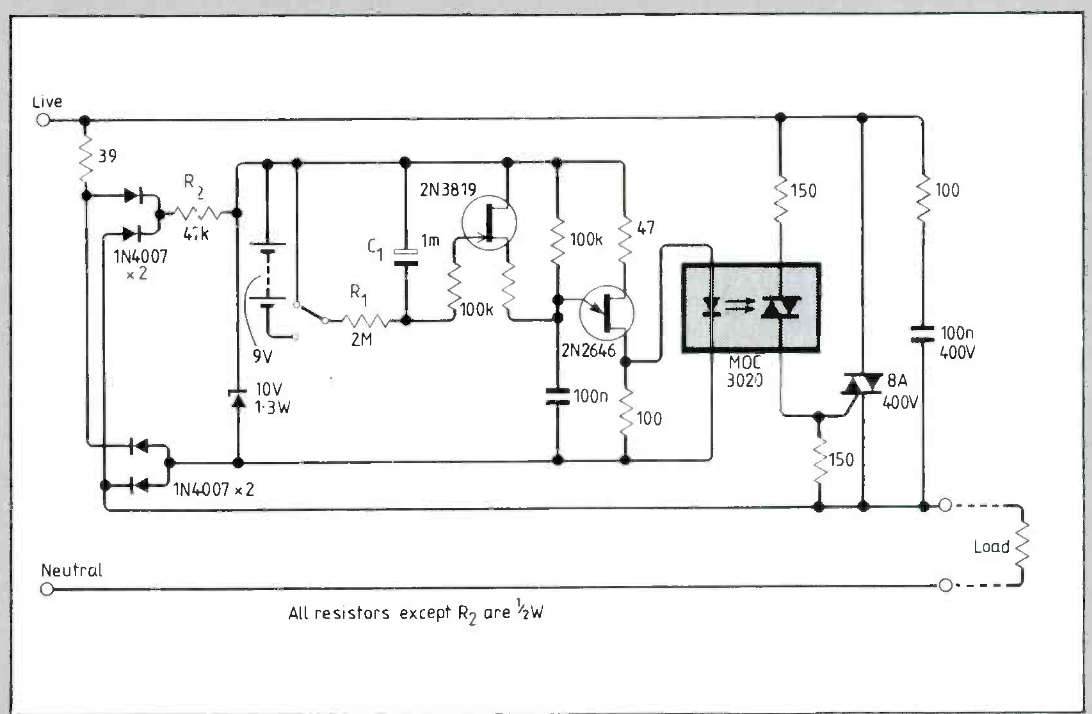
Steve Kirby
East Molesey
Surrey



Artificial daylight

For applications including tropical fish-tank lighting, this circuit gradually changes lamp brightness from off to full-on in 25 minutes, or vice versa depending on the switch position. A bridge rectifier and shunt zener diode provide mains synchronized d.c. pulses. Triac firing, through an opto-coupler, is from a unijunction transistor whose time constant is determined by a fet acting as a variable resistor. The capacitor which biases the fet, is charged or discharged depending on the switch position. If R_1 is disconnected, brightness remains constant for at least 24h through charge in C_1.

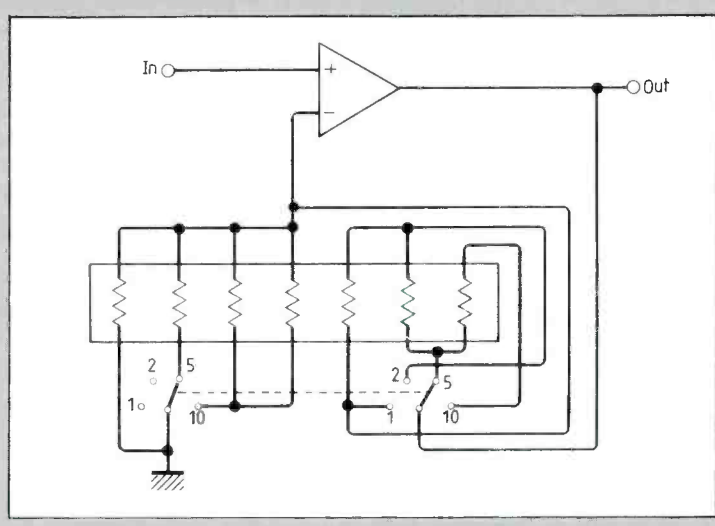
J. Clegg
Doncaster
Yorkshire



Accurate switched-gain for op-amps

Using a cheap array of seven equal resistors provides accurate switched op-amp gains of one, two, five and ten times. Resistance ratios for these gains in a non-inverting amplifier are 0^2, 1^2, 2^2 and 3^2 respectively so the input resistor may be made from zero, one, two or three resistors in parallel, and the feedback resistor form the same number of resistors in series.

B. P. Cowan
Bedford College
University of London

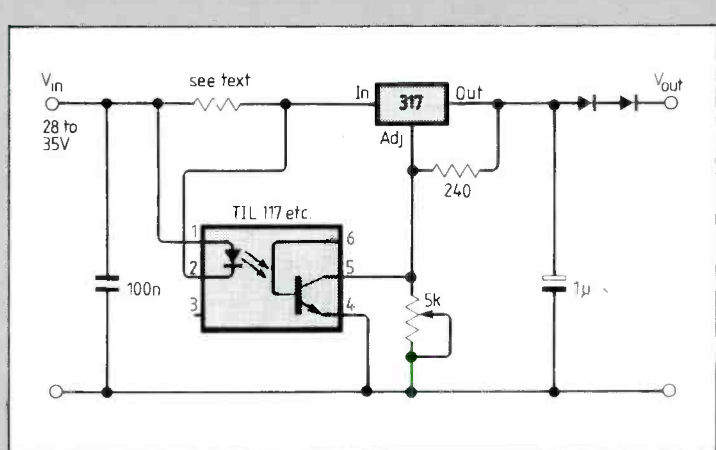


Current limiting for 317 regulators

Addition of an opto-isolator to a 317-based variable-voltage power supply allows precise current limiting. I have used this circuit to protect transistors during development of r.f. output stages of uncertain behaviour and it should be possible to apply this idea to simpler power supplies using power-transistor/zener-diode combinations.

When voltage across the series-pass resistor exceeds around 1V the isolator photodiode starts to emit, turning on the phototransistor and reducing control voltage to the regulator. Output diodes keep regulator output voltage at 1.5V above control voltage to limit output current under a dead short. Power and resistance ratings of the series resistor are chosen to suit the required current limit and the diodes must be able to carry more than the current limit value.

Lionel Sear
Truro
Cornwall



Combination lock with deterrent

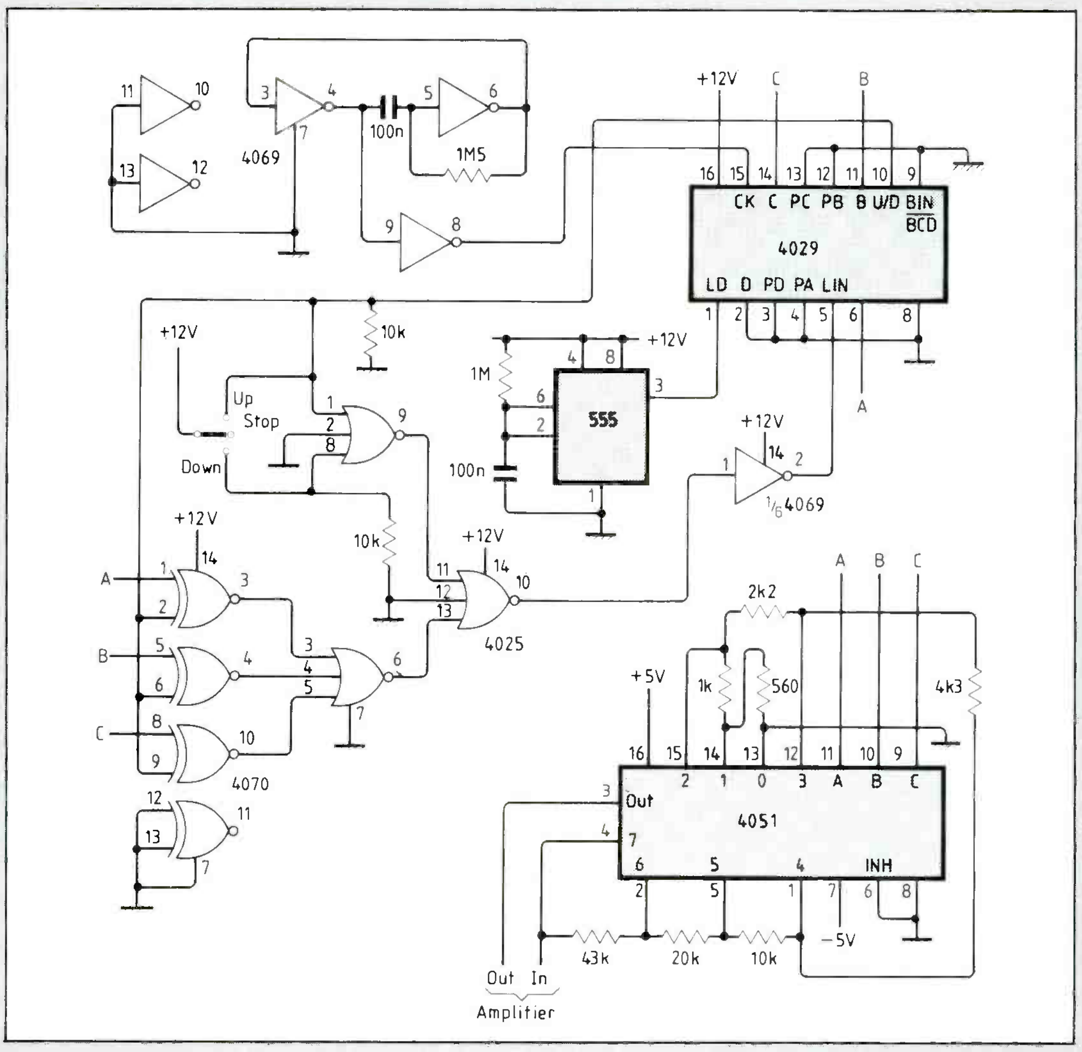
In this idea in the May issue, IC_1 should have been a 74148, E_0 of IC_2 is not connected to E_1 of IC_1, the transistor shown should have a base resistor and IC_{17a} is the left-hand section. On IC_6, Q and $\bar{Q}$ should be transposed. We apologise for these errors.

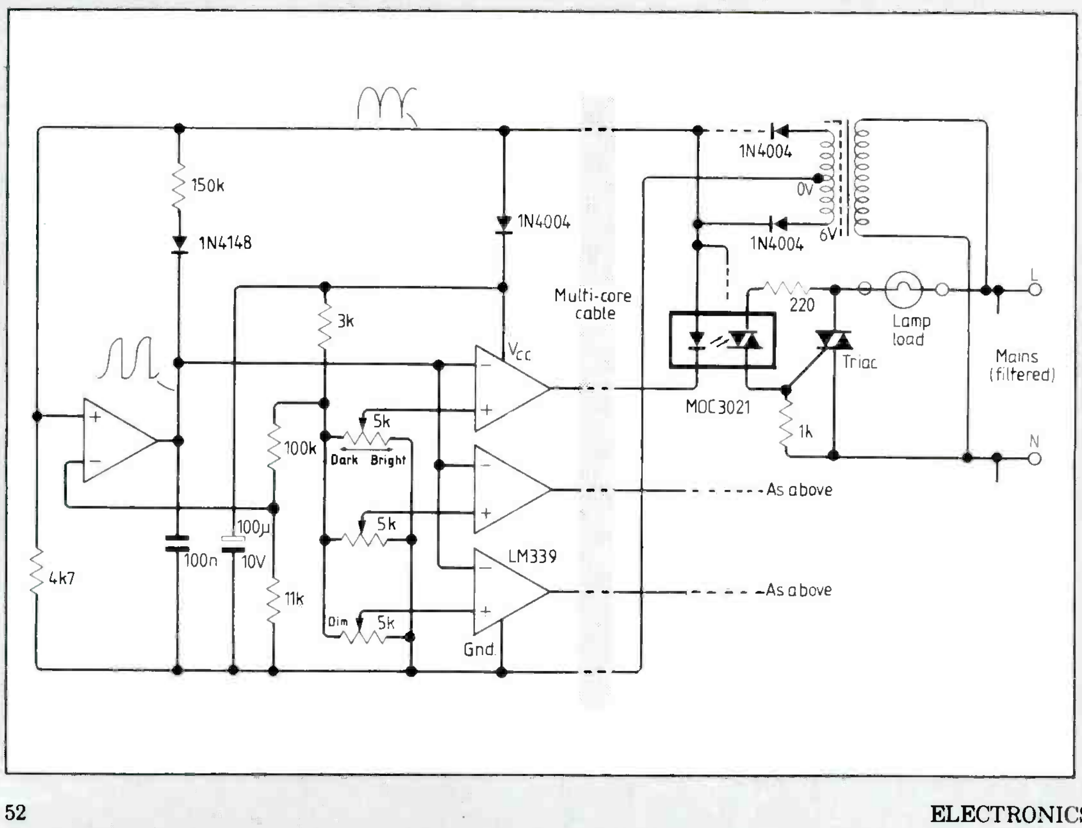
Remote volume control

Heart of this circuit, which requires only contact closures for volume increase/decrease, is a 4051 eight-channel multiplexer operating in analogue mode. The setting of this variable attenuator depends on output states of a 4029 up/down counter which is stepped through on contact closures under control of a buffered clock signal from pin eight of the 4069 inverter. Frequency of the clock is RC/2.2 and a 555 timer ensures that the volume level is low when the circuit is switched on.

One 4051 is required for each further audio channel, the maximum number of channels only being limited by 4029 drive capability.

Dennis J. Eichenberg
Ohio
USA



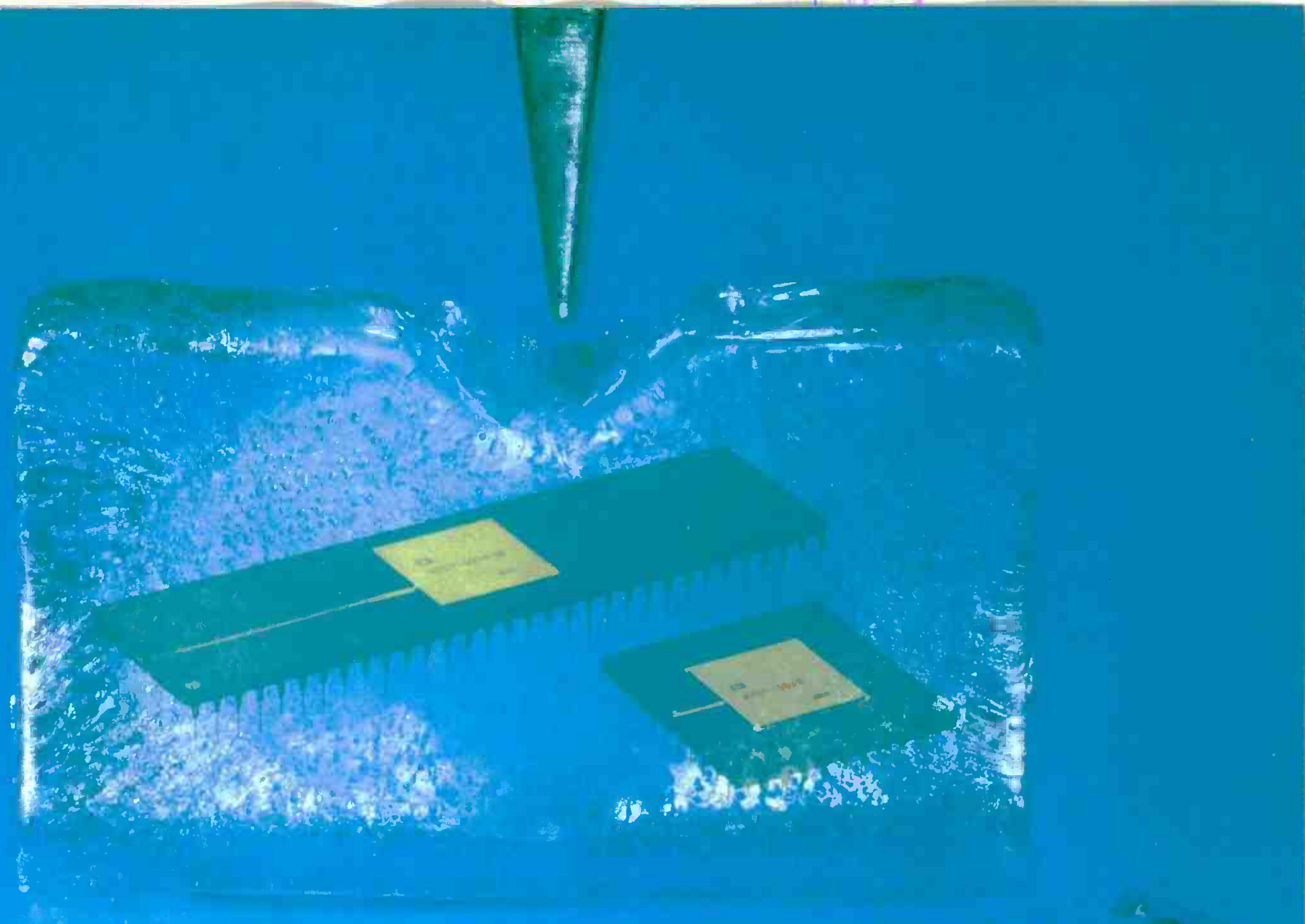


Three-channel light dimmer

Using a non-linear ramp to linearize power output, this light dimmer with three channels requires few components and allows triacs to be fired remotely through non-mains carrying cable. Remote firing also means that the triacs can be mounted next to the load which simplifies mains filtering. Channels may be added by using further comparators, isolators and triacs.

Advantage is taken of the LM339 open-collector outputs to eliminate series resistors at the three phase-control sections and directly discharge the ramp capacitor. Transformer output should not exceed about 6V to prevent excessive dissipation in the LM339.

Tim Williams
Tunbridge Wells
Kent



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				25°C AMB	70°C AMB	125°C AMB*
ADSP 1080	8 x 8 MULTIPLIER	MPY 08HJ	0.09	85	100	115
ADSP 1008	8 x 8 MULT/ACC	TDC 1008J	0.1	105	120	140
ADSP 1081	8 x 8 UNSIGNED MULT.	MPY 8HUJ	0.1	75	90	105
ADSP 1012	12 x 12 MULTIPLIER	MPY 12HJ	0.15	110	130	150
ADSP 1009	12 x 12 MULT/ACC	TDC1009J	0.15	130	155	180
ADSP 1016	16 x 16 MULTIPLIER	MPY 16HJ	0.15	145	170	200
ADSP 1010	16 x 16 MULT/ACC	TDC 1010J	0.15	165	190	220
ADSP 1110	16 x 16 SINGLE PORT MAC	PROPRIETARY	0.15	165	190	220
ADSP 1024	24 x 24 MULTIPLIER	PROPRIETARY	0.25	200	235	275

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CIRCLE 35 FOR FURTHER DETAILS.

Fibre optics communications

by Brett Wilson

Part 3 — Systems and applications. This last article in this three-part series looks at the range of applications in which fibre optic systems are being introduced.

In view of the very low energy levels involved in fibre optic transmission they are best suited to the transfer of information rather than power. It is in this area that they are making a major impact, even at this relatively early stage of their development. Indeed, British Telecom has recently announced that it will be ordering no more coaxial cable after 1985 for the telephone network, due to their growing commitment to fibre optics. It has been predicted that over half of all trunk telephone traffic will be carried on optical fibres by 1991.

There is no difficulty in principle in substituting optical fibres for copper cables in the majority of data transmission applications. After multiplexing the data in the normal manner the electronic modulator drives a light emitting or laser diode rather than a coaxial line amplifier, Fig.1. At the receiving end the signal can be treated again in the conventional manner once it is beyond the detector preamplifier. In small systems the additional complexity is minimal, whilst complex data systems such as telephone trunk routes can actually be simplified by adopting optical fibres as the transmission medium.

The range of telecommunications applications for fibre optics can be conveniently divided into three areas

—public telephone network
—broadband entertainment and information services
—computer local area networks.

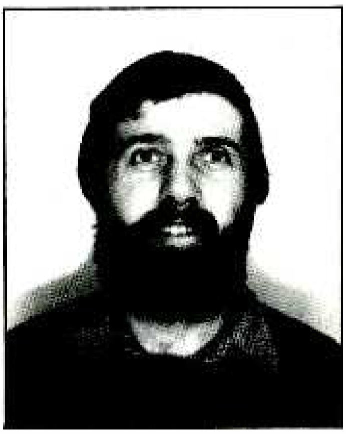
Public telephone network

Because of the very low bandwidth required for each telephone handset, it is doubtful if there will ever be an economic need to replace the usual copper wire pairs with an optical fibre. (This position changes of course when considering an integrated data network including telephony, television and data link). The major fibre application is in the area of junction and trunk telephone transmission where the traffic has been concentrated and multiplexed to a much higher data rate. Here experience has shown that the first generation systems have fallen into several broad performance areas, as we would expect from the previous look at fibres, sources and detectors.

The majority of installations have operated at a wavelength of around 0.85μm using medium performance graded index fibre with silicon avalanche photodetector receivers, Fig.2. Where the main consideration was not maximum repeater spacing l.e.ds have normally been used because of their lower cost, resulting in repeater separations of around 6km in the 30-45Mbit/s and 7km in the 100-140Mbit/s range[1]. The latest phase of the first generation systems has seen the use of the dispersion null at 1.3μm with low attenuation fibres resulting in even greater spacings for medium data rates.

An additional advantage arising from the increased repeater spacings is that well over 50% of the connections between major switching centres within cities can now be made repeaterless, with an increase in reliability and decrease in cost. This has also been the pattern of experience in N. America, Europe and Japan.

Optical fibres are not usually laid as a single fibre. Instead a number of them, eight being common, are made up into a cable around a steel strength member.



After a post doctoral fellowship at Manchester University, and a year teaching in Baghdad, Brett Wilson returned to Manchester to work on optical position detectors and sensitive non-contact current measurement. He then lectured at Nottingham University, where he's been concerned with novel uses of op-amps in addition to fibre optics, and is now back in Manchester, this time at UMIST. His Ph.D. was on a high-speed laser stroboscope for magnetic bubble research.

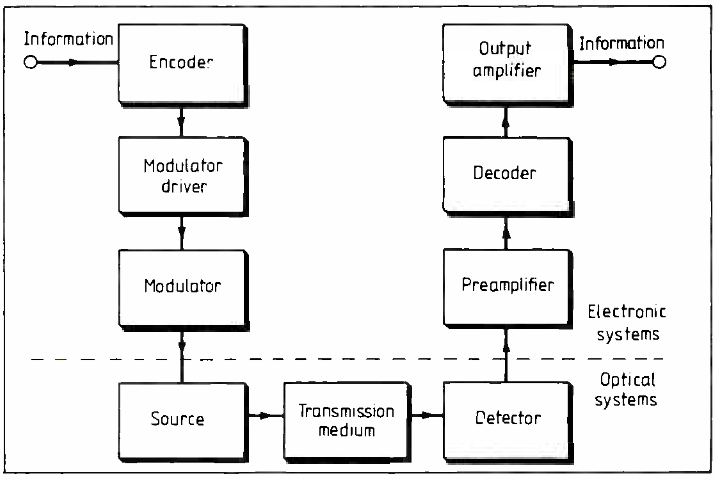


Fig.1. Principal components of an optical communications system.

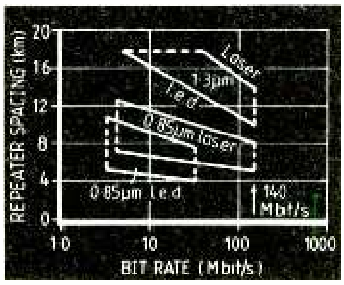


Fig.2. **Longer wavelength laser systems offer the best combination of repeater spacing and data rate, but shorter wavelength l.e.d. systems are less costly.**

Most of the cables are installed in existing ducts where their small size is a great advantage in an already crowded environment. Lengths of around 1km of optical cable are usually pulled through the ducts before being jointed using V-groove or arc-fusion techniques.

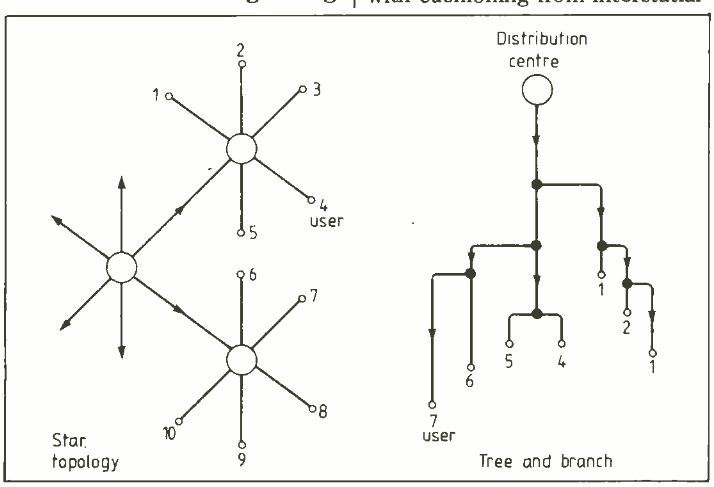
For second generation systems effort is being concentrated on long-haul high-speed communications where the cost is affected strongly by repeater spacings. Hence it is natural to use laser driven monomode fibres in their minimum dispersion region at 1.3µm. Repeater spacings of 20km are typical with data rates of 400Mbit/s being employed (NTT, Japan) over routes ultimately several thousand kilometres in length[2]. Most field trials, however, have been conducted with shorter routes of around 100km.

The promise of low-loss transmission with high data rates is obviously of great importance in the area of underwater telephone cables. In addition, the lower weight and smaller size of optical fibres compared to copper coaxial cables is of great economic and handling importance considering the long lengths of cabling, approximately 6500km, involved in a transatlantic crossing. The various agencies concerned have mapped out the nature of the first optical fibre transatlantic telephone cable, TAT 8, to be installed in 1988.

It is intended to operate multiple optical fibre pairs at 280Mbit/s, equivalent to 35,000 two-way voice channels, with repeater spacings of more than 35km. Monomode fibre will be used excited by 1.3µm injection laser diodes. Strength is provided by the usual arrangement of central and peripheral steel elements with cushioning from interstatial elastomer and an external polyethylene coating. Water resistance and electrical power in the form of a constant current for the repeater electronics is obtained via a continuously welded copper cylinder jacket. The overall diameter of the completed cable will be just over 20mm; under half the diameter of the previous copper coaxial TAT 7 cable.

The underwater repeaters, which have not yet been finalised, will probably use up to four laser transmitters, one actively employed and the other three as standby units. This is thought to be necessary because of the limited lifetimes so far achieved with i.l.ds coupled with the enormous cost of underwater repairs. Optical detection is performed by an InGaAs p-i-n diode rather than an a.p.d. because of the complexity of providing a high voltage supply to an a.p.d. A silicon bipolar transimpedance preamplifier is used in preference to a GaAs unit because as yet silicon fabrication technology is more proven than that required for GaAs. Active waveform retiming is carried out at each repeater by clock extraction circuitry. Various monitoring circuits transmit operational information back to the shore based stations.

Fig.3. **Tree and branch topology is best suited to broadband broadcast distribution in contrast to the star configuration which permits much easier installation of up-stream selection signalling.**



Broadband information services

The use of optical fibre technology has been much discussed with respect to the 're-cabling of Britain', where a single unit on the customer's premises would provide access to a wide range of tv channels and interactive information service. Connections between the customer's unit and the distribution centre can obviously be of the ordinary copper coaxial cable type or by optical fibres, either of which could be arranged as a tree and branch, or switched star topology, both of which are shown in Fig.3. The switched star system is currently favoured as offering the greatest future potential for system expansion. In contrast, over 80% of all American coaxial cable systems use a tree and branch topology.

Owing to the inherent difficulties and signal losses involved in splitting the signal in an optical fibre, it is likely that its use in a tree and branch network would be restricted to the main trunk. In a switched star network, however, the signal paths are a series of point to point transmissions ideally suited to the characteristics of optical fibre technology.

Most of the field trials that have been conducted around the world (UK, USA, Canada, Germany and Japan) to assess the potential of fibre optic transmission links have relied on some form of analogue intensity modulation of the light source. The reason is simply that frequency division multiplexing onto ever higher frequency carriers has been the traditional manner in which to multiplex telephone, and by extension, television channels. Analogue intensity modulation performs satisfactorily with coaxial cable techniques but does not ideally suit optical sources since in general they are non-linear unless pre-biasing techniques are employed. Even then circuit complexities arise because the lasing threshold of a semiconductor injection laser is temperature sensitive. The best properties of the optical transmission systems discussed in the previous articles are brought out by binary intensity modulation, i.e. on or off. For a fully integrated data network this is obviously the best form of modulation as it renders unnecessary any form of modulation change between the computing section and the distribution section.

However, there are certain bandwidth penalties to be paid when attempting to encode tv channels in a completely digital format. in an analogue format a PAL colour signal will occupy a bandwidth of 6MHz, but with eight-bit p.c.m. digital encoding this increases dramatically to around 120MHz to satisfy sampling requirements at an appropriate multiple of the colour subcarrier. In other words a single digital tv channel would occupy the equivalent of a 140MHz optical fibre telephone trunk circuit! Even with bandwidth compression techniques this figure is only reduced to approximately 70MHz. Clearly there is a problem in providing every user in a tree and branch network with an optical fibre and receiver electronics with sufficient bandwidth at an affordable price, capable of bringing in perhaps 10 or 20 simultaneous tv channels and ancillary services.

A switched star network overcomes many of these problems by employing upstream low speed signalling, so that customers may indicate to the star switching centre which service or channel they want at any given time. The switching centre then routes the required signal down the customer's line, which obviously only need sufficient bandwidth for one service at a time. The primary routes from the main control centre to each of the switched star centres must of course be able to carry the full range of services simultaneously.

British Telecom has gained valuable experience in this field with their Milton Keynes 'Fibrevision' experiment in which 18 houses received a full range of services via optical fibres[3]. Based on this experience, BT are proposing a 'Multi-star Wideband Network' offering

- —broadcast tv, d.b.s. tv, subscription tv, pay per view
- —videotex; alphanumeric and photographic
- —individual video, e.g. library discs
- —home data services.

The proposed topology of the network is shown in Fig.4. The originating site, or super head-end, would house the data library as well as the off-air tv and video equipment. This site would be connected by optical fibre 'super primary links' up to approximately 20km in length with no repeaters, to a number of hub sites. Each of these hub sites would simply regenerate and distribute the information over 'primary links' to a maximum of 120 wideband switching points where the real intelligence and flexibility of the system resides. The full range of services is available to all the switching points, but programmes are only transmitted down the 'secondary links' to each customer when they demand a specific tv channel or service.

It is envisaged that each wideband switching point will be able to service up to 300 customers with cable runs up to 500m. Even though the Fibrevision trial used optical fibres for these secondary links it is considered that cost still favours small bore coaxial cables, at least for the next few years. Eventually the secondary links will also be optical fibres. Each customer will be able to receive two simultaneous tv channels and a range of f.m. stereo sound encoded by frequency division multiplex on their 120MHz bandwidth secondary link. A customer termination unit, a small set-top u.h.f. converter and a remote control handset completes the information/control chain.

Where a super primary link to the super head end is relatively short it is intended to utilise 50μm graded index fibre driven by a 0.85μm semiconductor laser. On the longer super primary links it may be necessary to use 1.3μm monomode fibre. Each link will be composed of ten fibres. There will be five fibres for a full range of off-air and subscription television, with each fibre carrying four frequency multiplexed frequency modulated tv channels, resulting in a total of 20 broadcast channels.

Of the remaining five optical fibres constituting the 10 fibre link, three will be for dedicated tv bandwidth channels such as on-demand video library and videotex, again multiplexed four per fibre. Each fibre will be optically modulated by analogue intensity modulation. The remaining two fibres will carry switching and control signals — one upstream and one downstream.

At a hub site the optical signals are simply regenerated and relayed out to the wideband switching points. A firm decision does not seem to have been taken whether to use an injection laser diode along with an avalanche photo detector at 0.85μm on a graded index fibre for the primary links, or whether to upgrade an i.l.d. or l.e.d. at 1.3μm with a p-i-n fet receiver, again using graded-index fibre. What is certain is that in the primary links the five fibres containing the 20 broadcast tv channels will be optically tapped to serve several switching points. The primary links between hub sites and switching points will be less than 5km in length.

Within each wideband switching point a microprocessor-controlled matrix type of routing switch will route the 20 broadcast tv channels as demanded by each of up to 300 customers. Each customer will be able to receive two channels simultaneously. Requests for individual video programmes in the form of discs will be relayed up through the system to the super head end, which will then replay on one of the dedicated channels back down through the hub site and the customer's own switching point and out on to the customer's own secondary link.

Local area networks

A lan is a communications network connecting a number of users within a local geographical area to shared computing resources. The two most common topologies have been the contended bus with collision detection (Ethernet) and the ring structure, as in the Cambridge ring, Fig.5. Many of the features of optical fibres make them attractive for use in lans but usually only after some modification from a coaxial cable design has been implemented.

In the Ethernet system each station is connected to the coaxial bus via a bidirectional passive tap, making insertion of a new work station a relatively simple matter. Each station attempts to transmit its message when the bus is quiet. If a message collision is detected transmission is stopped and retried a short time later. With fibre optic technology it is relatively difficult to make passive couplers without an unnacceptably high loss, thus restricting severely the number of users that may be attached to the bus. To overcome this, Fibernet, the optical version of Ethernet, uses a central passive star coupler to enable 16 users to com-

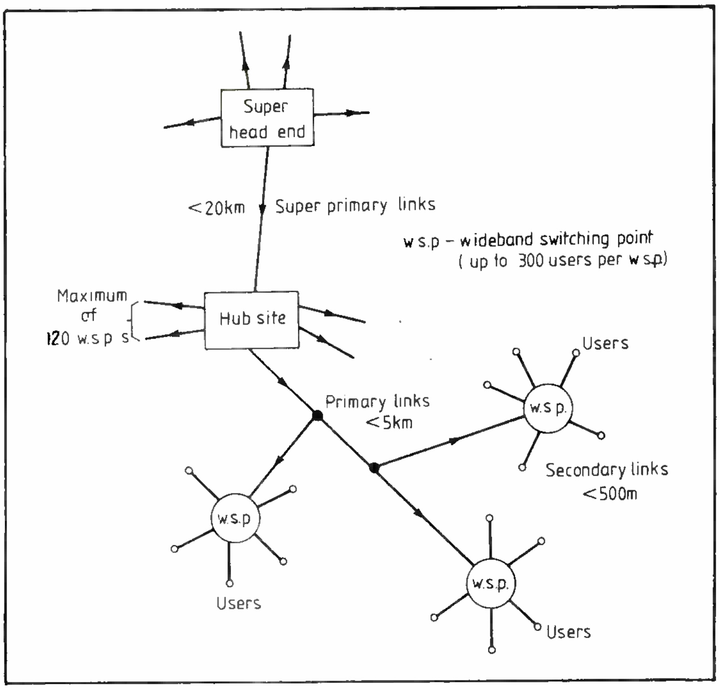


Fig.4. **British Telecom's proposed multi-star wideband network will use fibre optics in all but the short final link to the customer.**

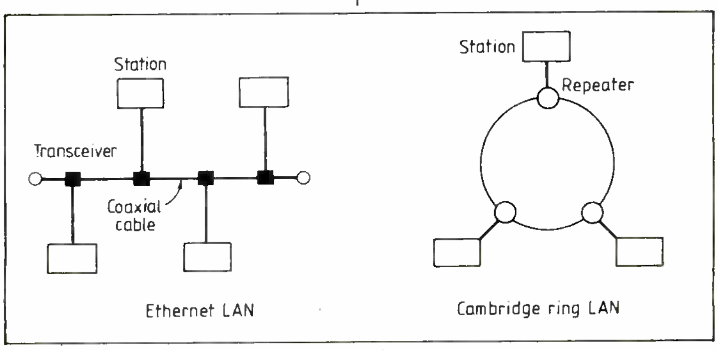


Fig.5. **Ethernet-style local area network uses a bi-directional data highway approach compared to the enclosed path of a Cambridge ring lan.**

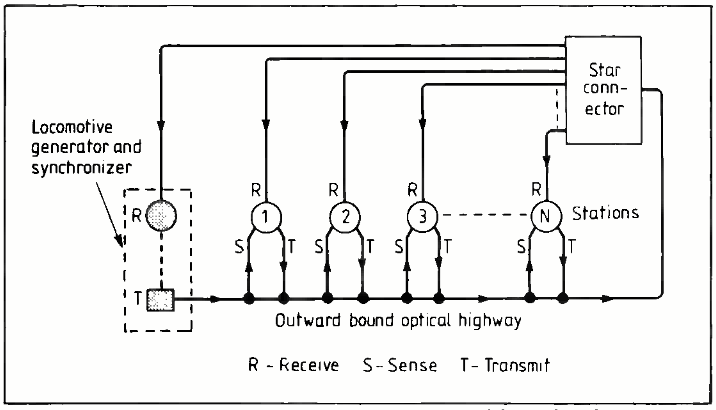


Fig.6. D-Net optical lan combines a data highway and a star return, making it more like an open ring.

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municate with each other.

At higher data rates, such as can be supported on fibre optics, the efficiency of a message contention scheme starts to fall rapidly. The transmission delay is not deterministic and the network cannot guarantee to support real time transmission such as telephony.

The alternative is a ring network. This structure suits the nature of fibre optics better because it is essentially a series of point to point transmissions. Since the signal is regenerated at each station there is little trouble with power levels. To increase the reliability of communications with respect to fibre failure for example, a double ring may be easily employed.

While commercial versions of optical ring lans are available, development attention is focusing more on structures such as D-Net where high data rates and low delays are obtainable[4]. Fig.6 shows an outline of D-Net in its star coupled form with a single star connector at the far end of the outward bound bus. The transmitter T sends regular 'locomotive' header signals out along the highway which are detected by all stations at their S-terminal. At each station a message packet may be attached to the appropriately numbered 'wagon' slot after the locomotive has passed. Because the locomotive is a synchronized event, re-triggered by reception of a previous locomotive back at the terminus R, the message delay through the system is tightly bound.

At the far end of the highway, the star coupler distributes the trains of information back to the receive terminals of all the stations. Just as there can be more than one train on the line between Manchester and London, so will D-Net support more than one train at a time, given a detailed knowledge of the maximum propagation time, bit slot lengths and number of stations. This configuration seems extremely attractive at very high speeds beyond 100Mbit/s because it retains a higher efficiency than a passive bus arrangement.

Fibre-optic sensors

One of the aims of research workers in the field of fibre optics has been to stabilize the transmission of information along an optical fibre against commonly encountered environmental changes, for example; pressure, temperature, strain, etc. they have succeeded to an extent where, in many applications, fibre optics is, or will soon be, the preferred transmission medium. In contrast, at the opposite end of the applications spectrum, there have been efforts to exploit variations in the same transmission parameters with respect to environmental disturbances in order to produce a range of fibre optic sensors.

Optical modulation and detection schemes, as classified in an informative survey of fibre-optic transducers (ref.5).

Parameter	Mechanism	Detection	Examples
Coherence	Interference between signal and reference fibre, or different propagation modes in multi-mode fibres.	Fringe counting or phase shift detection.	Fibre gyroscope, hydrophone multimode gauge for dynamic strain measurement.
Amplitude	Modulation of transmitted light by absorption, emission or refractive index change.	Analogue or digital.	Strain/pressure gauge using modulated micro-bending loss. Optical encoders.
Wavelength	Spectral dependent variations of absorption, emission and refractive index.	Amplitude comparison at two fixed wavelengths, or analogue signal for scanned wavelength.	Temp. measurement by · variable Fabry-Perot cavity · birefringent crystal · semiconductor bandgap shift
Time Resolved	Transient absorption or emission behaviour. Transit time of closed fibre loop with feedback.	Time-delay pulse analysis.	Temperature gauge by time decay of rare earth ion fluorescence. Nuclear radiation diagnostics using Cerenekov light.
Polarization	Changes in the gyratory optical tensor.	Polarization analyser and amplitude comparison.	Faraday rotation magnetic field transducer for non-contact current measurements.

Such sensors would exhibit many potential advantages, usually for the same reasons as in communications, namely; electrical isolation, freedom from electromagnetic interference and the lack of fire risk in sensitive areas.

The range of parameters that can be measured can conveniently be classified into

—mechanical (force, pressure, deformation)
—electrical (field strength, polarization, current)
—magnetic (field strength, polarization)
—temperature.

In most cases these measurands produce changes in the refractive index or in the absorption of the fibre, but some of them will modulate luminescence effects. The table presents information on the categories of modulation and detection that may be used with each of the five different optical parameters.

Some of the most sensitive fibre sensors constructed use an interferometric technique in which the optical phase shift produced in a fibre by interaction with the measurand is compared to the phase of a reference arm. Rotation sensors (gyroscopes) with sensitivities around 10^{-2} degrees per hour are currently operating. Similar techniques can be applied to phase shifts produced by pressure changes on the fibre, resulting in acoustic hydrophone sensors with higher sensitivities than piezoelectric types. Magnetic fields can also be detected by phase techniques if the optical fibre is coated with a magneto restrictive material.

Mechanical displacement can be measured by several arrangements of intensity sensing between movable fibre ends, either with an orthogonal or a slant cut. Vibration detection of a movable membrane from reflected light is also popular. One of the most widespread uses of amplitude detection is the sensing of a Gray code from an encoded disc or shutter, with resolutions available down to 10μm. Finally, modulated microbending loss can be used by clamping a fibre between two plates with a periodic mechanical grating. In general amplitude detection methods are less sensitive than phase modulated sensors and in addition suffer from unwanted and variable signal attenuation and temperature problems.

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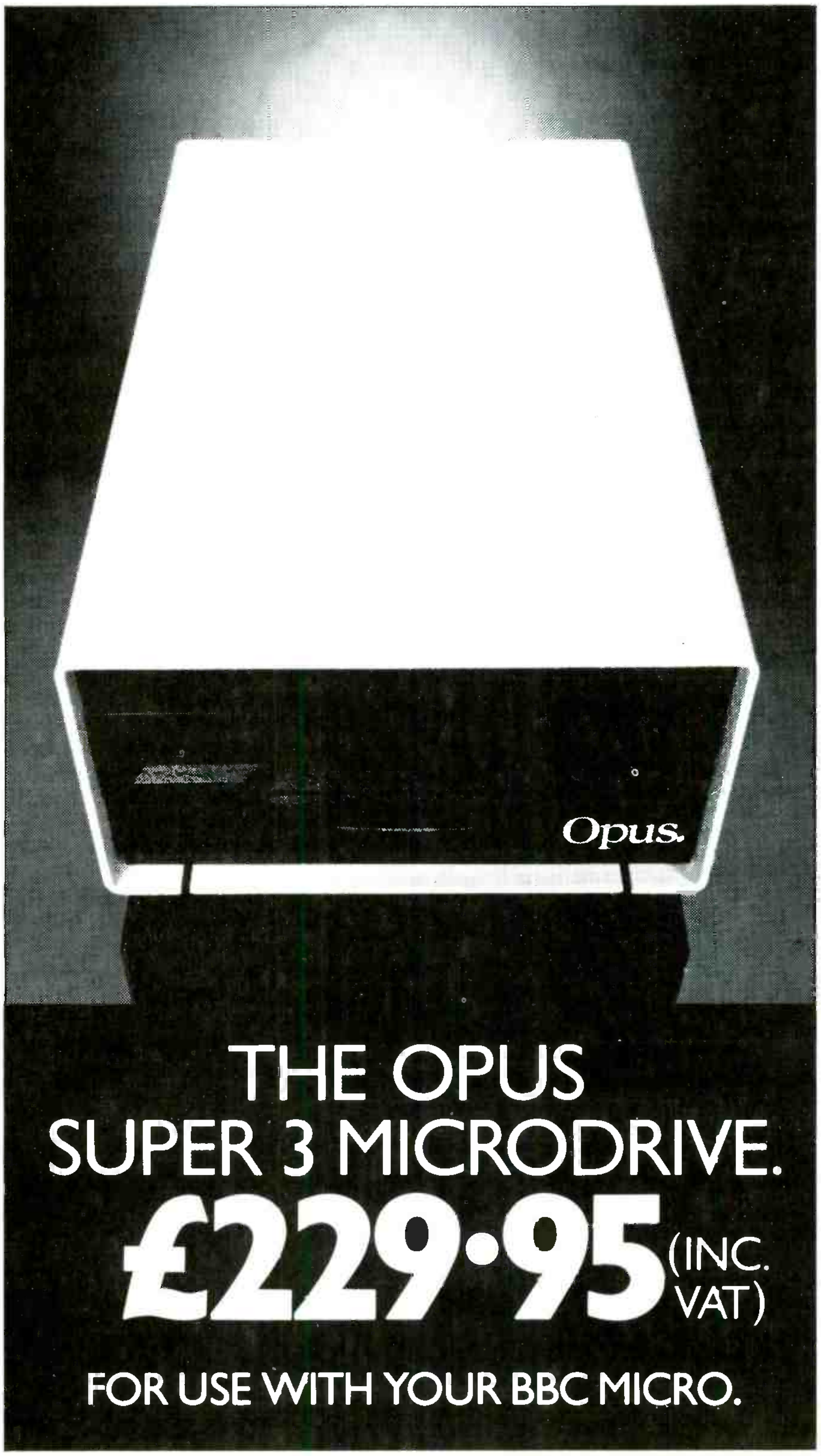

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CIRCLE 33 FOR FURTHER DETAILS.

Micro-controlled cassette recorder -2

by A.J. Ewins

Description of cassette recorder for use with microcomputer continues with description of f.s.k. modulator and demodulator.

The main criteria for choosing a suitable encoding technique for recording serial data from the output of a microcomputer (RS232 or t.t.l. levels) are, in my opinion, reliability, circuit simplicity and, perhaps most importantly, the ability to be used with any good set of recording/playback electronics. The microcomputer user is primarily concerned with reliability and ease of use of any encoding technique. He is not interested in very high speed techniques if half the time the data is recorded or played back incorrectly; or if the tape-recorder settings need constant adjustment.

There have been a number of designs in various electronic magazines for 'high' speed recording techniques. The fastest of these, of which I am aware, was for 4800 baud. I also have had some experience of designing suitable encoding techniques for high speed serial data recording and am therefore very aware of the problems. Readers may recall the series of articles, in this magazine, on a digital multichannel tape recorder. In this design I achieved a rate of 22,000 baud using complex, but well known, techniques called Miller or delay modulation. However, all these very high speed designs, including my own, rely on the ability to record single high/low or low/high signal transitions. The success or otherwise of the technique depends not only on getting the 'electronics' right but also on tape quality *and* the mechanical operation of the cassette deck. It is very sensitive to imperfections in the tape quality, dirty tape-heads and indifferent transport of the tape across the head. In my opinion the techniques are unlikely to be successful unless only the best tapes are used, the cassette deck is of the highest quality, and the tape-heads are regularly cleaned.

A technique that is *far* less sensitive to these three sources of error is frequency shift keying. Using a few modern i.cs, a voltage-controlled oscillator and a phase-locked loop, a modulator and demodulator are easily designed that are easy to set up and reliable in use. In f.s.k., the output of an oscillator is simply switched between two frequencies; to represent the low and high logic states. There is a maximum rate at which the switching between the two frequencies can take place; somewhere between a fifth and a tenth of the mean of the two frequencies is a good rule-of-thumb. Using a good set of record/playback electronics I set my sights cautiously on a mean frequency of 10kHz, i.e. 9kHz and 11kHz for the 'low' and 'high' frequencies. A bit rate of 2400 has a highest frequency content of 1200Hz when a train of successive ones and zeros are being transmitted. Thus this figure was taken as the highest rate that could be easily be transmitted using the two nominal frequencies of 9kHz and 11kHz. (Actually, by pushing the mean f.s.k. frequency up to 12kHz and careful design of the demodulator stage, it should be possible to record at 4800 baud. Alternatively, it should be possible to drop the mean frequency to 6kHz and still be able to record at 2400 baud.)

F.s.k. modulator & demodulator circuits

The circuits of the f.s.k. modulator and demodulator are shown in Figs 6 and 7. I claim no originality

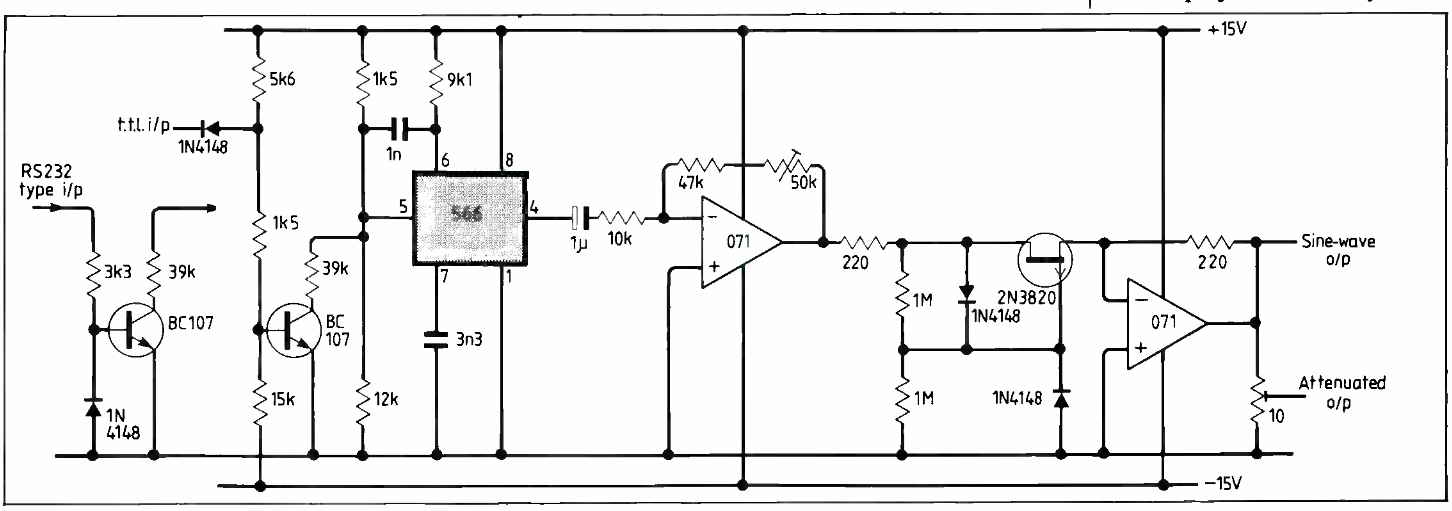

Fig.6. **F.s.k. modulator, based on Signetics circuits but with triangle to sine converter for greater flexibility in choice of record/playback circuitry.**

for these, being but a variation of circuits published by Signetics in their book on the 566 (v.c.o.) and 565 (p.l.l.) integrated circuits. To the circuit of the modulator I added a triangular-to-sine waveform converter. This makes the circuit capable of being used with a much wider range of cassette deck recorder/playback electronics, overcoming some of the problems associated with the high-frequency pre-emphasis circuitry. The triangle-to-sine wave converter is also a variation of a circuit to be found in the Signetics book. It is possible to adjust the sine wave, total harmonic distortion, to less than 1% by setting the amplitude of the triangular waveform correctly.

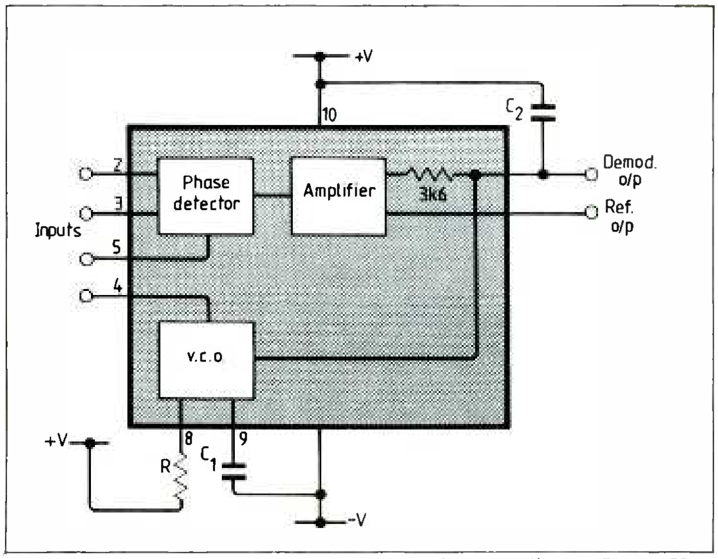

Fig.8. **Internal layout of 565 p.l.l.**

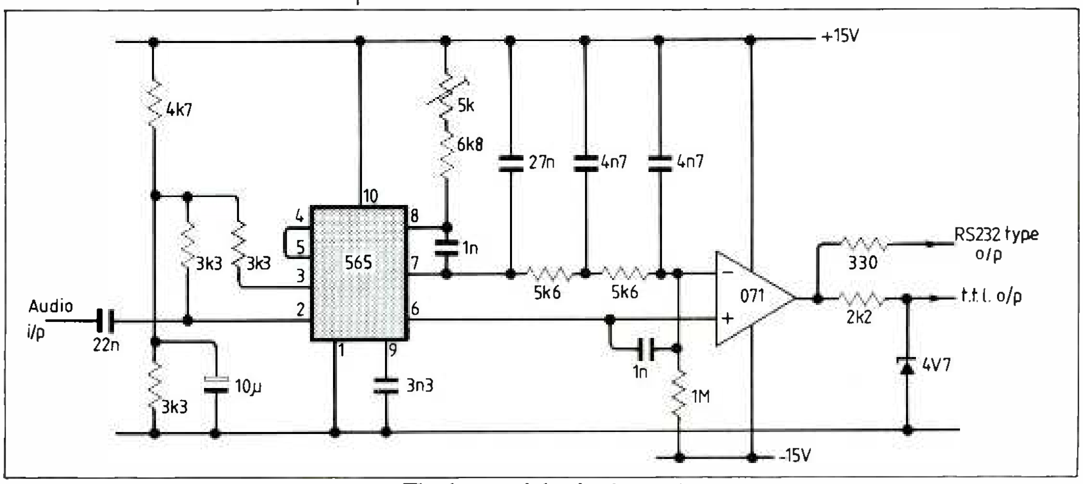

Fig.7. **F.s.k. demodulator, using Signetics 565 phase-locked loop.**

The heart of the f.s.k. modulator (Fig.5) is the voltage controlled oscillator i.c. the 566. These i.cs are designed to operate with a nominal voltage on their modulation input, pin 5, of $V_s/8$ below the positive supply rail, i.e. $7V_s/8$. A modulation of this voltage by ±10% produces a modulation of the frequency output by the same amount. For a V_s, of 15V, $V_s/8$ is 1.875V. Plus and minus 10% of this value gives voltages of approximately 1.69 and 2.06V below the positive supply rail, i.e. actual voltages on pin 5 of 13.31 and 12.94V. the 1.5kΩ and 12kΩ resistors produce a nominal voltage on pin 5 of 13.33V. When the transistor is conducting the 39kΩ resistor is effectively in parallel with the 12kΩ, reducing the effective resistance to about 9.2kohms. The voltage on pin 5, when the transistor is conducting, is thus reduced to a nominal value of 12.90V. Thus by switching the transistor on and off the voltage on pin 5 is modulated by ±10% about its centre value of 13.125V. The input stage to the transistor has been designed for either t.t.l. levels (between 0 and 5V) or RS232 type signals (±3 to ±15V). If both types of input are required there is no reason why two transistors should not be used with their collectors sharing a common 39k± resistor. It is, of course, important that the transistor of the unused input be in its off-state, i.e. non-conducting.

Apart from the voltage on pin 5, the frequency-determining components of the 566 i.c. are the 9.1k ohm resistor on pin 6 and the 3.3nF capacitor on pin 7. With these chosen values, the output frequency for a voltage of 7 $V_s/8$ on pin 5 is f=1.2/(4RC), i.e. 9990Hz. Thus, when the logic level on the input varies between low and high, the frequency out put of the 566 i.c. varies between about 9 and 11kHz.

The output from pin 4 of the 566 i.c. is a symmetrical triangular waveform of about 3V pk-pk with a positive d.c. bias voltage. The triangle-to-sine wave converter needs quite a large voltage drive and the variable gain stage is included for this purpose. The triangle-to-sine wave converter uses the non-linear I_{DS} - V_{DS} transfer characteristic of a p-channel j-fet to shape the triangular waveform: The output from it is a little less 1V, r.m.s. with a distortion factor of less than 1% when the input amplitude is correctly adjusted. A distortion meter is the only proper way of achieving the minimum distortion figure, but visual inspection using an oscilloscope can produce a good enough result. A variable or fixed attenuator is used to reduce the sinewave output voltage to a level suitable for recording on the cassette deck's record/playback electronics.

The circuit of the f.s.k. demodulator is shown in Fig.7, the heart of which is the 565 phase-locked loop. There is nothing unusual about its design but a few comments will be made so that its operation may be understood. The phase-locked loop consists of a voltage-controlled oscillator (an identical v.c.o. to that used in the 566 i.c.), a phase-sensitive detector and an amplifier with a single stage of low-pass filtering. The interconnection between the various elements of the p.l.l. is shown in Fig.8. When the frequency of the v.c.o. is locked to that of the incoming signal, the output from the phase detector (amplified and filtered) applied to the input of the v.c.o. is that voltage which the v.c.o. requires to produce the particular frequency. The voltage applied to the input of the v.c.o. is also the demodulated output signal that we require. For the v.c.o. to produce a different frequency output, the voltage on its input will have to change. This is exactly what the p.l.l. achieves; when a signal of a different frequency is applied to the input of

Continued on page 67

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VIDEO BAND WIDTH	10MHz
DISPLAY	80 characters by 25 lines
SLOT PITCH	0.41mm
INPUT: VIDEO	R.G.B. Analogue/TTL Input
SYNC	Separate Sync on R.G.B. Positive or Negative
EXTERNAL CONTROLS	On/off switch and brightness control

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CIRCLE 34 FOR FURTHER DETAILS.

SC84 microcomputer

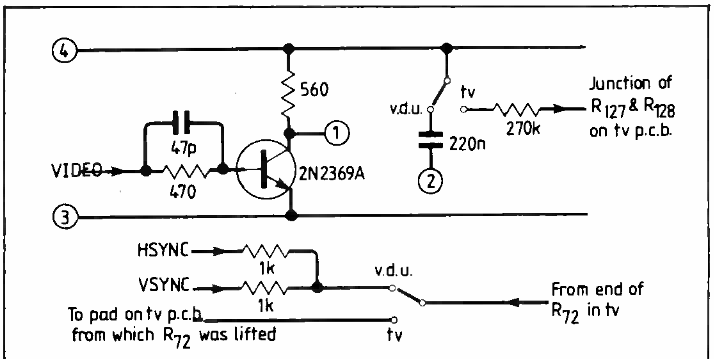
continued from page 34

output is captured in an eight-bit latch, IC_{305}, by the trailing edge of the next carry pulse and held during the next memory cycle. This allows the eprom to produce the dot pattern for character zero while character one is being brought from memory. The trailing edge of the next carry pulse occuring 500ns later allows plenty of time for the eprom to submit a dot pattern. This pulse enables parallel loading of the shift register IC_{307} used to convert the dot pattern from eprom into a serial stream of pixels. Being synchronous, the shift register does not load the dot pattern until the rising edge of the dot clock, which occurs while the load input is low. This edge occurs just before the end of the carry pulse and might not, at first, appear to be consistent with the synchronous philosophy propounded earlier as there is an undefined delay between this clock edge and ending of the carry pulse. Note though that it is this same clocking edge which advances the synchronous counter and thus ends the carry pulse, which must therefore change after the rising edge of the clock. Also, the required holding time for the loading signal after shift register clocking is zero and the clocking signal is from a Schottky gate with a very fast rise time, so the loading of data is assured. With this data stored in the shift register the trailing edge of the carry pulse loads a new value from v.d.u. memory into IC_{305} and the cycle repeats. This means that pixel output begins two character periods after the start of a scanning period. As mentioned earlier, the controller also supplies some direct video-control signals, one to enable the display (so that the screen may be blanked during non-display periods such as during flyback) and a second to indicate when the character position being accessed corresponds to the setting of the controller cursor register. As with M lines, these signals will be delayed and, taking the example of the display-enabling signal, they must be delayed by one and a bit character periods if they are to become active just as pixels for the first character on the line are clocked out of the shift register. One enhancement made to the Hitachi 6845 is that it is possible to delay the output of these two control signals by one or two character periods, which saves on i.cs. These signals are given a one character-period delay and synchronized by a two-bit latch, IC_{315}, which is also clocked by the carry signal.

At the other end of the system, the 74LS85 four-bit comparator produces a signal at pin 6 when $A_{13,14}$ and VDUSEL are low and A_{15} is high, i.e. an address on the address bus is in the range 08000 to 09FFF and the v.d.u. memory is switched into the memory. Note that the four matching comparator inputs are switched so it is possible to relocate the area in memory at which the v.d.u. appears (switch on=low). The address is set up before MREQ by the Z80 so the comparator signal can activate MEMDIS to inhibit a system-memory cycle. Further decoding is necessary though to ensure that this is a memory cycle; MREQ is gated so that v.d.u. signal SEL only goes low during a true v.d.u. memory access. Select signal SEL does several things. It switches the four 74LS157 multiplexers so that they direct bus address lines into the v.d.u. memory and connect the system WR signal to the memory and HD6845S. The v.d.u. memory and the 6845 are always selected so they would be incorrectly written to if WR wasn't gated. It also enables the data-bus buffer and clocks a set/reset latch made from half of an 74LS00. When set, this latch clears the 74LS273, forcing a display of one dot-row of the character generator corresponding to code 000 — which happens to be blank. The latch is reset by the character clock. This latch suppresses the speckling effect mentioned earlier, the algorithm being 'any c.p.u. access during the fetching of a character code to the character latch forces character code to zero'. While it might seem simpler to gate SEL directly with the video output to produce blanking, due to the pipelining technique SEL would blank the display between one and two characters too early.

The v.d.u. memory consists of 6Kbytes of static memory. Address and data lines to the v.d.u. memory i.cs do not correspond to their specified 'A' or 'D' numbers but this doesn't matter. The order used was chosen to ease p.c.b. layout. After all, if a data byte is written into memory with a particular addressing pattern, that same byte will be accessed when the same address is applied. The lower 11 bits of the address supplied by the multiplexers are fed to all three memories in parallel. The next two most-significant bits of the address feed a decoder which activates one of four output lines. The four lines pass to the memory i.c. enable inputs and the 6845 so that within the addressing range 08000 to 09FFF for which SEL is active, the memory is mapped at addresses 08800 to 09FFF and the 6845 control registers from 08000 to 087FF. Effectively, the 6845 only needs two locations, one to receive the number of the internal register that the c.p.u. wants to access and one which appears as that register. The fact that it has been allocated another 2046 in the rather coarse decoding is not a loss though, and it simplifies both hardware and software. The standard rom supplied programs the system for standard timing signals and a display consisting of 32 rows of 96 characters each. This means that only 32 by 96, or 3Kbytes, of v.d.u. memory is required and, for the basic system IC_{304} may be omitted. 6Kbytes of memory is needed though to work with the higher resolution graph plotting mode provided in Basic which reprograms the 6845 to scan twice as much memory and produce a display of 64 rows of 96 characters. In graph plotting with the character v.d.u., the split-screen plotting area is 192 by 180.

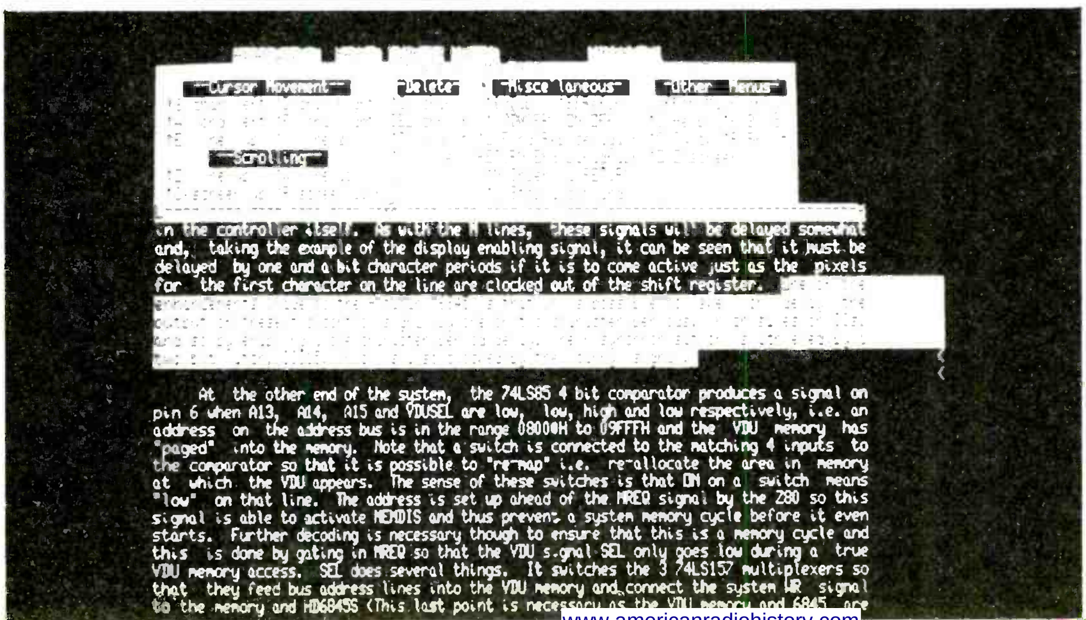
Fig.2. **A monitor is best for high density text display but a monochrome tv set with minor alterations can give satisfactory results. This modification for Ferguson/Ultra 3840, 3845, 3847, 3848, 6840 and 6845 tvs allows the set to be switched between computer input or broadcasts. Numbers in circles refer to pins on the cathode-ray-tube controller socket. The tv circuits must be isolated from the mains (see text).**



Connecting a monitor

A 30cm-screen monitor is about optimum. Synchronizing and video signals may be inverted to suit your requirements. For the switches controlling the sync. signals, S_{305} and S_{308}, on provides negative-going syncs, whereas switch sections S_{306} and S_{307} select either positive or negative-going video; note that these two switches must not be on at the same time. The dense display makes a stringent requirement on the monitor but standard types with bandwidths of 15MHz or more should be satisfactory. As a cheaper alternative, a television may be modified. This does not stop the set being used as a tv but does require some simple internal modifications. Following details show how to adapt a Ferguson 3845, which is the type used by most of the present Scientific Computer group, and give guidance for modifying other models. Make sure that the set you choose is one with an isolated supply, i.e. that there is no electrical connection between the mains and internal tv circuits, or use an external isolation transformer. The Ferguson set has a double-wound mains transformer — as do many portable tvs nowadays — but check to make sure if you use a set other than the 3845. Apart from the risk to yourself if you use a live-chassis set, you stand a good chance of permanently reprocessing large amounts of expensive circuitry should something untoward occur.

From the circuits in the tv set, Fig.2, find where the sync. signal is separated from the video, the polarity of the sync. signal, the cathode and grid pins of the c.r.t. socket, which of the two is driven with video, and the potential on the other. In the case of the 3845 these points are the end of R_{72} nearest the back of the set, negative sync., pins two and one respectively, the cathode and zero volts. Modifications required are to break the sync. signal path within the set, in this case by unsoldering and lifting away the end of R_{72}, and remaking the path with one half of a two pole change-over switch, the other input of which is a combination of the two sync. signals. The other half of the switch is used to connect a decoupling capacitor to



SC84

Processor
4/6MHz Z80 processor.
Maximum 64K-byte ram.
58K-byte ram available using SciDOS.

Display
Up to 32 lines of 96 characters full programmable. Scrolling window determined by software.
Graphics mode 0 gives 192 by 96 pixels, mode 1 gives 192 by 192 resolution. Characters and graphics may be displayed simultaneously.

Input/output
Up to four single or double-sided 8, 5.25, 3.5 or 3in disc drives may be used, either single or double density.
RS232 serial i/o data rates range from 1 to 38400baud with separate transmit/receive clocks. Synchronous serial i/o format is 5 to 8-bit auto-search and sync. or asynchronous 5 to 8-bit with 1, 1.5 or 2 stop bits. RTS and CTR signals conrol serial data flow.
Eight-bit parallel data input is buffered by schmitt i.cs. Eight-bit parallel output drives five t.t.l. loads. The mos i/o lins operate event counters, pulse timers and Z80 interrupts. Four mos timer lines are available for timing and sound generation.

A set of three Eurocard-format plated-through-hole boards for SC84 is available from Combe Martin Electronics, King Street, Combe Martin, Devon EX4 0AD. Price is £39 for the set including v.a.t. and inland or overseas postage. John Hodson — secretary of the Scientific Computer User Group — is organizing the SC84 user group. For further information, send an s.a.e. to him at 12 Broughton Road, Basford, Newcastle-under-Lyme (new address). A listing of SC84's machine-code operating system — MCOS — can be obtained by sending an s.a.e. to *Electronics and Wireless World*, Room L303, Quadrant House, The Quadrant, Sutton, Surrey SM2 5AS.

Keyboard and parallel i/o interfacing

Keyboard requirement is for a source of seven-bit ascii code with a positive-going level strobe, i.e. one which stays high as long as a particular key is pressed (circuit shown last month). As ascii is a seven-bit code, the eighth input bit is not wasted but used as a flag that the RS232C port is to echo v.d.u. program output when using MCOS. Not all keyboards have an auto-repeat function so it is provided on the board; an interrupt pulse is sent to the STI at the start of the strobe pulse and after a pause of approximately 0.5s further pulses occur at approximately 20Hz. Overall speed of the repeat system may be adjusted by changing the 1µF capacitor value, the 0.5s hold-off only may be adjusted by altering the 390kΩ resistor and the repeat frequency by altering the 1.8kΩ resistor. In all cases, reducing the value increases the speed of operation. The i.c. used for keyboard repeat, IC_{209}, also supplies the 2.4576MHz signal for bit rate generation. I recommend that you avoid a National Semiconductor part for this i.c., CD4093BE (RCA) or MC14093BCP (Motorola) being suitable.

Table 2. Interrupt vectors in memory.

Address	Service routine
0FF00	I/O line 0 (keyboard interrupt)
0FF02	I/O line 1
0FF04	I/O line 2
0FF06	I/O line 3 (pulse width/event B)
0FF08	Timer D
0FF0A	Timer C
0FF0C	I/O line 4 (pulse width/event A)
0FF0E	I/O line 5
0FF10	Timer B
0FF12	Transmit error
0FF14	Transmit buffer empty
0FF16	Receive error
0FF18	Receive buffer full
0FF1A	Timer A
0FF1C	I/O line 6 (disc controller INTRQ)
0FF1E	I/O line 7 (disc controller DRQ)

These are addresses of the two consecutive locations in memory at which the interrupt controller will expect to find the starting address of the service routine for that particular interrupt.

Table 1. Nominal allocations of Z80 i/o ports.

Port address (hex.)	Allocaton
0E0-3	Keyboard input and control port output
0E4-7	General purpose parallel i/o
0E8	Disc controller command and status port
0E9	Disc controller track register
0EA	Disc controller sector register
0EB	Disc controller data register
0EC-F	Not used
0F0	STI indirect register
0F1	STI parallel i/o port
0F2	STI interrupt pending register B
0F3	STI interrupt pending register A
0F4	STI interrupt inservice register B
0F5	STI interrupt inservice register A
0F6	STI interrupt mask register B
0F7	STI interrupt mask register A
0F8	STI pointer/vector register
0F9	STI timers A and B control register
0FA	STI timer B data register
0FB	STI timer A data register
0FC	STI usart control register
0FD	STI receiver status register
0FE	STI transmitter status register
0FF	STI usart data register
000	STI sync. character register
001	STI timer D data register
002	STI timer C data register
003	STI active edge register
004	STI interrupt enable register B
005	STI interrupt enable register A
006	STI data direction register
007	STI timers C and D control register

Wire links from ground pin TP_{201} to TP_{202-4} select addresses of the i/o ports. The i/o allocation used in the system software is given in Table 1. Links need only be included should these be changed for experimental purposes. If this is not envisaged, they may be left out altogether.

Parallel i/o is catered for by uncommitted eight-bit input and eight-bit output ports, a control port used for keyboard input, and output to the disc drives and system. There is an option for the eight-bit parallel output port, IC_{206}. Use a 74LS273 and make link 202 for a standard eight-bit port which is automatically cleared on RESET, or use a 74LS373 and make link 201 for a tri-state port enabled by applying a low level to pin one of the port connector. The latter option means that this port may then be connected in parallel with the eight-bit input port to form a bidirectional i/o port. Spare I lines on the STI, pins 11 to 13, are also available from pads adjacent to the i.c. pins as are the outputs from the four frequency generators. Link 203 should be wired in on the basic system but may be removed to free pin 16 of the STI for use in an interrupt daisy-chain, Table 2.

the driven pin, the cathode in this case, to suppress the tv video signal in computer monitor mode. In the 3845, a resistor is also connected to this switch and to the junction of R_{127}, the height control, and R_{128} which, looking at the back of the set, is the leftmost terminal of the height control. This allows automatic adjustment of picture height to the optimum for tv and computer.

The video signal is brought in on a short length of screened cable and buffered by a 2N2369A transistor before being applied to the tube grid. All connections are made through the tube socket, the prototypes being about 1in square pieces of Veroboard mounted directly on the back of the tube socket. This is the recommended position as long wires will ruin the video quality. When making this interface, remove the tube socket from the tube while soldering and use stiff wire to mount the interface board onto the socket and flexible wire (including the screened wire) to link from it to the switch, etc., in order not to put strain on the socket and c.r.t. neck. Most portable sets have the 3845 type of circuit where the cathode is driven and the grid is at zero volts. If neither the grid nor cathode is at a low potential then some form of level-shifting must be used or, better, a different type of set considered.

Normal settings for S_{301-4} are off-off-on-on, mapping the v.d.u. at hexadecimal addresses 0800-09FFF, switched in by VDUSEL being high. Other permutations are possible for experimentation.

SC84's disc-operating system, SciDOS, with utility software costs £36 extended Basic with graphics is £22.50 and Basic with enhanced file manipulation, i/o control, numeric/constant string handling and 12-digit precision is £31.50. These prices include v.a.t. and postage and become £24, £15 and £21 respectively for non-commercial users and further discounts are available for those buying more than one software package at once. John Adams is considering producing a kit of i.cs for SC84. For details of these items send an s.a.e. to him at 5 The Close, Radlett, Herts.

A switch-regulated power supply and further constructor's notes are subjects of a future article.

Continued from page 62

the p.s.d. the output voltage changes to drive the v.c.o. to the new frequency.

Operation of the phase-locked loop is exactly analogous to a servo-loop; it has a natural frequency, damping factor and a bandwidth with a second order, low-pass filter characteristic. Effectively what the p.l.l. does is to recover, from the frequency of the input signals, the original changes in voltage that drove the v.c.o. in the modulator. As the v.c.o. of the p.l.l. is identical to that of the 566, it is not surprising that the changes in voltage levels at the output of pin 7 are similar to those applied to the input of the v.c.o. of Fig.6. The voltage change applied to the v.c.o. of the modulator was 430mV (13.33-12.9); the voltage output from the 565 (pin 7) is thus of the same order.

The maximum operating voltage of the 565 i.c. is 26 volts. It cannot therefore operate from the ±15 volt supply rails and was consequently chosen to operate from the +15 volt supply rail and ground. (±15 volt supply rails were chosen because of the large voltage drive required by the triangle-to-sine wave converter of Fig.6; it will not operate satisfactorily from ±12 volt supplies.) The two inputs of the 565 i.c. pins 2&3, require an identical d.c. bias that is slightly less than the half-supply voltage. The potential divider consisting of the 4.7kΩ resistor and 3.3kΩ resistors produces the required d.c. bias on pins 2 & 3 via 3.3kΩ series resistors. The audio input may be to either of these two inputs, via a suitable decoupling capacitor. As the lowest audio signal frequency is not less than 9kHz, the decoupling capacitor may have a conveniently low value of 22nF.

The components that determine the free-running frequency of the v.c.o. of the 565 i.c. (which should be the centre frequency of 10kHz) are the resistor on pin 8 (a 6.8kΩ resistor in series with a 5kΩ variable) and the capacitor on pin 9. The values chosen are the same as those for the v.c.o. of Fig.6, except that the resistor is made adjustable. For a ±10% frequency deviation, the amplitude of the audio input signal can vary from 10mV to 1V r.m.s., and still maintain good tracking of the input frequency. The volume setting of the record/playback electronics on playback of the recorded signal is thus non-critical and a mid-way setting of 100mV r.m.s. ideal.

The expected direct voltage variation on the output of pin 7 for an input signal with frequency deviation of ±10% is, as mentioned earlier, about 430mV. This can be adjusted to ±215mV about the reference voltage level on pin 6 by adjusting the value of the 5kΩ variable resistor. This is most easily achieved by connecting the output of the modulator to the input of the demodulator and applying logic low and high levels to the modulator input.

The output from the demodulator, pin 7, which is applied (internally) to the input of the v.c.o. needs to be filtered for the p.l.l. to operate satisfactorily. This is achieved in this circuit by the 27nF capacitor connected between pin 7 and the +15V supply rail. For the chosen v.c.o. operating frequency of 10kHz and a rate of 2400 baud this value has been found to be satisfactory. It is also satisfactory for lower rates, but possibly not for a higher rate of 4800 baud. (Unfortunately I have not been able to try this out.)

To provide a t.t.l. and RS232 type output level, the output from the demodulator, on pin 7, needs to be amplified. This is achieved using an op-amp, as a comparator and the output from pin 6 as the reference level. The output from pin 7 is further filtered by the simple two-stage ladder filter composed of 5.6kΩ resistors and 4.7nF capacitors. The band-edge of the ladder filter is chosen to be approximately half way between the maximum keying rate (2400 baud or 1200Hz) and twice the input frequency (about 20kHz).

The 1nF capacitor connected between pins 7 & 8 acts in the same way as that between pins 6 & 5 of the 566 i.c.; i.e. to improve high-frequency stability. Similarly, the 1nF capacitor across the inputs of the op-amp comparator does the same thing. The 1MΩ resistor connected from the inverting input of the op-amp to the -15 volt rail ensures that a logic high level is output from the op-amp when *no* audio signal is present on the input to the demodulator. Two outputs are provided from the op-amp, one at t.t.l. levels suitable for coupling directly to t.t.l. i.c. inputs, and one at an RS232 type level.

I must confess, at this point, that although I have shown the modulator and demodulator circuits of Fig.6 and 8 with RS232 type inputs and outputs, I have not tried them out on my own computer, preferring to use t.t.l. levels. It is my understanding that RS232 type inputs and outputs normally invert the t.t.l. logic levels. In so far as I have shown the RS232 type inputs and outputs being used, this should not matter since, if the modulator is connected to the demodulator then a 'high' input on the modulator will produce a 'high' output from the demodulator. However, in the absence of an audio signal input to the demodulator the t.t.l. output should be high. If the RS232-type connection is used on the output of the demodulator, this will also be high. A subsequent RS232 input on the microcomputer may invert this to a logic low on its t.t.l-type output. To invert this logic, the 1MΩ resistor connected between the negative input of the op-amp comparator and the -15 volt supply rail should be connected to the +15 volt supply rail instead. A final article will describe the up/down tape counter and record/playback electronics.

LITERATURE RECEIVED

A neat modern design is carried through the S Range of meters and instruments from Philip Harris. They are designed with particular attention to reliability, ease of servicing and user safety and feature ease of storage and are clearly marked for identification. The range includes a dual-trace oscilloscope adaptor, various power supply and amplifiers, meters for joules, conductivity, pH, counters, timers and an electrical safety tester. Philip Harris Ltd, Lynne Lane, Shenstone, Staffs WS14 0EE. WW270

A CNC lathe which can be controlled from a BBC micro is produced by Colne Robotics and described in a leaflet. Included is the basic software which provides a comprehensive range of control codes to program and retain complex cutting sequences. Safety measures are provided by hardware safety cut-out switches and from within the software. Colne Robotics Co. Ltd, Beaufort Road, off Richmond Road, Twickenham, Middlesex, TW1 2PQ. WW271

A range of small p.c.bs, each with elements of a circuit can be linked together to make up more complex circuits. This is the Alpha system from Unilab. It is designed to be a 'low-cost, radical approach to the effective teaching and learning of basic electronics, initially for the 13+ age range.' There is also a range for more advanced work. Details supplied in a leaflet from Unilab, Clarendon Road, Blackburn, Lancs BB1 9TA. WW272

The functions of many different instruments are combined into one unit in the Griffin programmable scientific instrument, or GiPSI. Starting from a single or dual-input multimeter it may be converted into a variety of other instruments by the addition of plug-in modules and overlays to show the functions of the touch-sensitive membrane keyboard. Among the modules are a pH meter, measurements of pressure, magnetic flux, timing and counting, and many more. The meter can also be interfaced with a computer as part of a data acquisition system. Full details in a brochure from Griffin & George, 285 Ealing Road, Wembley, Middlesex HA0 1HJ. WW273

A number of programs for biological experiments are included in *Micros in the Lab*. Designed for use with the ZX Spectrum computer, full software and hardware details are given in this duplicated booklet. The centre that publishes it can also supply a number of components to ILEA schools. ILEA South London Science Centre, Wilson Road, London SE5 8PD. Telephone: 01-701 2224.

ILEA publish two magazines for school micro users–Computers in Primary Schools newsletter for primary schools and Educational Computing for secondary schools. Both come from the Inner London Educational Computer Centre, John Ruskin Street, London SE5 0PQ. WW275

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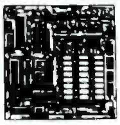

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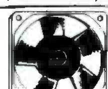

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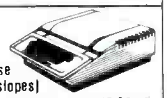

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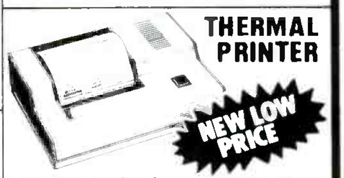

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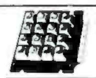

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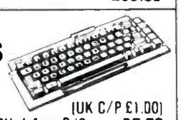

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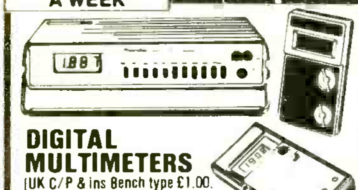

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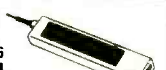

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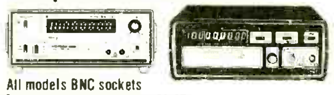

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TP1000 100 to 1000MHZ complete with AC adaptor P/S, 25mV RMS sensitivity £65.00

Optional probe kits - suitable for all models X1 £6.90 X10 £8.26

VARIABLE POWER SUPPLIES

220/240V AC input

PP241 single meter, A/V switch, 0/30V 1 amp £30.43

PP243 3 amp version £52.13

230N Twin meter 0/30V 1A £91.00

330N 3 amp version £164.00

(UK C/P above models £1.00)

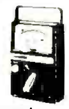
PL Laboratory series - LED readout - QMO versions series/parallel etc.

PL310 30V 1A £118.00 **PL310** QMO £249.00

PL320 30V 2A £145.00 **PL320** QMO £315.00

(UK C/P above models £2.50)

ANALOGUE MULTIMETERS



General range (★mirror scale)

(UK C/P 65p)

HC6015 15 range pocket 10K/Volt 1 meg ohm £7.39

M200 30 range 20K/Volt 20KBZ

Special purchase £8.65 (list price £19.00)

HM102BZ★ 22 range 20K/Volt 10A DC plus cont. Buzzer, 10 Meg ohm £11.74

TMK500★ 23 range bench, 30K/Volt 12A DC Plus cont. buzzer, 20 Meg ohm £20.83

NH56R★ 22 range 10K/Volt, 6 Meg ohm £10.39

830A★ 26 range 30K/Volt 10AC/DC: 10 Meg ohm £20.83

360TR★ 23 range bench, 100K/Volt, large scale, 10A AC/DC plus Hfe tester, 10 Meg ohm £34.74

AT2100★ 31 range de luxe 100K/Volt 10A AC/DC: 100 Meg ohm £29.13

AT1020★ 18 range de luxe 20K/Volt plus Hfe tester, 5 Meg ohm £18.26

YN360TR★ 19 range 20K/Volt plus Hfe tester 1 Meg ohm £12.13

KRT5001★ Range doubler 35 range total 50K/Volt 10A DC 20 Meg ohm £17.35

ST303TR★ 22 range 20K/Volt plus Hfe tester 12A DC 1 Meg ohm £15.61

ELECTRONIC INSULATION TESTER

500V/0-100 Meg ohm with carry case, leads etc.

YF501 £59.13 (UK C/P 65p)

SIGNAL GENERATORS

220/240V AC (UK C/P & ins £1.00)

Bench portable all sine/square/triangle/TTL/etc. External sweep mode.

FUNCTION

Thandar TG101★ 0.02HZ to 200KHZ various facilities £105.00

Thandar TG102★ 0.2HZ to 2MHZ various facilities £155.00

Jupiter 500 0.1 Hz - 500 KHZ £110.00

Thandar Pulse Bench portable

TG105★ 5HZ to 5MHZ Various facilities £105.00

★ Optional carry case £5.95

AUDIO

Leader LAG27 5 band sine/square O/P 0/5V RMS Dist 0.05% 10HZ to 1MHZ £83.00

Leader LAG120A 5 band 10HZ to 1MHZ to 0-3V RMS into 600 ohm 0.05% dist. sine/square £145.00

Leader LAG125 5 band 10HZ to 1MHZ to 0-3V RMS into 600 ohm sine/square/burst signals 0.03% dist £330.00

TRIO AG202A 4 band 20HZ to 200KHZ, 10V RMS O/P 0.5% dist CR OSC 0/10V pp O/P £88.00

TRIO AG203 5 band 10HZ to 1MHZ, 0.1% dist 0/7V RMS O/P £139.00

RF

TRIO SG402 6 range 100KHZ to 30MHZ RF 0.1V RMS int/ext mod £72.00

Leader LSG17 6 band 100KHZ to 150MHZ (96 to 450MHZ on Harmonics) RF 0.1V RMS, int/ext Mod. AF 1KHZ 1 volt (1MHZ Xcal optional £3.00) £95.00

DIGITAL CAPACITANCE METERS

Direct reading LED meters

DM6013 Pocket/bench 8 range 0.1pf to 2000mfd 3½ digit 0.5% with battery (UK C/P 65p) £52.13

CM200 Bench model 4½ digit 0.2% 1pf to 2500mfd 6 ranges (UK C/P 85p) £89.00

DIGITAL THERMOMETERS

Pocket size LCD thermometers complete with battery. Accept any type K probe (UK C/P 65p)

TH301 LCD -50°C to +750°C. 1°C resolution with thermocouple £59.50

TH302 LCD -40°C to 1100°C Cent/Fahrenheit 0.1° and 1° resolution with thermocouple £79.50

Range of various probes in stock£ 17.50 to £25.00

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(★ UK C/P £1.50 + UK C/P £1.00)

LH C909* VHS/BETA video head tester £45.00 each

OM358+ Scope multiplexer, 35MHZ, expands any scope to eight channels £169.00

LTC905★ Scope add-on semicon curve tracer £99.00

LCT906A+ Transistor tester (all types) £109.00

LTC907+ Transistor tester, signal injector tracer £178.00

LVT72+ FET/VOM/transistor tester £143.00

LCR740★ LCR bridge: cap, inductance and resistance £195.00

LDM170★ Distortion meter 20HZ to 20KHZ £310.00

LFG1300★ Sweep 0.3% function generator 0.002HZ to 2MHZ £395.00

TC40★ VHF/UHF FM and TV field strength meter Battery operated with carry case £177.00

MC321+ UK PAL TV colour pattern generator £222.60

MC328+ As above but PAL B-G-H £222.60

DM801+ 700KHZ to 250MHZ Dip meter inductive/cap res. freq. measurement etc. £62.00

CHART RECORDER 100mV (2mA) Panel mount 240V AC £149.00

LFM39 A-D★ Wow and flutter meter. Jis. CCIR. Din. £445.00

HZ65+ Scope add on component tester £24.00

LTC910A★ CRT tester/rejuvenator for b/w and colour £175.00

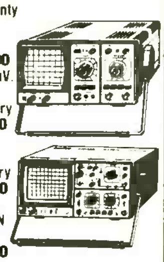
OSCILLOSCOPES

Full specification any model Send SAE

UK C/P - & ins

Single trace		Dual trace	
carrier	£2.60	carrier	£3.50
TNT	£5.20	TNT	£7.00
Securicor	£10.45	Securicor	£13.00

HAMEG 2 years warranty



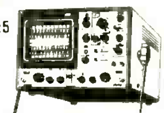
HM103 Single trace, 10MHZ, 2mV, 6 x 7cm display plus component tester £158.00

HM203 Dual trace 20MHZ 2mV. Algebraic add. 'Z' Mod. plus component tester (Optional carry case £21.50) £264.00

HM204 Dual trace 20MHZ, sweep delay, 2mV, plus component tester (optional carry case £21.50) £365.00

HM605 Dual trace 60MHZ, delay line, 1mV, 1MHZ CALGEN (optional carry case £21.50) £487.00

HITACHI



All models 5mV (1mV using x5 magnifier)

All models complete with 2 probes.

2 years warranty.

V212 Dual 20MHZ, bench portable 6" CRT CH1 O/P £335.00

V222 Dual 20MHZ, portable with DC offset and alternate magnifier £375.00

V203F Dual trace 20 MHZ lab port, with sweep delay, 5½" CRT £375.00

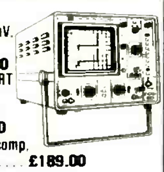
V422 Dual 40MHZ, portable with DC offset and alternate amplifier £580.00

V353F 35 MHZ dual trace lab port, with sweep delay, 5½" CRT. £580.00

V650F Dual 60MHZ lab portable with dual time base £850.00

Also in stock V134 storage, VC6015 digital storage scopes. Battery/Mains Scopes, Vector & TV monitor available

CROTECH

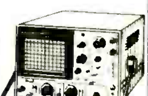


3030 Single trace 15MHZ, 5mV, 95mm CRT plus component tester £169.00

3132 Dual 20MHZ, 2mV, 5" CRT Algebraic +/-, 'Z' mod. plus component comparator and DC source outputs £283.00

3035 Single trace 10 MHZ + comp. tester, 5" CRT £189.00

TRIO 2 years warranty

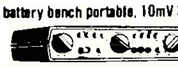


GOS3310 Single trace 10 MHZ 5mV, 75mm display. Mains port. £139.00

CS1562A Dual trace 10MHZ, 130mm CRT, 10mV, 1 microsec, with 2 probes £260.83

CS1566A Dual 20MHZ, 140mm CRT, 5mV, 0.5 microsec, with 2 probes £326.00

THANDAR



2 years warranty

SC110A 10MHZ battery bench portable, 10mV 32 x 26mm display. Size 255 x 150 x 50mm £165.00

(Optional carry case £5.95, AC adaptor/charger £6.95) Rech Nicad £11.00

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X10	£8.26	Demodulator	£16.00
X100	£16.00		

(UK C/P free with other item or 65p per 1 to 3 kits)

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CIRCLE 4 FOR FURTHER DETAILS.

Two-metre transceivers

A survey of amateur radio equipment for the popular 144-146MHz band

For most newly-licensed radio amateurs, the two-metre band is a natural starting point. It is the lowest band available to those without proficiency in morse code. It is also the most populous: there are no worries about finding other stations to talk to.

Most equipment now in use on 2m is factory-built, almost invariably in the Far East; and a wide choice is available with prices starting at a little over £100. But it is still possible for the constructor to get on the air with a home-built rig at a cost of perhaps a few tens of pounds*.

The average newcomer's choice is likely to be a narrow-band f.m. set, for use mainly in the channelized region above 145MHz. This type of rig closely resembles the sort of c.b. set from which many new licensees have recently graduated: the controls are few and simple, and operation involves little more than pushing the button and talking.

For this reason, experienced operators often prefer single-sideband operation, where the technical demands are greater and the rewards higher. With weak signals, s.s.b. has a considerable advantage over f.m. and is essential for serious long-distance working.

Nevertheless, many old hands do use f.m. A chat on two metres, possibly through the local repeater, can be a pleasant enough way of whiling away the traffic jams on the way to work.

A type of set which has grown rapidly in popularity in recent times is the hand-held portable transceiver. Small enough to fit into the pocket, it can be taken anywhere; and for those with something grander at home, it makes a convenient second rig. The latest models offer performance figures and features scarcely inferior to those of larger units. Most hand-helds offer f.m. only, though there is at present one s.s.b. model.

The third main transceiver type is the basestation. This is typically quite a large and complex unit, normally mains-powered but often with a d.c. supply option for use with a car battery. Most ready-built basestation units are multi-mode sets, providing all three of the common amateur radio transmission modes: narrow-band f.m., s.s.b. and (for morse code) c.w. Amplitude modulation is more or less dead on v.h.f., despite one or two attempts to revive it: the few stations still using a.m. are equipped mostly with second-hand commercial radiotelephones.

The multi-mode set also makes a useful building block for forays into the higher bands by providing a stable frequency source for multiplying up through devices such as varactor triplers.

Technical features

Commercial amateur radio equipment has changed considerably during the last few years. Perhaps the most conspicuous development, in v.h.f. transceivers at least, is that digital frequency synthesizers have almost entirely displaced switched crystal oscillators and free-running variable frequency oscillators.

True continuous tuning has become virtually a thing of the past in 2m equipment. Most sets tune in steps governed in the first instance by the frequency of the synthesizer's v.c.o. With f.m. equipment for the European market, the step size is often 12.5 or 25kHz. This gives easy tuning of the numbered f.m. channels on 2m, which are spaced 25kHz apart. So an f.m.-only set which scans in smaller steps may be awkward to handle when rapid retuning is called for. However, in many synthesized sets the channel spacing can be programmed by the user.

On s.s.b., tuning steps as small as 100Hz are the norm. But s.s.b. sets also have a clarifier or receiver incremental tuning control (r.i.t.), which allows the receive frequency to be offset slightly from the transmit frequency: this is to help resolve off-channel transmissions. On the more expensive multi-mode sets there may also be a control to pull the transmitter frequency slightly, for satellite working. With this, the operator can compensator for Doppler shift as the spacecraft approaches and recedes.

In some of the cheapest sets, the hand-held portables, frequency selection is by means of a bank of thumbwheel switches. This method works well enough if the switches are reliable, though some users may prefer to pay a bit more to have a digital display giving positive indication of the tuned frequency. Many recent portables have a low-power liquid crystal display, with a calculator-

*For a more complex transceiver suitable for home construction, see T.D. Forrester's design in *Wireless World*, November 1982 to April 1983, with a postscript in August 1983.

Model	Price (£)	Style	Tx modes	Other bands	Tx power	Syn/ xtal	F.m. step	Tuning method	Mem-ories	Scan mode	Dis-play	S-meter	Rx sensitivity	Audio out	Power needs	Battery capacity	Size (mm)	Weight (kg)	Features	Optional extras
WPO 2m Talkbox	68	kit	f	-	1W	X	-	-	6 ch	-	-	-	0·25µV,10dB	-	12V	-	-	-	Rx and tx available separately	Synthesized v.f.o., £38.50
Wood & Douglas	74	kit	f	-	10W	X	-	-	-	-	-	-	0·4µV,12dB	<1·5W	12V	-	-	-	Modular kit system	Synthesized version, £100; many add-ons
Belcom LS-20XE	139	hand	f	-	1>0·1W	S	5kHz	thumbw	-	-	-	-	1mV,>26dB	>0·1W	6V,20<500mA	4 x AAA	140x69x26	0·28	Very compact	Headset, NiCd cells, charger
FDK Palmcomm II	139	hand	f	-	>1·5W	X	-	knob	6 ch	-	-	-	-4dBµV,20dB	0·5W	12V,25<300mA	225mAh	68x154x41·5	0·47	Capacitor mic	Throat mic, headset, speaker-mic
Standard C110	140	hand	f	-	2·5/0·15	S	5kHz	thumbw	-	-	-	mc	0·2µV,12dB	0·3W	9V,20<750mA	450mAh	176x65x34	0·47	2.5W output is with optional NiCd pack	Choice of chargers
Yaesu FT203R	169	hand	f	-	2·5W	S	5/10kHz	thumbw	-	-	-	mc	0·25µV,12dB	0·45W	<13V,<0·7A	425mAh	65x34x153	0·45	Draws 20mA on standby	Headset for vox operation; bigger NiCd pack
Icom IC-2E	173	hand	f	-	1·5/0·15	S	5/10kHz	thumbw	-	-	-	-	<0·4µV,20dB	>0·3W	8V,20<550mA	250mAh	165x65x35	0·45	Very compact	Interchangeable NiCd packs in three sizes
Yaesu FT208R	179	hand	f	-	2·5>0·3W	S	5/10kHz	keypad	10	b,m	lcd	-	0·4µV,12dB	0·5W	10·8V,<0·5A		168x61x49	0·72	20mA standby current	Chargers, car adaptor, power amplifier
NDi HC-1400	179	mobi	f	-	25W	S	5	d	3	-	led	mc	<0·3µV,12dB	2W	13·8V,<5A	-	182x66x258	3·4		
Standard C8900	219	mobi	f	-	10W	S	5/25kHz	d,u-d	5	b,m	led	bar	0·15µV,12dB	2W	12V,0·4<2·8A	-	138x31x178	1·1	GaAs fet r.f. amp; tiltable display	-
Belcom LS-202E	225	hand	f,s	-	2·5/0·5	S	5kHz	thumbw	-	-	-	mc	0·25µV,10dB	>0·4W	9V,30<750mA	6 x AA	165x62x40	0·5	Dual mode; >3.5W output with 12V supply	Console for mobile use; can accept 25W linear amp.
Icom IC-02E	239	hand	f	-	3>0·5W	S	12·5/25k	keypad	10	m	lcd	bar	<0·32µV,20dB	>0·5W	8V,45mA<1A	250mAh	165x65x35	0·515	13.8V supply gives 5W r.f. output	Interchangeable NiCd packs
KDK FM-2033	239	mobi	f	-	25/5W	S	5/12·5k	d,u-d	11	b,m	lcd	bar	0·2µV,12dB	>2W	13·8V,0·3<6A	-	162x55x182	1·7	Receiver has 1kHz r.i.t. steps	
FDK Multi-725X	239	mobi	f	-	25>1W	S	5/12·5k	d,u-d	-	b	fluor	bar	-4dBµV,20dB	>1W	13·8V,<6·5A	-	162x62x260	2·3	Two v.f.os	Expander unit for 70cm
Trio TR-2500	246	hand	f	-	2·5>0·3W	S	5kHz	keypad	10	m	lcd	-	<0·2µV,12dB	>0·4W	8V,0·03<0·8A	400mAh	168x66x40	0·54	Removable NiCd pack	
Standard C58E	249	port	f,s,c	-	1W	S	>100Hz	d,u-d	5	b,m	lcd	mc	0·22µV,12dB	>1W	<16V,·09<·6A	450mAh	129x52x190·5	1·45	Separate mic	25W booster; mobile mounting bracket
Yaesu FT230R	259	mobi	f	-	25/3W	S	5/10kHz	d,u-d	10	b,m	lcd	mc	0·25µV,12dB	>1W	13·6V,0·3<5A	-	150x50x174	1·3	Two v.f.os	Speaker-mic
Yaesu FT290R	269	port	f,s,c	-	2·5	S	5/10kHz	d,u-d	10	b,m	lcd	mc	0·25µV,12dB	1W	70<800mA	8 x C	150x58x195	1·3	Two v.f.os; telescopic antenna	Speaker-mic etc.
Trio TM201A	279	mobi	f	-	25/5W	S	5kHz	d,u-d	5	b,m	led	bar	0·22µV	>2W	13·8V,<5·5A	-	141x39·5x183	1·25	GaAs fet r.f. amp, two v.f.os, separate speaker	Remote control/display unit
Icom IC-27E	319	mobi	f	-	25/5W	S	12·5/25k	d,u-d	9	b,m	led	bar	<0·4µV,20dB	>2W	13·8V,<6A	-	140x38x177	1·2	Very compact; two v.f.os	Speech synthesizer, £25
Trio TR-7930	323	mobi	f	-	25/5W	S	5kHz	kpad,u-d	21	b,m	lcd	bar	<0·25µV,12dB	>2W	13·8V,<6·5A	-	175x64x206	1·8		
FDK Multi-750XX	349	mobi	f,s,c	-	20/1W	S	100Hz/5k	d,u-d	-	b	fluor	bar	-4dBµV,20dB	1·3W	13·8V,<5A	-	162x62x260	2·3	Two v.f.os	Expander unit for 70cm
Icom IC-25H	359	mobi	f	-	45/2W	S	5/15/25k	d	5	b,m	led	bar	<0·6µV,20dB	>2W	13·8V,<9·5A	-	140x50x222	1·9	High-power version of old IC25E; two v.f.os	Memory back-up for mobiles
Standard C5800E	359	mobi	f,s,c	-	25/1W	S	>100Hz	d,u-d	10	b,m	led	bar	0·19µV,12dB	>2W	12V,·45<4·7A	-	149x55x218	1·9		Speaker-mic
Yaesu FT480R	399	mobi	f,s,c	-	15W	S	>1kHz	d,u-d	4	b,m	fluor	bar	0·35µV,20dB	2W	13·8V,0·5<3A	-	180x60x240	2·9	Dual v.f.os	Tone encoder, p.s.u., station console
Trio TR-9130	458	mobi	f,s,c	-	25/5W	S	12·5/25k	d,u-d	6	b,m	led	mc	<0·25µV,12dB	>2W	13·8V,<5·5A	-	170x68x241	2·4	Two v.f.os	
Trio TW-4000A	488	mobi	f	70cm	25/5W	S	5/25kHz	d,u-d	10	b,m	lcd	bar	<0·17µV,12dB	>2W	13·8V,<7·5A	-	161x60x217	2·0	GaAs fet preamps, two v.f.os	Voice synthesizer (£25) fits internally
Icom IC-290D	499	mobi	f,s,c	-	25/1W	S	1/5kHz	d	5	b,m	led	bar	<0·6µV,20dB	>2W	13·8V,<6A	-	170x64x218	2·5	Two v.f.os	NiCd battery for memory retention
Icom IC-271E	649	base	f,s,c	-	25>1W	S	1/5kHz	d,u-d	32	b,m	fluor	mc	<0·3µV,12dB	>2W	13·8V,<6A	-	285x110x275	5·2	For mains use, requires internal s.m.p.s., £149	Computer interface, voice synthesizer
Yaesu FT726R	739	base	f,s,c	-	10W out	S	20/200Hz	d,u-d	11	b,m	fluor	mc	<0·25µV,12dB	>1·5W	ac/12V,<4·5A	-	334x129x315	11	Duplex mode with optional satellite i.f. unit	R.f. modules for 6m, 70cm and (to come) h.f.
Icom IC-271HE	789	base	f,s,c	-	100>10W	S	1/5kHz	d,u-d	32	b,m	fluor	mc	<0·3µV,12dB	2W	13·8V,<18A	-	111x286x324		For mains use, requires internal s.m.p.s., £149	Computer interface, voice synthesizer
Trio TS-780	850	base	f,s,c	70cm	10>1W	S	5/12·5k	d	10	b,m	fluor	mc	<0·2µV,12dB	>2W	13·8V,<5A	-	290x124x322	10·1	Cross-band operation; two vfos; switchable rx b.w.	

style keypad for rapid frequency selection. The display may incorporate extra features such as a bar-graph meter to indicate transmitted power and received signal strength. In mains-powered sets, or mobile equipment designed to run from a car battery, a fluorescent display is sometimes fitted: this may give better readibility under unfavourable lighting conditions.

The transmitter

The maximum power level permitted to British amateurs on the 2m band (other than those with special dispensation from the licensing authority) is a carrier power supplied to the aerial of 20dBW, or in the s.s.b. mode a peak envelope power (p.e.p.) of 26dBW. These figures correspond to 100W and 400W respectively.

The power output of the average 2m mobile f.m. transceiver is in the region of 10W. Since this type of set is probably the most common, there is little point choosing something more powerful unless the performance of its receiver is better than average. There is no virtue in being able to shout at other stations if their replies are going to be lost in noise.

With portable and hand-held transceivers, transmit power is usually restricted to a watt or two for reasons of battery life; but often the power can be switched to a still lower level for contacts under good signal conditions, with a dramatic reduction in battery drain. Under typical conditions, with one-minute transmission periods alternating with three minutes of listening, the life expectancy of a battery pack is likely to be in the region of two and a half hours.

The current drain in the standby condition is a detail worth seeking out on the manufacturer's data sheet. Some of the early portables had led displays which were so heavy on current that they had to be blanked for much of the time. But if the user anticipates long periods of intensive operation, it is worth looking for a model with a quick-change battery pack so that a spare can be slipped in when the output starts to droop. With certain sets, the manufacturers offer a choice of packs in different sizes, some of them having a higher-than-usual nominal voltage to give increased transmit power.

The receiver

Receivers too have their share of design improvements. Ceramic filters offer excellent filtering at low cost, and new low-noise r.f. devices are bringing enhanced performance in the front-end. Beginning to make an appearance in commercial two-metre equipment is the gallium arsenide fet. But it is worth bearing in mind that fashionable components do not automatically make a set better.

Receiver sensitivity usually features prominently in radio manufacturers' promotional material, though the figures quoted are not always expessed in the same units and it can be difficult to raw meaningful comparisons. However, the 'goodness' of a receiver is affected by many other factors, including resistance to overloading, resistance to out-of-band signals and the quality of the filters. The sensitivity figures should not therefore be taken on their own as an index of the receiver's overall merit.

As it is with cars, so with transceivers: even the cheapest will get you from A to B if the road is open. So what are the advantages of buying one of the more expensive models? With radios, even the costliest cannot offer extra speed. But it can provide a range of features designed to make a session at the microphone more interesting and less tiring.

Among these are extra memories for storing commonly used frequencies; additional scanning modes; accessories such as a voice synthesiser to supplement the front panel display; plug-in radio-frequency modules for other bands; an interface unit enabling the transceiver to be controlled automatically by the user's computer; and of course more transmitter power and a better receiver.

Notes on the table

Price: the distributor's UK price, including v.a.t.
Style: entry indicates whether the set is intended for portable, mobile or base-station use. However, for many mobile units it is possible to buy desk-top consoles with mains power units; and for some portables, car fixing kits are available.
Modes: 'f' indicates narrow-band f.m.; 's' indicates s.s.b.; 'c' indicates c.w.
Other bands: this survey includes one or two dual-band models. For certain other sets, r.f. modules giving coverage of additional bands are available as an accessory.
Tx power: the transmitter power quoted by the manufacturer, normally for the f.m. mode. Two figures separated by an oblique stroke indicate high and low power settings. The separator '>' indicates that the power is continuously variable between the limits shown.
Syn/xtal: 's' denotes frequency-synthesiser tuning, 'x' denotes a crystal oscillator providing only those channels for which suitable crystals have been fitted.
F.m. step: the normal minimum tuning step in n.b.f.m. use. Some multi-mode sets are capable of much smaller steps even on f.m. In many cases, the size of the step is programmable: for example, 12.5 and 25kHz can be selected instead of 5 and 10kHz if the user wishes.
Tuning method: 'd' indicates a conventional knob or dial, 'thumbw' indicates thumbwheel switches and 'u-d' indicates up-down buttons.
Memories: most present-day sets permit storage and instant selection of a number of the user's favourite frequencies. Certain models also have one or more variable-frequency oscillators which can be used as additional memories.
Scan modes: some sets allow scanning of frequencies stored in memory ('m'), others provide scanning of the entire band ('b') or programmable sectors of it.
S-meter: most sets include a received signal-strength meter of some sort. Often this doubles as a power level indicator. The entry 'bar' indicates a bar-graph indicator as distinct from a moving-coil meter, 'mc'.
Receiver sensitivity: the figure shown is, where possible, for the f.m. mode.
Power needs: some hand-held sets tolerate a wide range of supply voltages, while mobile sets work best on the 13.8v provided by a reasonably healthy car battery. Figures for current indicate the consumption on standby and while transmitting on high power.
Battery, mA-hour: storage capacity of the standard battery. Most portable sets are supplied with nickel-cadmium rechargeable batteries. Batteries of other sizes may be available as an accessory. many sets, portable and otherwise, have a smaller battery (not indicated here) for memory retention.

Amateur Electronics UK
504-516 Alum Rock Road
Birmingham 8
Tel. 021-327 1497/6313
Yaesu

Arrow Electronics Ltd
5 The Street
Hatfield Peverel
Essex
Tel. 0245-381626
NDi

Lee Electronics Ltd
400 Edgware Road
London W2
Tel. 01-723 5521
Standard

Lowe Electronics Ltd
Chesterfield Road
Matlock, Derbyshire DE4 5LE
Tel. 0629-2817/2430/4057
Trio, Belcom

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Tel. 0409 24 543
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Thanet Electronics Ltd
143 Reculver Road
Beltinge, Herne Bay
Kent CT6 6PD
Tel. 02273-63859/63850
Icom

South Midlands Communications
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Totton, Southampton SO4 4DP
Tel. 0703 867333
Yaesu, KDK

Waters and Stanton Electronics
18-20 Main Road
Hockley, Essex
Tel. 0702-206835/204965
FDK, Trio

Wood and Douglas Ltd
Unit 13, Youngs Industrial Estate
Aldermaston, Reading RG7 4PQ
Tel. 0736-5324
2 m transceiver modules.

WPO Communications
20 Farnham Avenue
Hassocks
West Sussex, BN6 8NS
Transceiver kits

PREFERRED VALUES

It is not unusual for the engineer to be condemned for incompetence when his strictly practical camel fails to look like the mathematician's image of an elegant but non-existent breed of horse. Preferred values are selected not by rigid arithmetic, but as the result of some very clear and simple thinking about tolerances and their application to the real world. Since the 20% range has produced the most glaring 'anomaly', let us use it as our example.

To produce a series of figures such that any value will fall into the tolerance band of one of them, they must be related so that the top end of the lower band coincides with the lower end of the higher one. In our case this is to say that 120% of the lower should be 80% of the higher, so they should stand in the ratio of 1 : 1.5. In practice the 'Two-digit' rule will prevent this from always being met, and rounding of a calculated value will be required. This must always be in the sense to close the gap between the two values, since the other way will produce a 'hole' into which components could fall and so be lost. This consideration also leads to the conclusion that when rounding has taken place, the next value must be based on that rounded value and not the calculated one. This destroys once and for all any elegant arithmetic relation. Lastly, in order to keep the total number of values down as far as possible, it is sensible to select the 10% values from those already existing in the 5% range (if possible) and the 20% from the 10%.

We can now see where this reasoning gets us. Starting initially from the lowest value:

previous selected value ×1.5	selected value
-	1
1.5	1.5
2.25	2.2
3.3	3.3
4.75	4.7

Now the problem. On this basis the next value should be 7.0 (although it could be less) and the next is over 10 by quite a bit. Let us therefore consider what happens if we calculate back from 10. We will now have a value 6.7 (although it could be more). So there are four possible values available all of which would meet the 'no holes' criterion. 6.8 is the only one to appear in the 5% range, or in the 10% range for that matter.

Mr Scott tells my namesake that he will find the 'same standard of arithmetic' in all three ranges. Precisely so. However we have one more obstacle to overcome. Calculate the 5% range and you will get two values (1.4 and 1.7) which do not appear in the standard, transgressing the 'no-holes' rule. With them in there was a great deal of overlap, while without them the holes are only very small. The need to keep the number of values to the minimum was presumably judged to be the over-riding factor.

Even if the poor beast does have bad breath, it is still not a bad camel in a hard world!

Alan Watson
Pollense
Mallorca

GPIB COMBINER COMMENTS

I refer to the article in the April 1984 issue of *Wireless World* by D.J. Greaves., the 'GPIB combiner'.

Mr Greaves' design, though ingenious, is a complex hardware solution to a problem imposed by his coice of GPIB controller. The particular machine he employs (the CBM Pet) does not implement the full GPIB standard and lacks the ability to pass control. The concept of the design is based on a fallacy brought about by the author's reliance on a particular manufacturer's interpretation the function of a GPIB controller. Mr Greaves states 'The main disadvantage of the [GPIB] bus is that only one controller may be connected to the string of peripherals at one time.' That statement is incorrect.

The IEEE-488 Standard specifically allows for multiple bus controllers. A GPIB controller which implements the full IEEE-488 standard includes the capability to pass control to another controller connected to the same bus. Most GPIB controllers commercially available include this capability, typically as a high-level language statement. Also, several commercial l.s.i. devices are available which implement this GPIB feature. As recently as February 1984 your magazine described an interface module available for the BBC microcomputer using an l.s.i. device which includes bus control transfer.

More than one controller may have access to peripherals on a single GPIB through the existing standard using software. It is not necessary to spend time designing a hardware multiplexer for GPIB controllers. The user who finds that he needs to attach several controllers to his bus will find a neater and quicker solution by selecting his bus controllers with this capability built-in. There are several well known international manufacturers of GPIB instrumention, and several less-well-known national ones, who can supply GPIB controllers with pass-control as a standard feature.

J. Summers
Application Manager
Fairchild Camera and Instrument (UK) Ltd.

IS LIGHT VELOCITY A CONSTANT?

The questions about relativity theory will not go away; Michael M. Albahari ("Is light velocity a constant?" February letters) is mistaken if he considers that the issue could be resolved by accurate measurement of time and distance; the real conflict is between incompatible philosophical hypotheses.

The complex of notions embodied into the Special Theory of Relativity (and from which the General Theory was developed by processes of logic) is based on two propositions selected from several alternatives:

1. All inertial frames of reference are equivalent in their physical characteristics.

2. Light travels in any fixed direction with the same velocity c in all inertial reference systems.

Professor Albert Einstein stated (2) as a corollary to (1) in his 1905 paper 'Electrodynamics of Moving Bodies', but notwithstanding the validity of (1), it is impossible to give an unambiguous interpretation of (2) because velocity exists between two physical entities and is not something that resides independently within frames of reference.

Implicit in the theory as developed from (1) and (2) are two generally unstated propositions:

3. Electromagnet radiations impinge upon the surfaces of all materials conglomorates, from unoccupied space with the same velocity *c*.

4. Unoccupied space has no characteristic which regulates the propagation of radiations crossing it, except to guide it in a straight path.

To render (3) and (4) some appearance of plausibility Einstein made the suggestion that 'The relations between co-ordinates of two systems in uniform motion relative to each other cannot be indentical with those of Newtonian physics in which simultaneity is absolute'.

The problem of interpretation of this assertion in terms of experience is the real stumbling-block for relativity theory; the late Professor Herbert Dingle strongly suggested that no meaningful interpretation is possible. Some further propositions which readers may like to comtemplate are:

5. A unique universal medium (or aether) propagates radiations at the velocity *c*.

6. Material conglomerates moving through the aether of (5) suffer spatial contractions along the axis of motion in proportion to its rate and concomitantly their internal processes are retarded.

In his 1905 paper Einstein recognised the Lorentz-Fitzgerald contraction time-dilation effects as consequences of (2), the former effect being considered as 'apparent' and the latter as real, which was a blatant inconsistency.

The development of the General Theory requires the Lorentz-Fitzgerald effects to be physical; it is not generally stated that this in turn produces difficulties with the dynamics-energy possessed by rotating entities, and the development of the theory to require an increase of mass with increase in velocity through the ether violates the principle of energy-mass conservation.

Some further propositions are:

7. Electromagnetic radiation emanates from every emitter with a velocity relative to that emitter and remains directly related to that emitter indefinitely (i.e. each emitter is embedded in its own individual medium).

8. All radiating media have similar characteristics, and as a corollary exist 'within' or 'throughout' each other, and have a general propagational velocity of *c* where remote from matter.

9. The characteristics of media in (8) may be modified in the proximity of considerable conglomerates of dense matter.

Proposition (7) was originally stated by Michael Faraday (*Phil. Mag* Vol.28, No.188, May 1846), and as misinterpreted by Clerk Maxwell to have the meaning of (5) and thus taken as providing the basis for his equations of the electromagnetic field. When (5) appeared to have been rendered untenable by some rather inept exercises in research, Einstein raised his 1905 paper in an attempt to show that we can have as many ethers as we like; he made the mistake of implying that all receivers of radiation must be embedded in their own individual ethers, this being the interpretation he gave of (2). Faraday's proposition (7) amounts to the complement of this, and avoids the complication of (2). Although (1) may be invalid if the physical universe has a centre-point about which it is in rotation, and (2) cannot be tested unless its ambiguity is resolved, (3), (5), (7), (8) and (9) can be subjected to physical investigation to varying degrees of determination.

It is doubtful that the members of professional bodies are as yet prepared to embark on such work, since it would be inexpedient to demonstrate that their uncritical commitment to relativity theory may have been mistaken.

C. B. V. Francksen
Farnborough
Hants

XY PLOTTER

I am prompted to write to you because of the very interesting XY plotter by P.N.C. Hill. I am retired now, from running a plastics injection factory, but have long been keen on electronics, photography, astronomy.

For a number of years, I have been experimenting with a method of printing colour photographs direct on to paper by scanning as in the facsimile process. This started with EF50s and multiplier cells and progressed to transistors and has involved many different models using ballpens and also carbon paper for the image. I even tried a mixture of metal indicators soaked into paper with glycerine and electrodes of copper, nickel and molybdenum to mark the paper. So far, the carbon paper has seemed the best to manage with limited funds to spend on research.

In the course of these experiments I have used various steppers including the Clo-Syn motors from Stewart. Not being good enough with logic circuits I have had to use simple chips like the 4017BE which give a decade count from simple pulsing and can be made to count lesser steps by reset from one of the outputs. The 4017 is used for 400 steps by the circuit shown in my sketch.

A useful chip is the SAA1027 which will drive a Slo-Syn motor and reverse in an easy manner, but my circuits have been mainly for unidirectional running...

I think by the way that Mr Hill is wrong to state the rotor is not a permanent magnet. You can feel the holding force if you turn this by finger and thumb and generate about 50 volts or so in one winding by running it as a dynamo. Also, I have some motors from the States, including a Rapid Syn with four coils which has a magnetic hold so strong that it is hard to turn by hand. This performs very well as it has 12 volt coils and better torque than the Slo Syn.

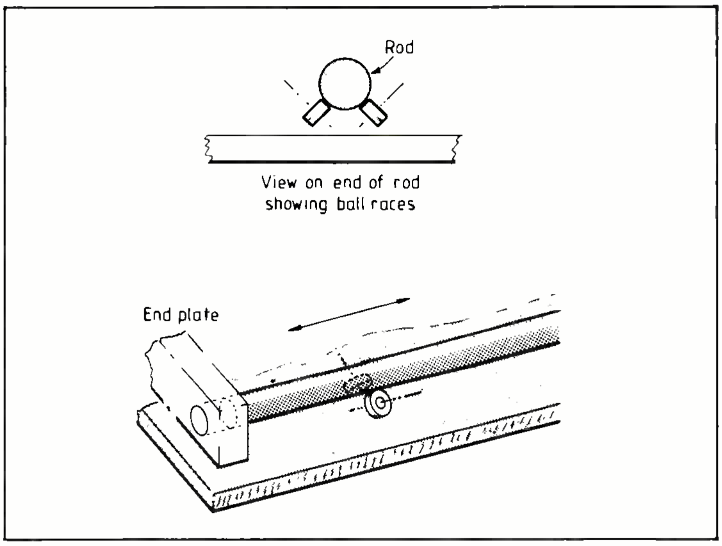
Despite this one seeming error, the article is most interesting as I have made up a plotter in the past, using ordinary motors and a potentiometer balance circuit to do transistor curve tracing. It was not very good and needed to be refined so it was scrapped.

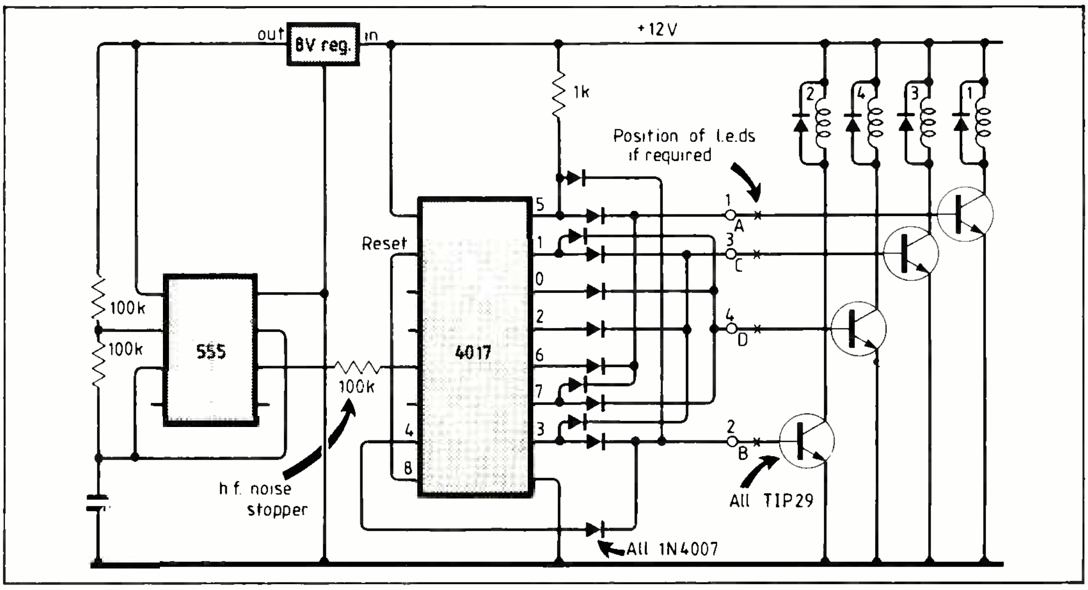
Your write-up leaves out some important details for me since it would be nice to make up a stepper plotter controlled by Basic and digital-to-analogue output from the computer with a potentiometer to compare positions.

The ball bearing idea is a good one and simple. I have used a system of crossed ball races with silver steel rods and this has proved quite good. See sketch.

A further article dealing in much more detail, with the electronics of the plotter would be welcome to me and I suspect many others.

A.J. Quinton
Thorpe Bay
Essex.





TECHNOCRATIC BONDAGE?

Your April leading article put the blame for restrictive aspects of our society on 'technocrats'. But government ministers rely on the advice from their ministers, i.e. from civil servants, and it has long been notorious that few graduates in science subjects make their way to the higher ranks of the civil service. (I guess that in addition to the fact that few of those who apply are accepted, it is probable that few apply.) So far from our troubles being due to 'technocrats', many are due to the fact that few of those in a position to influence policy have what might be called an 'engineering' outlook, a knowledge of scientific fact and method plus some appreciation of the human side of 'management'.

On the narrow issue of GCHQ I can only say that those who go to work in such an establishment should be forewarned of the burden which 'security' will place on them. From the little which I have seen from the outside, I would regard this burden of knowing things which must on no account be disclosed as the most serious factor associated with such work.

D. A. Bell
North Humberside

RELATIVITY

Much discussion concerning the Special Theory of Relativity has appeared of late both in your letter columns and in other publications, even to the extremes of scrapping the theory altogether and returning to the day of classical mechanics and the aether. On the other hand, some have raised more fruitful suggestions concerning the physical basis of the relativistic (or e—m) Doppler shift.

Surely at this stage in the career of that theory it should be evident that the theory suffers from a number of definite shortcomings: (a) it is physically incomplete, i.e., certainly questions of physics are still left open by the theory itself; and (b) as basically a correction factor to classical electrodynamics it suffers from a instrumentalist interpretation that prevents these fruitful physical questions from being asked, i.e., the theory concerns rigid rods and clocks, but does not directly have a microbasis.

Assuming that there is some validity in these observations on the theory the following questions seem to be quite open. What is the physical basis for the constancy of light's velocity if there is relative motion between source and the observer, especially since the classical physics requires that velocity to vary?

What is the physical basis for clocks (or any natural process) running slower when in the inertial system of which it is a part is in relative motion?. How is the special theory related physically to quantum mechanics? Does the paradox of the twins that age at different rates depend more on relative acceleration than on relative velocity? Is the special theory valid for systems in instantaneous velocity rather than constant relative velocity? Einstein's early success (1911) in deriving the red shift formula for a gravitational field could only be explained by assuming he used relative instantaneous velocity. Finally, does the wavelength change under conditions of relative motion between a light source and observer while the velocity of the light is constant? The constancy of wave length (and associated wave number) is an unwarranted carryover from classical physics, and even Einstein himself showed his conservative nature is making this latter assumption.

G. Blondeau,
CANMET, Dept of Energy,
Mines & Resources,
Ottawa, Ont.,
CANADA

I am beginning to get the hang of much that you have recently printed; in spite of the titles, it has had nothing to do with relativity!

Science comprises a considerable body of facts and theories which support one another and which are widely considered to be true. This body can grow in two very different ways. We may wake up to new implications of what is already accepted — 'new', that is, in the sense that no one had got round to digging them out before — or we may add new facts which fit in to the old body and so consolidate it. That is, we may build on the old structure.

But we can also work on the foundations. Some of the theories in science are fundamental, which means that their truth cannot be inferred from other accepted facts or theories- their sole purpose is to provide explanations of other theories and facts. Science likes a fundamental theory if it is felt on balance inexplicable things outweigh the unsatisfactory aspect of introducing a new inexplicable idea, and provided that it does not lead to inferences which conflict with observations. In other words a fundamental theory has to be useful (it must survive Occam's razor) and it must be refutable by established facts.

Now the special and general theories of relativity, wave mechanics, gauge theories and so on are all fundamental in this sense. All that their advocates claim for them is that if you assume them to be true, you can explain a wider range of facts than you can if you assume them to be false. It is not a valid objection to a fundamental theory to say that it embraces a concept which clashes with your old preconceived ideas, or that it cannot be derived from something else.

Science has always had trouble getting people to modify their tenaciously held ideas: the sun revolves around the earth, action at a distance is conceptually impossible, and so on. Even today people get stuck with wrong ideas through failing to look at all the evidence; a clockmaker would say that the great property of a pendulum is that its period is constant but a church bellringer would say that the one thing which makes change ringing possible is the fact that a small change in the amplitude makes a big difference to the period!

J. G. D. Pratt.
West Horsley
Leatherhead
Surrey

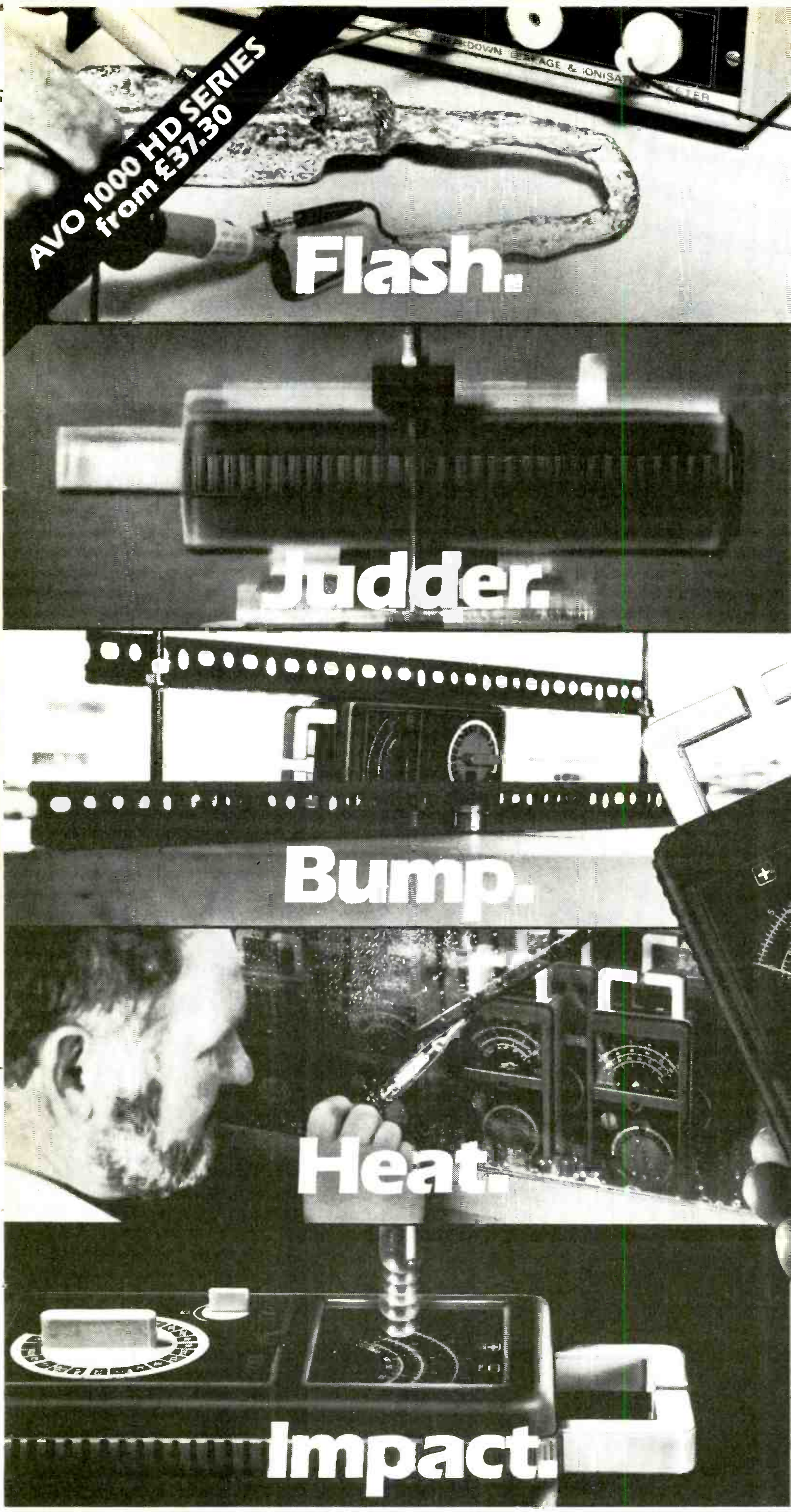
You do your journal no service by continuing to publish these embarrassing articles by Dr Murray. It is true that there are serious imperfections in both Relativity and Quantum Mechanics and if Dr Murray confined himself to explaining them to your readers one could not object, even if one had doubts whether he was the man best qualified to do so. But it is really too much when, although apparently not able to offer any constructive comment himself, he jeers at those men who have, over the years, painstakingly put these theories together. Newton is supposed to have said tht he saw so far because he stood on the shoulders of giants. No such humility from Dr Murray who can apparently see nothing from an even better vantage point.

The community of theoretical scientists — Dr Murray's despised establishment — is well aware of the imperfections of fundamental theory but is far from complacent about them. On the contrary it continues to devise procedures for obviating them while at the same time looking for more fundamental changes which would remove them altogether. A consensus is beginning now to emerge on what the basis of a new theory might be. As usual in these matters the roots of the new theory go back a long way — originally to Hamilton's quaternions but more significantly to the work of Eli Cartan at the beginning of the century. Cartan showed that a geometrical space could be discribed not only by vectors and tensors but also by more elemental entities variously called half-vectors or spinors. These entities were first used in physics by Pauli and slightly later by Dirac who in 1930 constucted a relativistically covariant wave equation in which electron spin is inherent. What is now becoming apparent is that the spinor formulation may also be required to remove the difficulties of macro-theory.

Dr Murray may denounce these developments as even more counter to common sense than Minkowsky space but then common sense has never been of much help in theoretical physics. The nub of the matter is however easily explained to any reasonably competent mathematician. Spinors are a sort of complex number, distinguished from ordinary complex numbers by the fact that their law of multiplication is not in general commutative, that is, A×B is not necessarily equal to B×A. In a group of spinors there is usually a sub-group whose multiplication law is commutative and whose properties palely reflect those of the full group; in the present case this sub-group is the complex numbers. What physics in general has been doing up to now is to use complex numbers when they should have been using the full group. Thus they have been in much the same situation as electrical engineers trying to make do with real numbers, knowing nothing about complex ones.

If a new theory along these lines is ever formulated and accepted it will be because it works better than the one it replaces.

E. R. R. Holmberg
Barnes
London SW13



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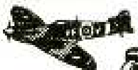

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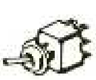

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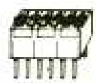

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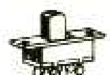
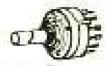
Miniature
Single and Double Pole Changeover
Standard
Latching and momentary

SLIDERS
Miniature & Standard. SP and DP in 1, 2 or 3 positions.

Many other types such as for timing and other special applications.





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2

CIRCLE 25 FOR FURTHER DETAILS.

Communications 84, Birmingham

Business communications seemed to be the central theme of the exhibition held at the NEC in Birmingham. The integration of communications services usually thought of as separate entities was emphasized by several exhibitors — the office computer terminal can also be a telex and teletex terminal and an autodial telephone as well as offering local computing, word processing, calendar and diary, calculator and directory. One such device launched by STC Telecommunications was Executel, a multipurpose work station with optional extension for a secretary which offerred most of the same facilities and a built-in intercom.

If you believe that electronics *is* communications, then the exhibition has something to offer to anyone interested in electronics. This is certainly confirmed by the variety of the products on show: anything from a complete satellite receiver station to a single transistor and almost anything that can be thought of that includes the prefixes tele or trans.

HAND-HELD TERMINALS/TESTERS

A number of hand-held terminals may also be used as support devices for communications equipment. Such devices made by G. R. Electronics have been used to test p.a.b.xs, multiplexers and other processor-based systems for commissioning and installation of such systems in the field. The 14B, for example has a 14-digit display, 92-character memory and RS232 and/or 20mA loop interfaces as standard. Options include a rechargeable battery pack making it completely independent of outside power sources, and RS422/432 interface for longer-cable signals.

Larger memories and more facilities are offered by the 42B and 42C terminals which have 40-character displays, battery operation with memory protection, signalling up to 9600 baud and from 8K to 64K of ram. Different protocols are optional and the units can store diagnostic routines for on-site testing and can capture data for later analysis. The company also offers an acoustic coupler and a data recorder to complete a battery-operated system for the collection and transmission of data. G. R. Electronics Ltd, Fairoak House, Church Road, Newport, Gwent NPT 7EJ.
EWW 215

VOICE RECOGNITION SYSTEM

The facility for someone to speak to a computer and get it to obey has been appealing to the imagination for some time and systems are available but still in the process of development. Pye Telecommunications proudly demonstarted their system at Comm 84 which they claim is both complex and reliable. It may be used remotely by two-way radio or telephone and has been found to work in up to 100dB helicopter noise when test established that only one error resulted amongst 3200 recognitions.(Some of the techniques used in voice recognition systems were described by Tom Ivall in our last issue.) Pye Telecommunications Ltd, St. Andrews Road, Cambridge CB4 1DW.
EWW 218

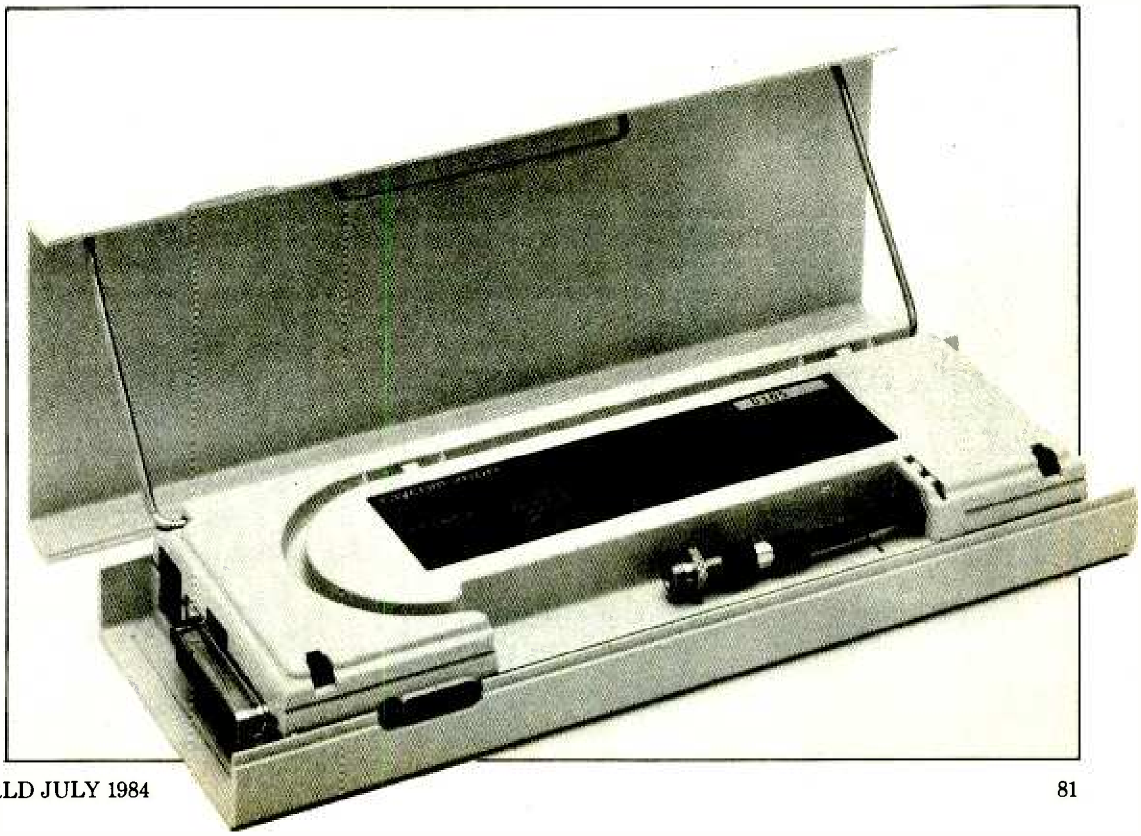
SOLID-STATE BATTERIES

Batteries do not often hit the headlines but some new offerings from Chloride are interesting. Solid-state lead-acid batteries use highly absorbent, porous separators made from microscopically thin glass fibres, that take up the liquid electrolyte within their pores. Consequently, there is no free acid, and no risk of corrosion from fumes or acid spillage. Under normal operating conditions there is no loss of water and so it is possible to dispense with normal vents though there is a small safety vent in case of accidental over-changing. The Powersafe range includes 2V cells of 48 and 110Ah capacities and a 6V block of 80Ah. Another range, Powerstore, is available in 12 different sizes with capacities ranging from 3 to 240Ah, in 2, 4, 6 and 12V configurations. Chloride Power Storage, PO Box 5, Clifton Junction, Swinton, Manchester M27 2LR.
EWW 216

FIBRE-OPTIC MODEM

High data rates, low transmission line costs and freedom from electromagnetic interference are three of the several benefits claimed for Easydata's Raycom 2000 fibre-optic modem. A dual RS232 interface allows two separate peripherals to have access to the full duplex data channel operating at 100Kbit/s over a range of one km. Interconnection of RS232 interface between adjacent remote sites permits cascading and allows the system to be extended for up to 10km.

A fibre splicing technique has been incorporated into the system and this is claimed to take one third of the time needed normally to make splices and yet offers a high-fidelity connection into each modem. The modems are priced at £250 each and saving is claimed from the use of single strand fibres, lower in cost than the equivalent twin strand or screened twisted pair cables normally used. Easdata Ltd, 7 Charleton Rise, Welwyn, Herts AL6 9RP.
EWW 217



P. F. RALFE ELECTRONICS

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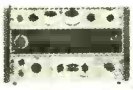

★ MARCONI SIGNAL GENERATORS ★

TF2002A/S (illustrated) 10kHz-72MHz. AM/FM. **£750**
TF2002. As above but AM only. **£450**
MARCONI TF1066B. AM/FM Generator. 10-470MHz. 0.2uV-200mV output. FM Deviation up to ±100kHz.
MARCONI TF995A/5. AM/FM Generator. Narrow deviation model 995 covering 1.5-220MHz. **£450.** TF2015. 10-520MHz. AM/FM. TF144H. AM 10kHz-72MHz **£295.**
MARCONI TF1064B/5. AM/FM Signal generator covering in three ranges 68-108, 118-185 and 450-470MHz. FM fixed deviations of 3.5 & 10kHz. AM fixed 30%. **£225**

★ 'DOLBY' NOISE WEIGHTING FILTERS ★

Cat. No. 98A. Noise weighting filters for CCIR/ARM signal-to-noise ratio measurements. As new units. **£40** each (+£1 p&p).

BECKMAN TURNS COUNTER DIALS

Miniature type (22mm diam.). Counting up to 15 turn "Helipots". Brand new with mounting instructions. Only **£2.50** each.

'1000 WATT AUDIO AMPLIFIER'

— for inter factory/office communication comprising two racks containing ten 100W Grampian audio amplifiers and receiver for background music, microphone and pre-amp controller. COMPLETE SYSTEM £550.

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SPERRY UNIVAC M4000 opto-isolator units providing 2KV of insulation between Modems and Terminals. 25 way 'D' connectors (RS232C Interface) in and out. Measures 9×5×7". Complete with handbook .... £25 — pp£2.

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Brand new stock of 'ASTROSYN' Type 20PM-A055 stepper motors. 28V DC. 24 steps per rev. 15 oz-in torque @ 100PPS. Body length 2½", diameter 2", shaft ¼" diam × 4¼" spirally threaded. Weight 16oz. Price each **£15** (p&p 50p). Connections supplied. INC. VAT.

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We have managed to obtain a stock of Labgear T.V. Service equipment affording vast savings on new price. All items are sold in full working condition and guaranteed.
LABGEAR CM6037/DB. UHF/VHF PAL COLOUR BAR GENERATORS Colour bars/cross-hatch/dot/blank raster/centre location. £80.
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LABGEAR CM6016/SM. UHF SIGNAL STRENGTH METERS. Variable tuning Channels 25-65. Calibrated 4-range moving-coilmeter, 30µV-3mV. Battery powered. £45.
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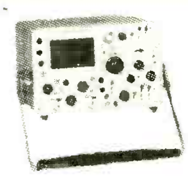
HEWLETT-PACKARD 1707A Dual-trace 75MHz.
TRIO CS1575 5MHz Dual-trace **£250**



★★ TEST EQUIPMENT ★★

MEGAPHONES — 'EAGLE' MV8SN. New. £40.
BEAVER Model E57500 Automatic test equipment.
MARCONI TF868 LCR Bridge
MARCONI TF2604 Electronic Multi-Meter
MARCONI TF893A Audio Power Meters **£85.**
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HEWLETT-PACKARD 3450A Multi-Function Digital Multi-Meter.
ROHDE & SCHWARZ 'SDR' AM Signal Generator 0.3-1GHz.
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ROHDE & SCHWARZ Polyscop SWOB II.
METROHM 500V Insulation Testers Transistorised **£40** pp £1.50.
BRUEL & KJAER Heterodyne Voltmeter 0.5-240MHz.
AIRMEC Display Oscilloscope 279, 4-trace, 14x10" CRT **£195.**
RIKADENKI 3-channel Chart Recorder, Model B-341.

8" WINCHESTER

UNITED PERIPHERALS model 3100 Mini-disc drives (3 × 8" sealed plattens) capable of over 19MBytes storage. External power supply requirements are 24V @ 3A and 5V @ 4A. Little used condition, believed OK but at the unbelievable price of just **£125** are sold without guarantee. Price inclusive of VAT and carriage and copy of user-handbook.

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8" Shugart type SA800 Floppy disc drives. Small quantity available, single-sided up to 800KBytes of storage. Power requirements, 5V @ 1.3A. Little used, excellent condition. **PRICE £90** — inclusive VAT and carriage and copy of user-handbook.

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TELONIC 2003 System. 800-1500MHz **£325**
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★ TEKTRONIX ★

FILE MANAGER SYSTEM MODEL 4907 Option 31 (Third disc drive). 4051 Graphic System compatible. **GPIB (IEEE 488-1975)** compatible.

PLEASE NOTE. All the pre-owned equipment shown has been carefully tested in our workshop and reconditioned where necessary. It is sold in first-class operational condition and most items carry a three months' guarantee. For our mail order customers we have a money-back scheme. Repairs and servicing to all equipment at very reasonable rates. PLEASE ADD 15% VAT TO ALL PRICES.

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1.6MB 8" FLOPPY DISC DRIVES New Stock

After our recent sell-out of the DRE7100 FDDs, we are pleased to offer another bargain package as follows: BRAND NEW American 'MFE Corp' model M-700 **DOUBLE-SIDED** 8" Disc Drives. Massive storage capability up to 1.6MBytes. Full IBM compatability. External power requirements are ±5V at 1.2A and +24V at 1.1A. Full spares/back-up available U.K. (Elcomatic's). Current list is over £315. **** NOW LOWEST PRICE EVER £180 — INCLUDING MANUAL INC CARRIAGE & INC VAT ****

DRE 4000 — SERIES DRIVES

Data Recording Equipment 5+5MB exchangeable disc drives model 4000A. Brand new units for **£275** — including power unit and full technical manual.

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Surplus BASF 12-Sector RK05 cartridges available ... small quantity only remaining at **£15** each. Carriage each £1.50.

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The following DC power supplies are available now from stock in limited quantities. All fully tested and guaranteed.

3.5V @ 10 Amps	**£15**	15V16A (110V IN)	**£20**
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'TORIN' Type U62B1. 230V Cap'Start (supplied), very powerful (200W. 3,000rpm) centrifugal fans for large rack cooling or enclosure extraction applications. Overall dimensions 20x12 cms, outlet 6x4 cms. BRAND NEW. Surplus stock. **£15 each inc. VAT, pp £1.50.**

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WW10

CIRCLE 55 FOR FURTHER DETAILS.

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pantechnic

THE POWERFET SPECIALISTS

OEM USERS

Pantechnic present the most adaptable high-powered amplifier ever.

FET SYSTEM AMP

Features:
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- LOW VOLUME. ¹⁄₁₅ Cubic foot inc. Heatsink
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OR 2 × 600W into 2 to 8Ω
OR 4 × 300W into 2 to 4Ω (200W into 8Ω)
OR { 1 × 600W into 2 to 8Ω, 1 × 300W into 2 to 4Ω, 1 × 150W into 4 to 8Ω }
Etc., etc.

Having been closely involved in a wide variety of OEM applications of their amp boards. Pantechnic became aware of numerous implementation problems often left untackled by other amp board manufacturers. These problems specifically of size and thermal efficiency became particularly aggravated at high powers and considerably lengthened OEM product development time.
By including thermal design in the totality of board design it has been possible to reduce the size of the electronics, and increase the efficiency of the transistor to heatsink thermal circuit. The combined effect of this has been to dramatically increase the volumetric efficiency of the amplifier/heatsink assembly. The **SYSTEM** Amp offers 1.2kW of power in a space of 180mm x 102mm × 77mm, excluding PSU and Fan.
The basis of this considerable advance is the PANTECH 74 Heat Exchanger, designed and manufactured by us. By eliminating the laminar air flow found in conventional, extruded heatsinks, heat transfer to the environment is greatly enhanced.
The flexibility of the 1.2kW amp stems from its division into 4 potentially separate amplifiers of 300W each (downrateable with cost savings to 150W). These can be paralleled, increasing current capability or seriesed (bridged in pairs) doubling voltage capability. In consequence a large variety of amplifier/load strategies can be implemented
As ever Pantechnic offer a full range of customising options including DC coupling, ultra-high slew, etc. Contact Phil Rimmer on 01-361 8715 with your particular application problem.
P.S. Specs, as ever, are exemplary.

A wide range of other amplifiers and other modules available.

Price and Delivery
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132 HIGH ROAD, NEW SOUTHGATE, LONDON N11 1PG

Technical Enquiries contact Phil Rimmer on 01-361 8715

CIRCLE 67 FOR FURTHER DETAILS.

M & B RADIO (LEEDS)

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OSCILLOSCOPES.

Tektronix 465 100MHZ Dual-Trace Delay Sweep 900.00
Tektronix 7403N Main-Frame 750.00
Hewlett-Packard 182A Main-Frame 550.00
Hewlett-Packard 182C Main-Frame 395.00
Hewlett-Packard 182A 4 Channel Plug-In and 1825A Time-Base and Delay Generator 1000.00
Telequipment D83 50MHZ Dual-Trace 450.00

ANALYSERS

Hewlett-Packard Fourier Analyser 5451B with 7900A Disk-Drive and Low-Pass Filters A to D Converters Etc 2,500.00

RHODE-SCHWARZ

SHF Signal-Generator 1.7 to 5.0 GHZ 850.00
VHF Signal-Generator 25 to 480MHZ SLSV 185.00
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UHF Signal-Generator 300 to 1,000 MHZ SDR 145.00
UHF Test Receivers 280 to 4600 MHZ USVD 175.00
Selentomat Type USWV 225.00
Stereodecoder Standard MSDC 225.00
UHF Power Signal-Generator SCRD 275 to 2750 MHZ .05 to 50 watts 400.00
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MISCELLANEOUS

Avo RM215F/3 Ac Breakdown Tester 195.00
Avo Universal Bridge B150 MK2 95.00
Advance X-Y Recorder HR96 65.00
Clare Multiple Earth Loop-Tester V144 75.00

Fluke RMS Differential Voltmeter 931B 450.00

HEWLETT-PACKARD.

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8052A Impulse Sound Level Meter 200.00
3406A Broadband Sampling Voltmeter 250.00
3480A Digital Voltmeter 135.00
1900A Pulse Generator 1925A Word Generator POA
Marconi TF144H/4 Standard Generator 150.00
Marconi 801D Signal-Generator 100.00
Radiometer SMG1 Stereo Generator 250.00
Racal 9908 Counter Timer 1.1GHZ 500.00
Racal Universal Counter 9835 100.00
Wayne Kerr Logarithmic LCR Bridge B500 295.00
Marconi Electronic Voltmeter TF2604 125.00
Marconi X-Y Displays TF 2212 100.00
Marconi X-Y Displays TF2213/1 250.00

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6433B Power Supply 0-36v 10A 195.00
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6453A Power Supply 0-15v 200A 275.00
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Hewlett-Packard Time Interval Probes 5363A 400

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Mercer 155 Electronic/Pneumatic Gauging System 175.00
General Radio Capacitane Bridge 1617A 350.00
All Prices plus V.A.T. SAE Enquiries.

WANTED

Test Equipment, Receivers, Valves, Components, Cable, PCB's Etc Top Prices Paid.

86 Bishopgate Street, LEEDS LS1 4BB. 0532-435649

CIRCLE 71 FOR FURTHER DETAILS.

AWARD-WINNING TAPE STREAMER

Using standard 0.5in computer tape the 9800 tape streamer from Thorn EMI Datatech may be used as archival back-up for hard disc data and for transferring data from mini to mainframe computers. The 9800, while taking a standard reel of tape is amazingly small and the combination of electronic, mechanical, and software design, combined with its ergonomic and aesthetic appeal has won for it a Design Council award.

The combination of hard disc and tape has become established in main frame computer usage for some time. With many peripherals and minicomputers however there has been a lot of reliance on floppy or hard discs and a system failure can lead to the loss of valuable data. The use of a back-up or archival tape can overcome the vulnerability of such a system. Datatech recognised a need for a high-speed, high-capacity desk-top tape store which was comparatively low in cost, hence the development of the 9800. Compatible with any computer system, the machine can automatically lace the tape through the tape path and onto the take-up hub. The tape cannot be put in the wrong way round, the machine will refuse to accept it and signal an error. Internally, all circuits are on plug-in cards and there are self-diagnostic testing routines built in for fault findings. As a trump card Thorn EMI are hasty to point out that the system is compatible with the IBM PC and expect to find a large market for the device amongst micro users. Thorn EMI Datatech Ltd, The Mill, Wookey Hole, Wells, Somerset BA5 1BB. EWW 210

NUJ/Reed International dispute
This space is one result of the continuing dispute between members of the National Union of Journalists and Reed International subsidiaries Business Press International, Butterworths, Hamlyn Books and IPC Magazines.

ADAPTIVE H.F. RADIO

A radio system which improves frequency management for communication networks that have several transceivers is announced by Racal Messenger. The VRM4550FS combines a frequency-scanning receiver with a selective call transmitter. It monitors up to ten pre-selected frequency channels, locks automatically onto a received signal and decides if it is the station being addressed before warning the operator of an incoming message. This facility enables the optimum receiver frequency to be selected, from the ten pre-programmed channels, by the transmitter station, taking into account the existing h.f. propagation conditions.

Sets of the transceivers can have a different selection of channel frequencies so that networks can interlace or overlap while being secure from each other. With a transmitting power of 100 or 120W the synthesized frequency transceivers operate between 1.6 and 30MHz. A small display indicates the selected channel while an audible tone and a flashing light warn the operator of an incoming call. Racal Messenger Ltd, 5 Bennett Road, Reading, Berks RG13 1LJ. EWW 211

WORD-PROCESSED TELETEX

An adaptor has been devised by BT to provide the Merlin word processor with the facility to connect to teletex services. This, claims Merlin, the business machine branch of British Telecom, "provides the ability to exchange text information in a rapid error-free and cost effective manner". Using the de-facto standard for electronic mail, the system will communicate with any other teletex terminals, of any manufacture. The system has been developed by BT research engineers and has undergone a series of network-user trials prior to its public launch. As well as providing teletex protocol, the system offers auto dialling, auto answer for unattended operation, store and forward operation allowing messages to be transmitted at times when the charges are lower, automatic logging of all documents sent and received and a full character set ensuring that the copy is received exactly as sent. Future expansion will include inter-working with telex and packet switched services. Merlin don't provide an address: all you need do is pick up a telephone, dial 100 and ask for Freephone Merlin. EWW 212

DATA MULTIPLEXER

The Polynet local-area network from Logica has been enhanced by the introduction of a highly flexible multiplexer, Polyline, to interface computers with the network. The device may be used with any computer or peripheral device with an RS232 port to give it access to the network which may also be used with high-speed computer-to-computer traffic. Polyline may be used to connect normally incompatible networked or stand-alone devices. In addition the multiplexer may be used to interface a terminal with external services, such as electronic mail, which may be available to the host computer. Each multiplexer can support up to eight asynchronous channels which operate full duplex and support communications over the network for six signal lines. Control of the network can be undertaken by a Terminal Manager software package. The Polynet/Polyline combination can be used to provide high-speed links between a number of otherwise incompatible mini and microcomputers from different manufacturers. Logica VTS Ltd, 84 Newman Street, London W1A 4SE. EWW 213

VOICE-OPERATED SWITCH

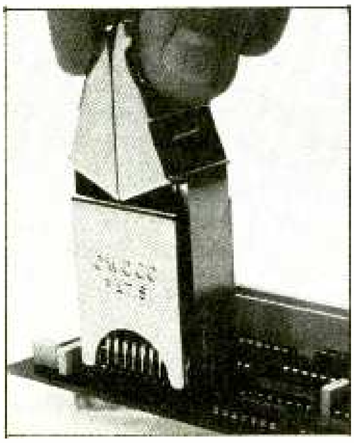
A microphone/switch combination that allows hand-free operation of a transceiver has many uses. The Sonic Tornado voice-operated switch is such a device and uses a inertial throat microphone or noise cancelling microphone. The unit can be used with ear-hanger headsets, or be fitted into breathing masks and helmets. Field trials have established that the sets will respond in 8ms when used by firemen with breathing aparatus, or in fully enclosed anti-radiation or laboratory suits. It has also been tested successfully by RAF search and rescue helicopter crews and by free-fall parachutists. Sonic Helmets Ltd, Communications Centre, 202 Bradford Road, Castle Bromwich, Birmingham B36 9AA. EWW 214

PCB TOOLS

Repair and reworking of printed circuit boards is claimed to be simple and economical with miniature power tools from Foredom. Based on a motor unit and a flexible shaft drive the tools can be used to clean, alter and modify boards with a variety of attachments including buffs, brushes, sanding discs, abrasive wheels, ball cutters, burrs, drills and saws. Power is supplied by a 0.1hp electric motor through the flexible shaft at speeds from zero to 14 krev/min. Speed may be varied by a foot control. Hirsh Jacobson Merchandising Co. Ltd, 91 Marylebone High Street, London W1.
EWW 219

PROM REMOVER

New from Sweden are these i.c. removers which can pluck a rom from its socket without damage to the p.c.b. or to the circuit. For once the model numbers seem to make some sense; 2428 is for 24 and 28-pin devices while 3640 is for 36 and 40 pins. Called Prom-outs they are available from Welwyn Tool Co. Ltd, 4 Black Fan Road, Welwyn Garden City, Herts AL7 1EH.
EWW 220



REEL TAPE RECORDERS

Analogue sound recorders designed for audio and video production work have been manufactured by Tascam. The 40 series comprises three different machines; the 42 with two tracks for stereo and 7.5 or 15 in/s tape speed; the 44 with four tracks and the same two speeds, and the 48 with eight tracks on 0.5in tape and a single speed of 15in/s. The machines can all use the SMPTE time codes and may be locked on to time code synchronizers, and search and cue facilities are available using the real-time counters. The machines use ceramic capstans to improve performance and minimize wear. Three heads are used and flux levels of 250nWb/m or 320 may be accommodated. NAB or IEC/DIN equalization may be used. The tape transport is heavy-duty, servo controlled with claimed low wow and flutter figures. Optional plug-ins provide synchronization with automated broadcast equipment or remote transport control. Each machine has both XLR (balanced 600Ω connections with a recording-level headroom of +28dBm) and phono (unbalanced 10kΩ) connections. Internal switching enables a +8dBm operating level.

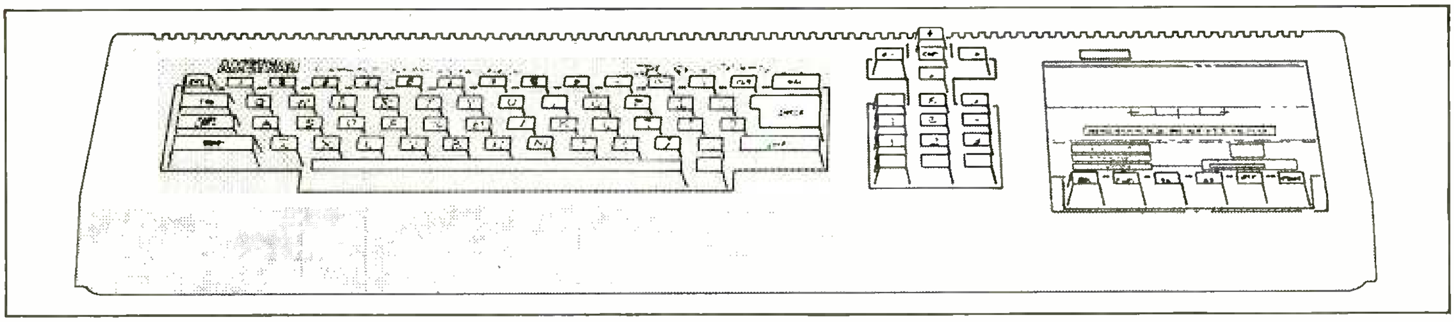
Tascam see the use of the 40 series to be in smaller studios, video post-production, dubbing, and in training and education. In contrast they have taken the opportunity to upgrade the two series 50 machines which they claim to be in the full professional league. The 50 series now includes the —10dBv phono outputs and balanced +4dB balanced connections. The two-track 52 now has front-mounted input and output level controls with pre and post fader switching. The 50 series also offers remote control facilities for the transport and for selection of channels. All switching and preset controls are available on the front panel. Model 58 offers eight tracks on 0.5in tape. Both the 52 and 58 machines have their bias and equalization set for use with high output/low noise tapes such as Scotch 226 or Ampex 456, and may be easily adjusted to the correct parameters for such tapes. If a particular low-bias tape is to be used, a small modification is needed to adjust the preset's range. Distributor: Harman (Audio) UK Ltd, Professional Products, Mill Street, Slough, Bucks SL2 5DD.
EWW 221

SERIAL COMMUNICATIONS

Much more than a dumb buffer is the serial communications card which includes an on-board M68000 processor running at 8MHz. The SCC-01 can also have up to 32Kbytes of local program stored in eprom or fusible-link prom, and 128Kbytes of dynamic ram. The unit communicates with a host processor through a VME bus by means of interrupt generation and 4Kbytes of dual port ram. There are twelve u.a.r.ts on the card, eight of which are used for several peripherals while the other four are available for monitoring in receive-only mode. The u.a.r.ts have programmable data rate generation and can detect breaks in a data stream. Four of the u.a.r.ts have been designated as fast channel devices and, if selected all four can be operated in synchronization at up to 1Mbaud. Plug-in daughter boards provide conversion from t.t.l. level to RS232, RS422 or 20mA level. The double Eurocard with the system on board has been designed for use in industrial environments and can operate within a temperature range of 0 to 70°C, and a relative humidity of up to 9%. All boards undergo a 48h temperature/power cycling programme. Manufactured by Wormald Data Systems, they may be obtained from Unit-C Ltd, Dominion Way West, Broadwater, Worthing, West Sussex.
EWW 222

FORTH EPROM PROGRAMMER

A single Eurocard accommodates a circuit which can be used to program, read, verify, and copy eproms. The TDS960 card is used in conjunction with the single-board TDS 900 Forth computer and the programmer software is provided on rom as well as a listing. The Forth listing enables the user to add any particular programming needs as may be required. The programmer card is the same cost as the TDS 900 c.mos computer; both are £179.95. Triangle Digital Services Ltd, 100A Wood Street, London E17 3HX.
EWW 223



Amstrad sounds off

On paper, Amstrad's CPC464 microcomputer scheduled for June introduction seems an ideal all rounder — cheap, fast, 64K ram, high-resolution graphics and with a colour or monochrome monitor included in the price. Of interest to we of technical bent there's the promise of even more, including full access to the 4MHz Z80 processor, CP/M, Basic interrupt operations, assemblers and disassemblers.

With built in cassette recorder and direct-drive green-tube monitor the basic version costs £229, and for a further £100 one can have the colour-monitor version. Monitors will not be available separately. Disc-based monochrome and colour-monitor versions will cost £429 and £529 respectively including CP/M and Logo (a US import language for educational programs). The Japanese Hitachi format (IBM data format) 3in disc drives should be available separately for around £200. There is as yet no CP/M compatible software on 3in disc.

At these prices one couldn't buy the parts and build one cheaper. Assuming no hidden snags, the only remaining question is reliability. Bill Poel, general manager of Amstrad's new software company Amsoft and co-founder of Ambit International (recently sold to Bulgin), told *E&WW* "Amstrad has increased reliability of its products over the years and will continue doing so. We expect a 2 or 3% return rate — the biggest problem will probably be with people who haven't read the instructions properly and those who spill tea in the cassette mechanism".

Main i.cs used are the 6845 c.r.t. controller for 80-column text and up to 640 by 200 picture elements, an 8912 three-channel sound generator and an 8255 parallel i/o device. Screen memory is 16K. There is a Centronics parallel printer output and an expansion port but regrettably the connectors are the edge of the p.c.b. and not gold plated.

The keyboard and its separate numeric and cursor-control pad is full size and uses familiar keytops but has a membrane switch matrix underneath to keep costs down. Matsushita membrane technology is used, conductive rubber against gold-plated p.c.b. contact areas so, theoretically at least, it should last a long time.

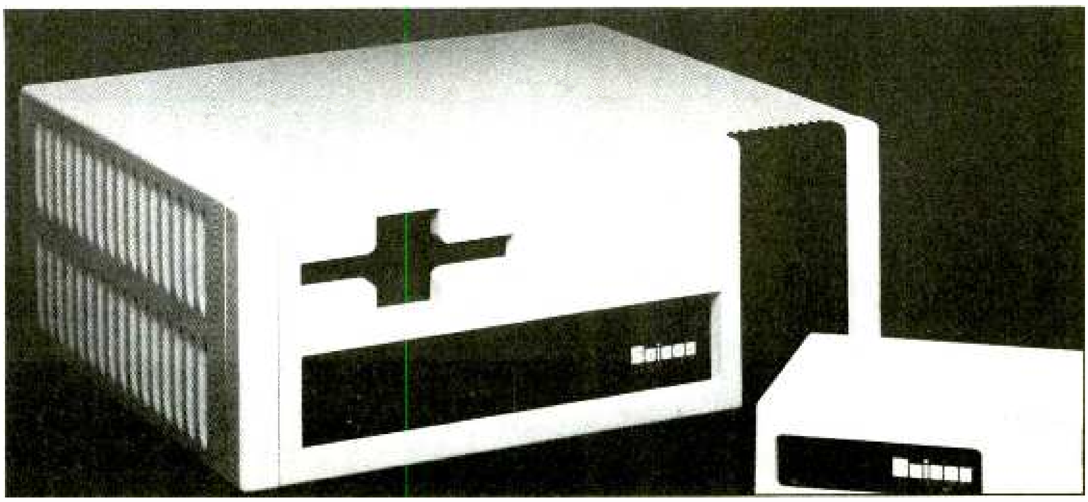
Considering that the average consumer is now wary of microcomputer manufacturers who promote products using predictions made by design engineers, Amstrad would be risking too much to promise all this but to present only part of it, especially when one takes into account Britain's current aggressive home microcomputer market. Delays in the introduction date could be devastating. The company expects to produce 200 000 units this year and sell them mainly through Dixons, Boots, Comet and Rumbelows. Amstrad Consumer Electronics plc, Brentwood House, 169 Kings Road, Brentwood, Essex CM14 4GF.

EWW 208

COMMUNICATIONS PROCESSOR TO EASE NETWORKING

Instead of employing separate communications devices, protocol converters, data concentrators, multiplexers, cluster controllers, packet processors, or nodal processors, the Netway communications system from Scicon combines all these functions into a single unit. The system can be configured to connect virtually any type of microcomputer, terminal, wordprocessor, and local-area network with host computers from IBM, ICL, DEC and Burroughs. Subsequent additions of dissimilar equipment to the network can be accommodated by upgrades to the disc-held software.

Netway has multiple distributed microprocessors within its hardware structure which has been optimised for communications. It uses a dynamic multi-tasking, multi-programming operating system called NCOS. The central unit of the system, Netway 200 with its 800Kbyte disc drive can be configured, on-line if necessary, to support local or remote microcomputers and other devices using the protocols of the host mainframe. Netway 200s works in conjunction with Netway 100s which interface individual devices into the network, and with the Netway 150 which provides remote connection to Netway local networks. The full capacity of the system is a large multi-node network incorporating up to 254 Netway processors each having a combination of up to 32 workstations and host ports, though the system can start by serving just one or a few workstations. Scicon Ltd, 49 Berners Street, London W1P 4AQ. EWW 209



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5" CASED Superb little unit made by **HITACHI** in ergonimcally designed free standing case. Very high definition will display small but readable 132 columns wide! 12v DC opp. @ 800 ma, so ideal for mobile use. Supplied in AS NEW condition complete with data. Composite 75 ohm vid inp. Black & White CRT *£45.00* or Green CRT *£55.00*. Carr & Ins £5.00.
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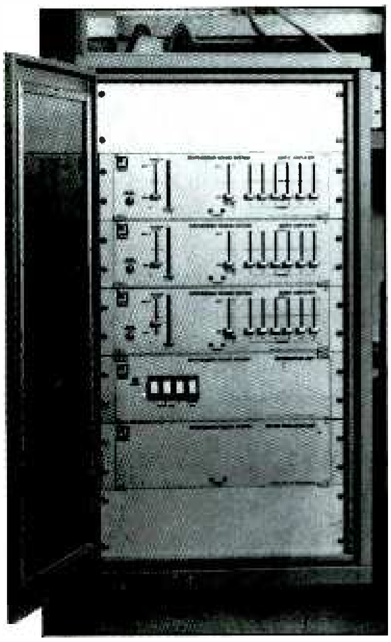

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Up to eighteen different sound envelopes may be stored in the synthesizer/amplifier unit from Haven Automation. These may be selected and mixed to emulate any combination of sounds 'from birdsong to double bass'. The synthesizer was originally developed to reproduce the complex sound spectra of a ship's engine room to make training exercises more realistic. The company is now exploring markets in the electronic enhancement of musical instruments, speech therapy, vehicle and aircraft simulations and the generation of sound effects.

The system fits into 19in racks and includes a sound simulator, three mixer/amplifiers and a distribution unit. Each circuit is identical to the others except that the different sounds are retained on eproms. The units interconnect and are controlled through a GPIB which is also used to control a set of filters to produce a required sound. Eighteen signals from the distribution unit are combined in the three mixer/amplifiers to give the desired mix and output level for a specific environment. Haven Automation Ltd, Cwmru Industrial Estate, Gendros, Swansea SA5 5LQ.

EWW 207

SATELLITE WEATHER MAPS

The use of new circuitry and a study of users' requirements has enabled Feedback to produce a weather satellite system, the WSR513, at a fraction of the cost of similar systems. The basic version will receive the APT (automatic picture transmission) signals from orbiting satellites in the 136 to 138MHz band. The addition of extra modules and a parabolic dish antenna allows reception of S-band transmission from geosynchronous satellites in the 1690 to 1697MHz band.

The basic version is supplied with a helical omnidirectional antenna which incorporates a single-stage preamplifier. This feeds a tuneable v.h.f. receiver and the a.m. subcarrier from this is output to a decoder which converts it to digital form which is entered into the internal memory and provides a synchronizing signal. The memory is continuously scanned by the raster timing generator, and images are converted back to analogue signals and displayed on the screen.

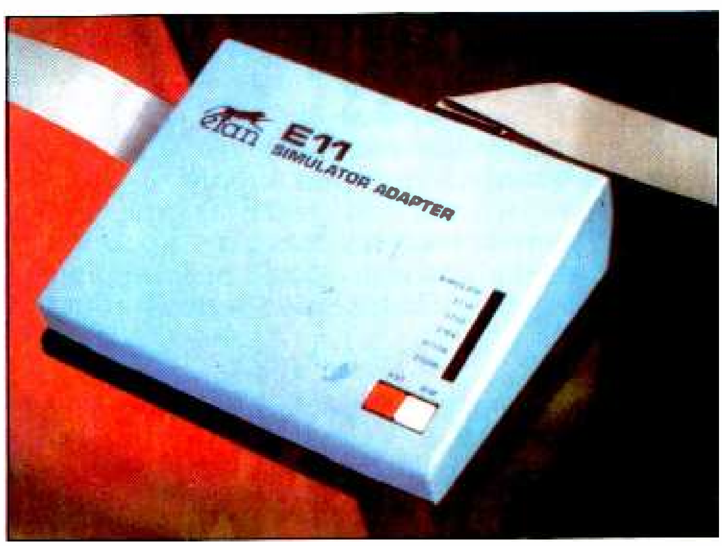
Front panel control allows the selection of resolution and format and local or satellite time for scan resolution and this can retain or remove the Doppler effect caused by satellite motion. The version to receive S-band transmissions includes a low-noise preamplifier

in the dish antenna. The signal from this goes through an r.f. switch which is used to select S-band or APT transmissions. Controls include channel selection, automatic scan synchronization, semi-automatic picture acquisition and the selection of a specific part of the image for storage in the memory. Apart from its obvious uses in weather prediction, the system may be used as a teaching aid in geography and in the study of the technical and engineering aspects. Each equipment is supplied with a comprehensive installation and operation manual as well as information on satellites and the prediction of orbits. Feedback Instruments Ltd, Park Road, Crowborough, East Sussex TN6 2QR.
EWW 205

EPROM EMULATOR

For use in conjunction with their E series of editing eprom programmers, Elan have introduced the E11 eprom simulator which can speed up program and hardware development by simulating a target eprom. Programs may be run, checked and easily altered before being committed to permanency in a eprom. One E11 may be used to simulate any of the current range of 24 and 28-pin devices including 2716, 2732, 2764, 27128 and 27256. Two units in a master/slave configuration may be used to provide twin eprom simulation or 16-bit simulation. The E11 is available in two versions; one up to 16K of memory (27128), the other up to 32K (27256).

Data is entered into the main programmer which is connected to the E11, the target eprom and to the microprocessor control system. The E11 has an access time typically of 175ns. Once programmed, the system may also be used connected directly to a microprocessor unit where it will function as a pseudo-eprom. Elan Digital Systems Ltd, 16 to 20 Kelvin Way, Crawley, West Sussex RH10 2TS.
EWW 206



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1926

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(2625)

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(2639)

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The Catholic Institute for International Relations operates a secular overseas programme and is a member of the British Volunteer Programme. (2614)

ELECTRONICS TECHNICIAN

required for expanding South London company in the amusement industry.

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Candidates should have an appropriate degree or equivalent (including overseas) qualification in electronics or be suitably qualified senior technicians who have appropriate training and about 15 years experience in a related field of work and who have either satisfied the CEI requirements for registration as a Technician Engineer or hold an HNC/FTC in Electronics or Telecommunications. Applicants should, preferably be corporate members of a relevant professional institution. All candidates should have at least 4 years experience in the design, installation and maintenance of communication systems, preferably in the field of mobile radio and be capable of the day-to-day supervision of a small section of technical instructors and administrative staff. The post requires an officer with a good knowledge of telecommunication practice and principles, including micro-electronics, and the capability of preparing and presenting courses which are essentially orientated towards the maintenance of telecommunication equipment coming into service because of the World Administrative Radio Conference (WARC) Frequency Conversion Programme.

Salary for this Stanmore-based post will be within the range £10,575-£12,660 (including £500 Outer London Weighting) according to qualifications and experience. SALARIES UNDER REVIEW.

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(2638)

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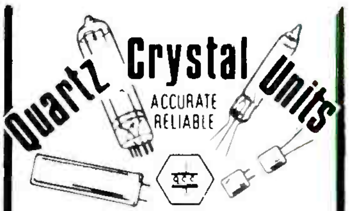

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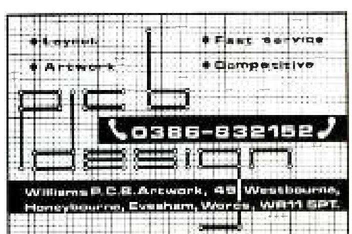

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ELECTRONICS & Wireless World

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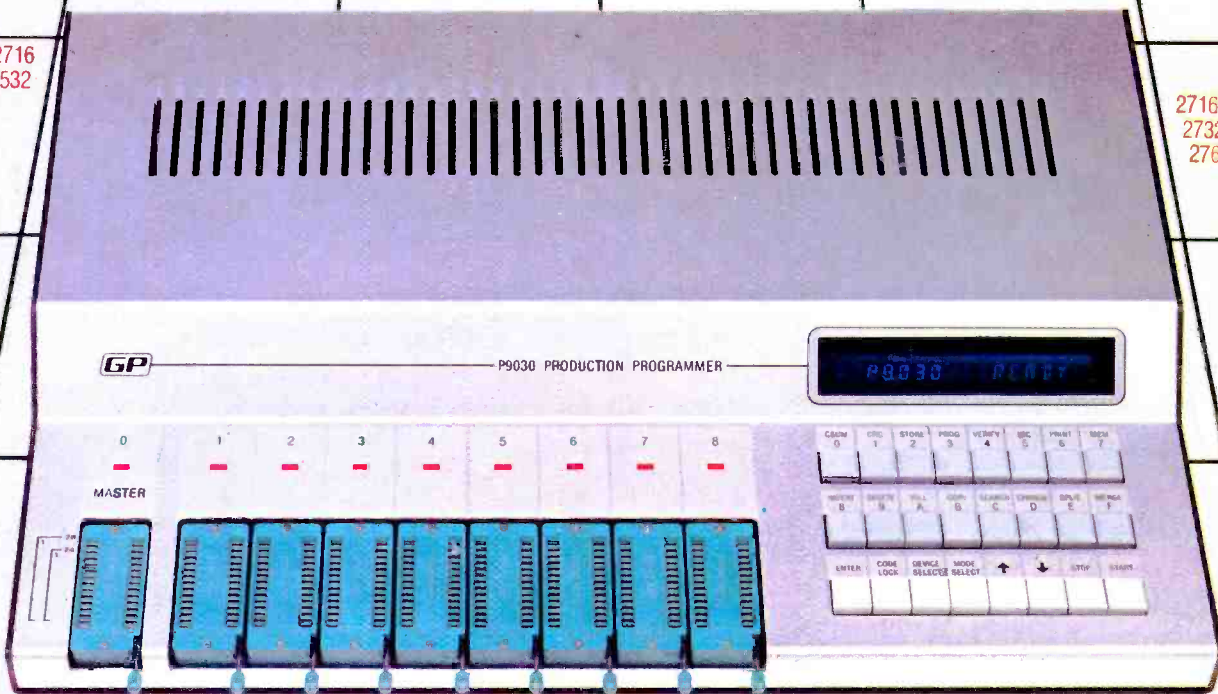

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