

electronics today

MAY 1979

INTERNATIONAL

50p

Six Channel
Fully Proportional
**RADIO
CONTROL
SYSTEM**

**HEADPHONE
AMPLIFIER**
**HOW IT
WORKS -
RADIO
STAR
CHESS**

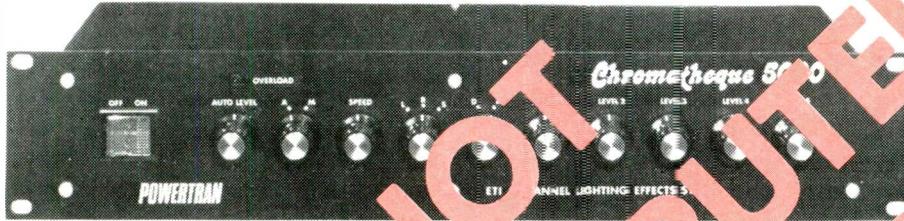


STRATO 4+2

CHROMATHEQUE 5000

5 CHANNEL LIGHTING EFFECTS SYSTEM

All kits also available as separate packs (e.g. P.C.B. component sets, hardware sets etc.) Prices in FREE CATALOGUE.



COMPLETE KIT ONLY
£49.50 + VAT!

This versatile system featured as a construction article in ELECTRONICS TODAY INTERNATIONAL has 5 frequency channels with individual level controls on each channel. Control of the lights is controlled either by the least expensive light emitting diode unit as a straightforward sound-to-light or a more expensive strobe all the lights at a speed dependent upon music level or front panel control or use the internal digital circuitry which produces some superb random and sequenced effects. Each channel handles up to 500W and as the kit is a single board design wiring and construction is very straightforward.

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

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



COMPLETE KIT ONLY
£49.90 + VAT!

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

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

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 CONSTRUCTION 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 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 noise generator, 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 trim) 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!

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!



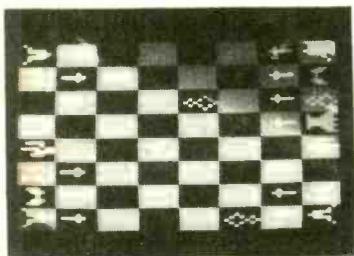
Cabinet size 24.6" x 15.7" x 4.8" (rear) 3.4" (front)

ORDERING INFORMATION AND MORE KITS ON PAGE 8

POWERTRAN



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.



Screen check p.54



Get ahead p.77

electronics today

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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	£1.80

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, 39v, 47v, 51v, 68v, 72v, 75v, 82v, 91v, 100v.

No. Z13 15p ea.

10w Metal stud type S010 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, 39v, 47v, 51v, 68v, 72v, 75v, 82v, 91v, 100v.

No. Z10 35p ea.

SILICON RECTIFIERS

200mA	
IS920 50v	£0.05
IS921 100v	£0.08
IS922 150v	£0.08
IS923 200v	£0.09
IS924 300v	£0.10

1 Amp	
IN4001 50v	£0.04 1/2
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	£0.08
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	£0.28
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	£0.83
IS30/400 400v	£1.28
IS30/600 600v	£1.76
IS30/800 800v	£1.84
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 X50mm plastic shaft 10mm bush supplied with shake proof washer & nut. Tolerance ±20% of resistance.

1831 1k ohms	£0.26*	1836 47k ohms	£0.26*
1832 2k ohms	£0.26*	1837 100kohms	£0.26*
1833 4k ohms	£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 X50mm 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 1Meg	£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 1.5amps at 250v AC

1879 4k7ohms £0.65* 1874 100kohms £0.65*

1871 10kohms £0.65* 1875 220kohms £0.65*

1872 22kohms £0.65* 1876 470kohms £0.65*

£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* 1874 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 10kohms £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 2kohms £0.80*

1895 1899 47kohms £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 2kohms £0.09* 1812 470kohms £0.09*

1806 4kohms £0.09* 1813 1Mohms £0.09*

1807 10kohms £0.09* 1814 2Mohms £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 £0.09* 1825 100kohms £0.09*

1819 1kohms £0.09* 1826 220kohms £0.09*

1820 2kohms £0.09* 1827 470kohms £0.09*

1821 4kohms £0.09* 1828 1Meg £0.09*

1822 10kohms £0.09* 1829 2Mohms £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. £3.80

O/No. 1952. Replacement element for 1948 iron. £1.90

O/No. 1949. Iron coated bit 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 popular X25 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. £3.80

O/No. 1935. Replacement element for 1931 iron. £1.80

O/No. 1932. Iron coated bit 1/8" for 1931 iron. £0.60

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. 1/2 size.
O/No. TR400 @£1.50 p&p £0.10

BRIDGE RECTIFIERS

SILICON 1 amp

Type	Order No.	Price
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

Type	Order No.	Price
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	£0.88

OPTOELECTRONICS

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

O/No.	Type	Size	Colour	Price
1501	ARL209(TIL209)	.3mm (1.25)	RED	£0.10
1502	MIL3232(TIL211)	.3mm (1.25)	GREEN	£0.15
1503	MIL3331(OPL212A)	.3mm (1.25)	YELLOW	£0.15
1504	ARL4850(FVL17)	.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 (1.25)	RED	£0.10
1522	MIL52	.5mm (2)	RED	£0.15
1514	ORP12	Light dependent resistor		£0.55
1520	OC711	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 (1.30" 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.	

SEMICONDUCTORS

TRANSISTORS

Type	Price	Type	Price	Type	Price	Type	Price	Type	Price	Type	Price
AC107	£0.22	BC125	£0.17	BD185	£0.68	BSX200	£0.18	ZTX107	£0.10	2N3053	£0.16
AC113	£0.20	BC126	£0.22	BD186	£0.68	BSY25	£0.16	ZTX108	£0.10	2N3054	£0.40
AC115	£0.20	BC132	£0.18	BD187	£0.75	BSY26	£0.16	ZTX109	£0.10	2N3055	£0.40
AC117	£0.30	BC134	£0.18	BD188	£0.75	BSY27	£0.16	ZTX300	£0.12	2N3391	£0.20
AC117K	£0.34	BC135	£0.15	BD189	£0.78	BSY28	£0.16	ZTK301	£0.12	2N3391A	£0.22
AC121	£0.20	BC136	£0.18	BD190	£0.78	BSY29	£0.16	ZTK302	£0.16	2N3392	£0.20
AC122	£0.14	BC137	£0.18	BD191	£0.95	BSY30	£0.16	ZTK303	£0.12	2N3393	£0.20
AC125	£0.18	BC139	£0.32	BD192	£0.90	BSY31	£0.16	ZTK304	£0.20	2N3394	£0.20
AC126	£0.18	BC140	£0.30	BD193	£0.95	BSY32	£0.16	ZTK305	£0.15	2N3395	£0.22
AC127	£0.18	BC141	£0.28	BD194	£0.95	BSY41	£0.29	ZTK500	£0.13	2N3402	£0.21
AC128	£0.16	BC142	£0.22	BD199	£0.99	BSY51	£0.26	ZTK501	£0.12	2N3403	£0.21
AC128K	£0.26	BC143	£0.22	BD200	£0.99	BSY95	£0.13	ZTK502	£0.16	2N3404	£0.21
AC132	£0.20	BC145	£0.46	BD201	£0.95	BSY95A	£0.13	ZTK503	£0.12	2N3405	£0.42
AC134	£0.20	BC147	£0.07	BD202	£0.80	BRY32	£0.46	ZTK504	£0.25	2N3414	£0.16
AC137	£0.20	BC148	£0.07	BD201/202	£1.70	BU105	£1.40	ZTK505	£0.16	2N3415	£0.16
AC141	£0.22	BC149	£0.07	BD201	£1.70	BU105/02	£1.95			2N3416	£0.29
AC141K	£0.30	BC150	£0.20	BD203	£0.80	BU204	£1.40			2N3417	£0.29
AC142	£0.20	BC151	£0.22	BD204	£0.80	BU205	£1.40			2N3614	£1.00
AC142K	£0.30	BC152	£0.20	BD203/204	£1.70	BU208	£1.90			2N3615	£1.06
AC151	£0.20	BC153	£0.25	BD205	£0.80	BU208/02	£2.25			2G303	£0.22
AC153	£0.30	BC157	£0.10	BD206	£0.80	E1222	£0.38			2G304	£0.30
AC154	£0.20	BC158	£0.10	BD207	£1.00					2G306	£0.40
AC155	£0.20	BC159	£0.10	BD208	£1.00					2G308	£0.36
AC156	£0.20	BC160	£0.26	BD222	£0.47					2G309	£0.36
AC157	£0.25	BC161	£0.38	BD225	£0.47	MAT100	£0.19			2G339	£0.20
AC165	£0.20	BC167	£0.12	BD232	£0.55	MAT101	£0.20			2G344	£0.20
AC166	£0.20	BC168	£0.12	BD233	£0.48	MAT120	£0.19			2G345	£0.18
AC167	£0.20	BC169	£0.09	BD234	£0.55	MAT121	£0.20			2G371	£0.18
AC168	£0.25	BC169C	£0.10	BD235	£0.55	MJ480	£0.95			2G371B	£0.12
AC169	£0.20	BC170	£0.09	BD236	£0.58	MJ481	£0.95			2G373	£0.18
AC171	£0.25	BC171	£0.09	BD237	£0.58	MJ490	£0.95			2G374	£0.18
AC176	£0.18	BC172	£0.09	BD238	£0.60	MJE211	£1.15			2G377	£0.32
AC176K	£0.26	BC173	£0.09	BD239	£2.20	MJE340	£0.68			2G378	£0.18
AC178	£0.25	BC174	£0.15	BDY11	£1.30	MJE370	£0.55			2G381	£0.18
AC179	£0.25	BC175	£0.35	BDY17	£1.80	MJE371	£0.60			2G382	£0.35
AC180	£0.20	BC176	£0.18	BDY20	£0.80	MJE520	£0.45			2G384	£0.32
AC180K	£0.28	BC177	£0.18	BF115	£0.22	MJE521	£0.65			2G385	£0.32
AC181	£0.20	BC178	£0.18	BF116	£0.22	MJE2955	£0.80			2G417	£0.26
AC181K	£0.28	BC180	£0.25	BF117	£0.50	MJE3055	£0.60			2N3903	£0.10
AC187	£0.18	BC181	£0.26	BF118	£0.75	MJE3440	£0.52			2N3905	£0.10
AC187K	£0.28	BC182	£0.09	BF119	£0.75	MP8113	£0.52			2N3906	£0.10
AC188	£0.18	BC182L	£0.09	BF121	£0.50	MPF102	£0.28			2N404	£0.20
AC188K	£0.28	BC183	£0.09	BF123	£0.50	MPF104	£0.35			2N424	£0.40
ACY17	£0.35	BC184	£0.09	BF125	£0.50	MPF105	£0.35			2N527	£0.50
ACY18	£0.35	BC184L	£0.09	BF127	£0.60	MPSA05	£0.20			2N598	£0.40
ACY19	£0.35	BC184L	£0.09	BF152	£0.25	MPSA06	£0.20			2N599	£0.46
ACY20	£0.35	BC186	£0.22	BF153	£0.28	MPSA55	£0.20			2N696	£0.13
ACY21	£0.35	BC187	£0.22	BF154	£0.22	MPSA56	£0.20			2N697	£0.12
ACY22	£0.35	BC207	£0.11	BF155	£0.28	ND120	£0.18			2N698	£0.18
ACY27	£0.35	BC208	£0.11	BF156	£0.28					2N699	£0.32
ACY28	£0.35	BC209	£0.12	BF157	£0.28	OC19	£0.85			2N706	£0.10
ACY29	£0.35	BC210	£0.09	BF158	£0.28	OC20	£1.85			2N706A	£0.12
ACY30	£0.35	BC212L	£0.09	BF159	£0.28	OC22	£1.50			2N707	£0.48
ACY31	£0.35	BC213	£0.09	BF160	£0.30	OC23	£1.50			2N708	£0.14
ACY34	£0.35	BC213L	£0.09	BF162	£0.30	OC24	£1.35			2N711	£0.30
ACY35	£0.35	BC214	£0.09	BF163	£0.30	OC25	£1.00			2N712	£0.30
ACY36	£0.35	BC214L	£0.09	BF164	£0.50	OC26	£1.00			2N718	£0.25
ACY40	£0.35	BC225	£0.26	BF165	£0.50	OC28	£0.80			2N718A	£0.25
ACY41	£0.35	BC226	£0.36	BF167	£0.24	OC29	£0.95			2N726	£0.29
ACY44	£0.35	BC227	£0.16	BF173	£0.20	OC35	£0.90			2N727	£0.29
AD130	£0.70	BC238	£0.16	BF176	£0.36	OC36	£0.90			2N743	£0.20
AD140	£0.85	BC239	£0.16	BF177	£0.28	OC41	£0.20			2N744	£0.20
AD143	£0.75	BC301	£0.28	BF178	£0.28	OC42	£0.20			2N914	£0.15
AD149	£0.60	BC302	£0.29	BF179	£0.30	OC44	£0.24			2N918	£0.30
AD161	£0.35	BC303	£0.28	BF180	£0.30	OC45	£0.20			2N929	£0.20
AD162	£0.35	BC304	£0.38	BF182	£0.30	OC70	£0.24			2N930	£0.18
AD162/162	£0.70	BC305	£0.18	BF183	£0.30	OC71	£0.15			2N946	£0.40
AD163	£0.55	BC327	£0.15	BF184	£0.20	OC72	£0.24			2N1131	£0.18
AD164	£0.75	BC328	£0.15	BF184	£0.20	OC74	£0.24			2N1132	£0.18
AF114	£0.25	BC338	£0.15	BF185	£0.20	OC75	£0.30			2N1132	£0.18
AF115	£0.25	BC440	£0.30	BF186	£0.26	OC76	£0.35			2N1303	£0.18
AF116	£0.25	BC441	£0.30	BF187	£0.26	OC77	£0.50			2N1304	£0.18
AF117	£0.25	BC460	£0.30	BF188	£0.40	OC81	£0.22			2N1305	£0.18
AF118	£0.20	BC461	£0.38	BF189	£0.10	OC81D	£0.24			2N1306	£0.25
AF124	£0.30	BC477	£0.20	BF195	£0.10	OC82	£0.30			2N1307	£0.25
AF125	£0.30	BC478	£0.20	BF196	£0.12	OC83	£0.26			2N1308	£0.30
AF126	£0.30	BC479	£0.20	BF198	£0.14	OC84	£0.38			2N1309	£0.30
AF127	£0.32	BC547	£0.10	BF199	£0.14	OC85	£0.38			2N1599	£0.35
AF139	£0.35	BC548	£0.10	BF200	£0.90	OC139	£0.80			2N1613	£0.20
AF178	£0.30	BC549	£0.10	BF202	£0.90	OC140	£0.80			2N1711	£0.20
AF179	£0.60	BC550	£0.14	BF222	£0.90	OC169	£0.80			2N1889	£0.45
AF180	£0.60	BC556	£0.14	BF224	£0.17	OC170	£0.35			2N1890	£0.45
AF181	£0.58	BC557	£0.13	BF240	£0.17	OC171	£0.35			2N1893	£0.30
AF186	£0.50	BC558	£0.12	BF244	£0.17	OC200	£0.38			2N2147	£0.75
AF239	£0.38	BC559	£0.14	BF245	£0.17	OC201	£0.95			2N2148	£0.70
AL102	£1.20	BCY30	£0.55	BF257	£0.25	OC202	£1.20			2N2152	£0.38
AL103	£1.20	BCY31	£0.55	BF258	£0.25	OC203	£1.00			2N2192	£0.38
ASY26	£0.38	BCY32	£0.60	BF259	£0.35	OC204	£0.90			2N2193	£0.38
ASY27	£0.40	BCY33	£0.55	BF262	£0.60	OC205	£1.15			2N2194	£0.38
ASY28	£0.38	BCY34	£0.60	BF263	£0.60	P346A	£0.35			2N2217	£0.22
ASY29	£0.38	BCY71	£0.15	BF270	£0.36	P397	£0.45			2N2218	£0.22
ASY50	£0.30	BCY72	£0.14	BF271	£0.31	R20008B	£2.60			2N2218A	£0.20
ASY51	£0.30	BCY72	£0.14	BF272	£0.30	R20108	£2.60			2N2219	£0.20
ASY52	£0.30	BC210	£0.60	BF273	£0.36					2N2219A	£0.24
ASY54	£0.30	BC211	£0.60	BF274	£0.38					2N2220	£0.20
ASY55	£0.30	BC212	£0.60	BF275	£0.35	ST140	£0.15			2N2221	£0.22
ASY56	£0.30	BD115	£0.60	BF329	£0.30	ST141	£0.20			2N2222	£0.20
ASY57	£0.30	BD116	£0.60	BF337	£0.30					2N2222A	£0.20
ASY58	£0.30	BD121	£0.65	BF338	£0.38	TIC44	£0.29			2N2368	£0.18
ASY73	£0.30	BD123	£0.65	BF457	£0.37	TIC45	£0.25			2N2369	£0.14
AU104	£1.40	BD124	£0.70	BF458	£0.37	TIP29A	£0.40			2N2369A	£0.14
AU110	£1.40	BD131	£0.35	BF459	£0.30	TIP29B	£0.42			2N2411	£0.26
AU113	£1.40	BD132	£0.35	BF594	£0.22	TIP29C	£0.44			2N2412	£0.25
		BD131/132	£0.80	BF596	£0.28	TIP30A	£0.40			2N2413	£0.25
BC107	£0.08	BD133	£0.40	BFR39	£0.24	TIP30B	£0.42			2N2711	£0.22
BC107A	£0.08	BD135	£0.40	BFR40	£0.25	TIP30C	£0.44			2N2712	£0.22
BC107B	£0.08	BD136	£0.38	BFR79	£0.28	TIP31A	£0.40			2N2714	£0.22
BC107C	£0.10	BD136	£0.35	BFR80	£0.28	TIP31B	£0.42			2N2904	£0.18
BC108	£0.09	BD137	£0.35	BFX29	£0.22	TIP31C	£0.44			2N2904A	£0.21
BC108A	£0.10	BD138	£0.35	BFX30	£0.30	TIP32A	£0.40			2N2905	£0.18
BC108B	£0.10	BD139	£0.36	BFX84	£						

ALL PRICES IN PENCE EACH UNLESS OTHERWISE STATED

CAPACITORS				Electrolytic Can Type				Miniature Low Value									
Electrolytic Axial Leads -10% to +50% Tol				High Ripple, IEC Grade 1, Low E.S.R. Supplied complete with Vertical Fixing Clip				Polystyrene, Axial, -1% Tol, > 63V D.C. Wkg									
μF	V d.c.	16	25	μF	V d.c.	1.4A @ 50°C	166	μF	424	632	630	629	nF	424	632	630	629
1.0				2200	16V	2.6A	3.6A	100	16	6			10	25			
1.5				10000	16V	5.8A	8.1A	222	120	16	8		12	26			
2.2				22000	16V	9.8A	13.7A	346	150	16	8		15	26			
3.3				2200	25V	1.3A	1.8A	175	180	16	6		18	27			
4.7				4700	25V	4.6A	6.4A	201	220	16	6		22	28			
6.8				10000	25V	8.0A	11.2A	264	330	18	8		33	41			
10				22000	25V	12.8A	17.9A	438	390	18	5		39	43			
15				1000	40V	0.9A	1.2A	168	470	18	5						
22				2200	40V	2.4A	3.3A	188	560	16	5						
33				4700	40V	5.6A	7.8A	231	680	16	5						
47				10000	40V	9.2A	12.8A	367	820	16	5						
68				1000	70V	1.8A	2.5A	190	1000	16	5						
100				2200	70V	4.0A	5.6A	235	1500	18	6						
150				4700	70V	7.5A	10.5A	376	1800	18	6						
220				10000	70V	12.8A	17.9A	568	2200	18	6						
330				2200	100V	4.0A	5.6A	222	2700	18	8						
470				4700	100V	7.8A	10.9A	346	3300	18	6						
680									3900	18	6						
1000									4700	18	6						
1500									5600	23	7						
2200									6800	23	7						
									8200	23	7						

Tantalum Bead				Order Code			
-20% Tol				Cap PR + μF + Volts			
μF	V d.c.	3.15	6.3	10	16	25	35
0.1							
0.15							
0.22							
0.33							
0.47							
0.68							
1							
1.5							
2.2							
3.3							
4.7							
6.8							
10							
15							
22							
33							
47							
68							
100							

Electrolytic Radial Leads				Order Code			
-10% to +50% Tol				Cap 034 + μF + Volts			
μF	V d.c.	6.3	10	16	25	35	40
47							
68							
1.0							
1.5							
2.2							
3.3							
4.7							
6.8							
10							
15							
22							
33							
47							
68							
100							
150							
220							

Trimmers				Order Code			
250V O.C. Wkg. Film Dielectric, Miniature				500V D.C. Wkg. C004 EA Tubular Type			
1.4 - 4.1pF	19	Cap 808 A	8 - 38pF	46	Cap 802 3		
2 - 8pF	19	Cap 808 B	8 - 68pF	48	Cap 802 6		
2 - 20pF	21	Cap 808 C	1 - 13pF	61	Cap 802 12		
5.5 - 59.5pF	29	Cap 808 D	1.7 - 19.7	62	Cap 802 18		

Polyester Radial Leads				Order Code			
Dipped Type, $\pm 20\%$ Tol, $\geq 250V$ D.C. Wkg. C280/352 Style				Cap 352			
Moulded Type, -10% Tol, $\geq 100V$ D.C. Wkg. 10.2mm Pitch Centres				Cap 360			
Moulded Type, -10% Tol, $\geq 100V$ D.C. Wkg. 7.6mm Pitch Centres				Cap PHE280			
μF	352	360	PHE280	μF	352	360	PHE280
001	5	6		1	6	8	9
0015	5	6		15	7	9	
0022	5	6		22	8	10	
0033	5	6		33	10		
0047	5	6		47	12		
0068	5	6		68	15		
01	5	6		10	19		
015	5	6		15	27		
022	5	6		22	32		
033	5	6		33			
047	5	6		47			
068	5	6		68			
1	5	6		10			

CASES			
Small Desk Console - Boss Industrial Mouldings			
Slope Front Console, Recessed Top			
ABS Base, C/W Brass Bushes, In Orange			
1mm Aluminium Top Panel Finished Grey			
W161, D96, H39 (57)	186	Case BIM1005 OR	
W215, D130, H47 (73)	268	Case BIM1006 OR	
Plastic Boxes - Boss Industrial Mouldings			
Moulded Box and Close Fitting Flanged Lid			
ABS Box, C/W Brass Bushes, and Lid In Orange			
L112 W62 D31	87	Case BIM2003 OR	
L1150 W80 D50	115	Case BIM2005 OR	
L190 W110 D60	195	Case BIM2006 OR	
Instrument Case - Boss Industrial Mouldings			
Covers Manufactured from 14SWG Aluminium			
Chassis Manufactured from 18SWG Mild Steel			
Covers Finished Orange			
Chassis Finished Matt Black			
W250 D167.5 H 68.5 (Chassis 153mm Deep)	1480	Case BIM3000 OR	
Plastic Boxes with Metal Lids - Boss Industrial Mouldings			
Recessed Top Box			
ABS Base, C/W Brass Bushes, In Orange			
1mm Aluminium Top Panel Finished Grey			
L85 W56 D29	87	Case BIM4003 OR	
L111 W71 D42	130	Case BIM4004 OR	
L161 W96 D53	182	Case BIM4005 OR	
Diecast Boxes - Boss Industrial Mouldings			
Diecast Box and Flanged Lid			
Aluminium Box and Lid In Natural Finish			
L113 W63 D31	104	Case BIM5003 NA	
L152 W82 D50	181	Case BIM5005 NA	
L192 W113 D61	280	Case BIM5006 NA	

VERO ELECTRONICS PRODUCTS			
2.5" x 5", 1" pitch Veroboard	59	VERO 21069J	
3.75" x 5", 1" pitch Veroboard	66	VERO 21072D	
2.5" x 1", 1" pitch Veroboard (5)	70/Pack	VERO 21076C	
3.75" x 5", 1" pitch Plain Board	56	VERO 21078E	
5.82" x 2.9", 1" pitch V.Q.DIP Board	111	VERO 21084E	
Spot Face Cutter	89	VERO 21013A	
Pin Insertion Tool for .040 type pin	122	VERO 21015F	
D5 Pins .040 (100)	38/Pack	VERO 21016G	
SS Pins .040 (100)	38/Pack	VERO 21017B	
6mm Board Standoff (100)	181/Pack	VERO 21321K	
15mm Board Standoff (100)	215/Pack	VERO 21322G	
19mm Board Standoff (100)	226/Pack	VERO 21323D	
Verewire Kit (1 open, 2 wire, 25-comb)	375/Kit	VERO 21341D	
Verewire Combs (100)	407/Pack	VERO 21339F	
Verewire Wire (4)	228/Pack	VERO 21340G	
Flip Top Box, Small, Black	192	VERO 21317D	
Flip Top Box, Large, Black	250	VERO 21319J	
Small Desk Consoles - Boss Industrial Mouldings			
Slope Front Console, Recessed Top			
ABS Base, C/W Brass Bushes, In Orange			
1mm Aluminium Top Panel Finished Grey			
Ventilation Slots In Base			
W105 D143 H32 (56)	206	Case BIM6005 OR	
W170 D143 H32 (56)	271	Case BIM6006 OR	
W170 D214 H32 (82)	375	Case BIM6007 OR	
All Metal Desk Consoles - Boss Industrial Mouldings			
Slope Front Console, Recessed Top			
Two Piece All Aluminium Construction			
Ventilation Slots In Rear and Base			
Choice of 15° or 30° Sloping Front			
Off White Top Panel, Blue Base			
W102 D140 H28 (51) 15° slope	1018	Case BIM7151A	
W165 D211 H33 (76) 15° slope	1350	Case BIM7154A	
W254 D287 H33 (76) 15° slope	1572	Case BIM7156A	
W356 D287 H33 (76) 15° slope	1823	Case BIM7158A	
W102 D140 H28 (76) 30° slope	1018	Case BIM7301A	
W165 D153 H28 (102) 30° slope	1202	Case BIM7303A	
W254 D259 H28 (102) 30° slope	1572	Case BIM7305A	
W356 D259 H28 (102) 30° slope	1823	Case BIM7308A	
Eurocard Size Desk Console - Boss Industrial Mouldings			
Slope Front Console			
ABS Case, C/W Brass Bushes, In Orange			
1mm Aluminium Top Panel, Finished Grey			
W169 D127 H45 (70)	375	Case BIM8006 DR	

HARDWARE			
D.I.L. Sockets			
8 Pin Low Profile Socket Tin	11	DIL SKT 8	
14 Pin Low Profile Socket Tin	13	DIL SKT 14	
16 Pin Low Profile Socket Tin	14	DIL SKT 16	
24 Pin Low Profile Socket Gold	66	DIL SKT 24	
28 Pin Low Profile Socket Gold	78	DIL SKT 28	
40 Pin Low Profile Socket Gold	127	DIL SKT 40	
Heatsinks			
Individual Type for 1 x T05 50°C/W	10	Sink 5F	
Individual Type for 1 x T066 10.5°C/W	26	Sink TV2	
Individual Type for 1 x T03 7.2°C/W	24	Sink TV3	
Individual Type for 1 x T0126 17°C/W	23	Sink TV4	
Individual Type for 1 x T0220 17°C/W	23	Sink TV5	
P.C.B. Components			
Dalo Pen, Blue Ink, Slow Drying	92	Pen 33PC	
Fuseholders			
Suit 20mm x 5mm Fuses			
F.C.B. Mounting, Open Type	8	Fuse/H20B	
Chassis Mounting, Open Type	17	Fuse/H20C	
Panel Mounting, Screwdriver Slot	77	Fuse/H20PT	
Panel Mounting, Finger Release	56	Fuse/H20P	
Fuses			
20mm x 5mm Glass			
Quick Blow, Range 100mA-5A	8	Fuse 20	
Slow Blow, Range 250mA-5A	22	A/S Fuse 20	
		+ Rating	
Lampholders, Panel Mounting			
Similar In Style to Fuse/H 20P			
Low Voltage Type Suits LES and M/F Bulbs.			
Low Voltage, Red, Amber or Green	75	Lamp LV	
Internal Neon 200/240V Red or Amber	95	Lamp N	
		+ Colour	
Bulbs, Low Voltage, L.E.S.			
6V, 0.36W, 6.5V, 1W; 14V, 0.75W	22	Bulb LES	
		+ Voltage	

RESISTORS			
Carbon Film, Fixed			
0.25W, E24 Values IRD-10M, 5% Tol.	1.5 ea.	90p/100 (Mult 10/Value)	£7.50/1000 (Mult 100/Value)
0.5W, E12 Values IRD-4M7,			

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4000 Buffered C-MOS - High Speed

5-15V 'B' Series, Up to 20MHz

				7400 T.T.L.															
HEF4000	14	HEF4046	100	HEF4514	250	N7400N	9	N7444N	83	N74122N	39	N74192N	60	N74LS28N	32	N74LS138N	85	N74LS253N	105
HEF4001	14	HEF4047	87	HEF4515	299	N7401N	11	N7445N	65	N74123N	37	N74194N	80	N74LS30N	16	N74LS139N	85	N74LS257N	104
HEF4002	14	HEF4048	28	HEF4516	90	N7402N	11	N7446AN	62	N74125N	32	N74195N	79	N74LS33N	24	N74LS153N	76	N74LS260N	107
HEF4006	95	HEF4050	28	HEF4517	382	N7403N	11	N7447AN	51	N74126N	32	N74196N	120	N74LS37N	24	N74LS155N	80	N74LS261N	300
HEF4007	14	HEF4051	69	HEF4518	69	N7404N	12	N7448AN	44	N74128N	44	N74197N	46	N74LS38N	24	N74LS156N	80	N74LS262N	130
HEF4008	80	HEF4052	72	HEF4519	55	N7405N	12	N7449N	31	N74132N	46	N74199N	139	N74LS40N	22	N74LS157N	54	N74LS273N	130
HEF4011	14	HEF4053	72	HEF4520	65	N7406N	25	N7451N	13	N74135N	46	N74200N	160	N74LS42N	116	N74LS158N	60	N74LS283N	116
HEF4012	14	HEF4056	37	HEF4521	188	N7407N	27	N7453N	15	N74147N	125	N74201N	125	N74LS44N	200	N74LS159N	80	N74LS290N	90
HEF4013	32	HEF4057	380	HEF4522	99	N7408N	13	N7454N	13	N74148N	83	N74202N	160	N74LS46N	200	N74LS160N	120	N74LS293N	100
HEF4014	84	HEF4058	14	HEF4523	120	N7409N	13	N7455N	23	N74149N	65	N74203N	160	N74LS48N	200	N74LS161N	78	N74LS294N	100
HEF4015	60	HEF4059	14	HEF4524	510	N7410N	11	N7456N	13	N74151N	26	N74204N	26	N74LS50N	16	N74LS162N	130	N74LS295N	100
HEF4016	35	HEF4060	14	HEF4525	110	N7411N	18	N7457N	22	N74153N	22	N74205N	96	N74LS52N	160	N74LS163N	130	N74LS296N	100
HEF4017	55	HEF4061	14	HEF4526	155	N7412N	17	N7458N	23	N74155N	53	N74206N	93	N74LS54N	16	N74LS164N	90	N74LS297N	100
HEF4018	65	HEF4062	16	HEF4527	78	N7413N	23	N7459N	23	N74157N	26	N74207N	49	N74LS56N	160	N74LS165N	105	N74LS298N	105
HEF4019	46	HEF4063	16	HEF4528	78	N7414N	23	N7460N	43	N74159N	59	N74208N	53	N74LS58N	160	N74LS166N	105	N74LS299N	105
HEF4020	88	HEF4064	16	HEF4529	386	N7415N	22	N7461N	26	N74161N	23	N74209N	68	N74LS60N	160	N74LS167N	105	N74LS300N	105
HEF4021	85	HEF4065	85	HEF4530	97	N7416N	22	N7462N	43	N74163N	23	N74210N	60	N74LS62N	160	N74LS168N	105	N74LS301N	105
HEF4022	82	HEF4066	14	HEF4531	171	N7417N	23	N7463N	83	N74165N	55	N74211N	60	N74LS64N	160	N74LS169N	105	N74LS302N	105
HEF4023	14	HEF4067	16	HEF4532	73	N7418N	26	N7464N	65	N74167N	74	N74212N	74	N74LS66N	160	N74LS170N	100	N74LS303N	105
HEF4024	45	HEF4068	16	HEF4533	82	N7419N	22	N7465N	23	N74169N	85	N74213N	111	N74LS68N	160	N74LS171N	100	N74LS304N	105
HEF4025	14	HEF4069	16	HEF4534	119	N7420N	22	N7466N	60	N74171N	85	N74214N	134	N74LS70N	160	N74LS172N	100	N74LS305N	105
HEF4027	32	HEF4070	14	HEF4535	119	N7421N	22	N7467N	30	N74173N	88	N74215N	111	N74LS72N	160	N74LS173N	100	N74LS306N	105
HEF4028	52	HEF4071	14	HEF4536	119	N7422N	22	N7468N	46	N74175N	62	N74216N	134	N74LS74N	160	N74LS174N	100	N74LS307N	105
HEF4029	80	HEF4072	16	HEF4537	140	N7423N	21	N7469N	88	N74177N	88	N74217N	134	N74LS76N	160	N74LS175N	100	N74LS308N	105
HEF4030	46	HEF4073	16	HEF4538	140	N7424N	21	N7470N	25	N74179N	88	N74218N	134	N74LS78N	160	N74LS176N	100	N74LS309N	105
HEF4031	200	HEF4074	16	HEF4539	140	N7425N	21	N7471N	40	N74181N	88	N74219N	134	N74LS80N	160	N74LS177N	100	N74LS310N	105
HEF4035	110	HEF4075	16	HEF4540	140	N7426N	21	N7472N	40	N74183N	88	N74220N	134	N74LS82N	160	N74LS178N	100	N74LS311N	105
HEF4040	68	HEF4076	16	HEF4541	140	N7427N	21	N7473N	40	N74185N	88	N74221N	134	N74LS84N	160	N74LS179N	100	N74LS312N	105
HEF4041	75	HEF4077	16	HEF4542	140	N7428N	21	N7474N	40	N74187N	88	N74222N	134	N74LS86N	160	N74LS180N	100	N74LS313N	105
HEF4042	54	HEF4078	16	HEF4543	140	N7429N	21	N7475N	40	N74189N	88	N74223N	134	N74LS88N	160	N74LS181N	100	N74LS314N	105
HEF4043	79	HEF4079	16	HEF4544	140	N7430N	21	N7476N	40	N74191N	88	N74224N	134	N74LS90N	160	N74LS182N	100	N74LS315N	105
HEF4044	84	HEF4080	16	HEF4545	140	N7431N	21	N7477N	40	N74193N	88	N74225N	134	N74LS92N	160	N74LS183N	100	N74LS316N	105

LINEAR INTEGRATED CIRCUITS

CA3011	92	NE592K	162
CA3018	75	RC4136	130
CA3020	191	TBA1205	79
CA3028A	86	TC4580	346
CA3046	76	TC4730	450
CA3048	245	TC4740	450
CA3080E	70	TD4100B	326
CA3080E	253	TD41022	648
CA3130E	90	TD41028	338
CA3140E	38	TD41029	338
CA3189E	266	TD41034B	617
LM301AN	30	TD42581	266
LM308N	900	TD42640	297
LM318N	200	TL081CP	75
LM319N	216	TL084CN	140
LM324N	70	UA705CT	46
LM339N	71	UA709CN	40
LM381N	110	UA710CN	41
LM381AN	180	UA711CN	65
LM382	120	UA714CT	42
		UA714CN	42
		UA717CN	50
		UA748CN	35
MC1458N	35		
MC1496N	97		
NE531	119		
NE535T	216		
NE540	225		
NE555N	25		
NE555N	60		
NE560N	351		
NE561N	427		
NE562N	461		
NE565N	120		
NE566N	155		
NE567N	170		
NE570N	405		
NE571N	459		

OPTO ELECTRONICS

	Order Code		
Light Emitting Diodes, Individual			
1.25" (3mm)	Red	14	COY54
	Green	17	COY95
	Yellow	17	COY97
Panel Mounting Clip to suit.			
		3	LE03 Chip
2" (5mm)	Red	5	COY24A
	Green	17	COY94
	Yellow	19	COY96
Panel Mounting Clip to suit.			
		5	LEDS Clip
Light Emitting Diodes - 7 Segment Display			
3" (7.6mm) C. Anode R.H. Decimal Pt.	Red	160	XAN3061
	Green	199	XAN3051
C. Cathode R.H. Decimal Pt. Red, Low current drain		160	XAN3074
6" (15.2mm) C. Anode L.H. Decimal Pt. Red		230	XAN6620
	C. Anode L.H. Decimal Pt. Green	230	XAN6520
	C. Cathode L.H. Decimal Pt. Red	230	XAN6640
Photoresistors			
ORP12		90	ORP12
ORP61		90	ORP61
Phototransistors			
OCF71		180	OCF71
BPX25		175	BPX25
BPX29		175	BPX29
Photocoupler			
FC0820		150	FC0820

SWITCHES

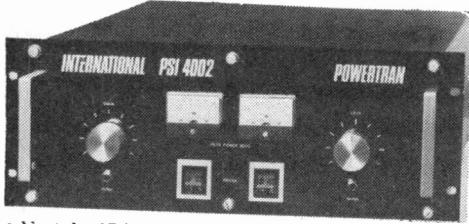
	Order Code		
Miniature Toggle - Honeywell			
SPDT		2A/250V A.C., 5A/28V D.C.	58
SPDT	C/O		67
SPDT	Double Bias To Centre		75
SPDT	Single Bias To Centre		75
SPDT	Bias		86
DPDT			92
DPDT	C/O		97
DPDT	Double Bias To Centre		102
DPDT	Single Bias To Centre		102
DPDT	Bias		96
Miniature Push - C & K			
SP	Push To Make, Momentary	0.5A/250V A.C., 1A/28V D.C.	54
SP	Push To Break, Momentary		54
Slide - Switchcraft			
DPDT	Standard Actuator		36
DPDT	Slot Actuator, Voltage Change, Marked 110/240		43

SEMICONDUCTORS

Diodes			
1N827	193	1N4006	7
1N914	4	1N4007	8
1N916	6	1N4148	3
1N4001	4	1N5407	15
1N4002	4	1N5404	16
1N4003	6	1N5405	16
1N4004	6	1N5406	16
1N4005	7	1N5408	16
		1N5409	16
		1N5410	16
		1N5411	16
		1N5412	16
		1N5413	16
		1N5414	16
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		1N5466	16
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POWERTRAN

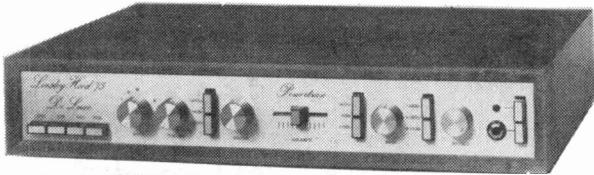
PSI 4002 STUDIO MODEL



cabinet size 17.2" x 17.2" x 6.7"

COMPLETE KIT ONLY £196.90 + VAT

**READ THE REVIEW
IN SOUND INTERNATIONAL DEC. '78 !**



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 ½ 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.

FOR ELECTRONIC KITS OF DISTINCTION

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!

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

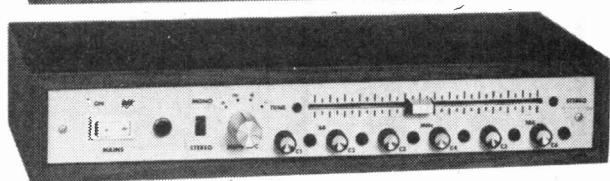
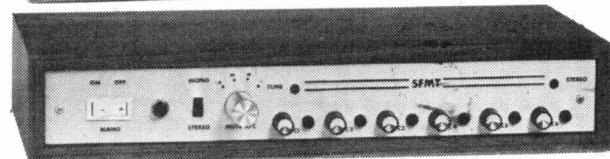
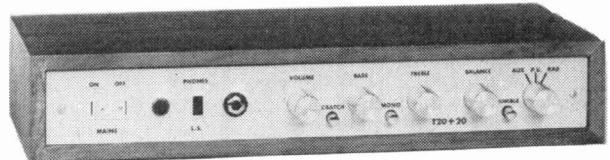
This easy to build version of our world-wide acclaimed 75W amplifier kit based upon circuit boards interconnected with gold plated contacts resulting in minimal wiring and construction delightfully straightforward. The design was published in *Hi-Fi News and Record Review* and features include rumble 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.



OUR CATALOGUE IS FREE! WRITE OR PHONE NOW!

POWERTRAN ELECTRONICS

PORTWAY INDUSTRIAL ESTATE
ANDOVER, HANTS SP10 3NM

ANDOVER
(STD 0264) 64455

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 availability 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

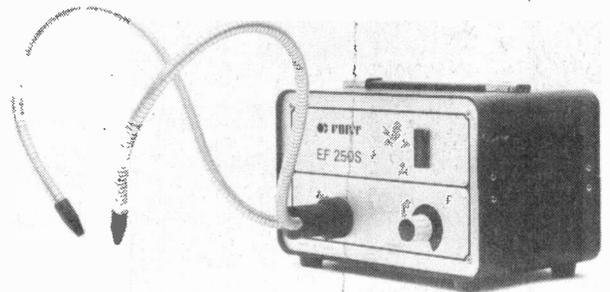
Another Electricity Board first, 'Fred' is an electronic spokesman and will give advice on how to save energy by using

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

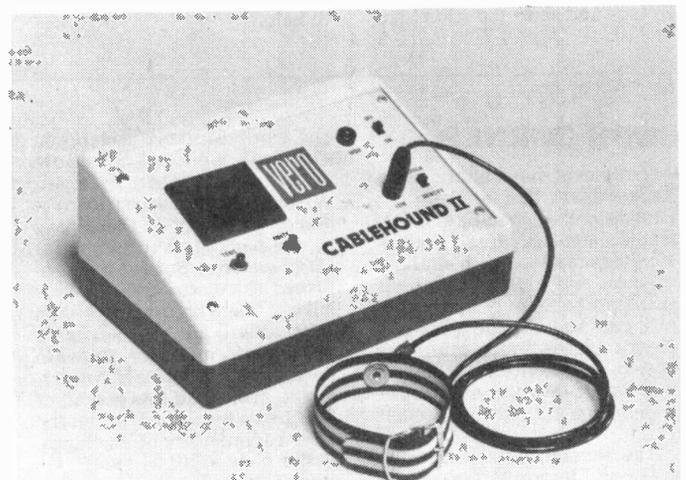
work. The light sources are available in a variety of ratings, from 50 to 250 Watts. The boxes will work on an AC supply of 110-240V (selectable) 50/60 Hz. The Tungsten-Halogen lamps are fully adjustable for brightness and are cooled by fan to prevent over-heating. Prices for the light sources start 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 its 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 its small size puts it into the truly 'pocket size' class. Price is around the £99 plus VAT mark and includes leads, battery and instruction manual. If you're interested Franel International Instruments Ltd at Dandbeck Way, Wetherby, West Yorkshire, should be able to help.

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.

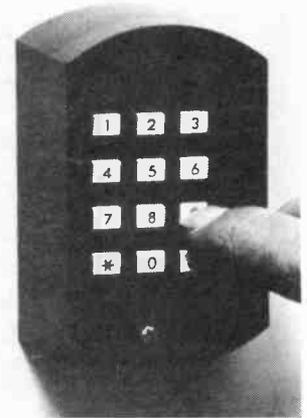
The second new publication is 'Your Electronic Calculator

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.

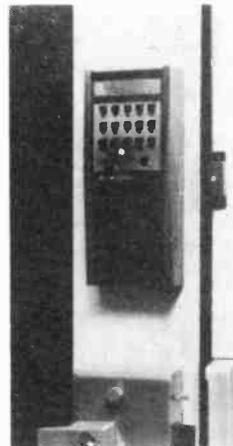
GATES ON YOUR DOORS

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 negligible.

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



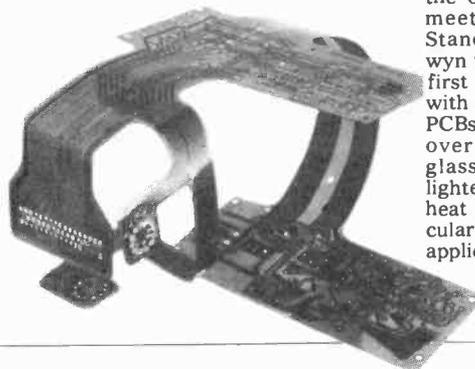
you read this, asking price — £14.95, installation should take only minutes and is powered by a 9V alkaline battery, with average use it will last for over one year.



COMP-U-LOCK

The second piece of equipment rejoices under the name of COMP-U-LOCK. As its 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.

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.

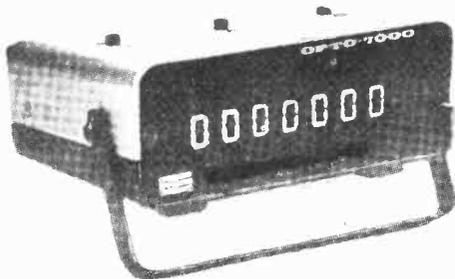
FREQUENCY COUNTING BREAKTHROUGHS

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
- Built-in pre-scaler and preamps standard
- Automatic Decimal placement
- 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**



SPECIFICATIONS

Frequency Range: 10 Hz to 60 MHz (65 MHz Typical)
(Switch Selectable) 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

Sole Distributors for the U.K. and Eire. Agents Wanted for U.K. and Eire.

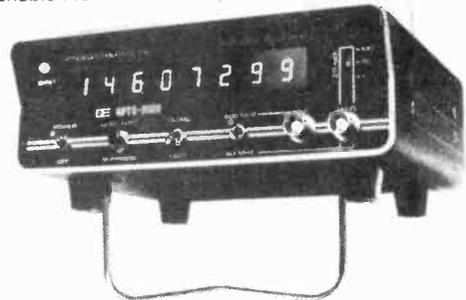


Maclin-Zand Electronics Ltd.,
38 Mount Pleasant, London WC1X 0AP.
Tel: 01-837 1165 or Hemel Hempstead 832 966

**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 **£16.00 + VAT**



Ex Stock
Delivery
Subject to
availability

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: 100 milliseconds (1/10 second)
(Switch Selectable) 1 second

Resolution: 1 Hz to 600 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

To: Maclin-Zand Electronics Ltd.
38 Mount Pleasant, London WC1X 0AP.

Please send me the following: Prices inc. p&p + VAT

<input type="checkbox"/> OPTO 7000	£110.16
<input type="checkbox"/> OPTO 7000 with built-in Ni-Cads + charger	£127.44
<input type="checkbox"/> OPTO 7000 with rear panel switch S4 for 1Hz resolution	£115.56
<input type="checkbox"/> OPTO 7000 with built-in Ni-Cads + charg. & switch S4 for 1Hz resolution	£132.84
<input type="checkbox"/> OPTO 8000.1A	£264.60
<input type="checkbox"/> 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

Overseas orders: VAT not applicable — add 10% for Airfreight & Handling.

ILP MODULES 15-240 WATTS

We are now stockists for these world famous fully guaranteed (2 years guarantee on all modules) Pre amps, Amplifiers & Power Supplies.

- HY5** Pre-amplifier. Input, magnetic pickup 3mV, ceramic 30mV. Output: Mains 500mV RMS, Distortion 0.1% at 1KHz. Price: **£6.27**
- HY30** Amplifier Kit. 15 Watts into 8Ω, extremely easy to construct. Output 15W RMS, Distortion 0.1% at 15W Freq. 10Hz-16KHz. Supply ±18V. Price: **£6.27**
- HY50** Hi-Fi Amplifier Module. 25 Watts 8Ω. Input Sensitivity 500mV. Output 25W RMS. Distortion 0.04% at 25W. Freq. 10Hz-45KHz. Supply ±25V. Price: **£8.18**
- HY120** Amplifier Module — 60 Watts 8Ω. Input sens. 500mV. Output 60W RMS. Distortion 0.04%. Freq. 10Hz-45KHz. Power Supply ±35V. Price: **£18.98***
- HY200** Hi-Fi/Disco Amplifier Module — 120 Watts 8Ω. Input sens. 500mV 120W RMS. Freq. 10Hz-45KHz. Power Supply ±45V. Size 114 x 100 x 85mm. Price: **£27.99***
- HY400** (Big Daddy) Amplifier Module — 240 Watts 4Ω. Ideal for High Power Disco or P.A. Output 240 Watts RMS 4Ω 114 x 100 x 85mm. Distortion 0.1%. Price: **£38.60***



- POWER SUPPLIES**
- PSU36 — Drives 2 x HY30s **£6.44**
 - PSU50 — Drives 2 x HY50s **£8.18**
 - PSU70 — Drives 2 x HY120s **£14.58***
 - PSU90 one HY200 **£15.10***
 - PSU180 2 x HY200 or one HY400 **£25.42***

JACK PLUGS		SOCKETS	
Screened chrome	Plastic body	open metal	moulded with break contacts
2.5mm 13p	10p	8p	11p
3.5mm 13p	10p	8p	12p
MONO 25p	14p	13p	17p
STEREO 32p	17p	15p	22p

DIN	PLUGS	SOCKETS	In Line
2 PIN Loudspeaker	10p	7p	20p
3, 4, 5 Audio	15p	10p	20p

CO-AXIAL (TV)	PLUGS	SOCKETS	In Line
PHONO assorted colours	10p	8p single	12p
Metal screened	15p	8p double	—
		18p 4-way	20p

BANANA	PLUGS	SOCKETS	In Line
4mm	11p	12p	—
2mm	10p	10p	—
1mm	6p	6p	—

WANDER 3mm DC Type	PLUGS	SOCKETS	In Line
AC 2-pin American	8p	8p	—
	15p	20p	—
	15p	15p	—

- SWITCHES***
- TOGGLE 2A, 250V **14p**
 - SPST **28p**
 - DPST **34p**
 - DPDT **38p**
 - 4 pole on/off **54p**
- SUB-MIN TOGGLE**
- SP changeover **58p**
 - SPST on/off **54p**
 - SPST biased **85p**
 - DPDT 6 tags **70p**
 - DPDT centre off **78p**
 - DPDT Biased **115p**
- SLIDE 250V:**
- 1A DPDT **14p**
 - 1A DPDT c/over **15p**
 - 1/2A DPDT **13p**
 - 4 pole 2-way **24p**
- PUSH BUTTON**
- Spring loaded **60p**
 - SPST on/off **65p**
 - SPDT c/over **65p**
 - DPDT 6 Tag **85p**
- MINIATURE**
- Non Locking **47p**
 - Push to Make **18p**
 - Push Break **25p**
- ROTARY:** Make your own multiway Switch. Adjustable Stop Shifting Assembly. Accommodate up to 6 Wafers **75p**
Mains Switch DPST to fit **34p**
Break Before Make Wafers. 1 pole/12 way. 2p/6 way. 3p/4 way. 4p/3 way. 6p/2 way. Spacer and Screen **5p**
- ROTARY: (Adjustable Stop)**
- 1 pole/2 to 12 way. 2p/2 to 6 way. 3 pole/2 to 4 way. 4 pole/2 to 3 way **41p**
 - ROTARY: Mains 250V AC. 4 Amp **48p**

DM900
3 1/2 DIGIT LCD Multimeter Capacitance meter (ETI Aug. 78)
Complete Kit **£64.80*** only (p&sp)

CRYSTALS*

- 100KHz **385**
- 455KHz **385**
- 1MHz **323**
- 1.0008M **395**
- 3.2768M **323**
- 4.032MHz **323**
- 4.433619M **135**
- 5.0MHz **365**
- 8.08333M **275**
- 10.0MHz **323**
- 10.7MHz **323**
- 18.432M **323**
- 20.0MHz **323**
- 27.648M **323**
- 48.0MHz **323**

ETI Projects: Parts available for: Click Eliminator Ambush, Guitar Effect Unit. Send SAE plus 5p for list.

ULTRASONIC TRANSDUCERS
450p* per pair

TRANSFORMERS* (Mains Prim. 220-240V)

- 6-0-6V; 9-0-9V; 12-0-12V 100mA **95p**
- 8V-0-8V; 6V-5A; 6V-5A; 9V-4A; 12V-3A **195p**
- 12V; 4.5V-1.3A; 15V-25A 15V-25A **195p**
- 12V; 4.5V-1.3A 4.5V-1.3A; 6V-1.2A 6V-1.2A; 12V-5A 12V-5A; 15V-4A 15V-4A; 20V-3A 20V-3A **220p** (20p p&sp)
- 24V; 6V-1.5A 6V-1.5A; 9V-1.3A 9V-1.3A; 12V-1A 12V-1A; 15V-8A 15V-8A; 20V-6A 20V-6A **290p** (45p p&sp)
- 60V; 6V-4A 6V-4A; 9V-2.5A 9V-2.5A; 12V-2A 12V-2A; 15V-1.5A 15V-1.5A; 20V-1.2A 20V-1.2A; 25V-1A 25V-1A; 30V-8A 30V-8A **250p** (50p p&sp)
- 100VA: 12V-4A 12V-4A; 15V-3A 15V-3A; 20V-2.5A 20V-2.5A; 30V-1.5A 30V-1.5A; 40V-1.25A 40V-1.25A; 50V-1A 50V-1A **850p** (60p p&sp). (N.B. p&sp charge to be added above our normal postal charge.)

VOLTAGE REGULATORS*

1A TO3	+	-ve	+	-ve
5V 7805	145p	7905	220p	—
12V 7812	145p	7912	220p	—
15V 7815	145p	—	—	—
18V 7818	145p	—	—	—
24V 7824	85p	7924	90p	—

100mA TO92 Plastic Casing

5V	7805	80p	7905	90p
12V	7812	80p	7912	90p
15V	7815	80p	7915	90p
18V	7818	85p	7918	90p
24V	7824	85p	7924	90p

LM300H **170p** LM327 **270p**
LM305H **140p** LM723 **43p**
LM309K **135p** MVR5 **180p**
LM317K **350p** TAA550 **50p**
LM323K **625p** TBA6258 **95p**
LM325N **240p** TDA1412 **150p**

ALUM. BOXES* WITH LID*

- 3x2x1" **45**
- 2 1/2x5 1/2x1 1/2" **68**
- 4x4 1/2" **68**
- 4 1/2x4 1/2" **69**
- 4 1/2x4 1/2" **78**
- 4x2 1/2x2" **64**
- 5x4x2" **82**
- 6x4x2" **88**
- 7x5x2 1/2" **114**
- 8x6x3" **148**
- 10x7x3" **172**
- 10x4 1/2x3" **142**
- 12x5x3" **165**
- 12x8x3" **210**

COMPUTER HARDWARE*

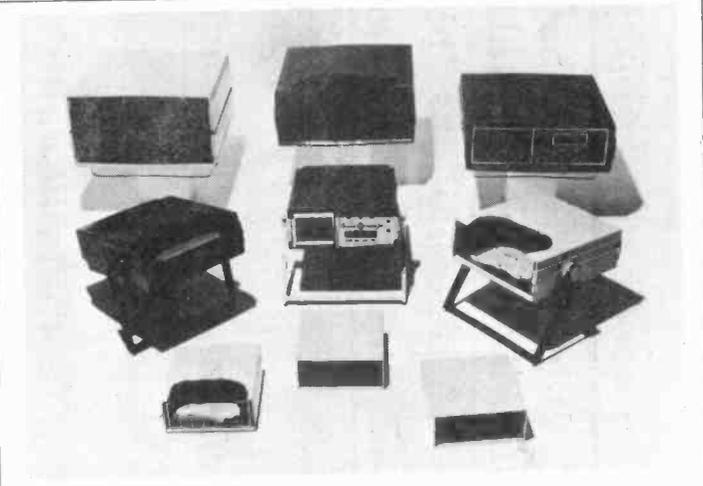
2112-2	175
2102	100
2111	175
2114	785
2513	650
2516	£28.50
2708	175
27L08	1095
2716	1650
3064	T8A
4027	325
4047	750
745188	185
745262	895
745287	325
745470	325
745475	825
81LS95	99
81LS96	99
81LS97	125
9900	£35
TMS8011	325
Z80	1195

393	230	4018	89	4046	128	4085	74	4450	295
395	218	4019	48	4047	87	4086	73	4451	295
396	218	4020	99	4048	58	4089	150	4452	—
398	276	4021	91	4049	48	4093	85	4490F	695
399	230	4022	88	4050	48	4094	190	4490V	525
445	150	4023	20	4051	72	4096	105	4501	17
447	144	4024	66	4052	72	4097	372	4502	120
490	180	4025	19	4053	72	4098	110	4503	69
668	182	4026	180	4054	110	4099	145	4506	51
669	182	4027	45	4055	128	4160	109	4507	55
670	248	4028	81	4057	2570	4161	109	4508	298
		4029	99	4059	480	4162	109	4510	99
		4030	58	4060	115	4163	108	4511	150
4000	15	4031	205	4063	110	4174	110	4512	99
4001	17	4032	100	4066	58	4175	99	4513	208
4002	17	4033	145	4067	380	4194	108	4514	265
4006	106	4034	196	4068	22	4408	720	4515	299
4007	18	4035	111	4069	20	4409	720	4516	125
4008	87	4036	325	4070	32	4410	720	4517	382
4009	50	4037	100	4071	21	4412F	1650	4518	102
4010	50	4038	108	4072	21	4412V	1380	4519	55
4011	16	4039	320	4073	21	4415F	795	4520	108
4012	18	4040	105	4075	23	4415V	795	4521	188
4013	42	4041	80	4076	85	4419	280	4522	199
4014	86	4042	75	4077	40	4422	845	4527	152
4015	89	4043	84	4078	21	4433	1098	4528	99
4016	44	4044	88	4081	20	4435	825	4529	165
4017	89	4045	145	4082	21	4440	1275	4530	85

VDU Chip and MODULE for TV
Convert your TV into a VDU by using the new Thompson-CSF TV-CRT controller chip SF.F96364. 16 line by 64 characters text refreshment. Cursor management. Cursor management on screen. Line erasing. Compatible with any computing system.

- SF.F96364E **£11.75***
- AV-3-1015 **£5.60***
- AV-5-1013UART **£4.50***
- 71301 ROM **£8.20***
- SFS80102 RAM **£2.05***
- 74LS163 **£1.18***
- SN75450 **£1.20***
- SN75451 **70p***
- SN75452 **70p***
- SN75454 **£2.25***
- UHF Modulator **£2.50***
- Complete Module **£136.50*** (Send 30p stamps for full technical data)

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



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, Hammer-smith, London W6.



TTLs by TEXAS 7400 13p 7401 14p 7402 14p 7403 14p 7404 14p 7405 14p 7406 32p 7407 32p 7408 18p 7409 18p 7410 18p 7411 24p 7412 20p 7413 30p 7414 50p 7416 27p 7417 27p 7420 17p 7421 40p 7422 22p 7423 34p 7424 34p 7425 40p 7426 40p 7427 34p 7428 36p 7430 17p 7432 30p 7433 40p 7437 35p 7438 35p 7440 17p 7441 70p 7442 80p 7443 112p 7444 112p 7445 100p 7446A 93p 7447A 80p 7448 80p 7450 17p 7451 17p 7453 17p 7454 17p 7460 17p 7470 36p 7472 30p 7473 34p 7474 30p 7475 35p 7476 35p 7480 50p 7481 100p 7482 80p 7483A 70p 7484 100p 7485 90p 7486 30p 7489 210p 7490A 30p 7491 80p 7492A 46p 7493A 30p 7494 84p 7495A 70p 7496 80p 7497 80p 74100 130p 74104 85p 74105 85p 74107 34p 74108 85p 74110 85p 74111 70p 74116 200p 74118 130p 74119 210p 74120 110p 74122 25p 74122 48p 74123 48p 74125 85p 74126 80p 74128 75p 74132 75p 74136 75p 74141 70p 74142 200p 74145 90p 74147 190p 74148 150p 74510 100p 7451A 70p 74513 70p 74514 100p 74515 90p 74516 90p 74517 70p 74519 190p 74520 100p 7451A 70p 74513 70p 74514 100p 74515 90p 74516 90p 74517 70p 74519 190p 74520 100p 7451A 70p 74513 70p 74514 100p 74515 90p 74516 90p 74517 70p 74519 190p 74520 100p	74186 700p 74190 800p 74191 800p 74192 800p 74193 800p 74194 1000p 74195 800p 74196 800p 74197 800p 74198 800p 74199 1500p 74200 1000p 74201 1500p 74202 1500p 74203 1500p 74204 1500p 74205 1500p 74206 1500p 74207 1500p 74208 1500p 74209 1500p 74210 1500p 74211 1500p 74212 1500p 74213 1500p 74214 1500p 74215 1500p 74216 1500p 74217 1500p 74218 1500p 74219 1500p 74220 1500p 74221 1500p 74222 1500p 74223 1500p 74224 1500p 74225 1500p 74226 1500p 74227 1500p 74228 1500p 74229 1500p 74230 1500p 74231 1500p 74232 1500p 74233 1500p 74234 1500p 74235 1500p 74236 1500p 74237 1500p 74238 1500p 74239 1500p 74240 1500p 74241 1500p 74242 1500p 74243 1500p 74244 1500p 74245 1500p 74246 1500p 74247 1500p 74248 1500p 74249 1500p 74250 1500p 74251 1500p 74252 1500p 74253 1500p 74254 1500p 74255 1500p 74256 1500p 74257 1500p 74258 1500p 74259 1500p 74260 1500p 74261 1500p 74262 1500p 74263 1500p 74264 1500p 74265 1500p 74266 1500p 74267 1500p 74268 1500p 74269 1500p 74270 1500p 74271 1500p 74272 1500p 74273 1500p 74274 1500p 74275 1500p 74276 1500p 74277 1500p 74278 1500p 74279 1500p 74280 1500p 74281 1500p 74282 1500p 74283 1500p 74284 1500p 74285 1500p 74286 1500p 74287 1500p 74288 1500p 74289 1500p 74290 1500p 74291 1500p 74292 1500p 74293 1500p 74294 1500p 74295 1500p 74296 1500p 74297 1500p 74298 1500p 74299 1500p 74300 1500p 74301 1500p 74302 1500p 74303 1500p 74304 1500p 74305 1500p 74306 1500p 74307 1500p 74308 1500p 74309 1500p 74310 1500p 74311 1500p 74312 1500p 74313 1500p 74314 1500p 74315 1500p 74316 1500p 74317 1500p 74318 1500p 74319 1500p 74320 1500p 74321 1500p 74322 1500p 74323 1500p 74324 1500p 74325 1500p 74326 1500p 74327 1500p 74328 1500p 74329 1500p 74330 1500p 74331 1500p 74332 1500p 74333 1500p 74334 1500p 74335 1500p 74336 1500p 74337 1500p 74338 1500p 74339 1500p 74340 1500p 74341 1500p 74342 1500p 74343 1500p 74344 1500p 74345 1500p 74346 1500p 74347 1500p 74348 1500p 74349 1500p 74350 1500p 74351 1500p 74352 1500p 74353 1500p 74354 1500p 74355 1500p 74356 1500p 74357 1500p 74358 1500p 74359 1500p 74360 1500p 74361 1500p 74362 1500p 74363 1500p 74364 1500p 74365 1500p 74366 1500p 74367 1500p 74368 1500p 74369 1500p 74370 1500p 74371 1500p 74372 1500p 74373 1500p 74374 1500p 74375 1500p 74376 1500p 74377 1500p 74378 1500p 74379 1500p 74380 1500p 74381 1500p 74382 1500p 74383 1500p 74384 1500p 74385 1500p 74386 1500p 74387 1500p 74388 1500p 74389 1500p 74390 1500p 74391 1500p 74392 1500p 74393 1500p 74394 1500p 74395 1500p 74396 1500p 74397 1500p 74398 1500p 74399 1500p 74400 1500p	93 SERIES 9301 160p 9302 175p 9308 316p 9310 275p 9311 275p 9312 160p 9314 225p 9316 165p 9321 225p 9322 160p 9334 225p 9368 200p 9370 200p 9374 200p VERO BOARD (Copper clad) 2 1/2 x 3 1/4 41p 33p 2 1/2 x 5 49p 45p 3 1/4 x 3 1/4 49p 45p 3 1/4 x 5 59p 60p 2 1/2 x 17 152p 121p 3 1/4 x 17 195p 163p 4 1/2 x 17 252p Pkt of 35 pins 30p Spot face cutter 85p Pin insertion tool 95p VERO WIRING PEN Spare spool (wire) 325p 3370 200p Combs .7p each	TRANSISTORS AC126 26p AC127/8 20p AC176 25p AC287/8 28p AF167/7 30p AD149 70p AD161/2 45p BC107/8 11p BC108 25p BC109C 13p BC117 20p BC147/8 9p BC149 10p BC157/8 10p BC158 11p BC169C 12p BC172 12p BC177/8 17p BC179 18p BC182L 10p BC182/3 10p BC183L 10p BC184L 11p BC187 30p BC212L 11p BC212 3 11p BC213L 11p BC214 12p BC46 31p BC477/8 30p BC516 7 50p BC547B 18p BC548C 18p BC549C 18p BC557B 18p BC558B 18p BC559C 18p BCY70 18p BCY71/2 22p BC131/2 80p BD135/6 54p BD139 58p BD140 60p BD242 70p BDY56 200p BF200 32p BF248 38p BF256/8 32p BF259 38p BF39 30p BF40 30p BF41 30p BF47 30p BF48 30p BF49 30p BF50 30p BF51 30p BF52 30p BF53 30p BF54 30p BF55 30p BF56 30p BF57 30p BF58 30p BF59 30p BF60 30p BF61 30p BF62 30p BF63 30p BF64 30p BF65 30p BF66 30p BF67 30p BF68 30p BF69 30p BF70 30p BF71 30p BF72 30p BF73 30p BF74 30p BF75 30p BF76 30p BF77 30p BF78 30p BF79 30p BF80 30p BF81 30p BF82 30p BF83 30p BF84 30p BF85 30p BF86 30p BF87 30p BF88 30p BF89 30p BF90 30p BF91 30p BF92 30p BF93 30p BF94 30p BF95 30p BF96 30p BF97 30p BF98 30p BF99 30p BF100 30p BF101 30p BF102 30p BF103 30p BF104 30p BF105 30p BF106 30p BF107 30p BF108 30p BF109 30p BF110 30p BF111 30p BF112 30p BF113 30p BF114 30p BF115 30p BF116 30p BF117 30p BF118 30p BF119 30p BF120 30p BF121 30p BF122 30p BF123 30p BF124 30p BF125 30p BF126 30p BF127 30p BF128 30p BF129 30p BF130 30p BF131 30p BF132 30p BF133 30p BF134 30p BF135 30p BF136 30p BF137 30p BF138 30p BF139 30p BF140 30p BF141 30p BF142 30p BF143 30p BF144 30p BF145 30p BF146 30p BF147 30p BF148 30p BF149 30p BF150 30p BF151 30p BF152 30p BF153 30p BF154 30p BF155 30p BF156 30p BF157 30p BF158 30p BF159 30p BF160 30p BF161 30p BF162 30p BF163 30p BF164 30p BF165 30p BF166 30p BF167 30p BF168 30p BF169 30p BF170 30p BF171 30p BF172 30p BF173 30p BF174 30p BF175 30p BF176 30p BF177 30p BF178 30p BF179 30p BF180 30p BF181 30p BF182 30p 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T.V. GAMES

PROGRAMMABLE - £31.86

COLOUR CARTRIDGE TV GAME

The Waddingtons Videomaster PROGRAMMABLE Colour Cartridge is the latest development in TV games technology. The console of this model can be compared to an audio cassette deck and is programmed to play a multitude of different games in COLOUR, using various plug-in cartridges.

At long last a TV game is available which will keep pace with improving technology by allowing you to extend your library of games with the purchase of additional cartridges as new games are developed.

Each cartridge contains up to ten different action games and the first cartridge containing ten sports games is included free with the console. Other cartridges are currently available to enable you to play such games as Grand Prix Motor Racing, Super Wipeout and Stunt Rider. Further cartridges are to be released later this year, including Tank Battle, Hunt The Sub, and Target.

The console comes complete with two removable joystick player controls to enable you to move in all four directions (up/down/right/left) and built into these joystick controls are ball serve and target fire buttons.

Other features include several difficulty option switches to handicap one player or to allow both players to compete in the professional mode, automatic on screen digital scoring and colour coding on scores, bats and balls. This in addition to the lifelike sounds transmitted through the TV's speaker, simulating the actual game being played, gives more realism to the games and added excitement for the player.

Manufactured by Waddingtons Videomaster and guaranteed for 1 year.



EXTRA CARTRIDGES:

- ROAD RACE - £9.58 inc. VAT. Grand prix motor racing with gear changes, crash noises, etc.
- SUPER WIPEOUT - £9.90 inc. VAT. 10 different games of blasting obstacles off the screen.
- STUNT RIDER - £13.13 inc. VAT. Motorcycle speed trials, jumping obstacles, leaping varying rows of up to 24 buses, etc.

6 GAME - COLOURSCORE II - £14.59 inc. VAT

This non-programmable console offers four exciting COLOUR games: Tennis, Football, Squash and Sale as well as an auxiliary socket for connection to 'Shooting Star', an electronic rifle. In add to the additional Moving Target Shooting Game, Shooting Star can be used as either a rifle or a pistol and comes complete with both a stock and barrel extension.

Features of the ColourScore II include removable hand controls for movement both up and down the screen, handicapping switch, ball speed switch, automatic on screen digital scoring and colour coding. Realistic hit sounds are transmitted through the built-in speaker.

SHOOTING STAR GUN optional extra £4.06 inc. VAT

Manufactured by Waddingtons Videomaster and guaranteed for 1 year.



10 GAME - COLOUR SPORTSWORLD £24.30 inc. VAT

This non-programmable console offers ten exciting COLOUR games: Tennis, Squash, Hockey, Sale 1, Football, Basketball, Gridball, Sale 2 and two unique built-in target shooting games.

Features include two removable joystick player controls to enable you to move in all four directions (up/down/right/left) and built into these joystick controls are ball serve and target fire buttons.

Other features include handicapping switch, ball speed switch, automatic on screen digital scoring and colour coding. Realistic hit sounds are transmitted through the TV's speaker.

Manufactured by Waddingtons Videomaster and guaranteed for 1 year.



8V-A7C MAINS ADAPTOR - £3.13 inc. VAT

Suitable for use with all of the models above. Unit is already fitted with a 13amp plug.

CHESS COMPUTERS



STAR CHESS - £55.50 inc. VAT PLAY CHESS AGAINST YOUR PARTNER using your own T.V. to display the board and pieces

Star Chess is a new absorbing, f.x. game for two players, which will interest and excite all ages. The unit plugs into the serial socket of your TV set and displays the board and pieces in full colour (or black and white) on your T.V. screen. Based on the moves of chess, it adds even more excitement and interest to the game. For those who have never played, Star Chess is a novel introduction to the classic game of chess. For the experienced chess player, there is a whole new dimension of unpredictability and chance added in the strategy of the game. Not only can pieces be taken to conventional chess type moves, but each piece can also exchange rook for its opponent.

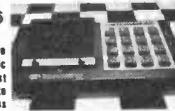
Star Chess is the first microprocessor based T.V. game to be developed in the U.K. and is manufactured by VIDEOMASTER (a subsidiary of Waddingtons, Europe's most experienced manufacturer of board games). The central processing unit forms a powerful computing system, taking instructions from both of the player hand controls, and is capable of executing and checking all the moves in the game, as well as generating a full range of sound effects. The unit can be used to play either chess or Star Chess, and comes complete with a free 10V mains adaptor, full instructions and a twelve month guarantee.

CHESS CHAMPION 6 - £85.50 PLAY CHESS AGAINST THE COMPUTER - 6 LEVELS

The very latest development in microprocessor technology now enables us to offer a massive reduction in the price of computer chess games. Chess Champion is a newly developed electronic microcomputer, manufactured by VIDEOMASTER (a subsidiary of Waddingtons, Europe's most experienced manufacturer of board games). The stylish, compact, portable console can be set to play at six different levels of ability from beginner to expert including 'Mate in two' and 'Chess by Mail'.

The various levels of play can be changed at any time during the game and you can use the override key to make multiple moves or board changes without the computer responding. The computer will only make responses which obey international chess rules. Casting, on passat and promoting a pawn are all included as part of the computer's programme. It is possible to enter any given position from magazines or newspapers or alternatively establish your own board position and watch the computer react. You can also add or subtract pieces during the game or re-color the board as desired to put your self either at an advantage or disadvantage. The computer always plays black, but can be set to be white the first move. The position of all pieces can be verified by using the computer memory recall button. Chess Champion comes complete with a free 9V mains adaptor, full instructions and a twelve month guarantee.

World chess champion ABATOLY KARPOV says: "This chess computer is a new and interesting partner with remarkable game variations."



CHESS CHALLENGER 7 - £92.50 CHESS CHALLENGER 7 - £92.50 inc. VAT

Play chess against the computer at 7 different levels. (Similar to Chess Challenger 10 but unit has only 7 levels of play). Price includes unit with wood grained housing, and Staunton design magnetised.

CHESS CHALLENGER 10 - £154.50 inc. VAT

NEW IMPROVED PROGRAMME - MK 2, APRIL, 1979
Play chess against the computer at 10 different levels. Price includes unit with solid walnut case, deluxe simulated leather & brushed gold felt playing surface, & Staunton design magnetised chess pieces. (Chess Challenger 10 illustrated above)



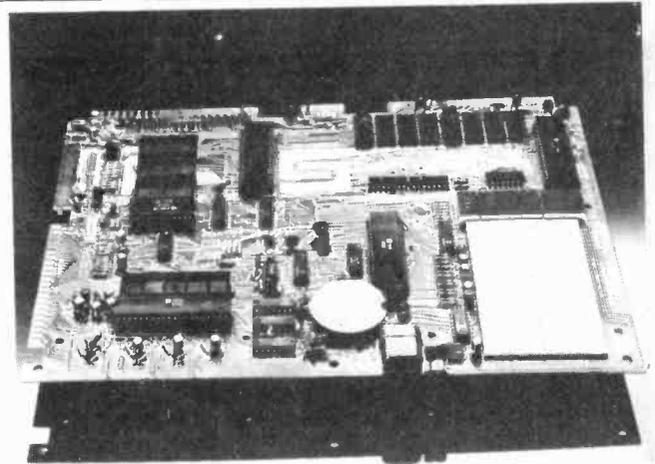
BORIS - £178.50 inc. VAT
Boris is an advanced chess computer that's programmed for all classic chess moves. He will play Black or White, even himself. He'll even teach you how to play chess and suggests the moves for you when you're unsure of what to do next. Boris can talk to his opponent through his alphanumeric display and will flash different messages during each game to keep you on your toes. Boris will not allow illegal moves, and will allow you to enter problems or set up your own board positions. Boris comes in hand crafted, solid walnut case with chess pieces and board.

FOR FREE BROCHURES - SEND S.A.E.

For free illustrated brochures and reviews on T.V. and chess games please send a stamped, addressed envelope and state which particular games you require information on. Callers welcome at our shop in Wellesly - demonstrations daily - Open from 9am-5.30pm Mon. Sat. (9am-1pm Wed.). To order by telephone please quote your name, address and Access/Barclaycard number VAT is included in all prices above - Postage & Packing FREE

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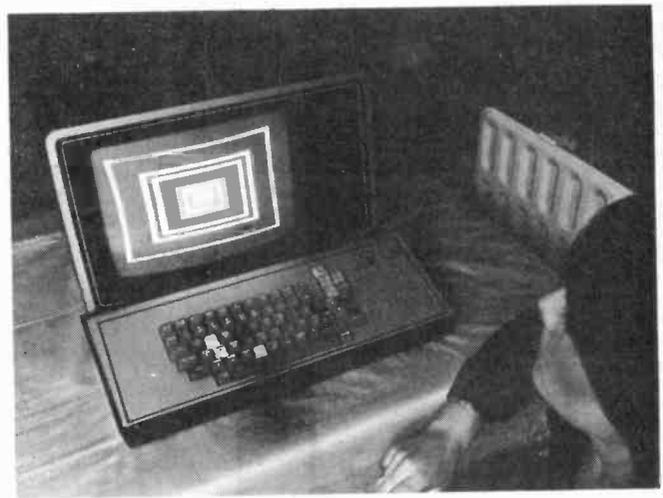
..... news digest.....



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 chronograph 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, HARDEX 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, HARDEX 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.

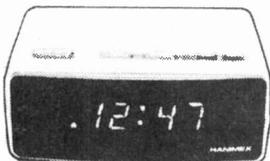
£ 9.95

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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 111mm x 60mm). Weight 1.43 lbs (0.65 kg).

£8.65 Thousands sold!

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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

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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, postal 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 guarantee 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.



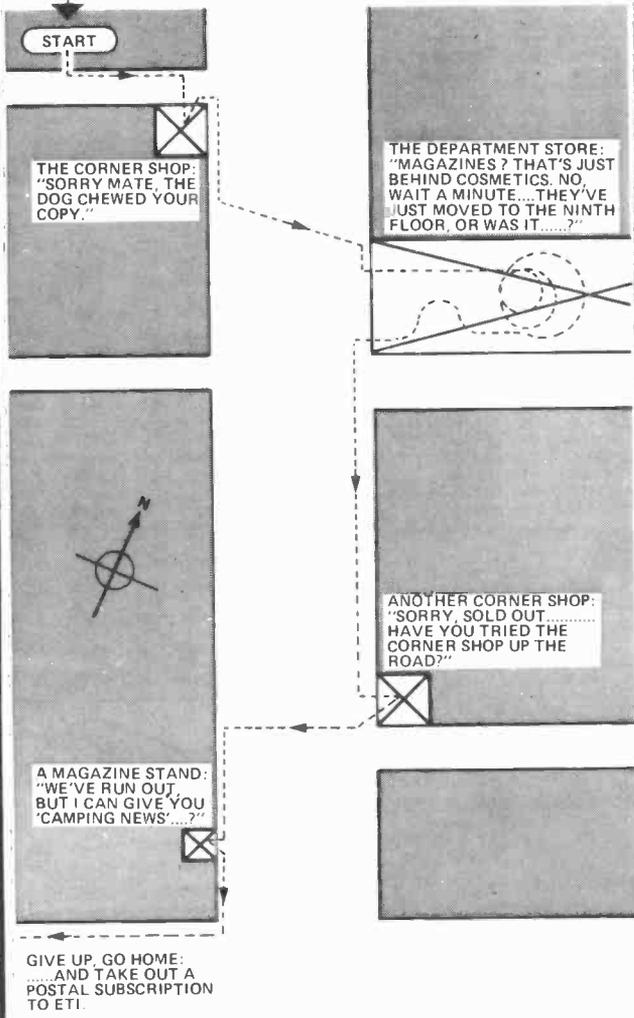
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Although ETI is monthly, it's very rare to find it available after the first week. If it is available, the newsagent's going to be sure to cut his order for the next issue — but we're glad to say it doesn't happen very often.

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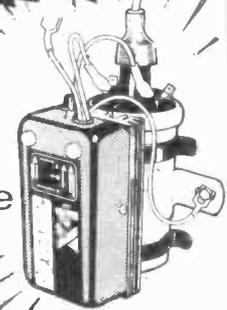
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THE KIT COMPRISES EVERYTHING NEEDED
Die pressed epoxy coated case. Ready drilled, aluminium extruded base and heat sink, coil mounting clips, and accessories. Top quality 5 year guaranteed transformer and components, cables, connectors, P.C.B., nuts, 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.

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Subminiature toggle. Rated at 3A 250V.

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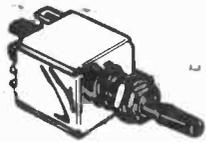
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Push to make 15p Push to break 20p

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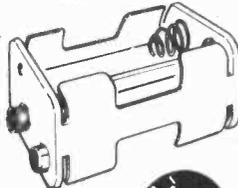
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To hold 4 HP7 batteries, square and long types 20p
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Ideal for use on mixers etc. Push on type with black base and marked position line. Cap available in red, blue, green, grey, yellow and black 14p



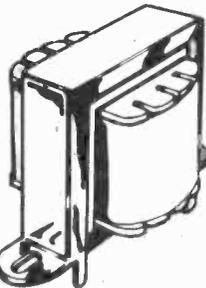
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240 Volt Primary

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BC147 7p	BFY50 15p	2N3442 135p
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BC149 8p	BFY52 15p	2N3704 8p
BC148 9p	MJ2955 98p	2N3705 9p
BC177 14p	MPSA06 20p	2N3706 9p
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BC182L 10p	TIP31C 65p	2N3904 8p
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BC184L 10p	ZTX107 14p	2N3906 8p
BC212 10p	ZTX108 14p	2N4058 12p
BC212L 10p		2N5457 32p
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BC214L 10p		2N5459 32p
BC477 19p	1N914 4p	2N5777 50p
BC478 19p	1N4001 4p	
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BCY70 14p	1N4006 6p	

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1N5402 15p	1N5404 16p
1N5406 18p	BZY88 series 2V7 to 33V 8p ea.

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LM324 50p	NE567 170p
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LM1830 150p	SN76033 200p
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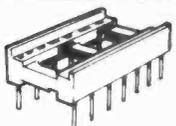
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4015 60p	4028 52p	4075 16p
4016 35p	4029 60p	4093 48p
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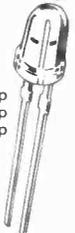


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SURFACE ACOUSTIC WAVES

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

RODYNE RECEIVER has been with us for now (although opinions vary as to its time the basic concept has altered very little since the advent of semiconductors came Varicap with it the demise of the mechanical filter). As ICs began to appear another bulky superhet shrank dramatically — the audio stage, however, seems to have resisted any change. The good old IF, indeed many a radio enthusiast in the thirties and forties would still recognise a superhet stage, possibly even feel quite at home

with it. The operation of the IF would not be the same, 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 than 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 oscillator 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.



SAWFs (Plessey Semiconductors 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 its construction, instead it relies on a substance called Lithium Niobate, which has very predictable piezoelectric 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 interleaved 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.

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, (wobblers 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.

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.

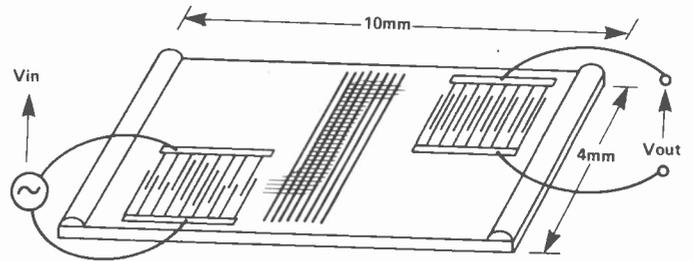


Fig. 1

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.

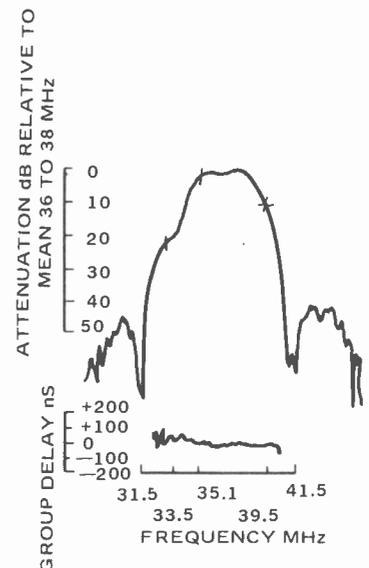


Fig. 2.

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.

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 SAWFs 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 signal applied to the input transducer causes an acoustic wave (proportional to V_{in}) to be propagated bidirectionally along the surface of the substrate. The transducer generates a wave symmetrically across its surface producing an unwanted output to the left of its 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 ($LiNbO_3$) 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.

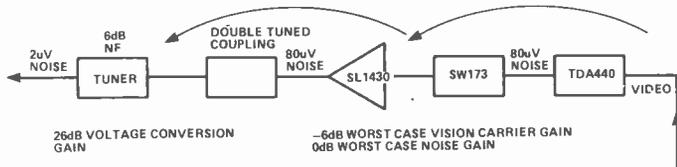
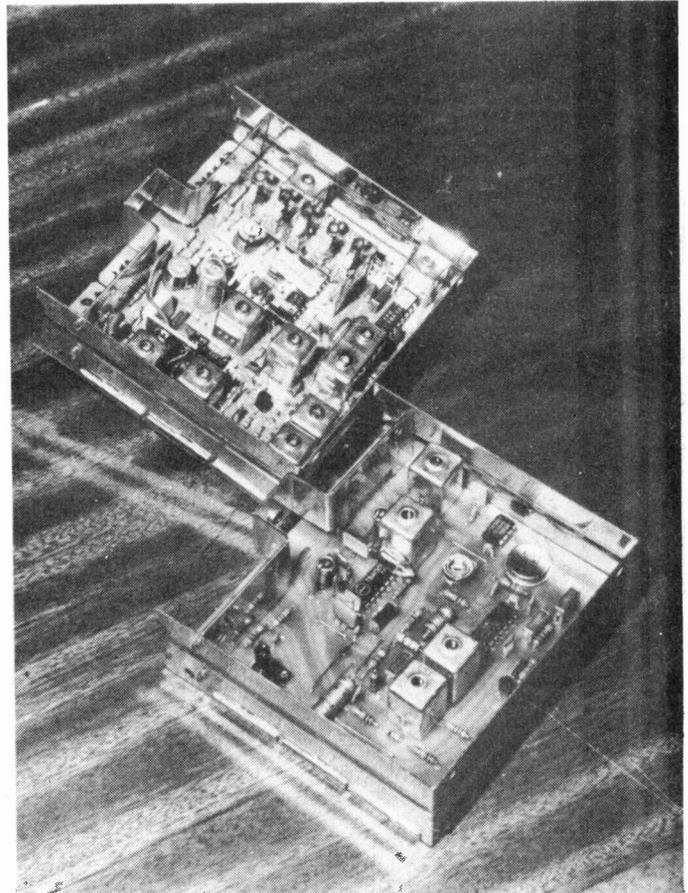


Fig. 3.

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.



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 (f_0) and bandwidth of the device. By 'tailoring' the shape and sizes of the electrodes a variety of

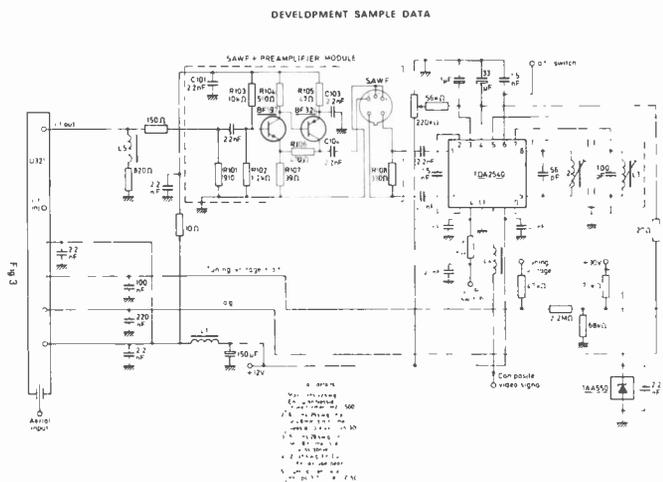


Fig. 4.

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

FEATURE: Surface Acoustic Waves

The bandwidth (Δf) is given by:

$$\Delta f / f_0 = 2 / N$$

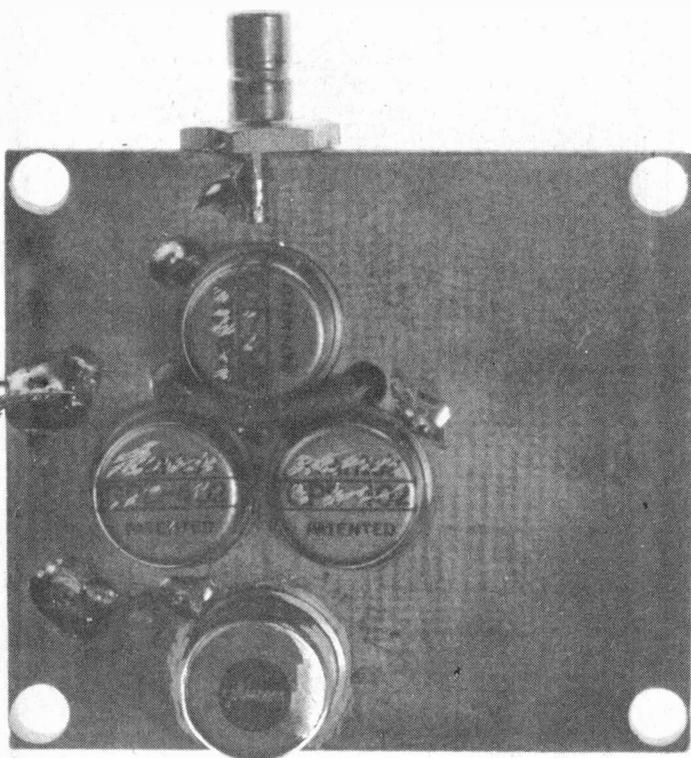
Where N is the number of electrode pairs. Such a device would possess a linear phase response.

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 is virtually square. It has an 8 MHz bandwidth which is flat ± 0.2 dB 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.



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 λ_0 between electrodes of the same polarity the frequency response of the filter would be $\sin x/x$ where the centre frequency is given by:

$$f_0 = \frac{\text{(velocity of wave propagation)}}{\lambda_0}$$



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0.8-9, 0.8-9	1A 1A	208	3.50 .65
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8.0	118	19.85	1.60
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2.0	127	7.20	1.10
3.0	125	10.75	1.20
4.0	123	12.00	1.40
5.0	40	13.80	1.50
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2	71	2.90	.80
4	18	3.70	.80
6	70	5.25	.85
8	4	7.10	1.10
10	5	7.90	1.10
12	6	8.50	1.10
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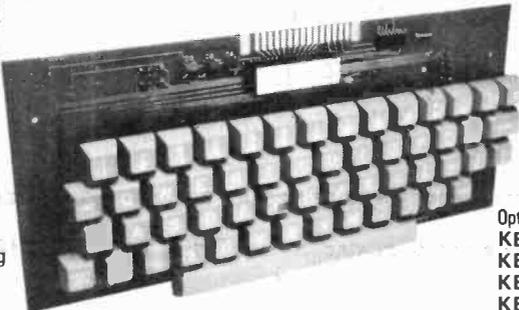
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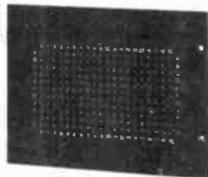
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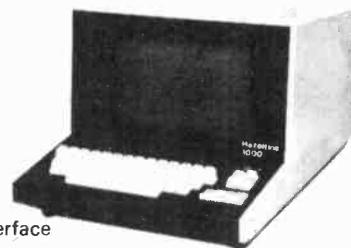
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Take a

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

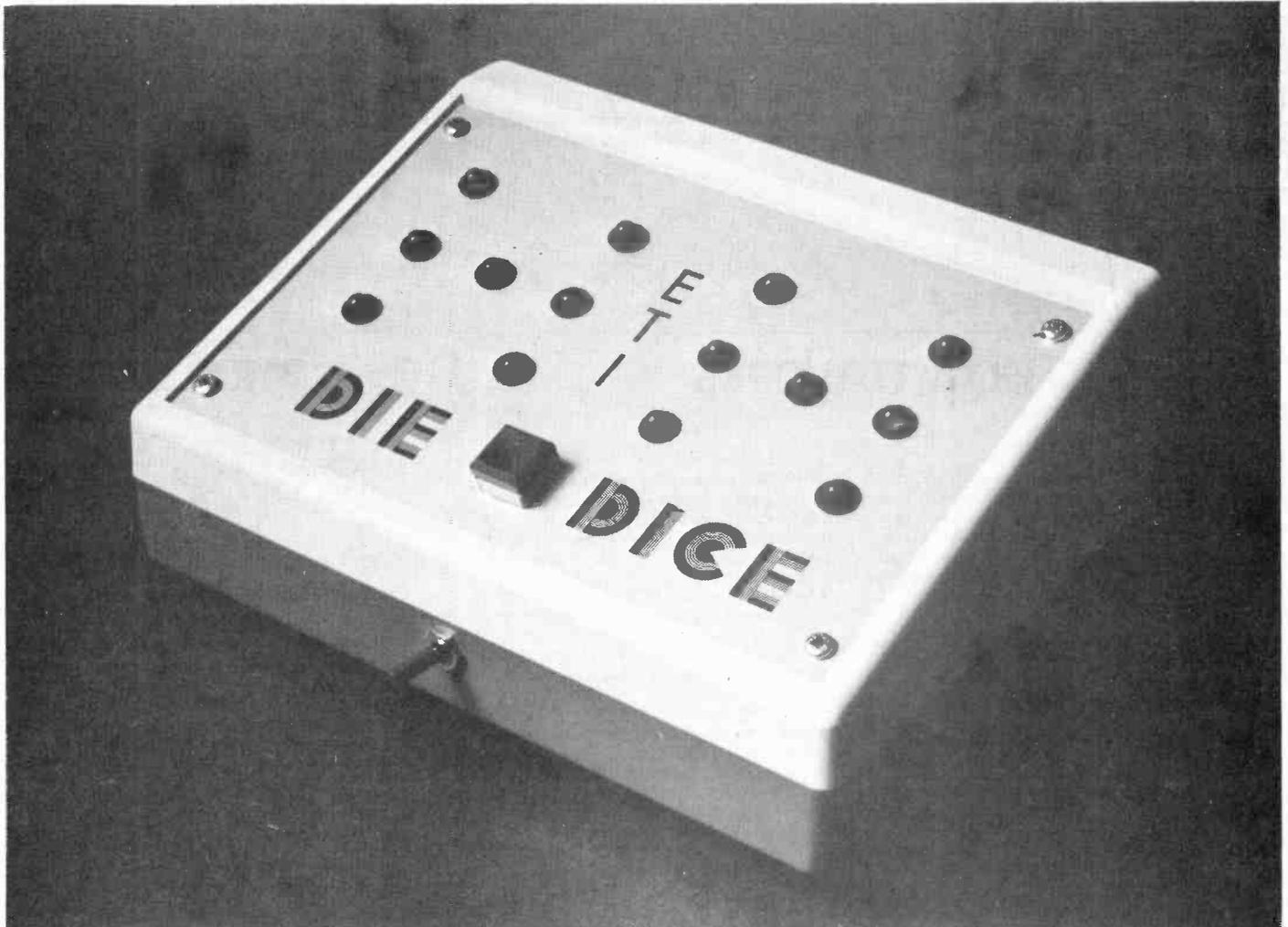
used red LEDs for the left-hand die display, and orange for the right. Not a good idea: the orange LEDs aren't contrasty enough, and are difficult to read. Our advice is use red LEDs for both displays.

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.

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 its 'solid state' counterpart.

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



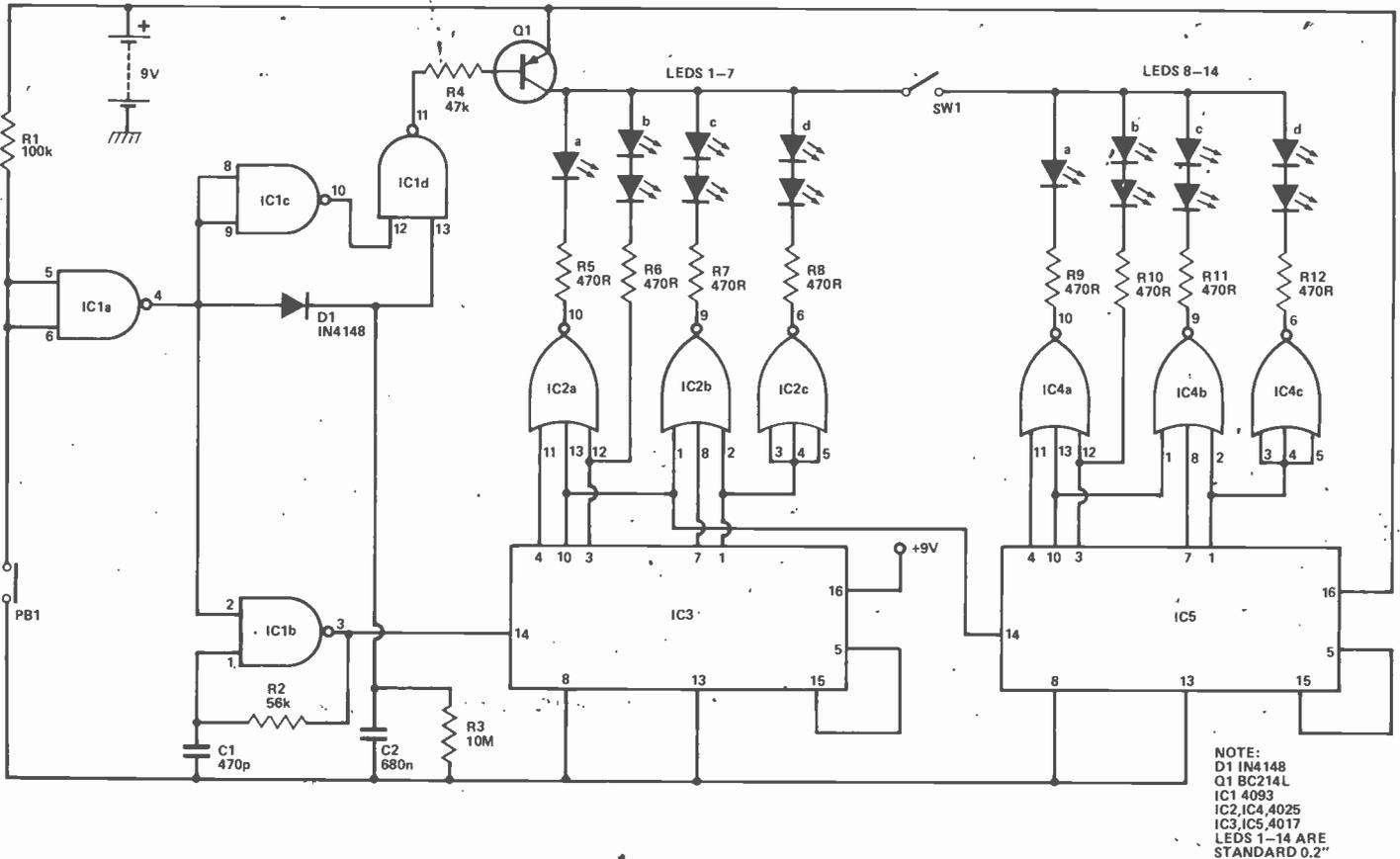


Fig. 2. The complete circuit diagram of Double Dice, as you can see the component count is significantly lower than any previously published design. ICs 3 and 5 are 4017s arranged as divide by six, counter-dividers.

HOW IT WORKS

The circuit may be divided into three sections; the clock-control and two identical counter-decoder stages. IC1 handles the control function and generates the clock pulses to drive the 4017 counters IC3 and IC5. The output from these is 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 reset 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 IC1a 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 1/4-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.

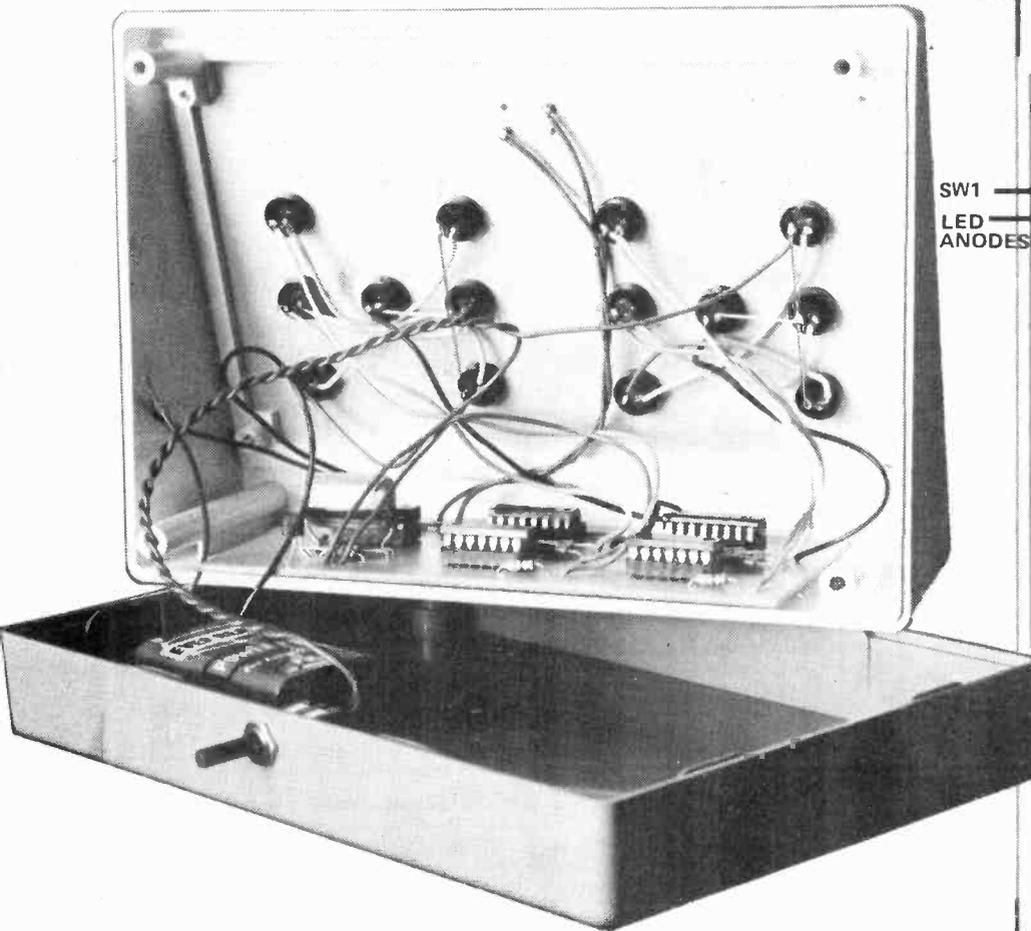


Fig. 3. Component overlay, note the orientation of the LCs.

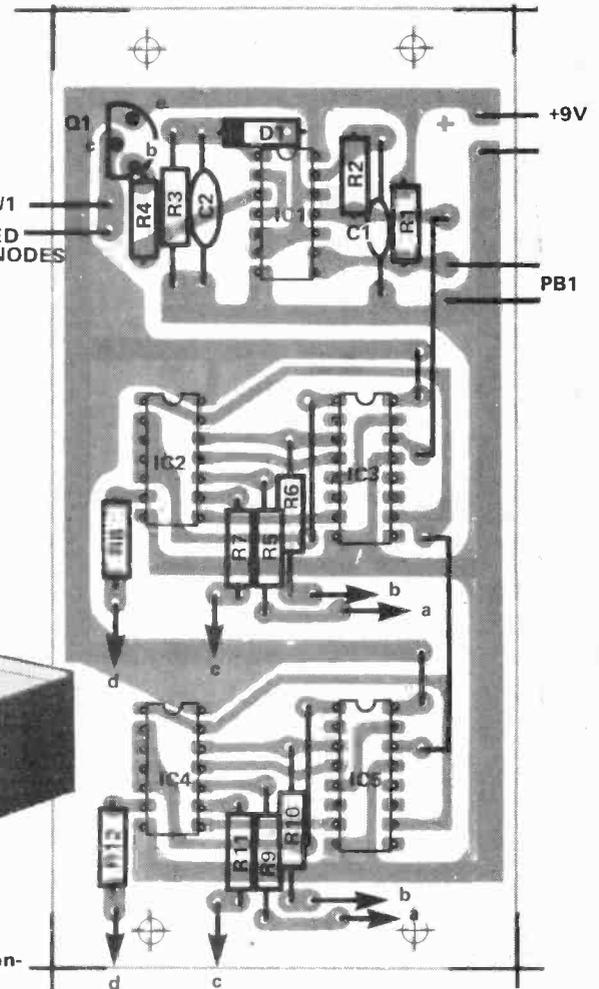


Fig. 4. Layout for the LED display, two are required.

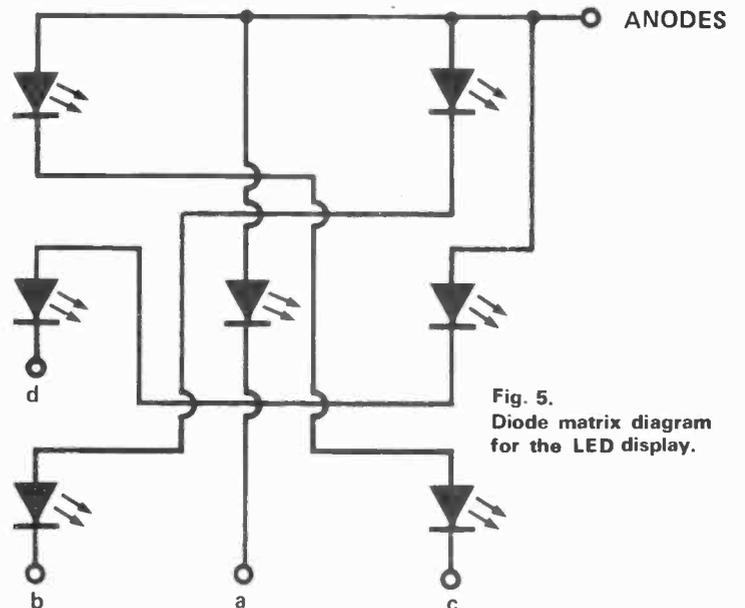
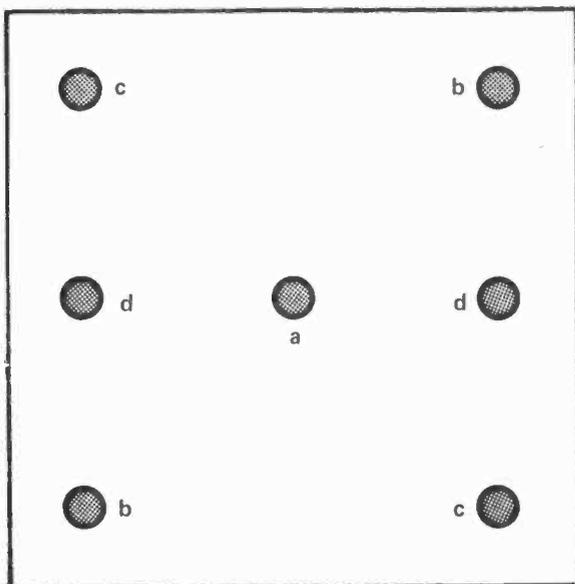


Fig. 5. Diode matrix diagram for the LED display.

BUYLINES

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

ambit[®] international

The PW Sandbanks Metal Locator: a kit based on this recently published design for this uniquely effective type of metal locator is available for only £35.00 + 8% VAT. The kit closely resembles the appearance as published, except that a close fitting injection molded housing replaces the vacuum molded electronics box - to improve the environmental suitability of the construction. Carriage for complete kits £1.

The New Catalogue - "Tecknowledgey Part 2"

Part 2 of the catalogue: by the time this advert reaches the press, part 2 should be on sale. Sorry it's late, but it contains so many new and interesting things that we felt we had to hold up production to include them. Part three by the autumn - and already there are many new items to go in! Part one 45p, part 2 50p. (inc PP etc).

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LEDS:

	3mm	5mm	2.5x5mm
Red	0.14	0.14	0.17
Green	0.18	0.16	0.20
Yellow	0.18	0.15	0.20
Orange	0.22	0.29	0.24

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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 Hi Fi 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.....

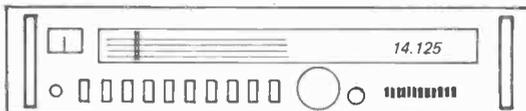
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The PW Dorchester - LW, MW, SW, & FM stereo tuner

THE DIGITAL DORCHESTER ALL BAND TUNER



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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.

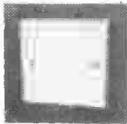
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2 Gresham Road, Brentwood, Essex.

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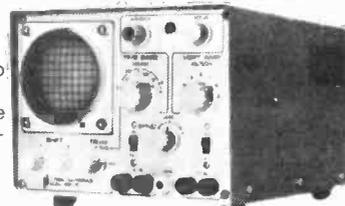
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Bandwidth (between 3dB points) - DC - 5MHz
Input Attenuator - (calibrated) - 9 step 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50V/div
Input Impedance - 1 Meg/40p is shunt
Input Voltage - Max - 600V P-P
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Deflection Sensitivity - 0-400mV/division
Bandwidth (between 3dB points) - 1 Hz - 350KHz
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4030	58p	4099	122p	4569	303p
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4033	145p	4162	90p	4581	319p
4034	200p	4163	90p	4582	164p
4035	120p	4174	104p	4583	84p
4036	250p	4175	95p	4584	63p
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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		
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7406	38	7475	38	40	74141	56	74195	95	137	74398	180			
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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

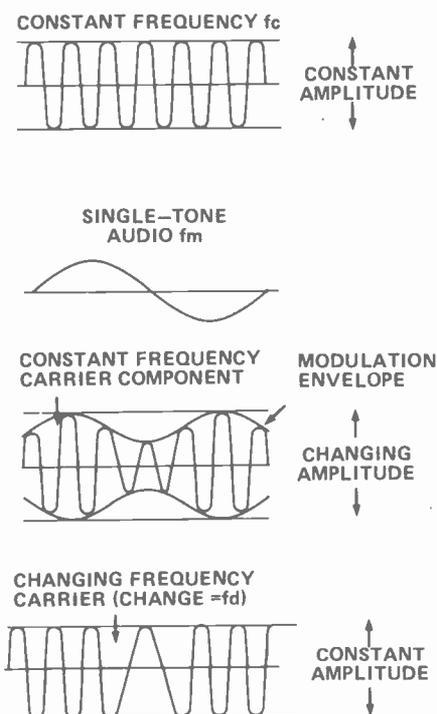


Fig. 1. Impressions of modulation (not to scale). (a) carrier wave, (b) single-tone modulation signal, (c) AM waveform, and (d) FM waveform.

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.

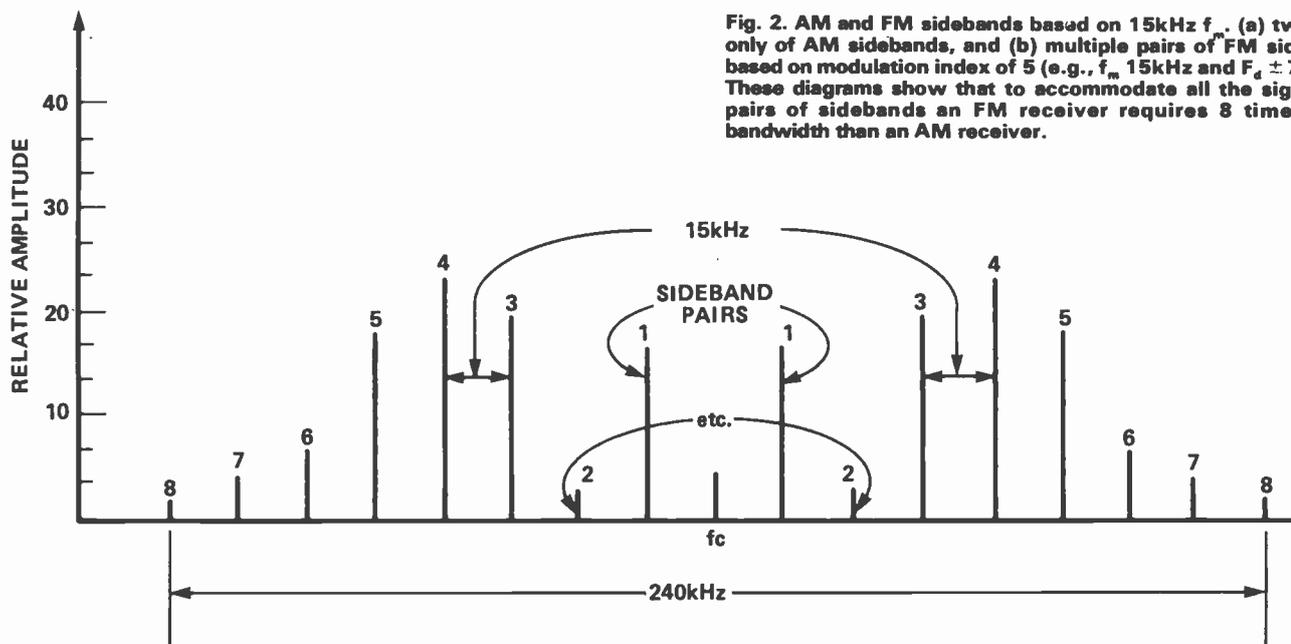


Fig. 2. AM and FM sidebands based on 15kHz f_m . (a) two pairs only of AM sidebands, and (b) multiple pairs of FM sidebands based on modulation index of 5 (e.g., f_m 15kHz and $F_d \pm 75$ kHz). These diagrams show that to accommodate all the significant pairs of sidebands an FM receiver requires 8 times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

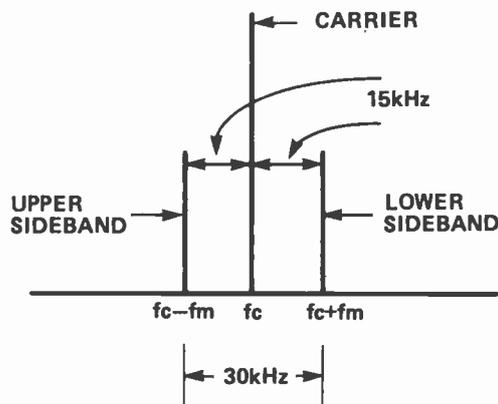
At FM it is the *frequency* of the carrier that is altered in sympathy with the sound. The stronger the sound, the greater the frequency change; and the higher the audio frequency the faster the rate of frequency change.

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

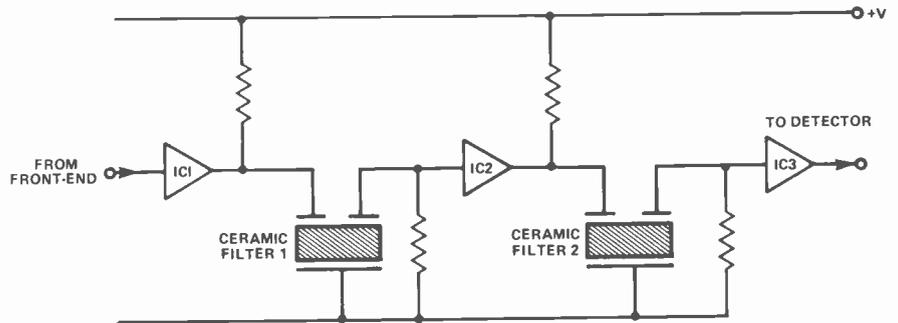
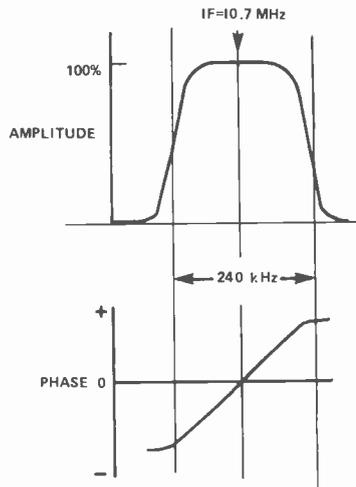


Fig. 3. Requirements of FM IF channel. (a) idealised amplitude response over 240kHz passband having sharply falling side skirts, (b) phase linearity within the passband, and (c) the type of circuit from which these requirements are closely approximated.

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 spurious 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 $f_c + \text{IF}$, 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,

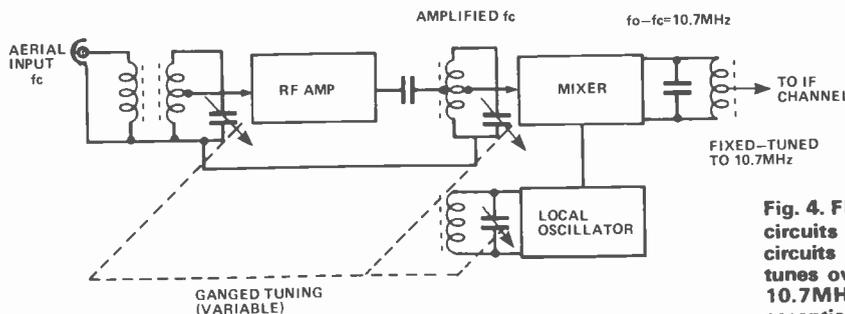


Fig. 4. FM front-end with RF amplifier using two variable-tuned circuits between aerial and mixer. The RF and mixer input circuits are tuned in step while the ganged oscillator tuning tunes over Band II so that the oscillator frequency is always 10.7MHz above the carrier frequency. Accurate tracking 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.

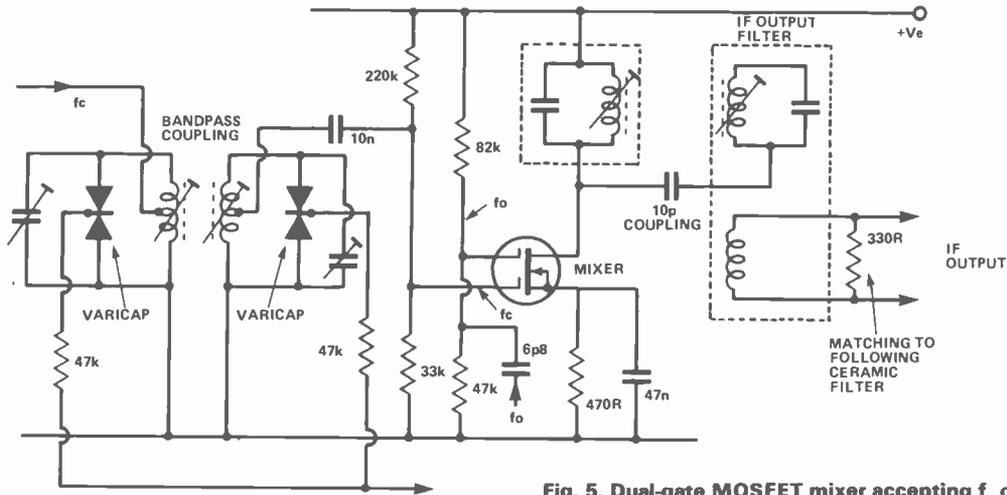


Fig. 5. Dual-gate MOSFET mixer accepting f_c on one gate and f_o on the other gate. The circuit also shows varicap tuning and a capacitively-coupled IF output filter.

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 stabilizer 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.

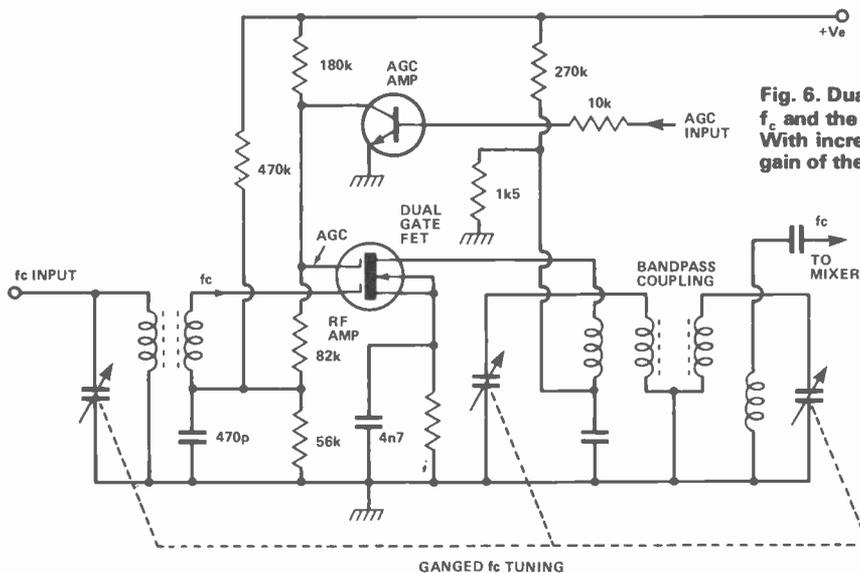


Fig. 6. Dual-gate MOSFET RF amplifier where one gate receives f_c and the other an AGC bias obtained from a bipolar amplifier. With increase in signal strength the bias increases so that the gain of the RF amplifier is diminished.

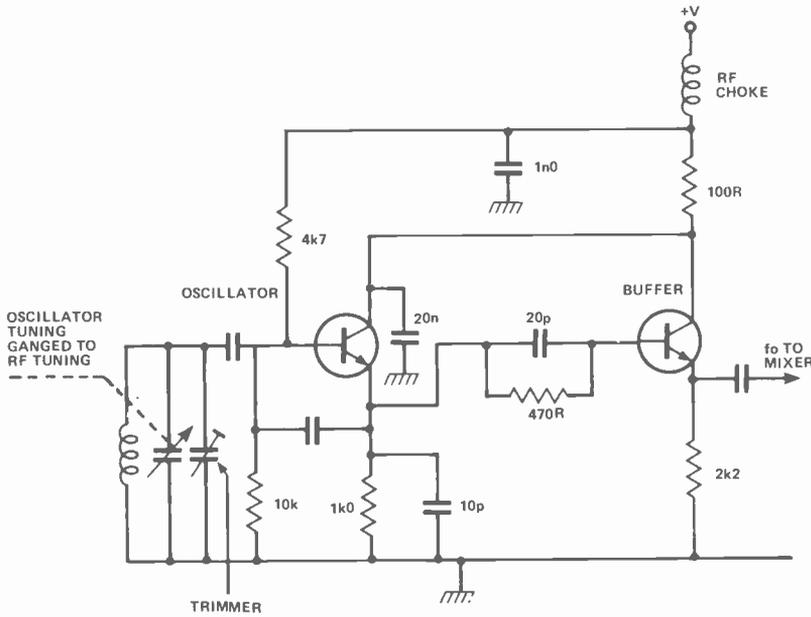


Fig. 7. FM local oscillator followed by buffer stage for feeding the mixer.

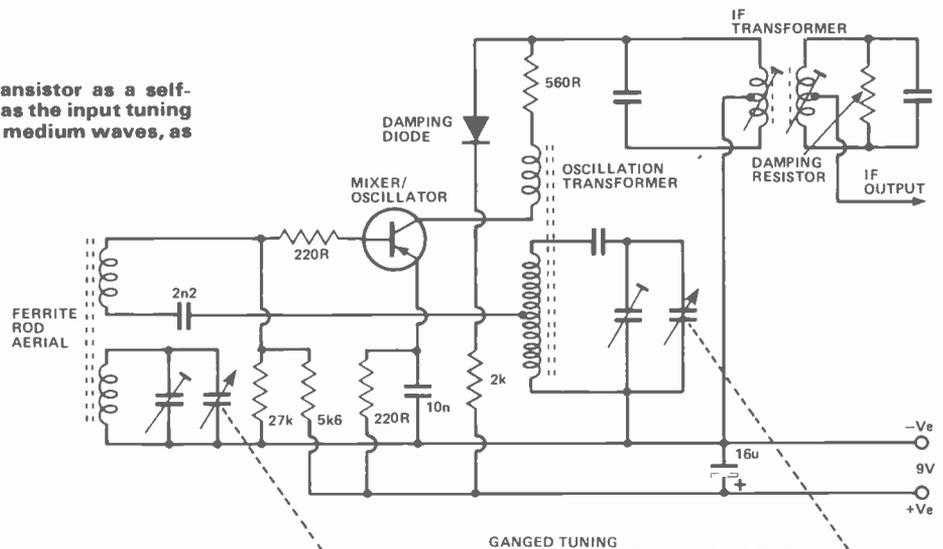
The majority of AM transistor portables employ a ferrite rod aerial which also serves as the input tuning. Only the more elaborate models boast an RF amplifier, and a self-oscillating mixer is commonly adopted, as shown in Fig. 8. Receivers with poor front-end selectivity are relatively prone to spurious 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 carrier 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.



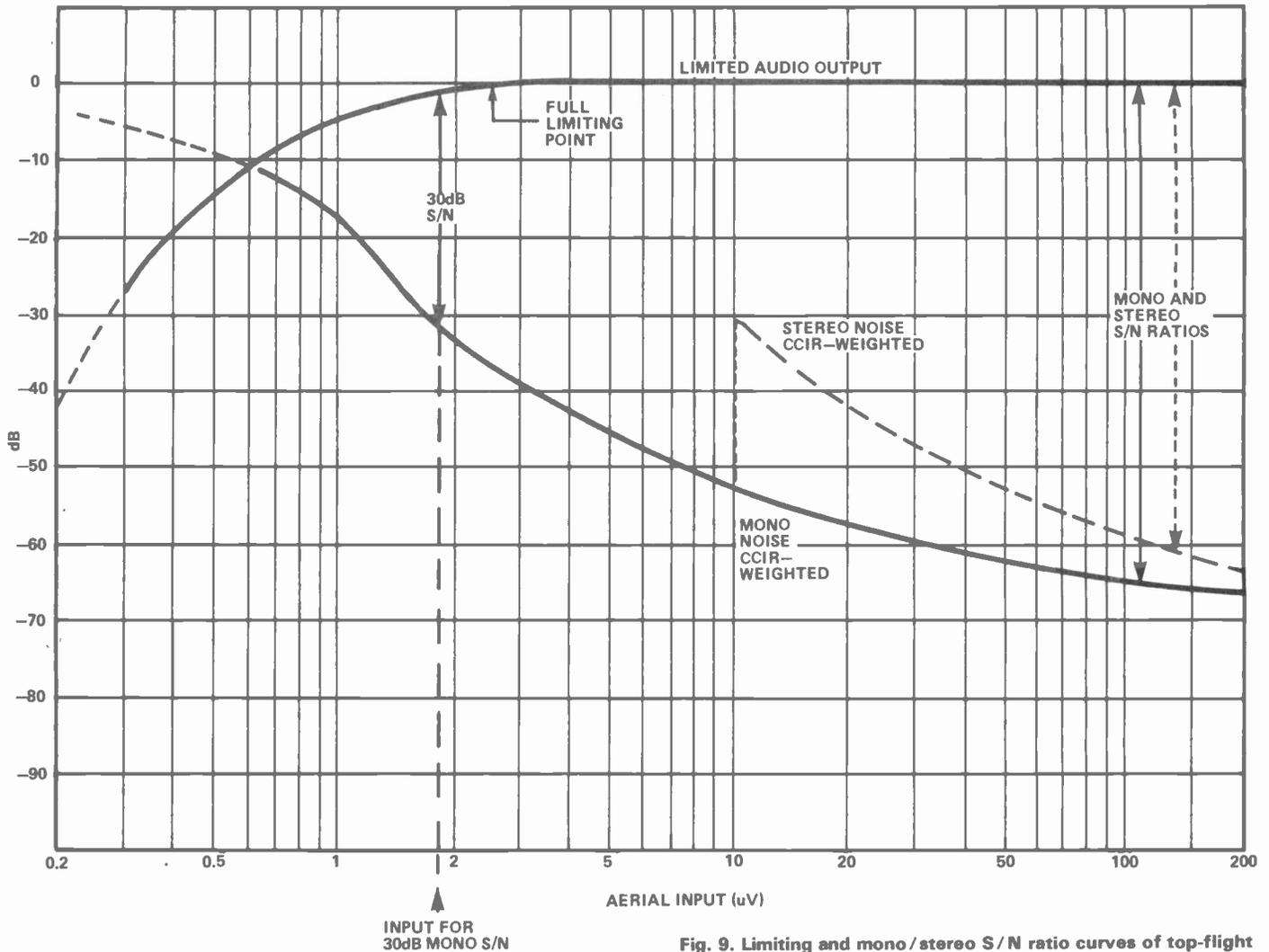


Fig. 9. Limiting and mono/stereo S/N ratio curves of top-flight hi-fi FM receiver.

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 transistor

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/L11 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

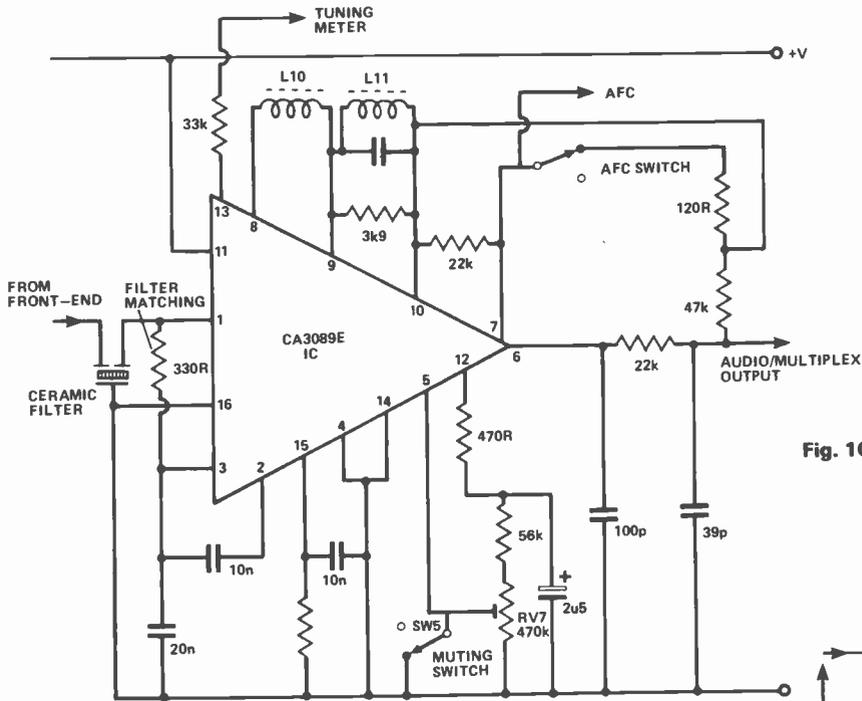


Fig. 10. FM limiting and detection by CA3089E IC (see text).

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 simpler 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

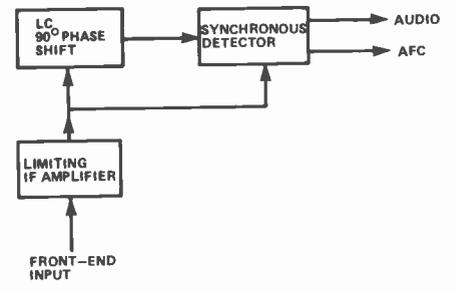
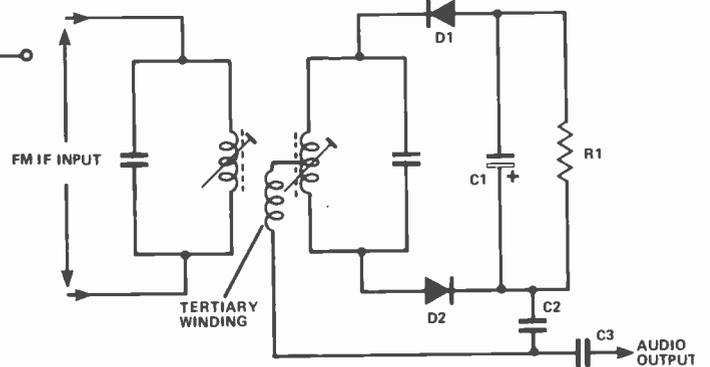


Fig. 11. Simplified quadrature detection.

Fig. 12. FM Ratio detector circuit.



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 ± 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 ± 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

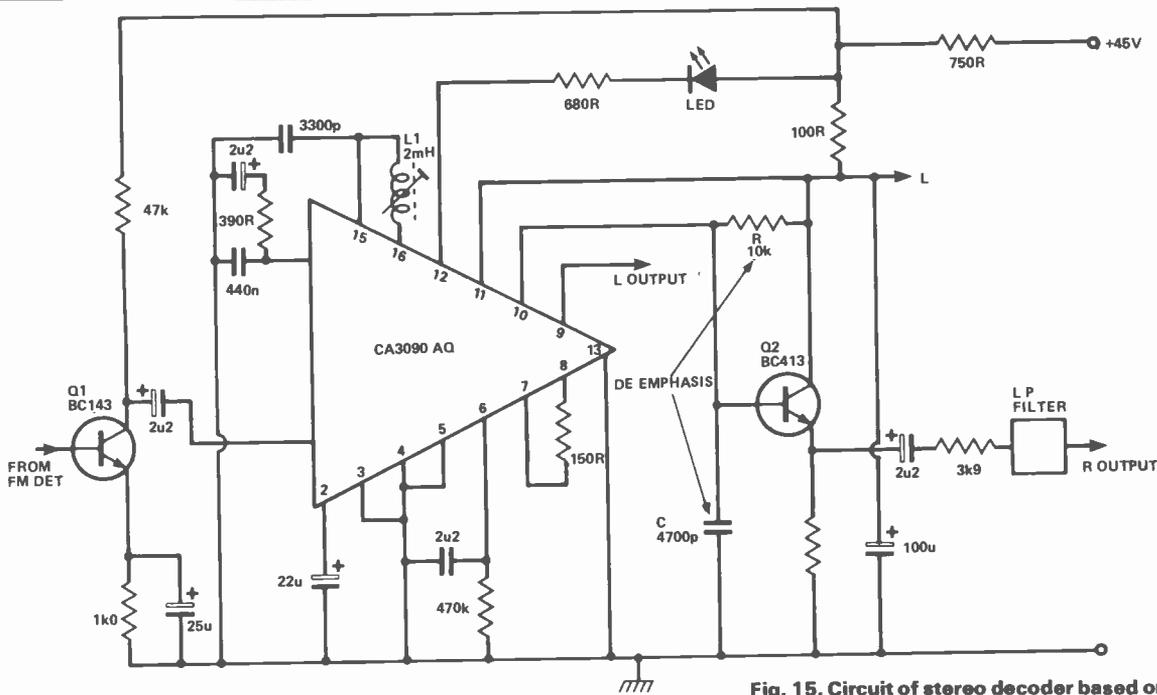


Fig. 15. Circuit of stereo decoder based on the CA3090AQ IC. L1 is PLL tuning and RC the de-emphasis. One channel only is shown; the other channel is similar.

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 spurious 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.

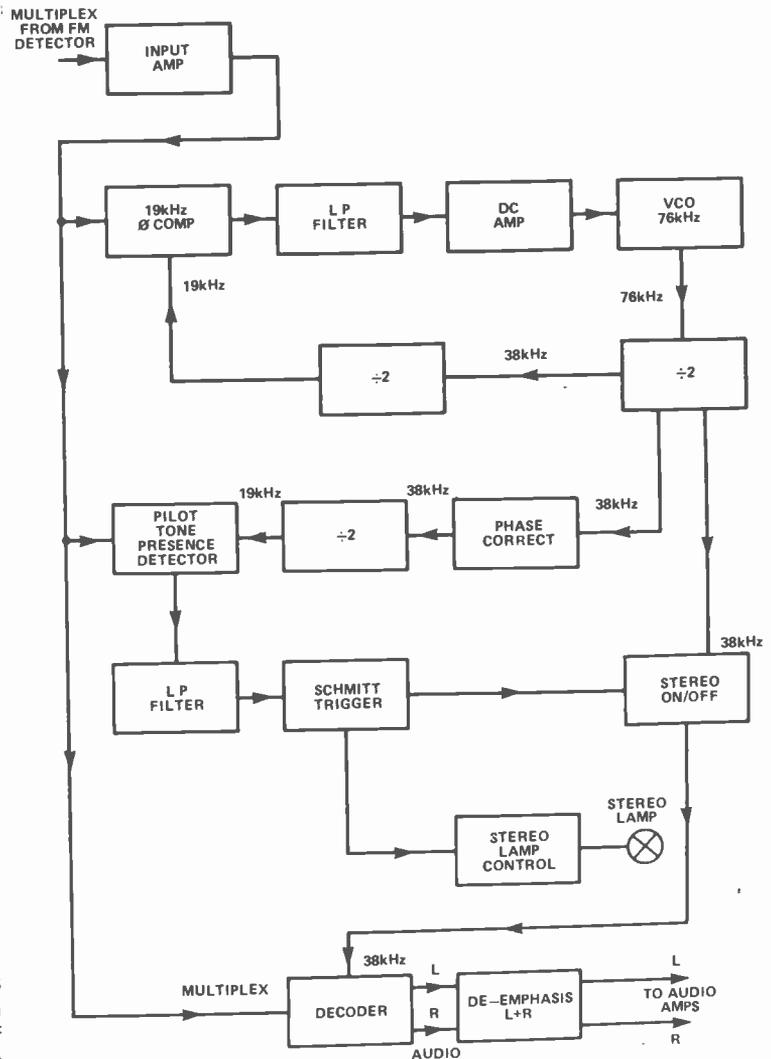


Fig. 16. Block diagram of PLL stereo decoder IC.

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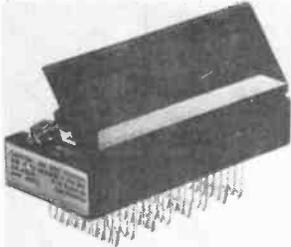
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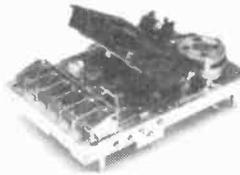
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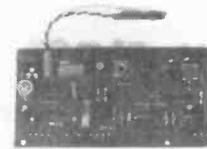


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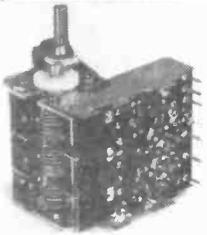
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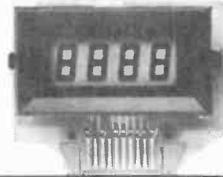
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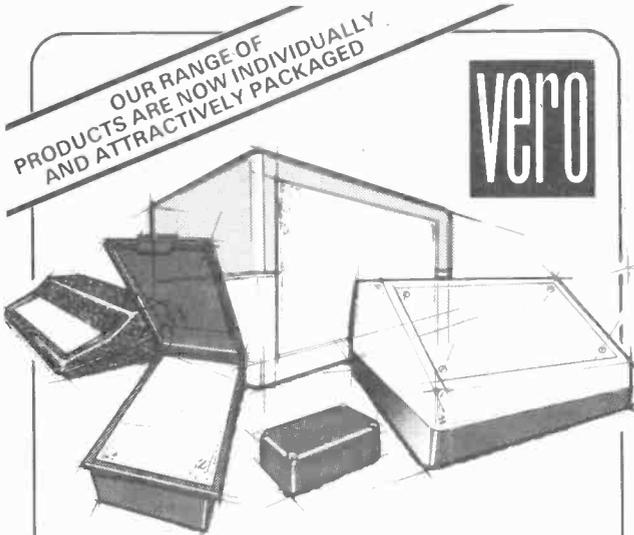
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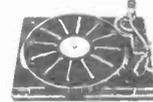
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AMBUSH! PART 2

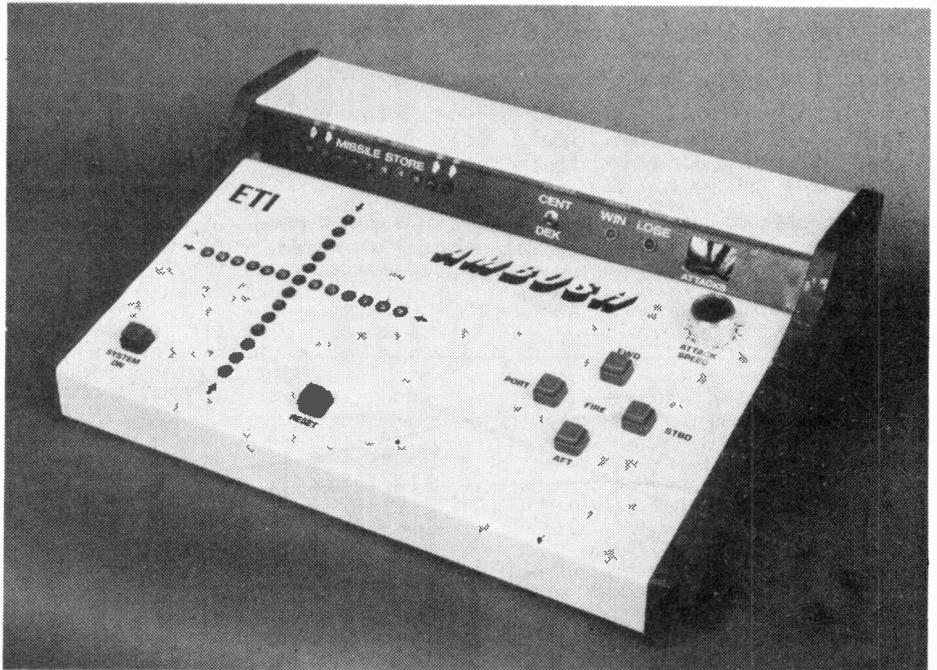
At last the second and final part of our very own space game Ambush. Red blood sweat and tears have gone into the production of the game and we believe it's all been worthwhile. Virtually guaranteed to provide hours of excitement, not one of those games you easily tire of. So switch it on and prepare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

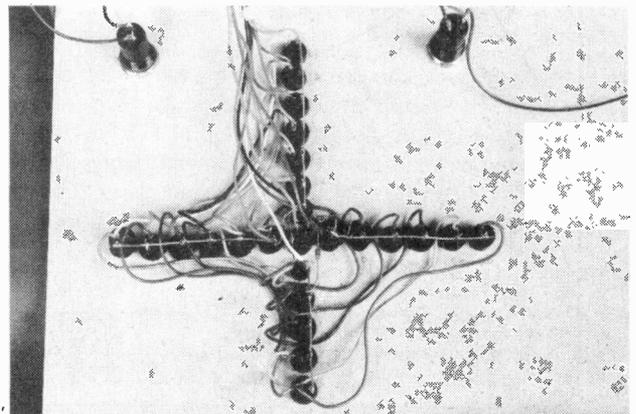
When it comes to fitting the LED's for the Main Display and for the Missile Store indicators, take the precaution of testing each LED individually to confirm its polarity and functioning before finally wiring it in place. Note that silicon diodes D22 to D25 are mounted directly on the Main Display matrix.

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 them. "Don't worry, mates. The Yappanies haven't got a chance against us. We've got masses of Phantom 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 Phantom 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 ship's starboard engine had ripped itself apart and hurled great chunks of white hot metal through the hull. The ship's 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 Phantom 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 Phantom 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 Phantom 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 Eatyeigh. He switched on the attack simulation computer, to check the extent of the sensor damage. The ship's 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.

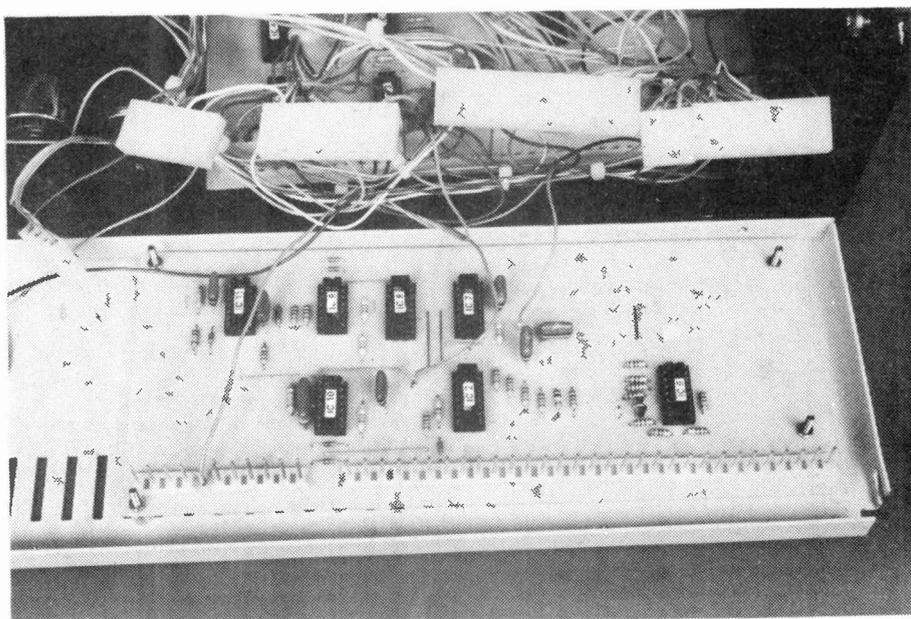
The computer showed that the Forward sensor was inoperative on sound, and gave only 250 milliseconds of range warning at normal battle speed. Port and Starboard sensors were operating at half strength on sound, and gave 300 milliseconds of range warning. The Aft sensor was fully operational on sound,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

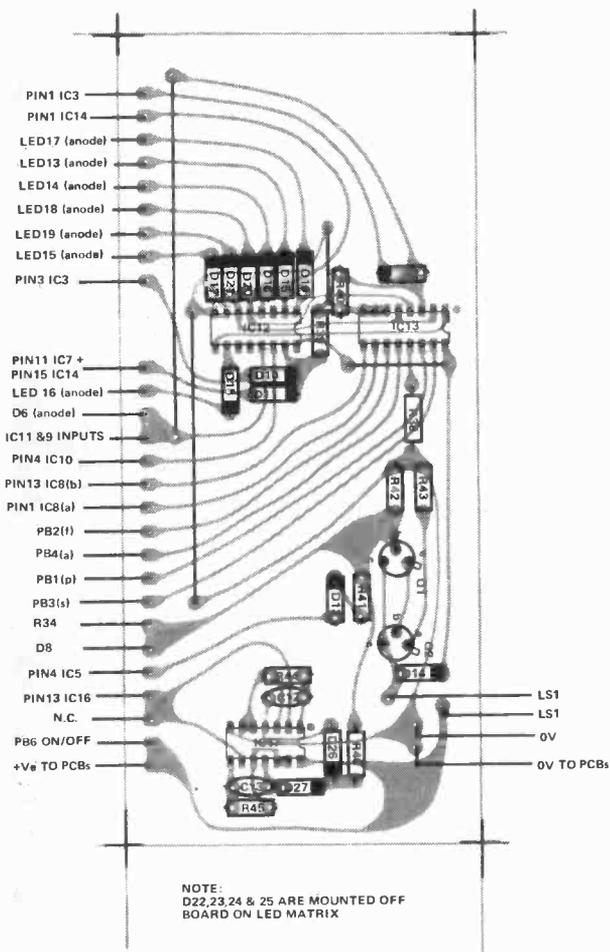
The Commander's voice boomed through the ship again. "All units at Red Alert. A Yappanie century of Kamanzi suicide craft has been detected, closing at high speed. Out." Joe threw the attack mode switch to the CENT position, and the fire control computer automatically adjusted the Phantom missiles into 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 craft's engine burst from the audio simulator. Joe stabbed his finger at the AFT fire button, heard the screech of a Phantom missile 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.

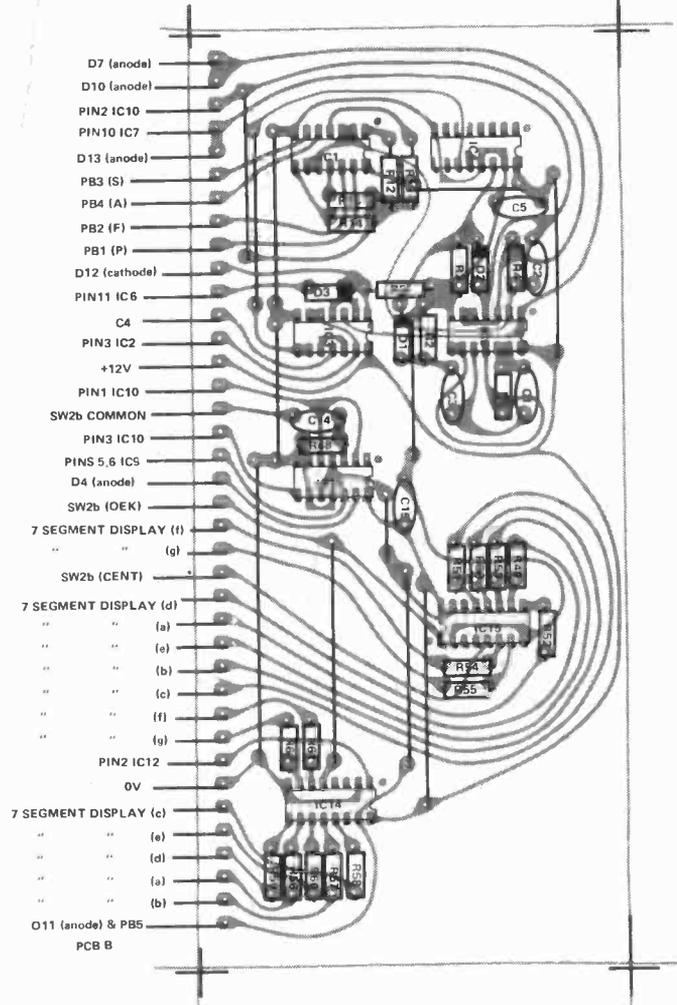
The attacks continued relentlessly. Sixty attacks were clocked up on the attack counter within the first five minutes. Joe glanced at the ammunition state indicator. Nearly seventy per cent of his ammo was used up. If he was to survive, he must reduce the fire time on each attack. He glanced back at 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 Phantoms 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 Eatyeigh 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.

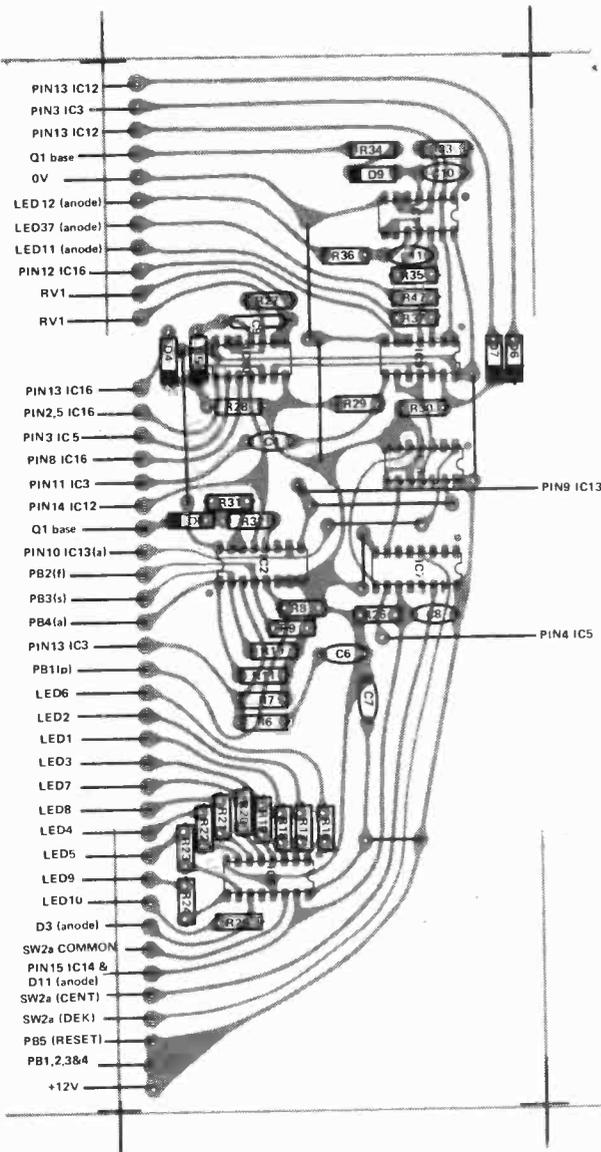
PARTS LIST

R1	6M8	SEMICONDUCTOR	
R2	390k	IC1	4016
R3, 8, 9, 10, 11, 31, 40, 48	22k	IC2, 13	4052
R4	10M	IC3, 9, 10	4001
R5, 26, 28, 29, 30, 39	47k	IC4, 6, 12	4017
R6, 16-25, 36, 37, 47	1k	IC5, 17, 11	4011
R7, 12, 13, 14, 15	100k	IC7	4040
R27	330k	IC8, 16	4026
R32	6k8	IC14, 15	4013
R33	680k	NOTE. All CMOS devices are B Series.	
R34, 41, 42, 46	10k	Q1	BC109
R35	2M2	Q2	BFY50
R38	270R	D14	1N4001
R43	33R	All other diodes are	1N4148
R44, 45	1M5	LED 1-37 are standard 0.2in dia.	
R49-82	470R	LED 7 segment displays are common cathode 0.3in	
POTENTIOMETER		MISCELLANEOUS	
RV1	1M0	LS1 2in 40R	
CAPACITORS		5 off SPST push buttons	
C1, 5, 6, 7, 8, 11, 14, 15	100n	1 off SPST latching push button	
C2, 3, 4, 10, 12, 13	10n	1 off DPDT min. toggle	
C9	150n	8 off HP11	
		2 off 4 section battery holders	
		case to suit	

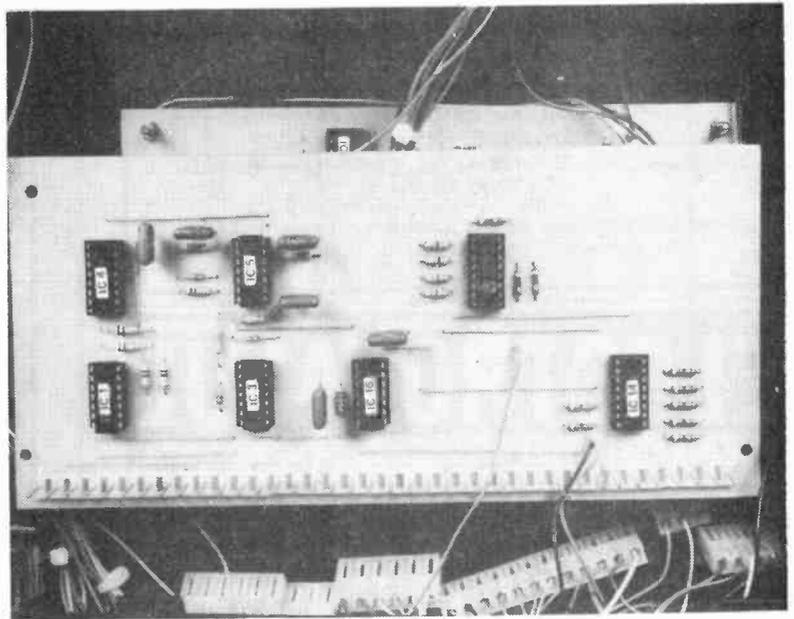
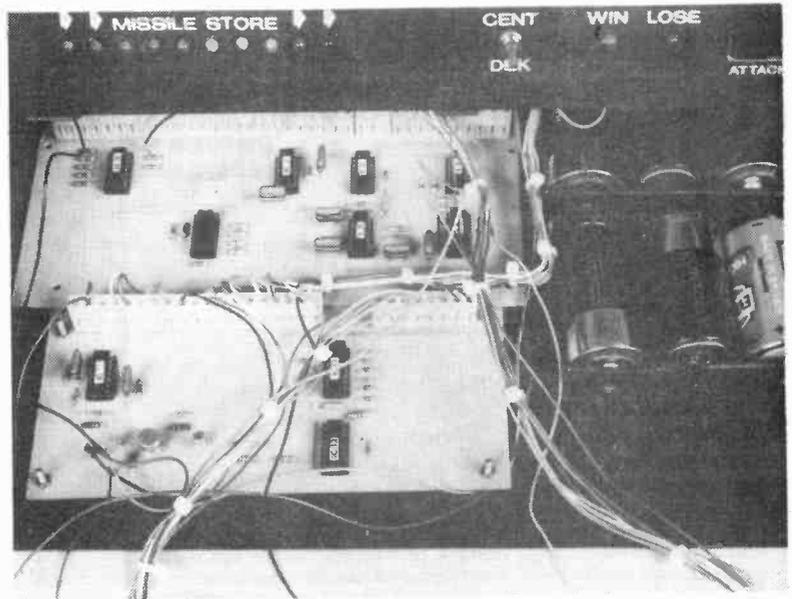
BUYLINES

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.



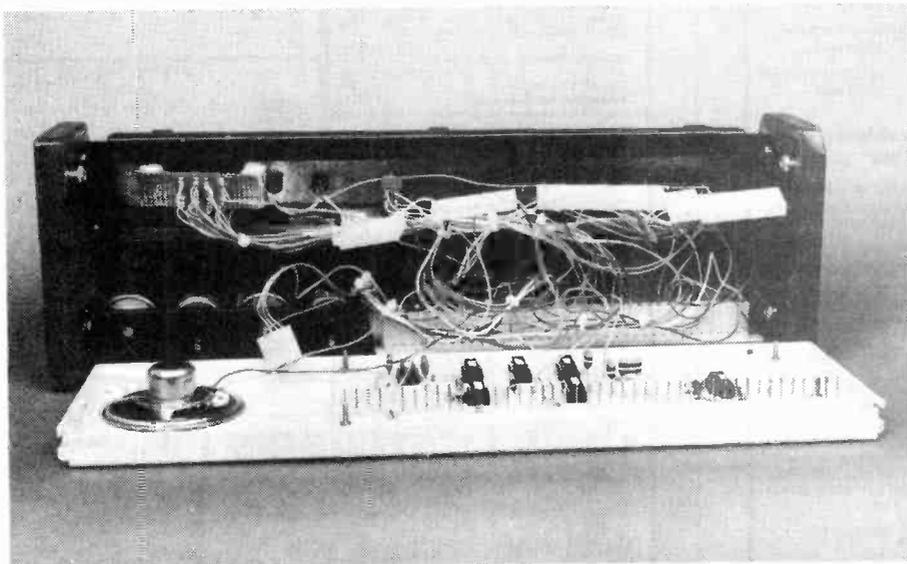
PCB, A. This panel holds the ammo register, random multiplex cock generator and most of the amplex switching functions.



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

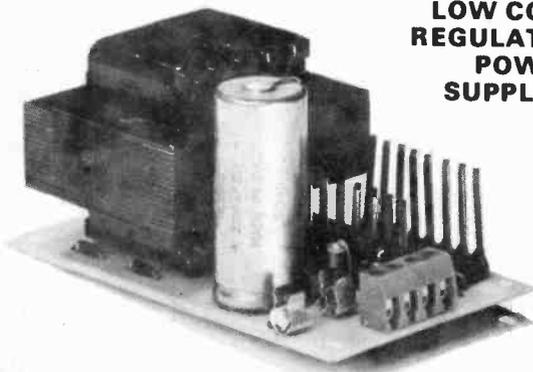
Centre. PCB, B showing the interconnecting plugs removed, the use of plugs or PCB connecting pins makes troubleshooting (we hope you don't have to) simple.

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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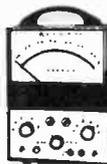
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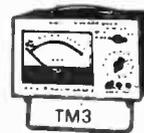


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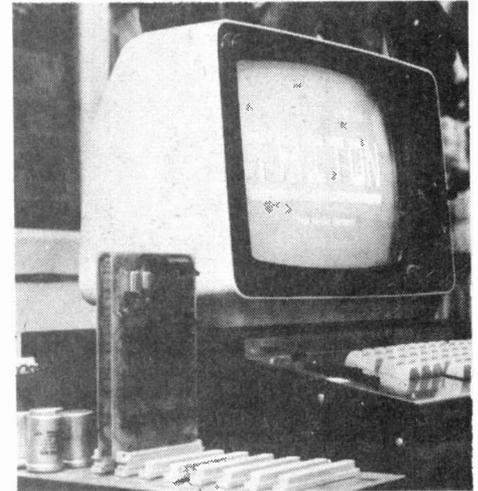
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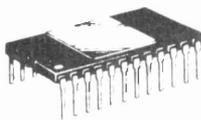
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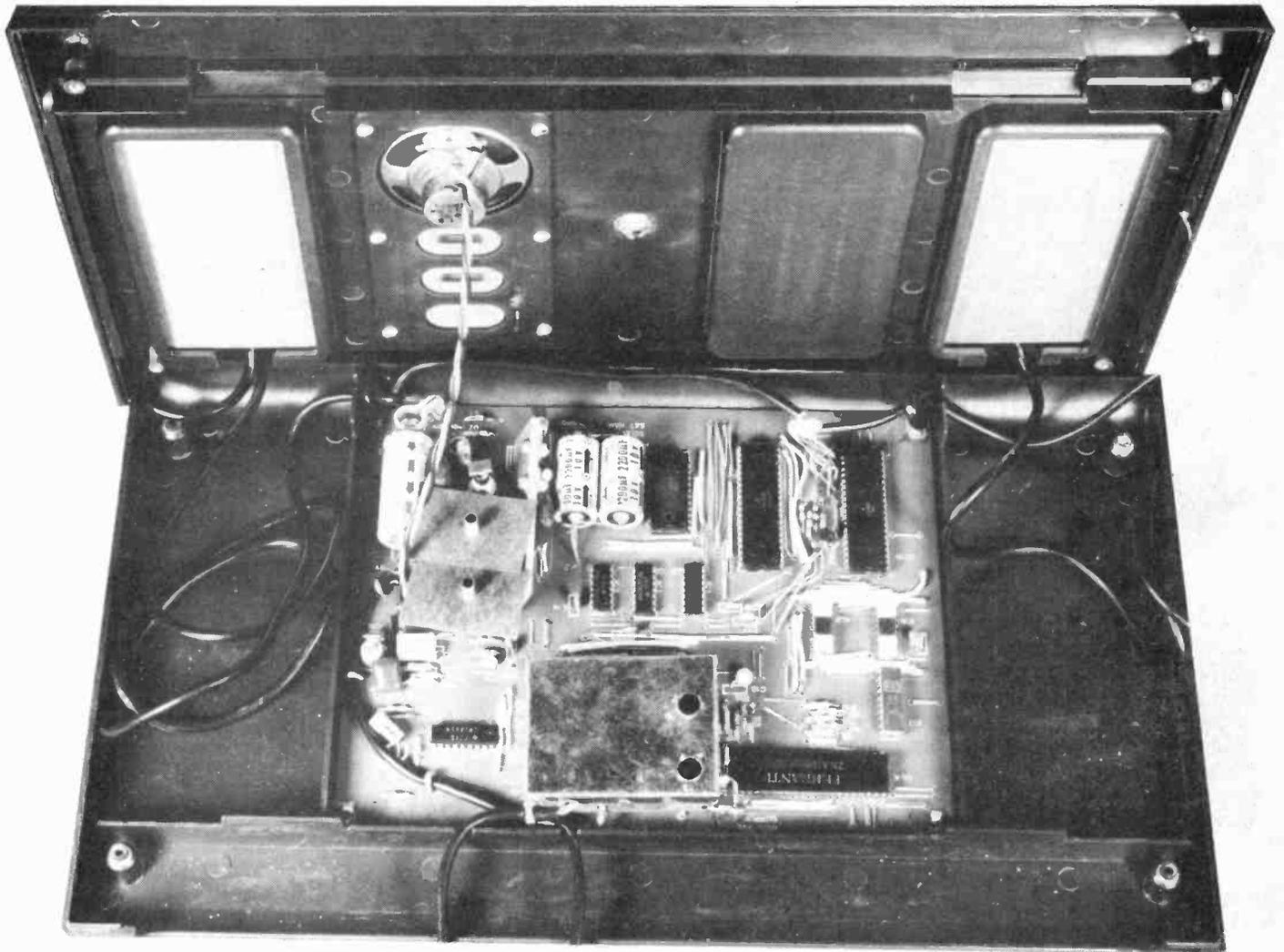
MOST OF YOU probably think that people who work on electronic magazines spend their days burrowing through mounds of exotic electronic equipment sent into us by eager manufacturers. Well to an extent that's true, we do get to see a fair amount of new stuff but how enthusiastic can you get over a 20 amp 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 STARCHES 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.

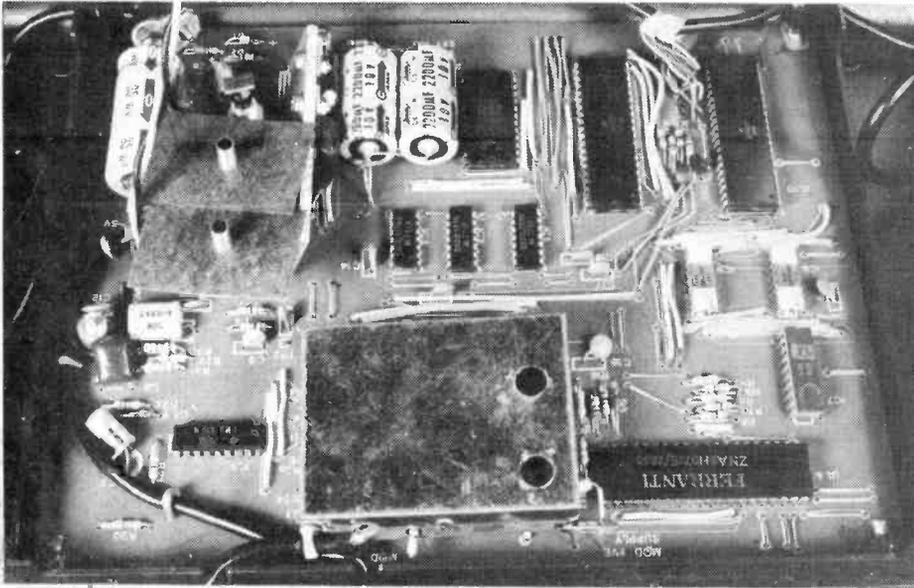
At this point it must be said that you've got to be able to play chess but that hurdle over you can forget any ideas you may have about playing ordinary chess with this machine, that's about as likely as the editor of ETI becoming the next Prime Minister. After a game or two it soon becomes abundantly 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.

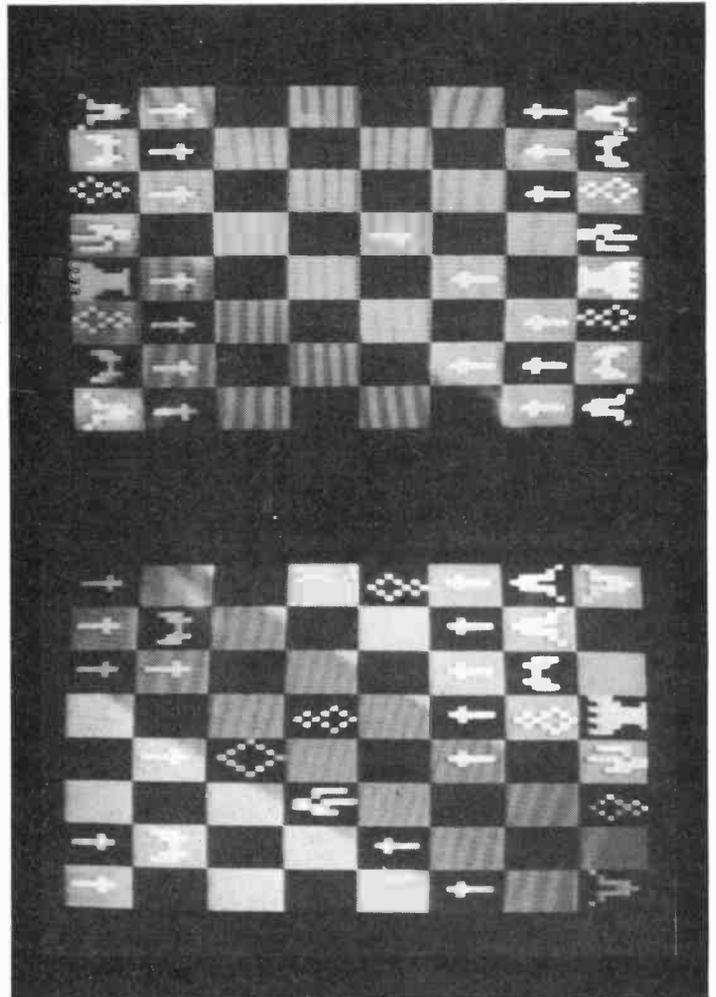
All of the pieces are given alternative names which is just as well, because none of them look even remotely like ordinary chessmen, the rook for instance is a star-cruiser. The final objective of the game is to destroy your opponent's King, although it can't be taken on its Starbase, it can still be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

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

(Inclusive of VAT and Postage),

To:
CLOCK RADIO Offer,
 ETI Magazine,
 25-27 Oxford Street, London W1R 1RF.

Please find enclosed my cheque/PO for £20.50 (payable to ETI Magazine) for my Clock Radio.

Name

Address

Please allow 28 days for delivery.

LADIES LCD WATCH



... and don't you ever say we don't listen to you again! Ever since we first did a gentleman's watch, we have been dealing with a constant never-ending stream of requests for a ladies' model. Well at long last we can claim to have done something about it!

It wasn't easy arranging this sort of price on a product this good — but ETI's done it again! The watch is small enough to look good on the prettiest wrist, and accurate enough to satisfy the most fastidious. Normal display shows time of course, with both date and seconds available on a push of a button. A backlight is also included.

Battery life should be greatly in excess of a year, and the bracelet is a smart stainless steel.

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

£9.95

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DIGITAL ALARM



THIS IS THE THIRD digital alarm clock that we are offering (we regret the earlier versions are no longer available). We have sold thousands and thousands of these and our buying power enables us to offer a first rate branded product at a really excellent price.

The Hanimex HC-1100 is designed for mains operation only (240V/50Hz) with a 12 hour display, AM/PM and Alarm Set indicators incorporated in the large display. A switch on the top controls a Dim/Bright display function.

Setting up both the time and alarm is simplicity itself as buttons are provided for both fast and slow setting and there's no problem about knocking these accidentally as a 'locking' switch is provided under the clock. A 9-minute 'snooze' switch is located at the top.

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

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(Inclusive of VAT and Postage)

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 ETI Magazine
 25-27 Oxford Street
 London W1R 1RF

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Name

Address

Please allow 28 days for delivery.

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 couple 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.

£12.95

(Inclusive of VAT and Postage)

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.

£10.50

(Inclusive of VAT and Postage)

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 independent date, day of week settings
- Good bleeping alarm
- Easy time correcting: on the sixth 'pip', press a button and it's reset to 00 seconds as long as watch is plus or minus 29 seconds.

It comes with a full guarantee of course.

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

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ETI Magazine,
25-27 Oxford Street,
London W1R 1RF.

Please find enclosed my cheque/PO for £27.95 (payable to ETI Magazine) for my Alarm/Chrono LCD watch.

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.

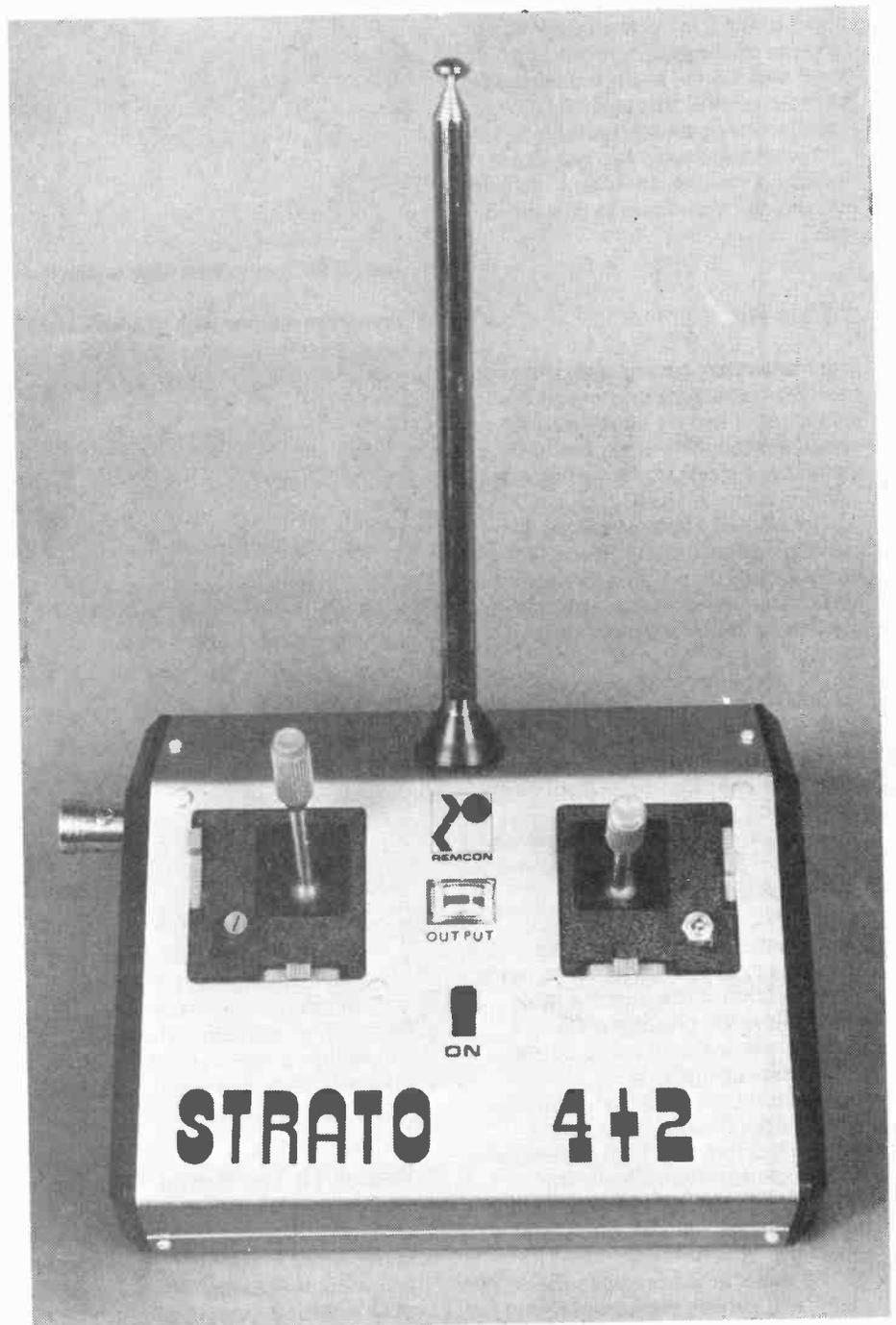
However Rencoms design, presented here, satisfies our requirements perfectly and fulfills a few we hadn't thought of. Firstly it is easily constructed and easy to set up — too many systems are marred by their requirements for expensive test gear in the alignment procedures. All that is needed here is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

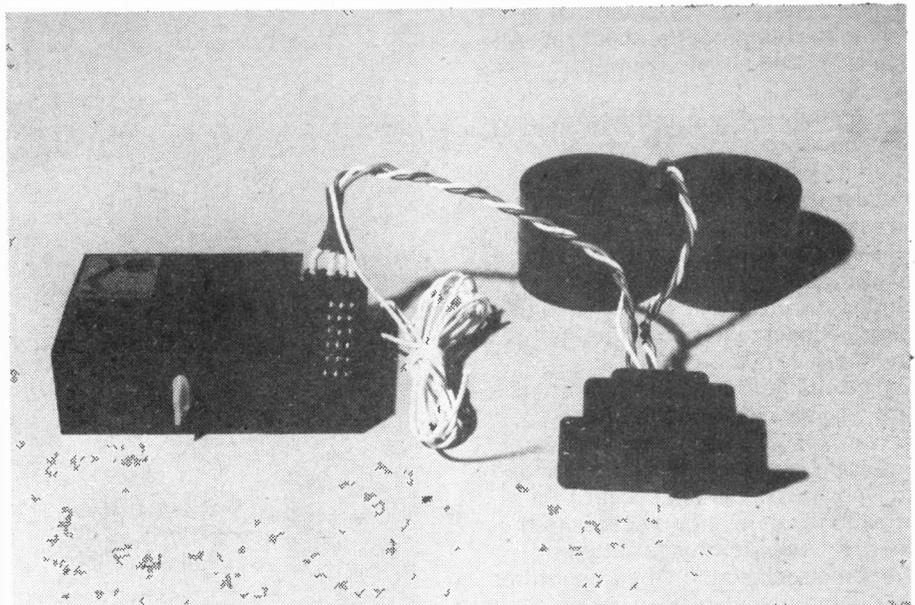
We chose an armoured vehicle as the example upon which to base our articles, as this is more general in principle than most and allows easier illustration. The model we used was the excellent Tamiya 1 / 16th Leopard kit. This gives a splendid model of the W. German tank with Tamiyas usual superb moulding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

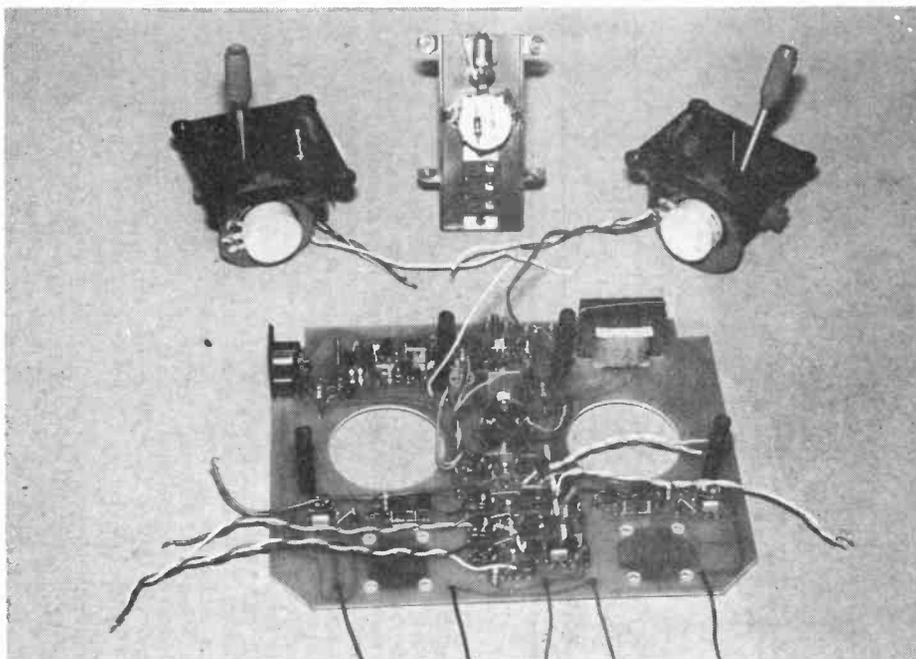
The meter should show a reading.

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.

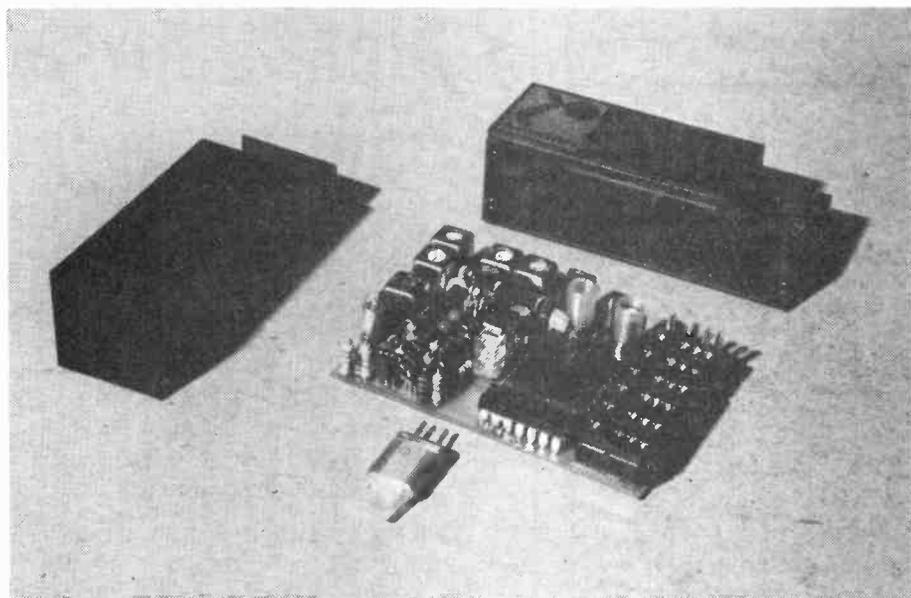
The reading should be about 80-90% of FSD so move the FSM aerial around slightly to obtain this.

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

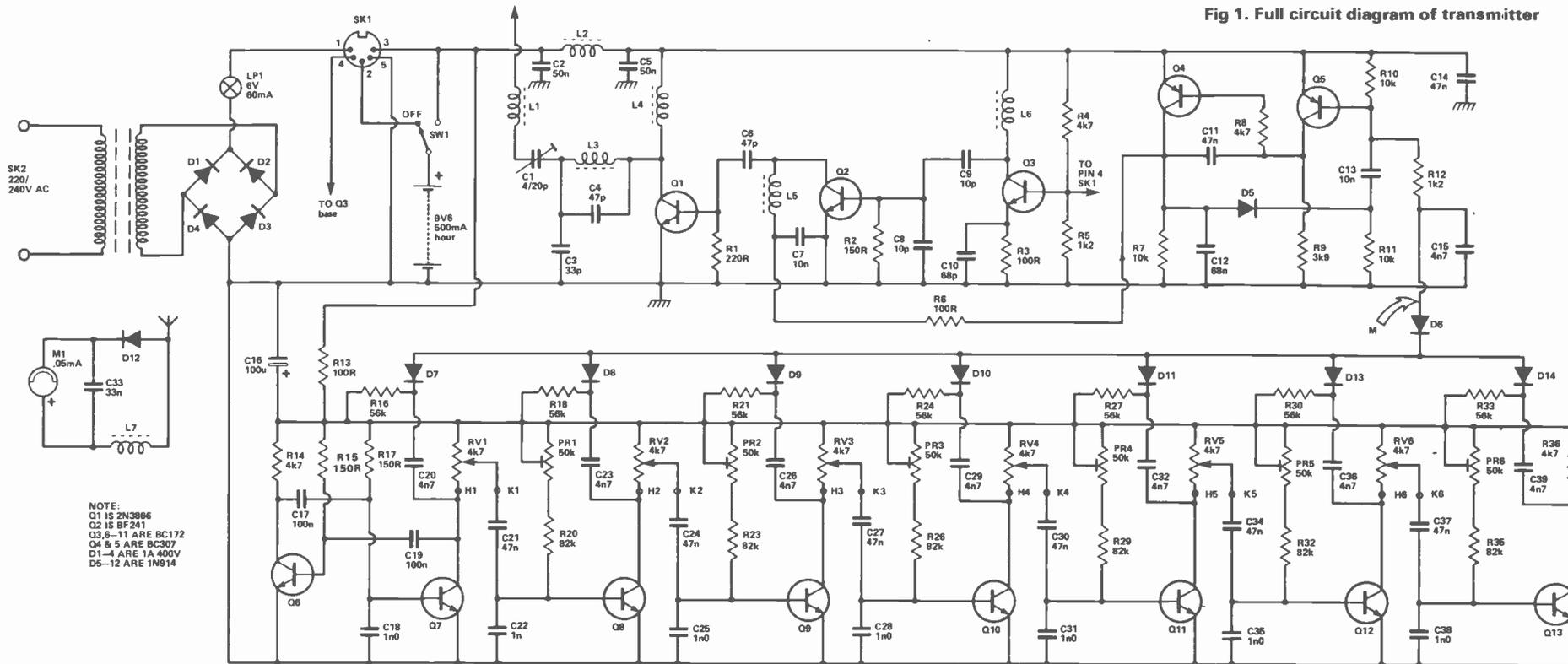
All components available separately. Rechargeable batteries also available. SAE for details.

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 multivibrator 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 biased. 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 permit setting 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 less than the

1ms minimum duration of channel data. When Q9 is again turned on, D9 and D6 are forward biased 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 bias current through R9, R6. When triggered by an encoder pulse via D6, Q5 conducts turns off Q4, which reverse biases 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!

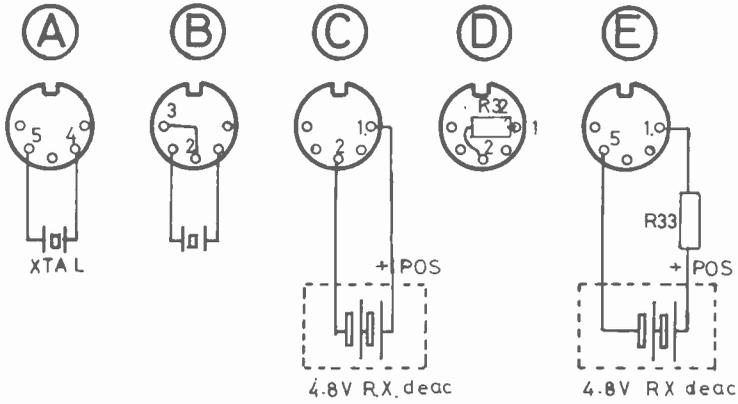
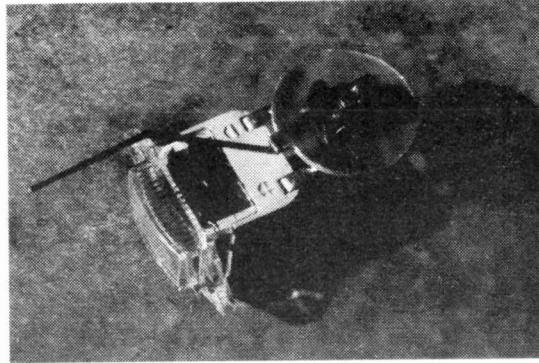
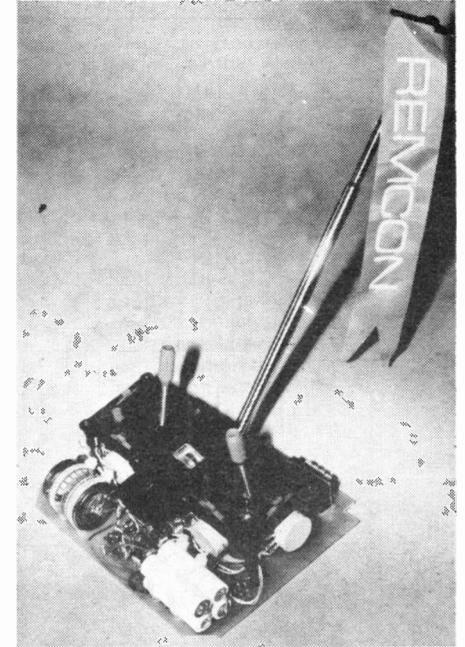
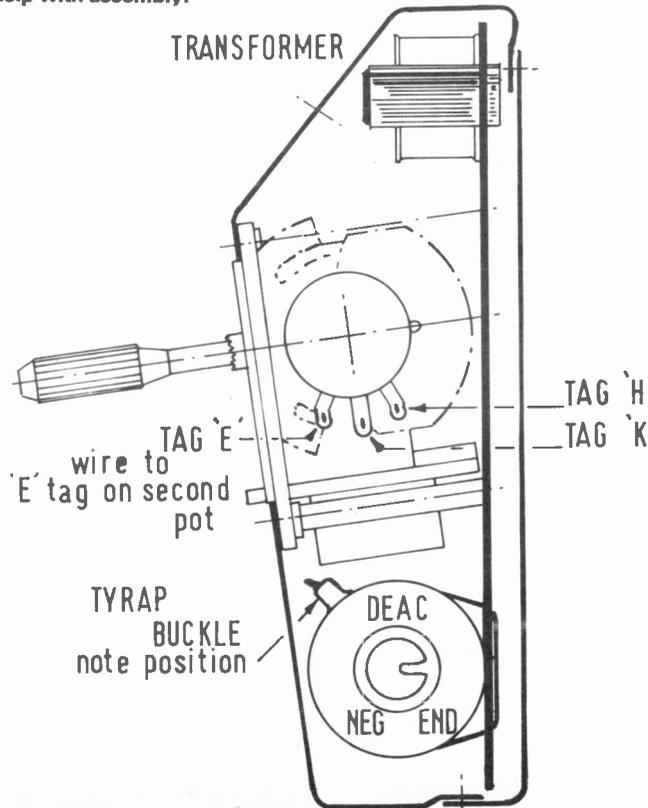
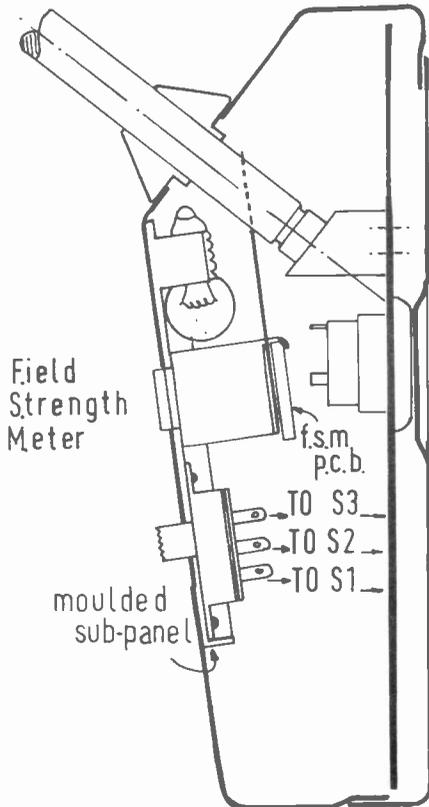


Fig 2. All the possible DIN plug configurations. See text for uses.

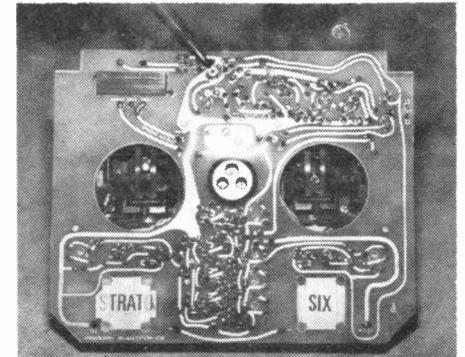


The field strength meter, with PCB ready for bending at the meter tabs.

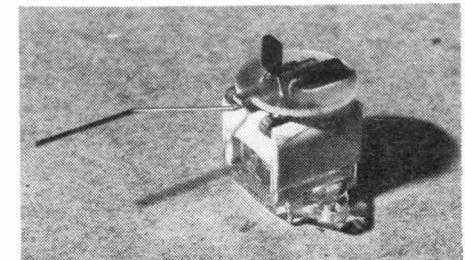
Fig 3. Section through transmitter case. Should help with assembly.



The complete Tx excluding the case.



Copper side of PCB. Note earth bush.



The field strength meter with pCB bent over for fixing.

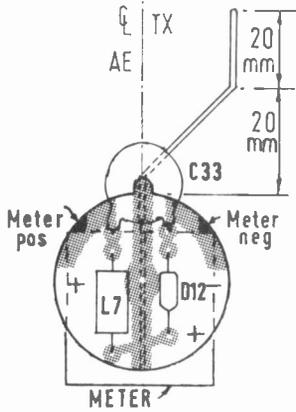
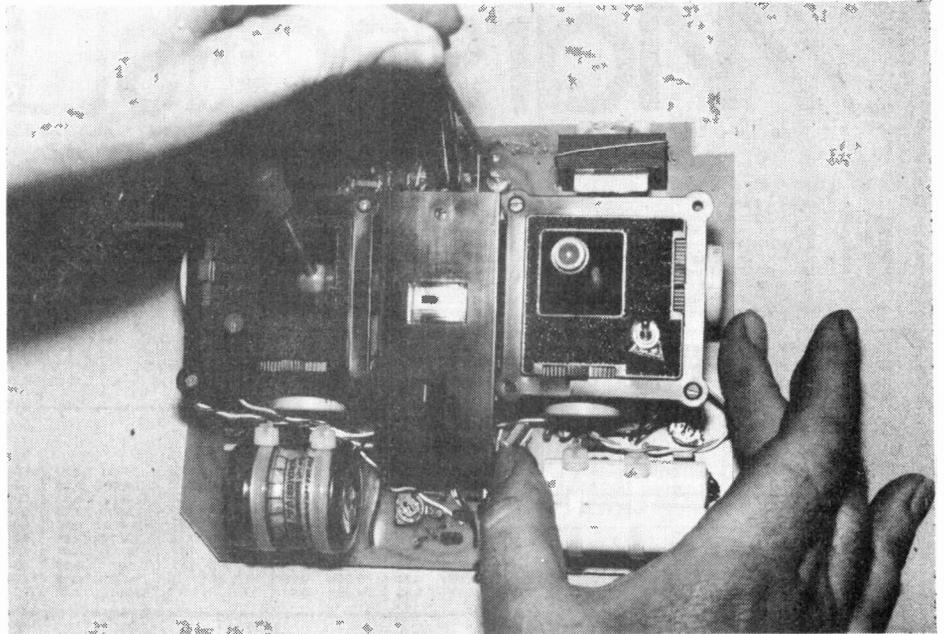
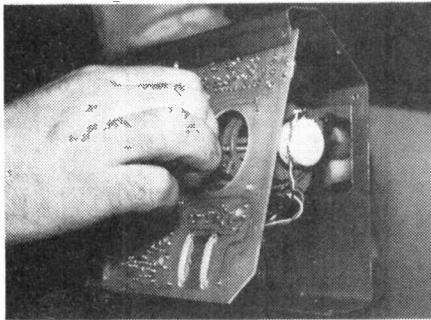


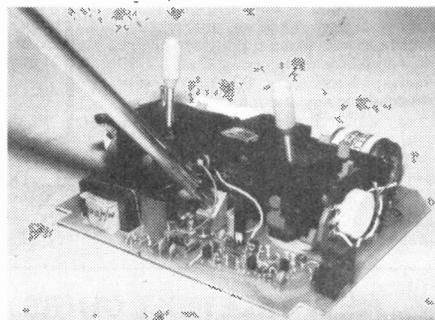
Fig 5. (Above) the overlay for the meter PCB. This mounts stop the meter itself



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

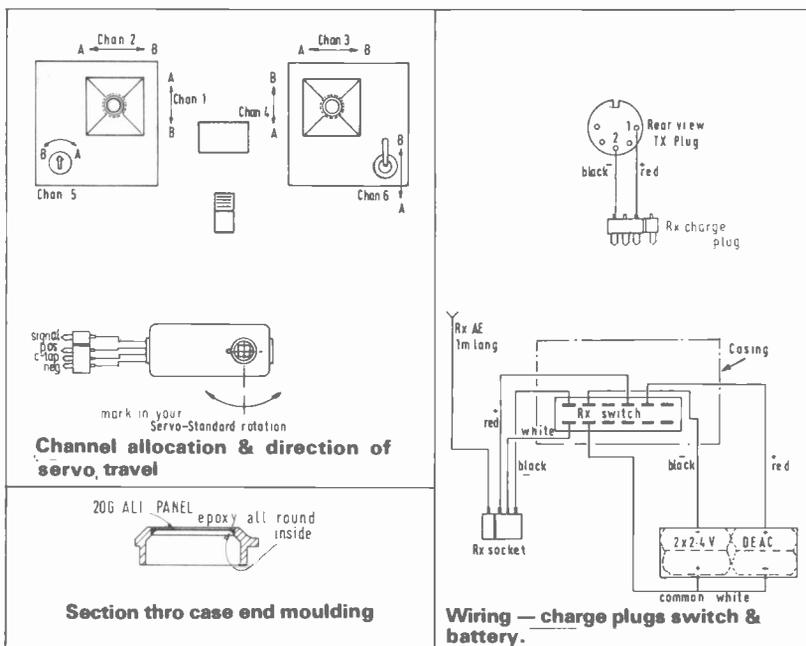


The top of the PCB slips under the flange at the top of the case.



The Rf end of the PCB.

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



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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Glasgow: 85 West Regent Street, G2 2QD. Tel: 041-332 4133 and Bristol: 1 Straits Parade, Fishponds Road, BS16 2LX. Tel: 0272 654201

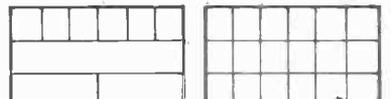
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LM340T-15	0.88	LM1800N	1.94	CA3006	4.60
LM340T-24	0.88	LM1801N	2.25	CA3007	4.15
LM341P-5	0.56	LM1908N	2.10	CA3008	2.55
LM341P-12	0.56	LM1812N	6.20	CA3012	1.65
LM341P-15	0.56	LM1820N	1.16	CA3013	1.85
LM341P-24	0.56	LM1828N	1.90	CA3014	2.20
LM345K	6.97	LM1830N	1.90	CA3018	0.75
LM348N	0.95	LM1845N	1.50	CA3018A	1.10
LM350K	6.50	LM1848N	1.96	CA3020	2.20
LM358N	0.80	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	LM2907H-8	1.80	CA3023	2.20
LM373N	3.35	LM2917H-8	1.80	CA3026	0.75
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	0.80
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	LM42500N	1.30	CA3036	1.21
LM386N	0.88	LM78L05CH	0.85	CA3038	2.90
LM387N	1.10	LM78L12CH	0.85	CA3038A	4.10
LM388N	1.15	LM78L15CH	0.85	CA3046	0.77
LM389N	1.00	LM78L24CH	0.85	CA3040	3.75
LM392N	0.87	LM7805KC	1.58	CA3041	1.65
LM701H	2.99	LM7812KC	1.58	CA3042	1.65
LM701C	2.99	LM7815KC	1.58	CA3043	2.20
LM702C	0.81	LM7824KC	1.58	CA3045	1.55
LM703JN	1.15	LM78L05CZ	0.30	CA3051	1.82
LM705CH	0.70	LM78L12CZ	0.30	CA3047	2.20
LM705-8	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	2.06
LM711CN	0.48	MC672P	1.75	CA3052	1.78
LM716	1.00	MC679P	2.10	CA3053	0.77
LM723CH	0.62	MC789P	1.80	CA3054	1.10
LM723C-14	0.46	MC790P	3.10	CA3059	2.10
LM741CH	0.50	MC798P	2.20	CA3060	2.50
LM741C-8	0.30	MC799P	2.20	CA3062	3.75
LM741C-14	0.60	MC832P	0.70	CA3064	1.10
LM747CN	0.70	MC839P	0.70	CA3065	1.10
LM748-8	0.50	MC836P	0.82	CA3066	3.80
LM748-14	0.50	MC837P	0.82	CA3070	1.90
LM900	0.50	MC838P	2.35	CA3070	1.90
LM911	0.50	MC840P	1.65	CA3070	1.90
LM921	0.50	MC844P	0.70	CA3072	1.90
LM923	0.50	MC848P	0.70	CA3075	1.70
LM1303N	1.15	MC849P	0.70	CA3076	2.12
LM1304N	1.52	MC857P	0.85	CA3080	0.85
LM1305N	1.02	MC861P	0.85	CA3080A	2.10
LM1307N	1.22	MC1035P	1.90	CA3086	0.50
LM1310N	2.10			CA3086F	1.87

MEMORIES (see catalogue for full range)

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MM5204Q	9.00	MM53114N	4.47	TMS4044-20NL	9.85	TMS9904	P.O.A.
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MM5307A/N	13.85	MM57109N	13.41	TMS4050-2NL	6.46	ADC0611CCN	9.30
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MM5316	4.80	MM57161N	6.70	TMS4060-2NL	6.46	ADC3711CCN	9.35
MM5330N	4.20	TMS2716JL	19.50	TMS4116-25JL	26.00	ADD3501CCN	9.30
MM80C95N	0.58	TMS4027-25NL	1.10	TMS4164NL	P.O.A.	ADD3701CCN	9.35
MM80C96N	0.85	TMS4033NL	6.75	TMS8011NC	5.38	AY2513	8.78
MM80C97N	0.58	TMS4036-2NL	3.28	TMS9900JL	44.41	AY-3850J	0.50
MM80C98N	0.58	TMS4039-2NL	2.78	TMS9901NL	10.66	AY-39710	12.78
MM82C19N	2.90	TMS4042-2NL	2.98	TMS9902NL	9.16	SFF77301A	0.95
MM88C29N	2.08					SFF96364	16.00

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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	1.06
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2N5061	0.5A	50v	T018	£0.33
2N5062	0.5A	100v	T018	£0.40
2N5063	0.5A	150v	T018	£0.43
2N5064	0.5A	200v	T018	£0.45
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SN74H53N	0.56	74LS86N	0.44	74LS196N	0.80
SN74H54N	0.55	74LS90N	0.64	74LS197N	0.80
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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
SN74L07N	3.10	74LS109N	0.42	74LS245N	1.65
SN74L74N	0.90	74LS112N	0.42	74LS247N	1.00
SN74L85N	2.82	74LS113N	0.42	74LS248N	1.08
SN74L93N	2.30	74LS114N	0.42	74LS249N	1.08
74LS00N	0.26	74LS112N	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	0.85	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
74LS16N	0.26	74LS154N	1.46	74LS293N	1.00
74LS17N	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	0.85	74LS323N	3.50
74LS28N	0.29	74LS160N	0.80	74LS324N	1.65
74LS30N	0.26	74LS161N	0.85	74LS325N	2.40
74LS32N	0.26	74LS162N	0.80	74LS326N	2.70

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

HI-FI RECEIVER



A fifty watt stereo amplifier and a high quality tuner would make two excellent projects in themselves. With specifications such as these boast, we could be sure that the units would soon become widely accepted as the very best in DIY hi-fi. However we've gone one better to combine the two units to produce a receiver of outstanding merit. If you're about to buy, build or borrow a high-class hi-fi — stop it at once until you've read next months ETI.

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 I²L 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

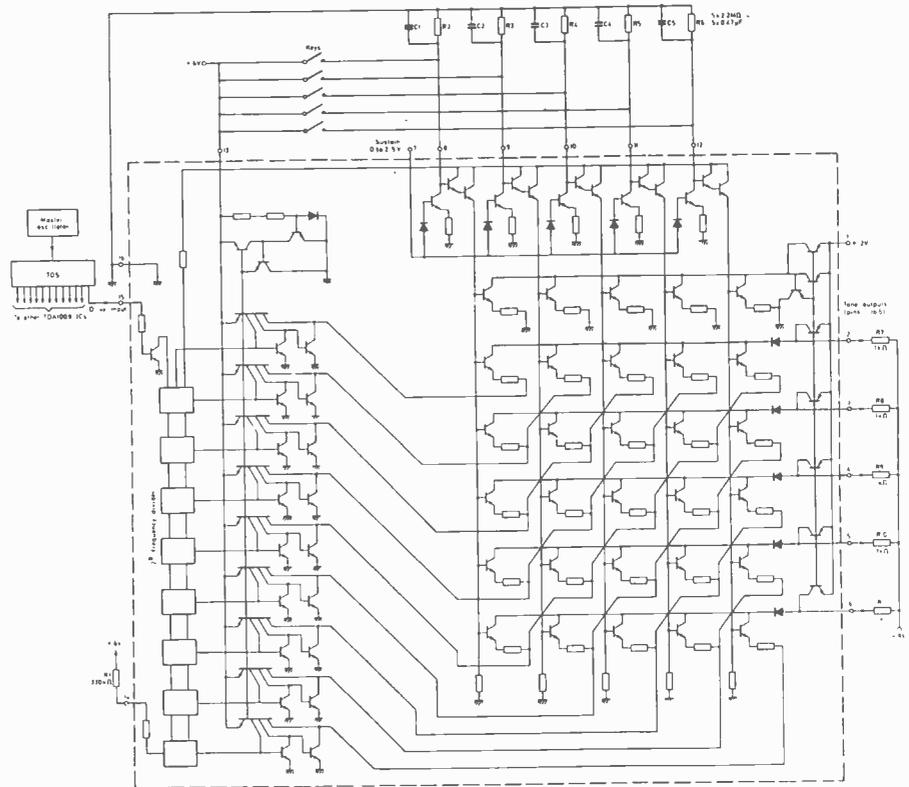


Fig. 1. TDA1008 and basic peripheral circuit.

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.

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 deter-

mined 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 μ A 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 μ A 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-circuit 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 sine-wave 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.

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.

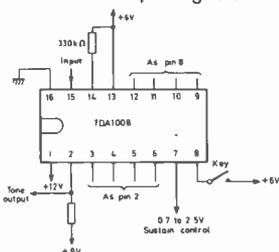


Fig. 4. Simplified connection diagram for TDA1008.

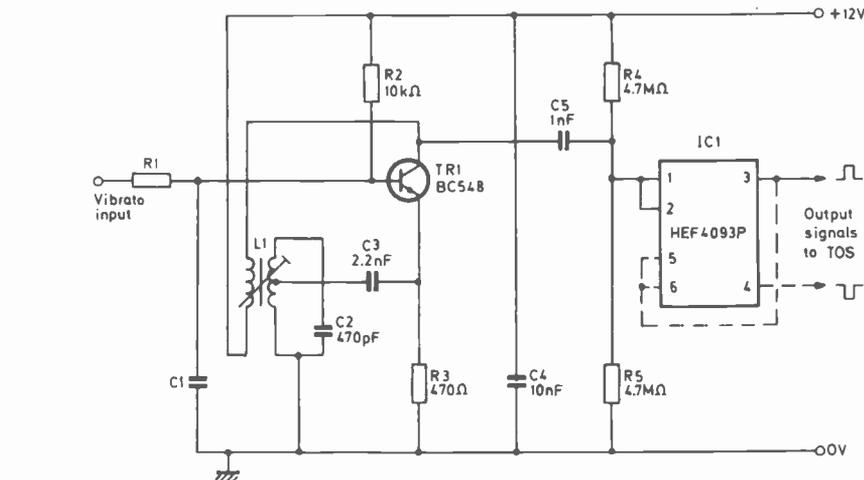


Fig. 2. Hartley oscillator and Wave-Shaping circuit.

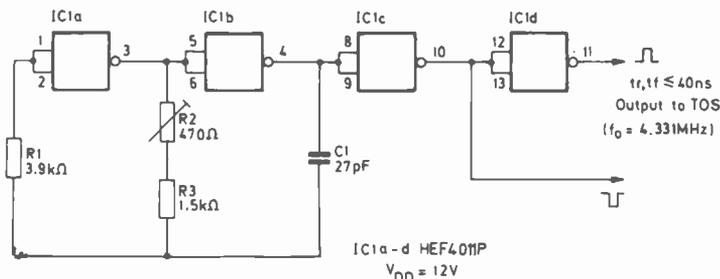


Fig. 3. Master oscillator using NAND gates.

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 ($\geq 8M$ ohms). This impedance, com-

bined 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.

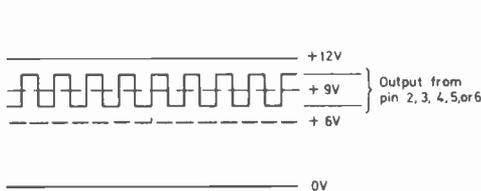


Fig. 5. Output signal from pin 2, 3, 4, 5 or 6.

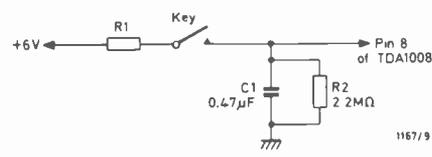


Fig. 6. Sustain circuit.

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.

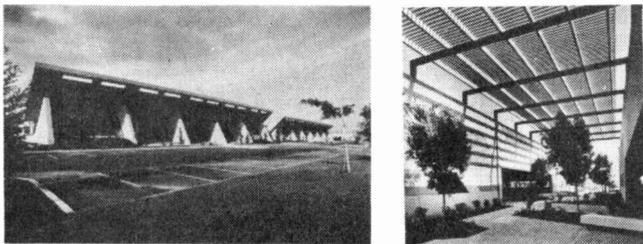
microfile

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

A slight case of sunstroke

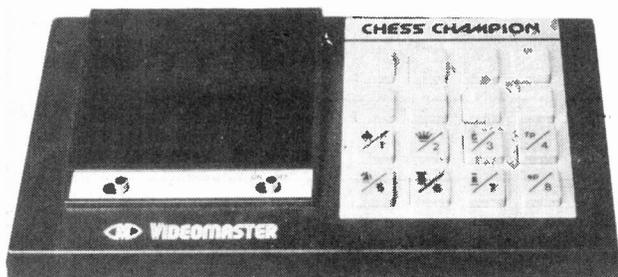
COMMODORE, THOSE WONDERFUL people who gave you a PET, have just taken a great step forward in the true American tradition. Rather than going to the moon they have headed for the Sun. A new solar powered industrial complex has been built in Silicon Valley at Santa Clara and they are moving in. The building 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 Technalogs 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

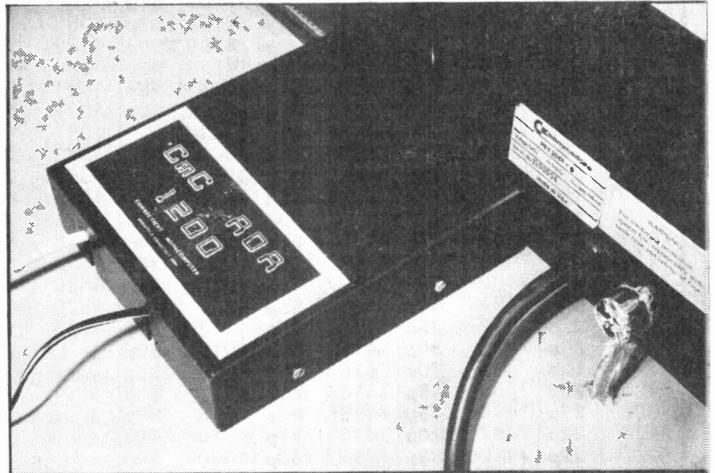
We have been getting news from around the country about computing clubs. A couple of recently formed ones have asked me to give a quick plug. This is a service we delight in performing so please keep the information coming in.

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 OHY. 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**

<p>MOTORS 1.5 to vdc Model Motors, 20p. Sub. Min. "Big Inch" Motors, 115vac 3rpm 30p. 12vdc 5 pole model motors 35p. 8 track 12vdc motors £1.25. Cassette motors vdc ex equip. 85p. Crouzet geared motor, 115vac 4rpm 95p. Smiths clock motor, synch. 240vac 1 rev. per hour. 96p.</p>	<p>SEMICONDUCTORS. All full spec. devices. 741 8 pin DIL 8 for £1.00. No 555 Timers 25p. TDA800 audio IC's 50p. 7418 1 wide band-width 35p. LM300 80p. 2M44 radio IC's 75p. Mullard 09P1 30p. TL305 Alpha numerical display £2.50. Miniature LDR's (same spec. as OP12) 30p.</p>	<p>TOSHIBA LEOS. 0.2" green 13p. 0.2" green diffused 14p. 0.2" green flat top 14p. 0.2" Clear 17p.</p> <p>TOSHIBA TL363 7 segment LED displays 0.3" Can. Anode 65p. Max3A min. 7 segment LED Comm. Anode (5mm) 40p.</p>	<p>MULTIMETERS big price reductions on pocket size meters. Model KRT100 1,000 ohms per volt, mirror scale, range selector switch, 1,000v AC/DC, 100Kvdc, 150ma DC current £4.85. Model KRT101 same spec. as the KRT100 but range selection is via probe insertion. £3.75. CONTINUITY TESTER. Tubular unit with probe and croc. fly lead. £1.35 with batt.</p>	<p>TRANSFORMERS. All 240vac primary (postage per transformer is shown in brackets after price). MINIATURE RANGE 5-0-5v 100ma, 5-0-5v 75ma, 12-0-12 50ma all 75p each (15p). 12-0-12 100ma 95p (15p). 0-6-0-6v 200ma £1.10 (20p). 0-4-8-9v 200ma these have no fixing bracket 85p (15p). 12v 500ma 95p (22p) 12v24 £2.25 (45p) 12v4A £2.75 (45p) 15-0-15v 1A £2.10 (45p). 30-0-30V to £2.75 (54p). 20-0-20v 2A £3.50. (54p). 0-12-15-20-24-30v 2 amp £4.50 (54p) 20v 2.5a £2.20 (54p).</p>	<p>TRIAC XENON PULSE TRANSFORMERS. £1 (SPO style) 30p. £1 plus 1 sub. min. pcb mounting 60p.</p> <p>DODGES. IM401 10 for 35p. IM404 10 for 45p. IM407 10 for 50p. 6Y127 10 for 75p. 6Y14 (bombard) 100 for £2.50. IM4140 (numbered) 100 for £2.25.</p>
<p>BUZZERS. Miniature solid state buzzers. 33 X 17 X 15mm white plastic case, output at 3 feet 70db (approx. low consumption only 15ma. 4 voltages available 0-0-12 or 24 vdc 75p each. LUD0 12v buzzer. Cream plastic case, 50mm diam x 30mm high, 80p. GPO open type buzzer, adjustable, works 0-12vdc 25p. SMITH'S AUDIBLE WARNING DEVICE. transistorised unit, all metal, 30mm x 13mm deep, operates on 6-12vdc 30p.</p>	<p>TOOLS. SOLDER SUCKER. Plunger type. High suction, nylon nozzle, £4.75. spray nozzles 65p each. Good quality side cutters, insulated handles 5" £1.35. Good quality snub nosed pliers, insulated handles. 5" £1.35p. Antex Model C15 watt soldering irons 240vac £3.80. Antex Model CX 17 watt soldering irons. 240vac £3.80. Antax 325 25 watt soldering irons 240vac £3.80. Antax ST3 stands (fits all above models) £1.40. Antex heat shunts 12p each. Servisol Solder Mop 45p each. Neon tester screwdrivers 8" long 40p. Miyata IC test clip, 16 pin £1.75.</p>	<p>TAPE HEADS. Mono cassette £1.30. Stereo Cassette £3. Standard 8 track stereo £1.75. 8N MM1330 ¼ track 50p. 8BR SRP90 ¼ track £1.95. TD10 dual head assembly 2 heads both ¼ track R/P with belt in erase £1.20.</p>	<p>MICRO SWITCHES. Standard button operated 28x25x8mm make or break new 15p each. roller operated version of the latter but no equip. 15p. Light action micro switch. 3 amp make or break 35x20x7mm 12p each. Cherry plunger operated micro switch. 2 norm. open and 2 norm. closed. plunger 20mm long (40x30x18mm) 25p each.</p> <p>ROCKER SWITCHES. 2 amp SPST single hole fixing, various colours (red, black, yellow, green, white) 19p each. 250vac 6 amp white rocker. 21x15x13mm 17p each.</p>	<p>PROJECT BOXES. Sturdy ABS black plastic boxes with brass inserts and lid. 75x56x35mm 43p 95x7x35mm 50p 115x9x37mm 58p.</p> <p>VERO POTTING BOXES 49x71x24mm in black or white with lid and screws 39p each.</p> <p>VERO HAND HELD BOX White ABS. 2.4"x3.7" tapered, with screws 65p each.</p>	<p>ZEMERS. 8ZY88 400mw ZV7 to 33v 6p each. 8ZY61 1.3 watt 7V5 to 33v 12p each.</p>
<p>SPECIAL OFFER SEMICONDUCTORS. Plastic voltage regulators, 1 amp new reduced in price 7805, 7812, 7815, 7824 all at 75p each. 7906, 7912, 7915, 7924 all 99p each. 3 types at give away prices: LM309K to 35v reg, 75p each. LM340H 6 volt 1 amp regs. 40p each. 723 14 pin DIL. regs 38p each. FE7B Union carbide 8 channel similar to 283819 15p. 3N140 or 8F861 40p each. M203 dual matched pair of single gate mosfets in one case 40p. 2N5062 plastic (T092) scrs 100V 800MA 18p each. 8X504 Opto Isolators, 4 lead infra red led to photocell 25p each.</p>	<p>MICROPHONES ECM105, condenser, omni directional, 600 ohms, on/off switch £2.95. EM506 Condenser, cardioid, uni directional, 600ohms or 50k, heavy chromed copper case £12.95. Dynamic stick Mike. 5,000 ohms, on/off switch, fitted with standard £2.95. EM104 Sub. min. tie pin microphones, condenser, 1,000 ohms imp. 50-16khz uses deaf aid battery (supplied) £5.25. STANDARD cassette mixers 200 ohm imped. fitted with 2.5/3.5mm jacks, on/off switch. £1.25. DYNAMIC P.A. Microphone, suitable for mobile use, hand held with thumb switch, curly lead, 50k imp. £3.40. CRYSTAL INSERTS. 35x10mm 45p each.</p>	<p>SWITCHES. Sub. Min. Toggle. SPST (8x5x7mm) 45p. DPDT (8x7x7) 50p. DPDT Centre off (12x11x9mm) 75p.</p> <p>PUSH SWITCHES (5x8mm, red top, push to make 14p each, push on break version (black top) 16p each.</p> <p>SLIDE SWITCHES all OPDT 15x8x12mm 12p. 16x11x9mm 12p. 22x13x8mm 12p. 22x13x8 centre off 13p. Multipole slider, double action (12 tag) 29x9x11mm 24p.</p>	<p>RELAYS. Clare Elliot sub. min. relay 10x10mm 2 pole c/o. 1.250 coil new 75p. Miniature encapsulated relay, 0.1 matrix mounting, single make operated on 12vdc 50p. Continental series, sealed plastic case type, 24vdc, 3 pole c/o 5 amp contacts, new 65p. 12vdc (130ohm) c/o. 3 make and 1 break contacts new 65p each. Metal Cased relay 50x45x17mm, has 4 heavy duty make relay inserts, operates on 12vdc 35p each.</p>	<p>MOTORIZED CAM UNITS. Many applications including random light displays for discs etc. 12 switches per unit each changeover type, fitted with low rev. geared motor which is 50vac, the unit is supplied with a capacitor, however to enable it to be used directly on 240vac £1.95 (ex equip).</p> <p>PUSH BUTTON TV TUNERS (no varicap) transistorised U.K.F. new £2.25.</p>	<p>MORSE KEYS. Beginners practice key 95p. All-metal type, fully adjustable £2.45.</p> <p>MURATA TRANSDUCERS. REC/SENDER, MA40L 40KHZ £3.25 pair.</p>
<p>SURPLUS BOARDS. No 1. This has 14 encapsulated relay relays, (12V) easily removable, £1.95. No 2. This has at least 11 c106 (50v2. 5uF SCS), one relay, a UJT and tantalum capacitors £1.95. No 3 I.F. Boards, these are complete IF boards made for car radios, 465KHZ, full set of IF and Osc. coils (T0K0) 40p each. No. 4 Lamp flasher board, suitable for low load 240Vdc applications approx 1 flash per second but can be varied via a preset pot 38p.</p>	<p>ELECTRICAL ITEMS. White with neon indicator and quick release fuse £3.25. 13 amp rubber extension sockets, white 30p each. 13 amp plastic fused plugs (orange) 25p each.</p>	<p>RIBBON CABLE 8 way single core miniature, 20p per metre.</p> <p>DECANALO ETCHING PEN. With spray tip, 75p.</p>	<p>STOP PRESS. New arrivals, 12 volt car stereo motors with pulley only 55p each. 8 track stereo playback heads only 75p each. Car radio boards, complete chassis with 6 transistors FS choice, etc., new but no info, 75p each. Car radio RF/IF and audio preamp boards, 2 transistors, LM382 IC, trimmers, IF's etc., new but no info, 65p each.</p>	<p>POWER SUPPLIES. 9VDC 120ma regulated, will replace P99 battery etc. £2.25. Switched type plugs into a 13 amp socket, has 3-4.5-6-7.5 and 9 volts 0 c out at either 100 or 400ms switchable £3.25. H244R stabilised power supply 3-6-7.5-9vdc at 400ma, has polarity reversing and on off switch and is fully regulated to give exact voltage from no load to maximum current £5.25.</p>	<p>TELEPHONE PICK UP COIL. Sucker type with lead and 3.5mm jack 55p.</p> <p>JUMPER TEST LEAD SETS 10 PAIR of leads with various coloured croc clips each end [20 clips] 80p per set.</p>

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7406	25p	7476	25p	74145	55p	74L500	18p	4071	12p	LM 304	200p	MM 5314	380p	TBA 641 A12	250p	
7407	25p	7480	40p	74147	100p	745112	80p	4072	12p	LM 307N	65p	MM 5316	480p	TBA 700	180p	
7408	12p	7481	85p	74148	90p	CMOS			4081	12p	LM 308 TO5	100p	NE 529 K	150p	TBA 720 Q	225p
7409	12p	7482	75p	74150	65p	4000	12p	4082	12p	LM 308 DIL	100p	NE 555	25p	TBA 750 Q	200p	
7410	12p	7483	75p	74151	45p	4001	12p	4093	70p	LM 309 K	100p	NE 556	90p	TBA 800	80p	
7411	15p	7484	70p	74153	45p	4002	12p	4510	60p	LM 310 TO5	150p	NE 562 B	400p	TBA 810	100p	
7412	15p	7485	60p	74154	70p	4006	80p	4511	70p	LM 311 TO5	150p	SAD 1024	1500p	TBA 820	100p	
7413	25p	7486	25p	74155	45p	4007	14p	4516	65p	LM 317 K	325p	SL 917 B	650p	TBA 920 Q	280p	
7414	45p	7489	130p	74156	45p	4009	30p	4518	65p	LM 324	70p	SN 76003 N	150p	TCA 270 Q	220p	
7416	25p	7490	25p	74157	45p	4011	12p	4520	65p	LM 339	60p	SN 76013 N	110p	TCA 270 S	220p	
7417	25p	7491	40p	74160	55p	4012	12p	4528	80p	LM 348 N	90p	SN 76013 ND	125p	TCA 760	300p	
7420	12p	7492	35p	74161	55p	4013	30p	4583	70p	LM 380	60p	SN 76023 N	110p	TCA 4500 A	450p	
7421	20p	7493	30p	74162	55p	4015	50p	LINEAR		LM 381 N	90p	SN 76023 ND	125p	TDA 1008	350p	
7422	15p	7494	70p	74163	55p	4016	30p	AY3 8500	450p	LM 382	90p	SN 76033 N	150p	TDA 1034	450p	
7423	20p	7495	45p	74164	60p	4017	50p	CA 3039	70p	LM 391	180p	SN 7627 N	160p	TDA 2002	300p	
7425	20p	7496	45p	74165	60p	4018	55p	CA 3046	60p	LM 555	25p	SN 76228 N	180p	TDA 2020	300p	
7426	22p	7497	120p	74166	75p	4019	40p	CA 3060	225p	LM 709 C	40p	SN 76660 N	75p	TL 084	120p	
7427	22p	74100	80p	74167	160p	4020	50p	CA 3065	200p	LM 710 TO5	60p	TAA 300	100p	XR 320	250p	
7428	25p	74104	40p	74170	100p	4022	50p	CA 3076	250p	LM 710 DIL	65p	TAA 350	190p	XR 2206	450p	
7430	12p	74105	40p	74173	80p	4023	12p	CA 3080	75p	LM 723 TO5	40p	TAA 550	35p	XR 2207	450p	
7432	20p	74107	25p	74174	60p	4024	40p	CA 3084	250p	LM 723 DIL	40p	TAA 570	220p	XR 2208	600p	
7433	28p	74108	100p	74175	60p	4025	12p	CA 3085	85p	LM 733	120p	TAA 661B	140p	XR 2216	650p	
7437	20p	74166	75p	74176	50p	4026	80p	CA 3086	60p	LM 741	20p	TAA 700	350p	XR 2567	250p	
7438	20p	74109	25p	74177	50p	4027	30p	CA 3088	190p	LM 748	40p	TAA 790	350p	XR 4136	150p	
7440	12p	74118	75p	74178	75p	4028	45p	CA 3089	160p	LM 1303 N	100p	TAD 100	150p	XR 4202	150p	
7441	45p	74120	80p	74179	120p	4029	50p	CA 3090AQ	360p	LM 1458	100p	TAD 110	130p	XR 4212	150p	
7442	40p	74121	25p	74180	90p	4030	30p	CA 3123 E	130p	LM 3080	75p	TBA 120 S	60p	XR 4739	150p	
7443	60p	74122	35p	74181	130p	4032	80p	CA 3130	100p	LM 3900	55p	TBA 120 T	85p	ZN 414	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									

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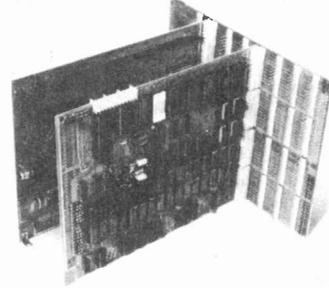
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Viscount IV unit in teak simulate cabinet. Silver finish rotary controls and pushbuttons with matching fascia, red mains indicator and stereo jack socket. Functions switch for mic, magnetic and crystal pickups, tape tuner and auxiliary. Rear panel features two mains outlets DIN speaker and input sockets plus fuse 20x20 watts RMS 40x40 watts peak. For use with 8 to 15 ohm speakers.

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Stereo pair 350 kit. System consists of 13" x 8" approx. woofer with rolled surround, 2 1/2" approx. Audax tweeter, crossover components and circuit diagram. Frequency response 20 Hz to 20 KHz. Power handling 15 watts RMS. 20 watts max. 8 ohm impedance.

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A.O.C. OLM 30 Mk III Magnetic Cartridge to suit

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Record changer with cueing device fitted with stereo ceramic cartridge ready to fit into your own pinth.

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Size 12" x 8 1/2"

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Ready built. Designed in a slim form for compact, modern installation. Rotary Controls: Vol On/Off, Bass, Treble, Balance. Push Buttons for Gram, Tape, VHF, MW, LW.

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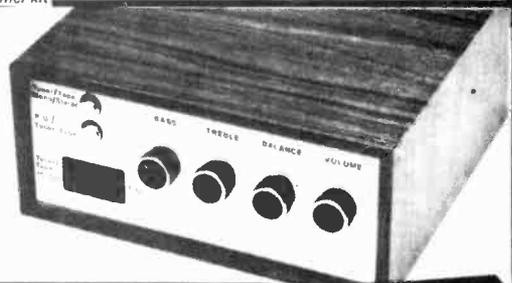
Suitable mains power supply parts, consisting of mains transformer, bridge rectifier, smoothing capacitor and set of rotary stereo controls for treble, bass, volume and balance.

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£3.95 per stereo pair plus £1.50 p&p.



10 + 10 AMPLIFIER KIT

An opportunity to buy a 10 watts per channel stereo amplifier kit which is suitable for use with a ceramic cartridge. The amplifier utilises proven Mullard modules and is available at a very competitive price. The amplifier kit comes complete with instructions and includes: a Mullard LP1183 stereo preamplifier module, two LP1173 power amplifiers with integral heatsinks, a power supply, Zobel networks, front and back mounting panels, a finished fascia panel, all control potentiometers (bass, treble, volume and balance), switches, input, output and headphone sockets, wire, and an easily assembled wrap around cabinet to house the finished unit.

p&p £2.05 **£11.95**

BARGAINS FOR PERSONAL SHOPPERS

LED 5 function men's digital watch stainless steel finish **£5.95**

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50 WATT MONO DISCO AMP

£29.95 p&p £2.50

Size approx. 13 1/2" x 5 1/2" x 6 1/2"

50 watts rms. 100 watts peak output. Big features include two disc inputs, both for ceramic cartridges, tape input and microphone input. Level mixing controls fitted with integral push-pull switches. Independent bass and treble controls and master volume.

70 & 100 WATT MONO DISCO AMP

Size approx. 14" x 4" x 10 1/2"

Brushed aluminium fascia and rotary controls. Five vertical slide controls, master volume, tape level, mic level, deck level. PLUS INTER DECK FADER for perfect graduated change from record deck No. 1 to No. 2, or vice versa. Pre fade level control (PFL) lets YOU hear next disc before fading it in. VU meter monitors output level. Output 100 watts RMS 200 watts peak.

70 watt **£57**
140 watt peak p&p £4.00
100 watt **£65**

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traditional design. **£20.95** each

NOTE YOU TO INDUSTRIAL UNREST, PLEASE ALLOW EXTRA TIME FOR YOUR ORDER TO REACH YOU.



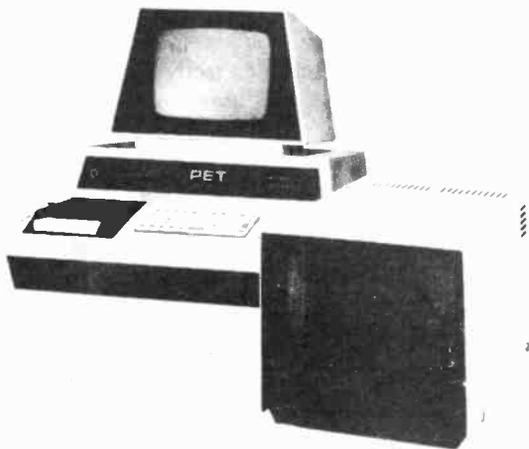
323 EDGWARE ROAD, LONDON W2
21E HIGH STREET, ACTON W3 6NG

ACTON: Mail Order only. No callers
ALL PRICES INCLUDE VAT AT 12 1/2%

All items subject to availability. Price correct at 12.3.79 and subject to change without notice.

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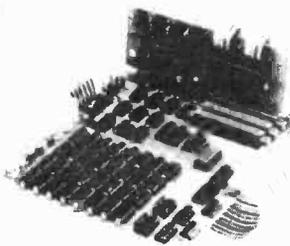
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*CALL OR WRITE FOR ADDITIONAL INFORMATION
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★ BUSINESS PACKAGES STARTING IN 1st QUARTER 1979 ★
*THIS SYSTEM REQUIRES EXPANDAPET MEMORY (MINIMUM 16K—SEE BELOW)

INTERNAL MEMORY EXPANSION FOR PET! EXPANDAPET™



32K UNIT ALLOWS 8K OF ASSEMBLY LANGUAGE SUBROUTINES ACCESSED VIA THE USR COMMAND
OPTIONAL PLUG-IN BOARDS
SERIAL I/O BOARD P.O.A.
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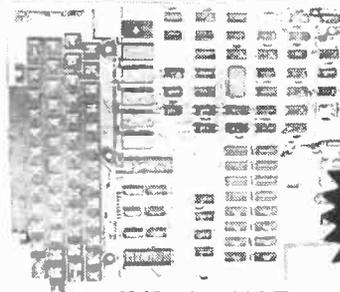
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Standard Features

- Uses the ultra powerful 6502 microprocessor
- 8K Microsoft BASIC-in-ROM
- Full feature BASIC runs faster than currently available personal computers and all 8080-based business computers
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Extras

- Available expander board features 24K static RAM (additional mini-floppy interface, port adapter for printer and modem and OSI 48 line expansion interface).
- Assembler editor and extended machine code monitor available.

Fully built and tested. Requires only 5V at 3 amps and a videomonitor or TV and RF converter to be up and running. Phone or write for delivery dates. Full one year warranty.

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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. ▶

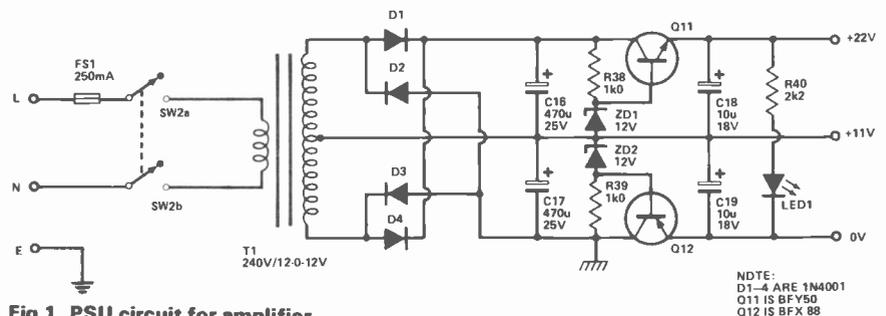
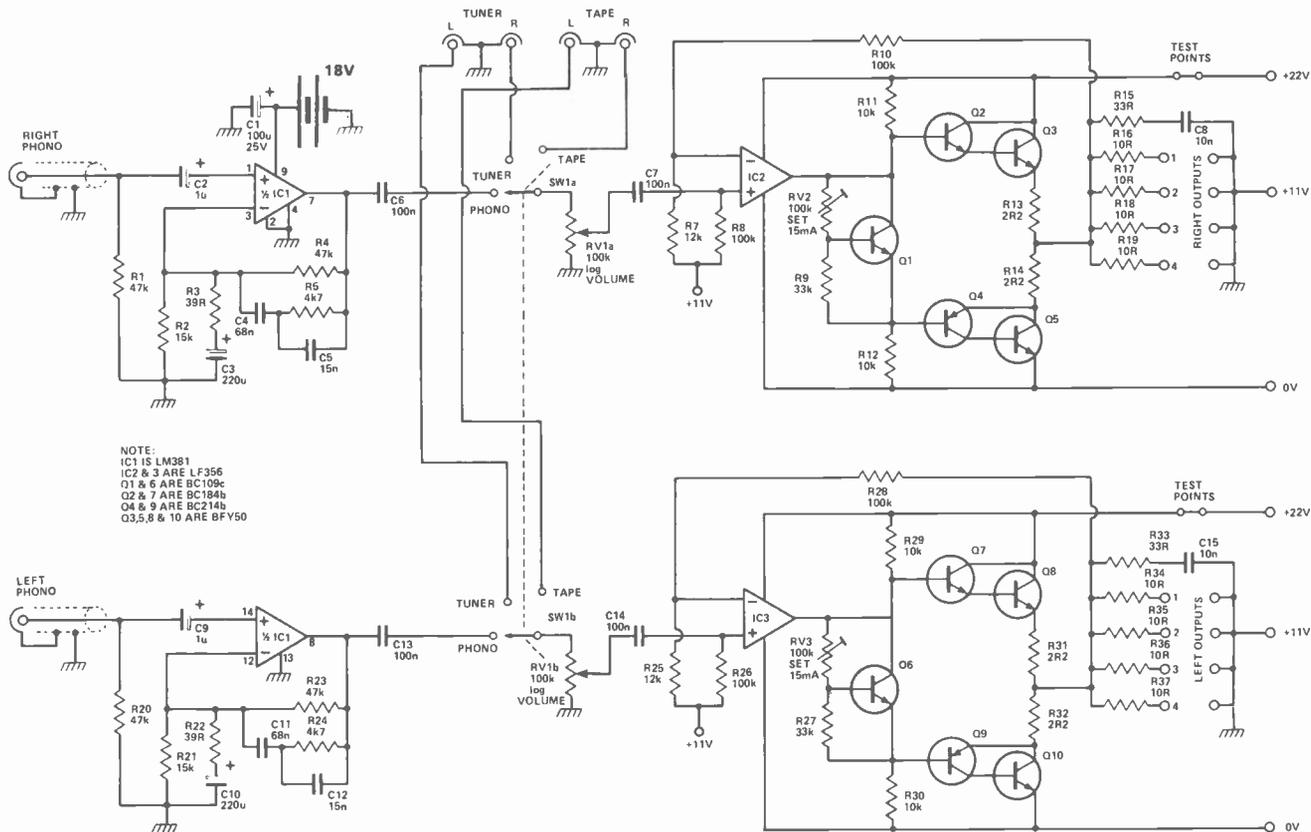


Fig 1. PSU circuit for amplifier.



NOTE:
 IC1 IS LM381
 IC2 & 3 ARE LF356
 Q1 & 6 ARE BC109c
 Q2 & 7 ARE BC184b
 Q4 & 9 ARE BC214b
 Q3, 5, 8 & 10 ARE BFV50

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 pre-amplifier 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.

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

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

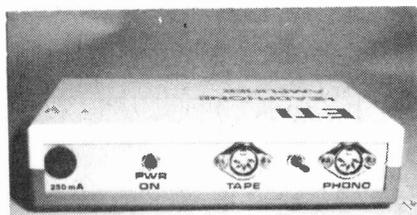
CAPACITORS

C1	100µ, 25V
C2,9	1µ

BUYLINES

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

Marshall's can supply this IC.



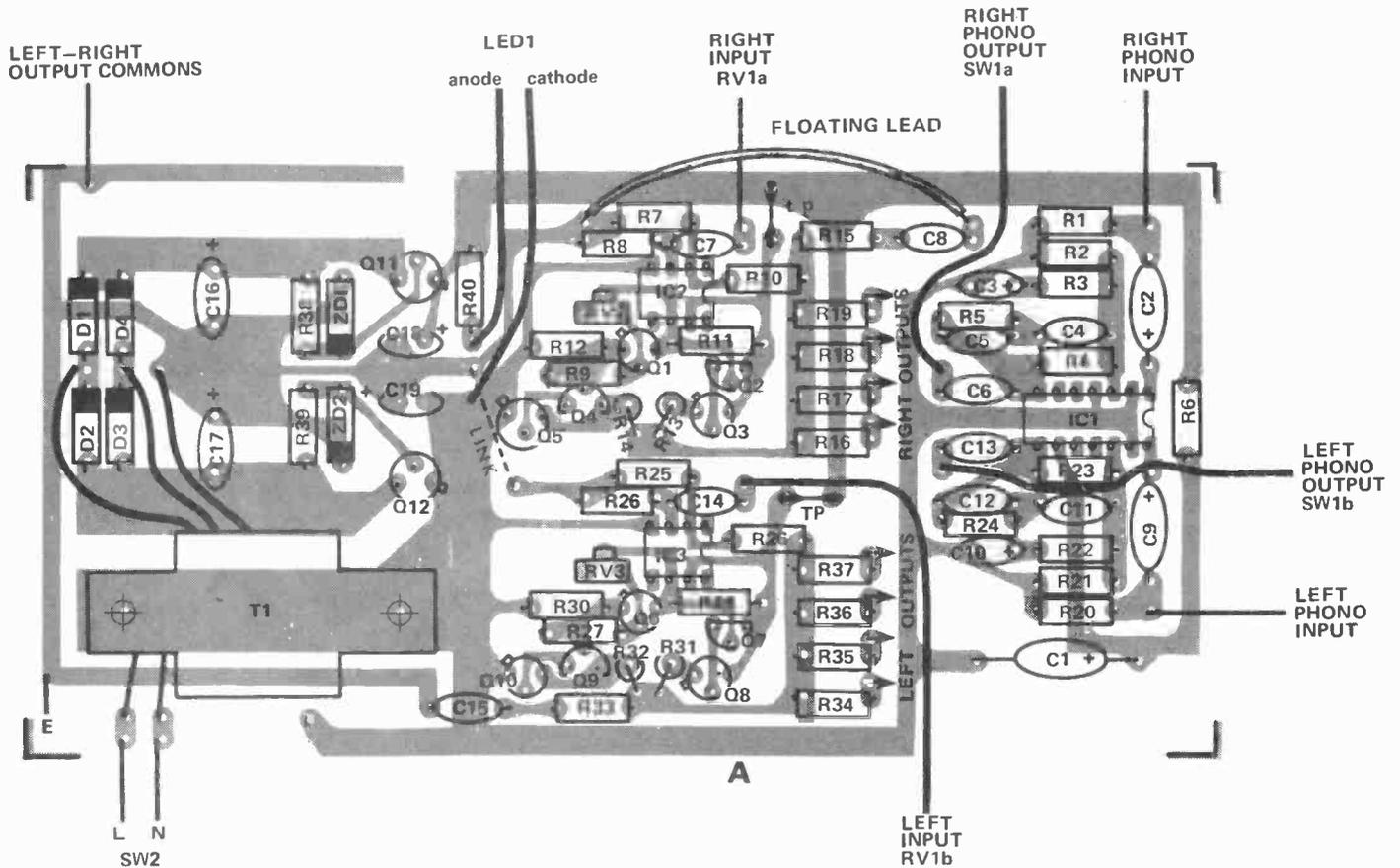


Fig 3. Component Overlay for the headphone amplifier with R6 in place to mains power the pre-amp. A lower noise figure can be obtained by battery powering the pre-amp. Connect the battery as shown in the circuit, and break the track at point A, Remove R6 from overlay.

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

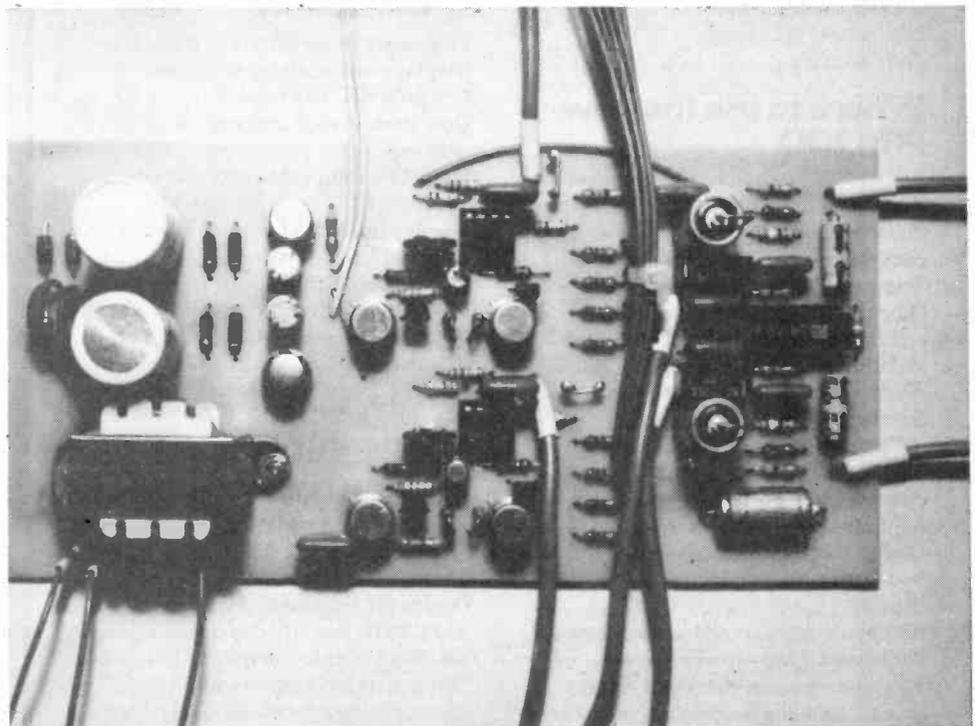
SEMICONDUCTORS

- 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.



The Sinclair PFM200 digital frequency meter.

20 Hz-200 MHz... 8 digits

...under £50.

The Sinclair PFM200 brings digital frequency measurement within the reach of every engineer. It has a performance comparable with the very best bench-top instruments, but it's packaged in a compact case which is rugged but light, ready for use anywhere.

The PFM200 out-performs many much more expensive instruments. Its 8-digit display and variable gate time give high-resolution coverage of frequencies from 20 Hz to over 200 MHz. It gives you exceptional sensitivity and simplicity, at a fraction of the price of meters with similar specifications!

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- 20 Hz-200 MHz guaranteed range (typically better)
- Frequency resolution down to 0.1 Hz
- High sensitivity (10 mV typical)
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- 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 synchronised circuits, scanning frequencies, video bandwidths, etc.



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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.

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

PFM200 Order Form

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PFM200s at £53.78
inc 8% VAT) each £.....

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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.....

Address.....

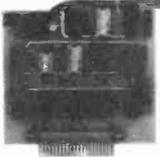
ETI/5

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E.S.

This HEX keyboard has 19 keys, 16 encoded with 3 user definable. The encoded TTL outputs, 8-4-2-1 and STROBE are debounced and available in true and complement form. Four onboard LEDs indicate the HEX code generated for each key depression. The board requires a single +5 volt supply. Board only \$15.00 Part No. HEX-3, with parts \$49.95 Part No. HEX-3A. 44 pin edge connector \$4.00 Part No. 44P.

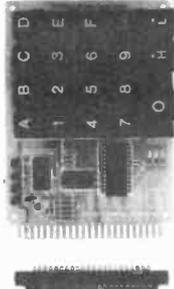


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3' ribbon cable with attached connectors to fit TRS-80 and our serial board \$19.95 Part No. 3CAB40

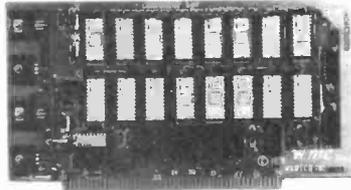
E.S. TRS-80 SERIAL I/O

- RS-232 compatible
- Can be used with or without the expansion bus
- On board switch selectable baud rates of 110, 150, 300, 600, 1200, 2400, parity or no parity odd or even, 5 to 8 data bits, and 1 or 2 stop bits, D.T.R. line. Board only \$19.95 Part No. 8010, with parts \$59.95 Part No. 8010A, assembled \$79.95 Part No. 8010C. No connectors provided, see below.



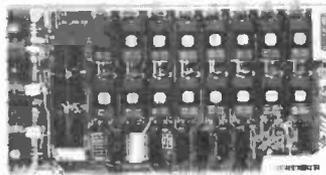
4K EPROM WMC inc.

This board is designed to operate with any speed or power 1702A. Addressable in 4K byte increments and can be configured to occupy either 2K or 4K segments. It can be populated one memory chip at a time. Bare board \$30, board with parts \$200, assembled \$230. Part No. EPM-1



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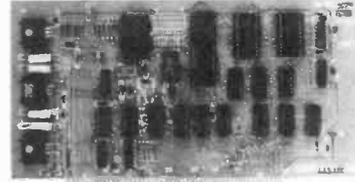
Designed to operate with any speed or power 2708 or single voltage (+5V) 2716. Addressable in 4K increments and can occupy multiples of 4K. It can be populated one memory chip at a time. Has bank addressing and Phantom Disable. The board comes with an exclusive software program that can be placed in a 2708 or 2716 that will, when used in conjunction with a RAM memory board, check out every line on the EPM-2. Bare board \$30, board with parts with 2708 \$455, assembled \$485. Board with parts with 2716 \$1,225, assembled \$1,255. Part No. EPM-2



8080A CPU (With Eight Level

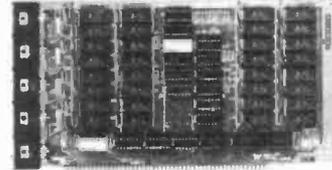
Victor Interrupt Capability) WMC inc.

Uses the 8080A and the 8224 clock chip. The crystal frequency used is 18 MHz and the vector interrupt chip is the 8214. The board will function normally without the interrupt circuitry. When the interrupt circuitry is built up, the board will respond to eight levels of interrupts. Designed to be a plug-in replacement for the IMSAI CPU board and will work in other computers with the appropriate modifications made to the ribbon cable connector pin out from the front panel. The board will work in systems without a front panel if the system has a PROM board that simulates the functions of the front panel. Bare board \$30, with parts \$185, assembled \$220. Part No. CPU-1



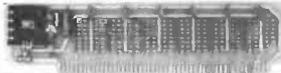
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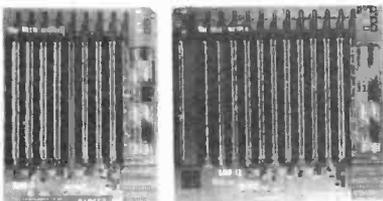
S-100 BUS ACTIVE TERMINATOR *

Board only \$14.95 Part No. 900, with parts \$24.95 Part No. 900A



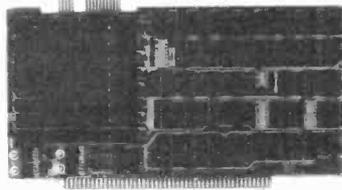
9 AND 13 SLOT MOTHER BOARDS WMC inc.

All traces are reflow solder covered and both sides are solder masked. The connectors used on these boards are the IMSAI™ type (.125" between pins, .250" between rows). Spacing between connectors is .750". All lines, except power and ground, have a passive RC network termination available. There is a kluge area available that will accept two 40 pin sockets and one 36 pin socket. The circuitry for supplying three separate regulated voltages to the kluge area is contained on the board. Part No. GMB-12 \$40 bare, \$105 kit, \$120 assembled. Part No. GMB-9 \$35 bare, \$90 kit, \$105 assembled.



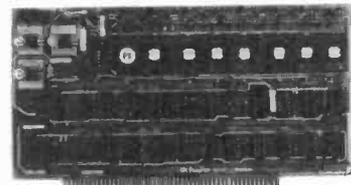
PIICEDN 65K DYNAMIC RAM

Main memory for microcomputers, intelligent terminals, business systems, medical systems, and OEM systems. ● High density random access memory 48K bytes or 64K bytes ● Fully buffered ● S-100 bus compatible ● Low power (dynamic memory) ● Transparent refresh ● Digital delay line techniques for reliable operation ● Multiple boards allowed using hardware or software controlled bank select ● "Phantom" signal for RAM/ROM overlap ● All boards are fully tested prior to shipment. Operating System test and extensive bit pattern testing. ● Works directly in 8080A processors or Z-80 environment at 2MHz ● Currently used by industry ● 1 year warranty. Only available assembled and tested with 48K \$1,250 Part No. 48K, or with 65K \$1,475 Part No. 65K



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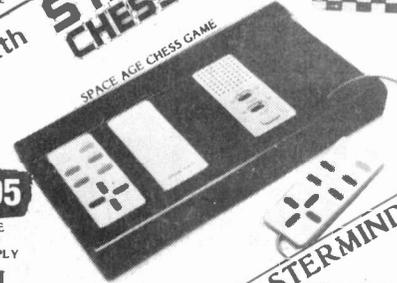
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STANDING WAVES

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 μs , frequency f is in MHz. For example: if the period is 0.4 μs , 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 ($3 \times 10^8 \text{ m/S}$), so that this is the quantity equal to frequency \times wavelength. For a 1 MHz wave, the wavelength is $3 \times 10^8 / 1 \times 10^6 = 300 \text{ m}$.

For a 1000 MHz wave, though, the wavelength is just $3 \times 10^8 / 10^9 = 0.3 \text{ m}$ — 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

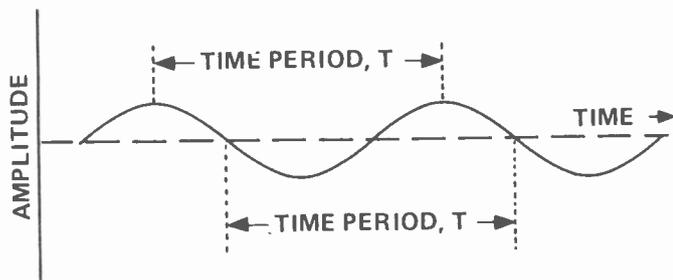


Fig. 1. Time period. This can be measured between neighbouring peaks or from one zero-crossing to the next-but-one, as shown.

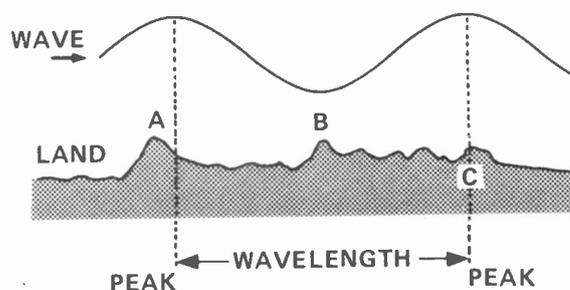


Fig. 2. Wavelength. Imagine the wavepeaks moving from left to right. At the instant shown, a peak is at point A, and a trough at point B, but the previous peak has reached point C. The distance between points A and C is one wavelength of this wave.

has a wavelength of 330/1000 metres, which is only 330 mm, almost the same as a 1000 MHz radio 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

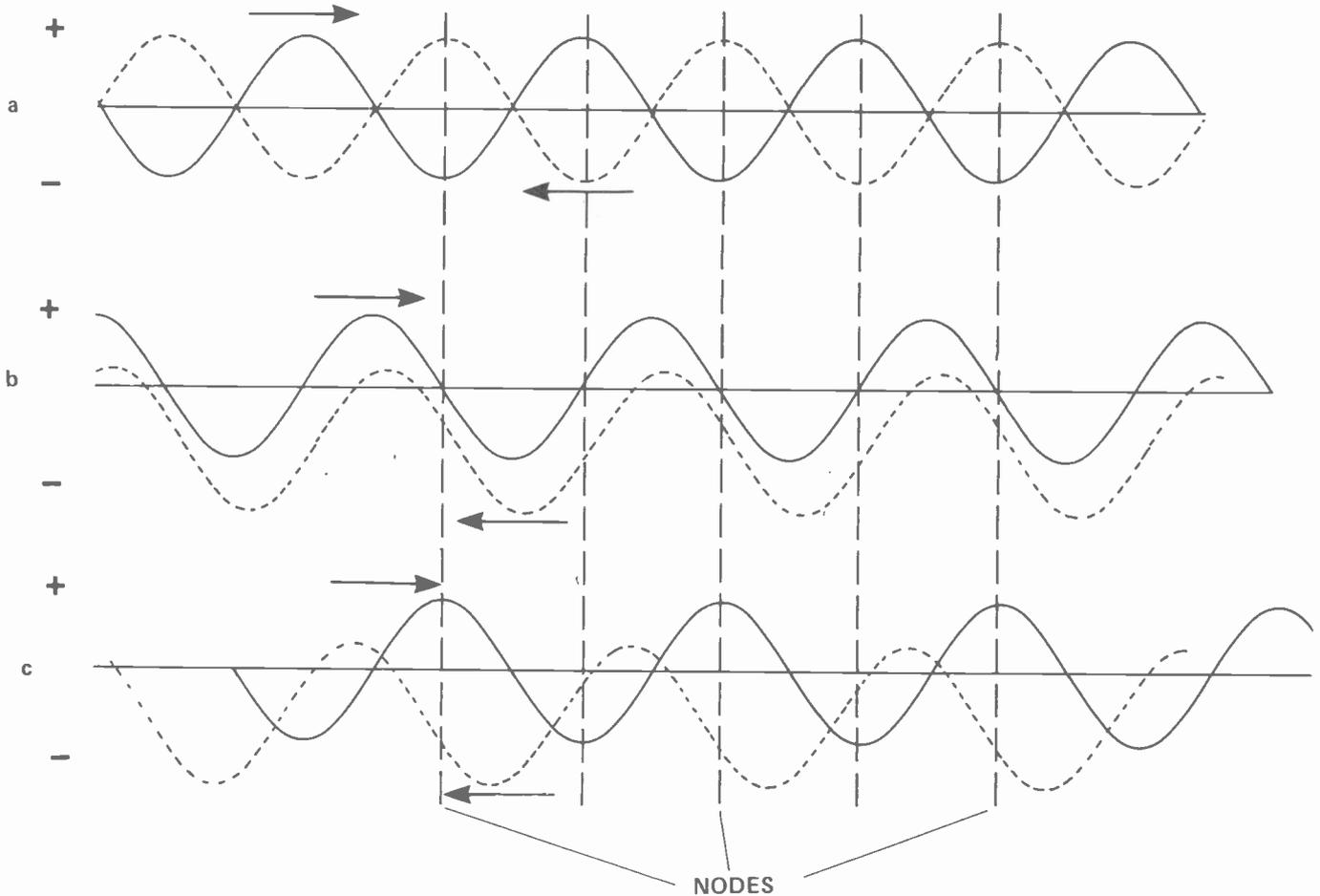


Fig. 3. Setting up standing waves. The solid line (a) represents a wave moving from left to right, the dotted line represents its reflection moving in the opposite direction. At (b), each wave has moved about $\frac{1}{4}$ cycle, and at (c) $\frac{1}{2}$ cycle along in its own direction. The positions 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.

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

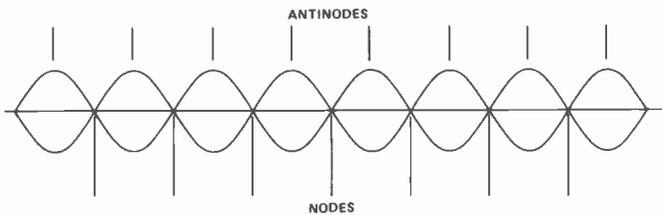


Fig. 4. Representing a standing wave. The standing wave has the same wavelength as the moving waves which cause it, but the nodes and antinodes are at fixed points, quarter of a wavelength apart from one another.

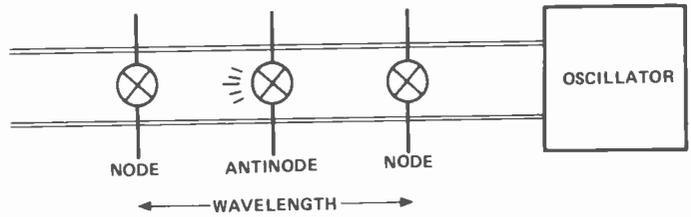


Fig. 5. Using Lecher lines. A high-frequency oscillator attached to parallel wires can display standing waves, using a small light bulb to detect the positions of nodes and antinodes.

in this position there will be the maximum transfer of signal from the aerial to the cable.

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 $\frac{1}{4}$ 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!

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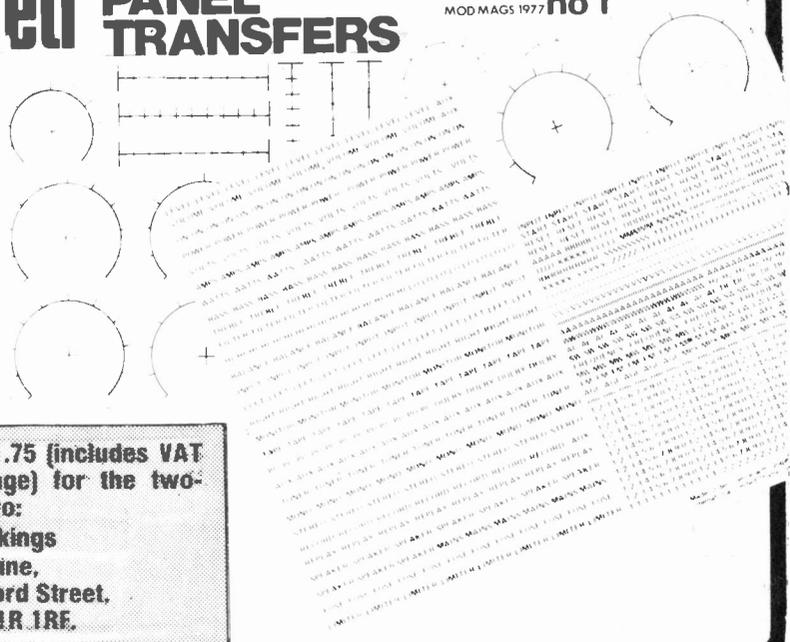
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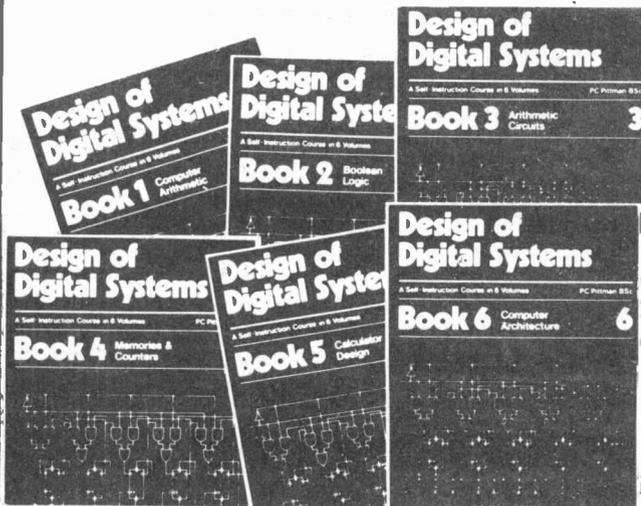
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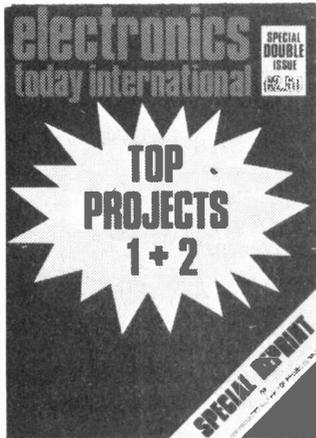
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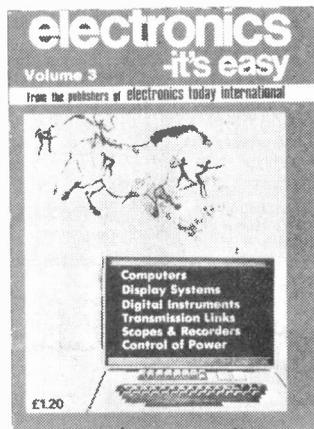
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£19.95



52QS-14B
Right, 8mm
£22.95

Up to 25 functions. Net, lap and first and second place times to 1/100 sec. F-100 Resin case and strap. 52QS-14B Stainless steel encased version with fully adjustable s/s bracelet.

CASIO QUARTZ 31QR Functions as 50QS above.



31QR-20B
Left, 8.5mm
£19.95



54QS-16B
Right, 7.5mm
6 digits
£24.95

6 DIGIT WATCHES (not Sports). Hours, minutes, seconds and day of week. (Model 54QS has an optional display of hrs, mins, date, day, ten seconds, seconds flash). And day, date, month, year calendar. Selectable 12 hr. (with am/pm) or 24 hr. clock.

DOWN CHRONO AND ALARM

45CS-22B
Left, Chrono
£34.95



25CS-16B
Right, 9.25mm
Alarm
£34.95

CHRONOGRAPH. 6 digits as above, with chrono measuring net, lap and 1st & 2nd place times from 1/100 second to 6 hours. Dual time facility. ALARM. Displays hours, minutes, seconds (or date), day, am/pm. Perpetual calendar. 24 hour alarm. 25 CR-16B Round alarm as above. **£24.95**

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THE AMAZING MELODY 80 Musical calculating diary watch

ADVANCE SPECIFICATION: Two separate Alarm Tunes. Calculator with keys 1-8 playing individual notes — a mini synthesizer! Complete Calendar, Watch, Stopwatch — measuring net and lap times to 1/10 second — Alarm Timer and Calculator with %, √ full Memory. Date calculations. RRP £31.95 **£25.95**

NEW

MP-100 MATH PET (LCD)

Sophisticated maths teaching aid at four selectable levels plus clock, two alarms, stopwatch. RRP £24.95. **£19.95**

NEW

M-811 MICRO CARD Key ring calculator

Tiny one-handed calculator with non-volatile memory (stores when switched off), automatic power-off, %, 3/16x1¼ x 2½ins. Pouch with key ring. RRP £17.95. **£14.95**

NEW

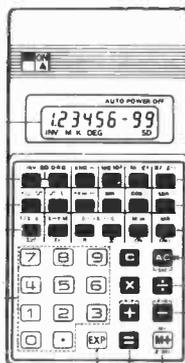
THE INCREDIBLE AQ-2000 Universal calendar watch

Watch, complete Calendar, Two Alarms, Stopwatch, Time Memory, Countdown Alarm, 8 digit Calculator.

LC Display of hours, minutes, seconds, am/pm, full calendar display of day, date and every Sunday. Also digital date, month, year, with day, Sundays.

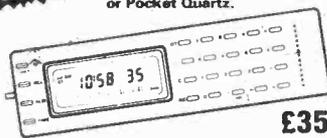
Displays any monthly calendar from 1901 to 2099. Memories and displays three optional important dates. Calculator with full Memory, %, K, Square Roots. One year battery life. ¼ x 2½ x 4 7/16 ins. Wal. RRP £29.95.

An incredible **£24.95**



NEW

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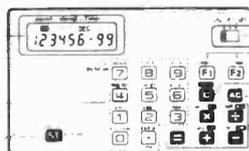


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CAR IMMOBILISER

Here's a low-cost project that gives your car good protection against joy riders and a drunken driver.

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.

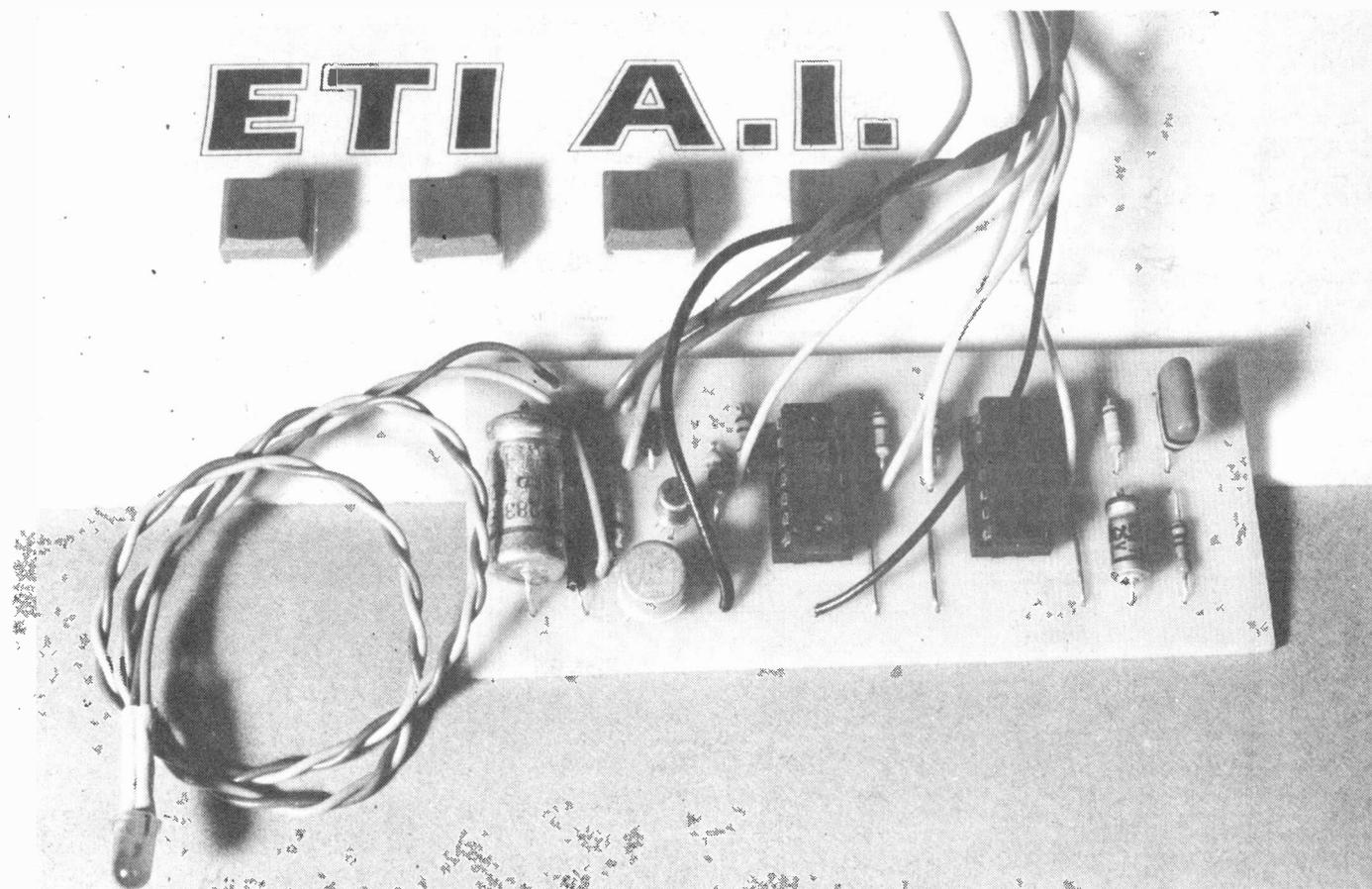
There are four basic concepts behind the ETI Automatic Immobiliser system. The first of these is that, since the immobiliser activates automatically as soon as the vehicle's ignition is turned on, the vehicle is given a good degree of protection against the drive-away car thief, even if the owner leaves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



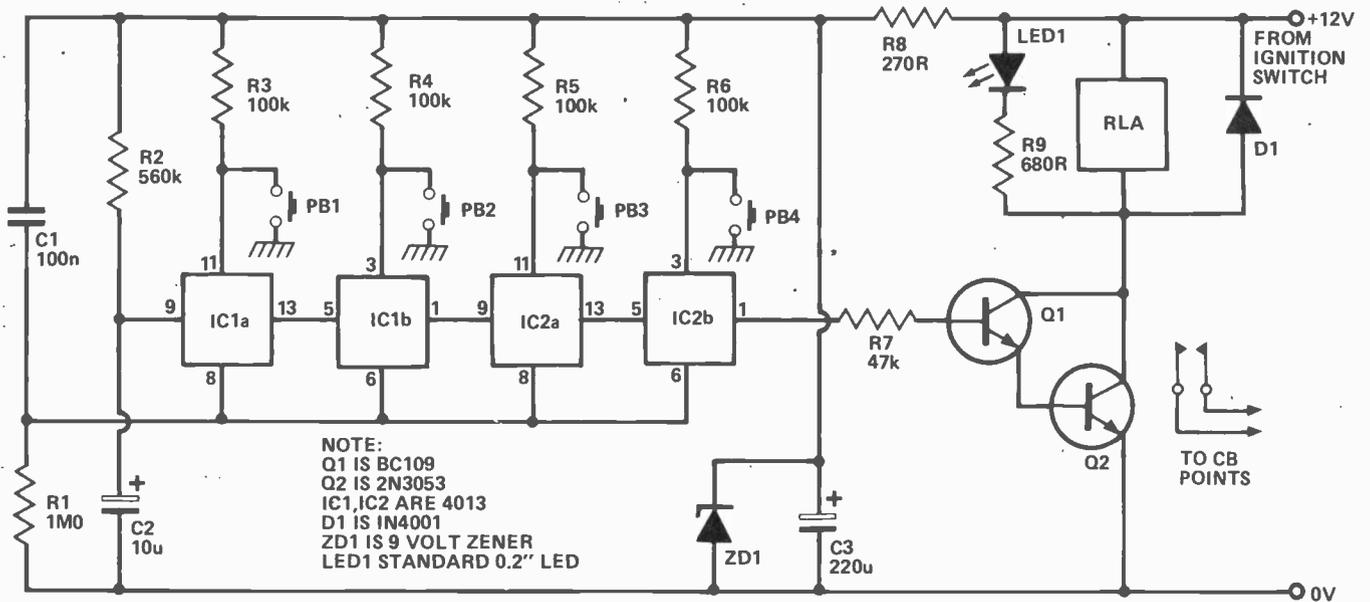


Fig. 1. Circuit diagram for immobiliser.

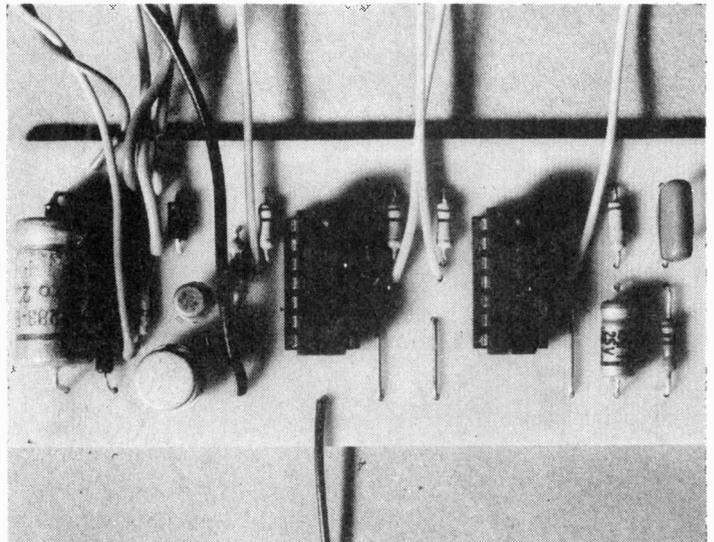
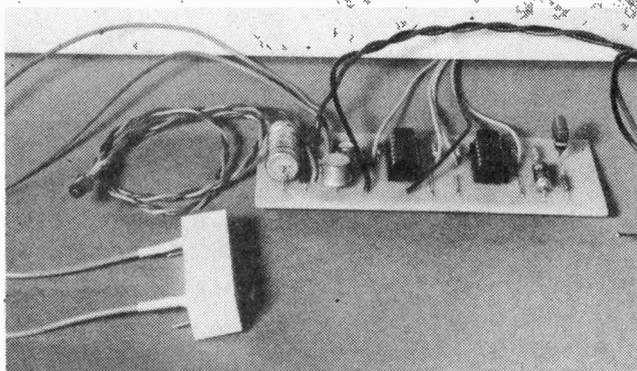
Construction

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

ETI A.I.



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 gain equal to that of Q1 multiplied by Q2. D1 protects the transis-

tors against the back EMF of the relay. System status is indicated by LED1.

To re-enable the system and start the car a logic '0' 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 '0' 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.

PARTS LIST

RESISTORS all 1/4 watt 5%

R1 1M0
 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, push to make pushbutton
 PB4 switches

RLA 12v relay (see text)

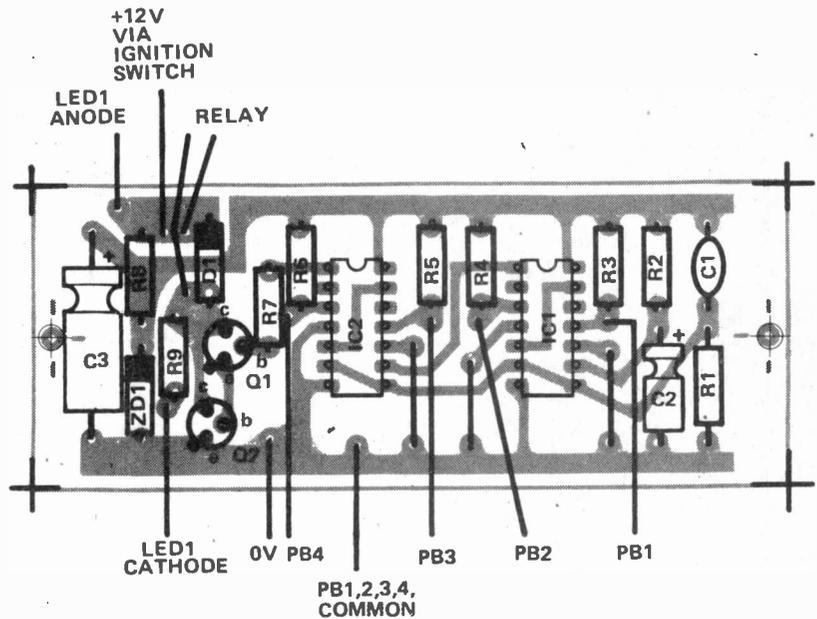


Fig. 2. Component overlay.

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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1 RF 040

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2 Surplus RF Board 020

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3 IF15

Matching IF Strip double conversion 10.7MHz/470kHz AM/NB FM excellent performance **£12.95**

4 IF20 Multimode IF Strip

Switched AM/NB FM/SSB/CW. 10.7MHz input gain 90dB. Typical sensitivity 10µV. Dual Conversion, will form the basis of a good communications receiver. Selectivity provided by filters at 10.7MHz and 455kHz **£21.95**

5 V.T05. — Medium Wave DX Front End Converter

Uses Up Conversion Principle to eliminate images. Comprising of an ultra low drift oscillator and Mosfet Front End for wide dynamic range. Freq. range 580kHz-1600kHz; Triple Tuning; A.G.C. Range 50dB; gain 30dB; Output 10.7MHz; when used with an IF15 or IF20, high gain IF strip a sensitivity of 1.0uV for 15dB S/N can be achieved. **£13.25**

6VT06 25-30MHz Front End Converter

Tunable over whole range uses Dual gate Mosfets. Covers European/American CB frequencies and Amateur 10 metre band can be used as a tuneable IF for many 2 metre converters. Low noise, high performance. Especially designed to go with IF15 and IF20 but compatible with any receiver covering 10.7MHz. **£13.25**

7VT07

Tunable 2 metre front end converter. Covers 144-146MHz. Three stage tuning uses bipolar devices for low current consumption can be battered powered for 2 metre direction finding or portable use. Ideal basis for 2 metre monitor. Receiver can be uses with IF 15, IF20 or comm. rx. Output 10.7MHz. **£9.95.**

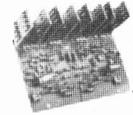
8VT01

108-150MHz MOSFET front end 26dB gain 10.7MHz 1F output. Covers 2 metres. Varicap tuned. Amateurs. Aircraft, etc. **£7.99.**



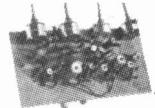
9 AMP 020

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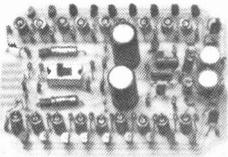
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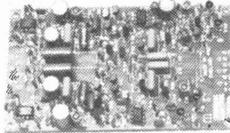
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CPR 1



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MC 1 PRE-AMPLIFIER

Suitable for nearly all moving-coil cartridges. Sensitivity 70/170µV switchable on the p.c.b. This module brings signals from the now popular low output moving-coil cartridges up to 3.5mV (typical signal required by most pre-amp disc inputs). Can be powered from a 9V battery or from our REG 1 regulator board.

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XO2 — two way XO3 — three way Slope 24dB octave. Crossover points set to order within 10V

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The regulator module, REG 1 provides 15.0-15v to power the CPR 1 and MC 1. It can be used with any of our power amp supplies or our small transformer TR 6. The power amp kit will accommodate it.

POWER AMPLIFIERS

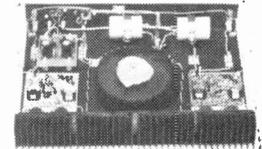
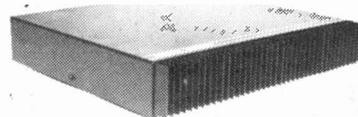
It would be pointless to list in so small a space the number of recording studios, educational and government establishments etc., who have been using CRIMSON amps satisfactorily for quite some time. We have a reputation for the highest quality at the lowest prices. The power amp is available in live types, they all have the same specification: T.H.D. typically 0.1% any power 1kHz 8 ohms, T.I.D. insignificant, slew rate limit 25V/µS, signal to noise ratio 110dB, frequency response 10Hz-35kHz, —3dB, stability unconditional, protection drives any load safely, sensitivity 775mV (250mV or 100mV on request), size 120 x 80 x 25mm

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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 ($\pm 200\text{kHz}$) 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 gnomonic 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

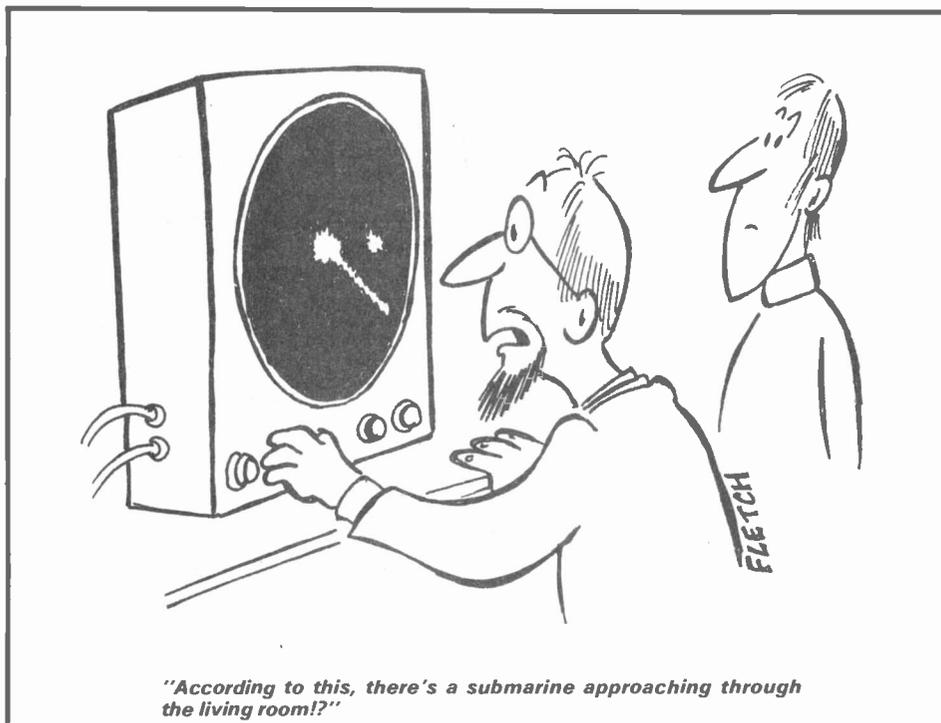
Dear Sir,

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

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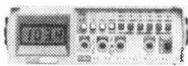
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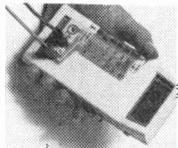
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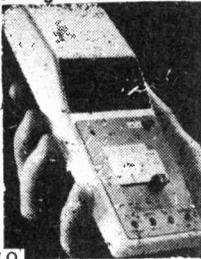
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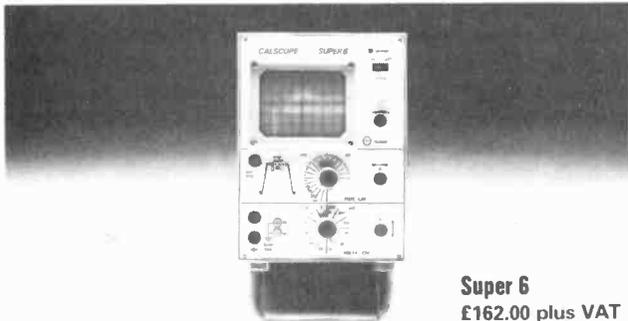
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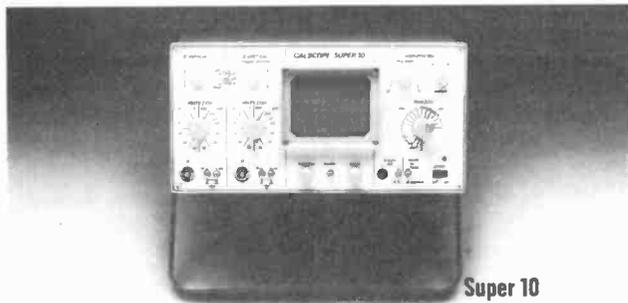
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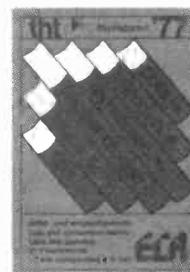
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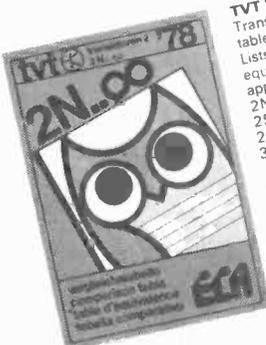
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Sep 77	Graphic Equaliser	601	1 75	20 28	BFGH
Sep 77	Graphic Equaliser P S U	602	65	1 94	BFG
Oct 77	Watchdog	604	90	18 80	BEGHL
Oct 77	Watchdog P S U	605	75	6 14	BEH
Aug 77	Sweep Oscillator	606	2 90	36 41	BFGHL
Sep 77	Stereo Simulator	607	70	5 77	BEGHL
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	Comander	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	BE
Nov 76	541 Train Controller	T001	80	15 86	BEHL
Jan 77	444 5 watt Stereo (2 pcbs)	T002	2 15	26 47	BEGK
Jan 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
Jan 78	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	BE
	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
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Aug 78	Etiew Plant Waterer	T020	1 00	5 03	BEH
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Oct 78	Complex Sound Generator	T024	2 95	21 88	BEH
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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
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	Light Activated Tachometer	T044	2 10	31 99	BEH
March 79	Headlight Delay	T045	70p	5 73	BEHL
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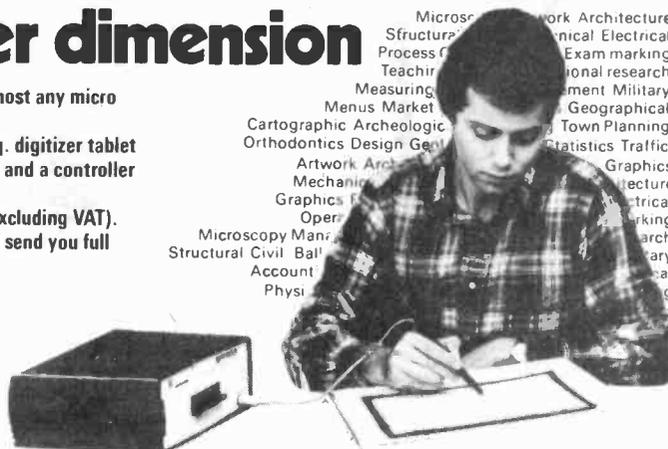
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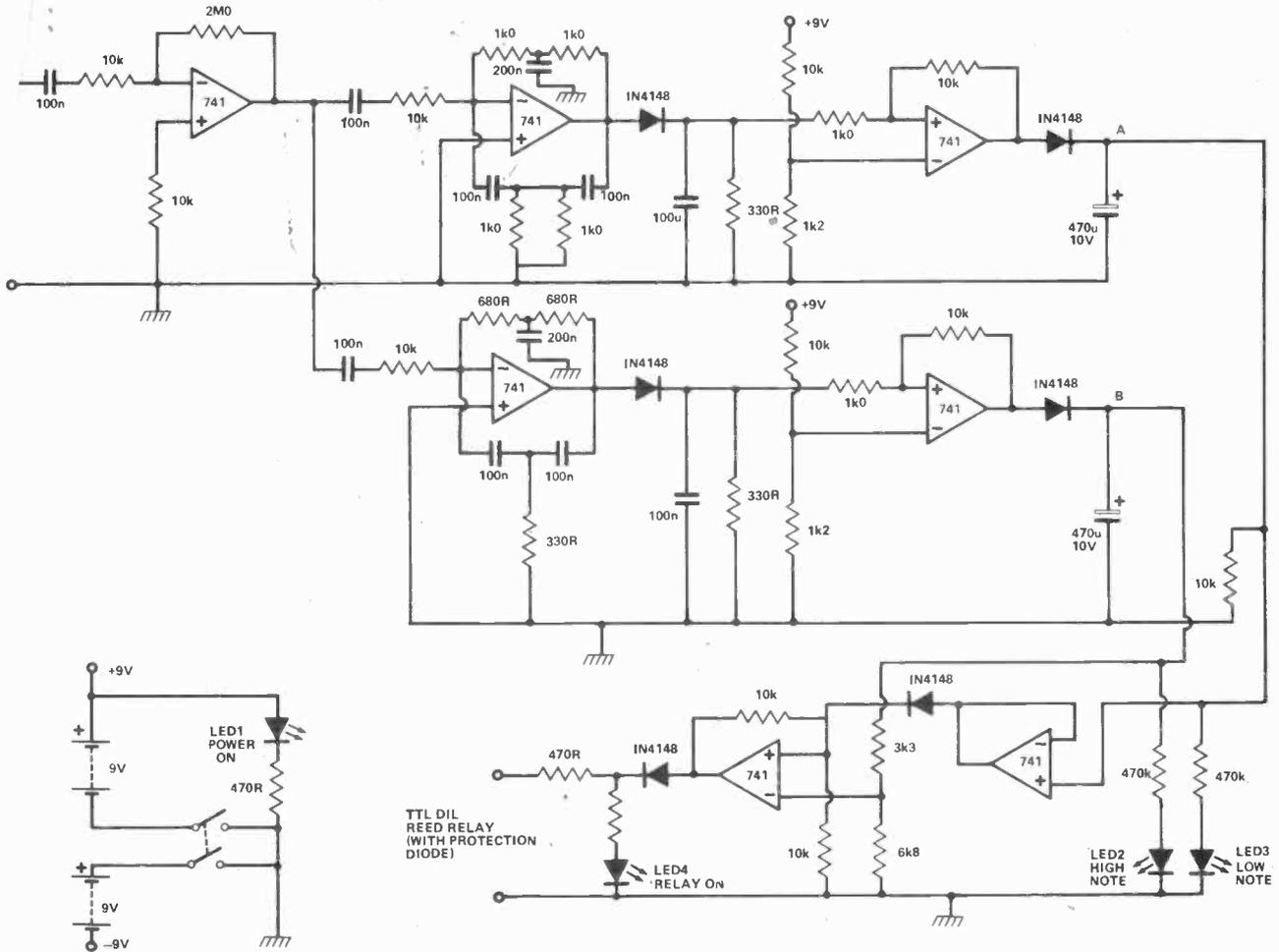
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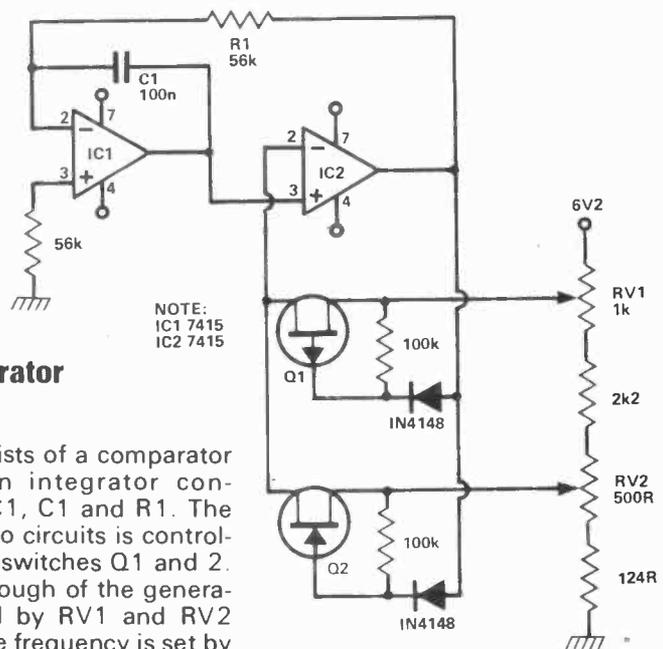
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R. I. Harrison

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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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½W 2% Metal Oxide 10R-1M E24 series. 1-99 6p; 100+ 4p. ¼W 1% Metal Glaze 1R-1M E24 series. 1-99 10p; 100+ 7½p. (add 20% for values under 10R and over 510k). 1W 5% Carbon Film 4R7-10M E12 series. 1-99 3p; 100+ 2½p.

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)

POTENTIOMETERS

Lin or Log less switch 1k-2M2 26p each. Dual 1in or log less switch 4k7-2M2 79p each. Log + DPSW 4k7-2M2 57p each. Spkr Vol controls. 3W w/w, splined shaft: 20R 50R 100R or 200R 37p each 100+ 26p.

CAPACITORS

50V min ceramic, 5% up to 1000pF
Value 1-99 100+
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
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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: 4.7 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.

100+ of any one type, less 25%

TANT BEAD CAPS

Value	volts	1-99	100+
0.1-1µ	35	12p	7p
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

PRESETS

Min 0.1W vert or horiz mntg 100R-4M7. 1-99 7p; 100+ 4½p. Std 0.3W vert or horiz mntg 100R-4M7.. 1-99 9p; 100+ 6p.

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BC109	9p	7p
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.2 Red LED	14p	10p
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76013N	130p	85p
76023N	130p	85p
76033N	160p	100p
1N4148	2p	1.3p
1N4003	4p	2.9p
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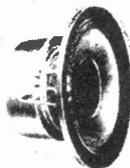
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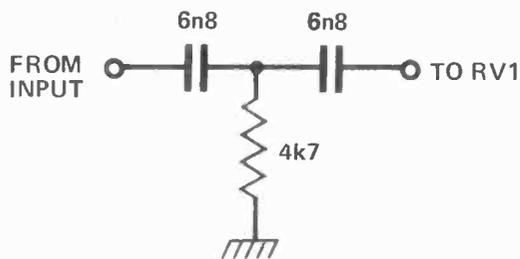
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Upgrading Valve Tuners

R. N. Soar

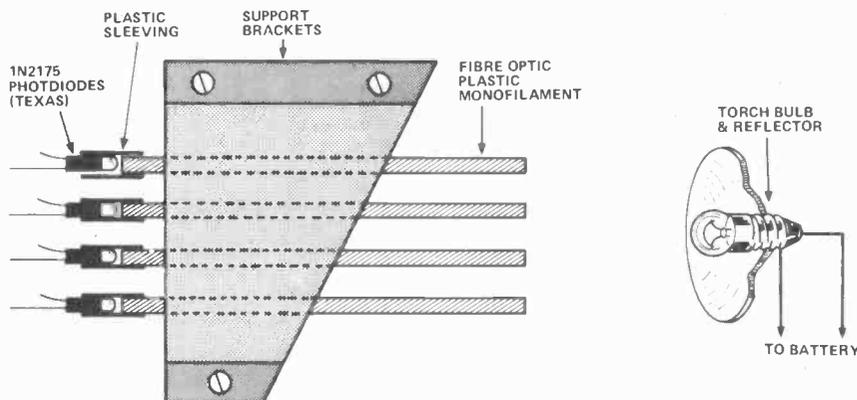
Older valve tuners often use an ECC85 type valve as the RF amplifier-mixer amplifier. The performance of these tuners can be permanently upgraded by using a solid state replacement such as a Fetron. A typical example is the TS12AT7, a plug in replacement for the ECC81/12AT7 range of valves but the performance 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.

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

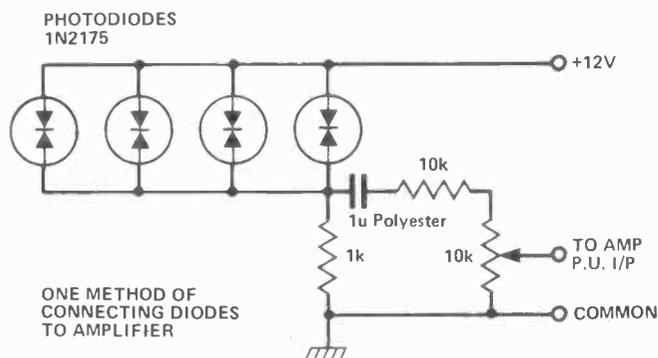
trigger the filter, giving an audible 'whoosh' of noise. This can be alleviated by adding a simple high pass filter to the control circuit. The filter removes signals below 5 kHz, resulting in a cleaner, less breathy, sound. It should be noted that the input impedance of this circuit is only about 3 k and it may be advisable to precede this circuit with an emitter follower.



Fibre Optic Bass Guitar

J. Smith.

This item is in effect a simple musical instrument. It consists of a number of short lengths of plastic monofilament fibre optic material arranged in such a way that when a fibre is touched then released it vibrates at its own natural resonant frequency (like a ruler twanged on the edge of a desk). When in a light beam supplied from a torch battery the vibrating end sends sine wave impulses along the fibre, at the fixed end there is a photodiode which with suitable circuitry feeds a signal to a normal audio amplifier. The sound produced is similar to that obtained using a tea chest, piece of string and Broom handle, remember those days? Thickness of the fibres and length are not critical and it is best to experiment to obtain the sound that pleases the constructor. The fibres need be no longer than about 60m/m. Remember the shorter they are the higher the note produced.



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7475	.25					
7476	.25					
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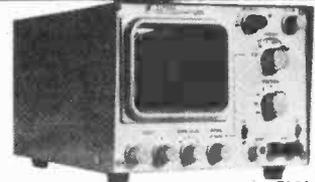
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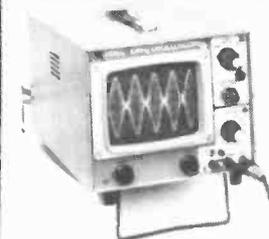
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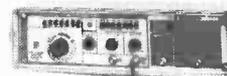
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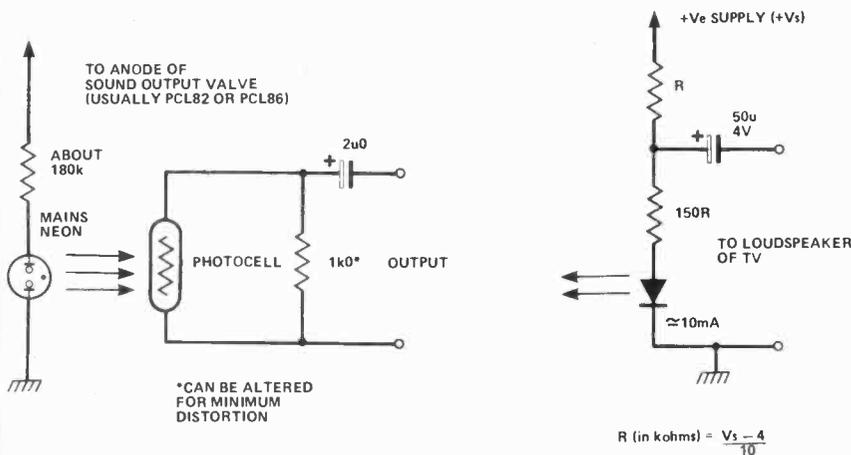
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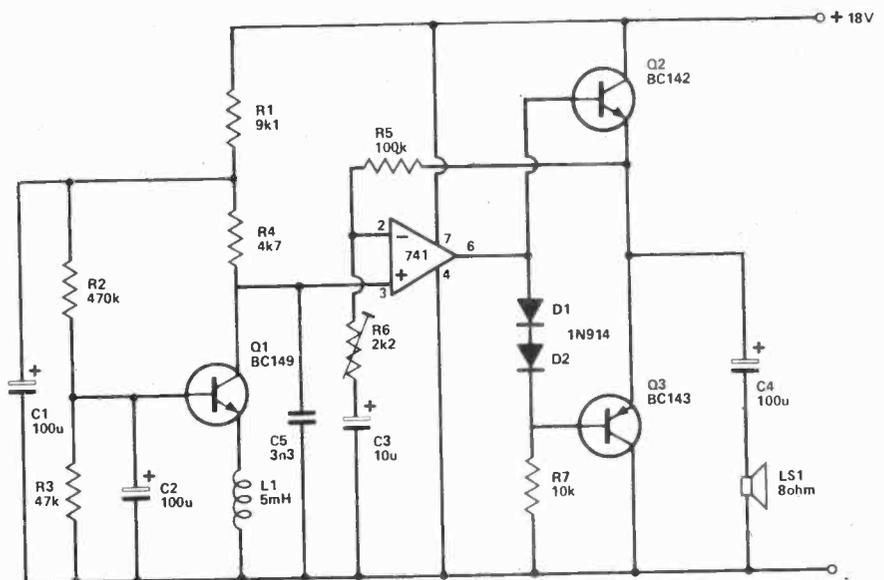
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The gain provided by the IC is made variable by the inclusion of R6 and this should be adjusted for a comfortable output level. D1, D2 in conjunction with R7 provides the small but necessary bias required by the output pair.

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



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4010	.35
4011	.20
4012	.20
4013	.40
4014	.75
4015	.75
4016	.35
4017	.75
4018	.75
4019	.35
4020	.85
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4022	.75
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4042	.65
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7401	.15	7483	.75
7402	.15	7485	.55
7403	.15	7486	.25
7404	.10	7489	1.05
7405	.25	7490	.45
7406	.25	7491	.70
7407	.55	7492	.45
7408	.15	7493	.35
7409	.15	7494	.75
7410	.15	7495	.60
7411	.25	7496	.80
7412	.25	74100	1.15
7413	.25	74107	.25
7414	.75	74121	.35
7416	.25	74122	.55
7417	.40	74123	.35
7420	.15	74125	.45
7426	.25	74126	.35
7427	.25	74132	.75
7430	.15	74141	.90
7432	.20	74150	.85
7437	.20	74151	.65
7438	.20	74153	.75
7440	.20	74164	.95
7441	1.15	74156	.70
7442	.45	74157	.65
7443	.45	74161	.55
7444	.45	74163	.85
7445	.65	74164	.60
7446	.70	74165	1.10
7447	.70	74166	1.25
7448	.50	74175	.80
7450	.25	74176	.85
7451	.25	74180	.55
7453	.20	74181	2.25
7454	.25	74182	.75
7460	.40	74190	1.25
7470	.45	74191	1.25
7472	.40	74192	.75
7473	.25	74193	.85
7474	.30	74194	.95
7475	.35	74195	.95
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		75108A	.35
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		75492	.50
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		74H01	.20
		74H04	.20
		74H05	.20
		74H08	.35
		74H10	.35
		74H11	.25
		74H15	.45
		74H20	.25
		74H21	.25
		74H22	.40
		74H30	.20
		74H40	.25
		74H50	.25
		74H51	.25
		74H52	.15
		74H53	.25
		74H55	.20
		74H72	.35
		74H74	.35
		74H101	.75
		74H103	.55
		74H106	.95
		74L00	.25
		74L02	.20
		74L03	.25
		74L04	.30
		74L10	.20
		74L20	.35
		74L30	.45
		74L47	1.95
		74L51	.45
		74L55	.65
		74L72	.45
		74L73	.40
		74L74	.45
		74L75	.85
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		74LS76	.50
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		74LS153	.85
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		74S00	.35
		74S02	.35
		74S03	.25
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		74S05	.35
		74S08	.35
		74S10	.35
		74S11	.35
		74S20	.25
		74S40	.20
		74S50	.20
		74S51	.25
		74S64	.15
		74S74	.35
		74S112	.60
		74S114	.65
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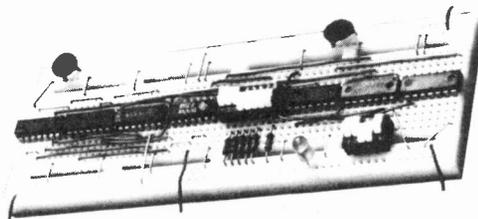
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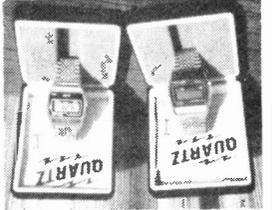
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BC127	0.075	0.080	0.040
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BC145	0.075	0.080	0.040
BC146	0.075	0.080	0.040
BC147	0.075	0.080	0.040
BC148	0.075	0.080	0.040
BC149	0.075	0.080	0.040
BC150	0.075	0.080	0.040
BC151	0.075	0.080	0.040
BC152	0.075	0.080	0.040
BC153	0.075	0.080	0.040
BC154	0.075	0.080	0.040
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BC161	0.075	0.080	0.040
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BC163	0.075	0.080	0.040
BC164	0.075	0.080	0.040
BC165	0.075	0.080	0.040
BC166	0.075	0.080	0.040
BC167	0.075	0.080	0.040
BC168	0.075	0.080	0.040
BC169	0.075	0.080	0.040
BC170	0.075	0.080	0.040
BC171	0.075	0.080	0.040
BC172	0.075	0.080	0.040
BC173	0.075	0.080	0.040
BC174	0.075	0.080	0.040
BC175	0.075	0.080	0.040
BC176	0.075	0.080	0.040
BC177	0.075	0.080	0.040
BC178	0.075	0.080	0.040
BC179	0.075	0.080	0.040
BC180	0.075	0.080	0.040
BC181	0.075	0.080	0.040
BC182	0.075	0.080	0.040
BC183	0.075	0.080	0.040
BC184	0.075	0.080	0.040
BC185	0.075	0.080	0.040
BC186	0.075	0.080	0.040
BC187	0.075	0.080	0.040
BC188	0.075	0.080	0.040
BC189	0.075	0.080	0.040
BC190	0.075	0.080	0.040
BC191	0.075	0.080	0.040
BC192	0.075	0.080	0.040
BC193	0.075	0.080	0.040
BC194	0.075	0.080	0.040
BC195	0.075	0.080	0.040
BC196	0.075	0.080	0.040
BC197	0.075	0.080	0.040
BC198	0.075	0.080	0.040
BC199	0.075	0.080	0.040
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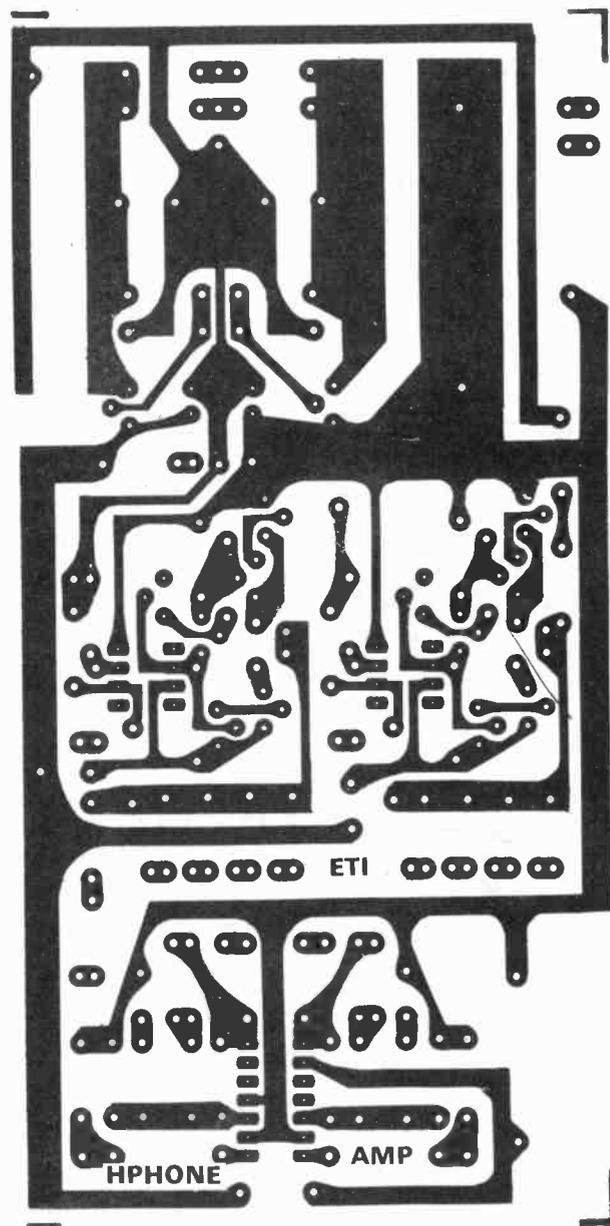
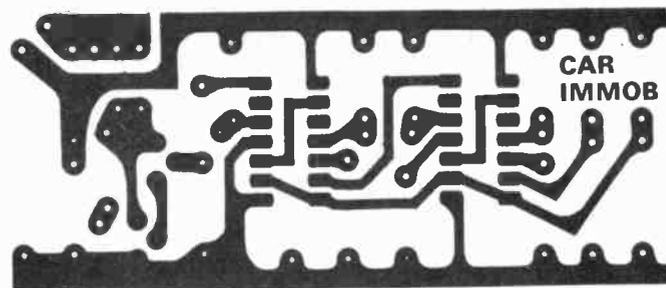
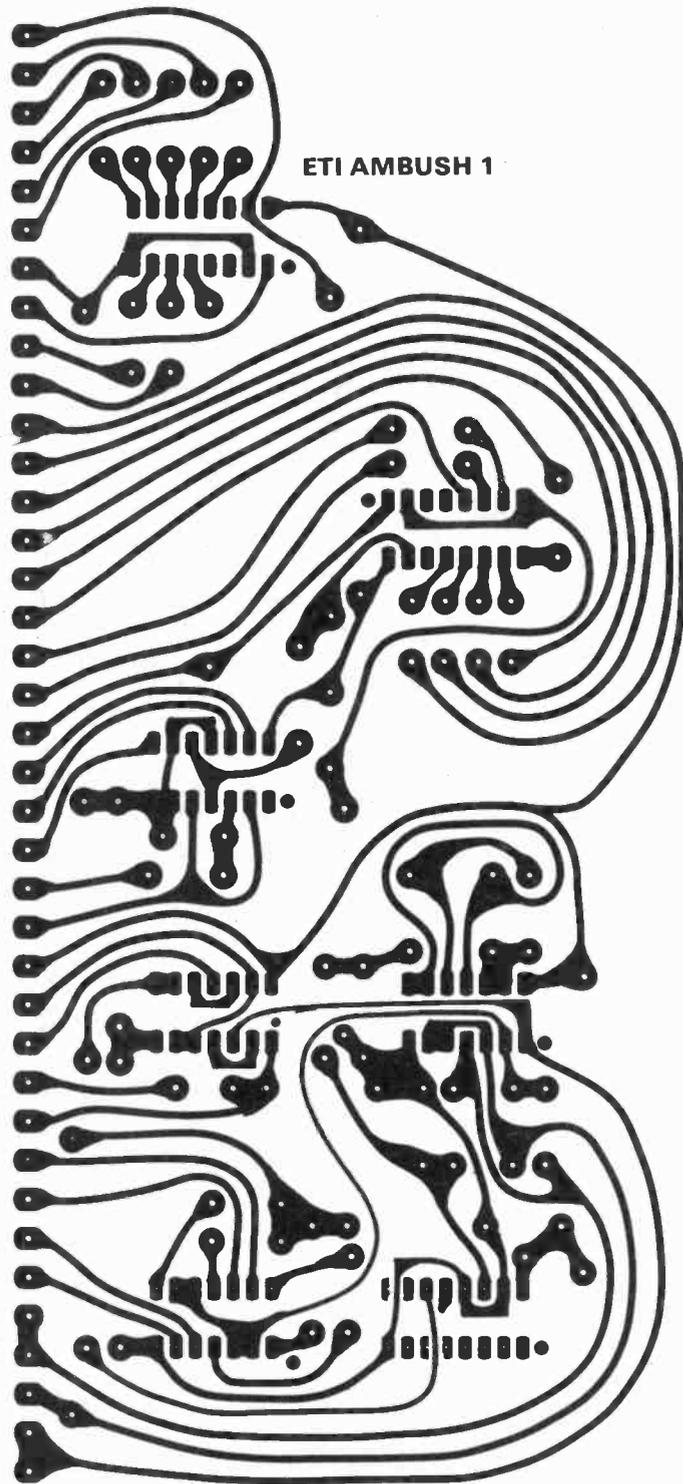
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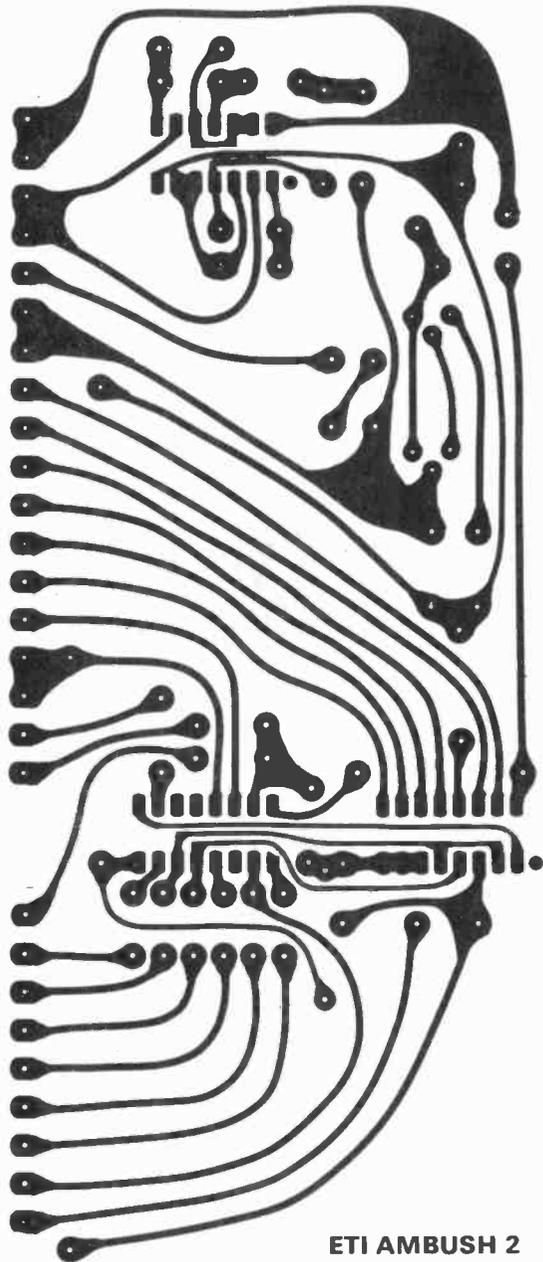
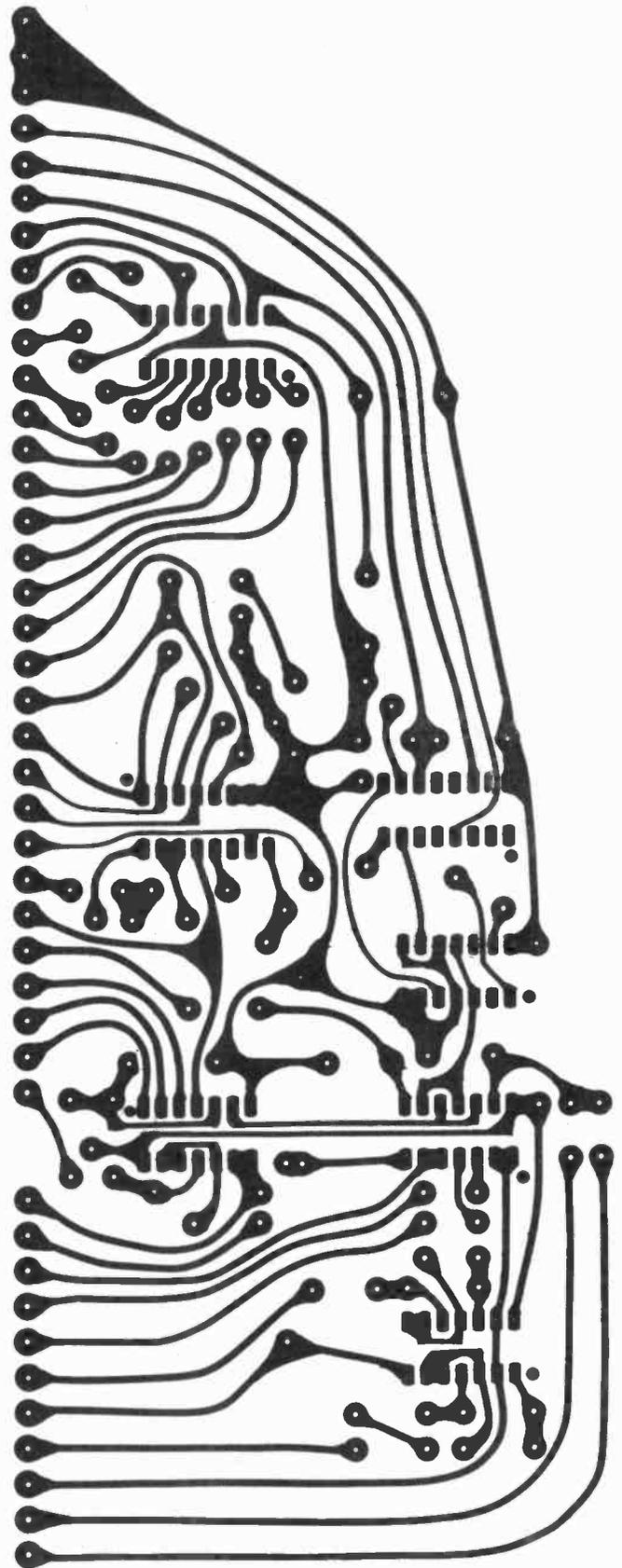
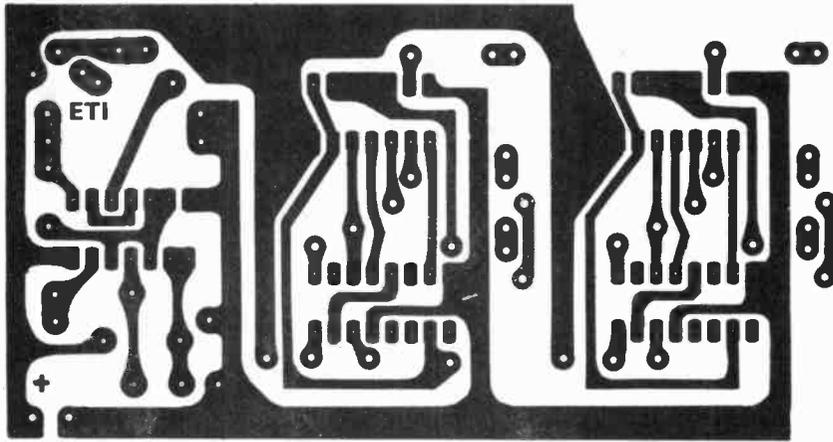
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PCB FOIL PATTERNS

This months project boards. Note that the radio control transmitter PCB is copyright Rencom and hence is not shown here.





ETI AMBUSH 2

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HY5 Preamplifier

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

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

APPLICATIONS: Hi-Fi — Mixers — Disco — Guitar and Organ — Public address.

SPECIFICATIONS:

INPUTS: Magnetic Pick-up 3mV; Ceramic Pick-up 30mV; Tuner: 100mV; Microphone: 10mV; Auxiliary 3-100mV; input impedance 47k Ω at 1kHz.

OUTPUTS: Tape 100mV; Main output 500mV R.M.S.

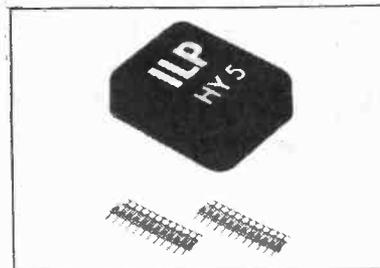
ACTIVE TONE CONTROLS: Treble \pm 12dB at 10kHz; Bass \pm at 100Hz.

DISTORTION: 0.1% at 1kHz; Signal/Noise Ratio 68dB.

OVERLOAD: 38dB on Magnetic Pick-up; **SUPPLY VOLTAGE** \pm 16.50V

Price £6.27 + 78p VAT. P&P free.

HY5 mounting board B1 48p + 6p VAT P&P free.



HY30 15 Watts into 8 Ω

The HY30 is an exciting New kit from I.L.P., it features a virtually indestructible I.C. with short circuit and thermal protection. The kit consists of I.C., heatsink, P.C. board, 4 resistors, 6 capacitors, mounting kit, together with easy to follow construction and operating instructions. This amplifier is ideally suited to the beginner in audio who wishes to use the most up-to-date technology available.

FEATURES: Complete kit — Low Distortion — Short, Open and Thermal Protection — Easy to Build

APPLICATIONS: Updating audio equipment — Guitar practice amplifier — Test amplifier — Audio oscillator

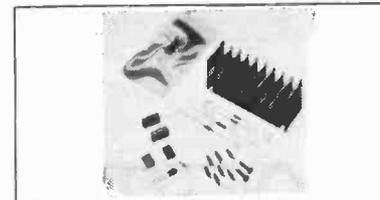
SPECIFICATIONS:

OUTPUT POWER 15W R.M.S. into 8 Ω ; **DISTORTION** 0.1% at 15W.

INPUT SENSITIVITY 500mV; **FREQUENCY RESPONSE** 10Hz-16kHz — 3dB.

SUPPLY VOLTAGE \pm 18V.

Price £6.27 + 78p VAT. P&P free.



HY50 25 Watts into 8 Ω

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

FEATURES: Low Distortion — Integral Heatsink — Only five connections — 7 Amp output transistors — No external components.

APPLICATIONS: Medium Power Hi-Fi systems — Low power disco — Guitar amplifier.

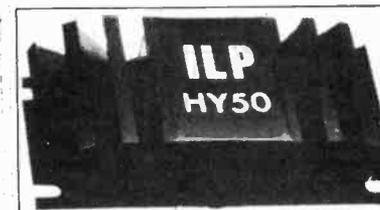
SPECIFICATIONS: **INPUT SENSITIVITY** 500mV.

OUTPUT POWER 25W RMS in 8 Ω LOAD IMPEDANCE 4-16 Ω ; **DISTORTION** 0.04% at 25W at 1kHz.

SIGNAL/NOISE RATIO 75dB; **FREQUENCY RESPONSE** 10Hz-45kHz — 3dB.

SUPPLY VOLTAGE \pm 25V; **SIZE** 105.50 x 25mm.

Price £8.18 + £1.02 VAT. P&P free.



HY120 60 Watts into 8 Ω

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

FEATURES: Very low distortion — Integral Heatsink — Load line protection — Thermal protection — Five connections — No external components.

APPLICATIONS: Hi-Fi — High quality disco — Public address — Monitor amplifier — Guitar and organ.

SPECIFICATIONS:

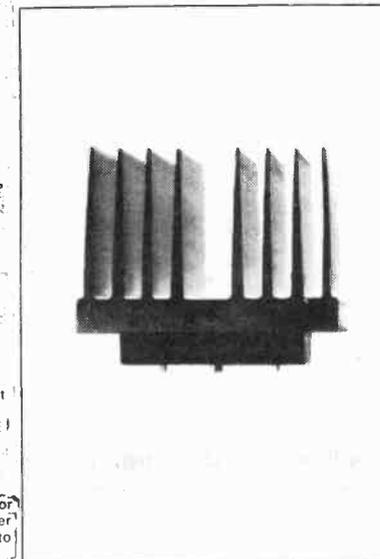
INPUT SENSITIVITY 500mV

OUTPUT POWER 60W RMS into 8 Ω LOAD IMPEDANCE 4-16 Ω ; **DISTORTION** 0.04% at 60W at 1kHz.

SIGNAL/NOISE RATIO 90dB; **FREQUENCY RESPONSE** 10Hz-45kHz — 3dB; **SUPPLY VOLTAGE** \pm 35V.

Size 114 x 50 x 85mm.

Price £19.01 + £1.52 VAT. P&P free.



HY200 120 Watts into 8 Ω

The HY200, now improved to give an output of 120 Watts, has been designed to stand the most rugged conditions, such as disco or group while still retaining true Hi-Fi performance.

FEATURES: Thermal shutdown — Very low distortion — Load line protection — Integral Heatsink — No external components.

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

SPECIFICATIONS:

INPUT SENSITIVITY 500mV

OUTPUT POWER 120W RMS into 8 Ω LOAD IMPEDANCE 4-16 Ω ; **DISTORTION** 0.05% at 100W at 1kHz.

SIGNAL/NOISE RATIO 96dB; **FREQUENCY RESPONSE** 10Hz-45kHz — 3dB; **SUPPLY VOLTAGE** \pm 45V.

Size 114 x 50 x 85mm.

Price £27.99 + £2.24 VAT. P&P free.

HY400 240 Watts into 4 Ω

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

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

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

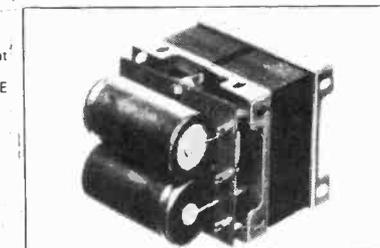
SPECIFICATIONS:

OUTPUT POWER 240W RMS into 4 Ω LOAD IMPEDANCE 4-16 Ω ; **DISTORTION** 0.1% at 240W at 1kHz.

SIGNAL/NOISE RATIO 94dB; **FREQUENCY RESPONSE** 10Hz-45kHz — 3dB; **SUPPLY VOLTAGE** \pm 45V.

INPUT SENSITIVITY 500mV; **SIZE** 114 x 100 x 85mm.

Price £38.61 + £3.09 VAT. P&P free.



POWER SUPPLIES

PSU36 suitable for two HY30's £6.44 + 81p VAT

PSU50 suitable for two HY50's £8.18 + £1.02 VAT

PSU70 suitable for two HY120's £14.58 + £1.17 VAT

PSU90 suitable for one HY200 £15.19 + £1.21 VAT

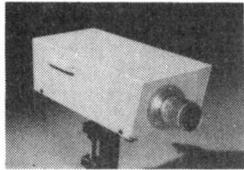
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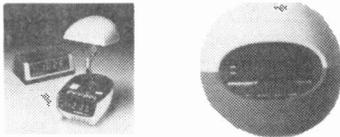
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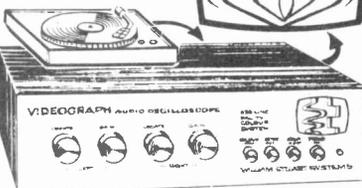
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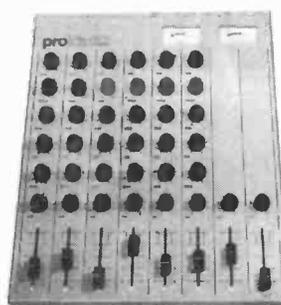
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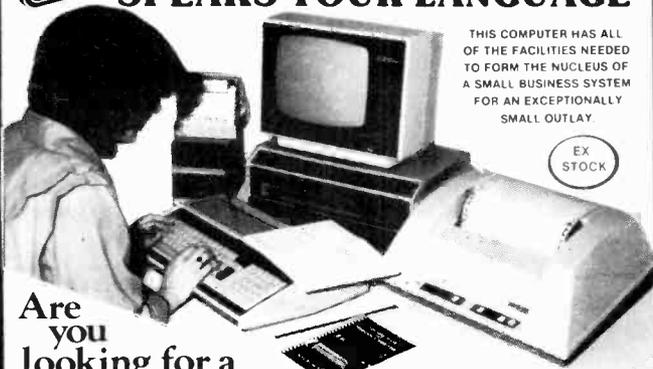
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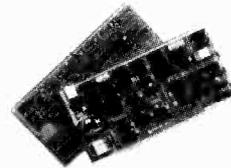
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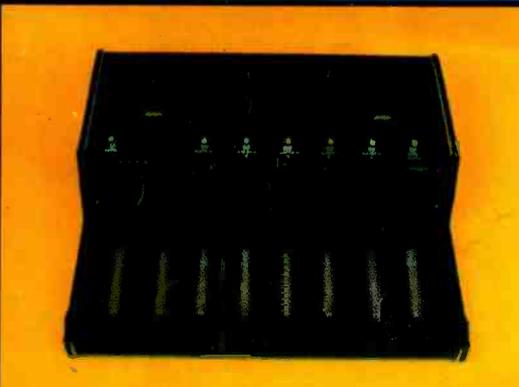
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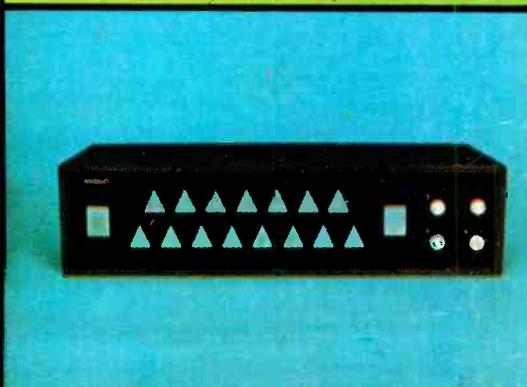
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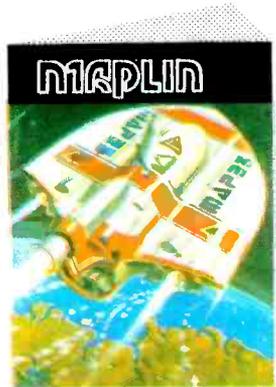
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