electronics today

MAY 1979

INTERNATIONAL

50p

HEADPHONE AMPLIFIER

HOW IT WORKS - RADIO

STAR CHESS

Six Channel Fully Proportional RADIO CONTROL SYSTEM

...NEWS....PROJECTS....MICROPROCESSORS....AUDIO...

CHROMATHEQUE 5000

5 CHANNEL LIGHTING EFFECTS SYSTEM

COMPLETE KIT ONLY £49.50 + VAT!

This versatile system featured as a constructional article in ELECTRONICS TODAY INTERNATIONAL has 5 frequency channels with individual level controls on each channel. Control of the lights is completely automatic in the least. You can use the unit as a straightforward sound-to-light or leave it strobe all the lights at a speed dependent upon music level or front panel control or use the internal circuitry which produces some superb random and sequencing effects. Each channel handles up to 500W and as the kit is a single board design wiring is minimal and construction very straightforward.

Kit includes fully finished metalwork, fibreglass PCB, controls, wire, etc. — complete right down to the last nut and bolt!

MPA 200 100 WATT (rms into 8Ω) MIXER/AMPLIFIER

COMPLETE KIT ONLY £49.90 + VAT!

Featured as a constructional article in Electronics Today International the MPA 200 is an exceptionally low priced but professionally finished general purpose rugged high power amplifier with adaptable input mixer which takes a wide range of inputs such as disco, microphone, guitar, etc. There are a wide range of controls and a master volume control. Mechanically the design is simplicity in the extreme with minimal wiring making construction very straightforward.

Kit includes fully finished metalwork, fibreglass PCBs, controls, wire, etc. — Complete right down to the last nut and bolt!

Parts for power amp module only or PCB, res, caps, s/c's **£10.60** + VAT

Custom designed toroidal transformer with mounting clamp **£10.50** + VAT

Parts for power supply only (caps, rects., fuses, F. holders) **£3.40** + VAT

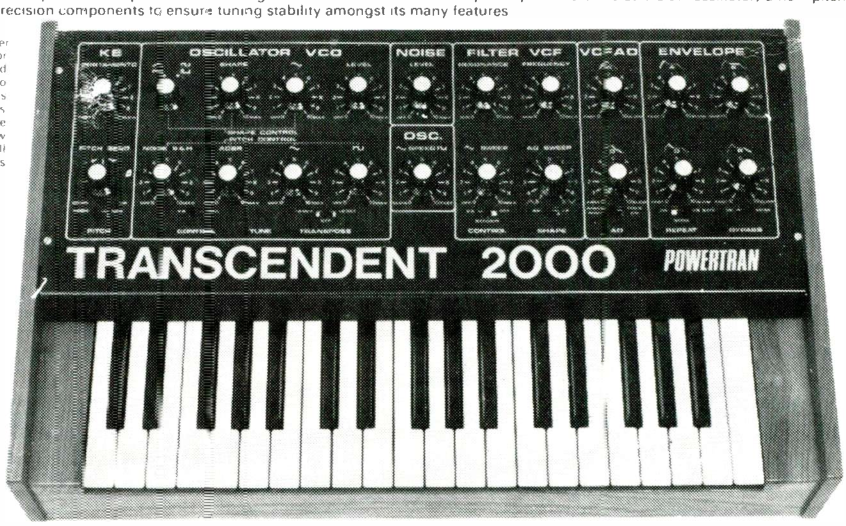
TRANSCENDENT 2000

SINGLE BOARD SYNTHESIZER

LIVE PERFORMANCE SYNTHESIZER DESIGNED BY CONSULTANT TIM ORR (FORMERLY SYNTHESIZER DESIGNER FOR EMS LIMITED) AND FEATURED AS A CONSTRUCTIONAL ARTICLE IN ELECTRONICS TODAY INTERNATIONAL.

The TRANSCENDENT 2000 is a 3 octave instrument transposable 2 octaves up or down giving an effective 7 octave range. There is portamento, pitch bending, a VCO with shape and pitch modulation, a VCF with band, low and high pass outputs and a separate dynamic sweep control, a noise generator and an ADSR envelope shaper. There is also a slow oscillator, a new pitch detector, ADSR repeat, sample and hold, and special circuitry with precision components to ensure tuning stability amongst its many features.

The kit includes fully finished metalwork, fully assembled solid teak cabinet, filter sweep pedal, professional quality components (all resistors either 2% metal oxide or 1% metal film!) and it really is complete — right down to the last nut and bolt and last piece of wire! There is even a 13A plug in the kit — you need buy absolutely no more parts before plugging in and making great music! Virtually all the components are on the one professional quality fibreglass PCB printed with component locations. All the controls mount directly on the main board, all connections to the board are made with connector plugs and construction is so simple it can be built easily in a few evenings by almost anyone capable of neat soldering! When finished you will possess a synthesizer comparable in performance and quality with ready built units selling for between £500 and £700!



Cabinet size 24.6" x 15.7" x 4.8" (rear) 3.4" (front)

COMPLETE KIT ONLY £172.00 + VAT!

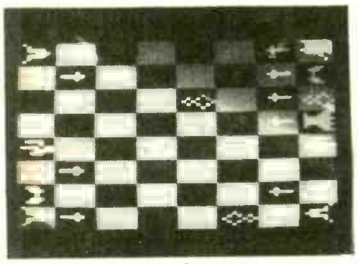
Comprehensive handbook supplied with all complete kits! This fully describes construction and tells you how to set up your synthesizer with nothing more elaborate than a multi-meter and a pair of ears!

POWERTRAN

ORDERING INFORMATION AND MORE KITS ON PAGE 8

DO NOT BUY A COMPUTER (UNTIL YOU HAVE READ APRIL WIRELESS WORLD)

ETI goes to war! The model tank shown on our cover is a Tamiya 1/16th Leopard A4, kindly supplied by Richard Konstam Ltd who import the kits. See page 62 for marching orders.



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Get ahead p.77

electronics today INTERNATIONAL

MAY 1979 VOL 8 NO 5

FEATURES

PROJECTS

INFORMATION

INTERNATIONAL EDITIONS

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SEMICONDUCTORS POTS & IRONS

SOCKETS

1611	8 pin DIL	£0.11
1612	14 pin DIL	£0.12
1613	16 pin DIL	£0.13
1614	24 pin DIL	£0.25
1615	28 pin DIL	£0.30
1616	TO18 Transistor	£0.12
1617	TU3 Transistor	£0.35
16117	TO5 Transistor	£0.12

VOLTAGE REGULATORS

Positive

MVR7805 v.a. 7805 TO220	£0.70
MVR7812 v.a. 7812 TO220	£0.70
MVR7815 v.a. 7815 TO220	£0.70
MVR7818 v.a. 7818 TO220	£0.70
MVR7824 v.a. 7824 TO220	£0.70
Negative	
MVR7905 v.a. 7905 TO220	£0.80
MVR7912 v.a. 7912 TO220	£0.80
MVR7915 v.a. 7915 TO220	£0.80
MVR7918 v.a. 7918 TO220	£0.80
MVR7924 v.a. 7924 TO220	£0.80
72723 14 pin DN	£0.45
LM309K TO3	£1.50

ZENER DIODES

400mw *(Bzy88) DO7 Glass encapsulated* range of voltages available. 1.3v, 2.2v, 2.7v, 3.3v, 3.9v, 4.3v, 4.7v, 5.1v, 5.6v, 6.2v, 6.8v, 7.5v, 8.2v, 9.1v, 10v, 11v, 12v, 13v, 15v, 16v, 18v, 20v, 22v, 24v, 27v, 30v, 33v, 39v.

No. Z4 8p ea.

1w-1.5w *Plastic and metal encapsulated* **ranges** of voltages available. **1.3v, 2.2v,** 2.7v, 3.3v, 3.9v, 4.3v, **4.7v, 5.1v,** 5.6v, 6.2v, 6.8v, 7.5v, **8.2v, 9.1v,** 10v, 11v, 12v, 13v, 15v, **16v, 18v,** 20v, 22v, 24v, 27v, 30v, **33v, 40v,** 47v, 51v, 68v, 72v, 75v, **82v, 91v,** 100v.

No. Z13 15p ea.

10w *Metal stud type SO10 case.* Range of voltages available. 1.3v, 2.2v, 2.7v, 3.3v, 3.9v, 4.3v, 4.7v, 5.1v, 5.6v, 6.2v, 6.8v, 7.5v, 8.2v, 9.1v, 10v, 11v, 12v, 13v, 15v, 16v, 18v, 20v, 22v, 24v, 27v, 30v, 33v, 43v, 47v, 51v, 68v, 72v, 75v, 82v, 91v, 100v.

No. Z10 35p ea.

SILICON RECTIFIERS

200mA	
IS920 50v	£0.05
IS021 100v	£0.07
IS922 150v	£0.08
IS923 200v	£0.09
IS924 300v	£0.10
1 Amp	
IN4001 50v	£0.04 ½
IN4002 100v	£0.05
IN4003 200v	£0.06
IN4004 400v	£0.07
IN4005 600v	£0.08
IN4006 800v	£0.09
IN4007 1000v	£0.10
1.5 Amp	
IS015 50v	£0.09
IS020 100v	£0.10
IS021 200v	£0.11
IS023 400v	£0.13
IS025 600v	£0.14
IS027 800v	£0.16
IS029 1000v	£0.20
IS031 1200v	£0.25
3 Amp	
IN5400 50v	£0.14
IN5401 100v	£0.15
IN5402 200v	£0.16
IN5404 400v	£0.17
IN5406 600v	£0.21
IN5407 800v	£0.25
IN5408 1000v	£0.30
10 Amp	
IS10/50 50v	£0.19
IS10/100 100v	£0.21
IS10/200 200v	£0.23
IS10/400 400v	£0.35
IS10/600 600v	£0.42
IS10/800 800v	£0.51
IS10/1000 1000v	£0.60
IS10/1200 1200v	£0.69
30 Amp	
IS30/50 50v	£0.58
IS30/100 100v	£0.69
IS30/200 200v	£0.93
IS30/400 400v	£1.25
IS30/600 600v	£1.76
IS30/800 800v	£1.94
IS30/1000 1000v	£2.31
IS30/1200 1200v	£2.88
60 Amp	
IS70/50 50v	£0.75
IS70/100 100v	£0.84
IS70/200 200v	£1.20
IS70/400 400v	£1.75
IS70/600 600v	£2.25
IS70/800 800v	£2.50
IS70 1000 1000v	£3.00
BYX38/300 6A 300v	£0.45
BYX38/600 6A 600v	£0.60
BYX38/300 Rev 6A 300v	£0.45
BYX38/600 Rev 6A 600v	£0.60

POTENTIOMETERS

CARBON POTS (Linear Track)
Single gang with wire end terminations, 6mm×50mm plastic shaft 10mm bushes supplied with shake proof washer & nut. Tolerance ±20% of resistance.

1831 1k ohms £0.26* 1836 47k ohms £0.26*
1832 2k2ohms £0.26* 1837 100kohms £0.26*
1833 4k7ohms £0.26* 1838 220kohms £0.26*
1834 10k ohms £0.26* 1839 470kohms £0.26*
1835 22kohms £0.26* 1840 1 Meg £0.26*
1841 2M2 £0.26*

CARBON POTS (Log Track)
1842 4k7ohms £0.26* 1846 100kohms £0.26*
1843 10kohms £0.26* 1847 220kohms £0.26*
1844 22kohms £0.26* 1848 470kohms £0.26*
1845 47kohms £0.26* 1849 1 Meg £0.26*
1850 2M2 £0.26*

DUAL CARBON POTS (Lin Track)
These high quality dual gang pots are fitted with wire end terminations and 6mm×50mm plastic shaft 10mm, bush and supplied with shake proof washer & nut track tolerance ±20% but matched to within 2db of each other. VC3
1851 4k7 £0.86* 1855 100kohms £0.86*
1852 10kohms £0.86* 1856 220kohms £0.86*
1853 22kohms £0.86* 1857 470kohms £0.86*
1854 100kohms £0.86* 1858 1Meg £0.86*
1859 2M2 £0.86*

DUAL CARBON POTS (Log Law)
1860 4k7ohms £0.86* 1864 100kohms £0.86*
1861 10kohms £0.86* 1865 220kohms £0.86*
1862 22kohms £0.86* 1866 470kohms £0.86*
1863 47kohms £0.86* 1867 Meg £0.86*

SINGLE GANG SWITCHED (Lin Law)
These potentiometers are fitted with double pole on-off switches. The switch is incorporated within the rotary action of the pot. Specification of pot is as VC1.
Switch rating 1.5 amps at 250v AC.
1870 4k7ohms £0.65* 1874 100kohms £0.65*
1871 10kohms £0.65* 1875 220kohms £0.65*
1872 22kohms £0.65* 1876 470kohms £0.65*1873 47kohms £0.65* 1877 1Meg £0.65*
1878 2M2 £0.65*

SWITCHED POT (Log Track)
Specification as VC2 but track having (log) law.
1879 4k7ohms £0.65* 1833 100kohms £0.65*
1880 10kohms £0.65* 1884 220kohms £0.65*
1881 22kohms £0.65* 1885 470kohms £0.65*
1882 47kohms £0.65* 1886 1Meg £0.65*
1887 2M2 £0.65*

DUAL GANG LOG-ANTI-LOG POT
1888 Track specification as dual gang pots VC3, but tracks mounted to log-anti-log action 100kohms £0.75*

SPECIAL VOLUME CONTROLS
A miniature 16mm type replacement volume control incorporating single pole on-off switch. Resistance value 5kohms. Tolerance ±20% 1/8watt rating.
1890 £0.54* VC8

MINIATURE ROTARY VOL CONTROL
5kohms log law with on/off switch. 20mm grooved spindle. Tag connections 17mm dia. Supplied with fixing nut. Used mainly for replacement.
1890 £0.54* VC9

WIRE WOUND POTS
A range of wire wound single gang pots with linear tracks of 1 watt rating, fitted with 10mm bush and supplied with shakeproof washer and nut.
VC6
1891 10ohms £0.80* 1895 220ohms £0.80*
1892 22ohms £0.80* 1896 470ohms £0.80*
1893 47ohms £0.80* 1897 1kohms £0.80*
1894 20ohms £0.80* 1898 2k2ohms £0.80*
1899 4k7ohms £0.80

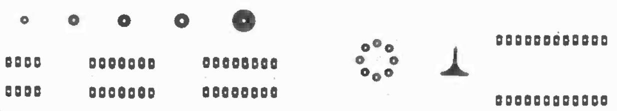
PRE-SET POTS HORIZONTAL MOUNTING
Miniature type for transistor circuits. The wiper of the preset is provided with a slot for screw driver adjustment. The tags of the preset will fit printed wiring boards with a pitch of 2.54mm. All tracks are linear law.
VC7
1801 100ohms £0.09* 1808 22kohms £0.09*
1802 220ohms £0.09* 1809 47kohms £0.09*
1803 470ohms £0.09* 1810 100kohms £0.09*
1804 1kohms £0.09* 1811 220kohms £0.09*
1805 2k2ohms £0.09* 1812 470kohms £0.09*
1806 4k7ohms £0.09* 1813 1Mohms £0.09*
1807 10kohms £0.09* 1814 2M2ohms £0.09*
1815 4M7ohms £0.09*

PRE-SET POTS VERTICAL MOUNTING
Miniature type for transistor circuits. Wiper adjustment is made by a screw driver slot. Designed to fit 2.54mm pitch board. All tracks are linear law.
VC7
1816 100ohms £0.09* 1823 22kohms £0.09*
1817 220ohms £0.09* 1824 47kohms £0.09*
1818 470ohms £009* 1825 100kohms £0.09*
1819 1kohms £0.09* 1826 220kohms £0.09*
1820 2k2ohms £0.09* 1827 470kohms £0.09*
1821 4k7ohms £0.09* 1828 1Meg £0.09*
1822 10kohms £0.09* 1829 2M2ohms £0.09*
1830 4M7ohms £0.09*

ANTEX IRONS

O/No. 1943. 15 watt high quality soldering iron totally enclosed element in a ceramic shaft fitted with 3/32" bit. **£3.80**
O/No. 1947. Replacement element for 1943 iron. **£1.90**
O/No. 1944. Iron coated bit 3/32" for 1943 iron. **£0.46**
O/No. 1945. Iron coated bit 1/8" for 1943 iron. **£0.46**
O/No. 1946. Iron coated bit 3/16" for 1943 iron. **£0.46**
O/No. 1948. General purpose 18 watt iron fitted with iron coated bit. **£3.60**
O/No. 1952. Replacement element for 1948 iron. **£1.90**
O/No. 1949. Iron coated but 3/32" for 1948 iron. **£0.46**
O/No. 1950. Iron coated bit 1/8" for 1948 iron. **£0.46**
O/No. 1951. Iron coated bit 3/16" for 1948 iron. **£0.46**
O/No. 1931. Highly popluar ×25 25 watt quality soldering iron ceramic shafts to provide near perfect insulation break-down voltage of 1500 volts AC and a leakage current of only 3-5uA and another shaft of stainless steel to ensure strength. **£3.60**
O/No. 1935. Replacement element for 1931 iron. **£1.60**
O/No. 1932. Iron coated bit 1/8" for 1931 iron. **£0.50**
O/No. 1933. Iron coated bit 3/16" for 1931 iron. **£0.50**
O/No. 1934. Iron coated bit 3/32" for 1931 iron. **£0.50**
O/No. 1953. SK1 soldering kit — this kit contains 15 watt soldering iron fitted with a 3/16" bit plus two spare bits, a reel of solder, heat-sink and a booklet "How to Solder." In presentation display box. **£5.55**
O/No. 1939. ST3 soldering iron stand. Stand made from high grade bakelite material chromium plated strong steel spring, suitable for all models, includes accommodation for six spare bits and two sponges which serve to keep the soldering iron bits clean. **£1.50**

PRINTED CIRCUIT TRANSFERS



Draw your own boards with the new BI-PAK etch-resistant transfers. Lay the symbols on the board, rub over with a soft pencil. The transfer will adhere to the board. Then complete the circuit with your BI-PAK etch-resist pen.

Each pack contains 11 sheets of transfers 1 of each as shown above.
Illustration — approx. ½ size.
O/No. TR400 @**£1.50** p&p £0 10

BRIDGE RECTIFIERS

Type	Order No.	Price
SILICON 1 amp		
50V RMS	BR1/50	£0.20
100V RMS	BR1/100	£0.22
200V RMS	BR1/200	£0.25
400V RMS	BR1/400	£0.36
SILICON 2 amp		
50V RMS	BR2/50	£0.45
100V RMS	BR2/100	£0.48
200V RMS	BR2/200	£0.52
400V RMS	BR2/400	£0.58
1000V RMS	BR2/1000	£0.68

OPTOELECTRONICS

NEW INCREASED RANGE — ALL 1ST QUALITY
LED'S (diffused)

O/No.	Type	Size	Colour	Price
1501	ARL209(TIL209)	.3mm (.125)	RED	£0.10
1502	MIL3232(TIL211)	.3mm (.125)	GREEN	£0.15
1503	MIL3331(OPL212A)	.3mm (.125)	YELLOW	£0.15
1504	ARL4850(FLV117)	.5mm (.2)	RED	£0.10
1505	MIL5251(TIL222)	.5mm (.2)	GREEN	£0.15
1506	MIL5351(MV5353)	.5mm (.2)	YELLOW	£0.15
1509	FLV111	.5mm (.2)	CLEAR (ill., Red)	£0.11

SUPER 'Hi-Brite' Type

1521	MIL32	.3mm (.125)	RED	£0.10
1522	MIL52	.5mm (.2)	RED	£0.10
1514	ORP12 Light dependent resistor			£0.55
1520	OCP71 Photo transistor			£0.35

LED CLIPS

1508/125	pack of 5	125 clips	£0.15
1508/2	pack of 5	2 clips	£0.18

DISPLAYS:

DL303	7 segment D.P. left (.30" height)	Common Anode	
RED	Single Digit	O/No. 1523	£0.70
DL707	7 segment D.P. left (.03" height)	Common Anode	
RED	Single Digit	O/No. 1510	£0.95
DL527	7 segment D.P. left (.50" height)	Common Anode	
RED	Two-Digit Reflector	O/No. 1524	£1.70
DL727	7 segment D.P. right (.510" height)	Common Anode	
RED	Two-Digit Light Pipe	O/No. 1521	£2.20
DL747	7 segmen tD.P. left (.630" height)	Common Anode	
RED	Single-Digit Light Pipe	O/No. 1511	£1.70

ALL @ 8% VAT

OPTO-ISOLATORS
Isolation Breakdown — Voltage 1500 — continuous fwd current 100mA

CIL74 Single-Channel 6 pin DIP standard type — optically coupled pair with Infra-red LED Emitter and NPN Silicon Photo Transistor. O/No. 1497 **£0.50**
CILD74 Multi-Channel 8 pin DIP Two Isolated Channels. O/No. 1498 **£1.00**
CILQ74 Multi-Channel 16 pin DIP Four Isolated Channels. O/No. 1499 **£2.20**

ALL @ 8% VAT

2nd GRADE LEDs
A pair of 10 standard sizes and colours which fail to perform to their very rigid specification, but which are ideal for amateurs who do not require the full spec.
O/No. 1507 **£1.50**

THYRISTORS

Volts	No.	Price
800ma	**TO 18 Case**	
10	THY600/10	£0.15
20	THY600/20	£0.16
30	THY600/30	£0.20
50	THY600/50	£0.22
100	THY600/100	£0.25
200	THY600/200	£0.38
400	THY600/400	£0.44
1 amp	**TO 5 Case**	
50	THY1A/50	£0.28
100	THY1A/100	£0.28
200	THY1A/200	£0.32
400	THY1A/400	£0.38
600	THY1A/600	£0.45
800	THY1A/800	£0.58
3 amp	**TO 68 Case**	
50	THY3A/50	£0.28
100	THY3A/100	£0.30
200	THY3A/200	£0.33
400	THY3A/400	£0.42
600	THY3A/600	£0.50
800	THY3A/800	£0.65
5 amp	**TO 66 Case**	
50	THY5A/50	£0.36
100	THY5A/100	£0.45
200	THY5A/200	£0.50
400	THY5A/400	£0.57
600	THY5A/600	£0.69
800	THY5A/800	£0.81
5 amp	**TO 220 Case**	
400	THY5A/400P	£0.67
800	THY5A/600P	£0.69
800	THY5A/800P	£0.81
7 amp	**TO 48 Case**	
50	THY7A/50	£0.48
100	THY7A/100	£0.51
200	THY7A/200	£057
400	THY7A/400	£0.62
600	THY7A/600	£0.78
800	THY7A/800	£0.92
10 amp	**TO 48 Case**	
50	THY10A/50	£0.51
100	THY10A/100	£0.57
200	THY10A/200	£0.62
400	THY10A/400	£0.71
600	THY10A/600	£0.99
800	THY10A/800	£1.22
16 amp	**TO 48 Case**	
50	THY16A/50	£0.54
100	THY16A/100	£0.58
200	THY16A/200	£0.62
400	THY16A/400	£0.77
600	THY16A/600	£0.90
800	THY16A/800	£1.39
30 amp	**TO 94 Case**	
50	THY30A/50	£1.18
100	THY30A/100	£1.43
200	THY30A/200	£1.63
400	THY30A/400	£1.79
600	THY30A/600	£3.50

No.	Price
BT101/500R	£0.80
BT102/500R	£0.80
BT106	£1.25
BT107	£0.93
BT108	£0.98
2N322B	£0.70
2N3535	£0.77
BTX30/50L	£0.33
BTX30/400L	£0.46
C106/4	£0.60

CABLES

DESCRIPTION	O/No.	Price/Metre
Microphone Cable	3126	£0.10
Twin Microphone	3127	£0.20
Twin Stereo Screened Cable	3128	£0.15
Multicore Standard 4-Core Screened	3129	£0.30
4-Core Individually Screened	3130	£0.22
Heavy Microphone Cable	3131	£0.18
Light-Core mains	3132	£0.10
Twin Oval Mains	3133	£0.09
Speaker Cable	3134	£0.07
Low Loss Co-axial Cable	3135	£0.22
15-Way Multi-Coloured Ribbon Cable	3136	£0.40

SEMICONDUCTORS

TRANSISTORS

Type	Price
AC107	£0.22
AC113	£0.20
AC115	£0.20
AC117	£0.30
AC117K	£0.34
AC121	£0.20
AC122	£0.14
AC125	£0.18
AC126	£0.18
AC127	£0.18
AC128	£0.16
AC128K	£0.26
AC132	£0.20
AC134	£0.20
AC137	£0.20
AC141	£0.22
AC141K	£0.30
AC142	£0.20
AC142K	£0.30
AC151	£0.20
AC153	£0.22
AC153K	£0.30
AC154	£0.20
AC155	£0.20
AC156	£0.20
AC157	£0.25
AC165	£0.20
AC166	£0.20
AC167	£0.20
AC168	£0.25
AC169	£0.20
AC171	£0.25
AC176	£0.18
AC176K	£0.26
AC178	£0.25
AC179	£0.25
AC180	£0.20
AC180K	£0.28
AC181	£0.20
AC181K	£0.28
AC187	£0.18
AC187K	£0.28
AC188	£0.18
AC188K	£0.28
ACY17	£0.35
ACY18	£0.35
ACY19	£0.35
ACY20	£0.35
ACY21	£0.35
ACY22	£0.35
ACY27	£0.35
ACY28	£0.35
ACY29	£0.50
ACY30	£0.35
ACY31	£0.35
ACY34	£0.35
ACY35	£0.35
ACY36	£0.50
ACY40	£0.35
ACY41	£0.35
ACY44	£0.35*
AD130	£0.70
AD140	£0.60
AD142	£0.85
AD143	£0.75
AD149	£0.60
AD161	£0.35
AD162	£0.35
AD161/162	£0.70
AD/140	£0.55
AF114	£0.25
AF115	£0.25
AF116	£0.25
AF117	£0.25
AF118	£0.40
AF124	£0.30
AF125	£0.30
AF126	£0.30
AF127	£0.32
AF139	£0.35
AF178	£0.60
AF179	£0.60
AF180	£0.60
AF181	£0.58
AF186	£0.50
AF239	£0.38
AL102	£1.20
AL103	£1.18
ASY26	£0.38
ASY27	£0.40
ASY28	£0.38
ASY29	£0.38
ASY50	£0.30
ASY51	£0.30
ASY52	£0.30
ASY54	£0.30
ASY55	£0.30
ASY56	£0.30
ASY57	£0.30
ASY58	£0.30
ASY73	£0.30
AU104	£1.40
AU110	£1.40
AU113	£1.40
BC107	£0.08
BC107A	£0.08
BC107B	£0.09
BC107C	£0.10
BC108	£0.09
BC108A	£0.10
BC108B	£0.08
BC108C	£0.10
BC109	£0.08
BC109A	£0.08
BC109B	£0.09
BC109C	£0.10
BC113	£0.16*
BC114	£0.16*
BC115	£0.19*
BC116	£0.19*
BC116A	£0.19*
BC117	£0.20*
BC118	£0.14*
BC119	£0.25
BC120	£0.40

Type	Price
BC125	£0.17*
BC126	£0.22*
BC132	£0.18*
BC134	£0.18*
BC135	£0.15*
BC136	£0.18*
BC137	£0.18*
BC139	£0.32
BC140	£0.30
BC141	£0.28
BC142	£0.22
BC143	£0.22
BC145	£0.46
BC147	£0.07*
BC148	£0.07*
BC149	£0.07*
BC150	£0.20*
BC151	£0.22*
BC152	£0.20*
BC153	£0.25*
BC154	£0.19*
BC157	£0.10
BC158	£0.10*
BC159	£0.10*
BC160	£0.26
BC161	£0.38
BC167	£0.12*
BC168	£0.12*
BC169	£0.09*
BC169C	£0.10*
BC170	£0.09*
BC171	£0.09*
BC172	£0.09*
BC173	£0.09*
BC174	£0.15*
BC175	£0.35*
BC177	£0.16
BC178	£0.16
BC179	£0.16
BC180	£0.25
BC181	£0.25*
BC182	£0.09*
BC182L	£0.09*
BC183	£0.09*
BC183L	£0.09*
BC184	£0.09
BC184L	£0.09*
BC186	£0.22
BC187	£0.22
BC207	£0.11*
BC208	£0.11*
BC209	£0.12*
BC212	£0.09*
BC212L	£0.09*
BC213	£0.09*
BC213L	£0.09*
BC214	£0.09*
BC214L	£0.09*
BC225	£0.26*
BC226	£0.36*
BC227	£0.16*
BC238	£0.16*
BC251	£0.15*
BC251A	£0.16*
BC301	£0.28
BC302	£0.29
BC303	£0.28
BC304	£0.38
BC327	£0.16*
BC328	£0.15*
BC337	£0.15*
BC338	£0.15*
BC440	£0.30
BC441	£0.30
BC460	£0.38
BC461	£0.38
BC477	£0.20
BC478	£0.20
BC479	£0.20
BC547	£0.10*
BC548	£0.10*
BC549	£0.10*
BC550	£0.14*
BC556	£0.14*
BC557	£0.13*
BC558	£0.12*
BC559	£0.14*
BCY30	£0.55
BCY31	£0.55
BCY32	£0.60
BCY33	£0.55
BCY34	£0.60
BCY70	£0.15
BCY71	£0.15
BCY72	£0.14
BCZ10	£0.60
BCZ11	£0.60
BCZ12	£0.60
BD115	£0.50
BD116	£0.80
BD121	£0.65
BD123	£0.65
BD124	£0.70
BD131	£0.35
BD132	£0.35
BD131/132	£0.80
BD133	£0.40
BD135	£0.38
BD136	£0.35
BD137	£0.35
BD138	£0.36
BD139	£0.36
BD140	£0.36
BD139/140	£0.80
BD155	£0.80
BD175	£0.60
BD176	£0.60
BD177	£0.68
BD178	£0.68
BD179	£0.75
BD180	£0.75
BD181	£0.85
BD182	£0.90
BD183	£0.95
BD184	£1.10

Type	Price
BD185	£0.68
BD186	£0.68
BD187	£0.75
BD188	£0.75
BD189	£0.78
BD190	£0.78
BD195	£0.90
BD196	£0.90
BD197	£0.95
BD198	£0.95
BD199	£0.99
BD200	£0.99
BD201	£0.80
BD202	£0.80
BD201/202	£1.70
BD203	£0.80
BD204	£0.80
BD203/204	£1.70
BD205	£0.80
BD206	£0.80
BD207	£1.00
BD208	£1.00
BD222	£0.47
BD225	£0.47
BD232	£0.55
BD233	£0.48
BD234	£0.55
BD235	£0.55
BD236	£0.58
BD237	£0.56
BD238	£0.60
BDX32	£2.20
BDY11	£1.30
BDY17	£1.80
BDY20	£0.80
BDX77	£0.90
BF115	£0.22
BF117	£0.50
BF118	£0.75
BF119	£0.75
BF121	£0.50*
BF123	£0.60*
BF125	£0.50*
BF127	£0.60*
BF152	£0.25*
BF153	£0.25*
BF154	£0.22*
BF155	£0.35
BF156	£0.28
BF157	£0.28
BF158	£0.28*
BF159	£0.28*
BF160	£0.30*
BF162	£0.30*
BF163	£0.30*
BF164	£0.50*
BF165	£0.50*
BF167	£0.24
BF173	£0.20
BF176	£0.38*
BF177	£0.26
BF178	£0.28
BF179	£0.30
BF180	£0.30
BF181	£0.30
BF182	£0.30
BF183	£0.30
BF184	£0.20
BF185	£0.20
BF186	£0.26*
BF187	£0.26
BF188	£0.40
BF194	£0.10*
BF195	£0.10*
BF196	£0.10*
BF197	£0.12*
BF198	£0.14*
BF199	£0.14*
BF200	£0.30
BF202	£0.90*
BF222	£0.90
BF224	£0.17
BF240	£0.17*
BF241	£0.17*
BF244	£0.30*
BF257	£0.25
BF258	£0.25
BF259	£0.35
BF262	£0.60*
BF263	£0.60*
BF270	£0.36
BF271	£0.31
BF272	£0.80
BF273	£0.36*
BF274	£0.38*
BF324	£0.35*
BF336	£0.30
BF337	£0.30*
BF338	£0.38
BF457	£0.37
BF458	£0.37
BF459	£0.38
BF594	£0.30*
BF596	£0.28*
BFR39	£0.24
BFR40	£0.25*
BFR79	£0.28*
BFR80	£0.28*
BFX29	£0.22
BFX30	£0.30
BFX84	£0.22
BFX85	£0.24
BFX86	£0.25
BFX87	£0.22
BFX88	£0.22
BFX90	£0.55*
BFY50	£0.16
BFY51	£0.16
BFY52	£0.16
BFY53	£0.16
BIP19	£0.38
BIP20	£0.38
BIP19/20	£0.80
BSX25	£1.45
BSX19	£0.18

Type	Price
BSX20	£0.18
BSY25	£0.16
BSY26	£0.16
BSY27	£0.16
BSY28	£0.16
BSY29	£0.16
BSY38	£0.19
BSY39	£0.19
BSY40	£0.29
BSY41	£0.29
BSY51	£0.25
BSY95	£0.13
BSY95A	£0.13
BRY39	£0.45
BU105	£1.40
BU105/02	£1.95
BU204	£1.40
BU205	£1.40
BU208	£1.90
BU208/02	£2.25
E1222	£0.38
MAT100	£0.19
MAT101	£0.20
MAT120	£0.19
MAT121	£0.20
MJ480	£0.95
MJ481	£1.05
MJ490	£0.95
MJ491	£1.15
MJE340	£0.68
MJE370	£0.55
MJE371	£0.60
MJE520	£0.45
MJE521	£0.65
MJE2955	£0.90
MJE3055	£0.60
MJE3440	£0.52
MP8113	£0.52
MPF102	£0.28
MPF104	£0.35
MPF105	£0.35
MPSA05	£0.20
MPSA06	£0.20*
MPSA55	£0.20*
MPSA56	£0.20*
ND120	£0.18
OC19	£0.85
OC20	£1.85
OC22	£1.50
OC23	£1.50
OC24	£1.35
OC25	£1.00
OC26	£1.00
OC28	£0.80
OC29	£0.95
OC35	£0.90
OC36	£0.90
OC41	£0.20
OC42	£0.22
OC44	£0.24
OC45	£0.20
OC70	£0.24
OC71	£0.15
OC72	£0.24
OC74	£0.26
OC75	£0.30
OC76	£0.35
OC77	£0.50
OC81	£0.22
OC81D	£0.24
OC82	£0.24
OC82D	£0.30
OC83	£0.26
OC84	£0.38
OC139	£0.80
OC140	£0.80
OC169	£0.35
OC170	£0.35
OC171	£0.35
OC200	£0.38
OC201	£0.95
OC202	£1.20
OC203	£0.85
OC204	£0.90
OC205	£1.15
P346A	£0.35
P397	£0.45
R20008B	£2.50
R2010B	£2.60
ST140	£0.15
ST141	£0.20
TIC44	£0.29*
TIC45	£0.35*
TIP29A	£0.40
TIP29B	£0.42
TIP29C	£0.44
TIP30A	£0.40
TIP30B	£0.42
TIP30C	£0.44
TIP31A	£0.40
TIP31B	£0.42
TIP31C	£0.44
TIP32A	£0.40
TIP32B	£0.42
TIP32C	£0.44
TIP41A	£0.44
TIP41B	£0.46
TIP41C	£0.48
TIP42A	£0.44
TIP42B	£0.46
TIP42C	£0.48
TIP2955	£0.60
TIP3055	£0.50
TIS43	£0.22
TIS90	£0.18*
UT46	£0.20

Type	Price
ZTX107	£0.10*
ZTX108	£0.10*
ZTX109	£0.10*
ZTX300	£0.12*
ZTX301	£0.12*
ZTX302	£0.16*
ZTX303	£0.16*
ZTX304	£0.20*
ZTX330	£0.15*
ZTX500	£0.13*
ZTX501	£0.12*
ZTX502	£0.16*
ZTX503	£0.12*
ZTX504	£0.25*
ZTX531	£0.25*
ZTX550	£0.16*
2G301	£0.22
2G302	£0.22
2G303	£0.22
2G304	£0.30
2G306	£0.40
2G308	£0.36
2G309	£0.36
2G339	£0.20
2G339A	£0.18
2G344	£0.20
2G345	£0.18
2G371	£0.18
2G371B	£0.12
2G373	£0.18
2G374	£0.18
2G377	£0.32
2G378	£0.18
2G381	£0.18
2G382	£0.18
2G401	£0.32
2G414	£0.32
2G417	£0.26
2N388	£0.36
2N388A	£0.56
2N404	£0.20
2N524	£0.40
2N527	£0.50
2N598	£0.40
2N599	£0.46
2N696	£0.13
2N697	£0.12
2N698	£0.12
2N699	£0.32
2N706	£0.10
2N706A	£0.12
2N707	£0.48
2N708	£0.14
2N711	£0.30
2N717	£0.30
2N718	£0.25
2N718A	£0.50
2N726	£0.29
2N727	£0.29
2N743	£0.20
2N744	£0.20
2N914	£0.15
2N918	£0.30
2N929	£0.20
2N930	£0.18
2N946	£0.40
2N1131	£0.18
2N1132	£0.18
2N1302	£0.15
2N1303	£0.18
2N1304	£0.18
2N1305	£0.18
2N1306	£0.25
2N1307	£0.25
2N1308	£0.30
2N1309	£0.30
2N1599	£0.35
2N1613	£0.20
2N1711	£0.20
2N1889	£0.45
2N1890	£0.45
2N1893	£0.30
2N2147	£0.75
2N2148	£0.70
2N2160	£1.00
2N2192	£0.38
2N2193	£0.38
2N2194	£0.38
2N2217	£0.22
2N2218	£0.22
2N2218A	£0.20
2N2219	£0.20
2N2219A	£0.24
2N2220	£0.20
2N2221	£0.20
2N2221A	£0.22
2N2222	£0.20
2N2222A	£0.20
2N2368	£0.18
2N2369	£0.14
2N2369A	£0.14
2N2411	£0.25
2N2412	£0.25
2N2646	£0.47
2N2711	£0.22
2N2712	£0.22
2N2714	£0.22
2N2904	£0.18
2N2904A	£0.21
2N2905	£0.18
2N2905A	£0.20
2N2906	£0.16
2N2906A	£0.19
2N2907	£0.20
2N2907A	£0.22
2N2923	£0.15*
2N2924	£0.15*
2N2925	£0.15*
2N2926G	£0.09*
2N2926Y	£0.08*
2N2926O	£0.08*
2N2926R	£0.08*
2N2926B	£0.08*
2N3010	£0.65
2N3011	£0.15

Type	Price
2N3053	£0.16
2N3054	£0.40
2N3055	£0.40
2N3391	£0.20*
2N3391A	£0.22*
2N3392	£0.20*
2N3393	£0.20*
2N3394	£0.20*
2N3395	£0.22*
2N3402	£0.21*
2N3403	£0.21*
2N3404	£0.29*
2N3405	£0.42*
2N3414	£0.16*
2N3415	£0.16*
2N3416	£0.29*
2N3417	£0.29*
2N3614	£1.00
2N3615	£1.06
2N3616	£1.05
2N3646	£0.09*
2N3702	£0.08*
2N3703	£0.08*
2N3704	£0.07*
2N3705	£0.07*
2N3706	£0.08*
2N3707	£0.08*
2N3708	£0.07*
2N3708A	£0.07*
2N3709	£0.07*
2N3710	£0.07*
2N3711	£0.07*
2N3772	£1.60
2N3773	£2.20
2N3819	£0.18
2N3820	£0.35
2N3821	£0.60
2N3823	£0.60
2N3903	£0.10*
2N3904	£0.10*
2N3905	£0.10*
2N3906	£0.10*
2N4058	£0.12*
2N4059	£0.14*
2N4060	£0.14*
2N4061	£0.12*
2N4062	£0.12*
2N4284	£0.18*
2N4285	£0.18*
2N4286	£0.18*
2N4287	£0.18*
2N4288	£0.18*
2N4289	£0.18*
2N4290	£0.18*
2N4291	£0.18*
2N4292	£0.18*
2N4293	£0.18*
2N4921	£0.55*
2N4923	£0.65*
2N5135	£0.10*
2N5136	£0.10*
2N5138	£0.10*
2N5172	£0.14*
2N5194	£0.56
2N5245	£0.40
2N5294	£0.34
2N5296	£0.36
2N5257	£0.32
2N5458	£0.32
2N5459	£0.35
2N5551	£0.36*
2N6027	£0.34
2N6121	£0.70
2N6122	£0.70
2S301	£0.50
2S302	£0.43
2S302A	£0.43
2S303	£0.56
2S304	£0.71
2S305	£0.80
2S306	£0.80
2S307	£0.80
2S321	£0.57
2S322	£0.43
2S322A	£0.43
2S323	£0.57
2S324	£0.71
2S325	£0.71
2S326	£0.71
2S327	£0.71
40311	£0.38
40313	£0.95
40316	£0.95
40317	£0.40
40326	£0.40
40327	£0.45
40346	£0.45
40347	£0.65
40348	£0.80
40360	£0.36
40361	£0.36
40362	£0.38
40406	£0.45
40407	£0.35
40408	£0.52
40409	£0.75
40410	£0.75
40411	£2.70
40430	£0.95
40476	£1.60
40494	£0.70
40495	£0.80
40512	£1.35
40594	£0.90
40636	£1.10

74 SERIES TTL

Type	Price	Type	Price	Type	Price	Type	Price	Type	Price
7400	£0.09	7427	£0.24	7472	£0.20	74105	£0.38	74163	£0.62
7401	£0.11	7428	£0.26	7473	£0.25	74107	£0.24	74164	£0.68
7402	£0.11	7430	£0.11	7474	£0.25	74110	£0.36	74165	£0.68
7403	£0.11	7432	£0.22	7475	£0.29	74111	£0.58	74166	£0.78
7404	£0.11	7433	£0.30	7476	£0.25	74118	£0.80	74174	£0.65
7405	£0.11	7437	£0.21	7480	£0.44	74119	£1.18	74175	£0.62
7406	£0.22	7438	£0.21	7481	£0.85	74121	£0.24	74176	£0.58
7407	£0.22	7440	£0.12	7482	£0.68	74122	£0.39	74177	£0.58
7408	£0.13	7441	£0.50	7483	£0.58	74123	£0.40	74180	£1.50
7409	£0.13	7442	£0.40	7484	£0.88	74136	£0.52	74181	£0.58
7410	£0.11	7443	£0.70	7485	£0.68	74141	£0.55	74182	£0.70
7411	£0.17	7444	£0.70	7486	£0.22	74145	£0.55	74184	£0.70
7412	£0.16	7445	£0.65	7489	£1.70	74150	£0.68	74190	£0.68
7413	£0.24	7446	£0.60	7490	£0.32	74151	£0.48	74191	£0.62
7414	£0.50	7447	£0.48	7491	£0.64	74153	£0.48	74192	£0.60
7416	£0.23	7448	£0.56	7492	£0.35	74154	£0.82	74193	£0.58
7417	£0.23	7450	£0.11	7493	£0.30	74155	£0.50	74194	£0.62
7420	£0.11	7451	£0.11	7494	£0.75	74156	£0.50	74195	£0.60
7421	£0.20	7453	£0.11	7495	£0.50	74157	£0.50	74196	£1.05
7422	£0.16	7454	£0.11	7496	£0.50	74160	£0.58	74197	£1.05
7423	£0.21	7460	£0.11	74100	£0.85	74161	£0.62	74198	£1.85
7425	£0.19	7470	£0.25	74104	£0.39	74162	£0.62	74199	£1.85
7426	£0.23								

CMOS ICs

Type	Price	Type	Price	Type	Price	Type	Price	Type	Price
CD4000	£0.14	CD4015	£0.76	CD4026	£1.20	CD4043	£0.88	CD4070	£0.17
CD4001	£0.15	CD4016	£0.42	CD4027	£0.50	CD4044	£0.82	CD4071	£0.17
CD4002	£0.16	CD4017	£0.75	CD4028	£0.68	CD4045	£1.40	CD4072	£0.17
CD4006	£0.82	CD4018	£0.85	CD4029	£0.85	CD4046	£1.30	CD4081	£0.17
CD4007	£0.17	CD4019	£0.42	CD4030	£0.48	CD4047	£0.87	CD4082	£0.18
CD4008	£0.92	CD4020	£0.90	CD4031	£2.00	CD4049	£0.42	CD4510	£0.99
CD4009	£0.45	CD4021	£0.82	CD4035	£1.00	CD4050	£0.42	CD4511	£0.95
CD4010	£0.48	CD4022	£0.82	CD4037	£0.95	CD4054	£1.10	CD4516	£1.00
CD4011	£0.15	CD4023	£0.15	CD4040	£0.88	CD4055	£1.00	CD4518	£1.00
CD4012	£0.16	CD4024	£0.65	CD4041	£0.76	CD4056	£1.35	CD4520	£1.00
CD4013	£0.42	CD4025	£0.15	CD4042	£0.72	CD4069	£0.17	CD4014	£0.80

LINEAR ICs

Type	Price	Type	Price	Type	Price	Type	Price	Type	Price
CA3011	£0.80*	LM301	£0.29*	MC1312	£1.90*	72710	£0.30*	SN76115	£1.90*
CA3014	£1.35*	LM304	£1.60	MC1350	£1.20*	UA711C	£0.32*	SN76660	£0.75*
CA3018	£0.65*	LM308	£1.00*	MC1352	£1.40*	72711	£0.32*	SL414A	£1.95*
CA3020	£1.70*	LM309	£1.50	MC1469	£2.95	UA723C	£0.45	TAA550B	£0.35
CA3028	£0.80*	LM320-5V	£1.50	MC1496	£0.90*	727	£0.45	TAA621A	£2.00*
CA3035	£1.40*	LM320-12V	£1.50	NE536	£2.66*	UA741C	£0.24*	TAA621B	£2.50*
CA3036	£1.00*	LM320-15V	£1.50	NE550	£0.95	72741	£0.24*	TAA661	£1.50*
CA3042	£1.50*	LM320-24V	£1.50	NE555	£0.24	741P	£0.20*	TAD100	£1.30*
CA3043	£1.85*	LM380	£0.85*	NE556	£0.60	UA747C	£0.60*	TBA540	£2.10*
CA3046	£0.70*	LM381	£1.45*	NE565	£3.20*	72747	£0.60*	TBA800	£0.80
CA4052	£1.60*	LM3900	£0.58*	NE566	£1.50*	UA748	£0.35*	TBA810S	£0.75*
CA3054	£1.10*	MC1303L	£0.85*	NE567	£1.70*	72748	£0.35*	TBA810	£0.98*
CA3075	£1.50*	Mc1304	£1.90*	UA702C	£0.46*	748P	£0.35*	TBA820	£0.70*
CA3081	£1.50*	MC1310	£0.95*	72702	£0.46*	SN76013N	£1.75*	TBA9200	£2.50*
CA3089	£2.00*			UA703	£0.25*	SN76023	£1.75*	TCA270S	£2.00*
CA3090	£3.60*			UA709	£0.25*	SN7611D	£1.50*		
CA3123	£1.90*			72709	£0.48*				
CA3031	£0.93			709P	£0.25*				
CA3140	£0.70			UA710C	£0.40*				

DIODES

Type	Price	Type	Price	Type	Price	Type	Price	Type	Price
AA119	£0.08	BAX13	£0.07	BY164	£0.51	OA10	£0.35	SD10	£0.06
AA120	£0.08	BAX16	£0.08	BY176	£0.75*	OA47	£0.08	SD19	£0.06
AA129	£0.08	BY100	£0.22	BY206	£0.30	OA70	£0.08	IN34	£0.07
AAY30	£0.09	BY101	£0.22	BYZ10	£0.45	OA79	£0.10	IN34A	£0.07
AAZ13	£0.15	BY105	£0.22	BYZ11	£0.45	OA81	£0.10	IN914	£0.06
BA100	£0.10	BY114	£0.22	BYZ12	£0.45	OA85	£0.10	IN916	£0.06
BA102	£0.32	BY124	£0.22*	BYZ13	£0.40	OA90	£0.10	IN4148	£0.06
BA148	£0.15	BY126	£0.15*	BYZ16	£0.41	OA91	£0.10	IS44	£0.05
BA154	£0.12	BY127	£0.16*	BYZ17	£0.36	OA95	£0.10	IS920	£0.06
BA155	£0.14	BY128	£0.16	BYZ18	£0.36	OA182	£0.13		
BA173	£0.15	BY130	£0.17*	BYZ19	£0.36	OA200	£0.08		
BB104	£0.15	BY133	£0.21*	OA5	£0.60	OA202	£0.08		

TRIACS

2 amp — TO5 Case

Volts	No.	Price
100	TR12a/100	£0.31
200	TR12a/200	£0.51
400	TR12a/400	£0.71

10 Amp — TO48 Case

Volts	No.	Price
100	TR110a/100	£0.77
200	TR100a/200	£0.92
400	TR100a/400	£1.12

6 Amp — TO66 Case

Volts	No.	Price
100	TR16a/100	£0.51
200	TR16a/200	£0.61
400	TR16a/400	£0.77

10 Amp — TO220 Plastic Case

Volts	No.	Price
400	TR100a/400p	£1.12

DIACS

BR100 £0.20 D32 £0.20

ORDERING Do not forget to state order number and your name and address.

V.A.T. Add 12½% to prices marked *. 8% to those unmarked. Items marked † are zero rated.

P & P: 35p unless otherwise stated.

GIRO account No. 388 7006.

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cabinet size 17.2" × 17.2" × 6.7"

200 + 200 watt AMPLIFIER

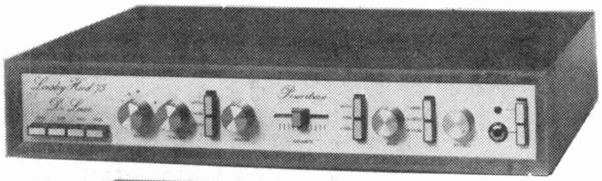
As featured in Electronics Today International

400W rms continuous — 800W peak!
0.03% THD at FULL power!
PLUS all the following features too!

- ★ Each channel totally independent with its own stabilised power supply driven by custom designed TOROIDAL transformers!
- ★ Inherent reliability — monster heat sinks for cool running at the hottest venues — electronic open and short circuit protection!
- ★ Ultra low feedback (an incredible low 14dB overall!), super high slewing rate (20V/μs); 200W rms continuous to 4 ohm from EACH channel, input sensitivity 0.775V (0dB).
- ★ Professional quality components, sturdy 19" rack mounting chassis complete with sleeve and feet for free standing work too.
- ★ Easy to build — plenty of working space with ready access to all components, minimal wiring, extensive instruction suitable for both experience constructors and newcomers to electronics.
- ★ Value for money — quality and performance comparable with ready-built amplifiers costing over £600!

COMPLETE KIT ONLY £196.90 + VAT

READ THE REVIEW
IN SOUND INTERNATIONAL DEC. '78 !



DE LUXE EASY TO BUILD LINSLEY HOOD 75W STEREO AMPLIFIER £99.30 + VAT

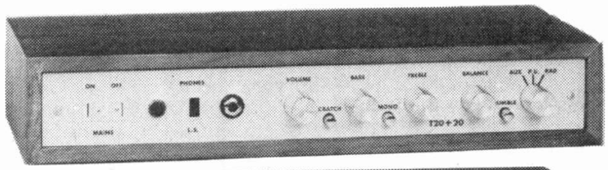
This easy to build version of our world-wide acclaimed 75W amplifier kit based upon circuit boards interconnected with gold plated contacts resulting in minimal wiring and construction delightfully straightforward. The design was published in Hi-Fi News and Record Review and features include rumble filter, variable scratch filter, versatile tone controls and tape monitoring whilst distortion is less than 0.01%.

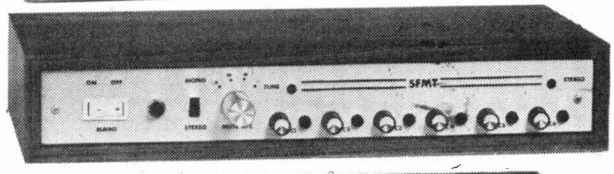
WIRELESS WORLD FM TUNER £70.20 + VAT

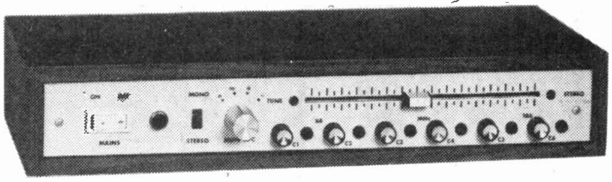
A pre-aligned front-end module makes this Wireless World published design very simple to construct and adjust without special instruments. Features include an excellent a.m. rejection, push-button station selection as well as infinitely variable tuning and a phase locked loop stereo decoder incorporating active filters for "birdy" suppression.

LINSLEY-HOOD CASSETTE DECK £79.60 + VAT

This design, published in Wireless World, although straightforward and relatively low cost provides a very high standard of performance. There are separate record and replay amplifiers and switchable equalisation together with a choice of bias levels are also provided. The mechanism is the Goldring-Lenco CRV with electronic speed control.







T20 + 20 20W STEREO AMPLIFIER £33.10 + VAT

This kit, based upon a design published in Practical Wireless, uses a single printed circuit board and offers at very low cost, ease of construction and all the normal facilities found on quality amplifiers. A 30 watt version of this kit (T30 + 30) is also available for **£38.40** + VAT.

POWERTRAN SFMT TUNER £35.90 + VAT

This is a simple low cost design which can be constructed easily without special alignment equipment but which still gives a first-class output suitable for feeding any of our very popular amplifiers or any other high quality audio equipment. A phase-locked-loop is used for stereo decoding and controls include switchable afc, switchable muting and push-button channel selection (adjustable by controls on the front panel). This unit matches well with the T20 + 20 and T30 + 30 amplifiers.

WWII TUNER £47.70 + VAT

This cost reduced model of our highly successful Wireless World FM Tuner kit was designed to complement the T20 + 20 and T30 + 30 amplifiers and the cabinet size, front panel format and electrical characteristics make this tuner compatible with either. Facilities included are pre-aligned front-end module, switchable afc, adjustable switchable muting, LED tuning indication and both continuous and push-button channel selection (adjustable by controls on the front panel).

COMPLETE KITS: Our complete kits really are complete. All of the projects shown on this page are supplied with fully finished metalwork, ready assembled high quality teak veneer cabinet, cables, nuts, bolts, etc., and full instructions — in fact everything!

All of the kits shown on this page are available as separate packs (except the Powertran SFMT Tuner) for those customers who wish to spread their purchase or perhaps make their own cabinets or metalwork. Prices are given in our FREE CATALOGUE.

PRICE STABILITY. Order with confidence. Irrespective of any price changes. We will honour all prices in this advertisement until June 30th, 1979, if the May, 1979 issue is mentioned with your order. Errors and VAT rate changes excluded.

EXPORT ORDERS: No VAT. Postage charged at actual cost plus 50p handling and documentation.
U.K. ORDERS. Subject to 12½% surcharge for VAT*(i.e. add ⅛ to the price). No charge is made for carriage. *or at current rate if changed.
SECURICOR DELIVERY: For this optional service (U.K. mainland only) add £2.50 (VAT inclusive) per kit.
SALES COUNTER: If you prefer to collect your kit from the factory, call at Sales Counter (at rear of factory). Open 9 a.m.-4.30 p.m. Monday-Thursday.

OUR CATALOGUE IS FREE! WRITE OR PHONE NOW!

POWERTRAN ELECTRONICS

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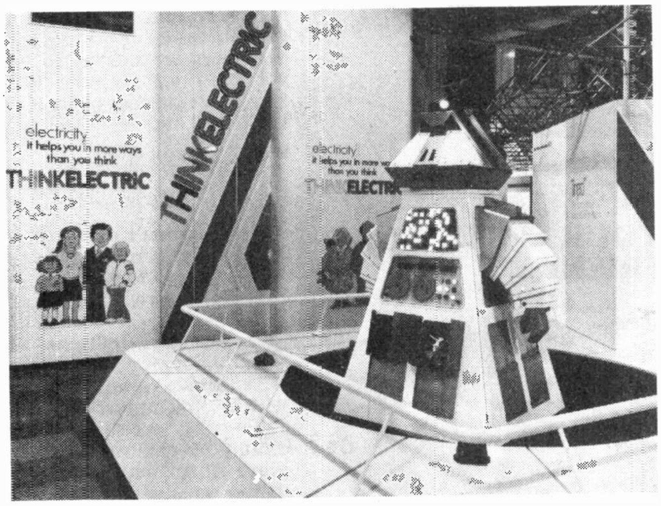
news digest

BYTE SIZED CHUNKS

Some new expansion kits for the three most popular MPU systems have been announced by Ithaca Audio Ltd. Each pack contains eight 16K Rams, packed in anti-static foam and are all 100% guaranteed. The kits are intended for the TRS 80, Apple 11, and Exidy Sorcerer. UK price and availablility are yet to be announced but for those who can't wait you could contact Ithaca Audio at:- Box 91, New York, 14850.

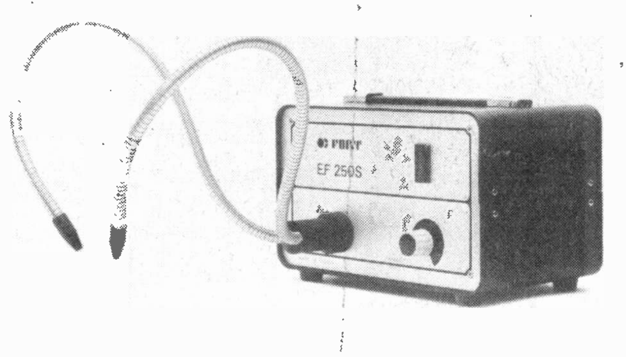


FRED'S BIG BILLS

Another Electricity Board first, 'Fred' is an electronic spokesman and will give advice on how to save energy by using more economical appliances. Using only 5KW, it is hoped to supply every home that has a 'white meter' with their own 'Fred.'

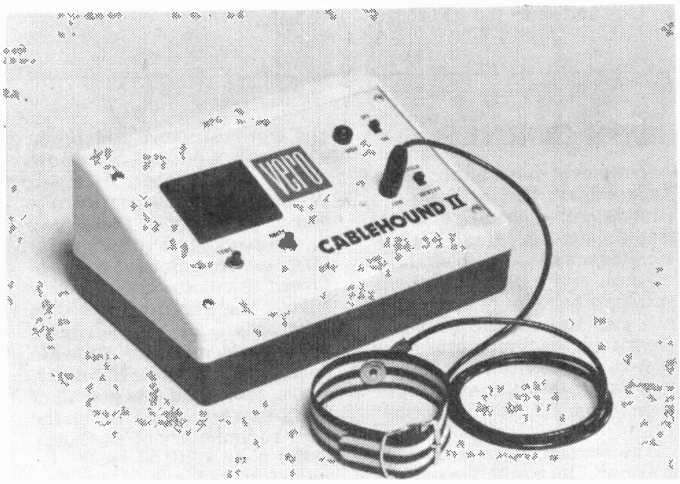
PUTTING OUT THE FEELERS

Pointing the way with their new 'cold' light-source boxes Optronic Fort Ltd are introducing a new design incorporating fibre-optic techniques. The Flexible or semi-rigid light guides can be obtained in a choice of thicknesses, and up to 1800 mm long. Because the light is 'cold' it would be ideal for illuminating areas sensitive to heat, particularly microscopic work. The light sources are available in a variety of ratings, from 50 to 250 Watts. The boxes will work on an AC supply of 110-240V (selectable) 50/60 Hz. The Tungsten-Halogen lamps are fully adjustable for brightness and are cooled by fan to prevent over-heating. Prices for the light sources start at around £145, call Optronic Fort Ltd at Cambridge Science Parl, Cambridge CB44BH for more information.



TROUBLE LOOMING? . . .

Anyone who has ever had to build up, or fault find a wiring loom will realise how useful the Vero Cablehound promises to be. It works by connecting one end of the loom to the unit and a wrist strap from the Cablehound to the operator. Particular wires can be identified simply by touching each wire in turn. Another feature is the inclusion of a digital readout to further identify individual wires. Two or more Cable-Hounds can be connected together to increase the loom identification size from 100 to 10 000 separate wires (or more if further units are added). Vero Systems Ltd will be only too pleased to supply any more details, contact them at 362 Spring Road, Sholing, Southampton, Hampshire.



.......news digest.......

LCD MULTIMETER

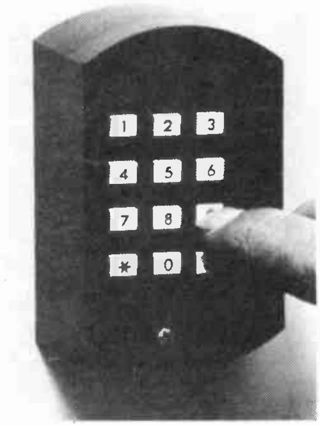
It's a fair bet that 1979 will see the digital multimeter make it's long awaited debut into the amateur market. It's true that one or two examples have appeared in the low price bracket, but have rarely been as good as an analogue meter of the same price. Data Precision hope to change all that with the introduction of their model 935. It features a 3½ digit LCD display with a claimed 0.1% basic accuracy. The unit has 29 ranges selectable by what the manufacturers call 'ergonomically designed' push-button switches. The device is fully protected over current and voltage and short duration high voltage transients. A standard 9V alkaline battery (PP9) should give over 200 hours of useful life, battery and over current fuses are accessible through a removable hatch, a replacement fuse is also located under the hatch.

Optional extras include high voltage, current and temperature probes, the case is claimed to be virtually unbreakable and it's small size puts it into the truely 'pocket size' class. Price is around the £99 plus VAT mark and includes leads, battery and instruction manual. If you're interested Franell International Instruments Ltd at Dandbeck Way, Wetherby, West Yorkshire, should be able to help.

GATES ON YOUR DOORS

Two interesting devices to grace your front door have been announced by Optimisation Ltd (45 South Street, Bishops Stortford, Herts). The first is the 'Door Guard', a calculator sized, fifteen digit keyboard. A caller is required to enter a three digit number whereupon a chime will sound. Should an incorrect number be pressed a piercing 96 dB siren will start, enough to deter even the most determined intruder. There are 2730 user pre-settable combinations, so the chances of a 'lucky guess' are almost negligable.

Another useful feature is the possibility of using the Door Guard for signalling departures, a good idea if there are children about. The device should be on sale by the time you read this, asking price — £14.95, installation should take only minutes and is powered by a 9V alkaline battery, with average use it will last for over one year.



COMP-U-LOCK

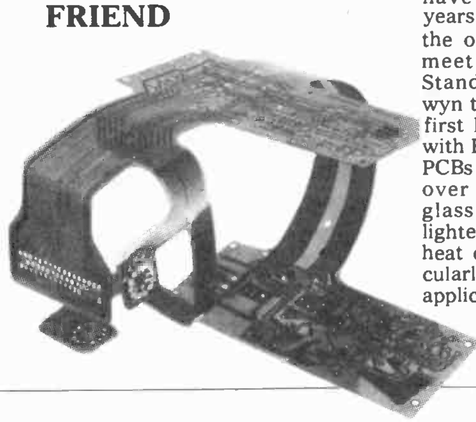
The second piece of equipment rejoices under the name of COMP-U-LOCK. As it's name suggests this is a digital door lock, requiring a four digit combination to be entered on a small waterproof key-pad strategically placed on your front door. Included in the kit is an electric door latch, a transformer for mains operation and a battery pack for back-up in the case of a power cut. We just hope that potential users do not forget their combinations, (numbers we hasten to add) because there are over 10 000 possible sequences to try if you are locked out.

BOOK CORNER

A couple of new books from Babani have just arrived, the first is called Practical Electronic Calculations and Formulae. Just crammed with all those obscure and elusive equations you'll probably only need once, but can never find (it's got plenty of the more mundane ones too). Definitely one for the workshop bookshelf. Order number is: BP 53 and it costs £2.25.

The second new publication is 'Your Electronic Calculator and your Money', the book, although well written (both books are written by F. A. Wilson) is just a trifle outdated, especially in these days of pre-packaged software for MPU systems. But for the confirmed calculator addict, particularly one who can't afford an MPU this book is a veritable mine of information. It shows in detail calculations for mortgages, profit and loss etc, all of which can be carried out on the most rudimentary of machines. Order code is BP 54 and it will retail for £1.35.

YOUR FLEXIBLE FRIEND



Flexible printed circuit boards have been around for some years now, so what's new? Well the one shown is the first to meet stringent new British Standard specifications. Welwyn the resistor people are the first British company to meet with BS 9765 approval. Flexible PCBs offer several advantages over conventional SRBP or glass fibre boards, they are lighter, smaller and allow better heat dissipation and are particularly suitable for wiring loom applications.

FREQUENCY COUNTING BREAKTHROUGHS

ADVANCING THE-STATE-OF-THE-ART IN FREQUENCY COUNTERS – INTRODUCING NEW LSI TECHNOLOGY COUNTERS AT AFFORDABLE PRICES.

MODEL OPTO 7000 7 Digits AC/DC/Portable MINIATURE 10 Hz to 600 MHz COUNTER ± 1 ppm TCXO ONLY £99.00 + £3 p&p + 8% VAT

The go anywhere portable counter that gives you more range, visibility, accuracy and versatility than any comparable unit at anywhere near its low, low price.

- De-luxe black and gold anodized aluminium case – combination handle/tilt-up bail
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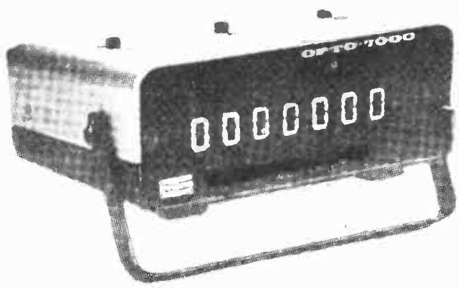
- No direct-connect required for RF pick-up
- Built-in amplifiers in both direct and pre-scale input circuits
- Signal inputs diode/overload protected
- DC power plug and chord included
- Built-in Ni-Cad rechargeable battery pack & charger (optional) £16.00 + VAT
- Rear panel switch (S4) for 1 Hz resolution (optional) £5.00 + VAT



Ex Stock Delivery Subject to availability

SPECIFICATIONS

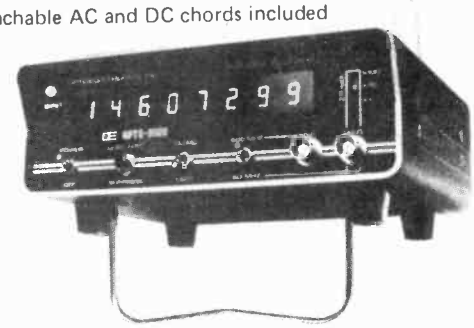
Frequency Range (Switch Selectable)	10 Hz to 60 MHz (65 MHz Typical) 10 MHz to 600 MHz Guaranteed (10 MHz to 700 MHz Typical)
Input Impedance:	1 megohm shunted by 20 pf (60 MHz input) 50 ohm (600 MHz input)
Input Protection:	1 megohm/60 MHz input - 100V up to 10 MHz 50V up to 60 MHz 50 ohm/600 MHz input - 2V max.
Gate Times (Switch Selectable)	100 millisecond (1/10 second) 1 second
Resolution:	*1 Hz (10 Hz to 6 MHz) with switch (S4) Option 10 Hz (10 Hz to 60 MHz) 100 Hz (10 MHz to 600 MHz)
Sensitivity:	<10 mV to 60 MHz 25 mV to 150 MHz 50 mV 450 MHz typ. (<75 mV Guaranteed)
Time Base:	Quartz Crystal, 5.24288 MHz, TCXO, first order linear compensation
Counter Accuracy:	±1 count, Temperature stability and aging
Temp. Stability:	.08PPM/C° (± 1 PPM 20° to 40°C, Typ.)
Aging:	<2 PPM/year
Display:	7, .4" Red LED Digits
Decimal Point:	Auto Placement
Connectors:	BNC type
Power Requirement:	1.5 Watts 7.5 - 15V AC/DC <250 ma
Batteries:	*4 - AA Ni-Cad, Constant Current Charger
Size:	1-3/4"H x 4-1/4"W x 5-1/4"D
Weight:	14 oz. (17 oz. with batteries & charger) *Optional - not included with basic unit*

Also available from retailers
AUDIO ELECTRONICS
301 Edgeware Road, London, W2
and
Z & I AERO SERVICES
85 Tottenham Ct. Road, London, W.1

MODEL OPTO 8000.1A Mains/DC/Portable 8 Digits 10 Hz to 600 MHz FREQ. COUNTER ±.1 ppm TCXO ONLY £240.00 £5 p&p + 8% VAT

The OPTO 8000 1A is a no compromise professional quality counter. Thanks to new CMOS LSI technology, size, power and cost have shrunk while performance improved. The OPTO 8000 1A combines this new technology with careful circuit design and unique packaging for a state-of-the-art counter that sets the pace.

- Selectable step attenuation X1, X10, X100
- 50 ohm and 1 Megohm inputs diode protected against overload
- Amplifier circuits for Super Sensitivity
- Front panel features "Lead Zero Blanking Control" and LED gate period indicator.
- Built-in Ni-Cad rechargeable battery pack & charger (optional) £16.00 + VAT
- Detachable AC and DC chords included



SPECIFICATIONS

Frequency Range:	10 Hz to 600 MHz in two over-lapping ranges. 1 Megohm input - 10 Hz to 60 MHz 50 Ohm input - 20 MHz to 600 MHz
Gate Times: (Switch Selectable)	100 milliseconds (1/10 second) 1 second
Resolution:	1 Hz to 60 MHz, 10 Hz to 600 MHz
Display:	8 LED digits with floating decimal point. Flashing LED gate period indicator
TIME BASE	
Frequency:	5.242880 MHz
Type:	TCXO (Temperature Compensated Crystal Oscillator) less than .1 ppm from 17° to 40° C less than 1.0 ppm from 0° to 60° C
Aging:	less than 1.0 ppm first year. (less than 1.0 ppm first three years typical) less than 0.5 ppm per year thereafter
Initial set accuracy:	less than 0.5 Hz at 25° C
External adjustment range:	± 10 ppm
Impedance:	1 Megohm shunted by 20pF, DC coupled (10 Hz to 60 MHz) 50 Ohm, AC coupled (20 MHz to 600 MHz)
Connectors:	BNC type
Typical Sensitivity:	2 - 10 MV RMS below 150 MHz 10 - 50 MV RMS below 600 MHz
Max Input Signal:	1 Meg input - 100V peak to peak up to 10 MHz 50V peak to peak up to 60 MHz 50 Ohm input - 2V peak to peak max.
Power:	220-250V AC nominal, 50 Hz, 2 Watts 8 to 16 VDC, 300 MA or internal batteries
Dimensions:	3-1/4" H x 7-1/4" W x 6-3/4" D
Weight:	Approximately 2.5 pounds

Delivery ex-stock, subject to availability – Otherwise allow up to 4 weeks

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38 Mount Pleasant, London WC1X 0AP.

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	Prices inc. p&p + VAT
☐ OPTO 7000	£110.16
☐ OPTO 7000 with built-in Ni-Cads + charger	£127.44
☐ OPTO 7000 with rear panel switch S4 for 1Hz resolution	£115.56
☐ OPTO 7000 with built-in Ni-Cads + charg. & switch S4 for 1Hz resolution	£132.84
☐ OPTO 8000.1A	£264.60
☐ OPTO 8000.1A with built-in Ni-Cad battery pack and charger	£281.88

I enclose Cheque/P.O. for £ ....

Name: ....

Address: (please print) ....

ET105

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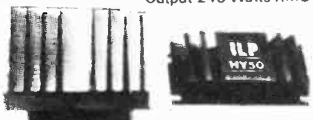

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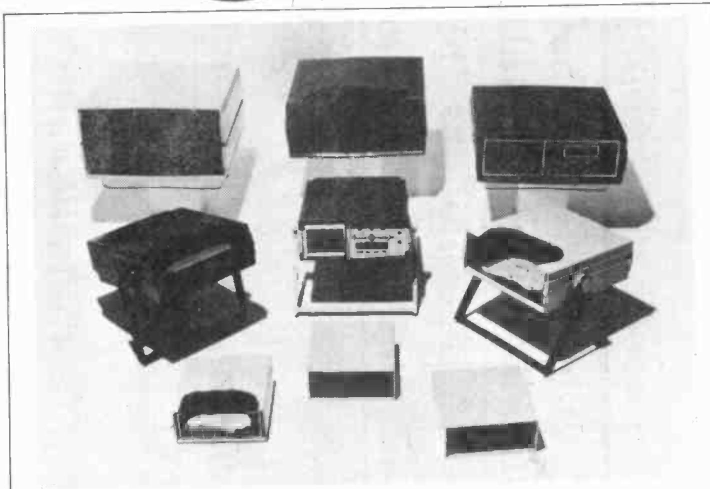
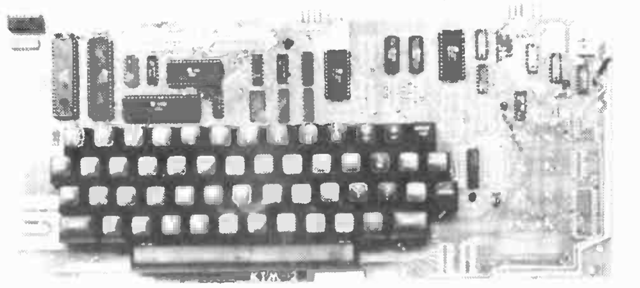


A CASE FOR TREATMENT

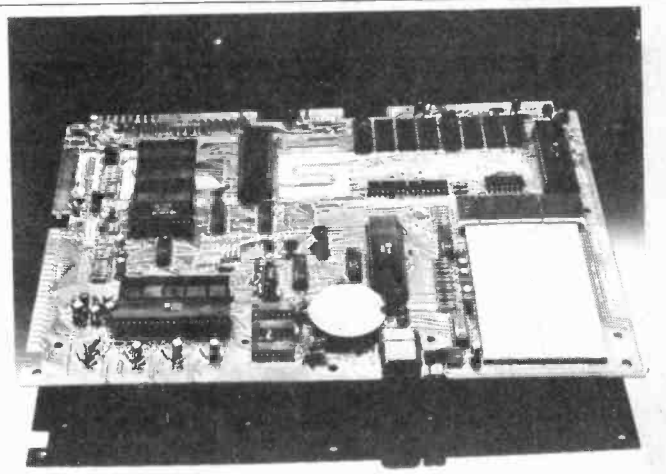
Some good looking new boxes from the OK Machine & Tool (UK) Ltd., there are over 25 sizes available with numerous variations to accommodate printers, terminals, clocks etc. Moulded from tough ABS plastic they are all dust and splash-proof. All the cases come in a choice of 3 colours, black, blue, or beige. The range is called 'Pac Tec' and is denoted the C series. OK will be delighted to help you. They live at 48a The Avenue, Southampton, Hants, SO1 2SY.

KEY BAUD?

A new Keyboard Terminal module has just come to our attention, it features all the currently favoured features and will interface with any RS232 computer (SYM-1 etc) up to 9600 Baud. The terminal boasts 128 graphic characters on a 40 character by 24 line format, each character having an 8x8 dot matrix. At £218 it's got to be the bargain of the month as the postage is free. Rostra Electronics can help with any queries — they can be found at: 275-281 aking Street, Hammersmith, London W6.

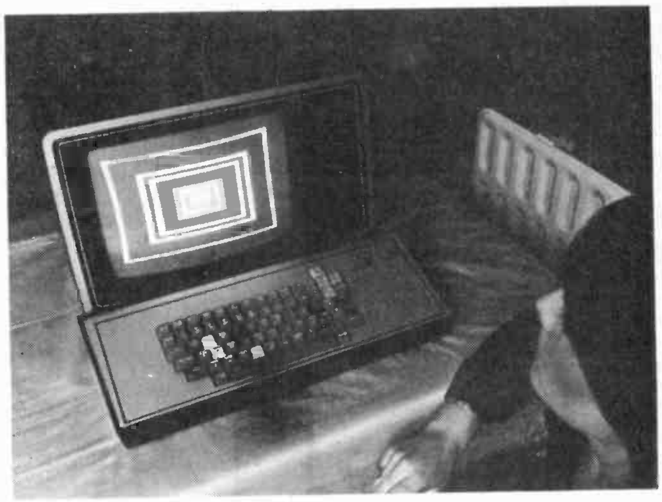


.... news digest........



SYM-1

AN ideal companion to the keyboard terminal (see key Baud) is the new SYM-1. MPU system. Intended clearly for the development market it should appeal to both engineers and hobbyists. The board is complete and ready to go, needing only the addition of a 5 V DC supply. The unit has 4K on-board software and 1k of static RAM. Full access is available to important busses and ports. The SYM uses the popular 6502 MPU already a firm favourite with TV games manufacturers, price is £175, post free. See Rastra Electronics for details.



UNCLE SAMS LATEST

Good to see the American built 'Compucolor II' is at last available in the UK. For £1,390 you get a very comprehensive system indeed. The integral VDU (8 colour) and Mini-Floppy Disk drive support the on-board 8K RAM which works in Basic. Abacus Computers Ltd will be importing the machines and examples can be seen at the Byte Shop and Trans Am of Chapel Street, London.

QUARTZ LCD 5 Function

Hours, mins., secs., month, date, auto calendar, back-light, quality metal bracelet.

£6.65

Guaranteed same day despatch.

Very slim, only 6mm thick.

M1

QUARTZ LCD 7 Function

Hours, mins., secs., month, date, auto calendar, back-light, seconds STOP WATCH.

£9.65

Guaranteed same day despatch.

Very slim, only 6mm thick.

M2

QUARTZ LCD 11 Function SLIM CHRONO

6 digit, 11 functions.
Hours, mins., secs., day, date, day of week.
1/100th, 1/10th, secs., 10X secs., mins.
Split and lap modes.
Back-light, auto calendar. Only 8mm thick.
Stainless steel bracelet and back.
Adjustable bracelet.

Metac Price

£12.65 Thousands sold!

Guaranteed same day despatch.

M3

QUARTZ LCD ALARM 6 Function

Hours, mins., secs., month, date, back-light, 24 hour ALARM.
Adjustable stainless steel bracelet.
Only 9mm thick.

£12.65

Guaranteed same day despatch.

M4

QUARTZ LCD ALARM 7 Function

Hours, mins., secs., day, date, alpha day, back-light, auto calendar.
Adjustable stainless steel bracelet.
Only 9mm thick.

£18.65

Guaranteed same day despatch.

M5

QUARTZ LCD Alarm Chronograph with Dual Time Zone Facility

Constant LCD display of hours and minutes, plus optional seconds or date display, plus day of the week and am/pm indication
Perpetual calendar, day, date, month and year.
24 hour alarm with on/off indication.
1/10 second chronograph measuring net, lap and first and second place times
Dual time zone facility night light.
Only 9mm thick

£24.65

M6

SOLAR QUARTZ LCD Chronograph with Alarm Time Zone Facility

Constant LCD display of hours and minutes, plus optional seconds or date display, plus day of the week and am/pm indication
Perpetual calendar, day, date, month and year
24 hour alarm with on/off indication
1/10 second chrono graph measuring net, lap and first and second place times
Dual time zone facility night light
Only 9mm thick

£27.65

M7

QUARTZ LCD Alarm Chrono

22 function, 6 digit.
Hours, mins., secs., date, day of week, stopwatch, split time, alarm, second watch (dual time), back-light.
FRONT BUTTON OPERATION.

£22.65

Guaranteed same day despatch.

METAC ★ PRICE

M8

SOLAR QUARTZ LCD Chronograph

6 digit, 11 function.
Hours, mins., secs. 1/100, 1/10 secs., mins.
Split and lap modules.
Auto calendar and back light.
Powered from solar panel with battery back-up.

£14.95

M9

SEIKO Alarm Chrono

LCD, hours, mins., secs., day of week, month, day and date, 24 hour Alarm, 12 hour chronograph, 1/10th secs., and lap time. Back light, stainless steel, HARDLEX glass.

List Price £130.00

METAC PRICE

£105.00

M10

SEIKO Chronograph

LCD, hours, mins., secs., day of week, month, day, date, 12 hour chronograph, 1/10th secs. and lap-time.
Back light, stainless steel water resistant, HARDLEX glass.

List Price £85.00

METAC PRICE

£68.00

M11

SOLAR QUARTZ LCD 5 Function

Genuine Solar

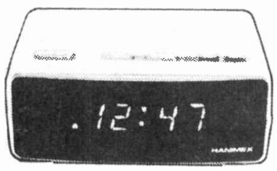
Solar panel with battery back-up.
Back light and auto calendar.
Hours, mins., secs., day, date.
Quality metal bracelet.

£ 9.95

Guaranteed same day despatch.

M12

HANIMEX Electronic LED Alarm Clock



Features and Specification:
Hour/minute display. Large LED display with p.m and alarm on indicator. 24 Hours alarm with on/off control. Display flashing for power loss indication. Repeatable 9-minute snooze. Display bright/dim modes control. Size 5.15" x 3.93" x 2.36" (131mm x 11mm x 60mm). Weight 1.43 lbs (0.65 kg).

£8.65 Thousands sold!

Guaranteed same day despatch.

M13

QUARTZ LCD Ladies Slim Bracelet

5 function.

Hours, mins., secs., day, date and back light and auto calendar.
Elegant metal bracelet in silver or gold.
State preference.

£15.95

Guaranteed same day despatch.

M14

QUARTZ LCD Ladies 5 Function

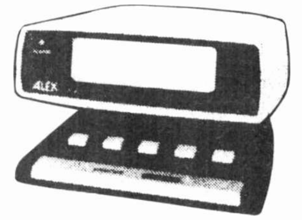
Only 25 x 20mm and 6mm thick.
5 function. Hours, mins., secs., day, date and back light and auto calendar.
Elegant metal bracelet in silver or gold.
State preference.

£9.95

Guaranteed same day despatch.

M15

DIGITAL LED CLOCK



Automatic brightness control. Weekend alarm cancel.

Features and Specification:
Hour/minute display. Large LED display with p.m and alarm on indicator. 24 Hours alarm with on off control. Display flashing for power loss indicator. Repeatable 9-minute snooze. Automatic brightness control. Weekend alarm cancel.

£10.95

Guaranteed same day despatch.

M16

HOW TO ORDER

Payment can be made by sending cheque, posta order, Barclay, Access or American Express card numbers. Write your name, address and the order details clearly, enclose 30p for post and packing or the amount stated. We do not wait to clear your cheque before sending the goods so this will not delay delivery. All products carry 1 year guaranteee and full money back 10 day reassurance. Battery fitting service is available at our shops. All prices include VAT.

Trade enquiries: Send for a complete list of trade prices — minimum order value £100.
Telephone Orders: Credit card customers can telephone orders direct to Daventry or Edgware Rd., 24 hour phone service at both shops: 01-723 4753 03272-76545.

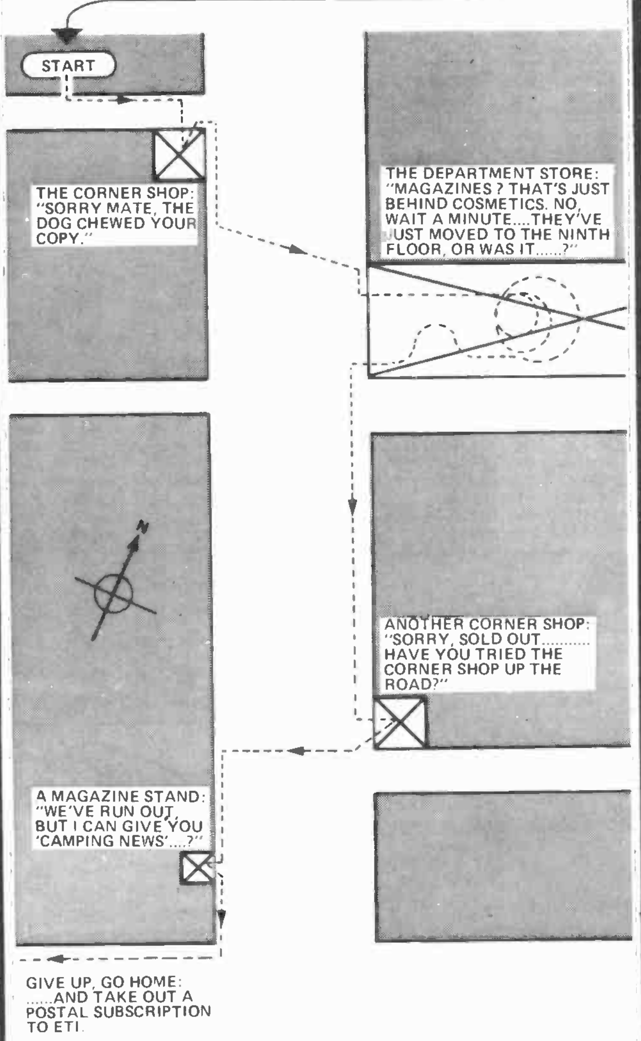
CALLERS WELCOME
Shops open 9.30 - 6.00.

Metac ELECTRONICS & TIME CENTRES

North & Midlands
67 High Street, DAVENTRY
Northamptonshire
Telephone: 03272 76545

South of England
327 Edgware Road
LONDON W.2
Telephone: (01) 723 4753

NON-SUBSCRIBERS START HERE



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

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

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

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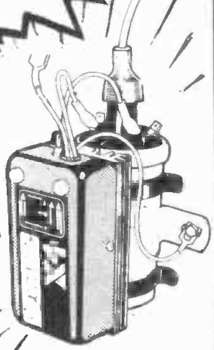
The latest kit innovation! from Sparkrite

Sparkrite- was featured by Shaw Taylor in "DRIVE IN"

the quickest fitting
CLIP ON
capacitive discharge electronic ignition in KIT FORM



- **Smoother running**
- **Instant all-weather starting**
- **Continual peak performance**
- **Longer coil/battery/plug life**
- **Improved acceleration/top speeds**
- **Optimum fuel consumption**

Sparkrite X4 is a high performance, high quality capacitive discharge, electronic ignition system in kit form. Tried, tested, proven, reliable and complete. It can be assembled in two or three hours and fitted in 1/3 mins.
Because of the superb design of the Sparkrite circuit it completely eliminates problems of the contact breaker. There is no misfire due to contact breaker bounce which is eliminated electronically by a pulse suppression circuit which prevents the unit firing if the points bounce open at high R.P.M. Contact breaker burn is eliminated by reducing the current to about 1/50th of the norm. It will perform equally well with new, old, or even badly pitted points and is not dependent upon the dwell time of the contact breakers for recharging the system. Sparkrite incorporates a short circuit protected inverter which eliminates the problems of SCR lock on and, therefore, eliminates the possibility of blowing the transistors or the SCR. (Most capacitive discharge ignitions are not completely foolproof in this respect). The circuit incorporates a voltage regulated output for greatly improved cold starting. The circuit includes built in static timing light, systems function light, and security changeover switch. All kits fit vehicles with coil/distributor ignition up to 8 cylinders.

THE KIT COMPRISES EVERYTHING NEEDED

Die pressed epoxy coated case. Ready drilled, aluminium extruded base and heat sink, coil mounting clips, and accessories. Top quality 5 year guaranteed transformer and components, cables, connectors, P.C.B., nuts, bolts and silicon grease. Full instructions to assemble kit neg. or pos. earth and fully illustrated installation instructions.

NOTE—Vehicles with current impulse tachometers (Smiths code on dial RV1) will require a tachometer pulse slave unit. Price £3.85 inc. VAT, post & packing.

Electronics Design Associates, Dept. ETI5
82 Bath Street, Walsall WS1 3DE. Phone: (9) 614791

Name ....

Address ....

Phone your order with Access or Barclaycard

*Including postage and packing UK only	QUANTITY REQ'D.
X4 KIT £16.65 inc. VAT	
TACHO PULSE SLAVE UNIT £3.85 Inc. VAT	

Send SAE if brochure only required.

I enclose cheque/PO's for

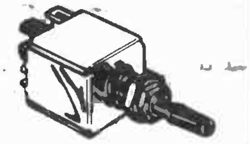
£ ____________

Cheque No.

Access or Barclaycard No. ____________

STEVENSON
Electronic Components

SWITCHES

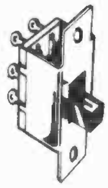


Subminiature toggle. Rated at 3A 250V.

SPDT 65p SPDT centre off 70p
DPDT 75p DPDT centre off 90p

Standard toggle.

SPST 34p DPDT 48p



Wavechange switches.
1P12W, 2P6W, 3P4W or 4P3W all 37p each.

Miniature switches (non-locking)
Push to make 15p Push to break 20p

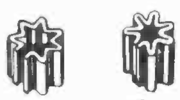
Slide Switches (DPDT)
Miniature 14p Standard 15p

REGULATORS

78L05	30p	7805	60p	79L05	70p	7912	80p
78L12	30p	7812	60p	79L12	70p	7915	80p
78L15	30p	7815	60p	7905	80p	LM723	35p

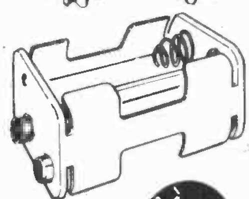
HARDWARE

HEATSINKS



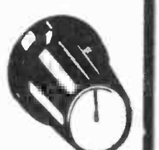
TO18 and TO5 push on type . 9p
TO220 . . . . 20p
TO3 . . . . 22p

BATTERY HOLDERS



To hold 4 HP7 batteries, square and long types 20p
PP3 clip 6p

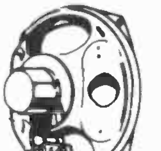
CONTROL KNOBS



Ideal for use on mixers etc. Push on type with black base and marked position line. Cap available in red, blue, green, grey, yellow and black . 14p

TERMINALS

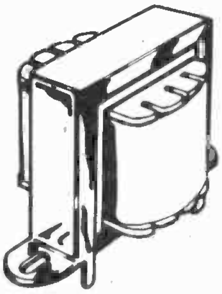
Rated at 10A. Accepts 4mm plug, black, blue, green, brown and red . . 27p



LOUDSPEAKERS

56mm dia. 8 ohms 70p
64mm dia. 8 ohms 75p
64mm dia. 64 ohms 75p
70mm dia. 8 ohms 100p
70mm dia. 80 ohms 110p

MINIATURE TRANSFORMERS



240 Volt Primary

Secondary rated at 100mA.
Available with secondaries of: 6 - 0 - 9, 9 - 0 - 9 and 12 - 0 - 12. 92p each

We now have an express telephone order service. We guarantee that all orders received before 5pm. are shipped first class on that day. Contact our Sales Office now! Tel: 01-464 2951/5770.

ORDERS DESPATCHED BY RETURN POST

Quantity discounts on any mix TTL, CMOS, 74LS & Linear circuits: 25+ 10%. 100+ 15%. Prices VAT inc. Please add 30p for carriage. Callers welcome. Official orders accepted.

BARCLAYCARD & ACCESS WELCOME.

Mail orders to: STEVENSON (Dept ET)

TRANSISTORS

				ZTX109	14p
				ZTX300	16p
				2N697	12p
				3N1302	38p
AC127	17p	BCY71	14p	2N2905	22p
AC128	16p	BCY72	14p	2N2907	22p
AC176	18p	BD131	35p	2N3053	18p
AD161	38p	BD132	35p	2N3055	50p
AD162	38p	BD135	38p	2N3442	135p
BC107	8p	BD139	35p	2N3702	8p
BC108	8p	BD140	35p	2N3704	8p
BC109	8p	BF244B	36p	2N3705	9p
BC147	7p	BFY50	15p	2N3706	9p
BC148	7p	BFY51	15p	2N3707	9p
BC149	8p	BFY52	15p	2N3708	8p
BC148	9p	MJ2955	98p	2N3819	22p
BC177	14p	MPSA06	20p	2N3904	8p
BC178	14p	MPSA56	20p	2N3905	8p
BC179	14p	TIP29C	60p	2N3906	8p
BC182	10p	TIP30C	70p	2N4058	12p
BC182L	10p	TIP31C	65p	2N5457	32p
BC184	10p	TIP32C	80p	2N5458	30p
BC184L	10p	ZTX107	14p	2N5459	32p
BC212	10p	ZTX108	14p	2N5777	50p
BC212L	10p				
BC214	10p	DIODES			
BC214L	10p	1N914	4p	1N4148	3p
BC477	19p	1N4001	4p	1N5401	13p
BC478	19p	1N4002	4p	1N5402	15p
BC479	19p	1N4004	5p	1N5404	16p
BC548	10p	1N4006	6p	1N5406	18p
BCY70	14p	BZY88 series 2V7 to 33V 8p ea.			

LINEAR

THIS IS ONLY A SELECTION!

		CA3140	70p	NE555	25p
		LM301AN	28p	NE556	60p
		LM318N	125p	NE565	120p
		LM324	50p	NE567	170p
		LM339	50p	SN76003	200p
709	25p	LM380	75p	SN76013	140p
741	22p	LM382	120p	SN76023	140p
747	50p	LM1830	150p	SN76033	200p
748	30p	LM3900	50p	SN76477	220p
CA3046	55p	LM3909	60p	TBA800	70p
CA3080	70p	MC1496	60p	TDA1022	650p
CA3130	90p	MC1458	35p	ZN414	75p

CAPACITORS

TANTALUM BEAD

each

0.1, 0.15, 0.22, 0.33, 0.47, 0.68, 1 & 2.2uF @ 35V 9p
4.7, 6.8, 10uF @ 25V 13p
22 @ 16V, 47 @ 6V, 100 @ 3V . . . 16p

MYLAR FILM

0.001, 0.01, 0.022, 0.033, 0.047 . . . . 3p
0.068, 0.1 . . . . 4p

POLYESTER

Mullard C280 series
0.01, 0.015, 0.022, 0.033, 0.047, 0.068, 0.1. 5p
0.15, 0.22 . . . . 7p
0.33, 0.47 . . . . 10p
0.68 . . . . 14p
1.0uF 17p

CERAMIC

Plate type 50V. Available in E12 series from 22pF to 1000pF and E6 series from 1500pF to 0.047uF . . . 2p

RADIAL LEAD ELECTROLYTIC

63V	0.47	1.0	2.2	4.7	10	5p
			22	33	47	7p
	100					13p
			220			20p
25V	10	22	33	47		5p
	100					8p
		220				10p
				470		15p
	1000					23p

CONNECTORS

JACK PLUGS AND SOCKETS

	screened	unscreened	socket
2.5mm	9p	13p	7p
3.5mm	9p	14p	8p
Standard	16p	30p	15p
Stereo	23p	36p	18p

DIN PLUGS AND SOCKETS

	plug	chassis socket	line socket
2pin	7p	7p	7p
3pin	11p	9p	14p
5pin 180°	11p	10p	14p
5pin 240°	13p	10p	16p

1mm PLUGS AND SOCKETS

Suitable for low voltage circuits, Red & black.
Plugs: 6p each Sockets: 7p each.

4mm PLUGS AND SOCKETS

Available in blue, black, green, brown, red, white and yellow. Plugs: 11p each Sockets: 12p each

PHONO PLUGS AND SOCKETS

Insulated plug in red or black 9p
Screened plug 13p
Single socket . 7p Double socket . 10p

74LS

		LS73	29p	LS156	80p
		LS74	29p	LS157	45p
		LS76	44p	LS164	90p
LS00	16p	LS76	35p	LS174	60p
LS01	16p	LS78	35p	LS175	60p
LS02	16p	LS83	60p	LS190	80p
LS03	16p	LS85	70p	LS192	70p
LS04	16p	LS86	33p	LS193	70p
LS08	16p	LS90	45p	LS196	80p
LS10	16p	LS93	45p	LS251	60p
LS13	30p	LS95	65p	LS257	55p
LS14	70p	LS123	56p	LS258	55p
LS20	16p	LS125	40p	LS266	40p
LS30	16p	LS126	40p	LS283	60p
LS32	24p	LS132	60p	LS290	55p
LS37	26p	LS136	36p	LS365	45p
LS40	22p	LS138	54p	LS366	45p
LS42	53p	LS139	50p	LS367	45p
LS47	70p	LS151	50p	LS368	45p
LS48	48p	LS153	50p	LS386	35p
LS54	16p	LS155	80p	LS670	180p

TTL

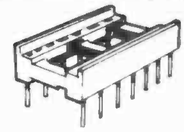
		7454	14p	74132	50p
		7473	25p	74141	56p
		7474	25p	74148	90p
		7475	32p	74150	70p
7400	12p	7476	28p	74151	50p
7401	12p	7485	70p	74156	52p
7402	12p	7489	145p	74157	52p
7404	12p	7490	32p	74164	70p
7408	14p	7492	35p	74165	70p
7410	12p	7493	34p	74170	125p
7413	25p	7494	52p	74174	68p
7414	48p	7495	52p	74177	58p
7420	12p	7496	50p	74190	72p
7427	24p	74121	25p	74191	72p
7430	12p	74122	33p	74192	64p
7442	43p	74123	40p	74193	64p
7447	55p	74125	35p	74196	55p
7448	58p	74126	35p	74197	55p

CMOS

		4018	65p	4050	28p
		4023	15p	4066	40p
		4024	45p	4068	20p
4001	15p	4026	95p	4069	16p
4002	15p	4027	35p	4071	16p
4007	15p	4028	52p	4075	16p
4011	15p	4029	60p	4093	48p
4013	35p	4040	68p	4510	70p
4015	60p	4042	54p	4511	70p
4016	35p	4046	100p	4518	70p
4017	55p	4049	28p	4520	65p

FULL DETAILS IN CATALOGUE!

SKTS

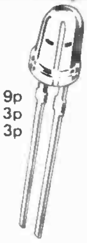


Low profile by Texas

8 pin	10p	16 pin	13p	28 pin	28p
14 pin	12p	24 pin	24p	40 pin	40p

Soldercon pins: 100:50p. 1000:370p

OPTO



LEDs	0.125in.	0.2in	
Red	TIL209	TIL220	9p
Green	TIL211	TIL221	13p
Yellow	TIL213	TIL223	13p
Clips	3p	3p	

DISPLAYS

DL704	0.3 in CC	130p
DL707	0.3 in CA	130p
FND500	0.5 in CC	100p

RESISTORS

Carbon film resistors. High stability, low noise 5%.
E12 series. 4.7 ohms to 10M. Any mix:

	each	100+	1000+
0.25W	1p	0.9p	0.8p
0.5W	1.5p	1.2p	1p

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SURFACE ACOUSTIC WAVES

Surface A[illegible]ustic Wave Filters (SAWFs) are a comparatively recent newcomer to the el[illegible] scene. They promise to revolutionise entire sections of colour TV [illegible]. Richard Maybury and Peter Haywood* take a look into the workings of

[illegible]RODYNE RECEIVER has been with us for [illegible] now (although opinions vary as to its [illegible]t time the basic concept has altered very [illegible]dvent of semiconductors came Varicap [illegible]ing with it the demise of the mechanical [illegible]t). As ICs began to appear another bulky [illegible]perhet shrank dramatically — the audio [illegible], however, seems to have resisted any [illegible]he good old IF, indeed many a radio [illegible]hirties and forties would still recognise a [illegible] stage, possibly even feel quite at home

[illegible] on the operation of the IF would not [illegible]his point, as most of you will realise the superhet works by mixing the incoming RF (from the aerial through a series of RF amplifiers) with an internally generated oscillator (the 'local' oscillator usually runs at a higher frequency to that of the incoming RF, around 465 or 470 kHz in the case of an AM receiver and 10.7 MHz for FM). The oscillator 'tracks' with the RF when the tuner dial is altered the local oscillators frequency will change accordingly. The result of mixing these two frequencies is to produce a product, sum and difference output. The IF stage will reject all but the difference output, hence it is really nothing more than a highly accurate 'notch' filter, tuned in the case of AM to 465 (or 470) kHz.

[illegible]conductors Ltd)

Early Days

Development work on SAWFs first began in the late 'sixties — the theory, however, was known as early as 1940. The SAWF is perhaps unusual in that it uses no silicon in it's construction, instead it relies on a substance called Lithium Niobate, which has very predictable piezo-electric properties. Simply explained that means it has the ability to convert electrical energy into mechanical energy and vice-versa. An electrical signal applied to the inter-leved Aluminium fingers (see Fig. 1.) of the input transducer sends an 'acoustic' wave across the surface of the filter and is converted back into electrical energy by a similar transducer at the other end of the device. Because the signal *is* acoustic it will travel slower than an equivalent electrical signal, so there is a significant delay between the input and output transducers.

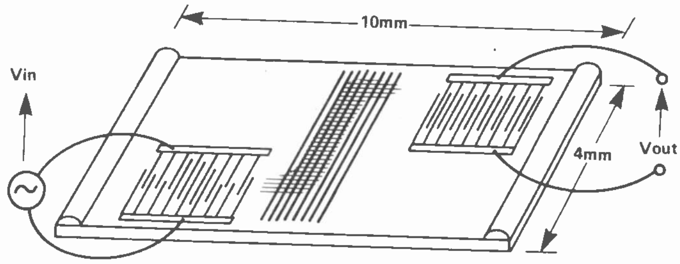


Fig. 1

Typical SAWF construction, the ridges at the two ends of the substrate act as acoustic absorbers for unwanted signals. The central electrodes serve to guide the acoustic wave from the input transducer to the output transducer.

A Notch In Time

Regarding the IF just as a filter can be somewhat misleading, because the accuracy and stability of an IF stage is of a very high order, and up to now could only have been achieved with a series of highly accurate LC networks. The main drawback apart from sheer physical bulk has always been the setting up needed for a conventional IF strip, often involving up to six or more separate tuning operations on sophisticated pieces of test equipment, (wobbulators or sweep-generators). With all these constraints it's not surprising that a search (mostly fruitless) has been going on for many years to find a suitable alternative; the most likely candidate looks like being the Surface Acoustic Wave Filter or SAWF for short.

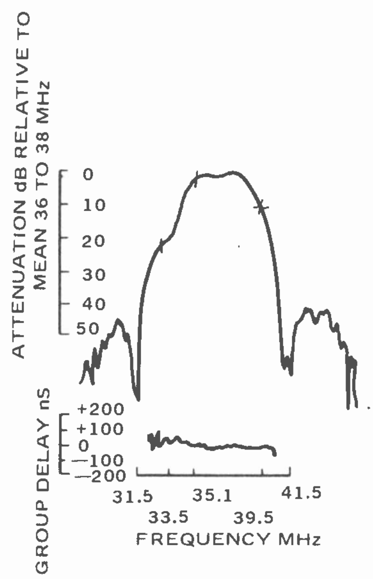


Fig. 2.

Typical response curve for a TV IF filter (Plessey), note the almost 'square' response, this kind of accuracy is nearly impossible to duplicate by conventional means.

Pioneering Plessey

Most of the early development work was carried out by Plessey Semiconductors Ltd at their Caswell plant about a decade ago, and in fact within three months of the research department being set up they had a working prototype. This early success led to the department being given a brief to produce a viable TV IF filter, demonstrating what had previously been possible only theoretically.

Early efforts to market SAWFs met with a slow response. This was not so much because of technical performance but because a comparison of costs showed little, if any, cost advantage of the SAWF version at that time over the conventional coil-type of IF most UK TV companies were committed to. Many TV manufacturers had invested a lot of money in coil-winding equipment and were naturally reluctant to scrap such expensive machinery.

The breakthrough came when Spain and Italy started colour TV transmissions. Because the IF is one of the most difficult areas of a TV set to design and build. (Colour TV demands a particularly high standard of IF design), the Spanish and Italian TV setmakers were saved from a difficult design problem by the use of SAWFs and sales of Plessey filters rocketed to around 70 000 a month. This naturally led to a rapid reduction in prices and gave Plessey confidence to invest further capital in setting up a high volume SAWF production plant capable of producing 10 million devices per annum.

Filtering Through

Technical refinement, and acceptance by the TV set-makers, enabled Plessey to penetrate some of the traditionally difficult markets. In the UK all but one of the TV manufacturers will be in full production with SAWFs by the end of 1979.

Although most of the initial arguments against the use of SAWF's were on economic grounds. The advantages found by users when in production are very wide ranging.

Perhaps the most commonly cited advantages are the consistently good performance, the simplicity from a production viewpoint due to the lack of adjustments and the small number of components on the IF board. Other advantages are the flexibility to change from UK standard sets to any other standard by changing the SAW filter and a few other components, and the improved reliability since the SAW filter is a robust passive component.

Construction

Basically a Surface Acoustic Wave Filter consists of Two transducers (see Fig 1) on a piezo-electric substrate. An electrical ⸱ applied to the input transducer causes an a⸱ ⸱vave (proportional to V in) to be propagated bi⸱ ⸱y along the surface of the substrate. The transducer ⸱enerates a wave symmetrically across it's surface producing an unwanted output to the left of it's body, this is absorbed by a raised wedge to prevent any spurious reflections crossing the 'chip'. The wave to the right of the transducer is re-directed by the central coupling grid to the output transducer where it is reconverted into an electrical signal (V out). The time taken for the wave to cross the device is typically 1.6 microseconds. The input transducer generates a further unwanted signal called a Bulk Wave this, not being a surface component passes under the central coupler and misses the output transducer.

Material

The substrate material commonly used for SAWF devices is Lithium Niobate (LiNbo3) which has a very high piezo-electric coupling factor, this results in filters with a low insertion loss. Being relatively cheap and having a low temperature co-efficient make it a practical choice, although much research is being carried out at the moment into alternative materials.

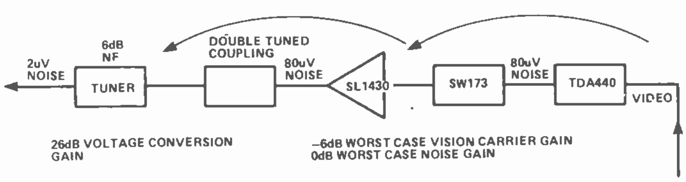


Fig. 3.

Block diagram showing diagram of SAWF within receiver design, noise levels are shown. The SL1430 is a purpose-designed SAWF pre-amplifier (Plessey) for use in TV IF filtering.

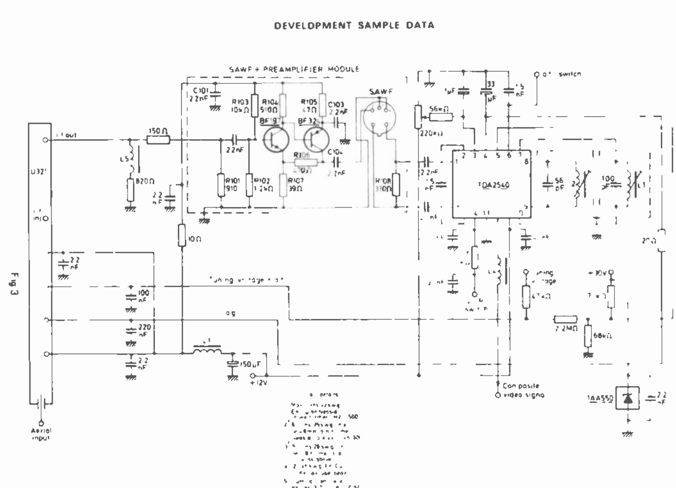
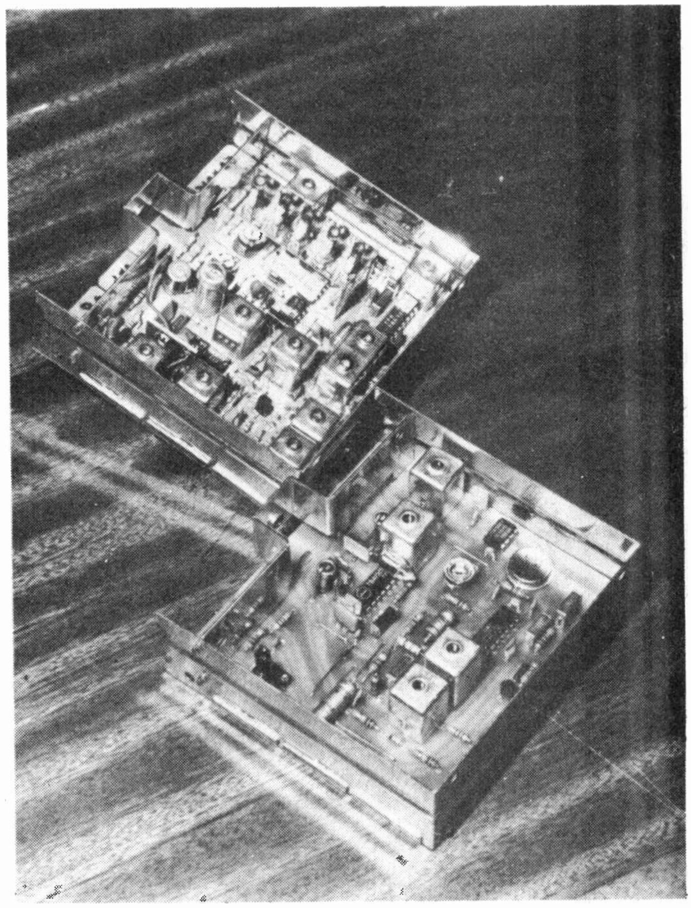


Fig. 4.

Complete Tuner/IF circuit using a Mullard SAWF, the component count is around a quarter that of a conventional IF (Diagram courtesy Mullard Ltd).



Pre-assembled Plessey IF/Tuner units. With the introduction of SAWFs these modules can be made substantially smaller than current IF and Tuner modules.

Transducers

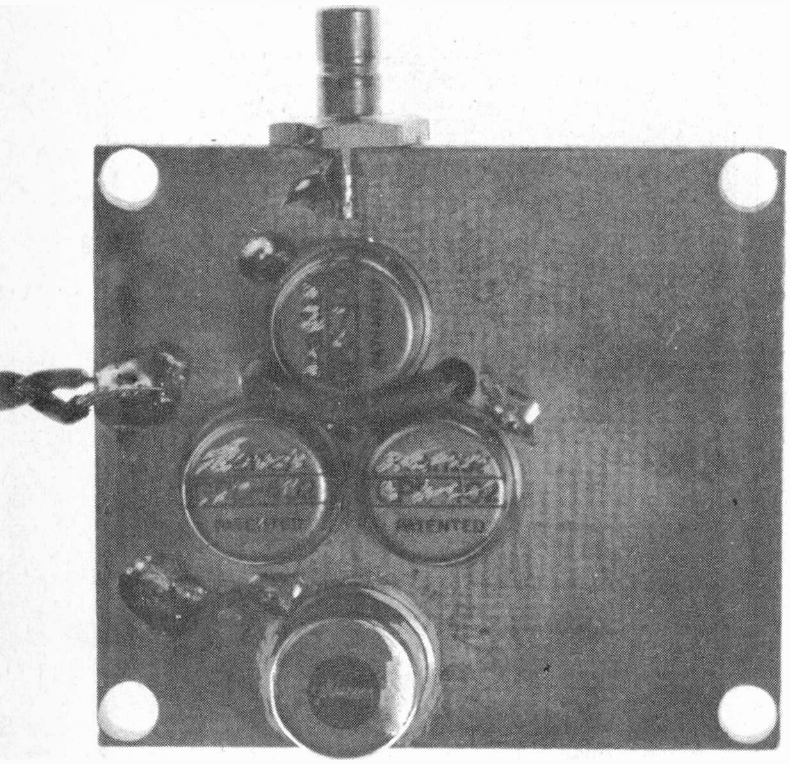
The Transducers consist of interdigital grids or fingers of electrodes formed from Aluminium. Each grid is around 200 Angstroms thick and 10 micro Meters wide.

Practical Considerations

In practice several other features are incorporated into SAWF design, the use of an acoustic absorber on the back face of the substrate is used to isolate the transducers from any mechanical interference (it also serves to mount the substrate on to the package or encapsulation). The edges of the substrate are 'cut' at an angle to steer any reflections away from the input and output transducers. Double thickness electrodes are also used to further reduce spurious reflections.

Bandwidth

The 'geometry' of the transducers dictates the effective frequency response (fo) and bandwidth of the device. By 'tailoring the shape and sizes of the electrodes a variety of



Simplified Plessey IF filter, it would be difficult to reduce component count further.

devices can be produced to suit different applications, or in the case of TV filtering, for different systems (ie PAL, — SECAM, NTSC etc). If the electrodes are evenly spaced with a gap of λo between electrodes of the same polarity the frequency response of the filter would be sin x/x where the centre frequency is given by:

$$f_o = \frac{\text{(velocity of wave propagation)}}{\lambda_o}$$

The bandwidth (Δf) is given by:

$$\Delta f / f_o = 2/N$$

Where N is the number of electrode pairs. Such a device would possess a linear phase response.

The central coupling grids consist of uniform strips of isolated electrodes, which effectively re-direct the surface wave to the output transducer.

The Future?

So far, SAW filters have been competing against conventional IF filters and are now recognised as being economic and technically advantageous. Already techniques are emerging from the development laboratory which will give even better response and cheaper filters. Parallel sound filters, which have separate outputs for sound and video signals are now in development. These will make possible TV sets with Hi-Fi quality sound. Professional SAW filters are now also being produced and these filters are very stable and can have response shapes which are almost impossible to produce any other way. For instance the CATV filter from Plessey in virtually square. It has an 8 MHz bandwidth which is flat ± 0.2dB and then falls off almost vertically to sidelobes which are lower than 55 dB down. The filters have also made new types of pulse compression/expansion radar possible.

Our thanks to Peter Haywood of Plessey Semiconductors Ltd for his help in preparing this article and to Mullard Ltd for additional information.

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Take a

SO WHAT, YOU MAY ASK, is the advantage of an electronic dice over its conventional and inexpensive plastic (solid state?) counterpart? The answer is that, apart from looking better (and being a better conversation piece), the electronic die or dice is very fast: it can be 'thrown'' and read in a fraction of a second, compared to the several seconds needed for the mechanical item. That enables the rate of play of a game to be speeded up, and consequently makes most games more fun to play. The electric die-dice is a particular boon to the war-games enthusiast.

Our dice has a few unusual features. It has only two panel-mounted controls. One of these is a two-way switch that lets you select either a single die or a double die (dice) display: the displays are naturally presented in the conventional die format. The other control is a push-button that gives the roll-and-throw action. When the button is pressed the die are rolled and the display is blanked out. The die are thrown and displayed on release of the pushbutton. Once thrown, the die are displayed for about seven seconds, and then black out automatically. When using the device, you can roll-and-throw as fast as you like: you don't have to wait for an autoblanking phase between actions. The unit consumes negligible current when in the standby mode, so no on-off switch is required.

The ETI die-dice is designed around readily-available CMOS IC's. It is the most economically die-dice circuit that we've seen so far. It uses only five IC's and eight discrete components, apart from the 14 LED's and 8 limiting resistors associated with the actual display.

Construction

Not much to say here. All the electronics, except the LEDs, are mounted on a single PCB, so construction should present no problems. On our prototype we

gamble: DOUBLE DIE

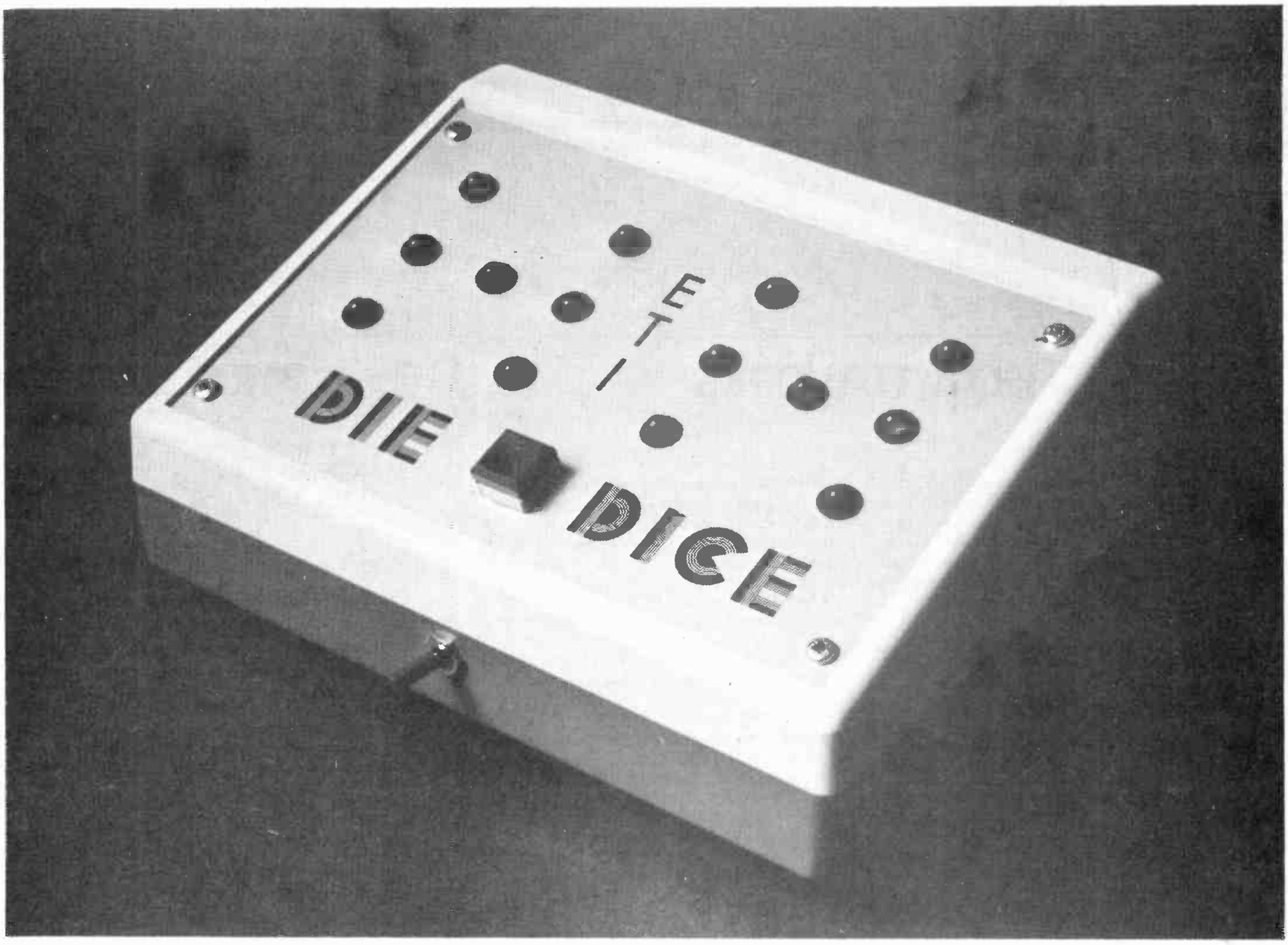
used red LEDs for the left-hand die display, and orange for the right. Not a good idea: the orange LEDs aren't contrasty enough, and are difficult to read. Our advice is use red LEDs for both displays.

Our prototype unit is housed in a sloping-front Verocase. The PCB is held in place by Sellotape sticky fixers. That's a good idea: it saves drilling holes in the case and the PCB. ▶

Double dice odds

COMBINATION	ODDS
any double number	1 in 6
a specified double	1 in 36
total of 2 or 12	1 in 36
total of 3 or 11	1 in 18
total of 4 or 10	1 in 12
total of 5 or 9	1 in 9
total of 6 or 8	1 in 7.2
seven	1 in 6
any two numbers	1 in 18

Fig. 1. The random element in Double Die is comparable to the mechanical version. The table on the right was compiled from extensive practical tests and as you can see it produces identical results to it's 'solid state' counterpart.



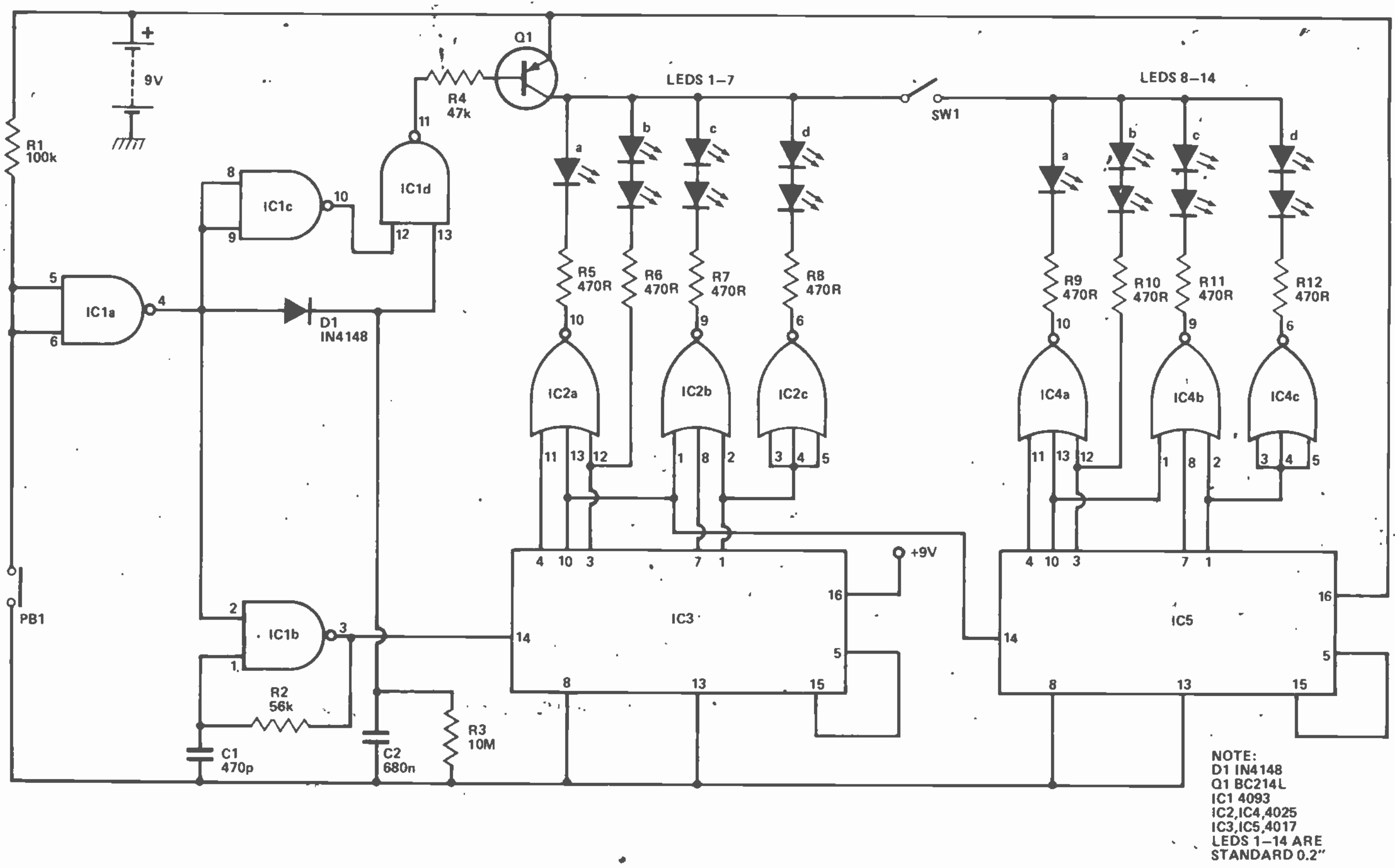


Fig. 2. The complete circuit diagram of Double Dice, as you can see the component count is significantly lower than any previously published design. ICs 3 and £ are 4017s arranged as divide by six, counter-dividers.

HOW IT WORKS

The circuit may be divided into three sections; the clock-control and two identical counter-decoder stages. IC1 handles the control fuction and generates the clock pulses to drive the 4017 counters IC3 and IC5. The output from these in then decoded to provide a conventional die display by IC2 and IC4.

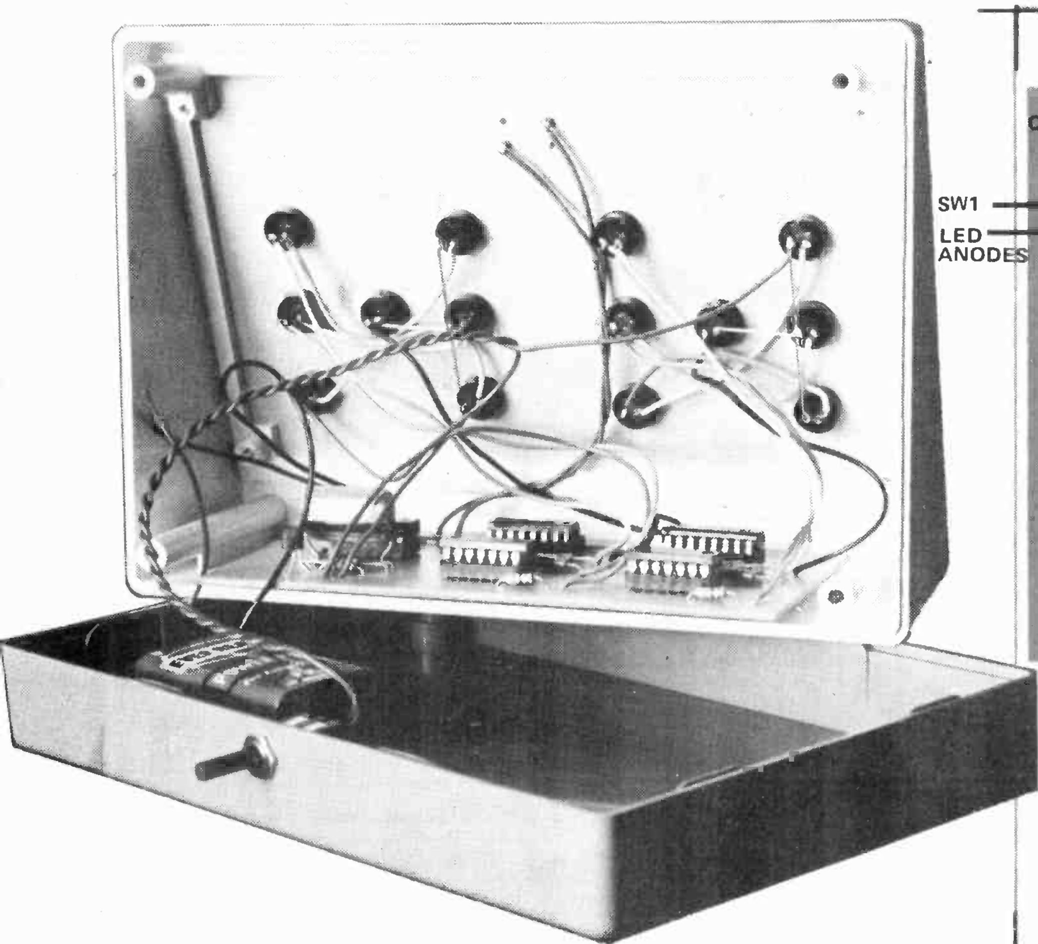
When PB1 is depressed the output of IC1a goes high. This signal, inverted by IC1c, disables IC1d as long as the switch is closed and Q1 remains off so no LEDs are lit. During this time, C2 is charged to about 9 volts through D1 and the clock oscillator IC1b is enabled.

Clock pulses are input to IC3, a 4017 configured as a divide by 6 counter-decoder. This is achieved by connecting decoded output '6' to the rest input. As the outputs are numbered from zero, output '6' goes high on the seventh clock cycle resetting the counter and providing six decoded outputs which go high sequentially. The rest pulse generated is too short to reliably clock the second counter IC5 so one of the decoded outputs from IC3 is used.

When PB1 opens, IC3 and IC5 which have been cycling continuously will stop at a random position as clock oscillator IC1b is disabled. The output of IC1 a will go low again and this signal inverted by IC1c enables one input IC1d. The other input of IC1d will be at a high level as C2 is still charged and so its output will go low turning on Q1 and the LEDs until the charge on C2 leaks away through R3 after about six seconds when the LEDs will extinguish. One or both displays will be illuminated depending on the position of SW1. If you wish to replace PB1 by a touch contact, R1 may be increased to 4M7.

PARTS LIST

RESISTORS (5% all ¼-watt)	
R1	100k
R2	56k
R3	10M
R4	47k
R5, 6, 7, 8, 9, 10, 11, 12,	470R
CAPACITORS	
C1	470p
C2	680n
SEMICONDUCTORS	
D1	IN4148
Q1	BC214L
IC1	4093
IC2, IC4	4025
IC3, IC5	4017
LEDs 1-7 red 8-14 yellow. standard 0.2"	
MISCELLANEOUS	
PB1 push-button SPST	
SW1 SPST	
P.C.B. Vero-case to suit.	



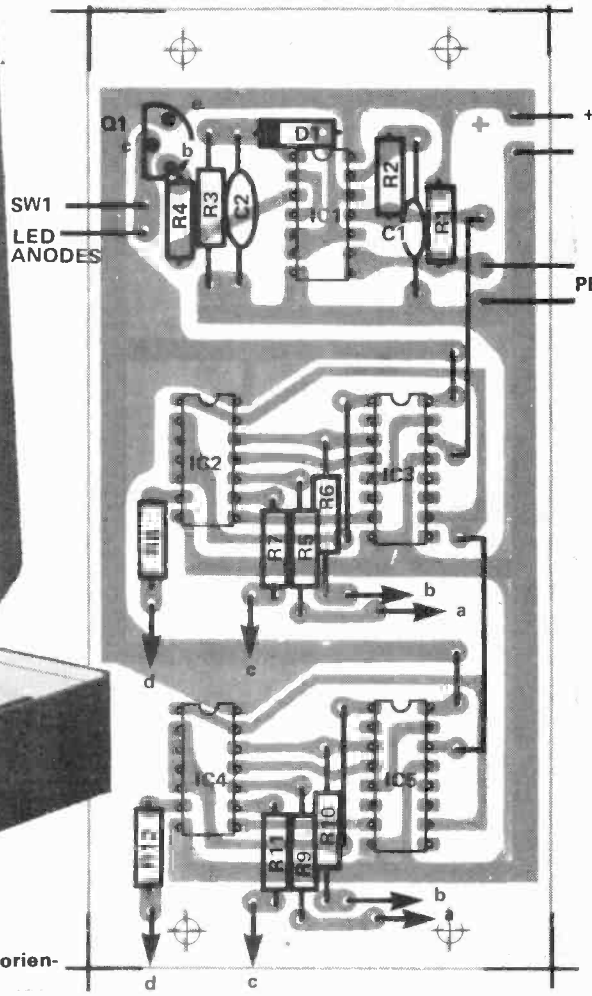
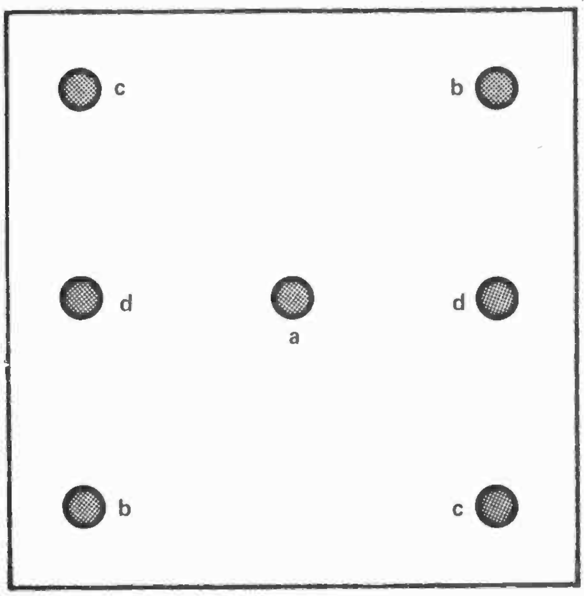


Fig. 3. Component overlay, note the orientation of the LCs.

Fig. 4. Layout for the LED display, two are required.



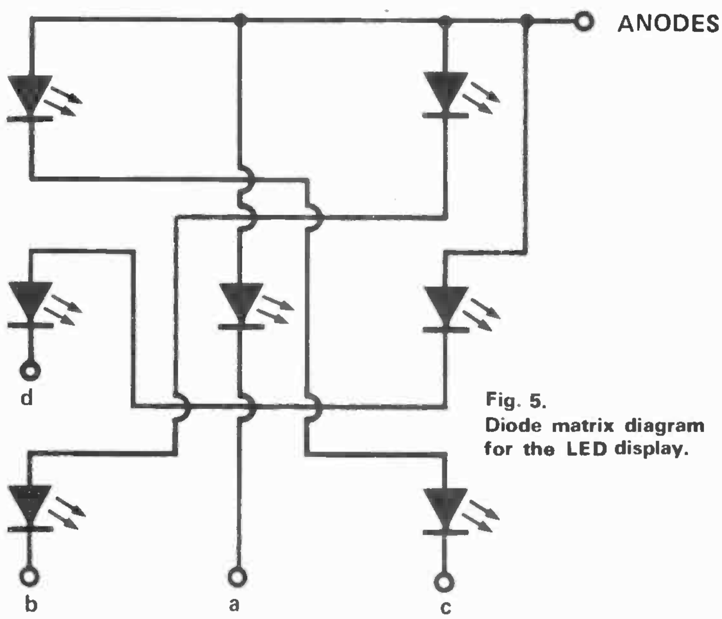


Fig. 5. Diode matrix diagram for the LED display.

BUYLINES

There should be no problem in obtaining any of the components used in this project. The !Cs are common types available from most electronics hobby shops.

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Radio and Tuner modules
We cannot really list all the details we would like to here - but with advent of the new mark 3 tuner system, the Dorchester and matching AF units, Ambit offers you the widest choice ever, plus hardware and styling that matches the very high standards we have set in this new range.

At last, DIY HiFi which looks as if it isn't.

That's not to say it doesn't look like HiFi - just that it doesn't look like the usual sort of thing you have come to associate with DIY HiFi. The Mk3 outstrips and outperforms all British made HiFi tuners, and most imported ones too. Certainly at the price, there isn't one near it. But more than that, it looks superb . A small pic here would be an insult, so send an SAE for details on the kit that looks as if isn't. It's something else.............

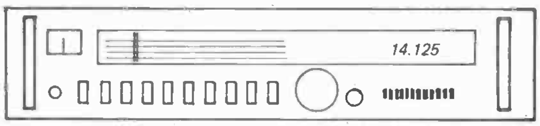
- ★ Exceptionally high performance - exceptionally straightforward assembly
- ★ Baseboard and plug-in construction. Future circuit developments will readily plug in, to keep the MkIII at the forefront of technical achievement
- ★ Various options and module line-ups possible to enable an installment approach to the system

and now previewing the matching 60W/channel VMOS amplifier:

- ★ Matching both the style and design concepts of the MkIII HiFi FM tuner
- ★ Hitachi VMOS power fets - characterized especially for HiFi applications
- ★ Power output readily multiplied by the addition of further MOSFETs
- ★ VU meters on the preamp - not simply dancing according to vol level
- ★ Backed with the usual Ambit expertise and technical capacity in audio

The PW Dorchester-LW,MW,SW,& FM stereo tuner

THE DIGITAL DORCHESTER ALL BAND TUNER



With styling and dimensions to fit in with the rest of AMBIT's new range of tuner & audio equipment.

When the new range of OKI digital frequency display ICs was announced, the original prototype of the Dorchester had been made - but since so many of you wanted to use the OKI frequency counterdisplay system with the Dorchester, we quickly designed a unit to incorporate the necessary facilities. The Digital Dorchester is designed in 19 inch form, and forms a perfect match for the other units in the range. If you don't want to go to the expense of the full Ambit DFM1 module, with AM/FM/Time/Timers, then the MA1023 clock module can be used instead -

The Dorchester has been described in PW Dec., Jan. and Feb. issues - but for those of you who may have missed it - it is an All Band broadcast tuner, covering LW/MW/SW and FM stereo in 6 switched ranges. Construction is very straightforward, with all the switching being PCB mounted - and the revolutionary TDA1090 IC used for AM/FM.

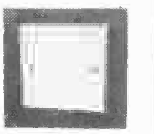
The electronics for the radio section of the Dorchester remain unchanged at £33.00, with 12.5% VAT. The hardware package, of case, meter, PSU now costs £33.00 + 8% with the MA1023 available for an extra £5 only.
For the fully digital version, with Ambit DFM1, the price is £56.50 + 8% VAT.

TERMS etc: CWO please, VAT on Ambit Items is generally 12½%, except where marked (*). Catalogue part 1:45p, part 2 50p all inclusive. Postage 25p per order, carriage on tuner kits £3. Phone Brentwood (0277) 216029/227050 9am-7pm. Callers welcome inc. Saturdays .

2 Gresham Road, Brentwood, Essex.

300w LIGHTING CONTROL KITS

TD300K Touch Dimmer.
Dimming and on/off functions are controlled by touch. Features include:



- ★ No mains rewiring
- ★ Switches on to preset brightness
- ★ Can be switched and dimmed from many locations using TDE/K kit making 2-way switching easy.

★★PRICE TD300K **£8.99**
TDE/K **£1.50**

Special Offer 10% discount on any 4 lighting control kits.

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TS300K TOUCHSWITCH. Two touchplates ON/OFF. **£4.30.**
TSA300K AUTOMATIC. One touchplate. Preset time delay off. **£4.30.**
LD300K LIGHTDIMMER. **£3.00.**

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TO220 Plastic Case 400v

3A	**49p**
6.5A with trigger	**80p**
8A	**62p**
12A	**70p**
16A	**90p**
20A	**165p**
25A	**190p**
SCR (C106D) 5A/400V	**38p**
Diac	**18p**

COMPONENTS

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Red **12p**	(10 for **£1.00**)
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DL 727 .5" display **£1.50**	(2 for **£2.80**)
LCD .5" display 3½ digit	**£8.10**
LDR .5" dia.	**50p**
555 **24p**	(4 for **90p**)
741 **22p**	(5 for **90p**)
LM3911 Temperature IC	**£1.00**
AY-5-1224	**£2.60**
AY-5-123D	**£4.50**
ZN1034E	**£1.80**
ICL 7106 DVM IC	**£7.50**
IN4001	**6p★**
IN 4148	**4p★**
BC182L	**10p★**
2N3819	**20p**

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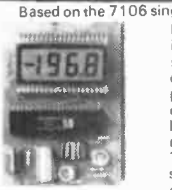
Based on the 7106 single IC 3½ digit DVM the kit contains a PCB, resistors, capacitors, presets, IC and 0.5" liquid crystal display. Components are also included to enable the basic DVM kit to be modified to a Digital Thermometer using a single transistor as the sensor. ONLY **£21.99**



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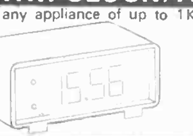

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FULL INSTRUCTION & OPERATING MANUAL

SPECIFICATIONS

ELECTRICAL DATA
VERTICAL AXIS (Y)
Deflection Sensitivity — 100mV/division
Bandwidth (between 3dB points) — DC — 5MHz
Input Attenuator—(calibrated)—9 step:0.1, 0.2, 0.5 1, 2, 5, 10, 20, 50V/div
Input Impedance—1 Meg/40pf in shunt
Input Voltage-Max — 600V P-P

HORIZONTAL AXIS (X)
Deflection Sensitivity — 0-400mV/division
Bandwidth (between 3dB points) — 1 Hz—350KHz
Gain Control—Continuous: when time base is EXT position
Input Impedance 1Meg
Input Voltage-Max — 600V P-P

TIME BASE
Sweep Range (calibrated)—100msec/div to 1 sec/div in 5 steps.
Fine Control — Variable between steps — includes time-base calibration position
Blanking — Internal — on all ranges

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Selection — Internal, external
Synchronisation Level — Continuous from positive to negative.

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4002	17p	4063	109p	4528	102p
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4007	18p	4067	400p	4530	90p
4008	80p	4068	25p	4531	141p
4009	58p	4069	20p	4532	125p
4010	58p	4070	20p	4534	614p
4011	17p	4071	20p	4536	380p
4012	17p	4072	20p	4538	150p
4013	55p	4073	20p	4539	110p
4016	52p	4075	20p	4541	141p
4017	80p	4076	90p	4543	174p
4018	80p	4077	20p	4549	399p
4019	60p	4078	20p	4553	440p
4020	93p	4081	20p	4554	153p
4021	82p	4082	20p	4556	77p
4022	90p	4085	82p	4557	386p
4023	17p	4086	82p	4558	117p
4024	76p	4089	150p	4559	388p
4025	17p	4093	50p	4560	218p
4026	180p	4094	190p	4561	65p
4027	55p	4096	105p	4562	530p
4028	72p	4097	372p	4566	159p
4029	100p	4098	110p	4568	281p
4030	58p	4099	122p	4569	303p
4031	250p	4160	90p	4572	25p
4032	100p	4161	90p	4580	600p
4033	145p	4162	90p	4581	319p
4034	200p	4163	90p	4582	164p
4035	120p	4174	104p	4583	84p
4036	250p	4175	95p	4584	63p
4037	100p	4194	95p	4585	100p
4038	105p	4501	23p		
4039	250p	4502	91p		
4040	83p	4503	69p		
4041	90p	4506	51p		
4042	85p	4507	55p		
4043	85p	4508	248p		
4044	80p	4510	99p		
4045	150p	4511	149p		
4046	130p	4512	98p		
4047	99p	4513	206p		
4048	60p	4514	260p		
4049	55p	4515	300p		
4050	55p	4516	125p		
4051	65p	4517	382p		
4052	65p	4518	103p		
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6800P	6.50	8216	1.95	2114	£10
6820P	£6	8224	3.50	2708	£10 55
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6810P	£4	8251	6.25	MEK6800	£220
6852	3.65	8255	5.40	TK80	£306
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8212	2.30	2112	£3 40	Harris etc OA	
		2513	£7.54		
		4027	£5 78		

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CA3140T	72p	709HC to5	64p
CA3160E	90p	709PC dil	36p
CA3160T	99p	710HC to5	65p
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	'N'	'LSN'		'N'	'LSN'		'N'	'LSN'		'N'	'LSN'		LSN
7400	13	20	7455	35	24	74126	57	44	74185	134		74377	124
7401	13	20	7460	17		74128	74		74188	275		74378	93
7402	14	20	7463			74132	73	78	74190	115	92	74379	130
7403	14	20	7470	28		74133		29	74191			74386	37
7404	14	24	7472	28		74136		40	74192	105	180	74390	140
7405	18	26	7473	32		74138		60	74193	105	180	74395	139
7406	38		7474	27	38	74139		60	74194	105	187	74396	133
7407	38		7475	38	40	74141	56		74195	95	137	74398	180
7408	17	24	7476	37		74142	265		74196	99	110	74399	150
7409	17	24	7478			74143	312		74197	85	110	74445	92
7410	15	24	7480	48		74144	312		74198	150		74447	90
7411	20	24	7481	86		74145	65		74199	160		74490	140
7412	17	24	7482	69		74147	175		74248		90	74668	110
7413	30	52	7483A			74148	109		74249		93	74670	249
7414	51	130	7484	97		74150	99		74251		90		
7415		24	7485	104	99	74151	64	84	74253		105		
7416	30		7486		40	74153	64	54	74257		108		
7417	30		7489	205		74154	96		74258		153		
7420	16	24	7490	33	90	74155	54	110	74259		420		
7421	29	24	7491	76	110	74156	80	110	74260		153		
7422	24	24	7492	38	78	74157	67	55	74261		353		
7423	27		7493	32	99	74158		60	74266		40		
7425	27		7494	78		74159	210		74273		124		
7426	36	27	7495A	65	99	74160	82	130	74275		312		
7427	27	29	7496	58	120	74161	92	78	74279		52		
7428	35	32	7497	185		74162	92	130	74283		120		
7430	17	24	74100	119		74163	92	78	74290		90		
7432	25	24	74104	63		74164	104		74293		95		
7433	40	32	74105	62		74165	105		74295		120		
7437	40	24	74107	32	38	74166			74298		100		
7438	33	24	74109	63	38	74167	20		74324		157		
7440	17	24	74110	54		74168			74325		242		
7441	74		74111	68		74169		200	74326		247		
7442	70	99	74112	88		74170	230	200	74327		237		
7443	115		74113		38	74172	625		74352		100		
7444	112		74114		38	74173	170		74353		100		
7445	94		74116	198		74174	87	120	74362		715		
7446	94		74118	83		74175	87	110	74365		49		
7447	82		74119	119		74176	75		74366		49		
7448	56	99	74120	115		74177	78		74367		43		
7449		99	74121	25		74180	85		74368		49		
7450	17		74122	46		74181	165	350	74373		77		
7451	17	24	74123	48		74182	160		74374		77		
7453	17		74124			74183		210	74375		60		
7454	17	24	74125	38	44	74184	135						

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8 DIGIT LIQUID CRYSTAL DISPLAY. This calculator style L.C.D. has 0.33" high digits with R.H. decimal points and overflow indicator. White digits on clear glass. With data **£2.95.** Catalogue Number 302.

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HOW IT WORKS
AM & FM RADIO

Gordon King manages to dispell a few rumours about a very widely misunderstood subject, Radio. Such diverse subjects as Varicap Tuning and Stereo FM are clearly explained.

OF THE TWO sound broadcasting systems the AM (amplitude modulation) system is capable of far greater range of reception than the FM (frequency modulation) system. This has nothing to do with the type of the modulation but is related to the carrier frequencies involved. FM sound radio uses a part of the VHF (very high frequency) spectrum called Band II and covering approximately 88 to 108 MHz, though all of this is not yet, used in the UK specifically for entertainment radio.

AM radio broadcasting occupies the long, medium and short wavebands which range respectively from about 50 kHz (6,000 metres) to 600 kHz (500 metres), 600 kHz to 1.5 MHz (200 metres), and 1.5 MHz to 300 MHz (1 metre). Conversion from frequency to wavelength merely involves dividing the propagation velocity (virtually 300 metres per microsecond) by the frequency, or from wavelength to frequency by dividing the velocity by the wavelength.

With increasing carrier frequency the waves tend more closely to follow the laws of light, and at VHF they emanate from the top of the transmitting aerial in rather the same way as light is radiated from the top of a lighthouse. They are less affected by obstructions, though, and are more prone to diffraction and refraction than light which to some extent allows them to pass round obstacles and penetrate walls, etc, but this accommodation is diminished at even higher frequencies. The reception distance of VHF waves, therefore, is limited to a little in advance of the 'line of sight' distance between the transmitting and receiving aerials, the extra being provided by atmospheric refraction and diffraction round the curved Earth.

On Reflection

However, VHF waves are less reflected back to Earth by the ionosphere, and most wave energy skyward-bound penetrates the ionosphere and vanishes into space — which is just as well for space communications! At the lower AM broadcast frequencies the ionosphere acts more like a 'mirror' to the signals, which not only prevents them getting into space but it also reflects them back to Earth over ranges far in advance of the 'line of sight' distance. World-wide reception is thus possible by the waves undergoing a number of 'hops' between ionosphere and Earth.

At certain frequencies ionospheric reflection is enhanced as night falls which means that signals well outside the basic reception range appear and are likely to cause interference with the signals from wanted local stations. To some extent this is avoided by an international agreement of wavelength spacing; but because there are so many medium-frequency stations to take account of the spacings cannot be very wide, so to reduce the effect of interference the bandwidth of AM receivers is restricted, as this attenuates or deletes the higher-order sidebands the quality of the reception is impaired. This is not necessary at FM because the stations can be adequately separated in Band II without the fear of distant stations producing signals which could interfere with those of the wanted signals. Moreover, FM has a far better immunity than AM so far as this sort of interference is concerned.

The FM system, therefore, is capable of far better audio quality than the AM system as it is currently exploited. It also carries an additional channel of information for stereo reproduction and is thus a 'hi-fi' broadcasting system as will be explained.

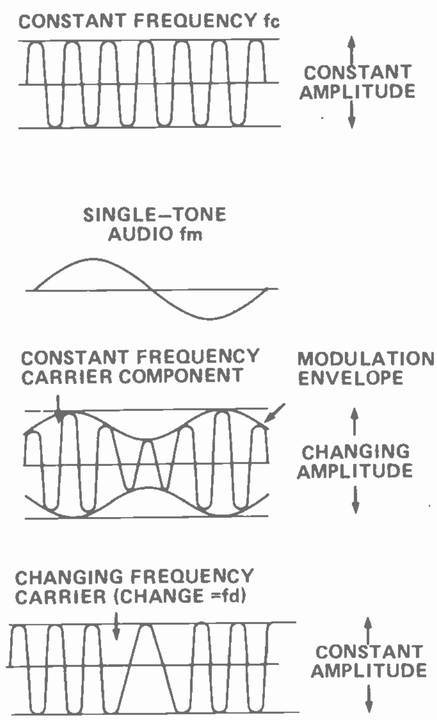


Fig. 1. Impressions of modulation (not to scale). (a) carrier wave, (b) single-tone modulation signal, (c) AM waveform, and (d) FM waveform.

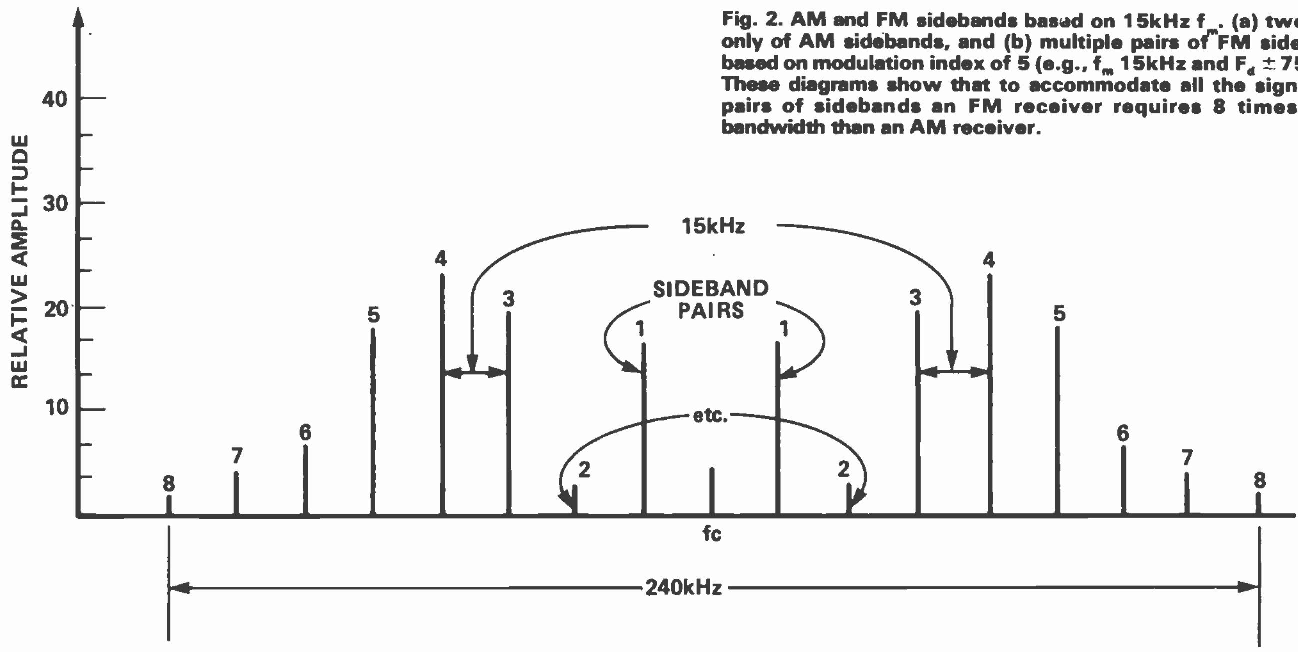


Fig. 2. AM and FM sidebands based on 15kHz f_m. (a) two pairs only of AM sidebands, and (b) multiple pairs of FM sidebands based on modulation index of 5 (e.g., f_m 15kHz and F_d ±75kHz). These diagrams show that to accommodate all the significant pairs of sidebands an FM receiver requires 8 times more bandwidth than an AM receiver.

Sidebands

Audio information at AM is carried by the carrier wave being caused to change in *amplitude* in sympathy with the sound. The stronger the sound, the greater the amplitude change; and the higher the audio frequency the faster the rate of amplitude change.

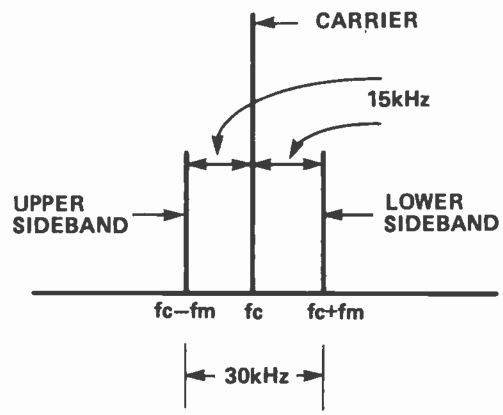
At FM it is the *frequency* of the carrier that is altered in sympathy with the sound. The stronger the sound, the greater the frequency change; and the higher the audio frequency the faster the rate of frequency change.

It is always instructive to look at a carrier wave modulated by a single-tone audio signal, as in Fig. 1, where at (a) we have the carrier, at (b) the modulation tone, at (c) the resulting AM signal and at (d) the resulting FM signal (not drawn to scale, of course!).

100% AM occurs when the carrier amplitude dissolves to zero at the troughs of the modulation envelope. If the modulation level is increased beyond this point very severe distortion sets in owing to the carrier holding at zero for a period of time. With FM sound broadcasting 100% modulation is said to occur when the change in carrier frequency is ±75 kHz on audio signal peaks. This is called the deviation frequency (f_d). It is noteworthy that with 625-line TV sound, which is also FM, f_d is ±50 kHz for 100% modulation. With stereo the total f_d includes both the mono and stereo information, the latter occupying approximately 10% of f_d, so that approximately ±67.5 kHz is available for the mono part.

Modulation

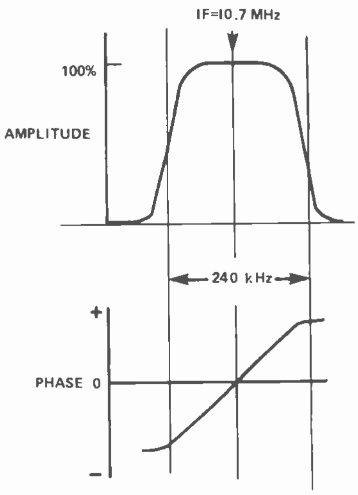
When a carrier wave (f_c) is modulated sideband signals corresponding to every component frequency of the modulation signal (f_m) result. With AM and a pure single-tone f_m upper and lower sidebands at f_c—f_m and f_c+f_m occur, as shown at (a) in Fig. 2. With FM the resulting sideband structure per pure single-tone of f_m is far more complicated, as shown at (b). At 100% AM each of the sidebands is 50% greater in amplitude than that of the



unmodulated carrier; but with FM f_d as well as f_m determine both the amplitude and number of the sidebands. Ratio f_d/f_m is the *modulation index* which has a value of five at full deviation by the top audio frequency (15 kHz).

Fig. 2 (b) shows that FM yields a sideband structure which spreads out either side of the carrier over a far greater spectrum than AM, and for the least distortion all sideband pairs above 1% amplitude must be accommodated by the receiver. The multiple sidebands result from the change from sinusoidal form of the carrier as its frequency is changed by f_m, and Bessel functions are used to determine the sideband amplitudes and frequencies for any modulation index. It is not proposed to become involved in the deep mathematics of this, but it can be so proved that for top quality mono the bandwidth requirement is about 240 kHz, and a little greater than this for the best stereo.

Assuming a top modulation frequency of 15 kHz at AM, the total bandwidth requirement is a mere 30 kHz, some 8 times less than for FM. Sadly, 30 kHz spacing between stations just cannot be accommodated in the highly congested medium-frequency scene, and to avoid



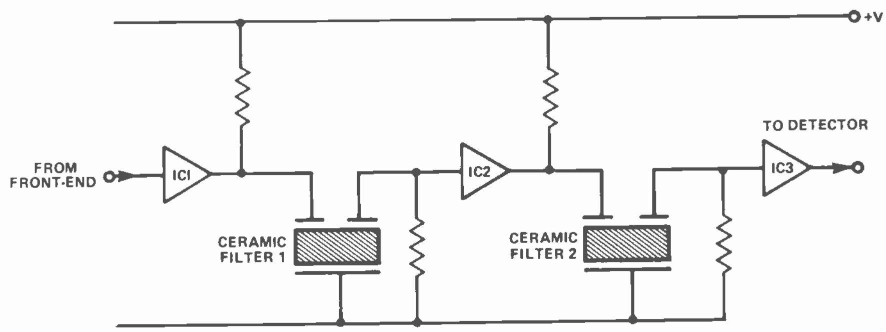


Fig. 3. Requirements of FM IF channel. (a) idealised amplitude response over 240kHz passband having sharply falling side skirts, (b) phase linearity within the passband, and (c) the type of circuit from which these requirements are closely approximated.

adjacent station interference the receiver bandwidth needs to be curtailed to 7 or 8 kHz at best with a consequent attenuation of the upper audio frequencies.

The Capture Effect

With FM channel spacing is 200 kHz (there is much more elbow room at VHF), and local station groups use far greater spacings between transmitters (2.2 MHz) so there is very little danger of interference. Moreover, FM exhibits what is called the *capture effect* which itself avoids interference provided the wanted signal is a little stronger than the unwanted one, even when the two stations have the same frequency! This results from the insensitivity of an FM receiver to amplitude variations of the carrier. When two signals interact one tends to amplitude modulate the other, which means that on AM the wanted signal needs to be very much stronger than the interfering one to give the same interference immunity as FM.

Receiver Requirements

From Fig. 2 it is dramatically apparent that an FM receiver requires much more bandwidth than an AM counterpart to do full justice to the high quality audio signal. The bandwidth needs to be reasonably phase-linear to ensure the least distortion at high modulation index and for the best stereo performance (channel separation, distortion, etc). Latter-day creations employ phase-linear quartz, ceramic and surface-wave acoustical filters to achieve these requirements, as distinct from the earlier LC transformer couplings, as shown in Fig. 3.

To help maintain a high S/N (signal-to-noise) ratio the VHF front-end must employ low noise-figure transistors, especially for the RF (radio-frequency) amplifier, and have a good coupling match to the VHF aerial. Most of the selectivity and response tailoring is undertaken in the IF (intermediate-frequency) channel at the standard IF of 10.7 MHz. Even so, a reasonable degree of front-end selectivity is desirable to restrict the amplitude of off-tune VHF signals arriving at the mixer from the aerial. A multiplicity of fairly strong signals here can generate intermodulation products of the 3rd-order variety and hence produce spuriae which might detract from the quality of the wanted signal. RFIM (radio-frequency intermodulation) immunity is achieved by using two or more variable-tuned circuits between the aerial and mixer and VHF transistors of good linearity (e.g., bipolars running at fairly high emitter current or FETs).

One important aspect of 3rd-order RFIM lies in the production of an interfering signal of $f_2+f_4-f_3$ where f_2, f_3 and f_4 correspond to Radios 2, 3 and 4. This interfering signal lies in the f_3 transmission and is perturbed by the modulation of any of the three transmissions. In bad cases of this interference (stemming from a receiver with a poor RFIM performance) the only solution lies in attenuating the aerial signal.

Most front-ends use an RF amplifier followed by the mixer which may generate its own local oscillator signal (f_o) or call for a separate oscillator stage. Whatever the arrangement, the mixer receives f_c and f_o and thus delivers $f_o \pm f_c$. The vast majority of FM front-ends use an f_o equal to f_c+IF, the IF thus corresponding to $f_o - f_c$, and it is this signal only which is accepted by the IF channel, as shown in Fig. 4.

Thus, if the aerial signal is, say, Radio 2 from Wrotham at 89.1 MHz, the local oscillator will be 10.7 MHz above this at 99.8 MHz, so that 99.8-89.1 equals the 10.7 MHz IF. Both additive and multiplicative mixing are used, the former generally when the mixer has just one input port,

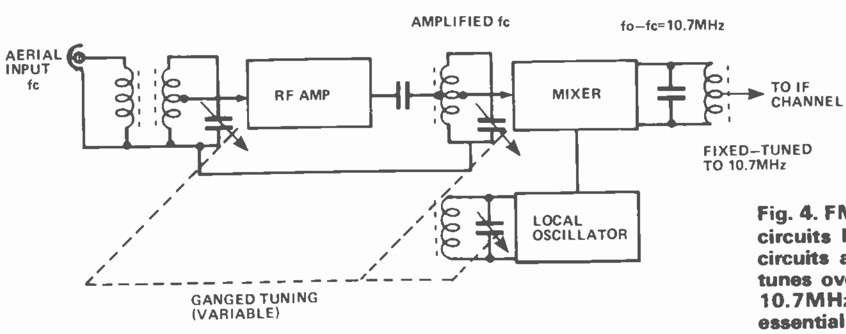


Fig. 4. FM front-end with RF amplifier using two variable-tuned circuits between aerial and mixer. The RF and mixer input circuits are tuned in step while the ganged oscillator tuning tunes over Band II so that the oscillator frequency is always 10.7MHz above the carrier frequency. Accurate tracking is essential to avoid a decrease in sensitivity over the tuning range. Some receivers have double bandpass tuning between the RF amplifier and mixing for further improvement in front-end selectivity.

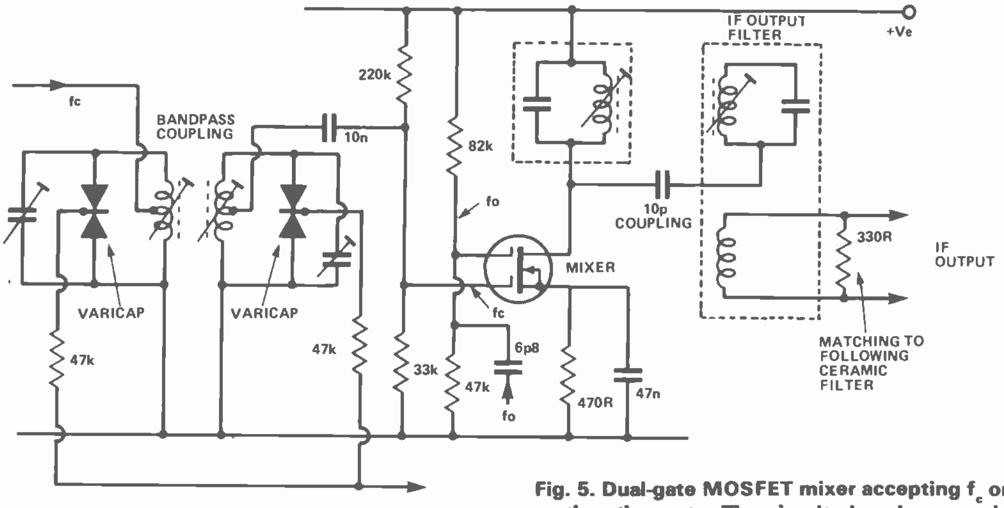


Fig. 5. Dual-gate MOSFET mixer accepting f_c on one gate and f_o on the other gate. The circuit also shows varicap tuning and a capacitively-coupled IF output filter.

and the latter when there are two inputs, such as with a dual-gate FET as shown in Fig. 5. This sort of FET (MOS) may also be used for the RF amplifier, with one gate accepting f_c and the other an AGC (automatic gain control) bias *via* an amplifier as shown in Fig. 6.

Varicap Tuning

Some contemporary receivers, especially of European origin, use varicaps (e.g., capacitor diodes) instead of a mechanical tuning gang. The bandpass section in front of the mixer in Fig. 5 is tuned in this way. The varicaps are diode pairs arranged to neutralise non-linearity which, when biased for reverse conduction, exhibit capacitance of value which decreases as the reverse bias is increased. For continuously variable tuning, therefore, it is necessary merely to bias the diodes together from a potentiometer which is mechanically coupled to the tuning system. To eliminate capacitance change and hence tuning drift the tuning voltage is derived from a stablizer or regulator. The scheme also lends itself to press-button station selection.

Also in Fig. 5 the IF signal is filtered out by a capacitively coupled circuit. The 330 ohm resistor matches the output to the following ceramic filter in the IF channel, as do the input and output filter resistors in Fig. 3. Unless this matching is correct the filters fail to provide the proper symmetry, selectivity and skirt sharpness.

Bandpass coupling at the output of the RF amplifier is also used in Fig. 6, but the tuning here is by a ganged mechanical capacitor.

Oscillator Stage

To avoid oscillator 'pulling' on strong carriers state-of-art FM receivers use a local oscillator followed by a 'buffer' stage, as shown in Fig. 7. Less elaborate models either use a separate oscillator coupled direct to the mixer or a self-oscillating mixer.

AM Front-Ends

Exactly the same principles apply to AM, but because f_c is that much lower the design of the front-end section is less critical. The IF is generally around 455 kHz and, as with FM, f_o is often the IF above f_c; but some models place f_o the IF *below* f_c, though this may reverse on some wavebands.

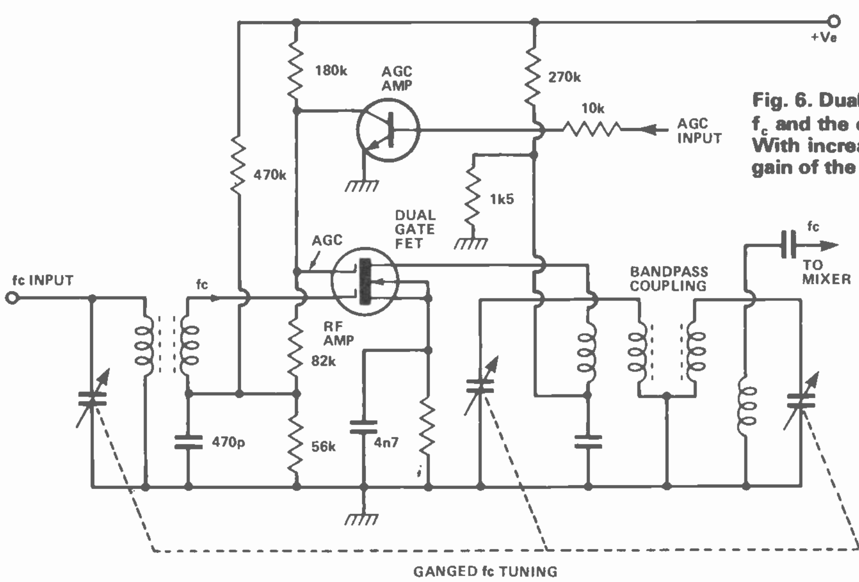


Fig. 6. Dual-gate MOSFET RF amplifier where one gate receives f_c and the other an AGC bias obtained from a bipolar amplifier. With increase in signal strength the bias increases so that the gain of the RF amplifier is diminished.

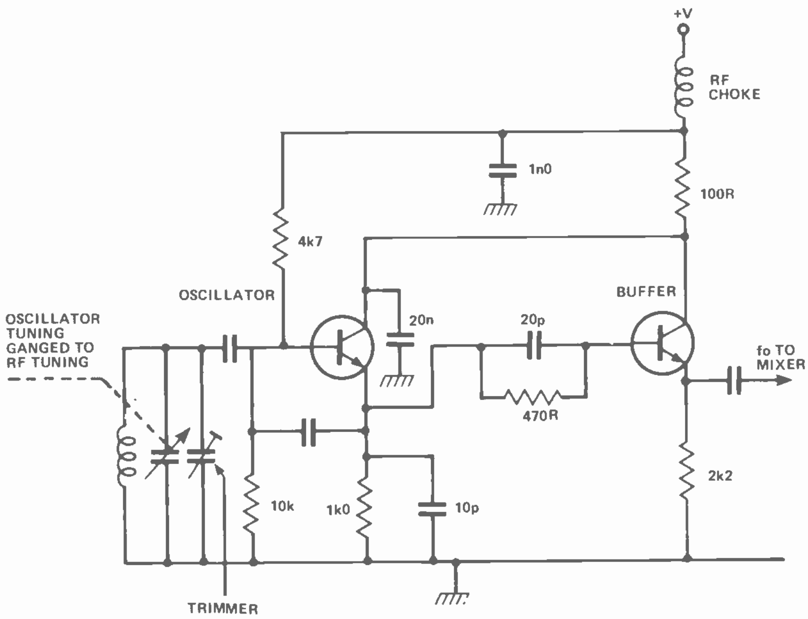


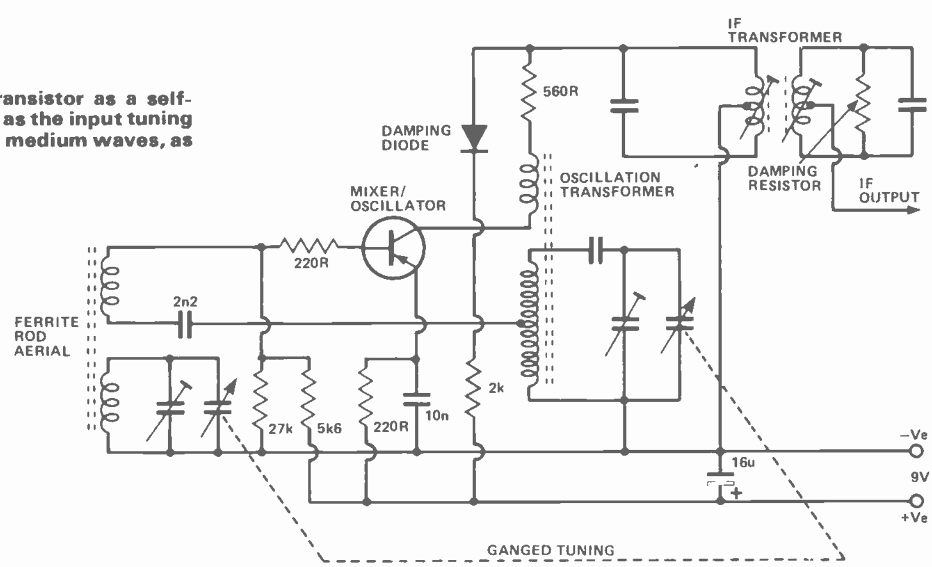
Fig. 7. FM local oscillator followed by buffer stage for feeding the mixer.

The majority of AM transistor portables employ a ferrite rod aerial which also serves as the input tuning. Only the more elaborate models boast an RF amplifier, and a self-oscillating mixer is commonly adopted, as shown in Fig. 8. Receivers with poor front-end selectivity are relatively prone to spurious responses at frequencies removed from the tuned frequency. A typical one is the 'image' or 'second channel'' response where the IF is produced from an input two times the IF above the tuned frequency when the oscillator is running at the IF *above* the signal frequency. For example, if the receiver is tuned to, say, 1,000 kHz the oscillator will be running at 1,455 kHz, so an incoming signal at 1,910 kHz (two times the IF above the tuned frequency) will heterodyne with the oscillator signal to yield the IF in terms of 1,910-1,455. When the front-end selectivity is sharp a signal two times the IF away from the tuned frequency would be well attenuated and not so likely to cause interference. Another is called the half-IF or 'repeat spot' response which falls half the IF away from the tuned frequency owing to the 2nd-harmonic of the oscillator heterodyning with the 2nd-harmonic of the off-tune signal from the RF stage and producing the IF again.

IF Channels

IF channels nowadays use ICs for the gain and resonant filters of the type already mentioned for the selectivity. FM IF channels employ amplitude limiting ICs or ICs deliberately arranged to limit above a certain signal amplitude. Although FM detectors are essentially insensitive to amplitude variations of the IF-converted carrier, especially ratio detectors, additional limiting is desirable in the IF channel further to enhance the AM rejection ratio and to help with the capture effect. A top-flight modern FM receiver will fail to rise in audio output level once the input cartier at the aerial has reached the 2 to 3 microvolt level, the effect then being a progressive improvement in S/N ratio with increasing level of aerial input, as shown by the curves in Fig. 9. Less exacting models will require an input of 100 microvolts or more before full limiting occurs. The ▶

Fig. 8. AM front-end using single bipolar transistor as a self-oscillating mixer. The ferrite rod aerial serves as the input tuning and may have switched windings for long and medium waves, as also the oscillator transformer.



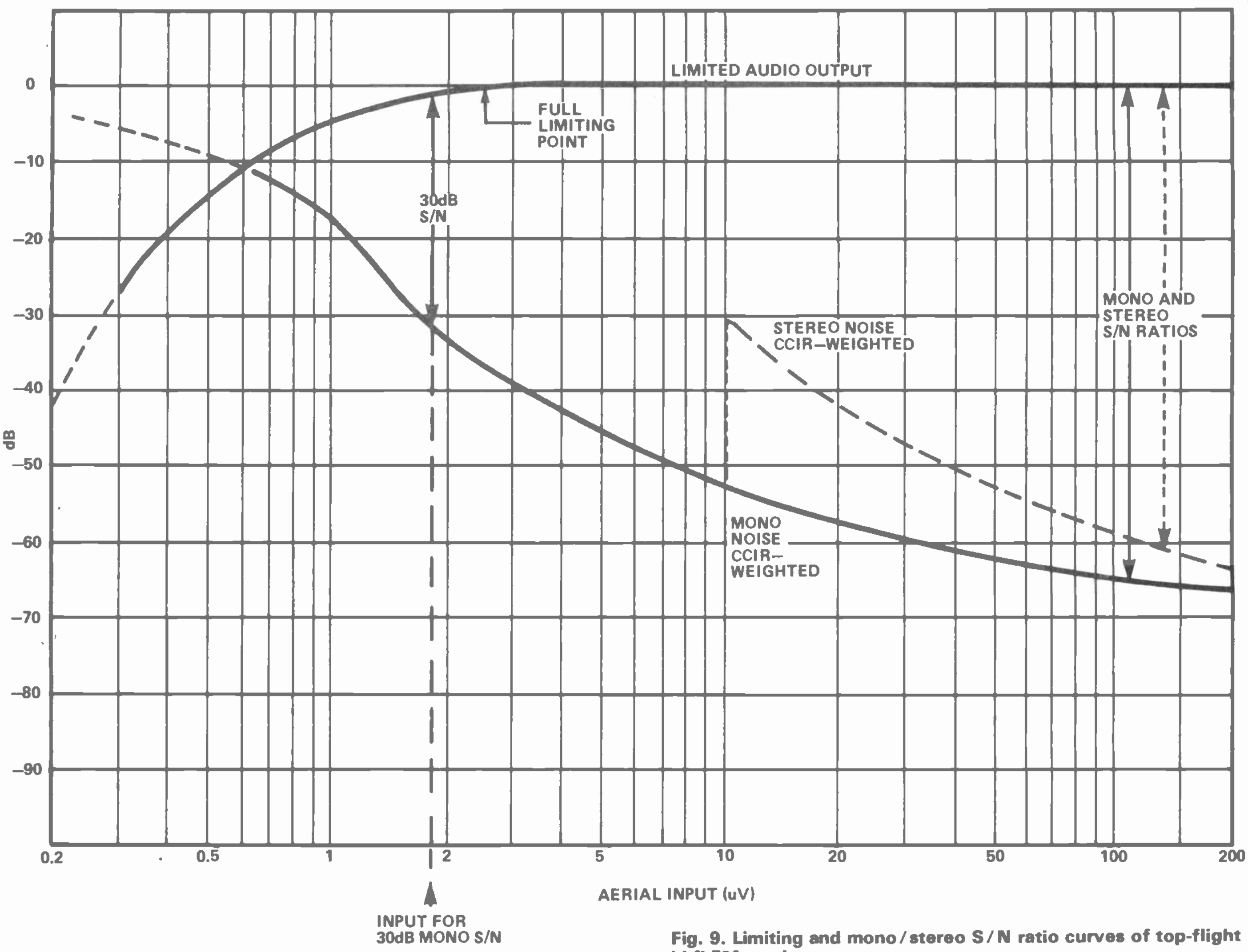


Fig. 9. Limiting and mono/stereo S/N ratio curves of top-flight hi-fi FM receiver.

action of the stereo decoder impairs the S/N ratio at the lower signal levels, catching up with though never reaching the mono ratio at higher inputs. There is always an ultimate S/N ratio impairment of about 2 dB on stereo with respect to mono owing to approximately 10% of the available deviation being used for the stereo information and the greater noise power bandwidth of the receiver in stereo mode.

The FM IF channel also provides the AGC bias for the front-end (when used), AFC control voltage (automatic frequency correction potential derived from the FM detector or separate discriminator for application to the oscillator varicap to hold the carrier at the centre of the IF passband), signal strength and tuning metering, and inter-station muting (where the audio output is disabled until the input reaches a predetermined level as a means of cutting the noise when tuning between FM stations).

The most complex of FM IF channels may employ a cascade of ICs (three or four) feeding into a bipolar transistor which in turn drives the FM detector. Additional ICs and bipolar transistors may be used for front-end AGC, AFC, muting and metering. The simplest adopts a complex IC, such as the CA3089E, which provides IF amplification, limiting, FM detection and audio preamplification for driving the stereo decoder, as shown in Fig. 10. The device contains no fewer than 80 transister integrations, and includes sections for delayed front-end AGC, AFC, signal strength meter drive, tuning indication and interstation muting. In the circuit the muting is operated by S5 and the threshold level set by RV7. S4 switches the AFC on and off, while coils L10 and L11 are concerned with the FM detection.

Quadrature FM Detector

The coils, in fact, are a part of a quadrature detector circuit, which is fast finding favour in FM receivers, facilitated by ICs, without which would demand a complex of discrete components. The arrangement is based on a 90-deg. phase shift and synchronous detector, as shown in Fig. 11. FM IF signal is amplified and heavily limited, and the resulting 'clipped' signal is passed to one input of the detector direct and to a second input *via* the phase shift, which is merely an LC circuit such as L10/11 in Fig. 10. The detector is essentially a 'multiplier' which combines the two inputs vectorially. Owing to the relative phase shift and the deviating FM signal the output consists of varying width rectangular pulses, and from these the audio signal is obtained by low-pass filtering.

Ratio Detector

This is another very popular FM detector whose circuit is given in Fig. 12. When the primary and secondary of the

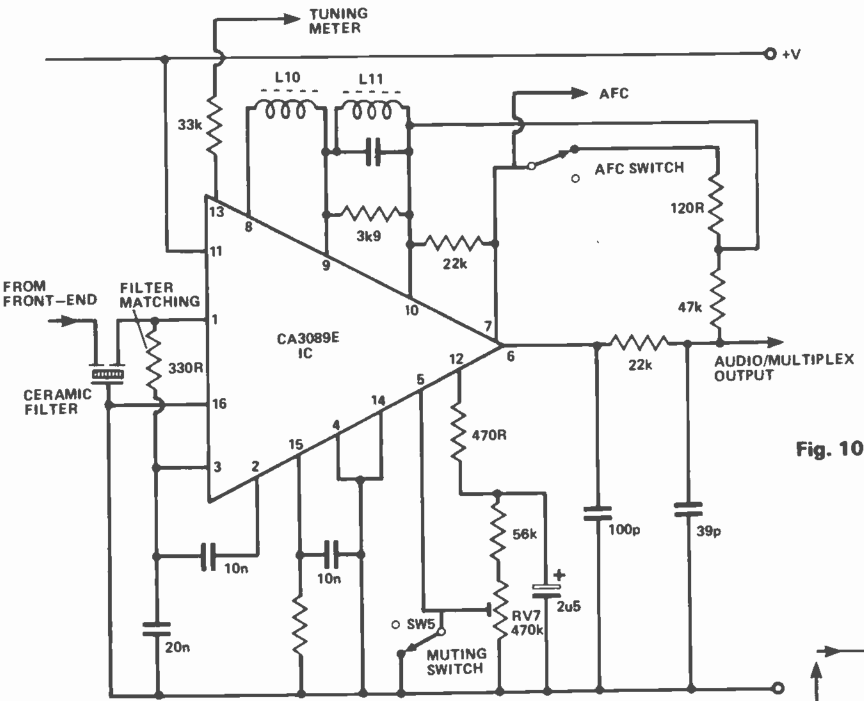


Fig. 10. FM limiting and detection by CA3089E IC (see text).

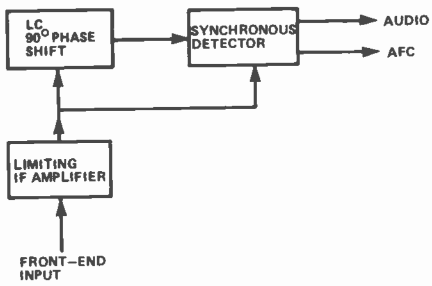
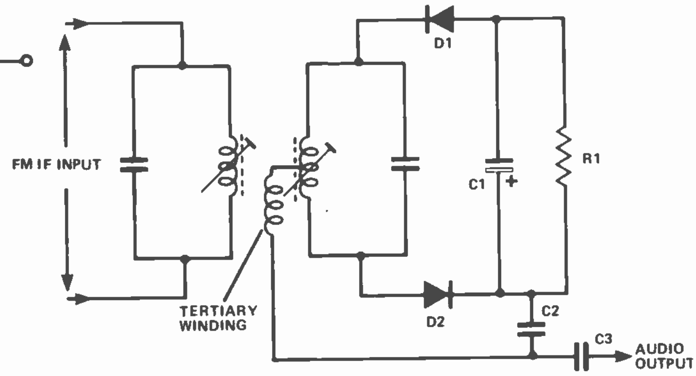


Fig. 11. Simplified quadrature detection.

Fig. 12. FM Ratio detector circuit.



steady-state potential across R1 is substantially unaffected by faster occurring amplitude changes of IF signal such as caused by electrical interference, etc. A value around 200 milliseconds is a fair compromise between poor limiting and sluggish tuning.

FM detectors generally have a bandwidth in advance of that of the IF channel to ensure that at maximum deviation the signal remains on the linear parts of the 'S' characteristic and as an aid to the capture effect.

AM Stages

The IF channel is far simplier in AM than FM receivers. Gain is given by a couple of bipolars or an IC and selectivity is introduced either by two tuned transformers or a ceramic filter (sometimes both). AM IF is around 455 kHz which, with the restricted bandwidth, makes it easier than FM to achieve the required gain with fewer devices.

Detection is invariably accomplished by a simple diode circuit as shown in Fig. 13. From the signal point of view this rectifies the AM waveform so that the average value varies in sympathy with the modulation. Subsequent filtering deletes the IF component. The rectified DC value of the carrier is commonly used as an AGC potential automatically to control the gain of the IF amplifier. At the front-end a damping diode may be used to reduce the mixer output on very strong aerial signals. Such a diode is shown in Fig. 8. This conducts and thus damps the IF output when the signal level rises above the value established by the biasing. Fig. 13 shows alternative biasing for this diode.

The tapped primary of the IF transformer ensures that the tuned circuit is not excessively damped by the output resistance of the transistor. This technique is also used in other sections as will be observed from the circuits.

FM Pre- and De-Emphasis

The S/N ratio of the FM system is further enhanced by the application of treble boost to the modulation signal at the transmitter (pre-emphasis) and compensating treble cut (de-emphasis) at the receiver. These are based on a time-constant which is 50 microseconds UK and 75 microseconds America. It thus refers to the 'turnover' frequency (that frequency where the boost or cut occurs) and is equal to $1/2\pi T$, where the frequency is in Hz and the time-constant (T) in seconds, which works out to about 3,184 Hz at 50 microseconds. The ultimate rate of boost or cut approximates 6 dB per octave (e.g., single-pole filter). FM produces a triangular noise output because the output from the detector is proportional to f_d. Because f_d max is $\pm$75 kHz and f_m max 15 kHz the noise content is significantly reduced and is reduced by a further 4 dB or so by the pre- and de-emphasis.

The de-emphasis consists of a simple RC time-constant at the detector output in the case of mono and at the decoder output in the case of stereo. It is not possible to apply de-emphasis at the detector when this is followed by a stereo decoder since the effect would be seriously to attenuate the complex stereo multiplex signal. The net result of the $\pm$75 kHz f_d and the pre- de-emphasis is a weighted S/N ratio of 75 dB or more mono and just over 70 dB stereo, depending on the noise figure and quality of design of the receiver.

Stereo Encoding

After separate pre-emphasis of the left (L) and right (R) audio channels at the transmitter the signals are fed to a combined adder and subtractor (matrix) which yields L+R mono information and L-R stereo information. The mono signal is passed to the transmitter in the usual way ▶

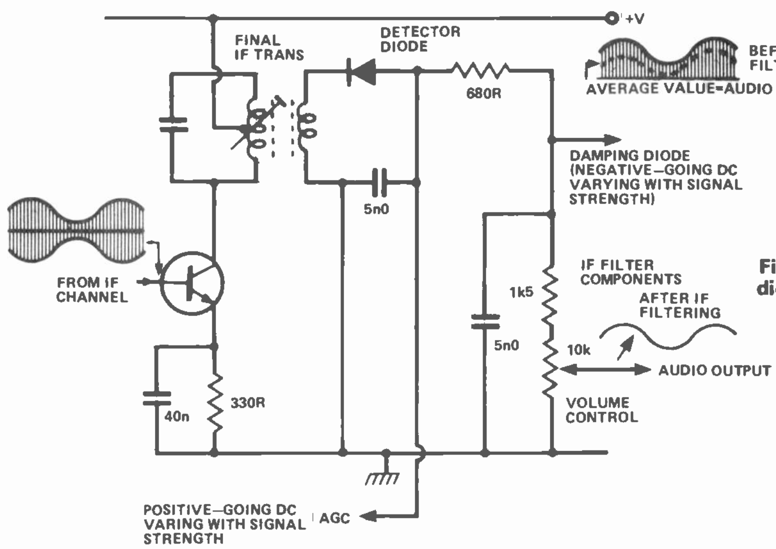


Fig. 13. AM detector circuit with feeds for AGC and damping diode (also see Fig. 8).

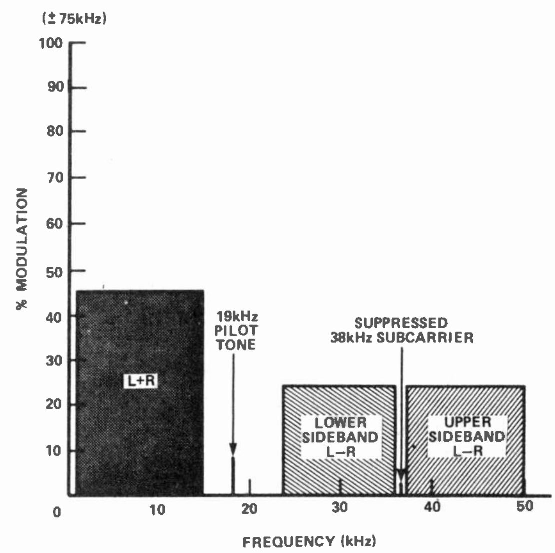


***Fig. 14.* Spectrum of multiplex signal at FM detector output on stereo signal when one channel only is modulated. See text for other modulation levels.**

tuned transformer are resonated to the undeviated carrier the two diodes conduct equally and since the diodes are connected in series a potential is developed across R1 which charges C1.

When the input deviates either side of its nominal frequency the balanced phasing condition is destroyed and the diodes fail to conduct equally. This results in current flowing out of the circuit through the 'phasing' or tertiary winding, and because this external current is geared to the deviation the audio signal develops across C2, which is fed out through C3.

An advantage of the ratio detector compared with the Foster-Seeley detector or discriminator (which also uses two diodes but connected back-to-back and is without the tertiary winding) is that it yields amplitude limiting. Provided time-constant R1/C1 is large enough the (allowing receivers not equipped with a stereo decoder to work on the signal without undue loss, which is an aspect of system compatibility), while the stereo signal is separately processed and subsequently 'added' to the mono signal for transmission. It is applied to an *amplitude* modulator whose carrier frequency is 38 kHz but which is suppressed so that only the lower and upper *sidebands* of the stereo information remain (in practice the residual 38 kHz subcarrier accounts for no more than 1% of the maximum deviation — e.g., less than ±750 Hz). The stereo information sidebands along with the mono information are then applied to the normal VHF modulator of the transmitter.

For the detection of suppressed carrier AM the carrier needs to be regenerated at the receiver (in the stereo decoder), and to facilitate this a 19 kHz pilot tone using up approximately 9% of the maximum deviation (e.g., about ±6.75 kHz) is also applied to the VHF modulator. The total modulation signal thus applied to the VHF carrier has the spectrum shown in Fig. 14. The L+R mono signal occupies the normal audio range from about 30 Hz to 15 kHz, next comes the 19 kHz pilot tone and then the lower and upper stereo sidebands between which is the suppressed 38 kHz sub-carrier. At no time can the total deviation of all these signals exceed ±75 kHz (e,g, 100% modulation). In Fig. 14 the total modulation consists of 45% L+R mono, 22.5% L-R stereo in each sideband (45% in all), 9% pilot tone and 1% residual subcarrier, adding up to 100%. This condition would obtain with an input only to one channel (e.g., L or R 1 unit and R or L zero). With both inputs receiving the same intensity of 'in phase' signal (e.g., stage-centre mono condition), the stereo information would be virtually zero so that a full 90% modulation capacity would be available for the L+R mono information (the remaining 10% being used by the pilot tone and residual subcarrier). With both inputs equal but in phase opposition (a very rare happening) all the information would be in the L-R stereo channel. Under normal music conditions, of course, the mono and stereo information is continuously changing, but the balance of 100% maximum is always maintained.

Stereo Decoding

The encoding system just described is based on the Zenith-GE developments which is universally adopted. Various schemes for decoding the signals back to the L and R channels for reproduction have been devised, the earlier ones using discrete components with valves and later transistors, and the latest ones using ICs specially developed for encoding. It is clearly outside the scope of this article to venture back into history, but a phase lock loop (PLL) IC decoder circuit used in many receivers is given in Fig. 15.

Multiplex signal (of Fig. 14 spectral form) is fed to pin 1 input *via* Q1. Inside the IC the PLL is formed by a 76 kHz voltage controlled oscillator (VCO), two divided-by-two stages yielding first 38 kHz and then 19 kHz, a 19 kHz

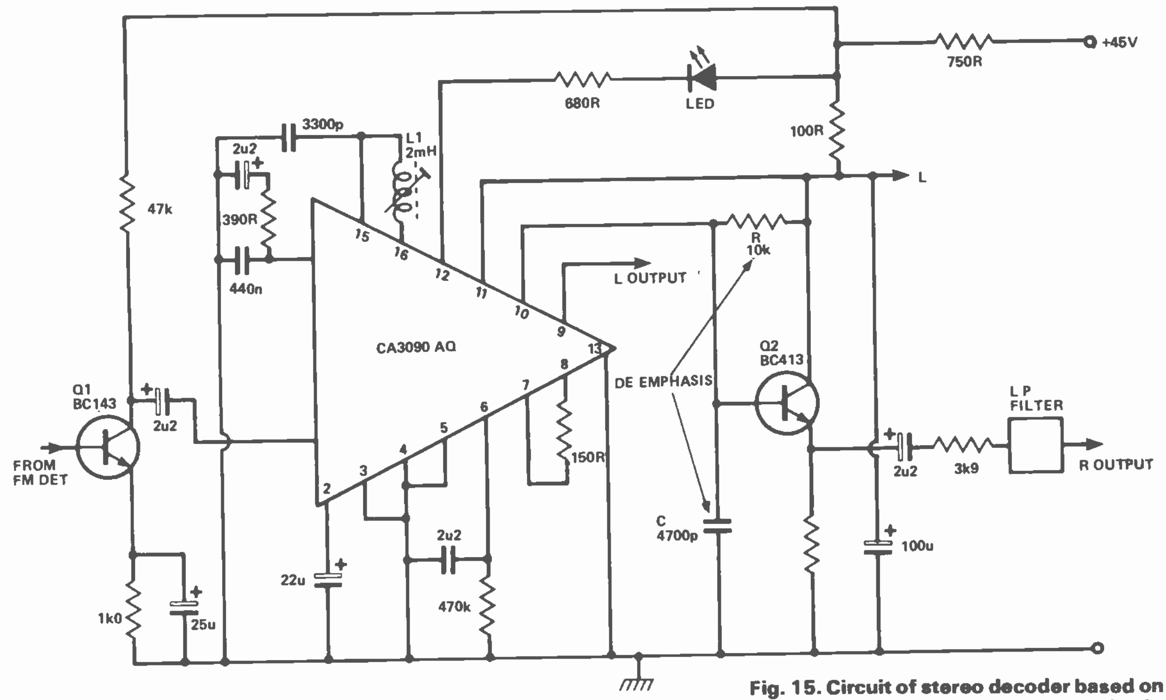


Fig. 15. Circuit of stereo decoder based on the CA3090AQ IC. L1 is PLL tuning and RC the de-emphasis. One channel only is shown; the other channel is similar.

phase comparator, low-pass filter and DC amplifier whose output is fed back to the VCO for control, as shown in Fig. 16.

The multiplex signal is first buffered and then fed to the phase comparator where the pilot tone component is compared with the loop-derived 19 kHz signal. The loop is thus locked and the 38 kHz signal from the first divider constitutes the reclaimed subcarrier which, along with the multiplex direct, is applied to the decoder section. This can be regarded as an 'inverse' of the encode matrix which, after AM demodulation, yields the L audio from (L+R)+L—R) and the R audio from (L+R)—(L—R). Each output is subjected to de-emphasis before being applied to the L and R audio amplifiers for driving the loudspeakers.

The IC is also equipped with automatic stereo switching so that on a non-stereo signal the two outputs deliver mono signal, and a stereo indicator switch which lights a small bulb or light emitting diode (LED) when stereo information (pilot tone) is detected. The circuit connections involved are shown in Fig. 15. The VCO locking is achieved by L1 which is a 2 millihenry inductor. Audio from each channel is 'buffered' by Q2 (same for the other channel though not shown) and passed through a low-pass filter for attenuating residual pilot tone and sub-channel spuriae before arriving at the audio stages of the receiver. Some of the very recent ICs incorporate a pilot tone cancelling circuit so avoiding the need for low-pass filtering and maintaining an excellent response to 15 kHz or more.

Of course, all stereo receivers have two separate audio channels for the L and R signals. Hi-fi receivers employ the latest technology in this area, some models yielding 60W per channel or more at remarkably low distortion. Less exacting receivers have relatively simple audio stages based on push-pull transistor pairs or hybrid power ICs.

There is no doubt that latter-day hi-fi receivers operating from off-air stereo signals (particularly when these correspond to 'live' transmissions) are capable of extremely high audio quality, on par with the best of most other programme sources. ETI

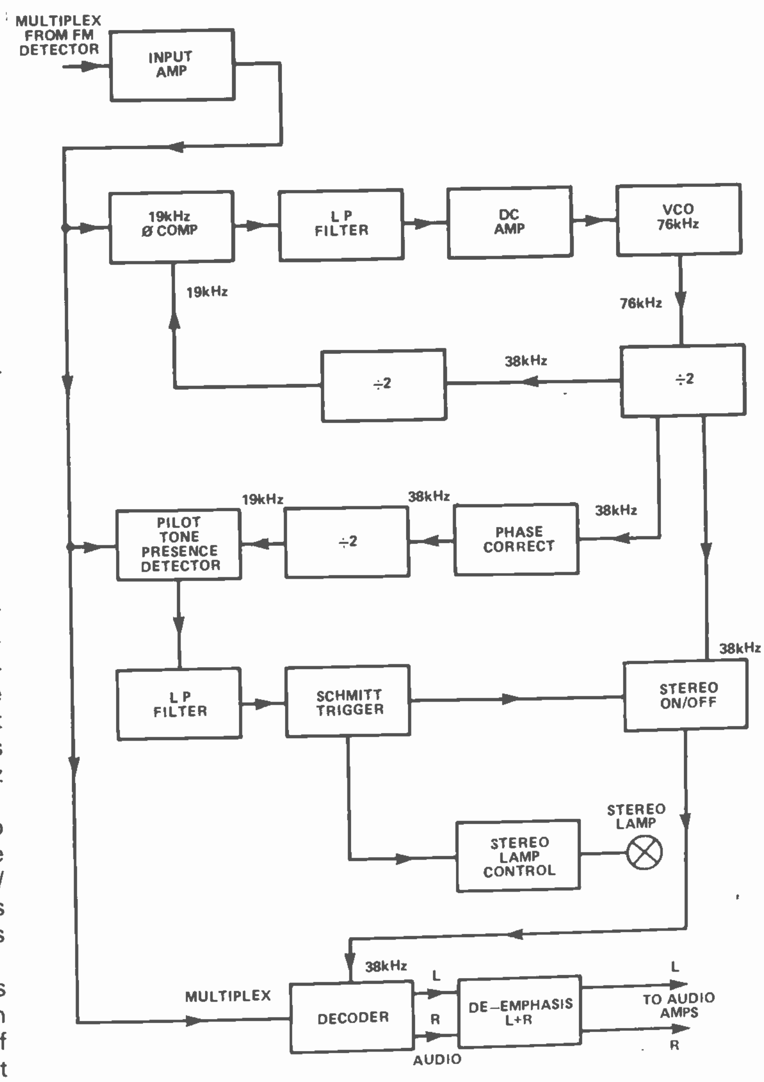


Fig. 16. Block diagram of PLL stereo decoder IC.

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April			No!	No!		No!	No!
May	No!	No!		No!		No!	No!
June	No!		No!	No!			No!
July		No!		No!			No!
Aug	No!	No!		No!		No!	No!
Sept		No!		No!	No!	No!	No!
Oct		No!		No!	No!	No!	No!
Nov		No!	No!	No!	No!	No!	No!
Dec		No!	No!	No!	No!	No!	No!

Photocopies of any article from any one issue are available, and cost 50p regardless of nos. of pages. Copies of series will be charged at article rate per installment. Mark envelope "P".

AMBUSH! PART 2

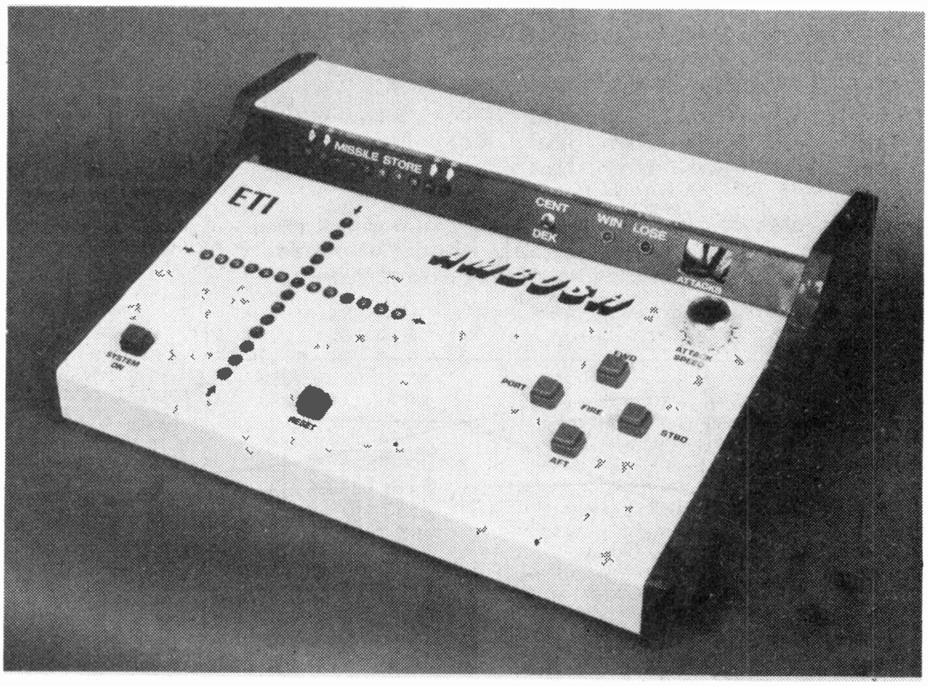
At last the second and final part of our very own space game Ambush. Red blood sweat and tears have gone into the production of the game and we beleive it's all been worthwhile. Virtually guaranteed to provide hours of excitement, not one of those games you easily tire of. So switch it on and prepare to do battle with the forces of evil.

THE MAJOR part of the Ambush circuitry, other than the LED displays, is wired up on a set of three PCB's. Considerable care should be taken over the construction, due to the difficulty that will occur in trouble-shooting the circuitry if it does not work correctly first time. Take special care to ensure that all diodes are fitted in the correct polarity, and that all IC's are correctly located.

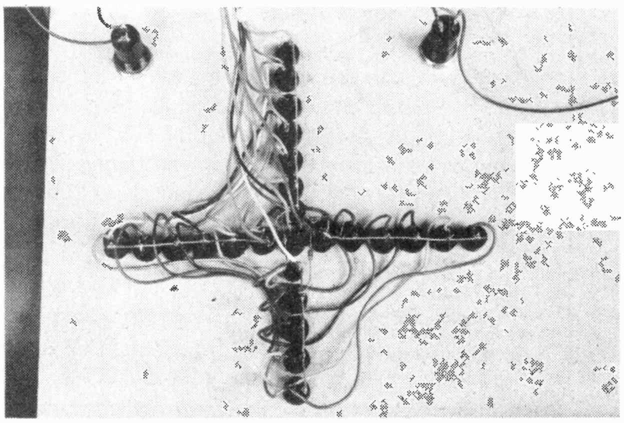
On our prototype unit we mounted all IC's in holders. We used Wafercon connectors on each board, rather than solder pins, to facilitate the interwiring. Take great care over the interwiring.

When it comes to fitting the LED's for the Main Display and for the Missile Store indicators, take the precaution of testing each LED individually to confirm its polarity and functioning before finally wiring it in place. Note that silicon diodes D22 to D25 are mounted directly on the Main Display matrix.

Our own Ambush game is mounted in an attractive but rather expensive case that we obtained from Boss Industries. The same company produces an 'economy' range of similarly shaped sloping front cabinets. We have powered our unit from a set of eight HP2 batteries, fitted in two 4-section holders. Our Attack counter is mounted on a 20mm x 60mm 0.1 inch matrix Vero board that is epoxy-glued into position on the front panel of the case.



The finished AMBUSH prototype, it really does look good in its case. The staff of ETI have had great fun over the past few weeks playing with the game. A case similar (or the same) to ours is highly recommended and would look good almost anywhere.



Inside the front panel of Ambush showing the display layout. All of the wiring on the prototype was completed before final assembly to allow for flexibility in arranging the PCBs within the case.

SCENARIO

Like all good wargames 'Ambush' has a scenario to go with it. This is it. The scout cruiser Eatyeigh is on a vital war mission to the planet Tora. An enemy fleet (Yappanies) is detected closing in on it by long range hyper radar. A message is flashed ahead to the cruiser's captain. The communications officer, white-faced, takes it to the control room wherein the crew are gathered to hear the news. . . .

The Captain read the message he had been handed. A worried frown briefly creased his brow. He looked up again and spoke. "Men, I have just received a message from Command Headquarters. Our intelligence units report that the Yappanies know of our mission. They are determined to stop us at any cost, and will probably attack us with a suicide fleet somewhere in space sector seventeen. We will reach that sector in just over three hours. All units will maintain Battle stations until further notice. Message ends." The screen flickered, and went blank.

Joe Reader sat back thoughtfully in his chair. He glanced at his three fellow gunners. He spoke reassuringly to they. "Don't worry, mates. The Yappanies haven't got a chance against us. We've got masses of Phanton missiles on board, enough to fight off an entire suicide fleet each. All you've got to do is sit there and wait for the little devils to appear on your sector screens, then press your Phanton FIRE buttons and blast 'em to hell." His three companions laughed. One of them made a rude sign.

Three hours later Joe Reader was sitting in the data viewing room, adjacent to the Fire Control centre, reading up on Yappanie battle techniques. A terrible explosion suddenly blasted through the ship. He was thrown to the floor by the blast. The ships starboard engine had ripped itself apart and hurled great chunks of white hot metal through the hull. The ships self-repair system immediately set to work, sealing the damaged hull. Joe raised himself from the floor, forced open a connecting door, and staggered into the Fire Control centre. A ghastly sight met his eyes.

The control centre was a shambles. His three companions were clearly dead. Blood was spattered on the walls and across the floor. Three of the four Phanton missile magazines had disappeared, blasted into space before the hull had resealed itself. Joe's mind raced. The ship was about to enter space sector seventeen. The Yappanie attack was about to start. Joe would have to fight off the attack alone. Feverishly, he started to patch all four quadrant fire control switches into his own control console. A damage control report could be heard echoing through the ship. All external attack sensors were damaged. Attack warnings would be minimal.

A few moments later the battle attack sirens screamed through the ship. Joe knew that the Yappanies would attack with either a full Century of one-man Kamanzi suicide craft, or a Dekuron of ten heavily armoured Sutzma battle cruisers. Ten fire units of Phanton missiles were needed to destroy a single Sutzma cruiser, whereas a single unit would destroy a Kamanzi. Joe checked the ammunition register, and made a quick calculation. He had just enough ammunition, in the form of Phanton missiles, to destroy either type of attack, so long as he fought off the attacks with fire bursts of no more than one hundred milliseconds each.

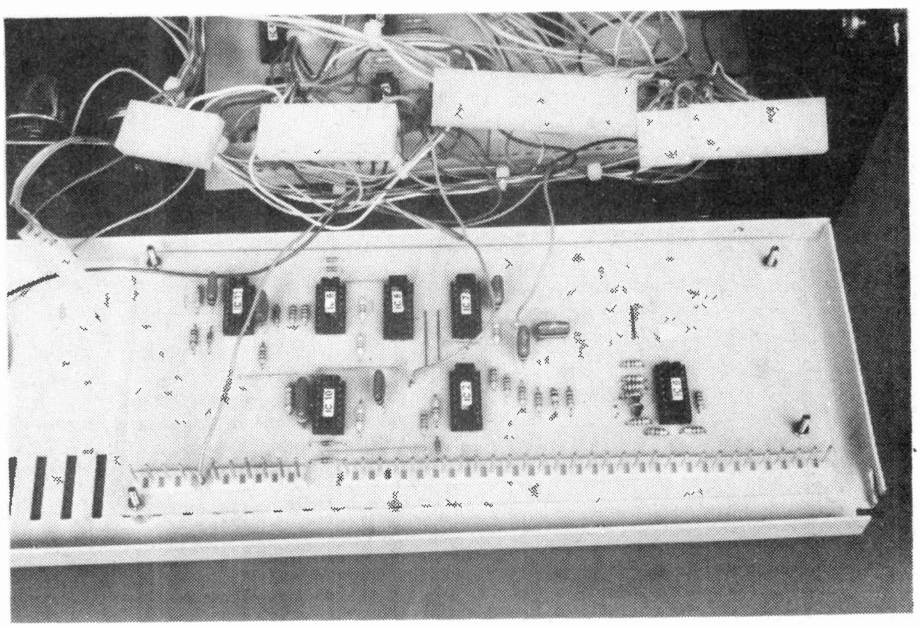
Joe knew how the attacks would be delivered. The Yappanies always attacked one at a time, at random intervals and from random directions, until they had either won the battle, or had been totally destroyed. He switched on the attack indicator unit. A cross formation appeared on the screen in front of him, each arm of the cross indicating a possible quadrant of attack. At the centre of the cross a red indicator gleamed, representing the starship Eatyigh. He switched on the attack simulation computer, to check the extent of the sensor damage. The ships sensor system projected a continuous beam that reflected back from the hull of any attacking vessel, and was modulated by the vessel's hull vibrations in the process. The reflected beams were then demodulated to give a visual output of range and an audible output of engine noises.

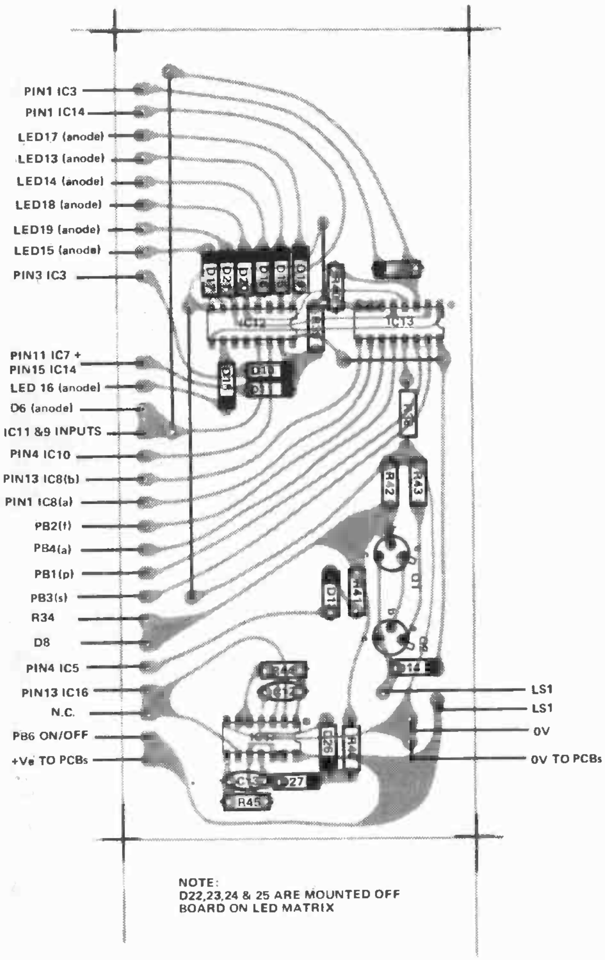
The computer showed that the Forward sensor was inoperative on sound, and gave only 250 milliseconds of range warning at normal battle speed. Port and Starboard sensors were operating at half strength on sound, and gave 300 milliseconds of range warning. The Aft sensor was fully operational on sound, and gave 350 milliseconds of range warning.

The Commander's voice boomed through the ship again. "All units at Red Alert. A Yappanie century of Kamanzi suicide craft has been detected, closing at high speed. Out." Joe threw the attack mode switch to the CENT position, and the fire control computer automatically adjusted the Phanton missiles into packets suitable for fighting a Kamanzi attack. Almost instantly, the first Kamanzi craft appeared as a rapidly moving spot of light at the bottom of the attack indicator screen, and the staccato sound of the crafts engine burst from the audio simulator. Joe stabbed his finger at the AFT fire button, heard the screech of a Phanton missle pack leaving its silo, and instantly saw the Kamanzi craft obliterated from his screen. Without hesitation, another attack started in the starboard quadrant, and was rapidly stopped by another pack of missiles. A pause of five seconds, then another attack from the aft quadrant.

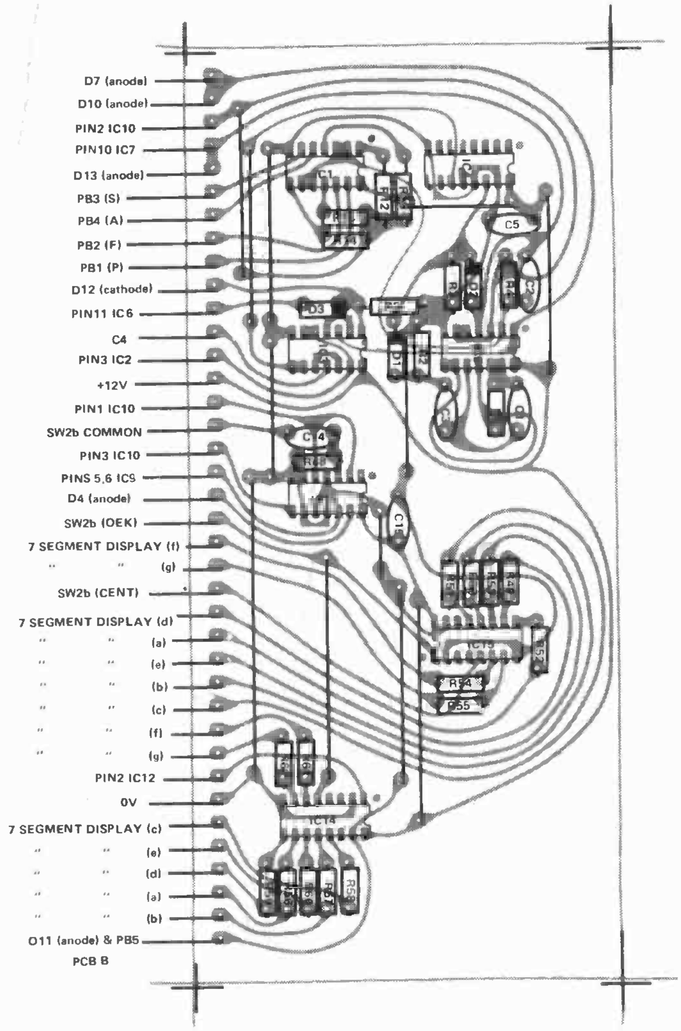
The attacks continued relentlessly. Sixty attacks were clocked up on the attack counter within the first five minutes. Joe glanced at the ammunition state indicator. Nearly seventy per cent of his ammo was used up. If he was to survive, he must reduce the fire time on each attack. He glanced back at the screen and saw an attack rushing in silently on the forward quadrant. He groped frantically for the Forward fire button, and hit three buttons at once. Three packets of Phantons screamed from the silo. The attacking craft disappeared from the screen. The ammo store indicator lurched downwards. An attack from the stern. Fire! A three-second pause. A port attack. Fire! Instantly, another attack in the same quadrant. Fire again. The attacks continued.

Part way through the seventh minute Joe noticed that the attack register recorded ninety-five, and that the ammo register was only a notch above the EMPTY state. He wondered if he could ward off the final five attacks. The crew of Eatyigh were depending entirely on him. "It's up to you now, Reader," he thought. Another attack came rushing in on the starboard quarter. . . .





PCB, C. The display drive and sound output sections.



PCB, B. Most of the display functions are carried out on this panel.

PARTS LIST

R1	6M8
R2	390k
R3, 8, 9, 10, 11, 31, 40, 48	22k
R4	10M
R5, 26, 28, 29, 30, 39	47k
R6, 16-25, 36, 37, 47	1k
R7, 12, 13, 14, 15	100k
R27	330k
R32	6k8
R33	680k
R34, 41, 42, 46	10k
R35	2M2
R38	270R
R43	33R
R44, 45	1M5
R49-62	470R

POTENTIOMETER

RV1	1MO

CAPACITORS

C1, 5, 6, 7, 8, 11, 14, 15	100n
C2, 3, 4, 10, 12, 13	10n
C9	150n

SEMICONDUCTOR

IC1	4016
IC2, 13	4052
IC3, 9, 10	4001
IC4, 6, 12	4017
IC5, 17, 11	4011
IC7	4040
IC8, 16	4026
IC14, 15	4013

NOTE. All CMOS devices are B Series.

Q1	BC109
Q2	BFY50
D14	1N4001
All other diodes are	1N4148

LED 1-37 are standard 0.2in dia.
LED 7 segment displays are common cathode 0.3in

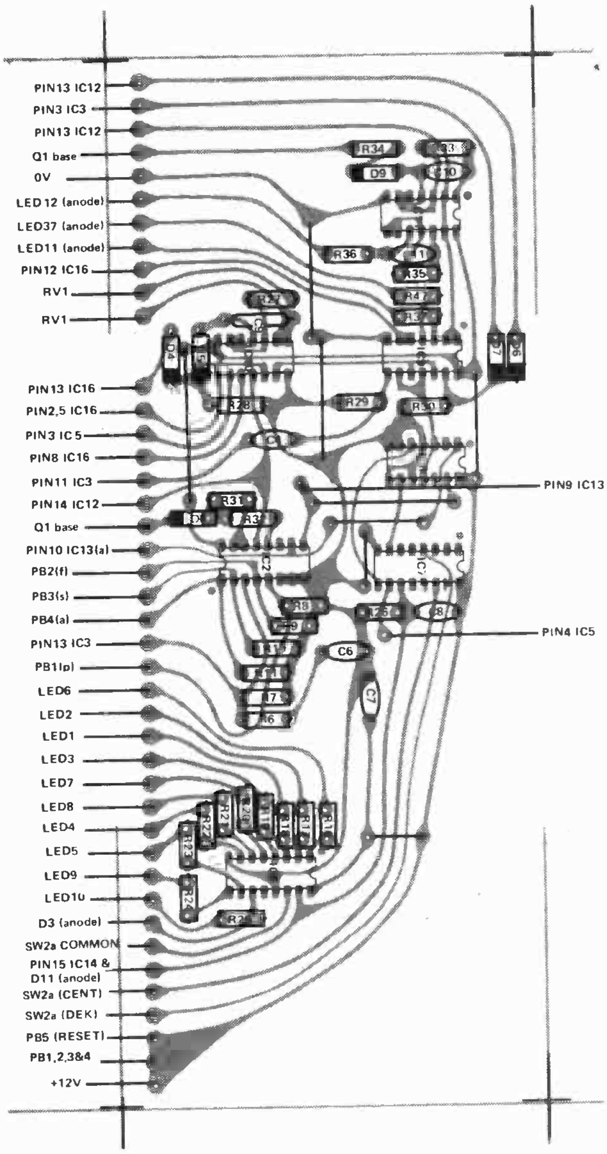
MISCELLANEOUS

LS1 2in 40R
5 off SPST push buttons
1 off SPST latching push button
1 off DPDT min. toggle
8 off HP11
2 off 4 section battery holders
case to suit

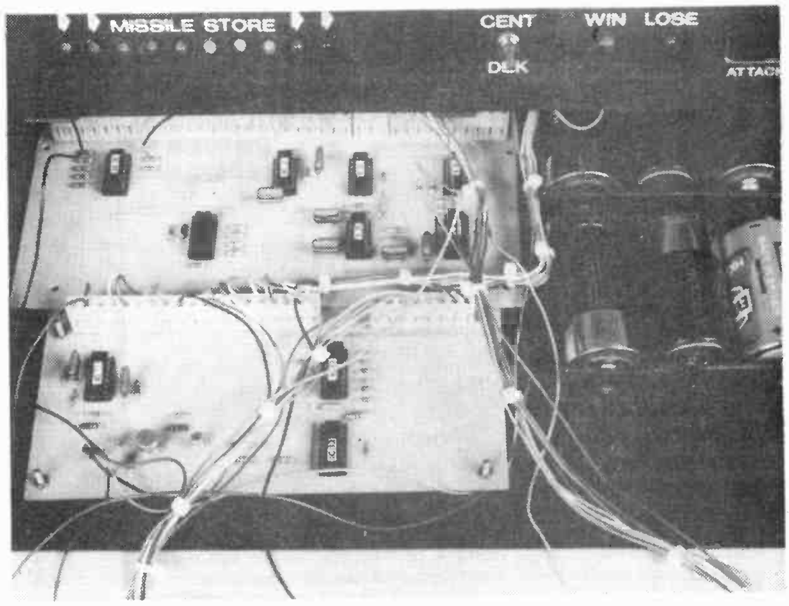
BUYLINES

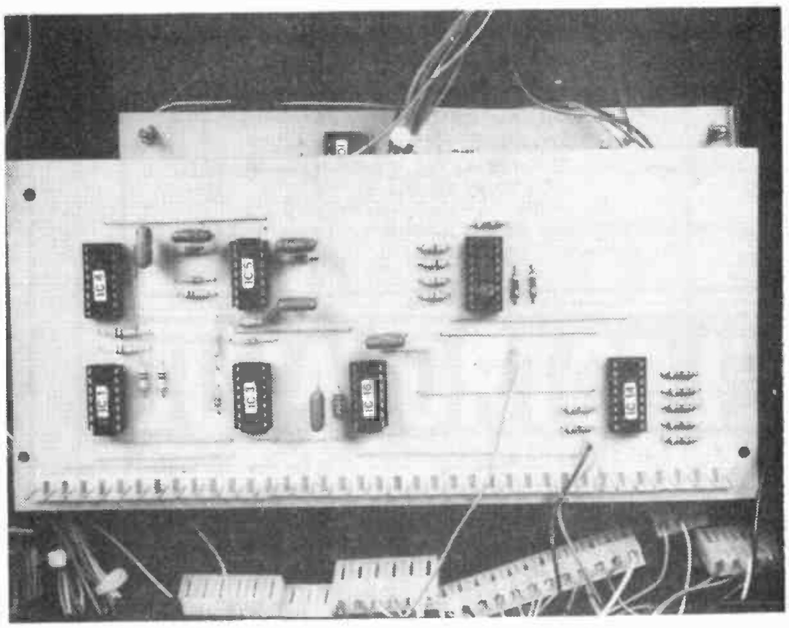
The case we used for the Ambush project is available from Boss Industries. Since panel layout is not critical, inventive ETI readers may be able to come up with their own hardware designs. All the ICs are common types, available from most component mail order firms.

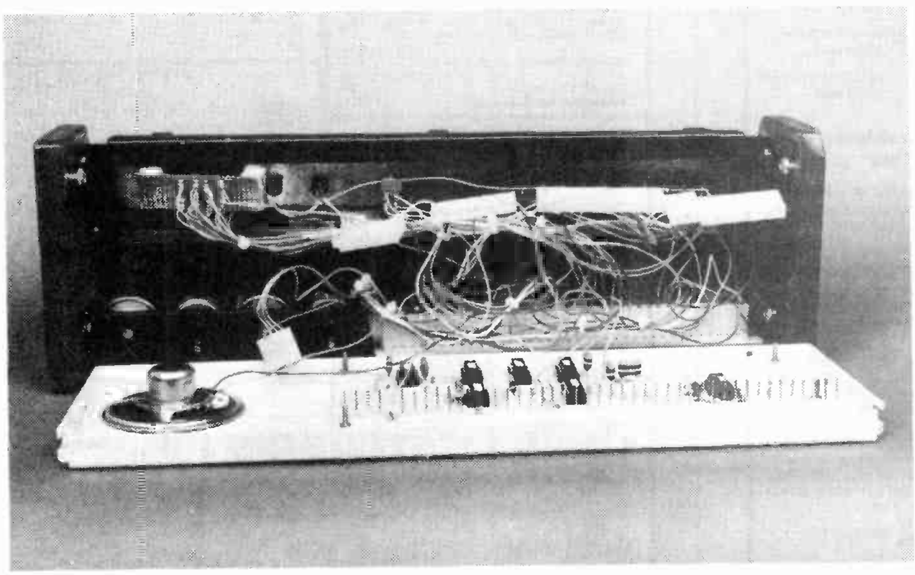
If you think you are likely to spend every waking hour zapping the starfleet, it's worthwhile investing in a mains adaptor, available from your local Tranny shop.



PCB, A. This panel holds the ammo register, random multiplex cock generater and most of the amplex switching functions.







Above. Internal view of ambush with top panel removed. The PCBs are mounted within the case on stand-off pillars.

Centre. PCB, B showing the interconnecting plugs removed, the use of plugs or PCB connecting pins makes troubleshooting (we hope you don't have to) simple.

Left. Inside Ambush from the rear, the speaker can be clearly seen, note also the battery pack on the base panel.

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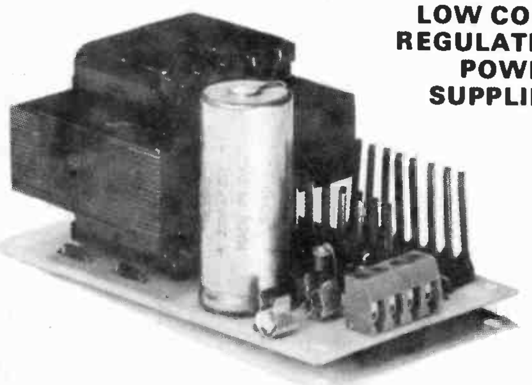

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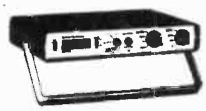

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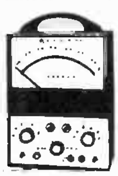

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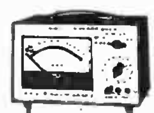

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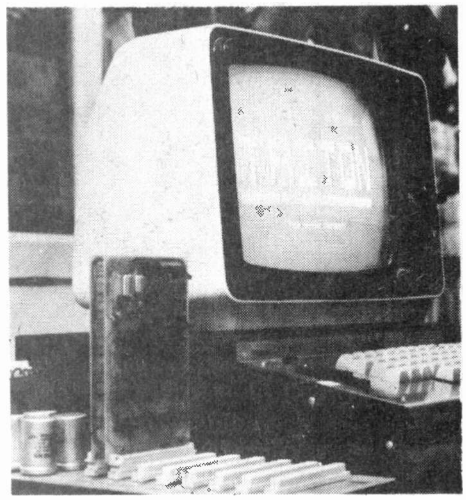

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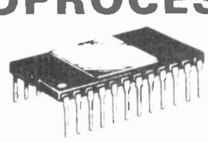

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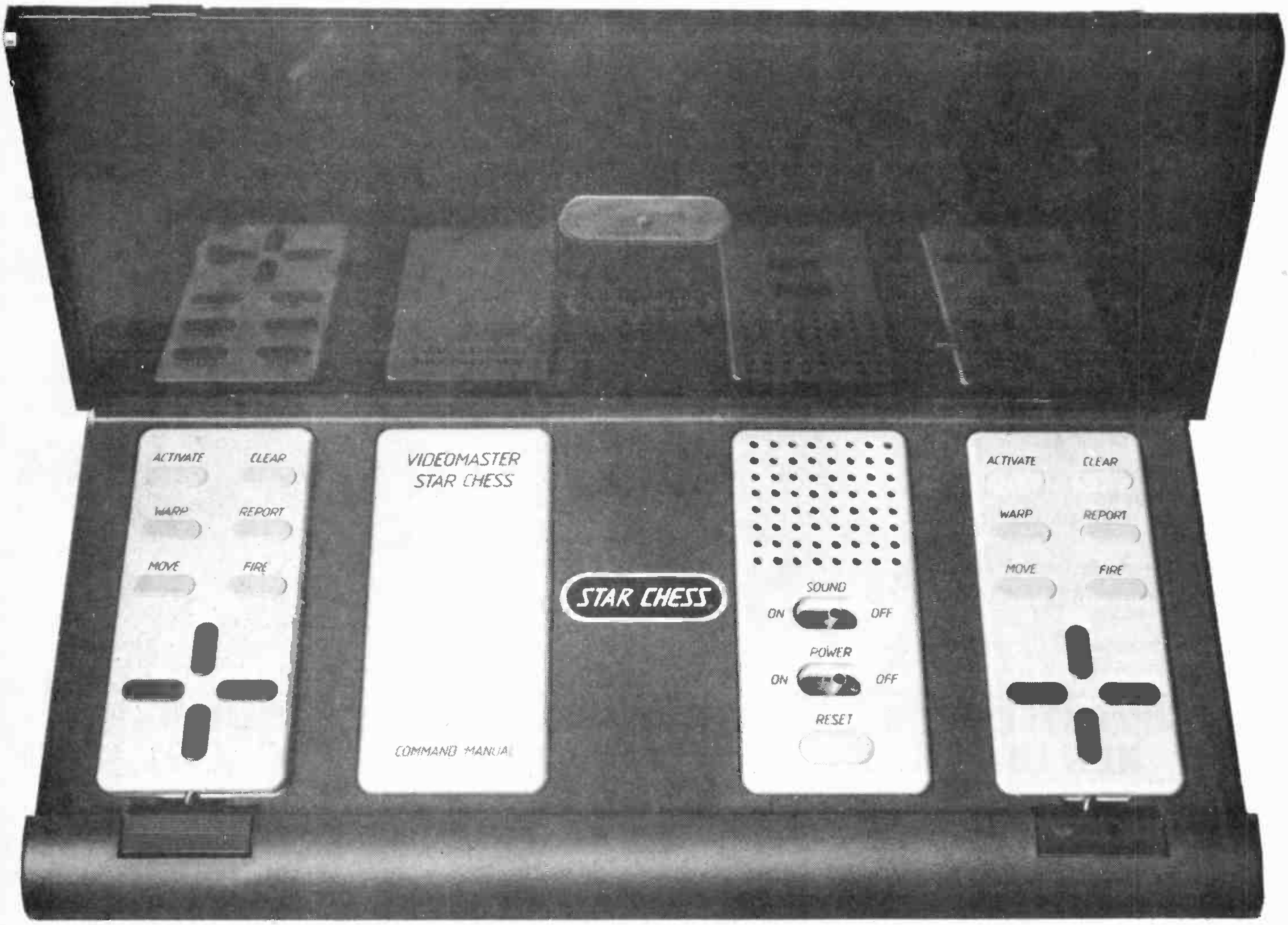


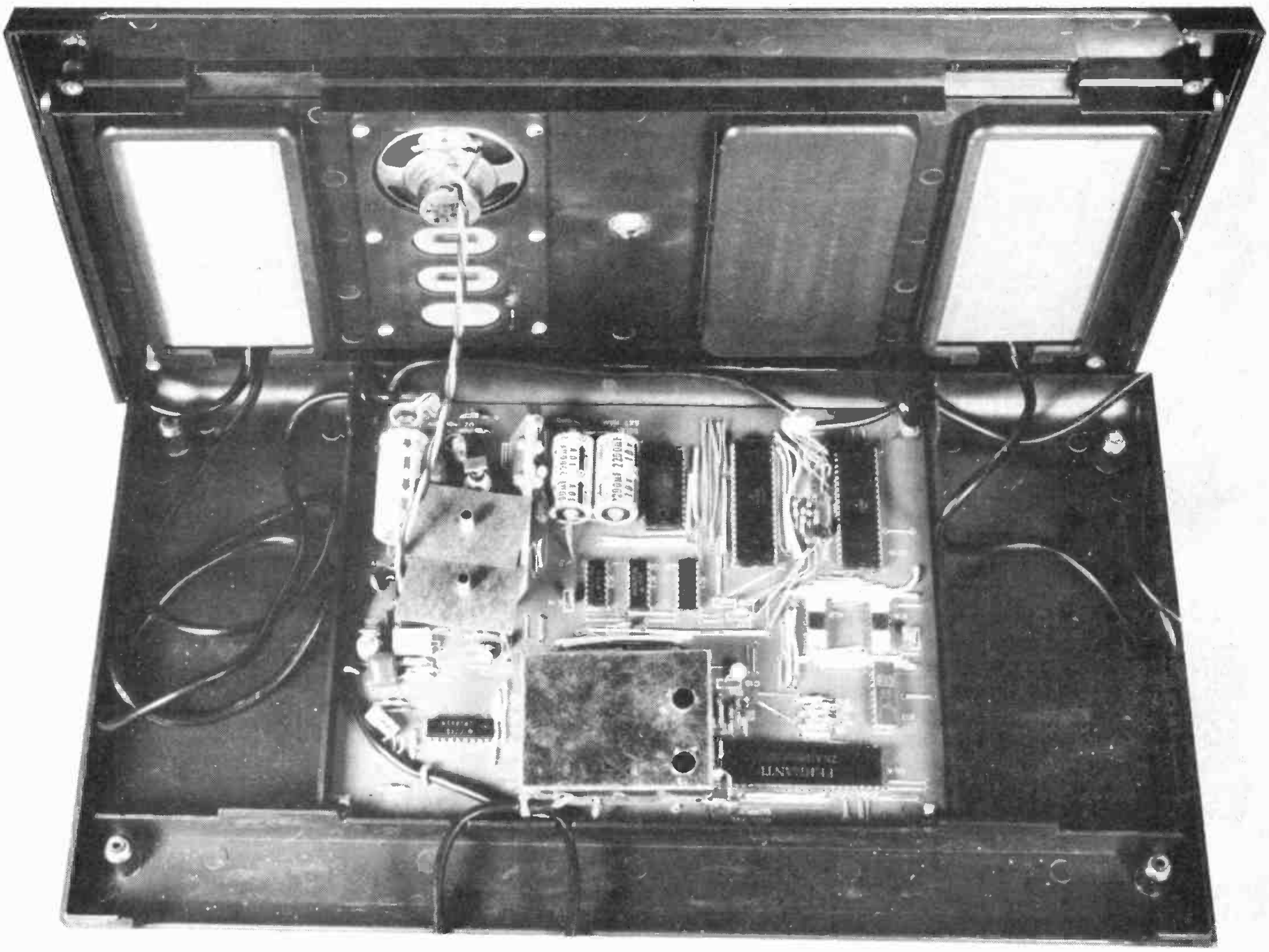
STAR CHESS

MOST OF YOU probably think that people who work on electronic magazines spend their days burrowing through mounds of exotic electronic equipment sent into us by eager manufacturers. Well to an extent that's true, we do get to see a fair amount of new stuff but how enthusiastic can you get over a 20 amp power supply or yet another revolutionary device that indicates 'heads or tails' at the flip of a switch?

Perhaps we're being a little unfair, the odd calculator or TV game does catch our jaded eyes but is usually followed by "Oh yeah and how many games does this one play?" It's true that we see more TV games than most people, so it's got to be good to get any kind of reaction, and such a game crept unceremoniously into the ETI offices last week. It had all the odds stacked against it from the beginning, for one thing it only had a one game repertoire, not a very good start for something costing almost sixty quid. It almost didn't get switched on! Perhaps it would have been better if it hadn't because ETI came to a virtual standstill for nearly three days.

Button boxes

Called STARCHESS it boasts a fine pedigree, coming as it does from Videomaster (now owned by Waddingtons). The game is housed in a fairly un-imposing black/grey box, looking like so many other TV games. The remote control boxes seemed to have more than their fair share of buttons but we're so used to a plethora of 'reset' and 'serve' knobs we didn't think much of it. Duly connected up to the power and TV set, it was switched on. Our ears were immediately assaulted by a shrill warbling sound punctuated by what can only be described as a noise like someone treading on a cat's tail — coming from the built-in speaker. A touch of the re-set



Chess games seem to be a growth area in the electronic games market, so find a mate and switch on the TV — Rick Maybury tells what to expect then . . . .

and clear buttons soon cured that.

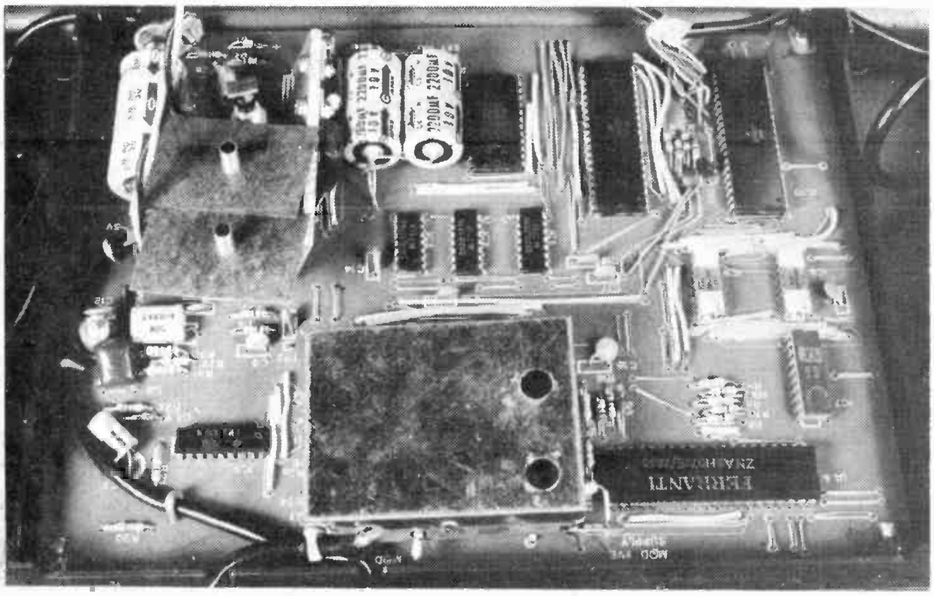
A quick fiddle with the TV's tuner brought in a sharp well defined chess board (in full colour) with some rather unconventional looking pieces lined up on the back ranks. A lengthy study of the instruction manual (more of that later) is highly recommended before any play commences.

At this point it must be said that you've got to be able to play chess but that hurdle over you can forget any ideas you may have about playing ordinary chess with this machine, that's about as likely as the editor of ETI becoming the next Prime Minister. After a game or two it soon becomes abundantly clear that what this game has that others seem to lack is the need to think, rather than a question of who can twiddle their knobs fastest?

A typical game is both noisy and exciting, the manufacturers have seen fit to include as many variables as possible but without making it cumbersome. We take our hats off to the software engineers who wrote the game.

A lovely mover

Each piece is moved by shifting a cursor with a set of four positional buttons arranged in a cross, when the cursor is over the piece to be moved the 'move' button is pressed, then the cursor is placed on the square to be occupied and the 'activate' button pushed. Every action is accompanied by a virtual symphony of 'squarks, warbles' and other equally strange noises, adding tremendously to the fun of the game. All of the pieces except the 'pawns' move exactly as ordinary chess. The main feature of the game, however, is the ability of each piece to 'fire' missiles in the direction it would normally move, so instead of taking an opponent's man you can take a pot-shot at it, although you're not guaranteed a ▶



(1)

Starchess, naked to the world. It has a surprising amount of parts for a 'dedicated' game, many of the ICs are unknown to us. The modulator deserves a mention: it produces one of the most stable and clear pictures of any TV game we've come across.

(2)

The preliminary stages of a game, the pieces may look rather unusual, particularly the 'queen' which looks a little like the 'Starship Enterprise.'

(3)

It's a bit confusing showing a game in black and white, there is an explosion on the screen (square C4). In fact the explosion is in red and accompanied by some very 'Star Wars' like sound effects.

hit, in fact you take a chance of hitting one of your own men if they are too close.

Each direct hit will destroy one of your enemy's 'shields' which can number from two (pawns) to seven for the King and Queen, and the amount of ammunition each man has is similarly limited. The pieces, however can replenish their ammunition by returning to the 'starbase' which is the squares occupied by the king and queen. When an opponent's shields have all been destroyed a further hit will produce a satisfying 'double explosion' (in red) and obliterate the piece completely.

Warped ideas

The second major feature is the ability to 'warp' any of your pieces from the board, the only danger in doing this is that the piece will return after a random period (from a few seconds to several minutes) and will reappear anywhere on the board, even on top of one of your own men (or your opponent's). The piece coming out of 'warp' makes a banshee like wail and slowly materialises (just like the transporter on the Starship Enterprise), but this is an extremely useful feature lending itself to risky but worthwhile tactics.

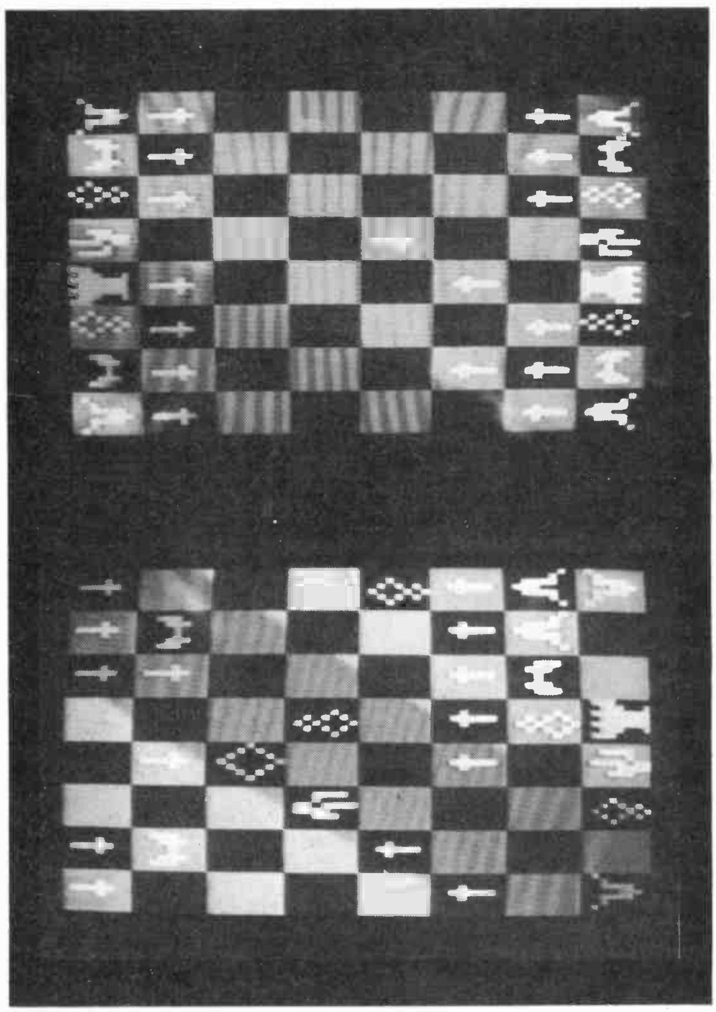
Yet another feature is the 'report' facility which apparently gives a readout of shield and weapon status but we found we rarely used it as it counted as one move.

All of the pieces are given alternative names which is just as well, because none of them look even remotely like ordinary chessmen, the rook for instance is a star-cruiser. The final objective of the game is to destroy your opponent's King, although it can't be taken on its Starbase, it can still be fired upon.

We did find we had one or two small niggles with the machine, it would have been a good idea for it to play ordinary chess, especially when most of the hardware is already there, and the power supply could have been located inside the case.

Taken overall, however it's without doubt the best 'dedicated' game we've ever come across and recommend it highly. By the way ETI Starchess team confidently challenges all comers to a shootout!

Any takers? ETI



Our thanks to N.I.C. Models for lending us an example of Starchess, just hope they don't want it back. But just in case they do it will cost us (and you) £59.95.

ETI MARK

CLOCK RADIO

You probably won't believe us as we're selling the goods but we're going to tell you anyway! We have *rejected* eight clock radios for Marketplace, they were all cheap enough but the quality was so poor that we couldn't have lent our name to them. However, we are now able to offer a portable LCD Clock Radio to you which meets our standards.

The clock is a 12-hour one with AM/PM indicated and a back light. The radio is Medium Wave and FM with very nice quality for a small speaker — for FM there's a telescopic aerial. The alarm can be either a 'beep-beep' type or the radio, there's also a snooze facility.

The case is sensibly rugged and is printed on the back with a World Time Zones map, a bit of a cheek really, especially as the time is relative to Japan!

We won't even mention the RRP — but just check on comparable prices — you'll find ours a bargain.

An example of this Clock Radio can be seen and examined at our Oxford Street offices.

£20.50

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ET PLACE

LCD CHRONO

We feel we've got to tell you carefully about this offer which we're introducing for the first time. Why? Because our price is so enormously lower than anywhere else you may suspect the quality.

The exact same watch is currently being offered by another magazine as a special at £24.95 — some of the discounters are selling it at £29.95, the price to ETI readers for exactly the same watch is £12.95.

The display is LCD and shows the seconds as well as the hours — and minutes — press a button and you'll get the date and the day of the week.

Press another button for a coujple of seconds and you have a highly accurate stopwatch with hundredths of a second displayed and giving the time up to an hour. There is a lap time facility as well — and of course a back light.

Our Chrono comes complete with a high grade adjustable metal strap and is fully guaranteed.

A sample of this watch can be seen and examined at our Oxford Street offices.

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(Inclusive of VAT and Postage)

To:
LCD Watch Offer
ETI Magazine
25-27 Oxford Street
London W1R 1RF

Please find enclosed my cheque/PO for £12.95 (payable to ETI) for my LCD Chronograph.

Name . . . .

Address . . . .

. . . .

. . . .

Please allow 28 days for delivery.

DIGITAL ALARM MK2

Both ETI and Hobby Electronics have sold a lot of digital alarm clocks — over 10,000 in fact — maybe that's something to do with the fact that we sell at real bargain prices. Now we can offer you a truly modern, space age model.

It includes all the facilities expected in a good design — fast, slow setting, snooze facility, etc plus two unusual features — automatic brightness control and a weekend alarm cancel.

An example of this clock can be seen and examined at our Oxford Street offices.

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DIGITAL ALARM CLOCK MK2 Offer,
ETI Magazine,
25-27 Oxford Street,
London W1R 1RF.

Please find enclosed my cheque/PO for £10.50 (payable to ETI Magazine) for my digital alarm clock.

Name . . . .

Address . . . .

. . . .

. . . .

Please allow 28 days for delivery.

ALARM-CHRONO LCD

Currently this watch is being discounted elsewhere for typically £39.95 (we don't quote RRP as this is meaningless) and the watch is a 'Chinese copy' of a very famous one in the £100 range!

The facilities are exceptional:

- Normal hours and minutes
- Continuous seconds or data display
- Day of the week
- Stopwatch with 0.1 secs resolution
- Lap time facility with automatic return to stopwatch after 6 seconds
- Different time zone setting with indepen-deht date, day of week settings
- Good bleeping alarm
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ALARM/CHRONO LCD WATCH Offer,
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25-27 Oxford Street,
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Name . . . .

Address . . . .

. . . .

. . . .

Please allow up to 28 days for delivery.

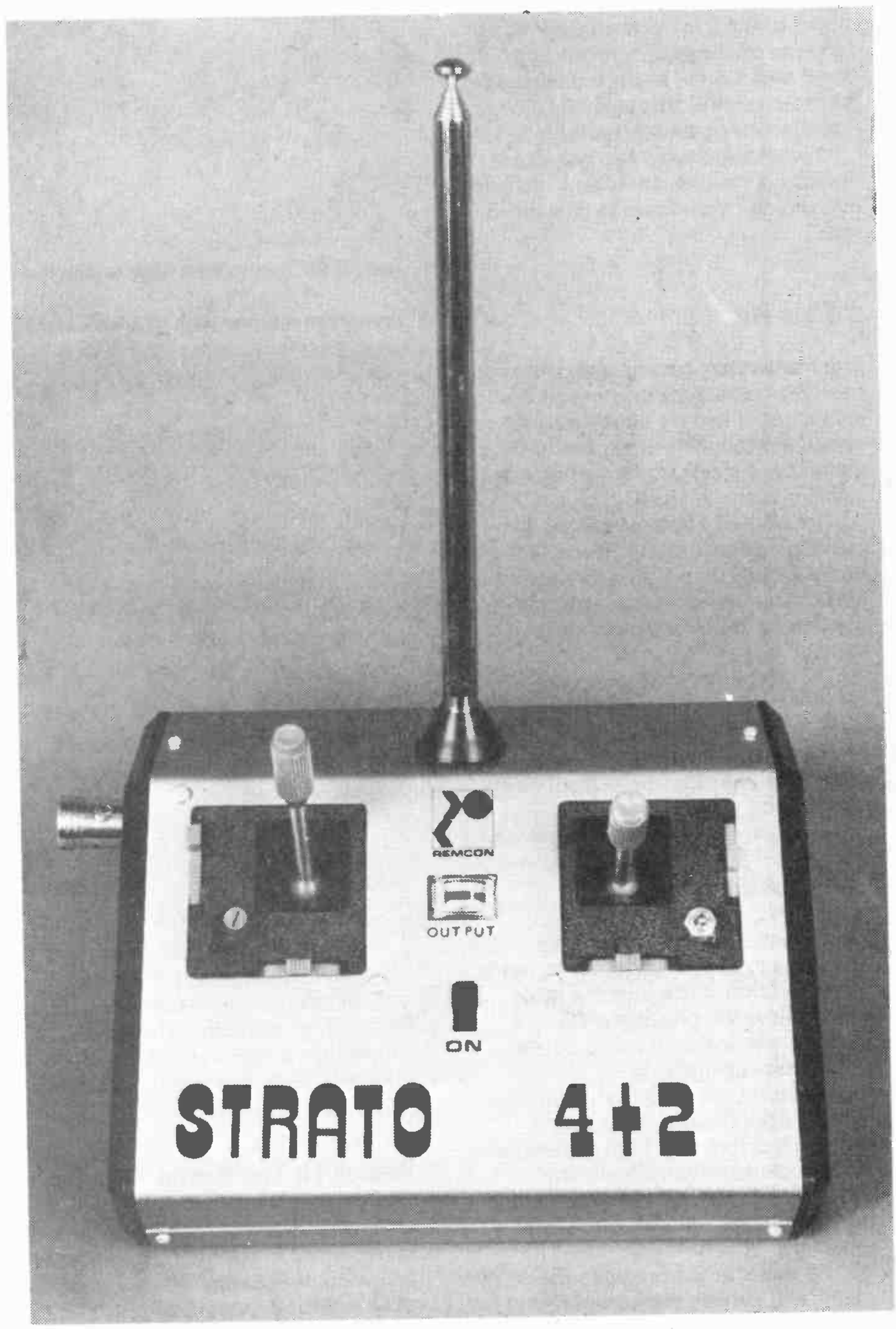
RADIO CONTROL SYSTEM
PART 1: TRANSMITTER

THERE WERE SEVERAL criteria we considered important in any radio control system before this project came up, and these have been perhaps the main reason for ETI keeping out of this field thus far.

However Rencoms design, presented here, satisfys our requirements perfectly and fulfills a few we hadn't thought of. Firstly it is easily constructed and easy to set up — too many systems are marred by their requirements for expensive test gear in the alignment procedures. All that is needed here is a simple voltmeter.

Secondly the transmitter produces a 'clean' output which does not interfere with adjacent channels to any degree worth mentioning. This is an essential requirement since the receiver can handle 10kHz channel spacing, and interference would render this unusable. In any case this is now a legal requirement in many countries.

The charger for both transmitters and receiver can be built into the transmitter case itself, which any enthusiast will recognise as a decided convenience a five pin socket fitted to the case allows access to the charger circuit for this facility, and the same socket holds the transmitter crystal (normally encased within a DIN plug). This means channels can be changed quickly — or the set disabled — simply by removing the plug.



Tune In

The Strato system can be built as either a four or six channel unit, and is suitable for any kind of model from airplane to boat. Choice of servo will be made according to the vehicle to be controlled. ▶

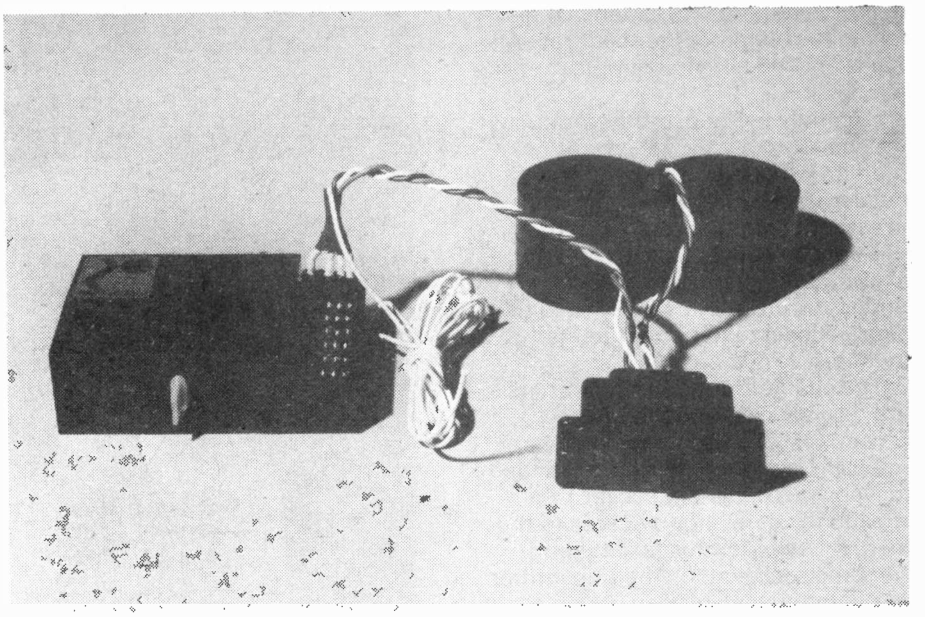
Publication of the system will be in two parts, transmitters first. Next month there will be full details of the receiver unit along with some hints on installing the radio control. There will also be a follow up article later designed to give some ideas of what can be achieved with a system of this versatility.

We chose an armoured vehicle as the example upon which to base our articles, as this is more general in principle than most and allows easier illustration. The model we used was the excellent Tamiya 1/16th Leopard kit. This gives a splendid model of the W. German tank with Tamiyas usual superb moulding detail and a drive system designed for radio control through an ingenious twin clutch system.

It is an expensive kit, but in our opinion is well worth it, and includes everything right down to the servo rods.

Above: the Tamiya tank upon which the system is based

Below: the receiver with its DEAC and charger switch



A Case For It

The transmitter case is designed for four channels to be controlled by joystick and two by either pot or simple switch. The latter could be useful for aircraft undercarriage and the like.

The angled aerial produces a radiation pattern that reduces the risk of an aircraft (in particular) getting itself into an area of low strength and thus passing beyond operator control.

The meter on the front panel is a form of field strength meter and is used initally for setting the only tuning control in the TX circuitry, and thereafter indicates RF output as a check upon performance.

Construction

Building the Tx should pose no problems to the average constructor, but when fitting the joystick and case, follow the photographs carefully otherwise it could cause unnecessary problems.

Assemble the PCB first, and check carefully the polarity of semiconductors etc. Fit the aerial and other sockets initially, then the passives and leave the transistors until last. Note the inductors are labelled.

The small PCB fits aback the meter and carries the components for the FSM.

Solder the output wires to the board at this stage as fitting the control pots later will be tricky else. Follow the installation drawings carefully and there should be no trouble. Check everything carefully though.

Power To The Aerial

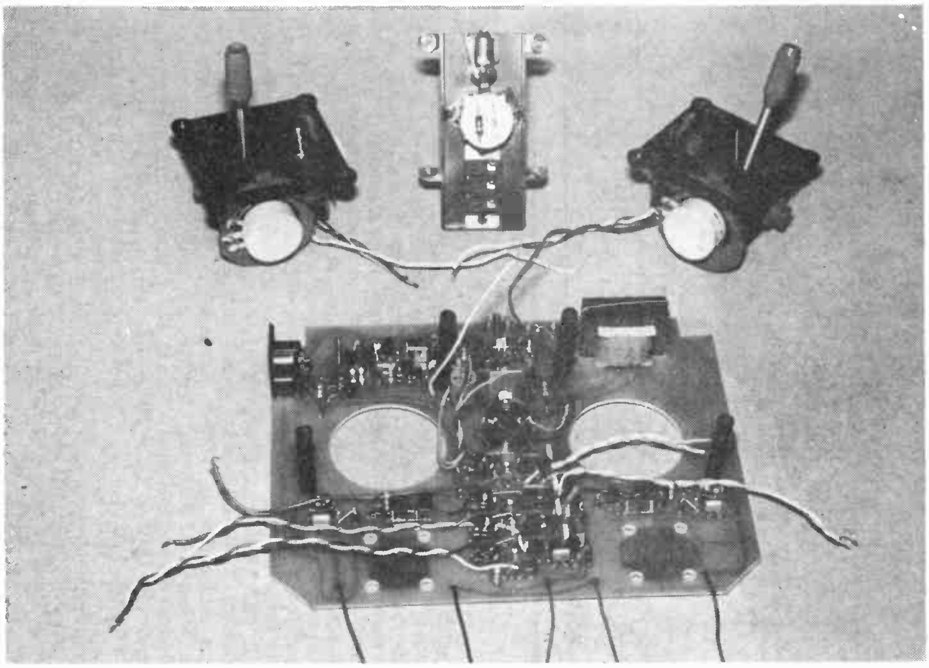
Once the board is complete and the sticks wired fit the rechargeable cells, screw in the aerial (telescoped) and plug in your crystal. Switch on.

The meter should show a reading. Rotate CI using a small insulated screwdriver or better yet a plastic control trimmer the reading will rise and fall as CI is rotated.

Extend the aerial fully and rotate CI to get a maximum meter reading. It helps during this operation to keep a finger on the —ve of the cells to provide an earth load.

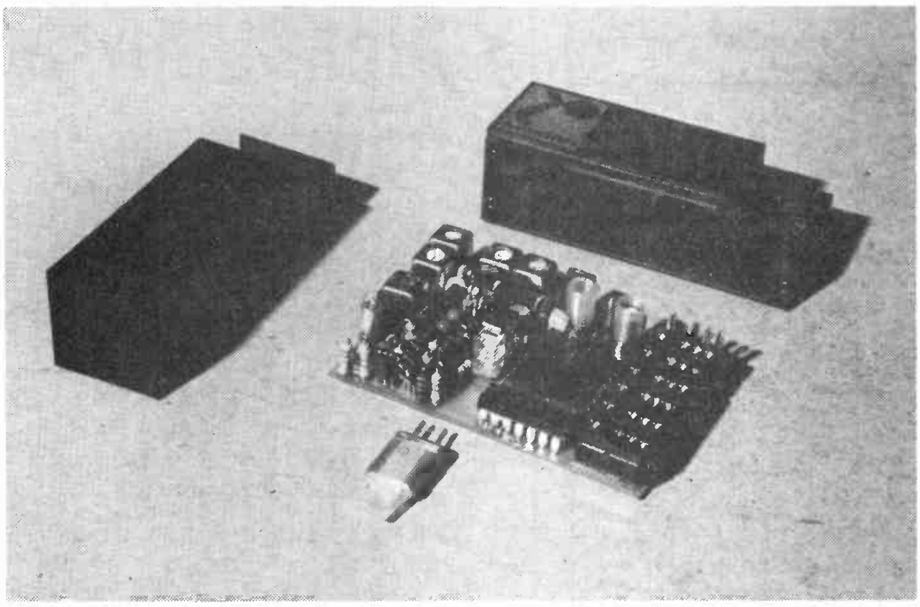
The reading should be about 80-90% of FSD so move the FSM aerial around slightly to obtain this.

The transmitter is now tuned. Presets PRI-6 are used to set the centres of servo operation and do not interfere with RF output at all.



Above: a denuded transmitter unit. The joysticks mount above the board.

Below: the receiver removed from its case. Note the crystal.



Fit the completed assembly to the case, lining up the aerial bush with the plastic grommet on the case top. For those not fitting the internal charger, cover the holes in the back of the case with some tape or card.

Charge

Remember that the cells used will take 14 hours to charge from flat, and the bulb will light quite brightly at first and then dim as charging progresses. To charge the Tx batteries alone fit the DIN plug with R32 across pins 1 and 2 and plug in the mains lead to the rear socket.

That same DIN socket is utilised many ways. Pins 4 and 5 are the connections for the Tx crystal. Pins 1 (+ve) and pin 2 (—ve) allow charging of both the Tx and Rx cells together. Pins 2 and 3 if strapped together can switch on the Tx so that when removed 'locks off' the unit. Makes unauthorised use a little difficult! Pins 2 (+ve) and pin 5 (—ve) connect an external charger to the Tx cells. 50mA maximum please.

Crystal Clear

By changing crystal you change channel, and the colour can be used ▶

BUYLINES

With a project of this type the metalwork is more important than for our usual endeavours. For the transmitter in particular, with the joysticks and aerial to be mounted, we cannot imagine anybody enjoying filing away for hours. In consequence we strongly recommend use of the hardware packs offered by the designers, Remcon. Our photographs and text employ these.

Ambit are marketing the components for this project, so between the two a complete kit is to be had. We estimate that, including four servos, the project will cost about £130 in total, which is approximately £60 less than a commercial set-up of approximately equal performance would cost.

The model we intend to base our installation on is the Tamiya Leopard A4 in 1/16th scale, which is designed for radio control. The kit is superb in all respects, both as a model and as a vehicle for radio control, and cannot be recommended highly enough. Beatties chain of stores stock the kit and it will cost around £90 including the gearbox/clutch/motor assembly for direction control.

Component details:
From Remcon.

Manual for system (worthwhile step-by-step constructional details) £2.75

£1.00 refundable against purchase of packs over £25

Transmitter hardware pack (everything except components and batteries):
4 channel £39.95
6 channel £45.00

All components available separately. SAE to Remcon for details.

Receiver hardware pack complete (six channels) £18.50

All components available separately.

From Ambit —

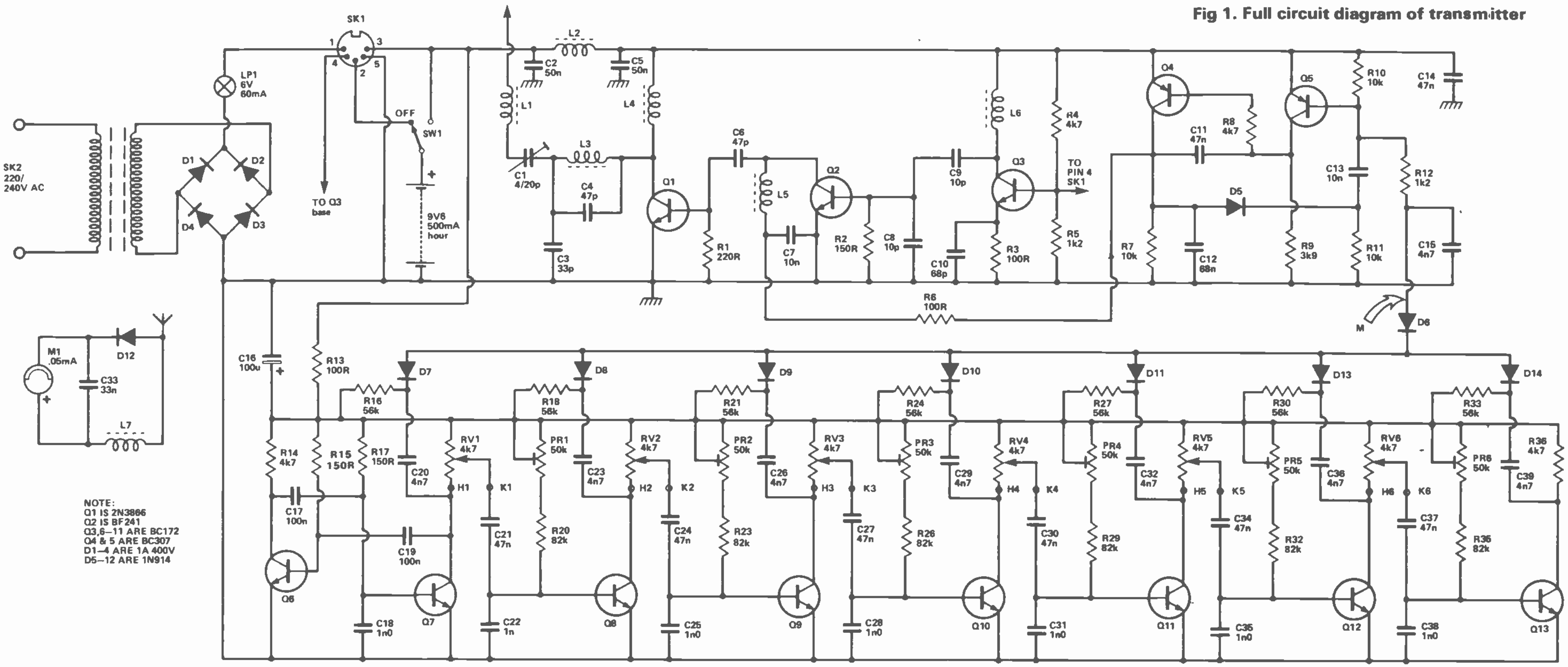
Transmitter components £10.95
Two PCB DIN plugs and charging resistors £1.60
Matched crystals (2) and DIN plug £4.00
Five-pin plug DIN (options) £0.75
Receiver components (complete) £8.95

All components available separately. Rechargeable batteries also available. SAE for details.

Any servo will operate with the Strato system. Next month we will give wiring details for the different types.

Addresses:
Ambit International, 2 Gresham Road, Brentwood, Essex.
Remcon Electronics, 1 Church Road, Bexleyheath, Kent.
Add 12½% VAT to all prices except manual.

Fig 1. Full circuit diagram of transmitter



HOW IT WORKS

This has been designed to meet the stringent requirements of continental post offices in respect of harmonic radiation and sidebands and has adequate power output to ensure out-of-sight range for model aircraft.

Referring to the transmitter circuit Q6, 7 R14-17, RV1, C16-19 comprise a conventional astable mutivibrator of unity M/S ratio, and period approximately 20mS. This is the system clock. If we look for a moment at Q8-11 it will be seen that these initially have their collectors close to the - ve rail potential due to their base bias. Now when the collector of Q7 goes to logic 0, the step change in voltage at the slider of channel 1 control potentiometer RV1, is passed via C21 to the base of Q8, cutting off its collector current. The collector of Q8 therefore goes to logic 1. The base potential of Q8 slowly rises on a time constant C21 (R19+R20) until the base/emitter diode again becomes forward biassed At this point the collector goes to logic 0 once again. When this happens, the -ve going stage voltage at the channel 2 control. potentiometer RV2 cuts off Q9, followed by the same pattern of events as detailed for Q8. This sequence is followed by Q10 and Q11. Potentiometers RV1-4 are the operator controls, and R19, 22, 25, 28 permitsetting of the pulse width with the channel controls centred. These adjustments are carried out to set the mid-travel position of the servos.

The encoding process is completed by the C,R and diode network at the collectors of Q7-11. Taking as an example, C26, C21, D9, capacitor C26 is normally charged to a potential approximately that on C16, When Q9 is cut-off by the pulse from Q8, C26 discharges on a time constant C26 (R21+RV3), which is much less than the 1ms minimum duration of channel data. When Q9 is again turned on, D9 and D6 are forward biassed by the current through R12 turns on Q5 which is part of the monostable which modulates the buffer stage Q2. Before triggering, Q5 to cut-off, and Q4 therefore turned on by base bise current through R9, R6. When triggered by an encoder pulse via D6, Q5 conducts turns off Q4, which reverse biasses D5. C13 then charges through R11, maintaining Q5 in its turned on state for a period determined by C13, R11. Since this occurs when Q7-11 collector go to logic 0 then five absolutely identical pulses will be generated by Q4 and Q5 in every 20 mS frame of data.

The RF section is one of elegant simplicity, having only one adjustment, C1, Q3 is the crystal oscillator using 27 MHz 3rd overtone crystal base to -ve rail 27 MHz output is coupled to the base of buffer/modulator stage Q12 via C9. As we mentioned in the description of the encoder, Q4 is normally conducting, which means that collector voltage is applied to Q2 via R6 and L5. The amplified RF from Q2 collector passes to the power amplifier Q1 via C6. Impedance matching from Q1 collector to the power amplifier Q1 via C6. Impedance matching from Q1 collector to the aerial is effected by pre- coupler C3, L3 C4, and base loading by the adjustable network L1, C1. A simple RF meter circuit is included, comprising the meter, C33, L7, D12, it is used to peak the aerial matching adjustments during initial setting up. Thereafter it constantly indicates the carrier strength.

Before leaving the transmitter it is perhaps worth mentioning C2, L2, C5, C11, C14, C15, C18, C22, C25, C28, C31. They are all there to prevent R.F. from reaching unauthorised, and sensitive parts of the circuit!

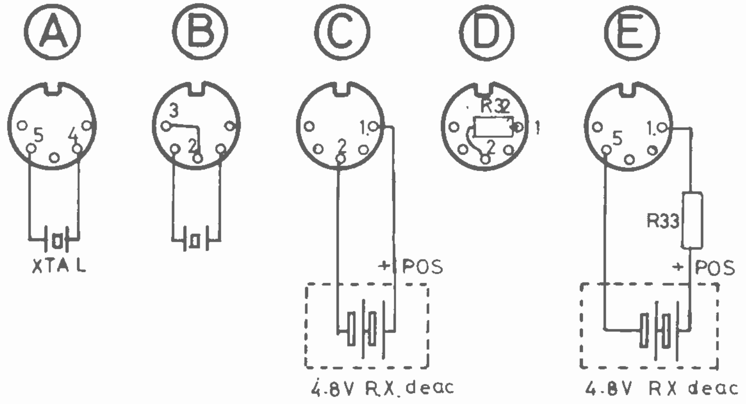
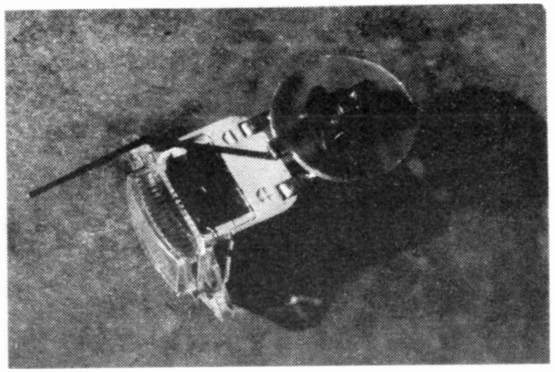
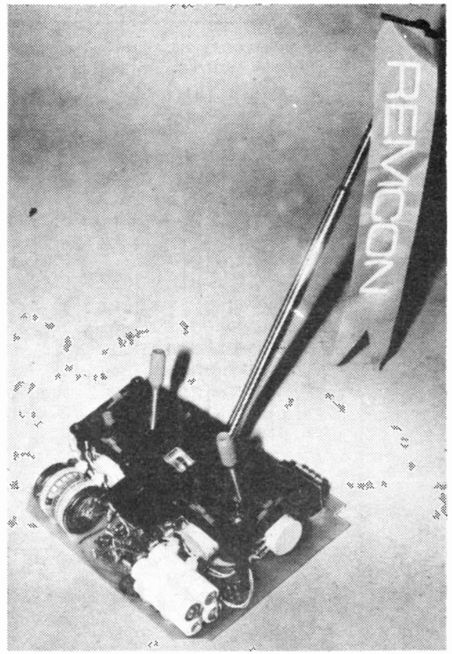


Fig 2. All the possible DIN plug configurations. See text for uses.

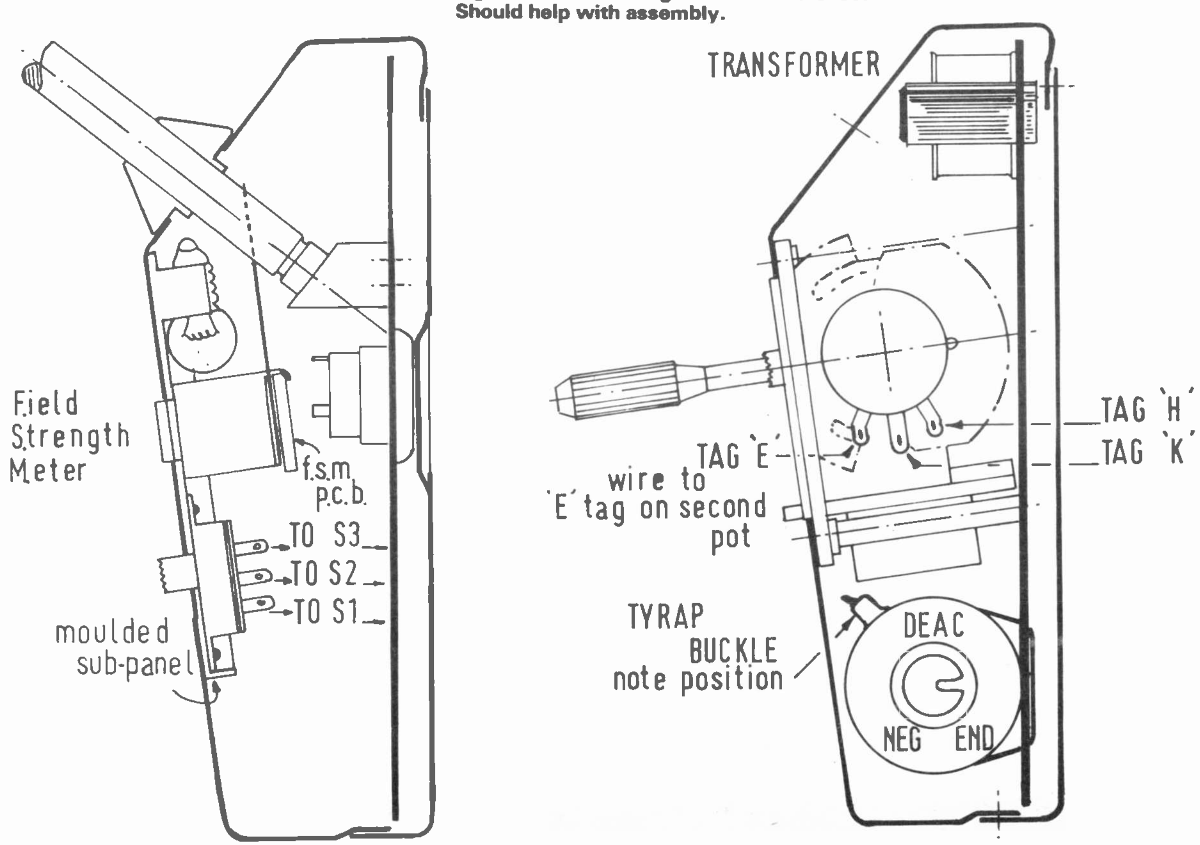


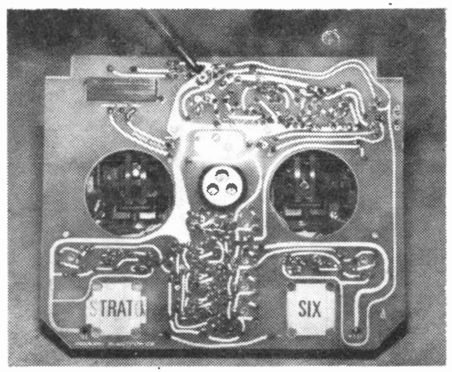
The field strength meter, with PCB ready for bending at the meter tabs.



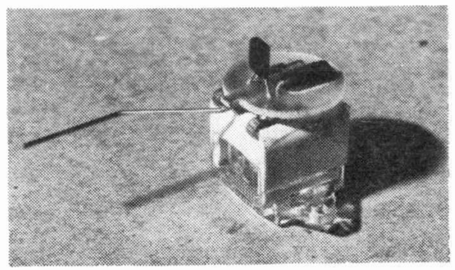
The complete Tx excluding case.

Fig 3. Section through transmitter case. Should help with assembly.





Copper side of PCB. Note earth bush.



The field strength meter with pCB bent over for fixing.

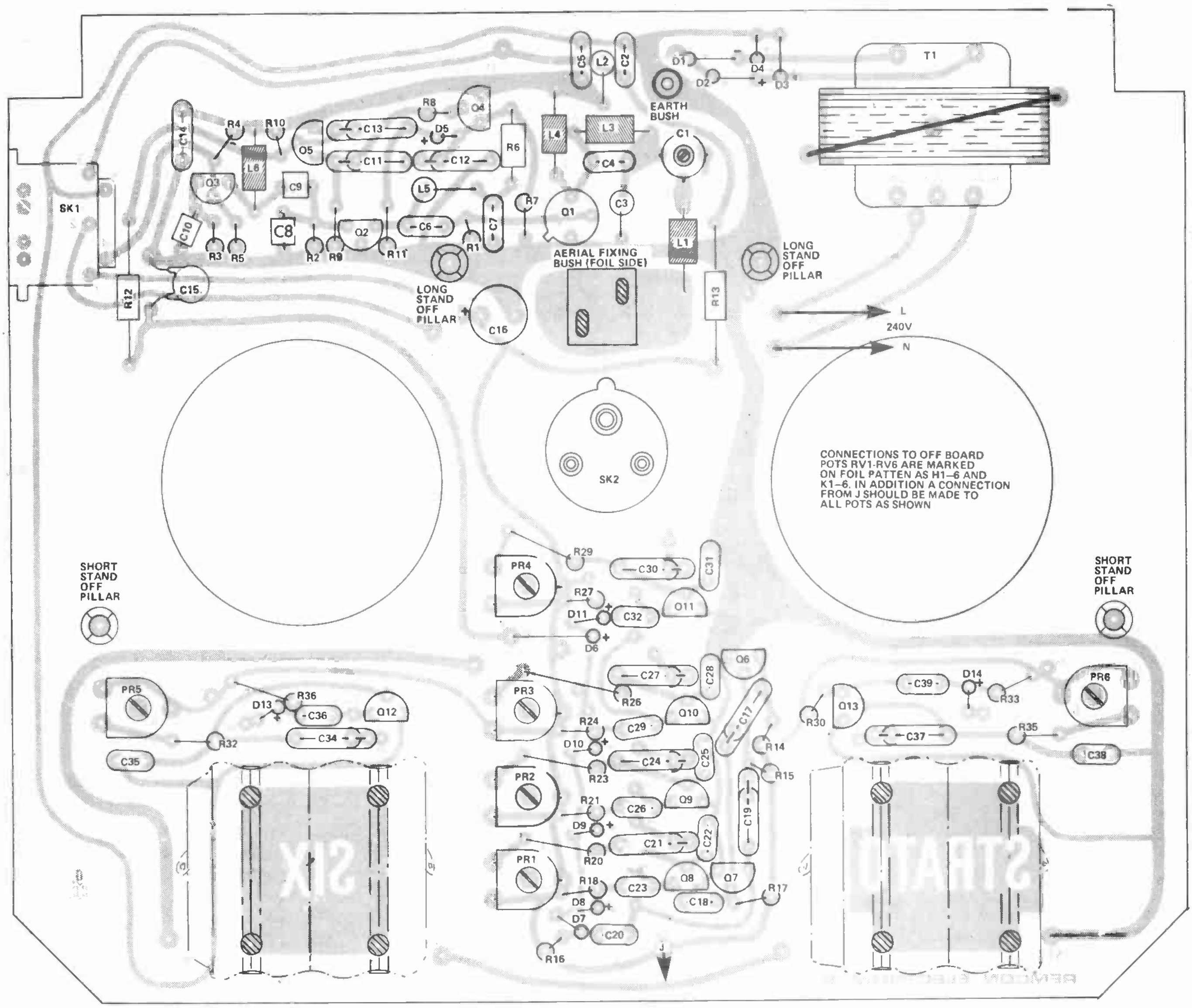


Fig 4. the main component overlay for the transmitter. Note that PR1-6 are 50k in value.

PARTS LIST

RESISTORS (all ¼W 5%)

R1	220R
R2,15,17	150R
R3,6,13	100R
R4,8,14,36	4k7
R5,12	1k2
R7,10,11	10k
R9	3k9
R18,21,24,27,30,33,16	56k
R20,23,26,29,32,35	82k

Note that R19,22,25,28,31,34 are annotated as PRI-6 to correspond to channel number

POTENTIOMETERS

RV1-RV6	4k7

CAPACITORS

C1	4-20p trimmer
C2,5	50n polystyrene
C3	33p polystyrene
C4,6	47p polystyrene
C7	10n polyester 5%
C8,9	10p polystyrene
C10	68p polystyrene
C11,14	47n ceramic
C12	68n polyester 5%
C13	10n ceramic
C15,20,23,26,29,32,36,39	4n7 ceramic
C16	100u electrolytic 25V
C17,19	100n polyester 5%
C18,22,25,28,31,35,38	1n0 ceramic
C21,24,27,30,34,37	47n ceramic
C33	33n ceramic

INDUCTORS

L1,2	4u7
L3	220n
L4	22u
L5	680n
L6	1u5
L7	10u

SEMICONDUCTORS

Q1	2N3866
Q2	BF241
Q3, 6-11	BC172
Q4,5	BC307
D1-D4	ITT 2002 or equivalent
D5-D12	1N914

MISCELLANEOUS (for charger version)
Mains skt, 6V 60mA bulb, 20V 1A secondary transformer, meter 200uA FSD, 5 pin DIN skt, metalwork (see Buylines), aerial — 1.4m long.

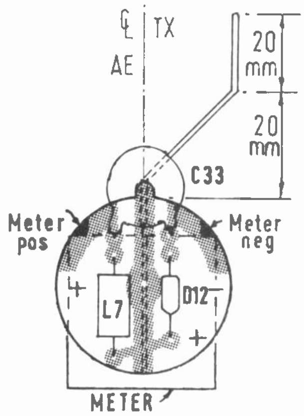
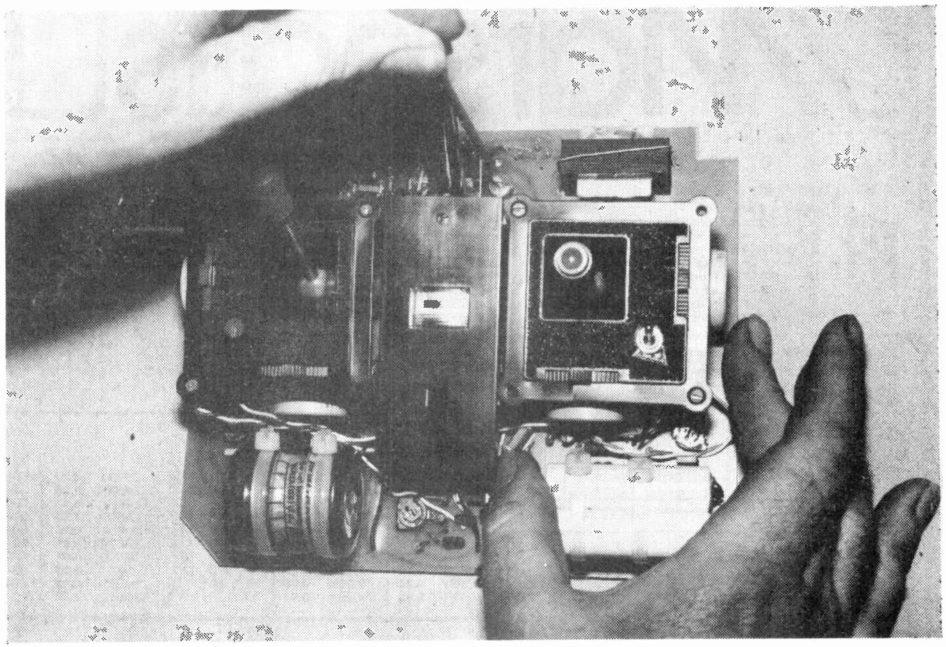
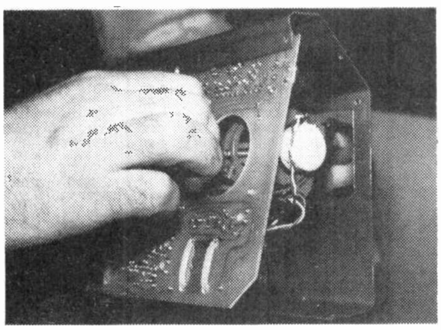


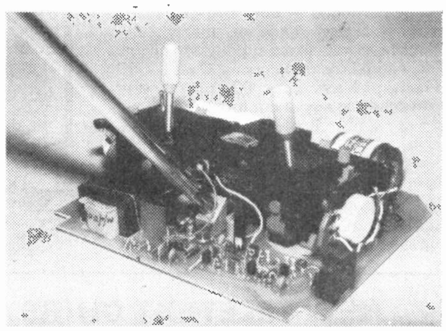
Fig 5. (Above) the overlay for the meter PCB. This mounts atop the meter itself



Tuning involves one adjustment only one note thumb on battery earth.

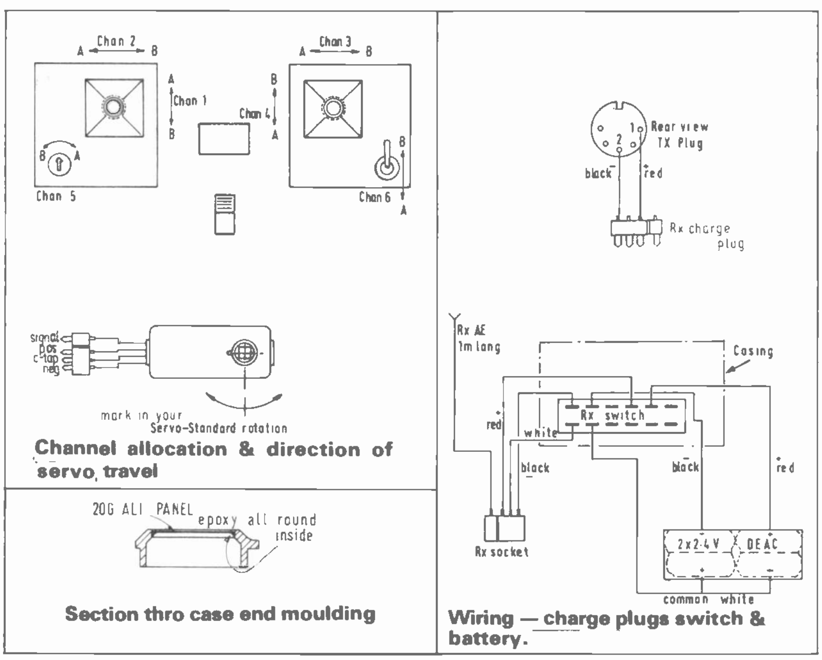


The top of the PCB slips under the flange at the top of the case.



The Rf end of the PCB.

Fig 6. (Below) Plug wiring for servos and channel line-up.



Channel allocation & direction of servo travel

Section thro case end moulding

Wiring — charge plugs switch & battery.

to identify operation easily. The standard system of coding is:—

Tx	Rx	Colour
26.995	26.54	Brown
27.045	26.59	Red
27.095	26.64	Orange
27.145	26.69	Yellow
27.195	26.74	Green
27.255	26.80	Blue

Conclusion

So that's about it for the transmitter, except to remind you that to run a radio control system you NEED A LICENCE. This costs £2.80 for five years and obtained from:—

The Home Office
Radio Regulatory Dept
Waterloo Bridge House
London
SE1 8UA.

Next month we will be giving full details of the receiver and installation of the system into a model. In the meanwhile for the fleet of soldering iron, or just plain impatient, Remcons manual contains full constructional details of the complete system and will be available shortly.

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London NW6 4T4. Tel: 01-624 0805
Telex: 21492

Retail sales: London: 40-42 Cricklewood Broadway, NW2 3ET. Tel: 01-452 0161/2. Also 325 Edgware Road, W2 Tel: 01-723 4242. Glasgow: 85 West Regent Street, G2 2QD. Tel. 041-332 4133 and Bristol: 1 Straits Parade, Fishponds Road, BS16 2LX. Tel 0272 654201

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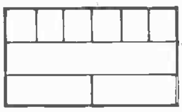
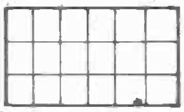


89 £1.62



818 £1.78

LINEAR (See catalogue for full range)

LM339N	0.60	LM1351N	1.30	CA3000	3.30
LM340T-5	0.88	LM1458N	0.45	CA3001	4.25
LM340T-12	0.88	LM1496N	0.97	CA3002	3.30
LM340T-15	0.88	LM1800N	1.94	CA3006	4.60
LM340T-24	0.88	LM1801N	2.25	CA3007	4.15
LM341P-5	0.56	LM1808N	2.10	CA3008	2.55
LM341P-12	0.56	LM1812N	6.20	CA3012	1.65
LM341P-15	0.56	LM1820N	1.16	CA3013	1.85
LM341P-24	0.56	LM1828N	1.90	CA3014	2.20
LM345K	6.97	LM1830N	1.90	CA3018	0.75
LM348N	0.95	LM1845N	1.50	CA3018A	1.10
LM350K	6.50	LM1848N	1.98	CA3020	2.20
LM358N	0.60	LM1850N	1.90	CA3020A	2.50
LM360N	3.00	LM1889N	2.50	CA3021	2.40
LM370N	3.30	LM1890N	P.O.A.	CA3022	2.20
LM371H	2.35	LM2907N-8	1.80	CA3023	2.20
LM373N	3.35	LM2917N-8	1.80	CA3026	0.70
LM374N	3.35	LM3301N	0.60	CA3028A	0.90
LM377N	1.80	LM3302N	0.55	CA3028B	1.25
LM378N	2.40	LM3401N	0.55	CA3029	0.75
LM379S	4.25	LM3900N	0.68	CA3029A	0.90
LM380N-8	0.96	LM3905N	1.15	CA3030	1.50
LM380N-14	1.08	LM3909N	0.78	CA3030A	2.20
LM381AN	2.70	LM3911N	1.10	CA3033	3.70
LM381N	1.69	LM3913N	P.O.A.	CA3034	2.75
LM382N	1.32	LM3914N	2.79	CA3035	1.95
LM384N	1.55	LM4250CN	1.30	CA3036	1.21
LM386N	0.88	LM78L05CH	0.85	CA3038	2.90
LM387N	1.10	LM78L12CH	0.85	CA3038A	4.10
LM388N	1.00	LM8L15CH	0.85	CA3039	0.77
LM389N	1.00	LM78L24CH	0.85	CA3040	3.75
LM392N	0.87	LM7805KC	1.58	CA3041	1.65
LM7018	2.99	LM7812KC	1.56	CA3042	1.65
LM701C	2.99	LM7815KC	1.56	CA3043	2.20
LM702C	0.81	LM7824KC	1.56	CA3045	1.55
LM703LN	1.15	LM78L05CZ	0.30	CA3046	0.77
LM709CH	0.70	LM78L12CZ	0.30	CA3047	2.20
LM709-8	0.50	LM78L15CZ	0.30	CA3047A	3.70
LM709-14	0.49	LM78L24CZ	0.30	CA3048	2.45
LM710CH	0.87	MC667P	2.75	CA3049	1.98
LM710-14	0.48	MC671P	1.75	CA3050	2.66
LM711CN	0.48	MC6772P	1.75	CA3051	1.82
LM716	1.00	MC724P	2.10	CA3052	1.78
LM723CH	0.62	MC789P	1.80	CA3053	0.77
LM723C-14	0.46	MC790P	3.10	CA3054	1.10
LM741CH	0.50	MC798P	2.20	CA3059	2.10
LM741C-8	0.30	MC799P	2.20	CA3060	2.50
LM741C-14	0.60	MC832P	0.70	CA3062	3.75
LM747CN	0.78	MC833P	0.70	CA3064	1.10
LM748-8	0.50	MC836P	0.82	CA3065	1.10
LM748-14	0.50	MC837P	0.82	CA3068	3.80
LM900	0.50	MC838P	2.35	CA3070	1.90
LM911	0.50	MC840P	1.65	CA3070	1.90
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LM1304N	1.52	MC849P	0.70	CA3076	2.12
LM1305N	1.02	MC857P	0.85	CA3080	0.85
LM1307N	1.22	MC861P	0.85	CA3080A	2.10
LM1310N	2.10	MC1035P	1.90	CA3086	0.50
				CA3038F	1.87

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MM5303N	6.83	MM56105N	10.43	TMS4045-20NL	9.95	TMS9905	P.O.A.
MM5307AA/N	13.65	MM57109N	13.41	TMS4050-2NL	6.46	ADC0817CCN	15.63
MM5314	4.60	MM57160N	6.71	TMS4051-2NL	6.46	ADC3511CCN	8.30
MM5316	4.60	MM57161N	6.71	TMS4060-2NL	6.46	ADC3711CCN	9.35
MM5330N	4.20	TMS2716JL	19.50	TMS4116-25JL	26.00	ADD3501CCN	8.30
MM80C95N	0.58	TMS4027-25NL	6.10	TMS4164NL	P.O.A	ADD3701CCN	9.35
MM80C96N	0.65	TMS4033NL	1.75	TMS6011NC	5.36	AY2513	8.75
MM80C97N	0.58	TMS4036-2NL	3.28	TMS9900JL	44.41	AY-3-8500	6.50
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74C02N	0.24	74C73N	0.54	74C107N	1.22	CD4001B	0.20	CD4014	1.00
74C04N	0.24	74C74N	0.56	74C150N	4.14	CD4002	0.18	CD4015	0.75
74C08N	0.24	74C76N	0.54	74C151N	2.47	CD4006	1.25	CD4016	0.52
74C10N	0.24	74C83N	1.30	74C154N	3.68	CD4007	0.18	CD4017B	1.05
74C14N	0.95	74C85N	1.30	74C157N	2.21	CD4008B	0.99	CD4918B	1.05
74C20N	0.24	74C86N	0.64	74C160N	1.11	CD4009	0.58	CD4019B	0.52
74C30N	0.24	74C89N	4.39	74C161N	1.11	CD4010	0.58	CD4020B	1.15
74C32N	0.24	74C90N	0.85	74C162N	1.11	CD4011B	0.20	CD4021	1.05
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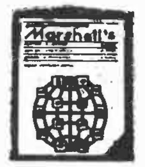

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SN74H30N	0.55	74LS78N	0.42	74LS193N	0.95
SN75H40N	0.55	74LS83AN	0.90	74LS194N	0.70
SN74H51N	0.55	74LS85N	0.95	74LS195N	0.70
SN74H53N	0.56	74LS86N	0.44	74LS196N	0.80
SN74H54N	0.55	74LS90N	0.64	74LS197N	0.80
SN74H55N	0.55	74LS91N	1.20	74LS221N	0.80
SN74H60N	0.55	74LS92N	0.70	74LS240N	1.50
SN74H62N	0.55	74LS93N	0.64	74LS241N	1.50
SN74L00N	0.55	74LS95AN	0.90	74LS242N	1.25
SN74L02N	0.56	74LS96N	1.35	74LS243N	1.25
SN74L04N	0.60	74LS107N	0.42	74LS244N	1.50
SN74L47N	3.10	74LS109N	0.42	74LS245N	1.65
SN74L74N	0.90	74LS112N	0.42	74LS247N	1.09
SN74L85N	2.62	74LS113N	0.42	74LS248N	1.09
SN74L93N	2.30	74LS114N	0.42	74LS249N	1.09
74LS00N	0.26	74LS122N	0.62	74LS251N	1.00
74LS01N	0.26	74LS123N	0.83	74LS253N	1.00
74LS02N	0.26	74LS124N	1.70	74LS257N	1.00
74LS03N	0.26	74LS125N	0.60	74LS258N	1.00
74LS04N	0.29	74LS126N	0.50	74LS259N	1.55
74LS05N	0.29	74LS132N	0.85	74LS261N	3.25
74LS08N	0.26	74LS136N	0.42	74LS266N	0.44
74LS09N	0.26	74LS138N	0.65	74LS273N	1.30
74LS10N	0.26	74LS139N	0.65	74LS275N	3.20
74LS11N	0.26	74LS145N	1.30	74LS279N	0.58
74LS12N	0.26	74LS147N	1.65	74LS280N	1.65
74LS13N	0.58	74LS148N	1.35	74LS283N	1.20
74LS14N	0.75	74LS151N	0.58	74LS289N	3.74
74LS15N	0.26	74LS153N	0.58	74LS290N	1.00
74LS20N	0.26	74LS154N	1.45	74LS293N	1.00
74LS21N	0.26	74LS155N	0.80	74LS295N	1.35
74LS22N	0.26	74LS156N	0.80	74LS298N	1.35
74LS26N	0.32	74LS157N	0.60	74LS299N	2.95
74LS27N	0.26	74LS158N	0.65	74LS323N	3.50
74LS28N	0.29	74LS160N	0.80	74LS324N	1.65
74LS30N	0.26	74LS161N	0.85	74LS325N	2.40
74LS32N	0.27	74LS162N	0.80	74LS326N	2.70
74LS33N	0.29	74LS163N	0.85	74LS327N	2.55
74LS37N	0.32	74LS164N	1.10	74LS348N	1.10
74LS38N	0.32	74LS165N	1.15	74LS352N	1.07
74LS40N	0.26	74LS166N	1.65	74LS353N	1.07
74LS42N	0.80	74LS168N	1.45	74LS365N	0.55
74LS47N	1.09	74LS169N	1.45	74LS366N	0.55
74LS48N	1.00	74LS170N	1.90	74LS367N	0.55
74LS49N	1.00	74LS173N	1.10	74LS368N	0.55
74LS51N	0.26	74LS174N	0.75	74LS373N	0.85
74LS54N	0.26	74LS175N	0.75	74LS374N	0.85
74LS55N	0.26	74LS181N	2.75	74LS375N	0.66

TRANSISTORS (See catalogue for full range)

2N3402	.21	2N3566	.25	2N3703	.14	2N4907	4.90	2N5033	.65	2N5194	.80	2N5306	.33	2N5543	7.50	2N6131	.70	BD181	1.90	BFW43	1.65
2N3404	.21	2N3567	.25	2N3704	.14	2N4908	3.72	2N5035	1.10	2N5195	.97	2N5307	.30	2N5550	.38	2N6132	.70	BD182	2.20	BFW59	1.75
2N3405	.21	2N3570	4.50	2N2705	.14	2N4909	4.98	2N5036	1.20	2N5209	.35	2N5308	.33	2N5551	.44	2N6133	.70	BD183	2.35	BFW87	1.75
2N3414	.18	2N3571	1.90	2N3705	.14	2N4910	1.20	2N5086	.30	2N5210	.38	2N5354	.27	2N5555	.65	2N6134	.70	BD187	.95	BFW90	1.75
2N3415	.18	2N3572	3.00	2N3707	.14	2N4913	1.45	2N5087	.30	2N5219	.16	2N5355	.20	2N5638	.45	2N6179	.77	BD201	1.10	BFX12	.35
2N3416	.21	2N3583	1.25	2N3708	.12	2N4914	1.65	2N5088	.30	2N5220	.15	2N5356	.23	2N5640	.46	2N6180	1.05	BD202	1.25	BFX13	.33
2N3417	.25	2N3584	1.35	2N3709	.12	2N4915	2.40	2N5089	.30	2N5221	.16	2N5358	1.75	2N5654	.55	2N6181	.88	BD203	1.28	BFX19	.49
2N3420		2N3605	.18	2N3710	.12	2N4916	.22	2N5126	.44	2N5222	.20	2N5365	.24	2N5655	.55	2N6253	1.00	BD204	1.35	BFX29	.34
	12.50	2N3606	.18	2N3711	.12	2N4917	.27	2N5127	.22	2N5223	.16	2N5400	.33	2N5656	.65	2N6254	1.45	BD220	.66	BFX30	.34
2N3439	.85	2N3607	.18	2N3712	1.35	2N4918	.65	2N5128	.22	2N5224	.16	2N5401	.44	2N5657	.75	2N6288	.50	BD221	.66	BFX34	.66
2N3440	.75	2N3632		2N3713	1.50	2N4919	.70	2N5120	.22	2N5225	.16	2N5415	1.05	2N5661		2N6289	.50	BD222	.66	BFX37	.49
2N3441	.92		12.75	2N3714	1.55	2N4920	.83	2N5130	.22	2N5226	.16	2N5416	1.65		17.00	2N6290	.50	BD223	.75	BFX68	1.10
2N3442	1.45	2N3638	.17	2N3715	1.55	2N4921	.54	2N5131	.22	2N5227	.16	2N5447	.16	2N5786	.98	2N6292	.50	BD224	.75	BFX84	.30
2N3444	1.35	2N3638A	.17	2N3716	2.29	2N4922	.60	2N5133	.22	2N5232	.22	2N5448	.16	2N5813	.55	AF239	.70	BD232	.75	BFX85	.38
2N3445	6.50	2N3639	.33	2N3724	.65	2N4923	.75	2N5137	.22	2N5232A	.23	2N5449	.20	2N6027	.64	AF240	1.25	BD233	.45	BFX86	.30
2N3443		2N3640	.25	2N3725	.60	2N4924	1.15	2N5138	.22	2N5239	2.25	2N5450	.16	2N6036	1.39	AF279	.88	BD234	.46	BFX87	.35
	10.00	2N3641	.25	2N3732	2.00	2N4926	1.70	2N5139	.22	2N5245	.37	2N5451	.16	2N6039	1.17	AF280	.95	BD235	.46	BFX88	.30
2N3447		2N3642	.22	2N3734	.75	2N4927	1.70	2N5140	.22	2N5246	.38	2N5457	.35	2N6099	.62	AFY42	1.65	BD538	.77	BFX89	1.37
	10.50	2N3643	.38	2N3735	7.00	2N4928	2.20	2N5142	.22	2N5247	.44	2N5458	.36	2N6107	.45	AU110	1.70	BD539	.60	BFY10	1.10
2N3448		2N3644	.40	2N4871L	.51	2N4944	.30	2N5143	.22	2N5248	.44	2N5459	.32	2N6108	.55	AU113	1.70	BD540	.60	BFY18	1.10
	12.00	2N3645	.38	2N4888	.54	2N4945	.30	2N5172	.24	2N5249	.38	2N5460	.65	2N6109	.55	BC409	.27	BD581	1.10	BFY19	1.10
2N3468	1.32	2N3646	.26	2N4889	.75	2N4964	.28	2N5179	.75	2N5266	3.00	2N5461	.53	2N6111	.49	BC413	.16	BD582	1.30	BFY87	1.10
2N3507		2N3662	.25	2N4891	1.30	2N4965	.28	2N5180	.58	2N5293	.44	2N5462	.65	2N6121	.41	BC414	.17	BD675	.60	BFY89	.38
	10.00	2N3663	.29	2N4898	1.55	2N4966	.28	2N5183	1.20	2N5294	.44	2N5484	.37	2N6122	.44	BC415	.16	BD676	.65	BFY41	.88
2N3512	1.10	2N3690	.45	2N4901	1.65	2N4967	.28	2N5188	.44	2N5295	.44	2N5485	.40	2N6123	.48	BD153	1.05	BD677	.70	BFY50	.35
2N35553		2N3691	.45	2N4902	2.20	2N4968	.28	2N5189	.49	2N5296	.44	2N5486	.40	2N6124	.45	BD155	1.10	BD678	.82	BFY51	.35
	3.25	2N3692	.45	2N4903	2.75	2N4969	.28	2N5190	.65	2N5298	.44	2N5490	.64	2N6125	.47	BD157	.70	BFS98	.33	BFY52	.35
2N3563	.25	2N3693	.50	2N4904	1.85	2N5010	5.75	2N5191	.75	2N5301	4.00	2N5492	.64	2N6126	.48	BD158	.70	BFW10	.83	BFY53	.40
2N3564	.25	2N3694	.50	2N4905	2.40	2N5011	8.25	2N5192	.80	2N5303	5.50	2N5494	.65	2N6129	.60	BD159	.70	BFW11	.83	BFY72	.99
2N3565	.25	2N3702	.14	2N4906	2.99	2N4030	.22	2N5193	.75	2N5305	.26	2N5496	.67	2N6130	.65	BD160	3.40	BFW30	2.45	BFY75	.77

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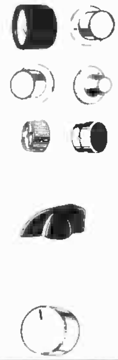

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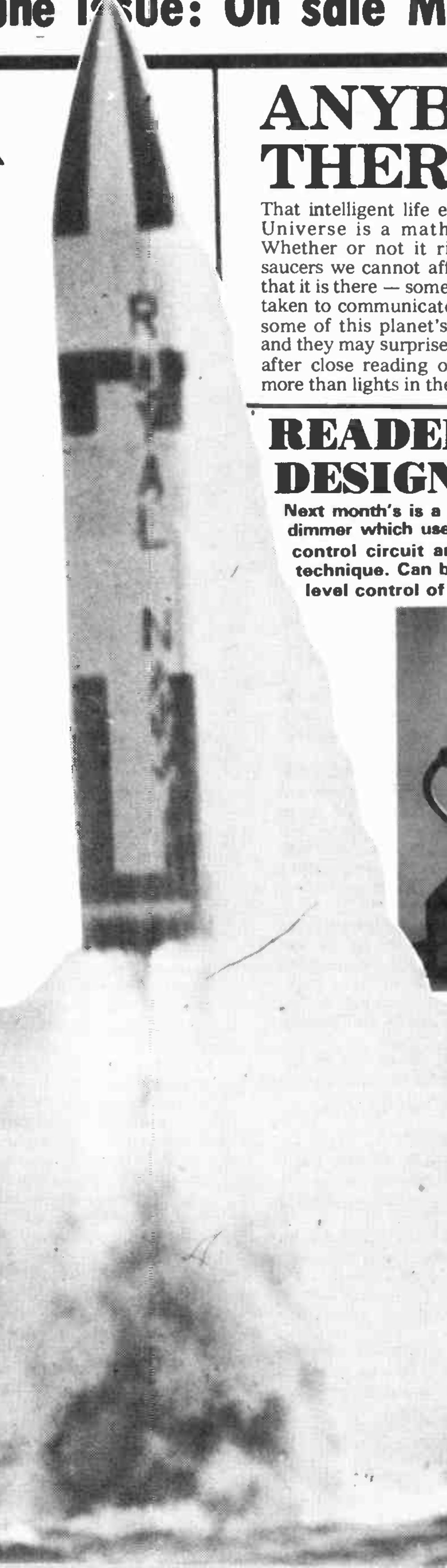
What to look for in the June issue: On sale May 4th



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ECM

ECM (Electronic Counter Measures). Without extensive capability in this field a modern fighter aircraft stands about as much chance against its opponents as would a bi-plane. Radar homing missiles can be jammed, locating radar foiled and laser targeting pick out a plane for ground-to-air attack in a fraction of a second. On the ground too, anti-tank missiles, remotely guided, can "take out" highly sophisticated (and expensive) tanks before they get time to retaliate. The principle behind the machinery are fascinating and their implications chilling. Read about them next month in our comprehensive article.

ANYBODY THERE?

That intelligent life exists elsewhere in the Universe is a mathematical certainty. Whether or not it rides around in flying saucers we cannot afford to ignore the fact that it is there — somewhere. Steps are being taken to communicate with other worlds by some of this planet's largest observatories, and they may surprise you. Don't blame us if after close reading of this, you encounter more than lights in the sky!

READERS' DESIGNS

Next month's is a remote controlled light dimmer which uses an ingenious voltage control circuit and ultrasonic transmission technique. Can be adapted to give remote level control of just about anything.

data sheet

TDA 1008 — **MULLARD**

Introduction

The TDA1008 integrated circuit provides frequency-dividing and gating functions for tone signal generation in electronic organs and other electronic musical instruments. An increasing variety of electronic organs has become available in recent years, their popularity having been enhanced by the rapid expansion of the home entertainments market. To provide effects such as sustain, percussion, and fifth coupling, the organ designer has usually needed to add special electronic circuits to the basic organ design, increasing overall cost. However, in a system based on TDA1008 ICs, these and many other effects can be easily provided without significantly adding to circuit complexity. The reduction in component count and number of key contacts compared with conventional systems results in a significant saving in cost, greater reliability, and easier servicing. With simplified circuits and fewer components, organ designs using TDA1008 ICs are also ideal for the home constructor.

The main features of the TDA1008 are given below.

The IC is a monolithic bipolar device using I^2L logic, and therefore requires no special handling techniques.

Only a single set of contacts is required for each key, because the TDA1008 provides five octave-related output signals when each of five key inputs is activated. Thus, in a typical system, only one busbar is required for each manual.

An outstanding feature of the TDA1008 is that the tone-output signals are symmetrical about a fixed DC level, and so no DC jump occurs in the outputs when the keys are operated. Thus 'plopping and scratching' sounds are eliminated from the audio output without the need for the usual additional suppression components.

The amplitudes of the five output signals from the IC are proportional to the DC voltage applied to each key input, and because the nominal impedance of these inputs is high, sustain and percussion effects can be added by using simple RC networks in conjunction with the key circuits.

The rate of attack and decay can be adjusted simply by varying a DC voltage applied to a 'sustain control' pin on the IC.

Description of TDA1008

The circuit of the TDA1008 IC with basic peripheral components is shown in Fig. 1. The IC comprises eight divide-by-two circuits and a matrix of gate circuits.

As shown in Fig. 1, the TDA1008 can be driven directly from a top-octave synthesiser, because only one input signal applied to pin 15 is required to produce nine octave-related notes within the IC. The minimum impedance at pin 15 is 28 k ohm.

Up to five keys can be connected to pins 8 to 12. When a DC voltage is applied to one of these inputs, five of the nine octave-related notes are routed by the matrix circuit to the five tone outputs, as shown in the truth table. Although the maximum input frequency of the TDA1008 is 100 kHz, as can be seen from the truth table the frequency chosen would normally be within the audio range to give the full range of audible tones. If more than one key input is activated, then the signal from each tone output will comprise the sum of all the tones for the activated inputs.

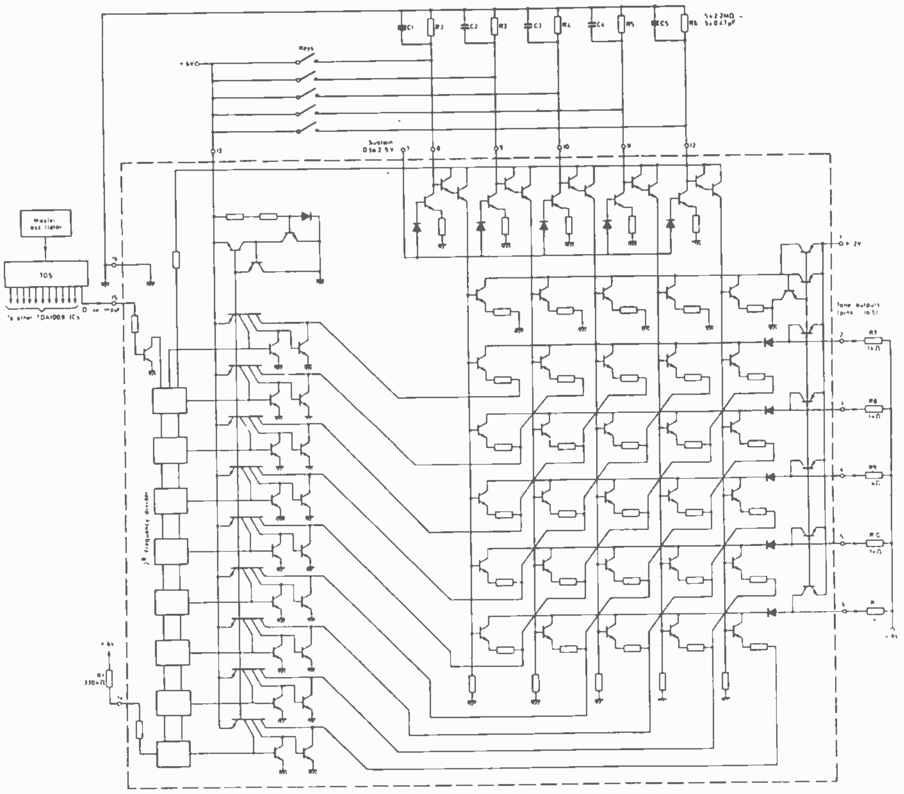


Fig. 1. TDA1008 and basic peripheral circuit.

The signal amplitude at each tone output (pins 2 to 6) is proportional to the DC voltage applied to each key input. Sustain and percussion effects can, therefore, be obtained by connecting simple RC networks to the key inputs. Some practical networks are described later. The networks shown in Fig. 1 (resistors R_2 to R_6 and capacitors C_1 to C_5) provide a simple sustain effect. The impedance of the key inputs, and hence the rate of discharge of C_1 to C_5, is determined by the DC voltage applied to pin 7 of the IC. With pin 7 at 0 V, the impedance of each key input is greater than 8 M ohms. When this voltage is increased towards 2.5 V DC, the impedance of each input falls accordingly. Thus the decay of the output waveforms at pins 2 to 6 can be adjusted continuously by simply varying the sustain control voltage at pin 7. The impedance of the tone outputs is determined mainly by the values of the load resistors R_7 to R_{11} (1 k ohms in the circuit shown).

The ungated output from the last divider stage is provided at pin 14. This output is used when the IC is tested during manufacture, but it can also be used by the organ manufacturer for a quick operational check of each TDA1008. (An output signal from pin 14 when an input signal is applied to pin 15 indicates that all the divider stages are operating correctly.) During normal operation, pin 14 should be connected through a resistor to the +6 V supply so that a current of 20 μA is drawn. In a practical circuit, this can be achieved by connecting a 330 k ohms resistor (R_1 in Fig. 4) between pins 14 and 13.

It is possible to derive a low-frequency output signal for a pedal board from pin 14. Provided that the current drain of 20 μA is maintained, a transistor can be used to amplify the low-frequency signal from this pin.

Practical Circuits for Organs Using TDA1008 ICs

The number of TDA1008 ICs required for a particular system depends on the number of octaves required by the organ designer. Normally, a minimum of twelve of these ICs would be required for subdivision of the twelve top-octave notes. For example, a master oscillator, a top-octave synthesiser IC, and twelve TDA1008 ICs would be required for a five-octave single-manual organ. All the ICs, together with the peripheral components, can be mounted on a single compact printed-wiring board.

A brief description of a variety of practical circuits for use with TDA1008 ICs is given below. The five-octave organ has been chosen as a practical example of a system using these circuits.

Master oscillator

The Hartley oscillator is a popular choice for electronic organs because of its inherent high stability. The sinewave output signal from this oscillator must be shaped by a Schmitt trigger to provide a squarewave with the correct slew rate for driving the TOS, as shown in Fig. 2. For TOS circuits that require two input signals of opposite phase, these can be provided as shown.

However, because the TDA1008 IC requires a stabilised supply, use can be made of this supply to simplify the oscillator circuit greatly, as shown in Fig. 3. Only four NAND gates contained in a single HEF4011P IC, three resistors (one variable), and a capacitor, are required to produce an output signal of the correct shape for the TOS. One of the gates can be used as shown to provide an output signal of opposite phase.

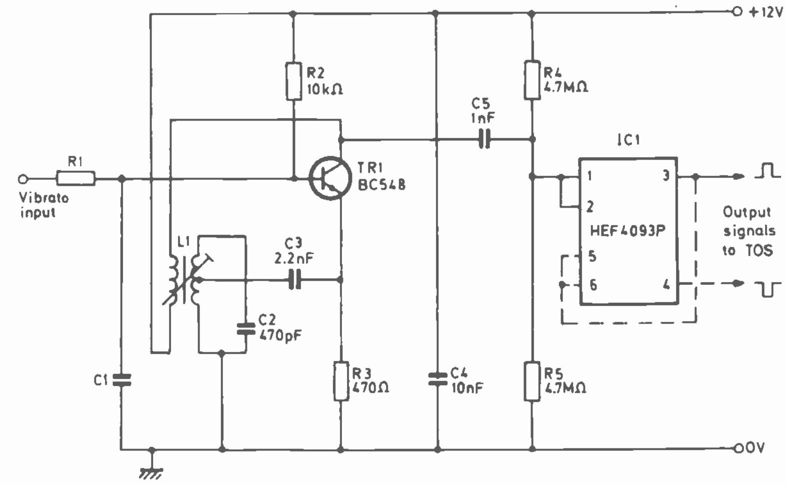


Fig. 2. Hartley oscillator and Wave- Shaping circuit.

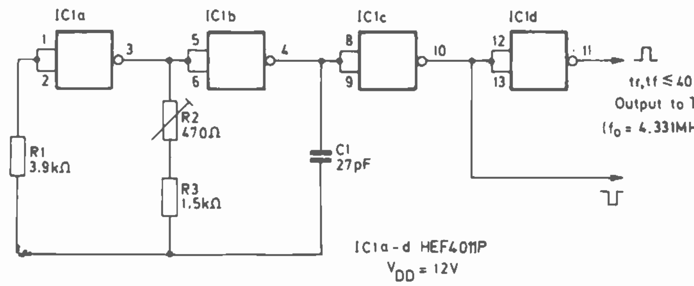


Fig. 3. Master oscillator using NAND gates.

Switching and envelope-shaping circuits

The TDA1008 IC can be connected as shown in Fig. 4, and will provide five octave-related tones at pins 2 to 6 by operation of a single key contact connected to each key input (pins 8 to 12). The signal obtained from each output, relative to the three supply voltages, is shown in Fig. 5. The amplitude of this signal is dependent on the voltage applied to the key inputs. If any of the output pins remain unused, these pins should be connected to the +9 V supply to avoid intermodulation between the output signals.

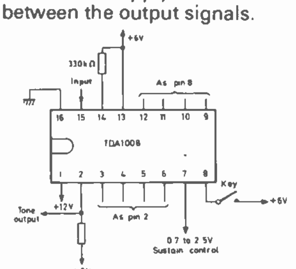


Fig. 4. Simplified connection diagram for TDA1008.

Sustain

The sustain effect, the continuation of a note or notes for a predetermined period after a key has been released, can be easily obtained in an organ system using TDA1008 ICs.

To apply sustain to the five tone-output signals simultaneously, it is only necessary to connect a capacitor between each key input of the TDA1008 and earth, as shown in Fig. 6. With pin 7 either open-circuit or at a low DC voltage, the impedance of each key input is high (≥8M ohms). This impedance, combined with capacitor C_1, provides a time-constant which gives the maximum sustain period (about 4s with the value shown for C_1). Resistor R_2 is included to reduce this maximum period to a practical value, determined mainly by the time-constant of R_2 and C_1. The time-constant is given by:

$$t = C_1 R_2,$$

where t is in seconds.

For more details of the device contact Mullard Ltd, at: Mullard House, Torrington Place, London WC1E 7HD.

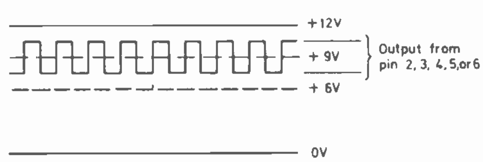


Fig. 5. Output signal from pin 2, 3, 4, 5 or 6.

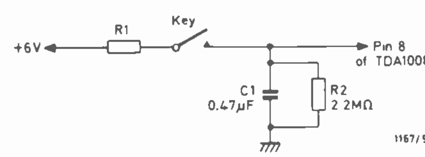


Fig. 6. Sustain circuit.

Tone output pin	Key input pin 8	9	10	11	12
2	f_{in}	$f_{in}/2$	$f_{in}/4$	$f_{in}/8$	$f_{in}/16$
3	$f_{in}/2$	$f_{in}/4$	$f_{in}/8$	$f_{in}/16$	$f_{in}/32$
4	$f_{in}/4$	$f_{in}/8$	$f_{in}/16$	$f_{in}/32$	$f_{in}/64$
5	$f_{in}/8$	$f_{in}/16$	$f_{in}/32$	$f_{in}/64$	$f_{in}/128$
6	$f_{in}/16$	$f_{in}/32$	$f_{in}/64$	$f_{in}/128$	$f_{in}/256$

TDA1008 Truth Table.

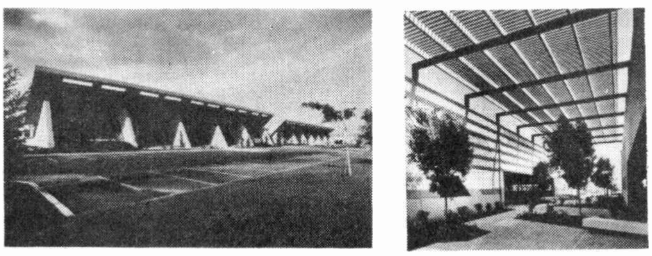
microfile

Microfile this month has been taken over by Henry Budget, (editorial assistant of Computing Today) during Gary Evans absence.

A slight case of sunstroke

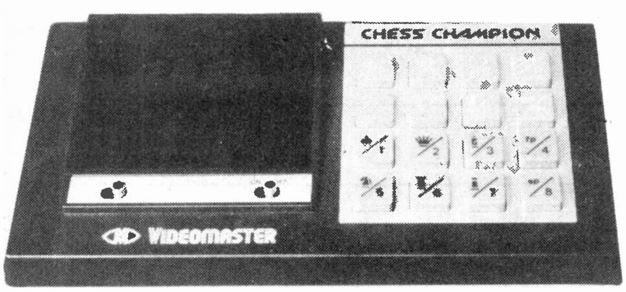
COMMODORE, THOSE WONDERFUL people who gave you a PET, have just taken a great step forward in the true American tradition. Rather than going to the moon they have headed for the Sun. A new solar powered industrial complex has been built in Silicon Valley at Santa Clara and they are moving in. The building was constructed with the help of the United States ERDA and is the first to get a 'solar grant.' The design was chosen out of 80 applications from 35 states.

In the 60 000 sq ft Commodore will house their headquarters, the LED and LCD production line, Pet and KIM assembly and warehousing space. The boffins reckon that 90% of all heating requirements will be met by the 6000 sq ft of roof mounted solar panels and a further 3000 sq ft of passive collectors. By using this little lot as a giant heatsink the building will be kept cool in summer and warm in winter . . .



Two views of the new Commodore plant in Silicon Valley. The picture on the right shows some of the roof-top solar panels used for heating.

Also from Commodore I have just heard the current UK sales figures for the PET. They are selling at 200 a week, with about 10% going to the hobby end of the market — that's about 13000 quid a week. (Who said hobbyists were poor?) Commodore reckon that they are holding up well against the competition as well . . .



The Videomaster Chess Champion, the level of play can be altered to suit your prowess, but be prepared for some slow games on the high levels.

We had a new chess player through the office last week micro based of course, and it nearly bored one of our staff to death. He decided to play it on level 5 and the machine took nearly six hours to make four moves. The device is the new Chess Champion from Videomaster and can cater for up to six levels so we may never see our colleague again if he tries that one . . .

The machine actually plays a very good game of chess and the response time is a good indication of the amount of thought that the program is putting in to each move. For the average player Level 1 or 2 will provide a reasonable game, Level 6 is strictly for the budding Grand Master . . .

Teletext comes home at last

On the subject of micro's — the faithful old 6800 is about to appear in a new home machine, with an added plus. The Liverpool based firm of Technalogics is producing a system that includes full Teletext decoding, allowing you to store information off-line and also to use the full graphics capabilities when running your own programs. The unit is configured for easy expansion and they hope to gain PO approval to connect to Prestel in the not too distant future. The cost of all this is only about £450 for a basic system and I hope to go and see one in the next couple of weeks. A full report will be published in Computing Today if I can get my hands on one.

Is it, will it . . .?

BUZZ! Down the grapevine came some news of the long awaited Texas micro. Allegedly it will be a 16 bit machine running PASCAL as the main language and a possible date of arrival is June. The last time I spoke to anyone from Texas the reply was 'No Comment' so we will just have to wait and see . . .

Club round-up

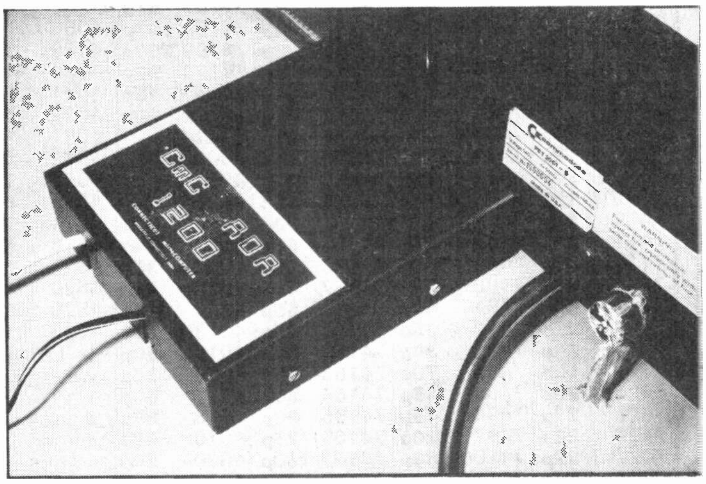
We have been getting news from around the country about computing clubs. A couple of recently formed ones have asked me to give a quick plug. This is a service we delight in performing so please keep the information coming in.

The Bristol Computing Club now meets regularly on the third Wednesday of each month and further information may be obtained from the Chairman, Mr L. Wallace, 6 Kilbernie Road, Bridge Farm Estate, Bristol BS14 0HY. Another new club is the Hull and District TRS 80 Users club. They will be meeting on the second Tuesday of each month and you can write for further information to the Chairman, Mr F. Brown, 421 Endike Lane, Hull, Yorkshire HU6 8AG.

Many thanks to the East London Branch of the ACC for the notice about their third meeting. They meet at the Harrow Green Library in Cathall Road, Leytonstone on the third Tuesday of each month between 7 and 10pm. Your contact here is Jim Turner at 63 Millais Road, London E11. Please note that when you write to these or any other club we may have mentioned in the past it will greatly help them if you enclose an SAE.

Connect your pet to better things

I've just received an interface adapter for the PET that should provide a solution to the problem of getting printout. The device is a CMC ADA 1200, such a lovely name, and has been announced by Petsoft in conjunction with their CMC Word Processor. It arrives in a small case that plugs directly onto the IEEE-488 bus port and will drive any RS232 device such as a printer. The unit comes complete with an encapsulated power supply and can be preset to any Baud rate from 110 to 9600 which makes it suitable for any printer around. The parity and stop bits are settable on a DIL switch to your own needs. The output port can be called direct from BASIC to give program listings or result output from calculations etc. The main use however is that it is directly accessed from the word processor package and will give you the basis of a small office package to handle letters and documents. The cost of the Word Processor program is £25 and the interface adaptor is going to set you back about £90 . . .



Another odd-on for PET, this time an interface adapter for a printer.

The BBC and ETI show.

We've had more than our fair share of dealings with the Beeb this month. First the bad bit, we wish to categorically state that the so-called spelling error shown on 'Thats Life,' was deliberate. Honest. Did you see that recent episode of 'Blakes Seven', our old friend Tolinka, the chess displaying MPU based devices was used for a game of speed-chess. The BBC recently got in touch with us with a view to using yet another of our past projects Twonky, the musical MPU as the basis for some theme music for a new childrens series. Alack and alas the programme was hit by industrial action, so Twonkys golden moment will have to wait. ETI

7400	**10p**	7460	**12p**	74137	**90p**	74195	**50p**	4055	**130p**
7401	**10p**	7470	**25p**	74138	**100p**	74196	**50p**	4056	**120p**
7402	**10p**	7472	**20p**	74141	**50p**	74197	**50p**	4060	**100p**
7403	**10p**	7473	**25p**	74142	**180p**	74198	**100p**	4066	**35p**
7404	**12p**	7474	**25p**	74143	**270p**	74199	**100p**	4069	**12p**
7405	**12p**	7475	**25p**	74144	**270p**	74293	**90p**	4070	**12p**
7406	**25p**	7476	**25p**	74145	**55p**	74L500	**18p**	4071	**12p**
7407	**25p**	7480	**40p**	74147	**100p**	745112	**80p**	4072	**12p**
7408	**12p**	7481	**85p**	74148	**90p**	**CMOS**		4081	**12p**
7409	**12p**	7482	**75p**	74150	**65p**	4000	**12p**	4082	**12p**
7410	**12p**	7483	**75p**	74151	**45p**	4001	**12p**	4093	**70p**
7411	**15p**	7484	**70p**	74153	**45p**	4002	**12p**	4510	**60p**
7412	**15p**	7485	**60p**	74154	**70p**	4006	**80p**	4511	**70p**
7413	**25p**	7486	**25p**	74155	**45p**	4007	**14p**	4516	**65p**
7414	**45p**	7489	**130p**	74156	**45p**	4009	**30p**	4518	**65p**
7416	**25p**	7490	**25p**	74157	**45p**	4011	**12p**	4520	**65p**
7417	**25p**	7491	**40p**	74160	**55p**	4012	**12p**	4528	**80p**
7420	**12p**	7492	**35p**	74161	**55p**	4013	**30p**	4583	**70p**
7421	**20p**	7493	**30p**	74162	**55p**	4015	**50p**	**LINEAR**	
7422	**15p**	7494	**70p**	74163	**55p**	4016	**30p**	AY3 8500	**450p**
7423	**20p**	7495	**45p**	74164	**60p**	4017	**50p**	CA 3039	**70p**
7425	**20p**	7496	**45p**	74165	**60p**	4018	**55p**	CA 3046	**60p**
7426	**22p**	7497	**120p**	74166	**75p**	4019	**40p**	CA 3060	**225p**
7427	**22p**	74100	**80p**	74167	**160p**	4020	**50p**	CA 3065	**200p**
7428	**25p**	74104	**40p**	74170	**100p**	4022	**50p**	CA 3076	**250p**
7430	**12p**	74105	**40p**	74173	**80p**	4023	**12p**	CA 3080	**75p**
7432	**20p**	74107	**25p**	74174	**60p**	4024	**40p**	CA 3084	**250p**
7433	**28p**	74108	**100p**	74175	**60p**	4025	**12p**	CA 3085	**85p**
7437	**20p**	74166	**75p**	74176	**50p**	4026	**80p**	CA 3086	**60p**
7438	**20p**	74109	**25p**	74177	**50p**	4027	**30p**	CA 3088	**190p**
7440	**12p**	74118	**75p**	74178	**75p**	4028	**45p**	CA 3089	**160p**
7441	**45p**	74120	**80p**	74179	**120p**	4029	**50p**	CA 3090AQ	**360p**
7442	**40p**	74121	**25p**	74180	**90p**	4030	**30p**	CA 3123 E	**130p**
7443	**60p**	74122	**35p**	74181	**130p**	4032	**80p**	CA 3130	**100p**
7444	**60p**	74123	**40p**	74182	**50p**	4033	**100p**		
7445	**65p**	74125	**35p**	74184	**120p**	4040	**60p**		
7446	**50p**	74126	**35p**	74185	**100p**	4043	**60p**		
7447	**50p**	74128	**60p**	74188	**320p**	4046	**90p**		
7448	**50p**	74130	**120p**	74190	**70p**	4047	**80p**		
7450	**12p**	74131	**90p**	74191	**70p**	4048	**50p**		
7451	**12p**	74132	**45p**	74192	**60p**	4049	**25p**		
7453	**12p**	74135	**90p**	74193	**60p**	4050	**25p**		
7454	**12p**	74136	**80p**	74194	**55p**	4054	**100p**		

CA 3140	**60p**	LM 3909 N	**65p**	TBA 480 Q	**200p**
LF 356	**80p**	MC 1310 P	**140p**	TBA 520 Q	**200p**
LF 357	**80p**	MC 1312 P	**150p**	TBA 530 Q	**200p**
LM 211 H	**250p**	MC 1314 P	**190p**	TBA 540	**200p**
LM 300 TR5	**170p**	MC 1315 P	**230p**	TBA 550 Q	**250p**
LM 301 AN	**30p**	MK 50398	**650p**	TBA 560 C	**250p**
LM 304	**200p**	MM 5314	**380p**	TBA 641 A12	**250p**
LM 307N	**65p**	MM 5316	**480p**	TBA 700	**180p**
LM 308 TO5	**100p**	NE 529 K	**150p**	TBA 720 Q	**225p**
LM 308 DIL	**100p**	NE 555	**25p**	TBA 750 Q	**200p**
LM 309 K	**100p**	NE 556	**90p**	TBA 800	**80p**
LM 310 TO5	**150p**	NE 562 B	**400p**	TBA 810	**100p**
LM 311 TO5	**150p**	SAD 1024	**1500p**	TBA 820	**100p**
LM 317 K	**325p**	SL 917 B	**650p**	TBA 920 Q	**280p**
LM 324	**70p**	SN 76003 N	**150p**	TCA 270 Q	**220p**
LM 339	**60p**	SN 76013 N	**110p**	TCA 270 S	**220p**
LM 348 N	**90p**	SN 76013 ND	**125p**	TCA 760	**300p**
LM 380	**60p**	SN 76023 N	**110p**	TCA 4500 A	**450p**
LM 381 N	**90p**	SN 76023 ND	**125p**	TDA 1008	**350p**
LM 382	**90p**	SN 76033 N	**150p**	TDA 1034	**450p**
LM 391	**180p**	SN 7627 N	**160p**	TDA 2002	**300p**
LM 555	**25p**	SN 76228 N	**180p**	TDA 2020	**300p**
LM 709 C	**40p**	SN 76660 N	**75p**	TL 084	**120p**
LM 710 TO5	**60p**	TAA 300	**100p**	XR 320	**250p**
LM 710 DIL	**65p**	TAA 350	**190p**	XR 2206	**450p**
LM 723 TO5	**40p**	TAA 550	**35p**	XR 2207	**450p**
LM 723 DIL	**40p**	TAA 570	**220p**	XR 2208	**600p**
LM 733	**120p**	TAA 661B	**140p**	XR 2216	**650p**
LM 741	**20p**	TAA 700	**350p**	XR 2567	**250p**
LM 748	**40p**	TAA 790	**350p**	XR 4136	**150p**
LM 1303 N	**100p**	TAD 100	**150p**	XR 4202	**150p**
LM 1458	**100p**	TAD 110	**130p**	XR 4212	**150p**
LM 3080	**75p**	TBA 120 S	**60p**	XR 4739	**150p**
LM 3900	**55p**	TBA 120 T	**85p**	ZN 414	**100p**

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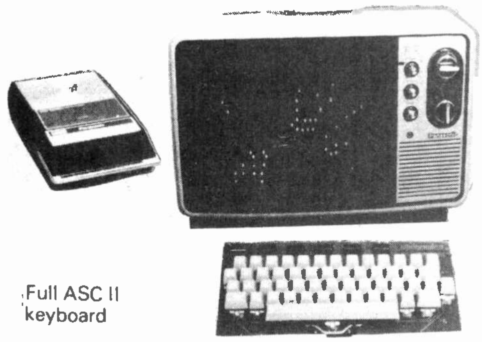

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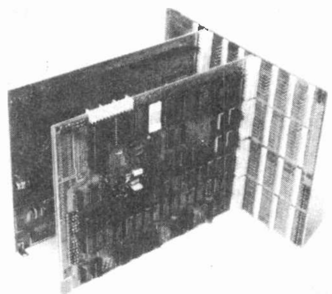

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HEADPHONE AMPLIFIER

Here's a project for the true hi-fi enthusiast, or for the guy who simply likes to 'listen in silence'.

A HEADPHONE AMPLIFIER is a gadget for the true hi-fi stereo enthusiast. It is a low-distortion wide-band low-power amplifier, without built-in tone controls. It lets its owner hear signals virtually 'as recorded', with none of the usual problems from 'processing' distortion, or from room acoustics. Equally important, it lets its owner listen to recordings at full orchestral levels without upsetting the neighbours or causing the pet budgie to shed its feathers.

The ETI headphone amplifier has a couple of special features. It has a low-noise RIAA-equalised preamplifier built into each channel, so it can accept input signals directly from a phono pick-up. It can switch-select either phono, tape, or tuner inputs, and can drive up to four sets of 8 ohm headsets simultaneously at total power levels up to a few hundred milliwatts. The unit can thus be used for both individual and group listening.

Each 'phone output channel of the amplifier has a source impedance of 10 ohms. This impedance provides each 'phone with good damping and transient response, and at the same time makes each output immune to short-circuit damage. The available power at each output is sufficient to drive the ear drums of a 'phone user to the threshold of pain when using a decent 8 ohm headset; you can't ask more than that.

Construction

All of the units electronics components, including the mains transformer, are mounted on a single PCB. The layout is quite compact, so extra care needs to be taken over the construction, particularly with regard to the polarities of semiconductor devices and electrolytic capacitors.

We fitted our prototype unit in a fairly tight-fitting Verobox, and used a 6-way DIN connector for the inputs, rather than the six individual connectors shown in the circuit diagram. Note that screened lead must be used to connect the two phono inputs to the input of the preamplifiers.

When construction is complete, set RV2 and RV3 to minimum resistance, insert a DC current meter in series with the test point of the Right channel, and switch the unit on. Check that the unit is functional, and then adjust RV2 so that the meter reads a quiescent current of 15 mA. Repeat the procedure for the Left channel, using RV3 to set the 15 mA quiescent current, and remembering to fit links across the test points after the meter is removed. The unit is then complete and ready for use. Good listening. ▶

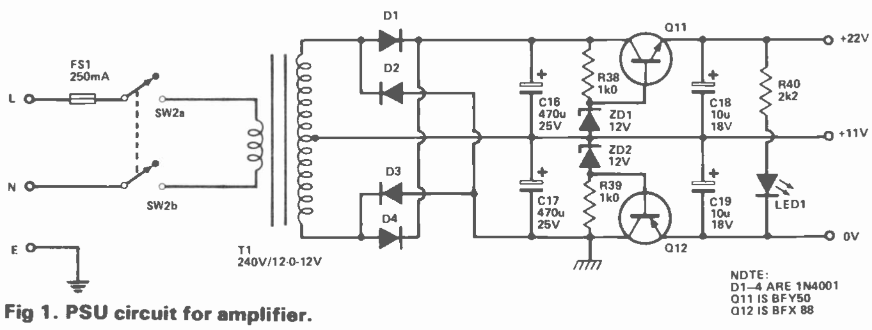


Fig 1. PSU circuit for amplifier.

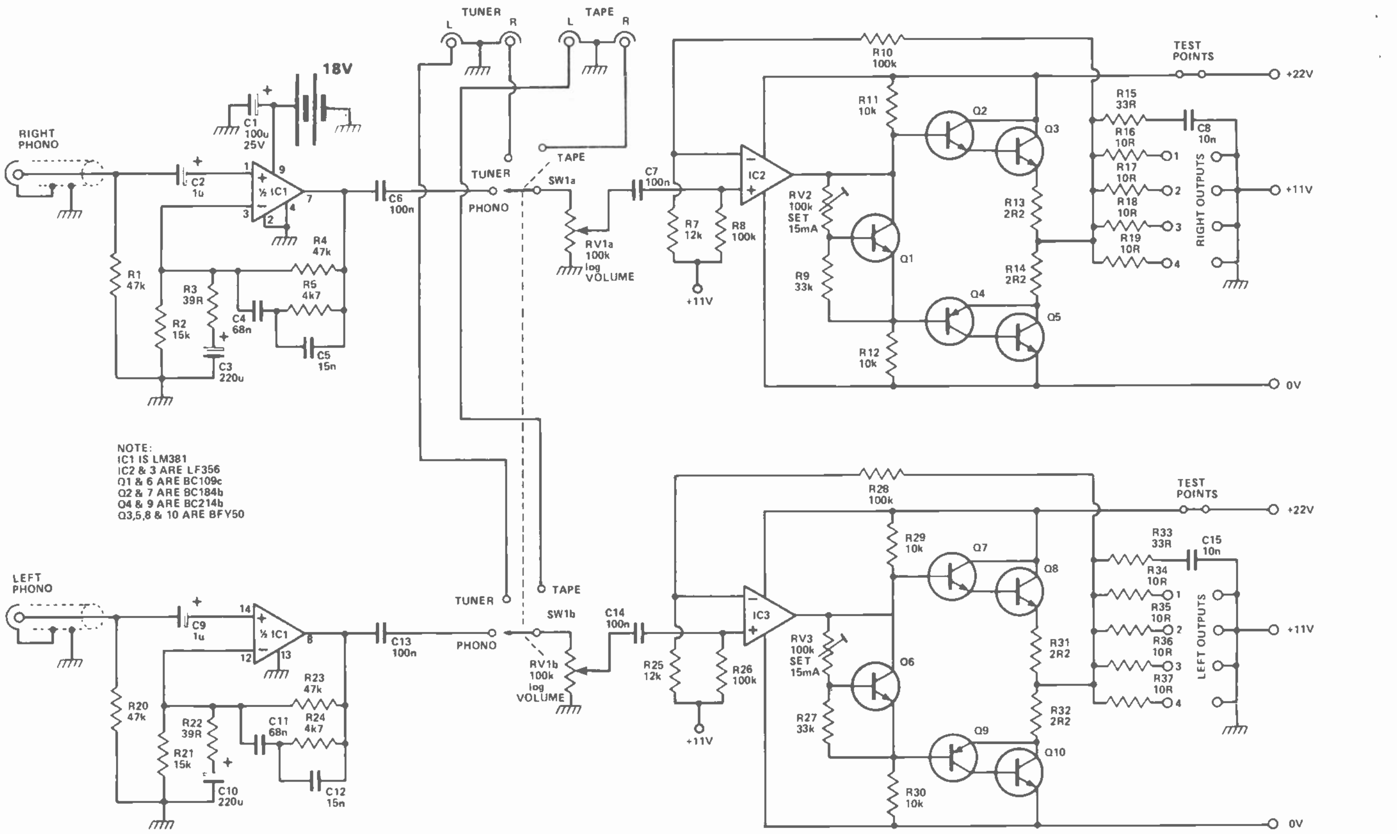


Fig 2. Main circuit. Note that R6 replaces the 18V battery if the pre-amp is mains powered.

HOW IT WORKS

The ETI Headphone Amplifier uses two identical amplifier channels, each comprising an RIAA-equalised preamplifier, an input-selection switch and a volume control, and a main amplifier stage. The design uses two mains-derived stabilised power lines, which are fed to each of the two channels.

Each pre amplifier stage is designed around one half of an LM381 low-noise dual preamplifier IC. In the Right channel, R1 matches the preamp input impedance to that of a standard magnetic pick-up, R2 and R4 set the quiescent output of the pre amplifier at approximately half-supply voltage, and R3 to R5 and C3 to C5 serve as the RIAA equalisation network. The preamplifier stage has a voltage gain of about 41 dB at 1 kHz, and gives an output of about 600 mV from a 5 mV input at this frequency.

Input signals to the main amplifier stage are derived from either the preamplifier output or the tape or tuner inputs via switch SW1 and volume control RV1. The amplifiers are standard class-AB types, with voltage gains of about ten. In the Right channel, the voltage gain is determined by R7 and R10. The quiescent current of the output transistor stages (Q3 and Q5) are controlled by 'amplified diode' transistor Q1, and are adjustable via RV2. Outputs are fed to each channel of each headset via a 10 ohm limiting resistor: R15 and C8 act as a Zobel network across the output, and enhance circuit stability.

Note that the op-amp used in each main amplifier stage is an LF356 high slew-rate type, which enables the amplifier to give a good high-frequency performance. Also note that the input and outputs of the amplifier are referenced to the 11 volt 'half supply' power line, and not to the zero volts grounded line.

The two power supply lines are derived from the mains via 12 V — 0 — 12 V step-down transformer T1. Each output is controlled by a series-pass transistor and zener diode regulator network. The nominal output voltages of the lines are 11 V and 22 V. The zero-volts line is grounded.

BUYLINES

The only component that may be difficult to find is the LF356 FET op-amp.

Marshall's can supply this IC.

PARTS LIST

RESISTORS

R1,4,20,23	47k
R2,21	15k
R3,22	39R
R5,24	4k7
R6	390R
R7,25	12k
R8,10,26,28	100k
R9,27	33k
R11,12,29,30	10k
R13,14,31,32	2R2
R15,33	33R
R16,17,18,19, 34,35,36,37	10R
R38,39	1k
R40	2k2

POTENTIOMETER

RV1	dual 100k
RV2,3	100k sub-min preset

CAPACITORS

C1	100µ, 25V
C2,9	1µ

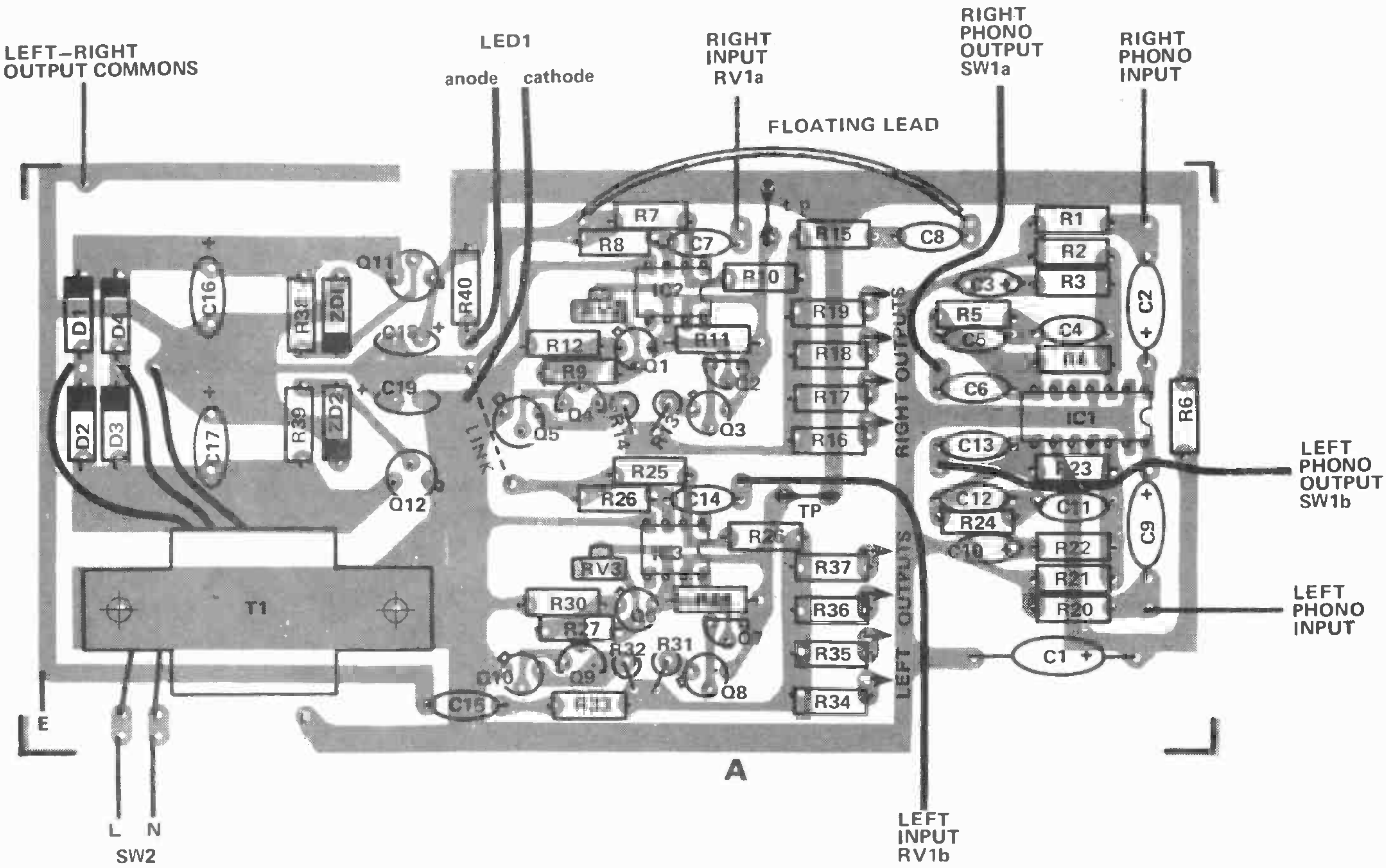


Fig 3. Component Overlay for the headphone amplifier with R6 in place to mains power the pre-amp. A lower noise figure can be obtained by battery powering the pre-amp. Connect the battery as shown in the circuit, and break the track at point A, Remove R6 from overlay.

C3,10	220µ
C4,11	68n
C5,12	15n
C6,7,13,14	100n
C8,15	10n
C16,17	470µ, 25V
C18,19	10µ, 18V

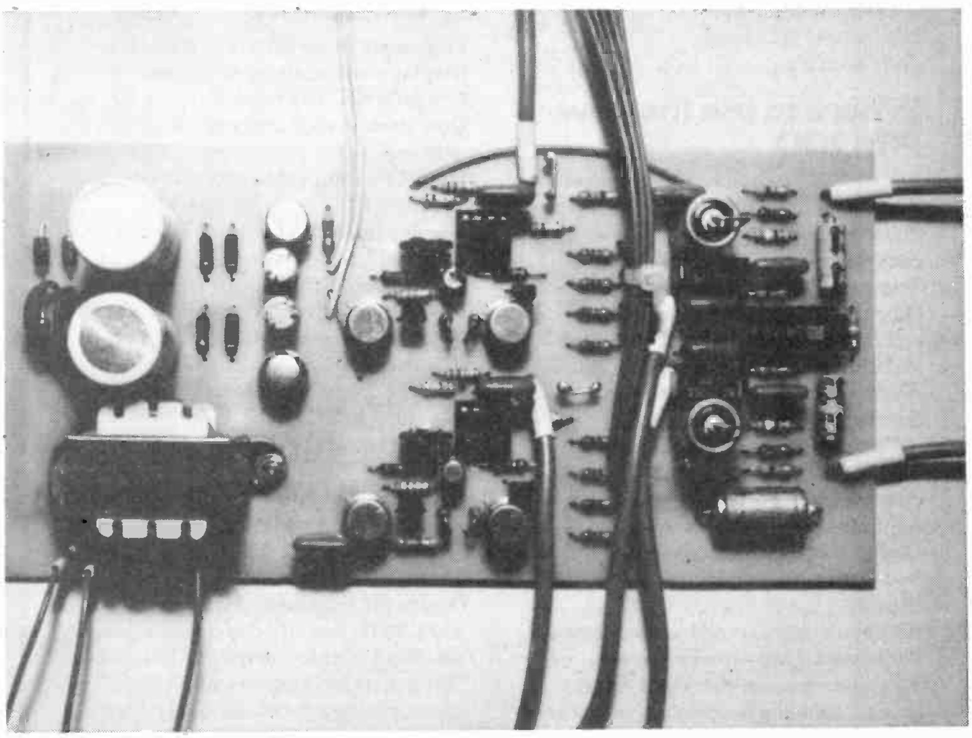
SEMICONDUCTORS

IC1	LM381
IC2,3	LF356
Q1,6	BC109C
Q2,7	BC184B
Q4,9	BC214B
Q3,5,8,10,11	BFY50
Q12	BFX88
D1,2,3,4	IN4001
ZD1,2	12V zener
LED1	standard 0.2"

MISCELLANEOUS

SW1	2-pole 3-way
SW2	DPDT
T1	12-0-12V, 100mA

Fuseholder and 250mA fuse connectors and case to suit.



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PFM200: features

20 Hz-200 MHz guaranteed range (typically better)
Frequency resolution down to 0.1 Hz
High sensitivity (10 mV typical)
High-accuracy crystal timebase
Full 8-digit capacity
Sharp, bright, easily-read LED display
Built-in attenuator
Variable sampling rate
Low-battery indication
Truly portable

Where to use the new PFM200

The PFM200 is useful in every field of electronics, providing the ultra-precise frequency information that an oscilloscope can't give . . .

Transmitter checks: mobiles, ham, radio control – check frequency and stability on Low and High band VHF, etc, up to 200 MHz AM and FM. In most applications, the PFM200's optional telescopic aerial avoids the need for direct connections.

Audio testing and design: check oscillator frequencies, bandwidth limits, crossover frequencies, resonances, etc, with resolution down to 0.1 Hz.

Digital testing: check computer clock frequencies, divider ratios and other digital circuitry.

RF circuit checks: test local oscillators, BFOs, test IF and detector performance.

Video equipment: check syncronised circuits, scanning frequencies, video band-widths, etc.

Technical specifications

Frequency range: 20 Hz to 200 MHz
Display resolution: up to 8 digits
Lowest frequency resolution: 0.1 Hz
Gate time: decade adjustable from 0.01 secs to 10 secs
Sampling rate: varies with gate time up to 5 per second
Display format: 8 LEDs, direct reading in kHz.
Attenuator: –20 db
Input impedance: 1M in parallel with 50 pF
Timebase accuracy: 0.3 ppm/°C, 10 ppm/ year
Dimensions: 6.2 in x 3 in x 1.25 in
Weight: 6 oz
Power requirement: 9V DC or AC adaptor
Sockets: standard 4 mm for resilient plugs
Standard accessories: test leads and prods, carrying wallet, owner's instruction manual
Optional equipment: AC adaptor for 240 V 50 Hz power; deluxe padded carrying case; connector kit comprising BNC, co-ax, DIN and phono adaptors, plus telescopic aerial for off-air transmitter measurements

Built, tested, ready to go

The Sinclair PFM200 comes to you fully built, tested, calibrated and guaranteed. It comes complete with leads and test prods, operating instructions and a carrying wallet. And getting one couldn't be easier. Just fill in the order form below, enclose a cheque/PO for the right amount (usual 14-day money-back undertaking, of course), and send it to us.

Sinclair Radionics Ltd, London Rd, St Ives, Huntingdon, Cambs., PE17 4HJ, England. Regd. No. 699483.

PFM200 Order Form

Please send me.............(qty PFM200s at £53.78 inc 8% VAT) each £..........

.............(qty) De-luxe carrying cases at £3.24 (inc 8% VAT) each £..........

.............(qty) AC adaptors for 240V power at £3.24 (inc 8% VAT) each £..........

.............(qty) connector kits at £10.58 (inc 8% VAT) each £..........

Post & packing (please add) £0.65

I enclose cheque/PO made payable to Sinclair Radionics Ltd for (indicate total amount) £..........

I understand that if I am not completely satisfied with my PFM200, I may return it within 14 days for a full cash refund.

Name..........

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ETI/5

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STANDING WAVES

A standing wave has nothing to do with goodbyes on railway stations, but they could just be responsible for the poor quality of 'Crossroads'.

YOU KEEP COMING across that phrase, don't you, and it seems a bit daft. Waves wave, after all, they don't stand about. Or do they? Depends how you look at it and what you're looking at.

Pick a wave, any wave, radiating off an aerial into space. When this happens, the wave is radiating out from the aerial in all directions. The wave is an electromagnetic wave but since we only usually detect the electric part we can forget about the magnetic part for the moment. Let's just remind ourselves of what a wave like this is and does.

Equating With The Problem

A radiated wave of this type is a travelling wave. If we intercept it with an aerial attached to a sensitive oscilloscope what we would see on the screen (Fig. 1) would be the familiar sine wave trace, so that we could measure the time between peaks of the wave. This time between peaks is called the period or periodic time (T) of the wave, and is the quantity we measure by making use of the calibrated time base of the oscilloscope. This time period is related to the frequency of the wave: $f = 1/T$ with T in uS frequency f is in MHz. For example: if the period is 0.4 uS, then the frequency is $1/0.4 = 2.5$ MHz.

The wave is travelling, though, so that places a distance apart will get a different phase of wave. In the drawing, of Fig. 2, A will receive a peak of the wave earlier than B, simply because A is nearer the transmitter. The distance between two places which receive peaks which are just 360° out of phase is the distance we call the wavelength.

In the time of one complete cycle, the wavelength is the distance that a wavepeak travels, so that the speed of the wave is simply frequency wavelength. For an electromagnetic wave (radio wave) in space, the speed is a constant 300 million metres per second (3×10^8m/S), so that this is the quantity equal to frequency $\times$ wavelength. For a 1 MHz wave, the wavelength is $3 \times 10^8 / 1 \times 10^6 = 300$m.

For a 1000 MHz wave, though, the wavelength is just $3 \times 10^8 / 10^9 = 0.3$m — hence the alternative title of 300 mm wave. This frequency $\times$ wavelength business applies also to sound waves, incidentally, except that sound waves crawl along a lot slower, about 330 m/S. A 1 kHz sound has a wavelength of 330/1000 metres, which is only 330 mm, almost the same as a 1000 MHz radio wave.

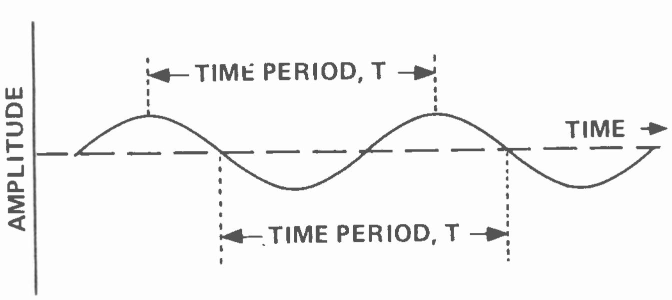


Fig. 1. Time period. This can be measured between neighbouring peaks or from one zero-crossing to the next-but-one, as shown.

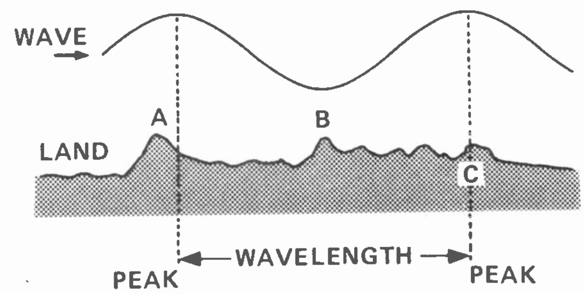


Fig. 2. Wavelength. Imagine the wavepeaks moving from left to right. At the instant shown, a peak is at point A, and a trough at point B, but the previous peak has reached point C. The distance between points A and C is one wavelength of this wave.

If we're in the business of beaming waves into space or testing loudspeakers in open fields, this is as much as we need to know about waves, but we find nearly always that there's some reflections around. Now the effect of a wave reflection meeting a wave is the same as the effect of two waves meeting each other — if the wave and the reflection are in phase, then the result is a large amplitude wave, if they are out of phase the result is a reduced wave. We can expect to find some variations in wave amplitude, then, if a wave meets its own reflection.

Reflecting On The Problem

The easiest example to sort out is when a wave meets a reflection of the same size travelling in the opposite direction. Now the mathematicians can do this without drawings, simply by fiddling with equations, and those of us who play with programmable calculators can sort it out that way — the fortunate owners of computers can watch the whole thing — play it out in slow motion. We have to do it the hard way — using imagination with the help of a few drawings. Fig. 3a shows a forward moving wave meeting a reflection — it's a diagram frozen at an instant in time because what is plotted is wave amplitude against *distance*. Fig. 3b shows the same picture an instant later, both waves have moved an identical distance in their opposite directions. A few more stills from this exclusive movie, and we begin to see glimmerings of something interesting. The combination of the forward wave and its reflection travelling in the opposite direction has produced a new wave pattern. At some points along this pattern, there is always complete cancellation — the forward wave and the reflected wave are always in antiphase so that there is no signal at this place — ever. At other places there are varying amounts of signal right up to a whopping great peak whose amplitude is about twice as much as either of the travelling waves. This pattern is what we call a standing wave (Fig. 4) — there is still a wave present, because a graph of voltage ▶

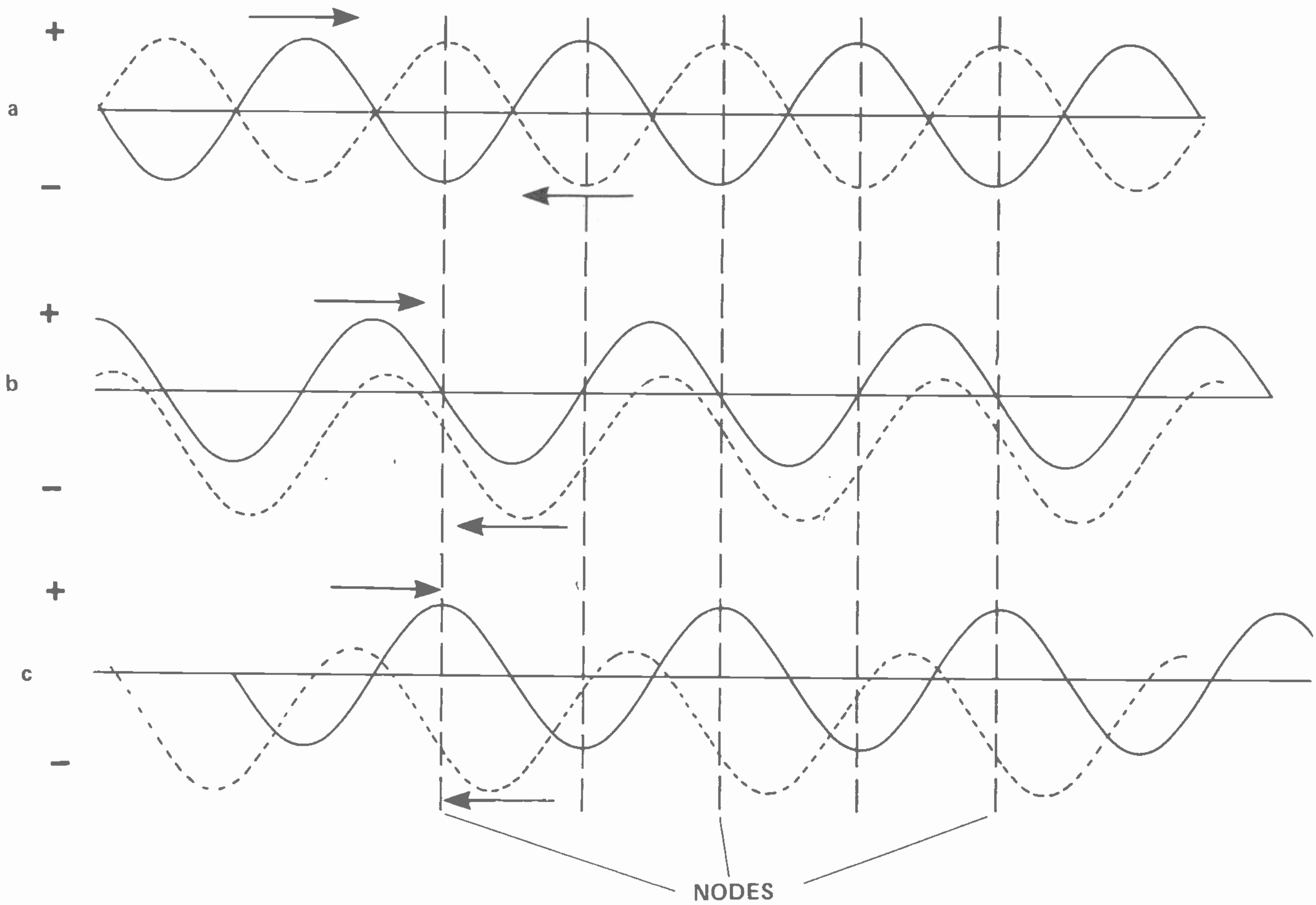


Fig. 3. Setting up standing waves. The solid line (a) represents a wave moving from left to right, the dotted line represents its reflection moving in the opposite direction. At (b), each wave has moved about ¼ cycle, and at (c) ½ cycle along in its own direction. The positions where the waves cancel (because they are equal and opposite, or both zero) remain fixed though. These positions are called nodes.

plotted against time shows a wave, but there's no movement of phase. In any standing (or stationary) wave like this there will be nodes — places where there's no wave signal at all — which are half a wavelength apart and antinodes — where there's a maximum wave signal — which are also half a wavelength apart but out of phase with the nodes.

The Effect On You

What's in it for us? Quite a lot, whether you dabble with high frequency signals or with loudspeaker cabinets. Standing waves have a lot of influence whenever a wave can be reflected. For example, there are places where UHF TV reception is terrible. Shifting the aerial slightly, though, makes the world of difference. Why? Because we're sitting in the middle of a standing wave pattern, that's why. Place your aerial at a node and you can forget about Kojak. Shift it by just half a wavelength, and yours is the strongest signal around. At 500 MHz, half a wavelength is just 300mm — not very far to shift.

How To Find Them

Standing waves can exist on a wire as well. One of the old classic methods of measuring the wavelength of a high-frequency radio oscillator is called Lecher Lines. The Lecher lines are two parallel metal bars of thick wires which are connected to the oscillator output. A shorting bar is fitted with a detector, which might be a neon lamp (for high voltage signals) a small lamp-bulb (for low voltage signals) or a diode/meter circuit Sliding the bar along the lines (Fig. 5) results in the detector indicating points of no signal, the nodes; and points of maximum signal, the antinodes. The distance between two neighbouring nodes, or two neighbouring antinodes, can be measured — this distance is half a wavelength.

The wavelength of a sound wave can be measured in the same way. One classic method of measuring the wavelength of a sound along a pipe was to sprinkle powder on the pipe. When the sound wave set up standing waves, the powder would gather into piles at the nodes of the standing waves, and spray away from the antinodes, so that the half-wave distance between nodes could be measured. It's equally easy to measure the wavelength of standing waves in a room by moving a microphone attached to an AC voltmeter and noting the position of nodes — once again the distance between two neighbouring nodes is equal to half a wavelength.

Leaving Loose Ends

If a length of coaxial cables connected to a circuit is left either open circuit or short circuit, standing waves can be set up in it, with a node at the short circuit or an antinode at the open circuit end. If the length of the cable is just right, that's fine. If it's not, then signals will reflect to and from along the cable, arriving at the circuit and with a time delay equal to the time taken to travel along the cable and back. Because of this effect, we seldom cut cables to a length which will permit standing waves — instead we terminate each end of the cable in a resistance value which will prevent reflections — this value of resistance has to be equal to a quantity called the characteristic impedance of the cable (calculated from the inductance and capacitance per metre of cable). With an open or shorted cable, on your telly, you can expect to see 'ghost' images — several edges to each object.

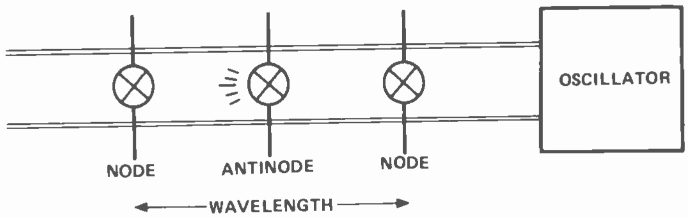


Fig. 5. Using Lecher lines. A high-frequency oscillator attached to parallel wires can display standing waves, using a small light bulb to detect the positions of nodes and antinodes.

Advantages And Disadvantages

We do, however, encourage standing waves in aerials. TV and FM aerials are cut to a total of half a wavelength so that a standing wave is set up on them. This allows us to do two things which would not otherwise be possible. One is to extract the maximum energy from the signal — the aerial responds like a tuned circuit to the correct wavelength; the other is to match the aerial to its cable. At one end of a half wave aerial we have an antinode — maximum wave amplitude. At this point we have maximum voltage, but no current. At the centre of the aerial there is a node — zero voltage but maximum current. We can select a point along the aerial to connect the cable so that the ratio of voltage to current is just right — 75 ohms for most coaxial cables, and in this position there will be the maximum transfer of signal from the aerial to the cable.

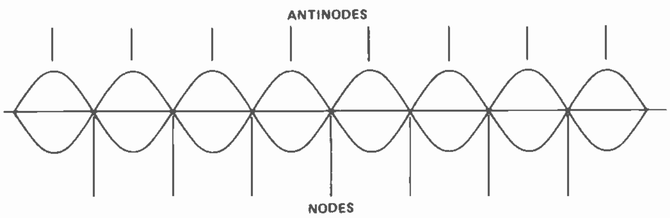


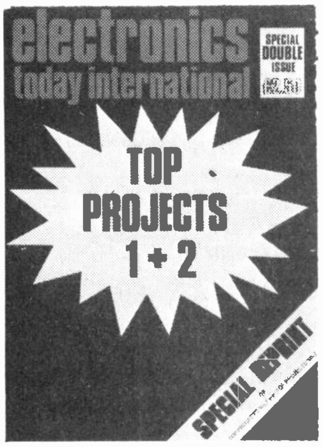
Fig. 4. Representing a standing wave. The standing wave has the same wavelength as the moving waves which cause it, but the nodes and antinodes are at fixed points, quarter of a wavelength apart from one another.

At the tuner, standing waves create another sort of problem — the problem of how to earth conductors. Earth one point of a conductor and there will be a node at that point — but there will also be an antinode (maximum signal) just ¼ wavelength away. The result is that earthing a conductor may have just the opposite of the effect you expect unless you earth at just the right place. Move any of the conductors in a tuner, and you disturb the standing wave pattern — even a dent in the metal case of a UHF tuner can make a difference.

It's not always such a happy story. The greatest difficulties with standing waves arise when we try to design a loudspeaker cabinet. Each solid surface and cracks or gaps will behave as a short circuit or an open circuit respectively. A loudspeaker cabinet will be a mess of standing waves, therefore, unless we do something to absorb them. The room we use for listening will also have standing waves at some frequencies (depending on its dimensions) and in some directions — this is particularly noticeable in an empty room stripped of all its furniture. All in all, standing waves are all around us — we have to live with them!

ETI

SPECIALS



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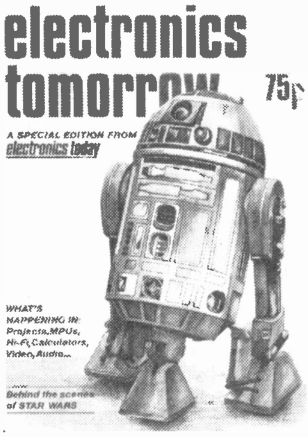

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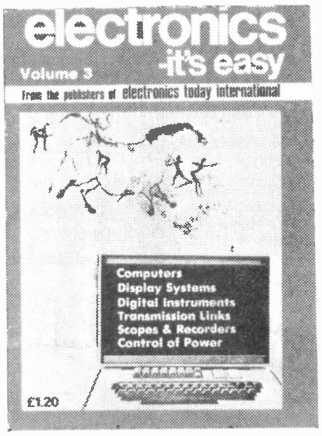

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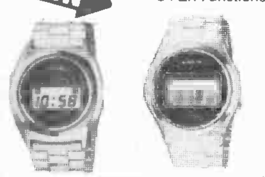

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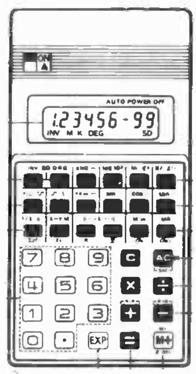

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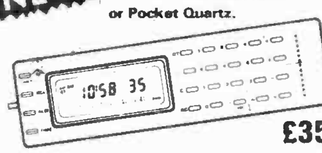

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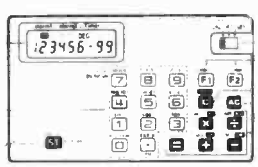

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THE ETI AUTOMATIC Immobiliser is an inexpensive but highly original car protection device. It has been designed to prevent a car being driven away by the 'joy rider' type of thief, or by a drunken owner-driver. Major features of the design are lack of circuit complexity, low building costs, and simple installation of the unit in any vehicle.

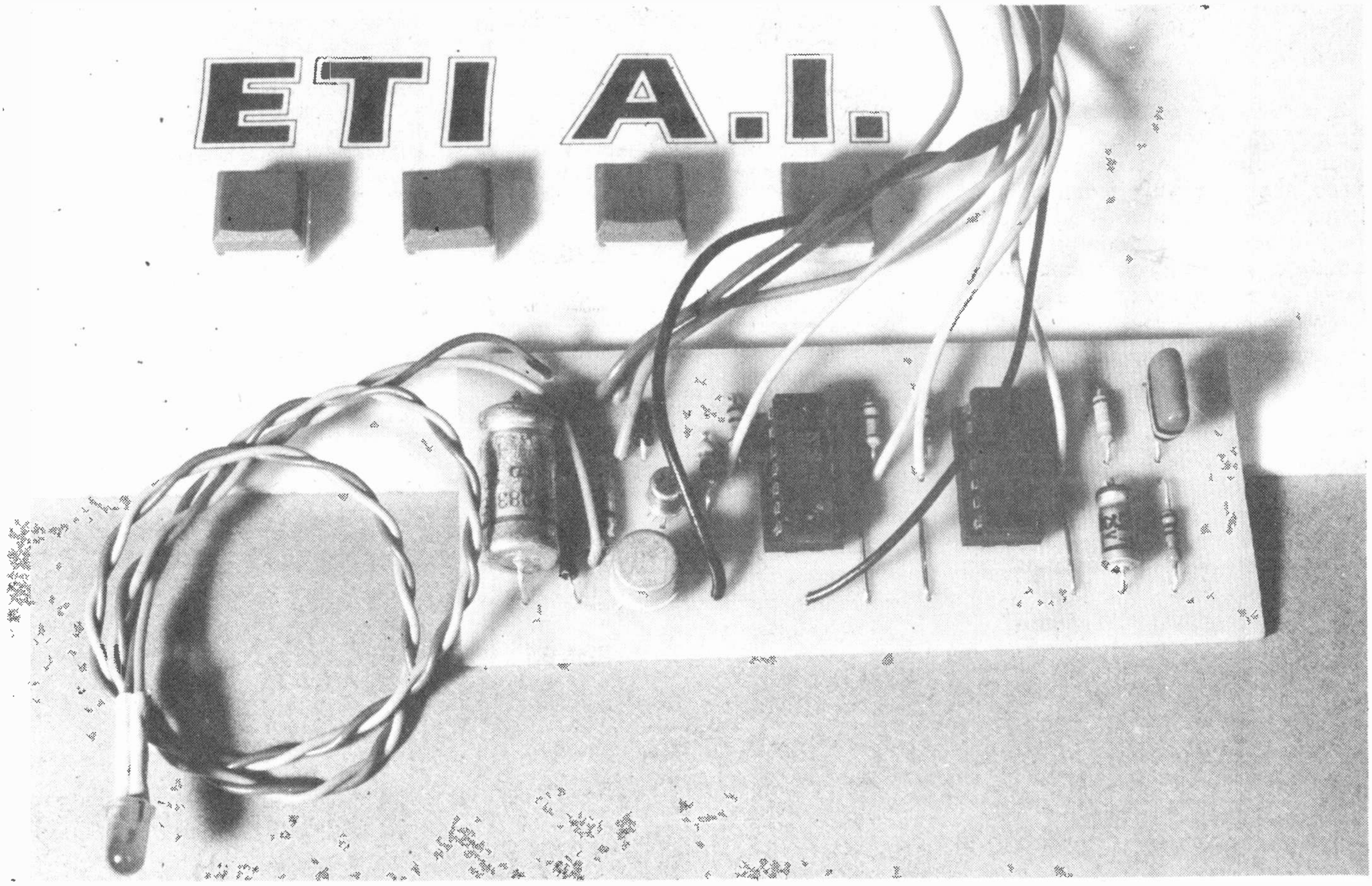
The circuit is designed to immobilise a vehicle's ignition system, by shorting out its contact-breaker points via a pair of relay contacts, as soon as the ignition is turned on. The owner then has five seconds to turn the immobiliser off by sequentially operating a set of four push buttons. If the four buttons are not correctly operated within the five second period, the ignition system remains immobilised and the vehicle's engine cannot be started. The automatic immobiliser timing sequence restarts each time the ignition is turned on.

There are four basic concepts behind the ETI Automatic Immobiliser system. The first of these is that, since the immobiliser activates automatically as soon as the vehicle's ignition is turned on, the vehicle is given a good degree of protection against the drive-away car thief, even if the owner leaves the car doors open and leaves the ignition key in its lock.

The second concept is that a thief entering the vehicle will have no idea of the purpose of the four push-button switches associated with the immobiliser, so these switches can be quite openly displayed on the vehicle's instrument panel, together with a LED that tells its legitimate owner the immobiliser circuit state.

Thirdly, because only five seconds are available to de-activate the immobiliser via the four sequentially-operated switches after first turning the ignition on, the system gives a good deal of protection against the fumble-fingered drunken owner-driver.

The final concept is that, because of the three factors already outlined above, the final circuit does not need to be super-sophisticated or to have an unbreakable 'key' sequence network in order to be highly effective in its functioning. Simplicity and effectiveness are thus the key features in the design of this ETI Automatic Immobiliser unit.



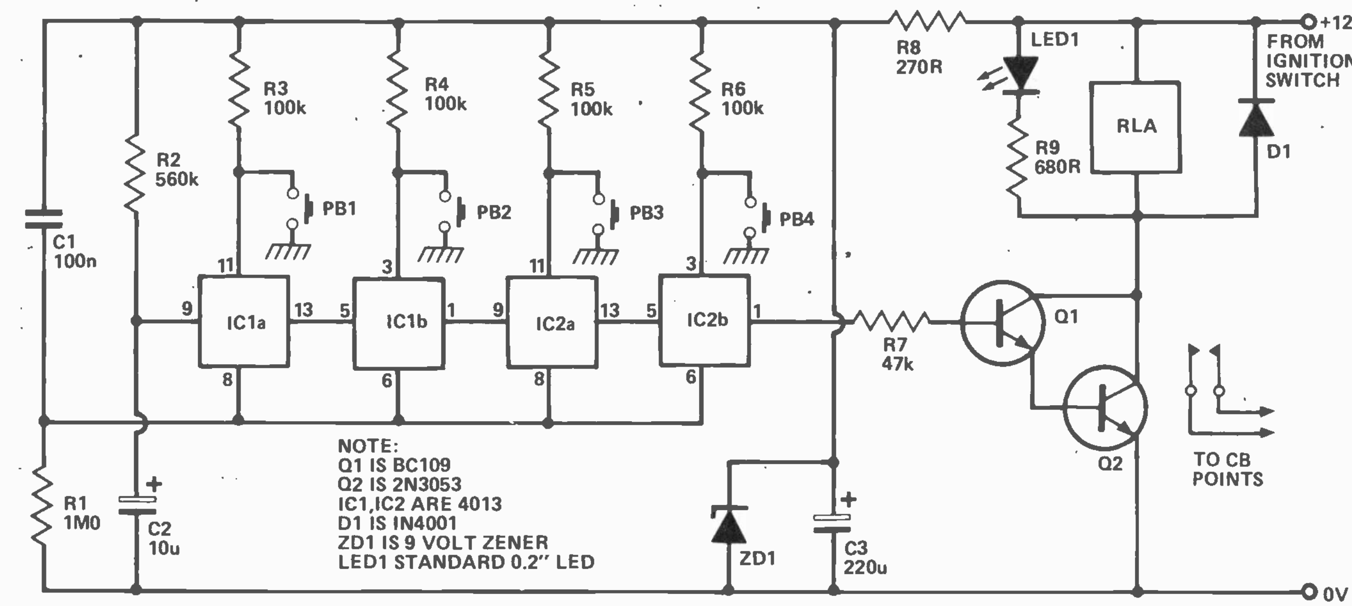


Fig. 1. Circuit diagram for immobiliser.

Construction

There should be no problems here. The relay can be any 12-volt type with a coil resistance greater than 100 ohms, and with one or more sets of normally-open contacts. The PCB and relay can be fitted in a metal box, or can be simply mounted on an aluminium plate that is screwed to the rear of the vehicle's instrument panel.

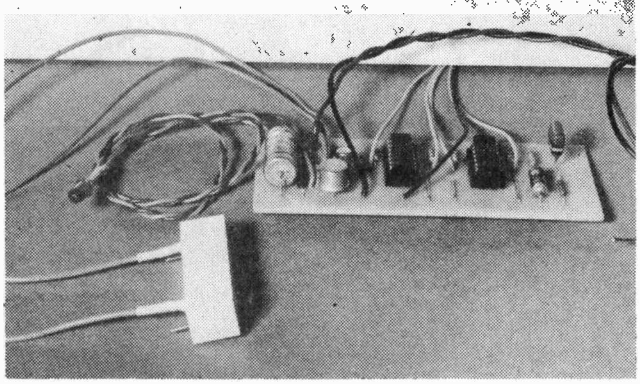
The unit's 12-volt rails must be connected to the vehicle's supply via the ignition switch. The normally-open relay contacts should be connected across the vehicle's contact breaker points. The LED and the four push-buttons can be mounted on the vehicle's instrument panel, either directly or via a screw-on panel. ETI

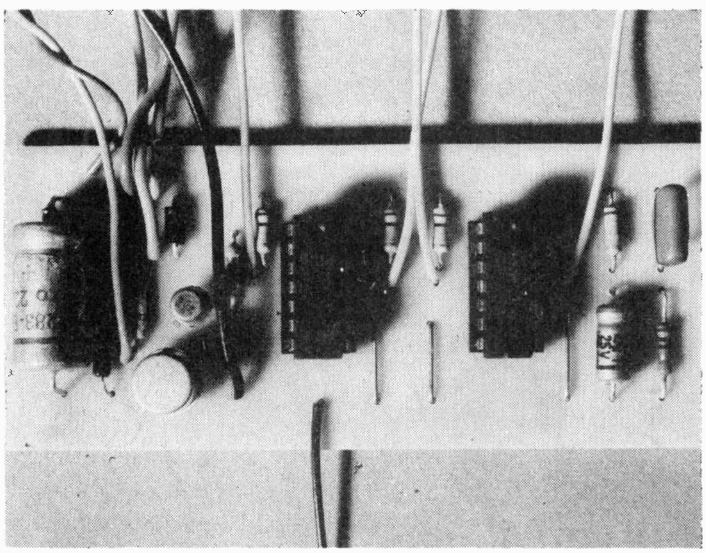
HOW IT WORKS

The circuit is designed around the 4013 D type flip-flop. It derives its power from the car battery via R8 with stabilization provided by ZD1, C3. The chip features direct set and clear inputs and complementary outputs. Data at the D input is transferred to the outputs on the positive going edge of the clock. The clear inputs are not used in this design and are tied to ground, the set inputs are connected together to the junction of R1, C1. This ensures that on switch-on the flip-flops will start up in the same state and a high level, logic 1, will be present at the output of IC2b. This voltage is fed to the base of Q1 via R7 and will cause the relay to turn on, disabling the car. Q1 and Q2 are connected as a super-alpha pair which effectively produces a super high gain transistor whose gain equals that of Q1 multiplied by Q2. D1 protects the transistors against the back EMF of the relay. System status is indicated by LED1.

To re-enable the system and start the car a logic 'O' must be present at the output of IC2b. This is produced by passing it down the line from the input of IC1a by depressing PB1, 2, 3 and 4 in turn. A novel feature is introduced here. At switch-on C2 is discharged and IC1a will see a low level logic 'O' at its input. This must be transferred to the output by depressing PB1 before the voltage rises above the transition level of the D input as C2 charges via R2. If PB1 is not depressed until about five seconds after switch-on then the junction of R2, C2 will present a logic '1' disabling the system until power is removed and re-applied. To make the system really difficult to beat, resistor, capacitor networks could be inserted between stages.

ETI A.I.





PARTS LIST

RESISTORS all ¼ watt 5%

R1	1MO
R2	560k
R3, R4, R5, R6	100k
R7	47k
R8	270R
R9	680R

CAPACITORS

C1	100n
C2	10u 16V electrolytic
C3	220u 16V electrolytic

SEMICONDUCTORS

Q1	BC109
Q2	2N3053
IC1, IC2	4013
D1	IN4001
ZD1	BZY88 C9V1 400mW 9 volt zener

MISCELLANEOUS

PB1, PB2, PB3, PB4	push to make pushbutton switches
RLA	12v relay (see text)

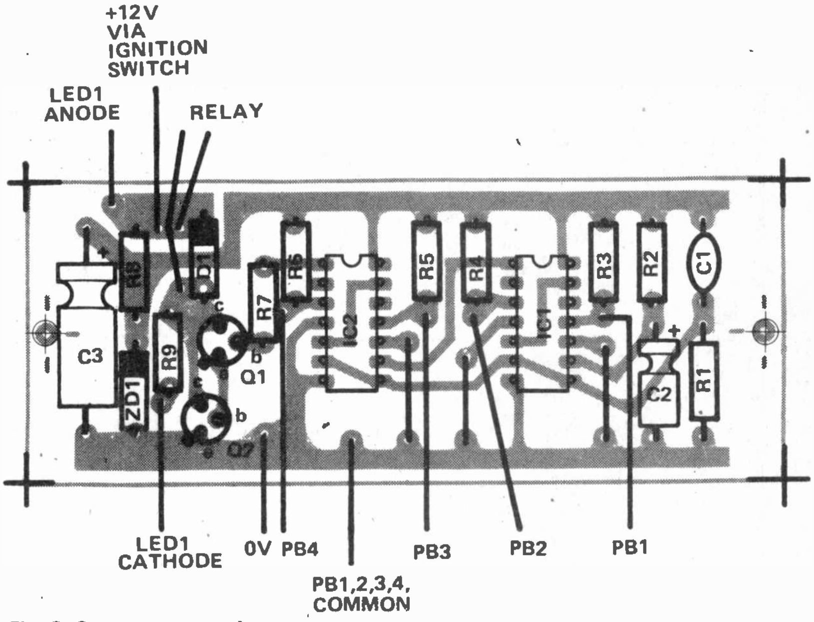


Fig. 2. Component overlay.

BUYLINES

No problems whatsoever with any of the parts for the Car Immobiliser, Maplin and Watford should be able to supply all the parts. The case is very much up to the individual, a strong watertight case however is essential to prevent any 'false alarms' due to ingress of water.

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81LS95/6/7/8	£1.25
75491 LED driver	50p
75492	92p
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8T26/28	£2.64

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DATA

Note: in this section all data books are subject to 0% VAT. For postage see 'Terms' at top of page.

c650 page COSMOS Databook (RCA)	£4.95
CMOS Databook (National)	£2.30
MC 145008 ICU Handbook (Motorola)	£2.25
M6800 Microprocessor Applications Manual (Motorola)	£9.95
'A Guide to SC/MP Programming' (Kemitron)	£3.75
'A Guide to Kitbug' (Kemitron)	75p
SC/MP Technical Description (National)	£2.76
NIBL Reference Manual (National)	£3.45
16-page data for IMS 8154 (ISP-8A/650) (National)	50p
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CDP 1802 MPU User Manual (RCA)	£4.50
CDP 1802 Subroutines (RCA)	£4.50
COSMAC MPU Guide (RCA)	75p
Memory Data (National)	£2.30
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MOSTEK Memory and Designers Guide	£2.20

Certain of the above data are subject to manufacturers' delays, so please check stock if urgently required.

SPECIAL: Z80 DATA PACK £13.95
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c90-page Z80 CPU Technical Manual
c10-page Z80-CTC Product Specification
c25-page Z80-P10 Technical Manual
c200-page Z80 Programming Manual
c25-page Z80 Micro Reference Manual

74LS

74LS00	14p	74LS27	28p	74LS76	40p	74LS125	60p	74LS163	£1.18	74LS240	£2.36	74LS283	£1.92	74LS375	£1.60
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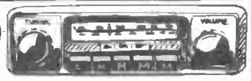

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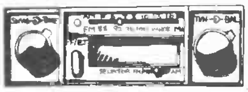

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audiophile....................

Not strictly news this month. Views. Readers views. Most of the letters to Audiophile are 'upgrading' enquiries. Most but not all – some of the more interesting appear below, presided over by Ron Harris.

THIS MONTH IT'S over to you. With all the letters that have come in to Audiophile since it began I thought it was about time some of them saw the light of print. The selection is taken over about three months, and I hasten to add that all have been answered prior to this public pondering.

As you can see we get quite a varied mailbag to put it mildly, but still not enough of you are writing (to ETI in general) for our liking. Let's have more feedback please. Mind you the two gentlemen who wrote in to ask who this Felicity Kendal is anyway have *not* been answered. After the sedatives had calmed my outrage, and the expletives died from the air, it was somehow still not possible for me to compose a reply within Home Office rules.

Time has passed, however, and has healed the wounds in passing. (And wounded the heels I hope.). So gentlemen, let me state the obvious in as calm a manner as possible. Felicity Kendal is quite simply the most beautiful woman in the universe. Write it out 1000 times before one more copy of ETI reaches your unworthy hand.

Anyway onto more sonic matters . . . .

BAD START?

Dear Sir,

I own a hi-fi system comprising a Garrard SP25 Mk.5, Goldring G800, and 'home brew' amp and speakers. The loudspeakers are comprised of twin-coned Fane bass units and a pair of EMI drivers for mid and top.

I should like to upgrade this system, and wonder what would be the first thing you'd do?

J. WATERS
FAVERSHAM

Sell It.

●

STEAM VALVE

Dear Sir,

Some time you (ETI) published a series of articles on the subject of valve sound in amplifiers. A friend recently brought these to my notice and it surprised me that an otherwise modern magazine like what ETI is known for should be backing this old-fashioned nostalgic rubbish. Do you really believe that valves sound better than transistors? Of course they can't! Why did we ever change if they do?

I suggest you set yourselves a listening test and then have the courage to publish the results!

W. WITHERS, M.Eng.
PERTH

Hold it a minute mush.
Somewhere amid the prejudices I think you express the opinion that ETI is pro-valve. If this is indeed the message, then it is mistaken. To condemn a whole technology in such sweeping terms, be it valve or transistor, is akin to running down football because the All Blacks beat Liverpool at hockey. (Think about it.)

My own opinion is that the best of the solid state designs give a more accurate representation of the signal than do the top vacuum tube units. Beyond that yer pays yer money and takes yer choice

●

BARK DISTORTION

Dear Sir,

I am writing to tell you (and your readers if you should choose to print this) and the great fun we used to have in the 'Old Days' of hi-fi. My very first gramophone used to use wooden needles, pine I think, which wore out very quickly, but gave (to me) amazing tone. Somehow nowadays it never sounds as good as I remember it being then. Are there any of your "more mature" readers who'd care to correspond with this old'un about the early days? Anyone remember shellac?

F. NEWTON
MANCHESTER

I *can't* resist this:— the pitch in pine sounded fine eh? In apology for that, if any readers care to write to Mr Newton via Audiophile, I will pass on the epistles.

●

EAT YOUR HEART OUT

Dear Sir,

ETI hi-fi reviews!?! How come? Not a bad idea but stop ignoring the budget end of the business. We also play records who stand and drool (at SME's) you know.

Also let's see yer credentials Mr Harris — wots yer reference system? Reveal all and get rid of these evil thoughts telling me it's a wind-up job from Woolies! Keep up the reviews but more radio? It still exists you know.

D. ALEXANDER
LONDON

You keep your hands off my credentials, they've never hurt anyone and are certainly not to be revealed within the pages of ETI. I didn't get where I am today going

around revealing me credentials.

As for reference system that consists of:— Technics SL150 Mk.2, SME 3009 Mk.3, Goldring G900SE Mk.2, Shure V15 Mk.4, Lecson AC1 and AP3 Mk.2, Pioneer TX9500 Mk.2, Celestion Ditton 66 loudspeakers and Sony EL7 Elcaset (for as long as they let me hang onto it!) Occasional use is also made of Ultimo 20 and Coral 777EX moving coil cartridges. The Technics is fitted with a GA Audio glass turntable mat, and for headphones I use Koss Pro 4AAs or ESP10s as the occasion demands. My budgie has a green beak and my plants all died last week.

Revealing enough?

●

QUADRUPLE QUERY

Dear Sir,

Please could you explain some terms I keep reading in hi-fi magazines (including yours) and that no one has ever explained? These are 1) Selectivity 2) Modulus 3) Dynamic Range 4) Musicality.

Also I wish to upgrade my Quad 33/303 set up for more power and would welcome suggestions. Thank you.

H. COHEN
STOKE

Easy ones first. A new amplifier to replace a Quad. Since you give very little information as to speakers, cartridge, room size etc etc I'm gonna have to assume that all you seek is a more powerful version of the same thing! In which case why not try the Quad 405 as a starting point? If this fails to appeal, and funds allow, cast an ear over units by Lecson, Meridian and maybe the Sony VFET designs.

Now to the definitions you requested. Quite a mixed bag this little lot. Ah well here goes:—

1) Selectivity (of tuners):—the ability of the machine to discriminate against signals on adjacent channels (± 200kHz) to the one you're trying to tune to. Good selectivity is a must with sensitive tuners.

2) Modulus:—Presumably you spotted this lying next to the word impedance. Otherwise it must have been a maths book. In literal terms modulus means "size of", ignoring positive and negative aspects. Phase differences can make impedance (resistance to passing a signal) difficult to express simply. Non-mathematically it is best just to regard modulus as meaning 'magnitude of' but remember there is more to it!

Mathematicians please don't write in — $z = x + iy = r(\cos\theta + i\sin\theta)$ mod $z = /z/ = r = \sqrt{x^2 + y^2}$ OK?

3) Dynamic Range:—the difference, in dB, between the softest and loudest sounds reproducible by the hi-fi under discussion. For example a cassette with 20dB of tape noise, and on which compression sets in at 70dB, has a dynamic range of 50dB.

4) Musicality:—oh what a lovely word! Whichever gnomic intellect invented it has my congratulations. The really nice thing about it is that NO-ONE knows what it means! Currently it is employed (I think) to express the amount of 'information retrieval' a system is capable of. Earlier in its history it was simply a word reviewers used to mean 'nice' with exactly the same amount of precision as the word implies. Next week it could be describing how satisfying a crunch is generated in the destruction of a piece of toast. Musical Mothers Pride?

EH?

Dear Sir,

I strongly feel that transient intermodulation distortion and slew rate limiting together with uneven harmonic distribution are the total reason for the so-called 'transistor sound' in modem amplifiers. Do you agree?

M. DAWES
SWANSEA

My answer lies entirely within the negative quadrant of the sphere of communication.

●

ALL AT SEA

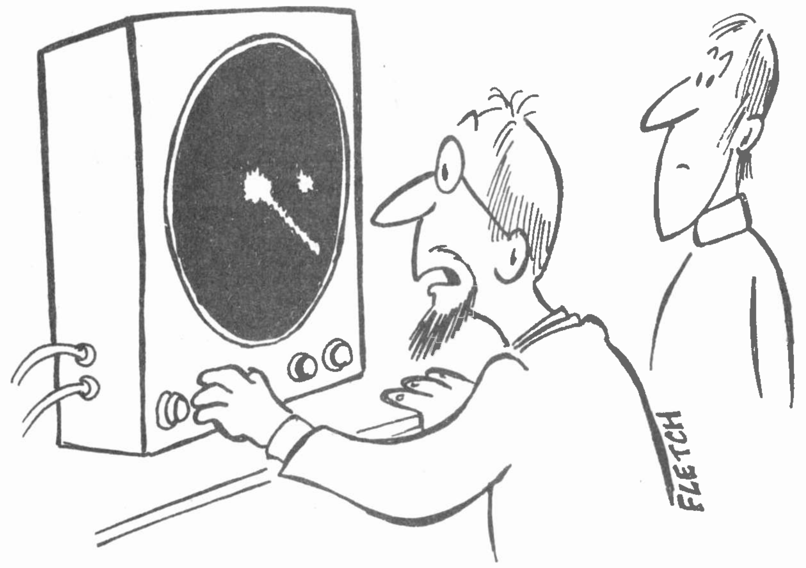
Dear Sir,

As a regular subscriber to ETI, I am writing to express my protest at ETI's hi-fi content. If I wanted to read about hi-fi I would buy hi-fi magazines, God knows there are enough of them.

What ETI should be doing is more articles explaining how circuits work, so that your readers can design them themselves. And how about more circuits for us boating enthusiasts?

S. McGREGOR
LONDON

How did you get on this page?



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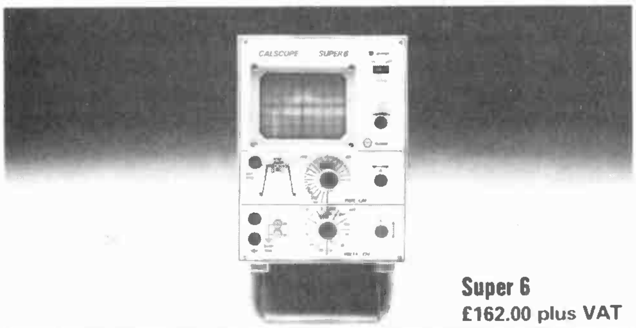

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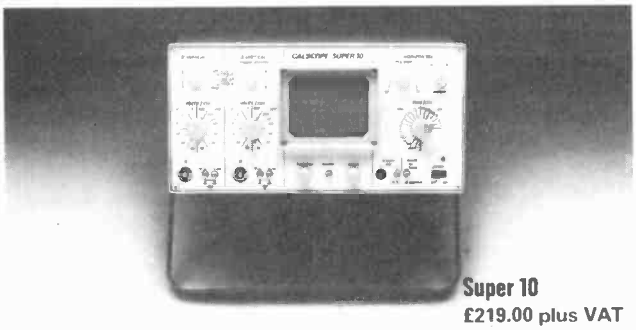

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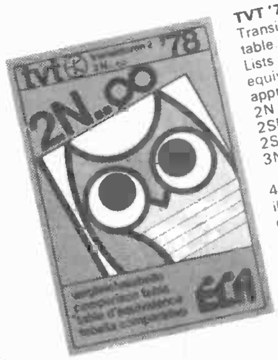

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Sep 77	*Graphic Equaliser	601	1 75	20 28	BFGH
Sep 77	*Graphic Equaliser P S U	602	65	1 94	BFG
Oct. 77	*Watchdog	604	90	18 80	BEGHL
Oct 77	*Watchdog P S U	605	75	6 14	BEH
Aug. 77	*Sweep Oscillator	606	2 90	36 41	BFGHL
Sep 77	*Stereo Simulator	607	70	5 77	BEGHL
Dec 77	*Freezer Alarm	608	65	7 07	BFHL
Nov 76	*General Purpose Preamp	609	70	3.83	BEG
Jul 77	*GSR Monitor	612	80	16 55	BEGHL
Apr 77	*Burglar Alarm	613	70	9.00	BEGH
Feb 77	*Bench Amplifier	615	80	11 10	BEGHL
Nov 77	*Compander	617	1 75	23.30	BEGHL
Mar 77	*50 watt High Power Amp	618	1 45	7 91	BE
Mar 77	*100 watt High Power Amp	619	1 45	10 61	BE
Mar 77	*High Power Amp P S U	620	1 20	14 75	BEJ
Oct 77	*Digital Thermometer	621	1 40	18 70	BFGHL
Feb 77	*LED Dice	624	60	5 83	BEGHL
	*Active Crossover (2 pcbs)	625	2 40	12 70	BFGHL
	*Marker Generator	626	90	6 97	BEGHL
Nov 77	*Skeet	627	1 75	18 37	BEGHL
	*Flash Trigger	628	75	5.07	BEGJ
	*Disco Light Show	629	3 30	21 94	BFGJ
	*Pink Noise Generator	630	70	3 35	BEL
Nov 76	541 Train Controller	T001	80	15 86	BEHL
Jan 77	444 5 watt Stereo (2 pcbs)	T002	2 15	26 47	BEGK
Feb 77	448 Disco Mixer	T003	1 75	16 36	BEJ
Dec 77	Clock B	T004	2 30	13 61	BE
Jan 78	House Alarm A	T005	2 20	25 68	BEHM
	House Alarm B	T006	95	3 99	BE
Feb 78	Metal Locator Mk II	T007	1 05	19 10	BEHL
March 78	Frequency Shift P S U	T008	75	4 89	BE
	Frequency Shifter	T009	1 65	21 04	BEL
	L C D Meter	T010	1 10	25 72	BEG
	Light Dimmer	T011	65	7 17	BEH
Apr 78	Gas Monitor	T012	90	13 96	BEHL
May 78	Star Trek Radio	T013	95	7 97	BFH
	Stars & Dots	T014	2 00	22 28	BEHL
June 78	Spectrum Analyser (2 pcbs)	T015	9 75	66 53	CEHM
	Wein Oscillator	T016	1 00	14 56	BEHL
	Torch Finder	T018	55	1 82	BE
	Temperature Meter	T019	1 10	25.51	BEG
Aug 78	Elliwet Plant Waterer	T020	1 00	5 03	BEH
Sept 78	Cross Hatch Generator	T021	1 40	12 64	BEGHL
	Stac Timer	T022	2 30	23 26	BEJL
	Wheel of Fortune	T023	1 35	8 36	BEHL
Oct 78	Complex Sound Generator	T024	2 95	21 88	BEH
	R F Power Meter	T025	1 20	12 94	BEHL
	Power Bulge	T026	70	2 98	BEHL
	Telephone Bell Extender	T027	1 00	9 65	BEHL
Oct. 78	Proximity Switch	T028	1 95	13 11	BEGH
Feb 78	Ultra Sonic Receiver	T029	70	9 03	BEH
Feb 78	Ultra Sonic Transmitter	T030	55	4 57	BEH
Nov 78	Cuts Cassette Interface	T031	2 25	12 76	BEH
	Audio Oscillator (2 pcbs)	T032	2 90	33 74	BEHL
Dec 78	Car Alarm (2 pcbs)	T033	1 80	5 52	BEJ
	Wine Temperature Meter	T034	1 10	5 79	BEHL
	Curve Tracer	T035	1 00	9 31	BEHL
	Eprom Programmer	T036	2 25	20 21	BEH
	Eprom Programmer P S U	T037	1 30	5.09	BE
Jan 78	Car Tachometer	T038	1 75	10 00	BF
	Digital Module A & B (2 pcbs)	T039	1 80	18 77	BE
	Digital Dial (Excl T039)	T040	1 25	7 60	BE
	Log Converter	T041	3 50	23 66	BE
Feb 79	Tape Slide Synchroniser	T042	2 10	17 47	BEHL
	Tape Noise Limiter	T043	70	3 04	BEHL
	Light Activated Tachometer	T044	2 10	31 99	BEH
March 79	Headlight Delay	T045	70p	5.73	BEHL
	Logic Trigger	T046	1.95	16.06	BEH
	Stage Dimmer Control Module	T047	2.65	41.75	BEH
	Stage Dimmer Module 10 amp	T048	5.75	TBA	—
	Stage Dimmer Module 20 amp	T049	5 75	TBA	—
	Audio Power Meter	T050	3.25	63.56	BEH

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Mar	Audio Level Meter	1 20
May	Audio Exp/Compressor	3 95
Sep	560 ABC VDU (Set 3)	5 60
	710 2m Power Amp	1 00
Oct	241 Double Dice	1 50
	252 1-2 Hour Timer	60
	152AB TV Pattern Gen (Set 2)	3 15
Nov	543AB STD Timer (Set 2)	2 20
Dec	544 Heart Rate Monitor	1 10
	447 Audio Phaser	1 60
	446 Audio Limiter	1 35
1977		
Jan	570 Reaction Tester	1 60
	549 Metal Locator I	95
	Patch Detector	60
	Heads or Tails	60
Feb	448A Headphone Amp	60
	449 Balanced Pre-Amp	75
	449A VU Meter	1 10
	Door Bell	75
Mar	155 ABCD Digital Voltmeter (Set 4)	4 30
	Drill Controller	70
	Function Generator	95
	Temperature Alarm (Set 2)	1 40
Apr	Fuzz	60
	63D Hex Display	70
	P S U	60
	804 TV Game	1 70
May	Metronome (Simple)	60
	Inject Tracer	80
June	Digital Freq Meter (Set 4)	3 40
	Bass Enhancer	2 70
Jul	081 Tachometer	60
	Micro Amplifier	55
	Alarm Alarm	60
Aug	Moisture Indicator	75
	Bongas	75
	Egg Timer	70
Sep	Loud Hailer	70
	Continuity Tester	60
Oct	Spirit Level	95
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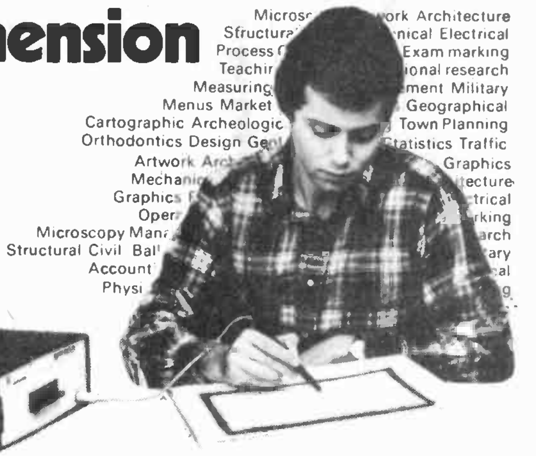

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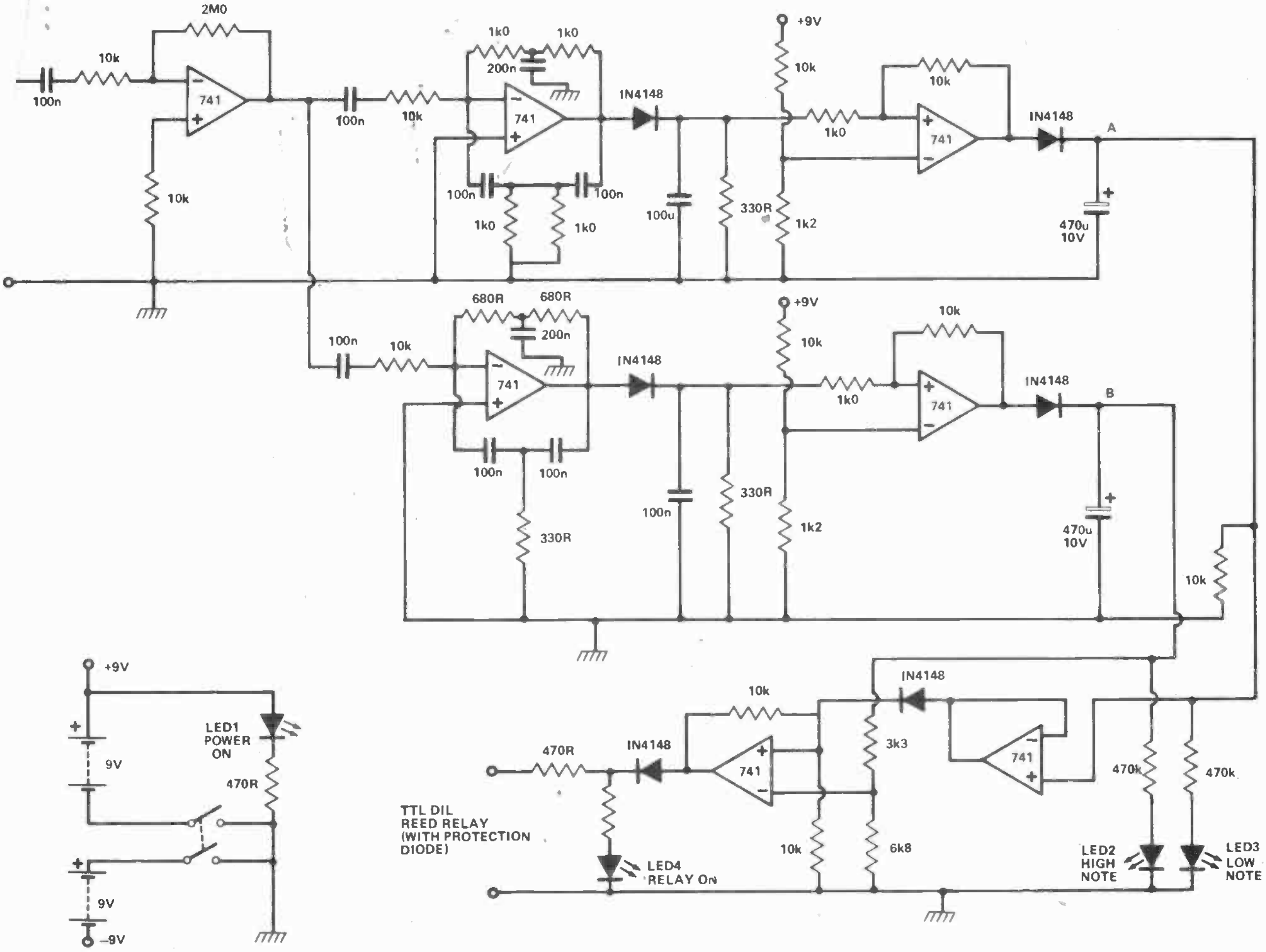
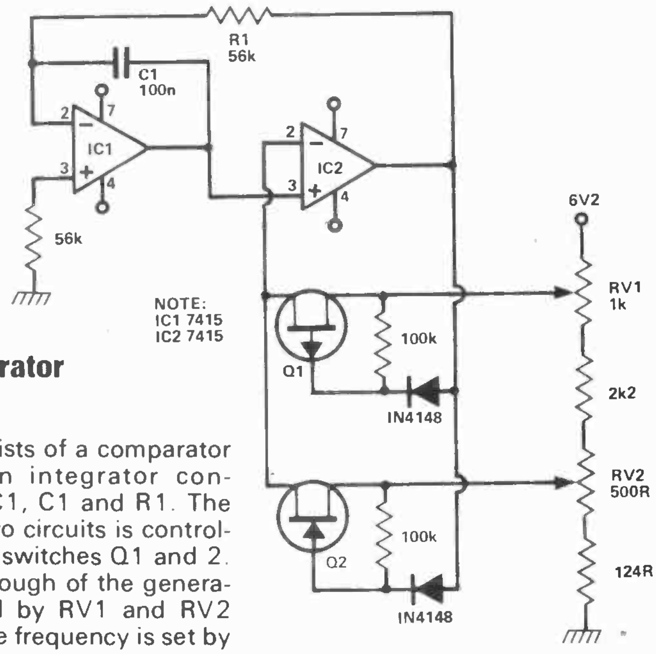


Whistling Switch

R. C. W. Gate

The circuit acts as a remote control switch, activated by whistling a high note and reset by a low note.

The input from the microphone is amplified by IC1 and then processed by two notch filters. The outputs of these are rectified and smoothed and used to fire the Schmitt trigger constructed from two operational amplifiers, IC's 6 and 7. The output points A and B can be used separately to drive other logic functions provided that if high impedance logic is used a 10 k resistor is placed in parallel with the 470 uF capacitor at these points.



Triangle Generator

R. I. Harrison

The circuit consists of a comparator IC2 driving an integrator constructed from IC1, C1 and R1. The output of the two circuits is controlled by the JFET switches Q1 and 2. The peak and trough of the generator is controlled by RV1 and RV2 respectively. The frequency is set by C1 and R1.

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

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

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WIREWOUND

Watts	Range	1-99	100+
1	OR22-1k8	7p	4½p
2½	OR22-15k	9p	6p
5	OR47-33k	12p	9p
7/8	2R-22k	14p	10½p
9/10	OR4-60k	16p	12½p
15	1R-75k	18p	14½p

(Full list of values in cat)

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1.5-1000pF	3p	2.25p
1500-.047	4p	2.8p

100V MYLAR, E12 series

Value	1-99	100+
.001-.0082µ	4p	3p
.01-.1µ	5p	3.6p
.15	7p	4.8p
.22µ	9p	6.2p
.33µ	10p	7.4p
.47µ	14p	10.6p

250V polyester

Value	1-99	100+
.01-.068	4p	2.8p
.1-.22	5p	3.8p
.33	8p	5.6p
.47	12p	7.3p
.68	15p	9.6p
1.0	20p	13.4p
1.5	26p	18p
2.2	32p	22p
3.3	39p	26p
4.7	49p	32p
6.8	63p	39p

ELECTROLYTICS

25V: 0.47 1 2.2, 3.3, 4.7, 10, 15, 22, 23, 47µ **7p**; 100µ **8p**; 150µ **10p**; 220µ **12p**; 330µ **15p**; 470µ **19p**; 1000µ **26p**; 1500µ **31p**; 2200µ; **38p**; 3300µ **51p**; 4700µ **60p**; 10000µ can **87p**; 40V: .47 1µ **7p**; 2.2, 4.7, 10, 15, 22µ **8p**; 47µ **9p**; 100µ **11p**; 150µ **13p**; 220µ **15p**; 330µ **20p**; 470µ **24p**; 1000µ **34p**; 1500µ **45p**; 2200µ **60p**; 4700µ **72p**. 63V: 1, 2.2µ **8p**; 4.7µ **9p**; 10µ **10p**; 22µ **11p**; 47µ **12p**; 100µ **13p**; 220µ **18p**; 470µ **26p**; 1000µ **51p**; 2200µ **78p**; 4700µ can **220p**.
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1.5µ	35	12p	7½p
2.2µ	35	12p	8p
3.3µ	35	12p	8½p
4.7µ	35	14p	9½p
6.8µ	35	14p	10½p
10.0µ	35	14p	11½p
15µ	20	14p	11½p
22µ	16	14p	11½p
33µ	10	14p	11½p
47µ	6	14p	11½p
68µ	3	14p	11½p
100µ	3	14p	11½p

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.2 Red LED	14p	10p
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76013N	130p	85p
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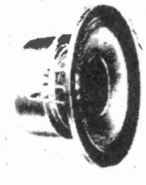

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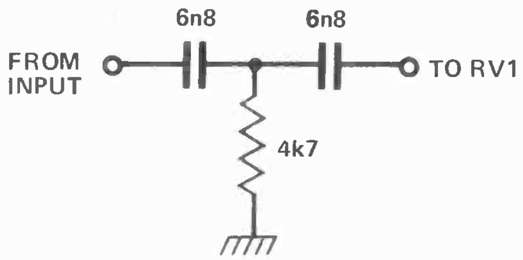


Modification to Tape Noise Limiter Feb '79

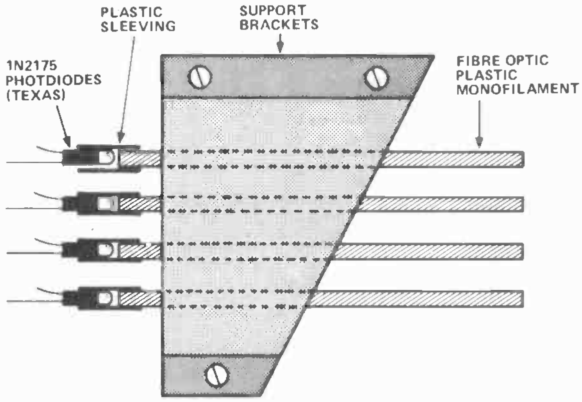
P. Burns

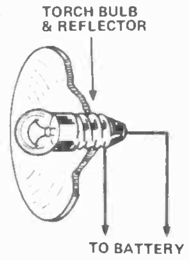
The performance of this unit may be greatly improved by this simple modification. The original circuit assumes that a high level music signal will mask background noise. In reality a high level bass signal will trigger the filter, giving an audible 'whoosh' of noise. This can be alleviated by adding a simple high pass filter to the control circuit. The filter removes signals below 5 kHz, resulting in a cleaner, less breathy, sound. It should be noted that the input impedance of this circuit is only about 3 k and it may be advisable to precede this circuit with an emitter follower.

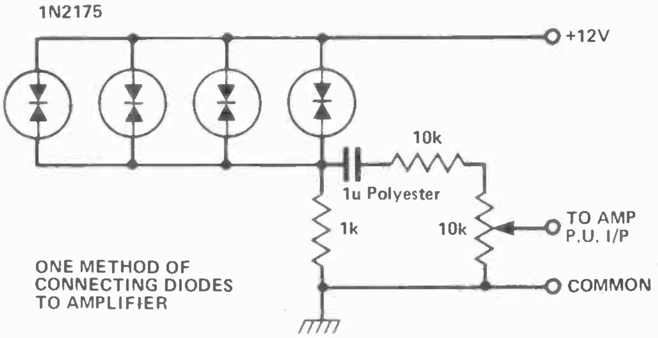
Upgrading Valve Tuners

R. N. Soar

Older valve tuners often use an ECC85 type valve as the RF amplifier-mixer amplifier. The performance of these tuners can be permanently upgraded by using a solid state replacement such as a Fetron. A typical example is the TS12AT7, a plug in replacement for the ECC81/12AT7 range of valves but the performance is almost the same as the ECC85, only the heater connections are different and this does not apply to solid state. The advantages of replacement are that gain never falls off, thermal drift does not occur and performance is generally better. The only disadvantage is that the Fetrons cost several pounds but can be obtained from East Cornwall Components Ltd.







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Fibre Optic Bass Guitar

J. Smith.

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7407	.24	74153	.45
7408	.12	74154	.70
7409	.12	74156	.45
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7411	.15	74161	.55
7412	.15	74163	.55
7413	.25	74164	.55
7414	.45	74165	.60
7420	.12	74166	.75
7426	.20	74175	.60
7427	.20	74176	.50
7430	.12	74180	.75
7432	.20	74181	1.25
7437	.20	74182	.50
7438	.20	74190	.70
7440	.12	74191	.70
7441	.60	74192	.55
7442	.38	74193	.60
7443	.60	74194	.55
7444	.60	74195	.55
7445	.60	74196	.55
7446	.50	74197	.55
7447	.50	74198	1.00
7448	.50		
7450	.14		
7451	.14		
7453	.14		
7454	.14		
7460	.14		
7470	.25		
7472	.21		
7473	.21		
7474	.21		
7475	.25		
7476	.25		
7480	.40		
7483	.75		
7485	.60		
7486	.25		
7489	1.20		
7490	.25		
7491	.40		
7492	.32		
7493	.28		
7494	.50		
7495	.50		
7496	.50		
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7in NYLON CABLE TIES 100 for £1.50 p&p 20p. Cannon 25 way male or female with cover plus 2 metres 25 way cable assembled £2.50 each plus p&p 20p.

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TRIMPOTS 50Ω T05 20p, 100Ω Cermet 20p, 100Ω Painton PCB 20p, 200Ω ditto 20p, 250Ω ditto 20p, 500Ω ditto 20p, 1K ditto 20p, 2K ditto 20p, 2K Helitrim 20p, 5K PCB 20p, 1M skeleton min. vert. 12p p/p 20p.

CANNON D-TYPES. Only ones left: 15 way socket 50p, 37 way plug 80p, 50 way socket £1.20, 50 way wire wrap socket £1.30, 25 way ribbon plugs 90p. Cinch 25-way plastic cover 60p, Metal cover and retainer 80p. P/P 20p.

NEW SN76477 sound generator IC (train, plane, explosion, phaser gun etc.) with data, £2.80 + 20p P/P.

MICROSPEECH Speech Synthesiser board (assembled and tested, British made) single PCB, plugs directly into a SWPTc 6800 buss. The package offered consists of PCB MSP-software on floppy disc, hardware and software manual. Will interface to other systems — leaflet s.a.e. and details of MPU being used £320 inclusive.

SUPERSAVER 1 Price smash — 10K multiturn electratrim panel mounting pots, 6 for £1, p&p 20p.

SUPERSAVER 2 Hybrid Systems DAC 371-8 (8-bit) DIL packaged + data, ideal MPU users, brand new £2 price smash! now £1.75 each (fraction of original cost) p/p 20p.

SUPERSAVER 3 IR Bridge rectifier type 12T 20T (12 amps 200V) 3 phase or single phase. 95p plus p&p 20p.

MEMORIES 2708 £6-85, 2102 (Signetics) £1, 1702A £2.95, 2513 (upper case) £4.65, Mostek MK4012N (1024 x 1), few only, 68p, p/p 20p.

SUPERSAVER 4. RS338-383 miniature decade thumbwheel switch £1.35 p/p 20p.

9-WAY MALE/FEMALE connector (Elco 8129) 0.1 inch pitch, PCB mounting ideal for bussing two PCBs together 35p/pair p/p 20p.

LEDS (red) TIL 209 9p, 0.2 10p, Vernitron Ceramic filters FM-4 10.7MHz 45p, BD 236 40p, 2N3055 (TI) 40p, BC183L 10p, BC213L 10p, BF195 10p, 2521V (Dual 128 bit static shift register 65p), RS 12-0-12 50mA sub-miniature transformer £1.35, suitable clock IC £3.25, TMS3128NC (static shift reg) £1.25, LM711CH TO-99 (Voltage comparator) 25p, FPE 100 infra red emitter + data 15p, MM5314 £2.95, DIL SWTS 4 way 60p. TBA810S + DATA 65p.

P/P 20p

All enquiries, Sae please, Cat. SAE 8x6 or free with goods. P/P same for quantities except where greater than £1.

Rush orders as some stocks are limited

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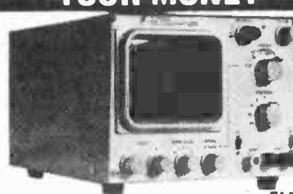

ELMAC 4" SCOPE

SPECIFICATIONS

ELECTRICAL DATA

VERTICAL AXIS (Y) Deflection Sensitivity — 100m V/division. Bandwidth (between 3 dB points) — DC — 5MHz. Input Attenuator — (calibrated) — 9 step 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50/div. Input impedance — 1 Meg/40 pf in shunt Input Voltage — Max — 600V P.P.
HORIZONTAL AXIS(X). Deflection Sensitivity — 0.400mV/division. Bandwidth (between 3 dB points — 1Hz-350KHz. Gain Control — Continuous when time bases in EXT position. Input Impedance — 1 Meg. Input Voltage — Max — 500V P.P.
TIME BASE. Sweep Range (calibrated) — 100msec/div to 1μ sec/div in 5 steps. FINE Control — Variable between steps — includes time-base calibration position. Blanking — Internal — on all ranges.
SYNCHRONISATION. Selection — Internal external. Synchronisation Level — Continues from positive to negative.
POWER SUPPLY. Input voltage — 115/200V AC± 10% at 50/60Hz Power Dissipation — 18W.
CRT DATA — 4in. — flat face, single beam. — Maximum high voltage — 1.5kV. — Fitted with 8x10 division blue filter graticule.
PHYSICAL DATA Dimensions — 15cm(h)x20.5cm(w)x28cm(d) Weight — 4.3Kg(approx.) Stand — 2 position flat and inclined Case — Steel, epoxy enamelled. Front panel — Aluminium enamelled epoxy printing. **(As recommended by ETI)**

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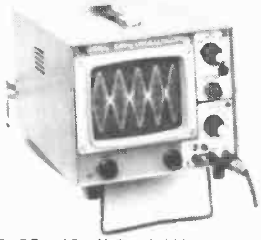
£99 (+ £7.92 VAT + £1.50 Carriage

Test leads available £2.00
Barclay and Access

10MHz Scope with 5 x Magnifier for **£147.95** (+£11.94 VAT).



5" CRT

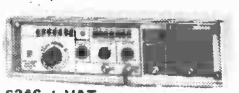
SAE for further details

- ● DC to 10 MHz bandwidth.
- ● 10mV to 50V/cm in 12 calibrated steps.
- ● 0.5 μS to 0.1 Sec/cm sweep range in 6 calibrated steps plus 12.1 Vernier.
- ● Magnifier x5.
- ● Fully automatic trigger.
- ● DC to 1.5 MHz horizontal bandwidth.
- ● Fastest sweep 10ns/cm with Magnifier.

Sensitivity: <1 cm deflection 10 Hz to > 15MHz L.F. trigger extends below 5 Hz with 2 cm deflection. Trigger circuit locks to the mean value of the displayed waveform. It will lock to almost any waveshape including sine, square, triangle, pulse and TV video signals. When no signal is present to repetition rate is below 5Hz the trace free runs producing a bright base line. Company orders welcome by phone and Telex.

6MHz OSCILLOSCOPE 3106B

Similar in appearance to 10 MHz 'scope.
10mV to 50V/cm in 12 calibrated steps, 0.5 μ S to 0.1Sec/cm sweep range in 6 calibrated steps plus 12.1 Vernier. Magnifier x5. Fully automatic trigger. DC to 1.5MHz horizontal bandwidth.
Our 3106B with 1,600v arceleration Voltage. 10 mv/cm sensitivity, auto trigger for the full bandwidth and x5 magnifier giving 1000NS/cm. Fastest sweep time (equivalent to 15 MHz oscilloscopes). SAE for brochure.
£132 (+£10.56 VAT)



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1000:1 internal sweep range. Sweep boundaries are controlled by main function generator frequency dial setting and the sweep width control setting. Sweep rate continuously adjustable.

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- ● 0-100%, continuously adjustable AM depth
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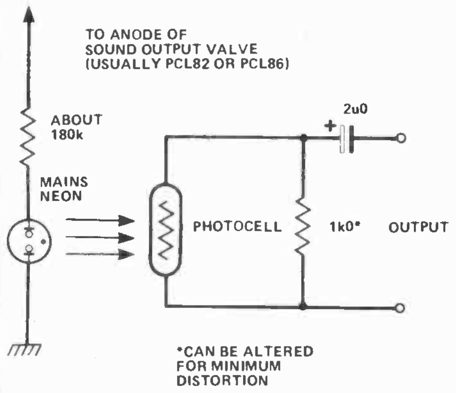
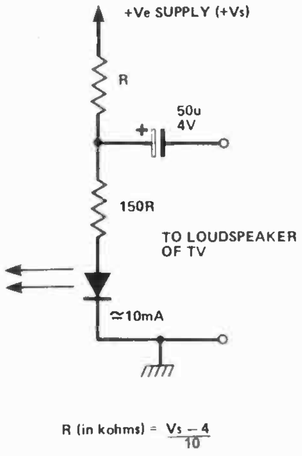
Television Optoisolator

A. P. Hiley



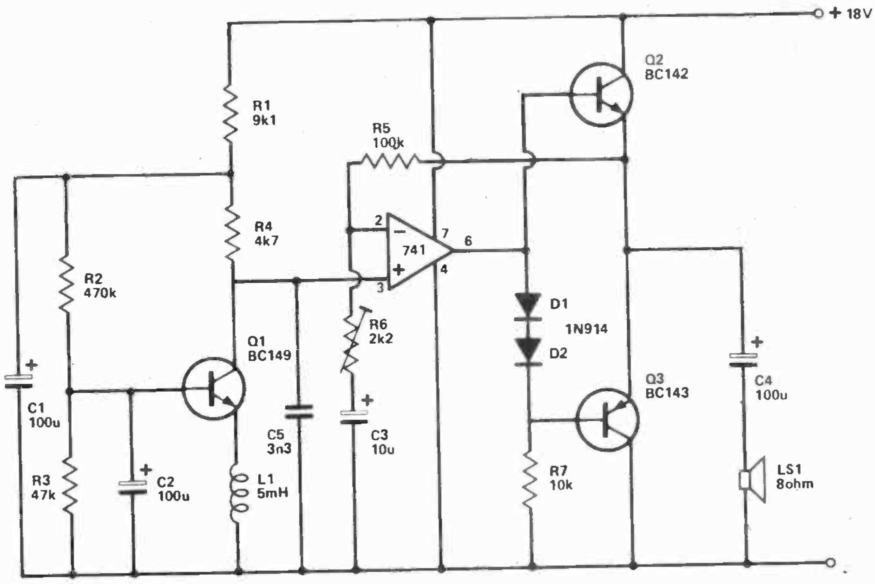


The problem of how to connect a tape recorder, or amplifier, to a television set is not an easy one to solve, because most televisions, having no mains transformer, have the chassis connected directly to the mains. The easiest, and simplest solution is to incorporate some form of optoisolation between the television and the external equipment. This particular design is simple, has a very low noise level, and introduces negligible distortion.

The LED or neon is brightness modulated by the output of the television sound channel. The light is picked up by a small, cheap silicon photocell, placed a fraction of an inch away. A small current is produced, proportional to light intensity, which produces a PD across the load resistor, which is a replica of the original signal.

Telephone Amplifier

J. P. Macaulay



One of the most frustrating things in life must be to wait in line whilst one's wife converses (nags?) on the phone. What makes the matter worse is that only one side of the conversation is heard. The circuit here will at least enable you to hear what's going on at the other end of the line.

The signals are picked up by the coil L1, a 5 mH RF choke taped to the side of the set. Q1 operates in the common base mode with the output signal appearing across the collector resistor, R4. The output stage consists of two complementary transistors fed from the output of IC1 and included in it's feedback loop.

The gain provided by the IC is made variable by the inclusion of R6 and this should be adjusted for a comfortable output level. D1, D2 in conjunction with R7 provides the small but necessary bias required by the output pair.

The interstage capacitor provides a 13db point in the bass end at 300Hz.

C5 defines the upper frequency limit of the circuit at 3 khz, the best bandwidth for maximum intelligibility.

Quiescert current consumption is less than 5 mA so the circuit can be easily run from a pair of PP3's in series.

DIODES/ZENERS

QTY.				
	1N914	100v	10mA	.05
	1N4005	600v	1A	.08
	1N4007	1000v	1A	.15
	1N4148	75v	10mA	.05
	1N4733	5.1v	1 W Zener	.25
	1N753A	6.2v	500 mW Zener	.25
	1N758A	10v	"	.25
	1N759A	12v	"	.25
	1N5243	13v	"	.25
	1N5244B	14v	"	.25
	1N5245B	15v	"	.25

SOCKETS/BRIDGES

QTY.					
	8-pin	pcb .20	ww	.35	
	14-pin	pcb .20	ww	.40	
	16-pin	pcb .20	ww	.40	
	18-pin	pcb .25	ww	.95	
	20-pin	pcb .35	ww	.95	
	22-pin	pcb .35	ww	.95	
	24-pin	pcb .35	ww	.95	
	28-pin	pcb .45	ww	1.25	
	40-pin	pcb .50	ww	1.25	
	Molex pins .01	To-3 Sockets		.25	
	2 Amp Bridge	100-prv		.95	
	25 Amp Bridge	200-prv		1.50	

TRANSISTORS, LEDS, etc.

QTY.			
	2N2222	(2N2222 Plastic .10)	.15
	2N2222A		.19
	2N2907A	PNP	.19
	2N3906	PNP (Plastic Unmarked)	.10
	2N3904	NPN (Plastic Unmarked)	.10
	2N3054	NPN	.45
	2N3055	NPN 15A 60v	.60
	T1P125	PNP Darlington	1.95
	LED Green,	Red, Clear, Yellow	.15
	D.L.747	7 seg 5/8" High com-anode	1.95
	MAN72	7 seg com-anode (Red)	1.25
	MAN3610	7 seg com-anode (Orange)	1.25
	MAN82A	7 seg com-anode (Yellow)	1.25
	MAN74	7 seg com-cathode (Red)	1.50
	FND359	7 seg com-cathode (Red)	1.25

9000 SERIES

QTY.			QTY.		
	9301	.85		9322	.65
	9309	.35		9601	.20
	9316	1.10		9602	.45

MICRO'S, RAMS, CPU'S, E-PROMS

QTY.			QTY.		
	8T13	1.50		2107B-4	4.95
	8T23	1.50		2114	9.50
	8T24	2.00		2513	6.25
	8T97	1.00		2708	10.50
	74S188	3.00		2716 D.S.	34.00
	1488	1.25		2716 (5v)	59.00
	1489	1.25		2758 (5v)	23.95
	1702A	4.50		3242	10.50
	AM 9050	4.00		4116	11.50
				6800	13.95
	MM 5314	3.00		6850	7.95
	MM 5316	3.50		8080	7.50
	MM 5387	3.50		8212	2.75
	MM 5369	2.95		8214	4.95
	TR 1602B	3.95		8216	3.50
	UPD 414	4.95		8224	3.25
	Z 80 A	22.50		8228	6.00
	Z 80	17.50		8251	7.50
	Z 80 PIO	10.50		8253	18.50
	2102	1.45		8255	8.50
	2102L	1.75		TMS 4044	9.95

C MOS

QTY.		
	4000	.15
	4001	.15
	4002	.20
	4004	3.95
	4006	.95
	4007	.20
	4008	.75
	4009	.35
	4010	.35
	4011	.20
	4012	.20
	4013	.40
	4014	.75
	4015	.75
	4016	.35
	4017	.75
	4018	.75
	4019	.35
	4020	.85
	4021	.75
	4022	.75
	4023	.20
	4024	.75
	4025	.20
	4026	1.95
	4027	.35
	4028	.75
	4029	1.15
	4030	.30
	4033	1.50
	4034	2.45
	4035	.75
	4037	1.80
	4040	.75
	4041	.69
	4042	.65
	4043	.50
	4044	.65
	4046	1.25
	4048	.95
	4049	.45
	4050	.45
	4052	.75
	4053	.75
	4066	.55
	4069/74C04	.35
	4071	.25
	4081	.30
	4082	.30
	4507	.95
	4511	.95
	4512	1.10
	4515	2.95
	4519	.85
	4522	1.10
	4526	.95
	4528	1.10
	4529	.95
	MC 14409	14.50
	MC 14419	4.85
	74C151	1.50

LINEARS, REGULATORS, etc.

QTY.			QTY.			QTY.		
	MCT2	.95		LM323K	5.95		LM380 (8-14 Pin)	1.19
	8038	3.95		LM324	1.25		LM709 (8-14 Pin)	.35
	LM201	.75		LM339	.75		LM711	.45
	LM301	.45		7805 (340T5)	.95		LM723	.40
	LM308	.65		LM340T12	.95		LM725	2.50
	LM309H	.65		LM340T15	.95		LM739	1.50
	LM309K (340K-5)	1.50		LM340T18	.95		LM741 (8-14)	.35
	LM310	.85		LM340T24	.95		LM747	1.10
	LM311D	.75		LM340K12	1.25		LM1307	1.25
	LM318	1.75		LM340K15	1.25		LM1458	.65
	LM320H6	.79		LM340K18	1.25		LM3900	.50
	LM320H15	.79		LM340K24	1.25		LM75451	.65
	LM320H24	.79		LM373	2.95		NE555	.45
	7905 (LM320K5)	1.65		LM377	3.95		NE556	.85
	LM320K12	1.65		78L05	.75		NE565	.95
	LM320K24	1.65		78L12	.75		NE566	1.25
	LM320T5	1.65		78L15	.75		NE567	.95
	LM320T12	1.65		78M05	.75			
	LM320T15	1.65						

– TTL –

QTY.			QTY.			QTY.			QTY.		
	7400	.10		7482	.75		74221	1.00		74LS02	.30
	7401	.15		7483	.75		74367	.95		74LS04	.30
	7402	.15		7485	.55		75108A	.35		74LS05	.35
	7403	.15		7486	.25		75491	.50		74LS08	.35
	7404	.10		7489	1.05		75492	.50		74LS09	.35
	7405	.25		7490	.45		74H00	.15		74LS10	.35
	7406	.25		7491	.70		74H01	.20		74LS11	.35
	7407	.55		7492	.45		74H04	.20		74LS20	.30
	7408	.15		7493	.35		74H05	.20		74LS21	.35
	7409	.15		7494	.75		74H08	.35		74LS22	.35
	7410	.15		7495	.60		74H10	.35		74LS32	.35
	7411	.25		7496	.80		74H11	.25		74LS37	.35
	7412	.25		74100	1.15		74H15	.45		74LS38	.45
	7413	.25		74107	.25		74H20	.25		74LS40	.40
	7414	.75		74121	.35		74H21	.25		74LS42	.75
	7416	.25		74122	.55		74H22	.40		74LS51	.45
	7417	.40		74123	.35		74H30	.20		74LS74	.45
	7420	.15		74125	.45		74H40	.25		74LS76	.50
	7426	.25		74126	.35		74H50	.25		74LS86	.45
	7427	.25		74132	.75		74H51	.25		74LS90	.65
	7430	.15		74141	.90		74H52	.15		74LS93	.65
	7432	.20		74150	.85		74H53	.25		74LS107	.50
	7437	.20		74151	.65		74H55	.20		74LS123	1.20
	7438	.20		74153	.75		74H72	.35		74LS151	.85
	7440	.20		74154	.95		74H74	.35		74LS153	.85
	7441	1.15		74156	.70		74H101	.75		74LS157	.85
	7442	.45		74157	.65		74H103	.55		74LS160	.95
	7443	.45		74161	.55		74H106	.95		74LS164	1.20
	7444	.45		74163	.85		74L00	.25		74LS193	1.05
	7445	.65		74164	.60		74L02	.20		74LS195	.95
	7446	.70		74165	1.10		74L03	.25		74LS244	1.70
	7447	.70		74166	1.25		74L04	.30		74LS367	.95
	7448	.50		74175	.80		74L10	.20		74LS368	.95
	7450	.25		74176	.85		74L20	.35		74S00	.35
	7451	.25		74180	.55		74L30	.45		74S02	.35
	7453	.20		74181	2.25		74L47	1.95		74S03	.25
	7454	.25		74182	.75		74L51	.45		74S04	.25
	7460	.40		74190	1.25		74L55	.65		74S05	.35
	7470	.45		74191	1.25		74L72	.45		74S08	.35
	7472	.40		74192	.75		74L73	.40		74S10	.35
	7473	.25		74193	.85		74L74	.45		74S11	.35
	7474	.30		74194	.95		74L75	.85		74S20	.25
	7475	.35		74195	.95		74L93	.55		74S40	.20
	7476	.40		74196	.95		74L123	.85		74S50	.20
	7480	.55		74197	.95		74LS00	.30		74S51	.25
	7481	.75		74198	1.45		74LS01	.30		74S64	.15
										74S74	.35
										74S112	.60
										74S114	.65
										74S133	.40
										74S140	.55
										74S151	.30
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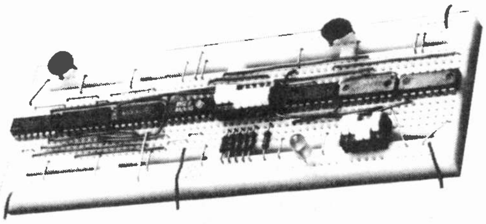

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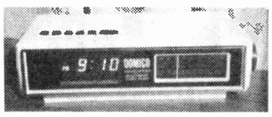

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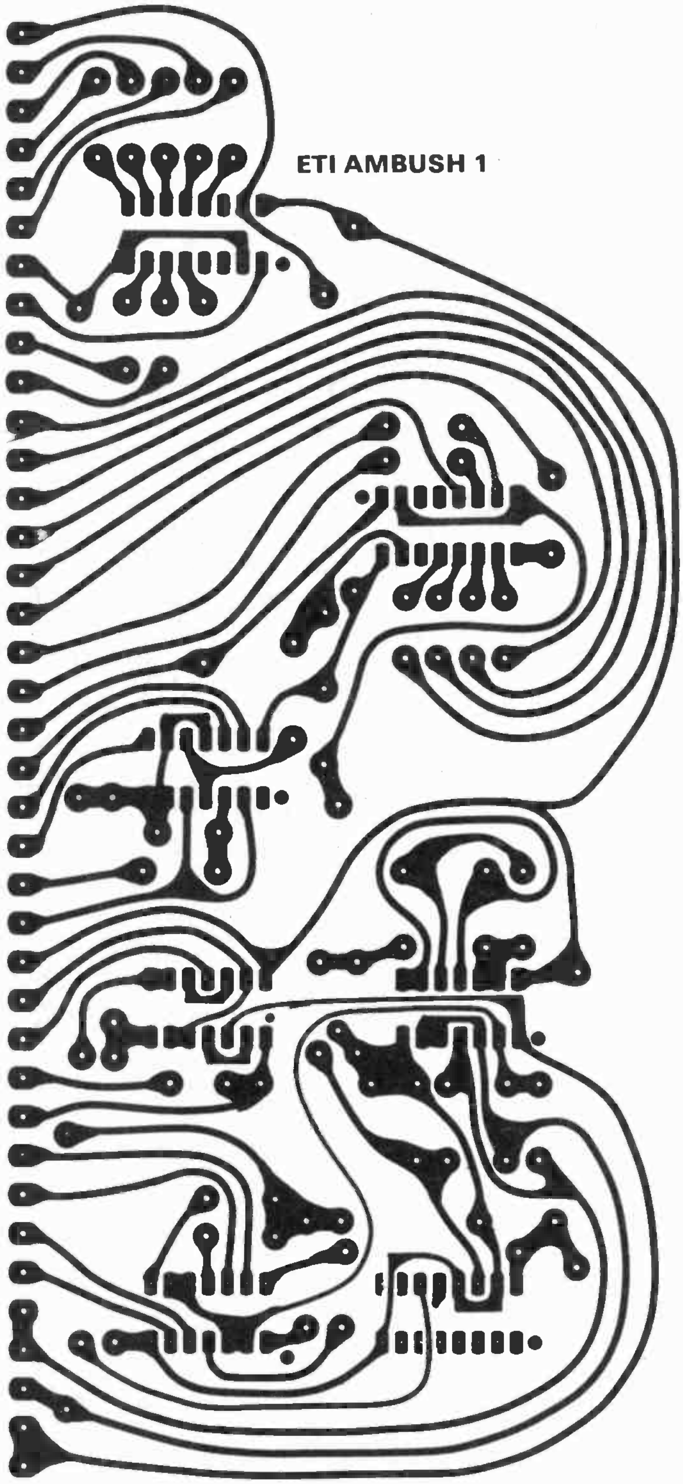

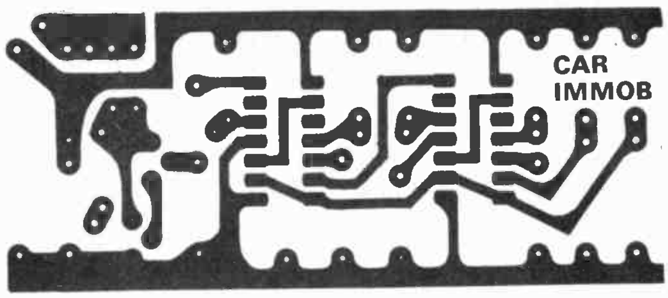

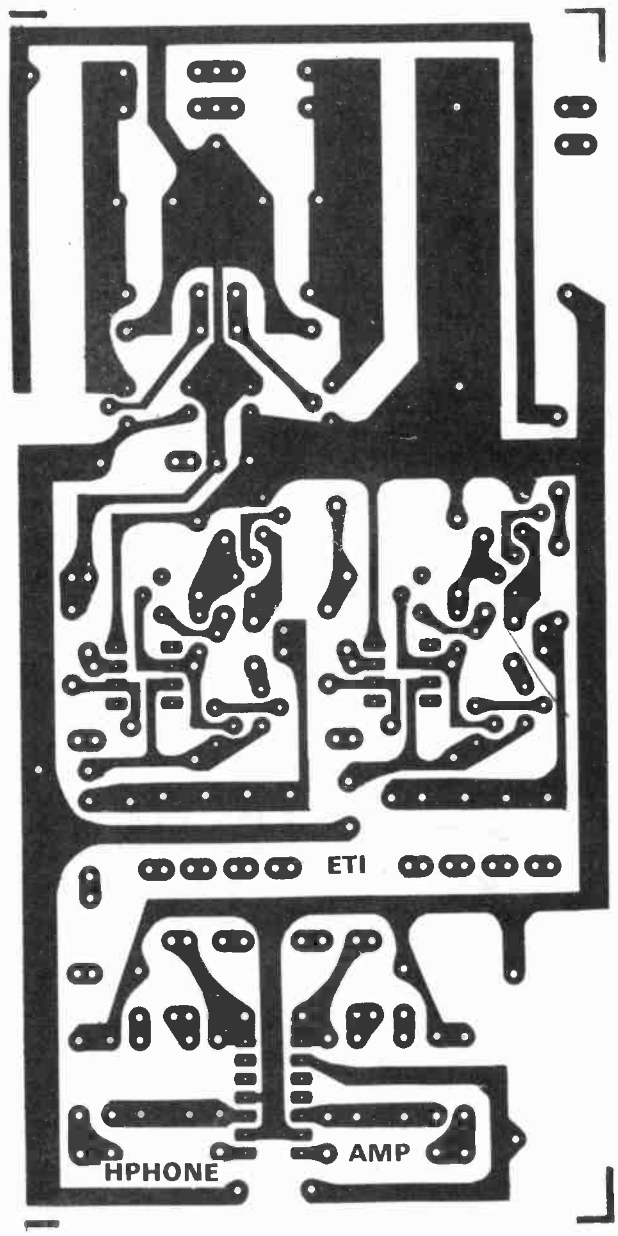

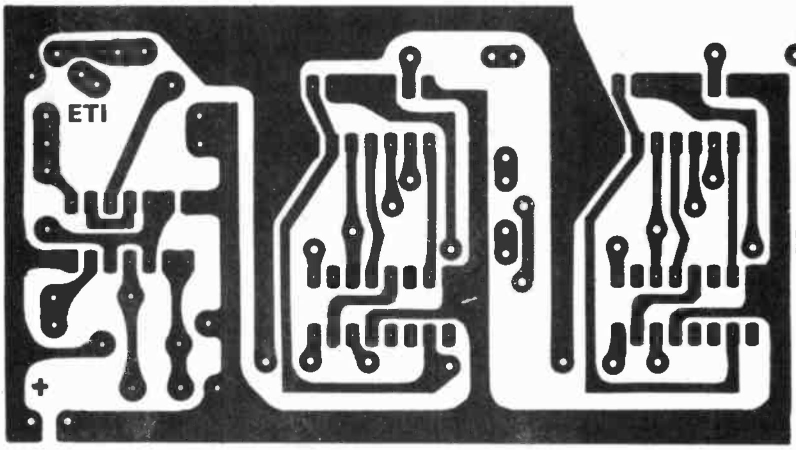

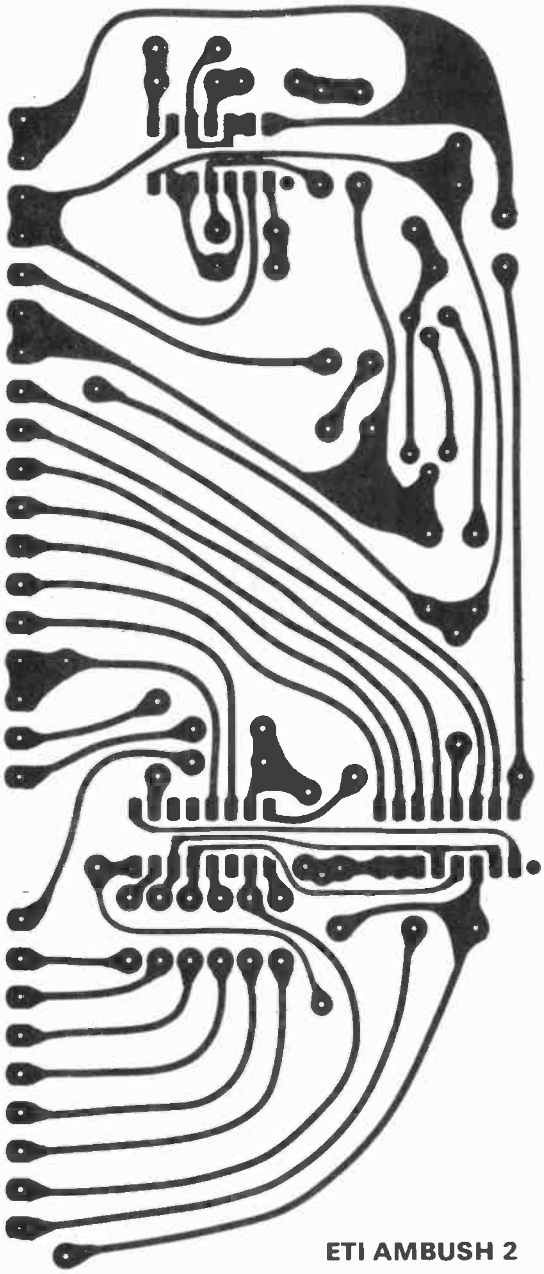

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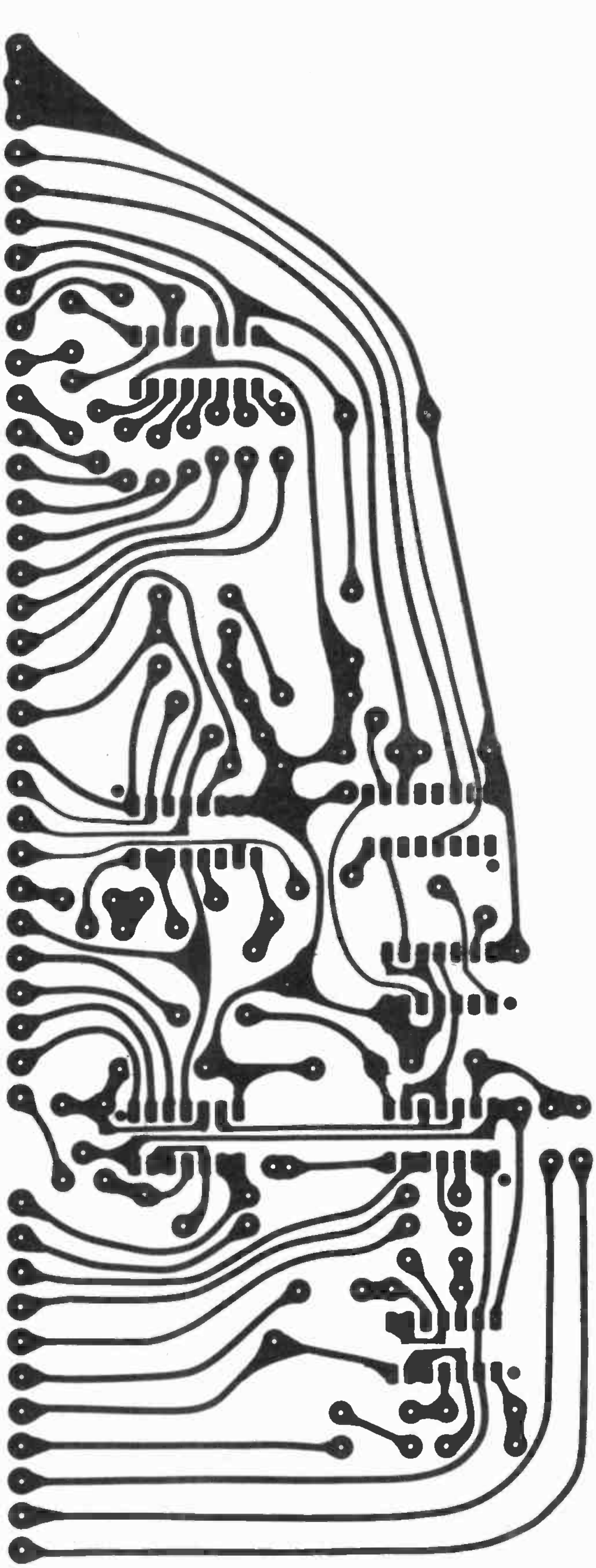

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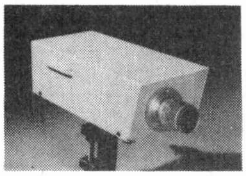

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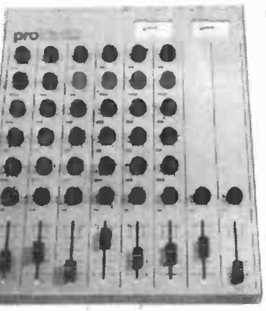

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