DECEMBER 1976

40p

# electronic light display



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709 T099 709 DIL 14 710 DIL 14

710 DIL 14 35p\*
723 Regulator 49p\*
741 DIL 8 PIN 22p\*
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747 Dual 741 69p\*

741 T099 33p\* 747 Dual 741 69p\* 748 DIL 8 PIN 33p\*

LOW

29p 25p\* 29p\* 35p\*

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PAK B: 74 10 RED LEDS full spec fit

PAK B: 74 10 RED LEDS full spec fit

PAK B: 74 10 RED LEDS full spec fit

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VOL. 52 NO. 8 ISSUE 838 DECEMBER 1976

BRITAIN'S PREMIER MAGAZINE FOR THE DO-IT-YOURSELF RADIO AND ELECTRONICS CONSTRUCTOR

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	127 20 p	109C 13p	300	35p	88	22p	TIS43	35p	Ĭ
2	128 20 p	117 18p	301	34p	BFY50	17p	ZTX300	13p *	ı
	151 <b>35</b> p	142 22p	303	35p	51	16p	302	18p*	1
	153 <b>35</b> g	143 24p	338	16p*	52	18p	500	15p*	
	176 20p	147A 9p	557	9p*	BY164	40 p	502	18p*	1
	187 20 p	1478 10p		18p	ME0401	18p*	1N914	5p	ı
	188 <b>20</b> p	148 9p	F 72	14p	0411	18p°	1 N4001	5p	
	AD149 680	148B 10p	BD123	90 p	ME4001	10p*	4002	6p	4
	161 420	149B 11p	124	68p	4101	11p*	4005	9 p	4
	162 42p	149C 11p	131	36 p	MPF102	32p*	4006	10p	1
	MCH/PR	154 18p	132	38p	OA47	8p	4148	5p	3
•	1:04		139	54p*	90	5p	2N2219	20p	
l	AF116 24p	177 <b>17</b> p	155	75p*	91	4p	2646	40p	1
ŀ	117 24p	178B 18p	BF158	20p*	200	6p	2926O	13p*	
	124 30 p	179B 19p	184	25p	O C28	90 p	2926G	15p*	-1
l	239 46p	184B 12p	185	28p	29	58p	3053	18p	-
•	AU113 1 50	* 184L 11p	194	10p*	35	80p	3055	60 p	
1	BC107 11p	187 26p	196	12p*	44	30p	3702	11p*	1
ı	107A 12p	212A 13p		12p*	71	25p	3703	10p*	1
	108 <b>10</b> p	212L 15p		15p*	ORP12	65p	3704	13p*	1
ı	CIL108 6p			38p	TIP29A	47p*	3705	10p*	4
ı	BC108B 11p	214 15p	338	34p	30 A	56p*	3707	12p*	•
1	108C 12p	214L 17p	BFW11	68p	31 A	57p	3819E	25p*	-1
ı	DIODES	BRIDGES	RESIST	ORS	1+p* each		EAR I/C'		١
		D 100V 1A 24p				/41		33p	1
ı		p 200V 1A 25p	1 ohm -	10m ol	hm		80 SL60745		-1
ł		p 400V 1A 26p	TENEDO	(400	w) BZX 83	LM39	900N	69p	
	400V 3A 21	n 1001 171 201		E)/4	5V6, 7V5,	NE55	5	60p	- 1
l			01/1 101/	101/	18V, 22V,	SN76	013ND	1 60*	ı
•	THYRISTO		30V. AI	124,	p*each.			1.75*	-1
	60V 1A	20p					023N	1.75*	
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250v-9250v. 100mA 6·3v. 4a. 0·5·6·3v. 3a. 24·85
250v-9500v. 130mA 6·3v. 4a. 0·5·6·3v. 3a. 24·85
250v-9500v. 100mA 6·3v. 4a. 0·5·6·3v. 3a. 34·36
250v-9500v. 100mA 6·3v. 4a. 0·5·6·3v. 3a. 34·36
250v-9500v. 100mA 6·3v. 4a. 0·5·6·3v. 3a. 34·36
250v-950v. 100mA 6·3v. 4a. 0·5·6·3v. 3a. 31·0·0
425·0·425v. 200mA 6·3v. 4a. 0·5·6·3v. 3a. 31·0·0
450v-0-450v. 250mA 6·3v. 4a. 0·5·6·3v. 2a. 31·0·0
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Switched AFC Multi turn pre-sets

LED Stereo Indicator

Typical Specification: Sensitivity 3µ volts Stereo separation 30db Supply required 20-30v at 90 Ma max.

STEREO PRE-AMPLIFIER

Frequency Response + 1dB
29Hz-28KHz.
Sensitivity of inputs:
1. Tape input 100mV into
100K ohms
2. Radio Tuner 100mV into
100K ohms
3. Magnetic P.U. 3mV into
100K ohms
P.U. input equalises to R1AA
curve within 1dB from 29Hz to
20KHz. Supply 26-35V at 20mA.
Dimensions—209mm×30mm×
33mm.

the settings of the pre-set controls.

former T461.

Instructions supplied.

25 Watts (RMS)

 Max Heat Sink temp. 90C.
 Frequency response 20Hz. ● Distortion better than 0-1 at 1kHz. ● Supply voltage 15-50v. Thermal Feedback. Latest Design Improvements. ● Load—3,4,5, or 16ohms. ●Signal to noise ratio 80db. Overall size 63mm. 13mm.

Especially designed to a strict specification. Only the finest components have been used and the latest solidstate circuitry incorporated in this powerful little amplifier which should satisfy the most critical A.F. enthusiast.

Stabilised Power Supply Type SPM80

SPM80 is especially designed to power 2 of the AL60 Amplifiers, up to 15 watts (r.m.s.) per channel simultaneously. With the addition of the Mains Transformer BMT80, the unit will provide outputs of up to 1.5A at 35V. Size: 63mm, 105mm, 30mm, Incorporating short circuit protection.

INPUT VOLTAGE OUTPUT VOLTAGE OUTPUT CURRENT OVERLEAD CURRENT DIMENSIONS

33-40V. A.C. 33V. D.C. Nominal £3.00 10m A-1-5 amps 1.7 amps approx. 105mm × 63mm × 30mm

TRANSFORMER BMT80 £2 60 + 62p. postage

A top quality stereo pre-amplifier and tone control unit. The six push-button selector switch provides a choice of Inputs together with two really effective filters

for high and low frequencies, plus tape output.

 $2\frac{1}{2}\%$ 

MK60 AUDIO KIT:

Comprising: 2: AL60's 1x SPM80, 1 x BTM80, 1 x PA100, 1 front panel and knobs. 1 Kit of parts to Include onioff switch, neon Indicator, stereo headphone sockets plus Instruction booklet. CoMPLETE PRICE £27-35 plus 62p postage.

TEAK 69 AUDIO KIT:
Comprising: Teak venered cabinet size 16½" x 11½" x 3½", other parts include aluminium chassis, heatsink and front panel bracket plus back panel and appropriate sockets etc. KIT PRICE £8-20 plus 62p postage.

COMPLETE **AUDIO CHASSIS** 



7 + 7 WATTS R.M.S.

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The Stereo 30 comprises a complete stereo pre-amplifier, power amplifiers and power supply. This, with only the addition of a transformer or overwind will produce a high quality audio unit suitable for use with a wide range of inputs i.e. high quality ceramic pick-up, stereo tuner, stereo tape deck etc. Simple to Install, capable of producing really first class results, this unit is supplied with full instructions, black front pack, knobs, mains switch fuse and fuse holder and universal mounting brackets enabling it to be installed in a record plinth, cabinets of your own construction or the cabinet exhibits. Leaf for the beginner or the advanced constructor who requires Hipperformance with a minimum of installation difficulty (can be installed in 30 mins.).

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TEAK CASE £3.65 plus 62p p & p.

## equipment mono and other modules for Stereo

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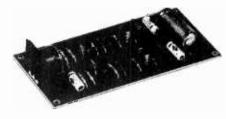
35 kms power Amp!

A High Fidelity Power Amplifier with a maximum Power Output of 35 watt R.M.S., which has a maximum operating voltage of 60v. A MUST for all HI-FI users.

AND for those who need more

Maximum supply voltage Power output for 2% THD Harmonic distortion Load impedance Input impedance Frequency response +3dB Sensitivity for 25 watts O/P Max. Heat sink temperature Dimensions Mounting Fuse requirements

15-60v 35 watts R.M.S. 0 1% 3-8-16 ohm 50K ohm 20Hz-40KHz 280mV R.M.S. 90°C 102mm x 64mm x 15mm 2, 4BA fixing holes in heat sink



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MODULES

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Frequency response ± 3dB Po = 2 walls 50Hz-25KHz. Sensitivity for Rated O/P—Vs = 25v. RL = 80 ohm. f=1KHz 75mV. RMS. Size: 75mm x 63mm x 25mm.

AL20; 5w £2.65 AL30 10w £2.95

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125 RMS

#### SPECIFICATION:

**AL250** 

Output Power: 125 watt RMS Continuous

Operating voltage: 50-86 Loads: 4-16 ohms

Frequency response: 25Hz-20kHz Measured at 100 watts

Sensitivity for 100 watts output at 1kHz: 450mV Input impedance: 33K ohms

50 watts into 8 ohms: 0.06% S/N ratio: better than 80dBs Damping factor, 8 ohms: 65 Semiconductor complement: 13 transistors 5 diodes Overall size: Heatsink width

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Total harmonic distortion

190mm, length 205mm, height

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Frequency Response 28Hz-28KHz (-3d8)
Bass and Treble range ± 12d8 Input Impedance 1 meg ohm Input Sensitivity 300mV
Supply requirements 24V. 5mA
Size 152mm x 84mm x 33mm

Power for AL20-30, supply S450 etc. Input voltage 15-20v A.C. Output voltage 22-30v D.C. Output Current 800 mA Max. Size 60mm x 43mm x 26mm.

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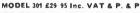
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APPLICATIONS: Hi-Fi-Mixers-Disco-Guitar and Organ-Public address

SPECIFICATIONS: This SPECIFICATIONS: The SPECIFICATIONS: The SPECIFICATIONS: INPUTS Magnetic Pick-up 3mV; Ceramic Pick-up 3mV; Tuner 100mV; Microphone 10mV; Auxiliary 3.100mV; Input impedance 4 7kD at 1kHz.
OUTPUTS. Tape 100mV; Main output 500mV R.M.S.
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Price £4-75 + 59p VAT P&P free.

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15 Watts into 8Ω

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

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

audio oscillator.

SPECIFICATIONS:
OUTPUT POWER 15W R.M.S. into 8Ω; DISTORTION 0-1% at 1-5W.
INPUT SENSITIVITY 500mV. FREQUENCY RESPONSE 10Hz-16kHz-3dB.
SUPPLY VOLTAGE ± 18V.

Price £4-75 + 59p VAT P&P free.

### **HY50**

25 Watts into  $8\Omega$ 

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 amplifler

SPECIFICATIONS: INPUT SENSITIVITY 500mV
OUTPUT POWER 25W RMS Into εΩ LOAD IMPEDANCE 4-16Ω DISTORTION 0-04% at 25W

at 1kHz SIGNAL/NOISE RATIO 75dB FREQUENCY RESPONSE 10Hz-45kHz—3dB. SUPPLY VOLTAGE ±25V SIZE 105 50 25mm Price £6.20+77p VAT P&P free.

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60 Watts into  $8\Omega$ 

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Five connections -No external components APPLICATIONS: Hi-Fi-High quality disco-Public address-Monitor amplifier-Gultar and

SPECIFICATIONS
SPECIFICATIONS
INPUT SENSITIVITY 500mV
OUTPUT POWER 60W RMS into 8Ω LOAD IMPEDANCE 4-16Ω DISTORTION 0·04% at 60W at 18Hz

at 1kHz SIGNAL/NOISE RATIO 90dB FREQUENCY RESPONSE 10Hz-45kHz —3dB SUPPLY VOLTAGE

±35V SIZE 114 50 85mm

Price £14.40+£1.16 VAT P&P free.

### **HY200**

120 Watts

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

SPECIFICATIONS: HI-FI-Disco-Monitor-Power slave-Industrial-Public Address SPECIFICATIONS
INPUT SENSITIVITY 500mV
OUTPUT POWER 120W RMS into 8Ω LOAD IMPEDANCE 4-16Ω DISTORTION 0-05% at 100W at 14Hz.

into 8Ω

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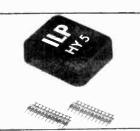
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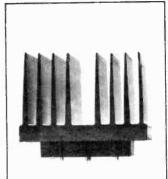
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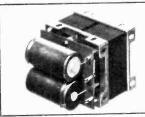
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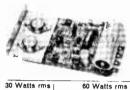
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\* Front panel to suit £3-50

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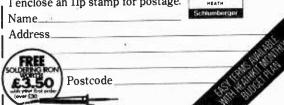
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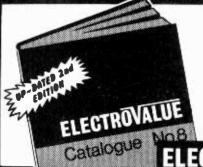
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£5.50 £8.96 £14.95 £12.00 £10.95 £6.60 £8.95 £17.75 £18.75 £44.00 £49.00	KEF kit 1 KEF kit ill Peerless 1050 Peerless 1070 Peerless 2050 Peerless 2050 Peerless 2050 Pichard Allan Twin assembly Richard Allan Triple 8 Richard Allan Triple 12 Richard Allan Super Triple Richard Allan RAB Kit Richard Allan RAB Kit Richard Allan RAB Kit Richard Allan RAB Kit Richard Allan RAB Kit	pair each pair each pair pair each each each each pair pair pair	£36 -00 £46 -00 £46 -50 £54 -00 £39 -50 £39 -50 £39 -50 £20 -70 £25 -90 £29 -80 £37 -80 £59 -40

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## WITCH HUNT

HE Home Office has withdrawn permission from Amateurs to use the double sideband suppressed carrier (DBSC) mode of transmission. The excuses, I hesitate to call them reasons, are both puzzling and illogical. For example, the Radio Regulatory Division has suddenly discovered that DBSC is not authorised by international radio regulations. The fact that Amateurs have been permitted this mode for some time, that Amateurs in other countries will continue to have this privilege, does not seem to have been discovered by the Home Office—yet.

Perhaps the funniest excuse given by Whitehall Bureaucracy is that DBSC is difficult to monitor unless special equipment is used. If the Home Office stands by this, then it is quite plain that it does not understand DBSC and not much else about the reception of radio signals, either. Amateurs have been able to receive DBSC using their ordinary communications receivers so perhaps the professionals should ask the Amateurs for guidance and

technical tuition?

This is not the first time that the white-collar brigade has found itself embarrassingly inferior. Back in 1968 many Amateurs were sent an official communication asking them to send morse more slowly! They were sending CW faster than the licence permitted, too fast for the professionals to read!

Certainly the RSGB has received protests on the subject. The Society position is that it will simply not accept the ruling and it has reopened the matter with the Home Office. The point is put that Amateurs do not deserve to lose privileges, but unless complacency is replaced by keen interest they are going to lose more. Remember, there is a major international communications conference due in 1979. Frequency space is precious; why waste it on Amateurs? Take it away, they're complacent, they won't do anything.

Ahl you may cry, what about all that valuable "self training" which government is so keen Amateurs should have? And the simple reply is, "What self training?" How many Amateurs today construct their own transmitters or receivers? Very, very few. Many trot out and purchase black boxes for a few hundreds of pounds. Are not those who do this helping to reduce the Amateur Radio spectrum

to Citizen Band status?

Let us not, then, throw brickbats at the Home Office. Instead, let us approach it with solid, well founded arguments. Don't let's bitch at the RSGB for "doing nothing". Any Society will act on instructions from its members. So let us instruct. The ball is firmly in our court. If we don't play it, the pendulum may well continue to swing towards less and less privileges for the individual and then towards fewer and fewer rights.

LIONEL E. HOWES—Editor

**VACANCY ON PW** 

A vacancy exists on PW for a Technical Sub-Editor. Applicants should have a good knowledge of modern radio and electronic techniques. The work is very interesting consisting mainly of the preparation of articles for publication. Previous experience of this work is desirable. Write with brief personal details to the Editor, Practical Wireless, Fleetway House, Farringdon Street, London EC4A 4AD.

## NEWS...

#### Laskys move north

ELL Scotland, you need never feel as though you are missing out on something ever again. Laskys—that well known southern emporium of HiFi fame has spread its wings north of the border. Two new shops have recently been opened —one at 53 High Street, Ayr, and the other at 133, King Street, Kilmarnock.

Both shops previously traded under the name of Valley Electronics who earlier this year were taken over by Audiotronics, the brand name of Laskys.

#### Up, Up and Aiwa

IWA, who despite the economic climate of late, claim an ever increasing growth rate in the UK Hi-Fi market, have decided to consolidate their sales and service network in this country. To this end, they have established a new subsidiary company—Aiwa Sales and Service (UK) Ltd.

This new organisation, the seventh overseas venture to be set up by the parent company, came into official existence from the 1st August 1976. The address of the new company is:—8 Grey Cain Road, Watford, Herts.

#### Walls have ears

Vou all knew about those wires that run around the walls of houses and whose owners are 'paid one shilling a year, or something like that, for the privilege of letting the company use their bricks for support. Well most are owned by British Relay who use the lines for their cable TV network. Now it seems, British Relay are making these cables available to local authorities and community groups wishing to operate local radio stations.

The offer is said to be restricted to areas where the

## NEWS...

## NEWS...

## NEWS...

cables are not already fully loaded with local and national BBC programmes and independent radio channels. In offering to make its cable network available, British Relay says its charges will not be too high as the company does not wish to make a profit for as long as the programmes remain experimental and are run as a social service.

Why not invade?

T a loose end? Live in Hastings? Then trot along to the Hastings Electronic and Radio Club, where they will welcome any people interested in amateur radio, HiFi, television, digital techniques etc.

The club meets at the Social Centre Hall, Middle Street, Hastings, on the third Wednesday of each month at 7.30 p.m. At the present moment, there are about 50 members, but the more that join, according to the club's publicity officer Martin Oliver, the more diverse the activities within the Electronics field could become.

#### We apologise . . .

It appears that the address given for information concerning the RAE Courses, published in October was incorrect. The correct address is as follows:—J. Brett (Principal), Cove School, St. John's Road, Farnborough, Hants.

#### **Kiddy** calc

really, that after just about every adult has a calculator to play with, a company would have the rather dubious "bright idea" of producing a calculator for the—wait for it—6 to 9 age group.

Manufactured by Texas Instruments, the "Little Professor" calculator is described as being more of a learning aid, with up to 16,000 pre-programmed basic maths

problems. Apparently the child selects the type and degree of difficulty of the problem and then leaves the rest up to the machine. An answer is then made—if correct the complete equation appears for one second, and then the next problem appears. How-



ever if an incorrect answer is given the problem reappears. Three wrong answers are allowed, after which the machine senses that its user is not quite with it, and automatically displays the correct answer.

After ten problems, this little monster—sorry "professor"—will display a score out of ten, which would swiftly be followed by the next ten problems. How's that for progress?

#### Read-all-about-it

T'S not often the chance of a free booklet comes up, but Marconi Instruments 12-page illustrated offering a booklet explaining the TF2008 AM/FM signal generator. This generator is claimed to suitable for measurements on almost every type of communicaand broadcast receiver operating up to 510MHz, and for specialized receivers such as those used for navigational aids. It has eleven tuning bands covering 10kHz to 510MHz and possesses the ability to be used as a sweep generator.

The booklet describing this signal generator is entitled "All in

One Package" and is available from Publicity Department, Marconi Instruments, Longacres, St. Albans, Herts. Tel: St. Albans

#### Go on-have a go!

JUST starting for the fifth successive year is the 3M Young Poet Awards Scheme. This scheme requires school-children to compose poems and record them onto open reel tape or cassettes.

Last year, nearly 2,000 tapes were entered by schools throughout the United Kingdom, and this year's contest (1977) will again be for entries in three categories. The three categories are as follows:—

(a) Junior—7 to 11 year olds. (no more than 20 lines)

(b) Secondary—12 to 15 year olds. (no more than 30 lines)

(c) Senior secondary—16 to 18 year olds. (no more than 30 lines)

To make the contest more attractive, 3M will be awarding trophies, a heavy duty Wollensak cassette recorder for the winners' schools, plus individual prizes for the winners and runners-up. Judging will be by a panel comprising poets and educationalists, while entries will be judged on originality, technique, command of English and oral presentation. An unusual rule in this contest is that poems will be accepted in standard English or a local dialect.

Full details and entry forms are now available from Nigel Cobb, 3M United Kingdom Limited, 3M House, Wigmore Street, London W1A 1ET. Tel: 01-486 5522. Closing date for receipt of entries is January 26th 1977.

## Capacitance Meter PW Sept. 76

SEVERAL readers have contacted us because they have had difficulty in locating the FET, type 2N5485. Stocks are available from: C.T. Electronics, 270 Acton Lane, Chiswick, London W4 5DG. Tel. No. 01-994 6275.

# SIMINIA SIMINIA VITE CONVERTER

HE usual specialised VHF converter, such as may be employed for 2m reception, employs a crystal-controlled oscillator and there will often be multiplier and RF stages present. These features assure a high degree of frequency stability and high sensitivity, but they add considerably to the cost and complication of the unit and the fixed frequency oscillator also imposes limits on the VHF bands which can be received.

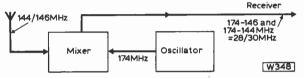


Fig. 1: Simple diagram illustrating the method of changing frequency in the converter.

A converter with a tuned oscillator, and no RF stage, is by comparison very inexpensive and straightforward. It has the great advantage that it is readily adjusted for a whole range of reception and output frequencies. Naturally frequency stability cannot equal that of a converter with a crystal-controlled oscillator but many popular VHF receivers use a capacitor tuned oscillator and are able to perform satisfactorily. So the converter described here has no RF stage (which does not contribute very greatly to sensitivity in any case) and a tuned oscillator. If it is enclosed in a metal box as described, and placed to the side or back of the receiver out of the way, no hand-capacitance or similar troubles will be found to arise.

#### COVERAGE

The converter may be used from about 70MHz up to a limit which depends somewhat on transistors and other details but may exceed 200MHz. The relationship between received, oscillator and output frequencies for 2m reception is shown in Fig. 1. Here, the oscillator is HF of signal frequency and set to 174MHz. The difference between oscillator and aerial frequencies is 28 to 30MHz, so tuning the receiver over this band provides reception on 144 to 146MHz. The reception frequency need not, of course, be that given, but will depend on the signals required.

The output frequency, to which the receiver is tuned, need not be 28 to 30MHz. However, a band around 24 to 30MHz or so will usually have the advantage of reduced breakthrough of unwanted

#### F.G. RAYER G3OGR

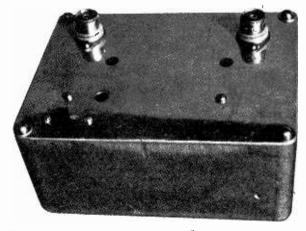
signals. It is not necessary that a 2MHz segment be tuned as reception is obtained outside this limit, with a consequent increase in the width of the band upon which reception is possible. It is general not to use a receiver frequency of lower than 4MHz.

For the oscillator, frequency is determined by the converter input and output frequencies (e.g., the range tuned by the receiver, and the frequency of the wanted VHF signals). The oscillator is either higher in frequency, or lower in frequency, than the wanted VHF signals. The frequency difference equals the receiver frequency. This will be clear from Fig. 1. In practice, it will be found easy to tune the oscillator until the wanted signals are heard with the receiver. However, Fig. 1 will be of aid in working out a convenient way to obtain coverage of a wanted VHF band.

#### THE RECEIVER

Such a converter is normally used in conjunction with a short-wave communications-type receiver which will usually tune up to about 30MHz. It will also have a metal case which will keep down unwanted signals such as broadcast or other interference, and the receiver will usually have an RF amplifier.

Reception obtained depends on the facilities on the receiver. Many VHF signals are AM and will be received in the usual way, but for CW or SSB reception, the receiver must have the capability for



Not a very prepossessing box! But after adjustments it can be placed out of the way.

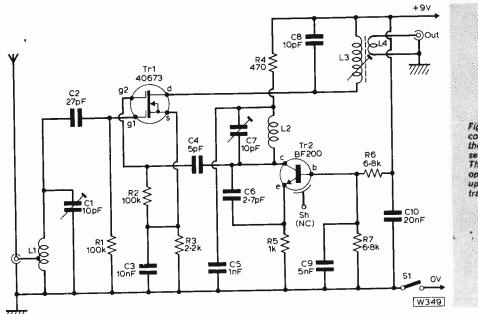


Fig. 2: Complete circuit of the converter. Trimmer C1 peaks the signals while trimmer C7 sets the operating frequency. The maximum frequency of operation will depend largely upon the characteristics of the transistor Tr2, a BF200.

this mode. Other VHF signals will be FM, but whether or not these can be tuned in satisfactorily depends on the receiver selectivity, as reasonable FM detection may be possible by tuning the signal on to the slope of the IF passband. Good quality or high fidelity FM reception should not be expected by this means.

#### CONVERTER CIRCUIT

This is shown in Fig. 2 where L1 is the mixer aerial coil, and L2 the oscillator coil. Core-tuned coils are commonly employed but here tuning is effected by the small presets C1 and C7. This greatly eases band modification, because L1 and L2 are merely self-supporting coils soldered to pins and so can be changed in a few moments.

A co-axial socket is provided for the aerial. Many signals can be obtained by a short rod or stout wire,

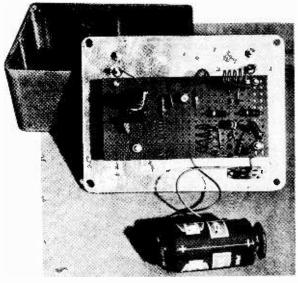
projecting vertically from this socket. Naturally an improved aerial will greatly increase range and volume, while the use of a co-axial lead from it to the converter reduces capacity effects which can be present with the rod. For 2m the aerial can be simple dipole about 993mm (3812in) overall, either wire or self-supporting tube, with a feeder from the centre. Such an aerial is easily made to fit on a light wooden post. It will also give reception over quite a wide range of frequencies.

Transistor Trl is the mixer with injection from the BF200 oscillator Tr2 via C4. In the converter constructed, the grounded base oscillator Tr2 functioned up to 230MHz.

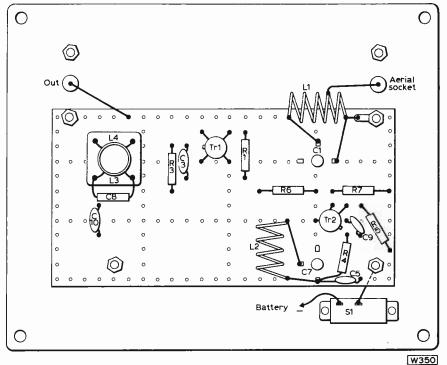
The mixer drain feeds the resonant circuit L3 which is broadly tuned to the receiver frequency and it has a coupling winding L4. This allows a coaxial lead to be used to the receiver, to avoid unnecessary pick-up of interfering SW signals.

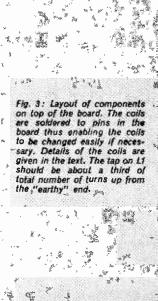
#### ★ components list

R	tesiators 4
	R1 100kΩ »: * R5 1kΩ
	R2 100kΩ *
	R3 2.2k(1) R7 6.8k(1)
	R4 4700 All 1 or 1W 5%
	K4 41002
C	anacitors *** * * * * * * * * * * * * * * * * *
	C1 10pF timmer 5C 2-7pF
	(Jackson 'Tëtfer')
1 3	C2 27pF C7 10pF trimmer, as C1 9
	C3 10nF C8 10pF
	C4 5pF C9 5nF
	C5 1nF C10 20nF
	All fixed capacitors are ceramic
4 1	
	Semiconductors Tr2 BF200
A 40	
34	Miscellaneous * . * ***
***	Metal box about 125 x 100 x 50mm (5 x 4 x 2in.) Plain
	veroboard 0-15(n, matrix 95 x 48mm (31 x 11in.)
2	Slide switch. Battery and clips. Coaxial sockets 2.
** 1	Former 7mm with core. 6BA nuts and bolts.
*	



The finished board is bolted to the lid of the box and wires taken to the coaxial sockets and the on-off switch.





#### CONSTRUCTION

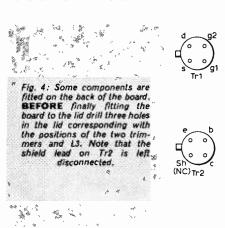
The metal box used is slightly under 125 x 100mm (5 x 4in) and is about 50mm (2in) deep. Components are assembled on a 0.15in matrix perforated board about 95 x 48mm ( $3^{3}_{4}$  x  $1^{7}_{8}$ in), Fig. 3. First drill both board and box top together for the four 6BA mounting bolts and also fit the two co-axial sockets and on-off switch. The bolts are long enough to allow about 15mm clearance between board and box top. Components are mounted on both sides of the board, as in Figs. 3 and 4. Short connections are used and the by-pass capacitors can be small disc ceramic types. Pins are fitted as shown to take L1 and L2. If trimmers other than those listed are used take the upper or rotating part to the earth line for C1, or C5 for trimmer C7. The tags MC are connected to the metal box through the mounting bolts. When the board has been wired, fit it as in Fig. 3, and connect co-axial and switch leads. Holes match with L3 and the trimmers.

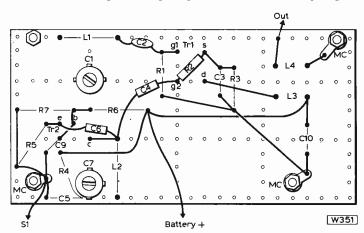
#### **INDUCTORS**

The output coil L3 is wound on a 7mm cored former and has 15 turns of 26SWG enamelled copper wire close wound. Core adjustment allows this to be tuned around the 28 to 30MHz region. L4 is 4 turns of insulated wire, overwound on L3, at the "earthed" end (C10). To cater for a receiver tuned over the 14 to 16MHz range the coil may have 28 turns of 32SWG enamelled copper wire, with a 22pF parallel capacitor instead of the 10pF shown. L4 is then 7 turns.

For 70MHz a coil covering about 65 to 95 MHz can be wound with 20SWG wire. Use 9 turns, with an outside diameter of 10mm and with turns spaced to occupy 20mm. For 144MHz a coil covering about 115 to 150MHz is suitable and this can have 5 turns, 9mm outside diameter and 20mm long. For frequencies over about 175MHz, two turns, 8mm outside diameter and 18mm long, may be used.

Reception frequency is of course critically depen-



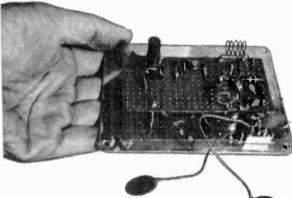


dent on L2 and C2. Here, an oscillator range of about 85 to 115MHz can be obtained with 6 turns, 9mm outside diameter and 9mm long. For 2m a smaller coil is necessary and it can have 4 turns, being 8mm outside diameter and 17mm long, for a coverage of about 140 to 185MHz. The smallest coil found able to sustain oscillation was 1 turn, 9mm outside diameter, which covered from 190 to 230MHz.

#### TUNING ADJUSTMENTS

The core of L3 is peaked up for best reception at about the middle of the range to be tuned on the receiver (as example, say 29MHz). This can be done with any signal received through the converter or by temporarily placing an insulated lead from the short-wave aerial against the drain lead to L3 and tuning L3 for best reception of a signal in the actual receiver band.

L1 tuning is extremely flat and can simply be peaked up when some VHF signal of about the wanted frequency is heard. Very flat tuning here does not indicate any fault. To find the wanted signals, slowly rotate C7 throughout its range, When set, tuning is carried out on the receiver. The tuning of L2 is critical and slight re-adjustments will move the VHF signals up and down the receiver scale, which may be useful to dodge troublesome SW breakthrough.



Another view of the converter. Initial testing can be done with it out of the box. Final frequency adjustments must be made with the converter and battery in the box. Ensure the battery cannot move about inside the box.

C6 was found to provide oscillation over the ranges described. Oscillation is not occurring if a milliameter in series with R4 shows no change in current when L2 is touched with the fingers. In these circumstances reception through the converter is impossible. With other transistors, it may be worth modifying C6, but the value necessary here is very small.

Tuning the receiver over a wider band gives greater VHF coverage, but if the receiver is tuned too far from the frequency to which L3 is set, sensitivity will be reduced unnecessarily. As signals at the converter aerial circuit may be either above or below the oscillator frequency, strong signals will break through on the second channel. This is unlikely to matter unless the receiver is used at a rather low frequency. For example, wanted and second channel aerial frequencies will be separated by 60MHz if the receiver is tuned to 30MHz, but only by 8MHz if the receiver is used on 4MHz.

## TELEVISION

### DECEMBER

#### . THE ART OF ALIGNMENT

Many people are shy about receiver alignment. Amongst possible causes are the absence of any standard work on the subject, the confusing instructions so often found in service manuals, and the fact that if you don't know what you're doing you can end up in a right mess. Harold Peters sets out to cure this state of affairs, giving a down to earth account of the principles along with practical examples and hints.

### • THE PHILIPS G8 COLOUR CHASSIS

We are often asked about the popular Philips G8 colour chassis introduced in 1970. A. Denham describes the fault conditions he has commonly encountered on the various versions of it.

#### • TV SOUND CIRCUITS FOR THE CONSTRUCTOR

It is sometimes desirable to be able to monitor the TV sound through a separate system to that in the set. Recent TV sound i.c.s. make the construction of a complete TV sound channel particularly simple – using just one i.c. and a handful of components. A practical, tested design is given, also an output stage which can be used to replace obsolete i.c. sound output stages.

#### SERVICING TELEVISION RECEIVERS

Les Lawrey-Johns reports on his experiences with Philips 320 solid-state monochrome chassis.

#### MINIATURE VHF AERIALS

When Bands I and III are re-engineered the question of new v.h.f. TV aeriais will arise. Need they be such massive structures as the present generation? Recent developments indicate that much smaller types are practicable. Pat Hawker reports.

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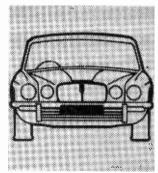




AVE you ever left your works in the evening, returned to your car and found the battery flat because you forgot to turn off your lights when you got out of the car that morning?

Probably very few can say they haven't at least left the lights on, even if the result wasn't a flat battery, and the approaching dark mornings must increase the chances of repeating the mistake, or, for the lucky ones, making it for the first time.

Now a simple electronic device will ensure that your memory isn't the last line of defence.



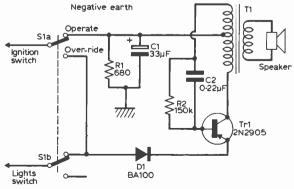
#### Theory of operation

The unit functions by looking at the state of the car's lights and of the ignition. When both are off the unit is happy, when both are on the unit is happy but when the lights are on and the ignition off then the unit complains by giving an audible note.

There are, of course, times when it is required to

There are, of course, times when it is required to accept the condition of lights on only and, to avoid an unpleasant noise, an override is provided. However, when the override has been used it has to be cancelled when the ignition is switched on again or the unit complains once more with its audible note.

Fig. 1. The schematic diagram of the unit for both negative and positive earth systems. Please note that Tr1, in the positive earth unit, should be BC107 as per parts list.



#### **Circuit operation**

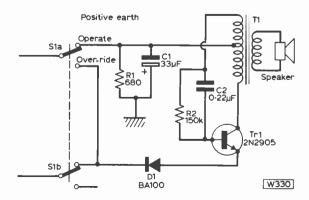
The schematic for the unit is given as fig 1. In the circuit, which is an audio oscillator, the transformer and C2/R2 provide the phase shift and determine the frequency of operation. Because the tone isn't critical a wide range of capacitor and transformer types and values can be used. Those given in the parts list proved quite successful.

Resistor R1 provides a DC return path under certain circumstances and capacitor C1 acts as an AF bypass for it, preventing any of the audio being lost.

The unit derives its power from the car's battery but it can be via either the ignition switch and earth or the light switch and earth depending on the mode of use.

#### **Switch operations**

With the selector switch S1 at normal, the ignition off and the lights off there is no supply to the unit



#### \* components list

R1 680Ω 10% ½W 150kΩ 5% ½W R2 C1 = 33µF, 25V, electrolytic C2 0.22 µF, any material D1 OA90, or equivalent Tr1 2N2905, for Negative Earth BC107, for Positive Earth T1 Transformer, miniature transistor output, 1  $2k\Omega$  primary,  $8\Omega$  secondary Double pole, Double throw, toggle, lever or To suit the output transformer Speaker Miscellaneous, Perforated board, Board pins, Transistor Socket (if required), Switch Bracket

and it remains dormant. When the ignition is switched on, but the lights are not, there is a path to earth for the ignition voltage, via R1, but the remainder of the circuit is inoperative.

When the ignition and the lights are both on, the collector and emitter of Trl are at equal potentials so the circuit does nothing. If the ignition is turned off whilst the lights are on, the collector of Trl is returned to earth through R1 and the emitter is supplied with the battery voltage. Under these conditions the circuit will oscillate and produce the

With the selector switch in the override position, the supply from the light switch is left open circuit irrespective of the lights being on or off. The potential at the ignition switch is applied to the emitter of Trl through Dl.

If the ignition is off, then, under this switch position, the unit is not energised and all is quiet even though the lights are on. However, when the ignition is switched on the battery potential is applied to the emitter of Tr1 and, since its collector is returned to earth via R1, the circuit oscillates and the alarm sounds as a reminder to return the system to normal. The alarm will, of course, stop when the switch is returned to the operate position.

#### Construction

The method used for mounting the components and the unit itself will depend to a large extent on the space available in the car and on the preferred mounting position.

In the author's case, sufficient space existed behind the dash panel so the components were mounted on a small piece of perforated board and bolted into a box. The box, less the normal/override switch, was bolted behind the dash. The switch was mounted on the dash handy to the ignition switch and wires run between the two.

If space permits, the board can be mounted on an aluminium bracket and the complete unit fastened into its resting place by the switch locking nuts.

The supply for the lamps is probably most conveniently taken from the switched side of the light switch itself, although if the location of the unit warrants it, it could be tapped off the lamp connector. The supply can be wired to either the parking lights or the headlamps. In the latter case make sure the headlamp flasher doesn't operate the warning.

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#### FLAT PICTURE

Pilgrimages can be rather long, but perseverance can make all the difference. One person who is quite definitely persevering is a German researcher in Dortmund. His pilgrimage is to the shrine of the flat television tube. And he thinks his journey could be over within the next couple of years.

Already, this gentleman has built a prototype pocket television receiver with a  $12 \times 9$  centimetre display—flat screen, of course. The prototype is black-and-white, but already there are plans to build a colour display. The favourites at the present state-of-the-art are electroluminescence and liquid crystal.

Don't think it's just a theoretical dream either. Quite apart from building a prototype, an automated system to produce the flat screens has been worked out and is not terribly expensive. Part of the system involves laying down thin film transistors directly on to glass in order to drive the screen.

One tast thought. The researcher thinks that the system of the minute pocket television could be employed in a midget projection TV system. Presumably, boring programmes will be eyed at 12 × 9cm while the Miss World contest would be projected on to the outside wall of the nearest freshly "Snowcemed" house.

#### EYE, EYE!

Bet you've often heard the expressions 'A backward glance', or having 'eyes in the back of your head'. American researchers are coming close to doing just that—they're trying to give blind people an 'eye' in the middle of their back!

Numerous systems are under current investigation, some showing greater promise than others. Perhaps the most obvious is the implantation of minute electrodes into the brain. The signals come from a tiny television camera and are converted into impulses which the brain would normally receive from the eye had it been working. Some success has been reported here but obviously the system is intricate and complex. One cannot just plug into the brain.

The newer research is tackling the problem differently and in a very intriguing manner. The researchers argue that the skin is sensitive to various pressures. So why not have some form of sensor system which simply feeds its output to a matrix of "pins" held in close contact with a patient—say to his/her back?

And it works! After about one month of training, a blind person is able to read one-inch high characters. With further training, very much smaller characters can be "read". One person who has tried out the system can get to work quite unaided. He uses public transport and walks a fair distance, too.

Admittedly this method does not allow the patient to see in the exact way that sighted people can, but the training to translate the electrode or needle sensations into 'visual' images seems to work and most certainly works in practice. Again, it doesn't involve any surgery and no insertion of probes into the brain.

Another researcher in this field also pursuing somewhat similar lines has an array of 1,024 electrodes which are held in contact with the stomach. By feeding it with signals from a vidicon attached to a microscope on a production line, a completely 'blind' operative can perform assembly tasks equal to more fortunate, sighted operators.

Some interesting facts have come to light during the experiments. For example, the minimum number of points needed to evoke 'sight' is 1,400. The human eye offers a resolution of some 20,000 points and admittedly when this comparison is made the experimental system does appear inadequate. But these are early days—look at the development of integrated circuits.

## CENTRALLY HEATED ZENER

Whatever will those semiconductor manufacturers get up to next? This time they've fixed their beady little eyes on the zener diode. This device is commonly used to provide a stable voltage reference. In theory, all one needs is a zener plus a suitable series resistor and a stable voltage is

made available. As you've doubtless guessed, nothing is ever that simple. The zener diode has a weakness—it is sensitive to temperature variations and this thermal sensitivity alters the diode's stability. The semiconductor whizz kids decided to do something about the problem—they've built a chip to house a zener diode and a tiny heater which keeps the zener at a constant temperature. The result is that the tiny chip holds variations to 1ppm/°C (one part per million per degree centigrade).

When winter comes and you're cold, just think of all those zeners sitting comfortable by their own little fires. Ain't life beautiful?

#### SOAPY MAGNETS

Bubbling with enthusiasm, that's a fair description of one Japanese company. It's excited about it's latest product—a bubble memory. The industrious orientals have managed to cram 256,000 bits into a 9mm square chip. Each individual memory cell measures a tiny 16 micrometres and the 'bubbles' in the memory have slimmed down to only 4 micrometres.

The 'bubbles' are really minute magnetic domains. Thus a bubble is either magnetised or not magnetised, or is either a north pole or south pole orientated. This gives the yes or no, one or nought pattern suitable for memories.

#### MINIFLOPPY . . .

Talking about memories, have you heard about floppy discs. These are very thin discs of material which can be magnetised by a head as it spins round and stops etc rather like the pick-up arm and gramophone record.

Well, it just had to happen. Someones brought out a midget version called the Minifloppy (I like it, I like it). The storage of information has been carried out by using cassettes in many areas and the Minifloppy is aimed at that area of the market. This includes the microcomputer hobby market, according to the manufacturers.



# PRODUCTION bill tull

#### A well balanced pair!

Fresh from its debut at Audio '76 is Goldring's new turntable unit, the L90. This new model is belt driven and features an illuminated stroboscope together with an electronically controlled speed adjustment and shut-off mechanism. A redesigned ultra lightweight pick-up arm is also part of this new package, as is the wooden plinth and smoked Perspex cover.

To match the full potential of this new deck, Goldring have introduced a new cartridge called the G900E. Weighing in at less than 5 gms. it is claimed to track with precision at 1 gm.

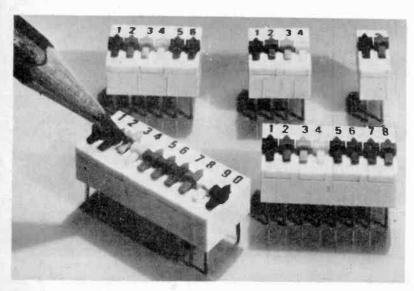
Also, just arrived from Goldring is the latest in Music Centres—the Lenco L3000. Units incorporated comprise an AM/FM tuner with stereo decoder, belt driven turntable unit, a stereo cassette tape recorder, and finally a high quality stereo amplifier, Price of the L90 turntable is £148 00, and for the L3000 £298 00 including

speakers or £252·00 excluding speakers. All prices are exclusive of VAT.
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#### Multi-DIL Switches for PCB mounting

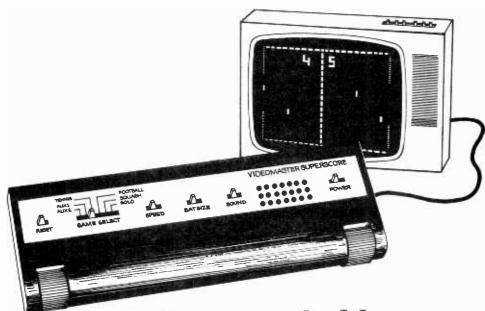


Erg Components have recently announced an entirely new range of Dual-in-Line switch modules called 'SpectraDIL'. These switches are available in 2, 4, 6, 8 and 10 pole versions, and range from 5 to 25mm in length. The basic single throw style has a white case with laterally operated arrow shaped sliders, coloured in accordance with the international colour code.

Features include gold plated spring loaded wiping contacts suitable for microvolt to low power switching and a typical resistance of 10milliohms. Useful life of these switches is claimed to be in excess of 10,000 operations at full 10VA rating.

Prices start from 10p per pole per switch per 100, and as all types are held in stock, the firm claim that despatch is immediate.

Erg Industrial Corporation Ltd., (Dept. PW), Luton Road, Dunstable, Beds. Tel: 0582 62241.



# Here's the remarkable new

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This all-new Videomaster plugs into your 625-line UHF TV set (for overseas customers having VHF sets we can supply the necessary VHF modulator) to give you four exciting games (including tennis and football) and two future game options. It features on-screen digital scoring, realistic hit sounds, two bat sizes, two

ball speeds, automatic serving and much more. It runs on six  $1\frac{1}{2}$  volt SP11 type batteries (not supplied).

The Videomaster Superscore kit costs only £24.95 including VAT (recommended retail price of the ready built model is over £40.00) and comes complete with ready-tuned UHF or VHF modulator, circuit board with printed legend, all resistors, transistors and diodes, built-in loudspeaker, socket for mains adaptor, and, of course, the TV game chip itself.

Easy to put together the Superscore has full assembly instructions, circuit diagram and circuit description. Don't miss this chance to own the newest electronic game at such low cost.

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#### CB oggler!

In the July issue of Practical Wireless you wrote a most interesting article called "One flew over the Citizen's Band". Firstly let me say that to someone like myself, and many others who are eagerly awaiting the advent of a CB licence being available in this country, oh! what joy to be able to read those dreaded words "CB" in your magazine. Yes, for far too long many organisations and individuals have looked down their noses at this mention of CB. So somewhere along the line at long last it has reached PW, and we can hope the Government departments concerned.

I agree all the way that we do not want a carbon copy of the US style jumble in and around the big cities, and I know that frequency allowance is the big, big problem. I am only a shortwave listener, no more, and have tape contacts in the States who have sent recordings of CB-ers at work, so I know the jumble that results in over-crowding of the air-waves. Just tune in any time to the 25, 31 metre bands etc.

But can you give any idea of where and when, or who, or what concern motivated the idea of CB in the UK? I know you said that the problems were—"when, where and how?" But over the last few years any attempt to ask about CB and it being allowed here only resulted in a form being sent -so I could go to tech for a couple or more years and sit for my Radio Amateur licence—which is what I do not want! OK you can say that I'm wanting the easy way out, getting on the air for the cost of a licence over the nearest post office counter, but if it can happen not only in the USA, but Canada, and Germany, Sweden, and even some eastern European countries-then why not here? So please-you have whet not only my appetite, but many of my friends too.

By the way, just for the record, I am 39 this year, so it is not the case of a kid getting on the air for a giggle, oh no. For far too many years I've oggled my pals CB-rigs fitted in cars, shacks etc, plus the genuine usefulness it can hold to the serious user. Many lives would be saved in Snowdonia for example, if the poor unfortunates had carried a small walkie-talkie with them, the limits are endless. So keep up the good work, and many thanks for your article.—M. B. Walker (Coventry).

#### Text book PW?

In reply to your leader article in the September issue of PW titled "Wireless or What?"

I have been receiving PW monthly for about 5 years and have always found it extremely good value for money. However, there seems to have been a gradual drop in the number of constructional projects which the reader of "modest means" can build. Even the Take 20 seems to have disappeared.

My suggestion is that each month there are three types of project. One could be a part of a more complex project, eg teletennis, etc. The second type could be a fairly complex project which could be featured in one month's PW and costing less than £20, and the final type should be similar to the Take 20 showing construction details of projects costing less than £5. The latter group would enable either the beginner or a reader of limited budget to build something regularly. Any or all of the projects in any one month could be "wireless" or "electronic" which would give plenty of scope.

Another suggestion is that each month there could be an article which would enable readers who would like to transmit to reach the City & Guilds radio amateur examination standard. Then more simple 2m equipment projects could be included. This may revive the almost unused 2m band. D. Jewitt (Hull).

#### No Justice

To answer Nick Moyes and his friends, PW October 1976. Thousands of people such as farmers, climbers, boat owners and hikers want CB, people who have no knowledge or interest in the mechanics of radio, but who could make good use of a system which could possibly save their lives. It seems to be a strange state of affairs, where anybody can bang out 1.5W on 27MHz to play with a toy boat or plane, but radiate 100mW from a 'walkie talkie' on the same frequency, and you are in line for a £400 fine and/or six months in prison.

I agree that when CB comes to this country (and the sooner the better) there is a need for strict control, a licence to be produced before the purchase of equipment etc., but surely we are in a first rate position in this country to learn from the mistakes that have been made in other countries as regard to frequencies and licensing conditions. I think that anybody who has ever listened to US truck drivers on CB will agree that it makes far more entertaining listening than the only too predictable talk of the weather, and what dipole is being fed from which valve that radiates from our SW friends.—Peter Jones (Swansea).

#### No honestly!

On reading Mr. Dodd's letter in the September issue of PW criticising your magazine, help but reply couldn't defence.

May I point out to Mr. Dodd that without all this so called "electronic gimmickery" he talks of, the articles could so easily become boring. Magazines like PW must move with the times or be left behind in a rut. If it is valves you want, look through all your back issues for there are plenty to be found. As for "wireless", only my Grandfather calls it that now! (How about P.R.

I am sure there is enough radio (the modern term for the device which does the same, but a better, job as the wireless), to satisfy any enthusiast. Anyhow,

there are limitations beyond which the entire topic of radio can go no further without issuing all readers with an electronics degree. As PW publishes three or four articles twelve times a year, surely this point would soon be reached.

Perhaps the electronic (ugh) "gimmickery" will teach the old fashioned the new religion of semiconductors, and show them how infinitely more interesting, convenient and versatile they are than the outdated valve.

The revolution is well on the way to victory, and being a young man yourself Mr. Dodd, surely you can appreciate the advantages of semiconductors and adapt to their strange world easier than many. Being eighteen, I have bypassed valves and started on semiconductors (including I.C.'s) and found PW invaluable as a source of knowledge and practical, sound advice. I should hasten to add that I am not completely ignorant of valves (thanks to the "valveless" PW) and I know which I prefer!

If as you say PW is catering for the under twenties, good luck to them, for that is where their future custom is coming from. As to the oldies (i.e. over twenties, nowadays if you are over forty you are senile apparently) stop grumbling about what you are missing and turn on to the new kind of electronics, it's more fun, honestly! Stephen A. Hill (Leeds).

#### Bionic RSGB

With reference to W. M. Miller's (Cambridge) comments on my letter to yourselves, May issue, regarding the RSGB's attitude to publishing articles for the beginner.

Mr Miller states that in Technical Topics section of the Radio Communication, there have been many simple articles published. Well I have been receiving the Journal of the RSGB since the days of the "Bull" and the amount of articles printed for the beginner, certainly does not amount to many.

He also states that the RSGB is not a publishing house. This statement is a little odd, for if they can print articles on linear amplifiers, tunnel diodes, active and passive phasing techniques, etc, they can also print articles

for the novice. Not all the newly elected members of the RSGB, Mr Miller, are Electronic Wizards nor do they possess a Steven Austin Bionic Brain, they just want suitable articles dealing with the first steps of our wonderful hobby.

I can assure Mr Miller I am a fully paid up member of the RSGB, unlike G4CEX (although I share his views), I also greatly appreciate the very good work the Society does on behalf of the radio fraternity, but come on RSGB please cater for the beginner, for, after all, today's beginners are tomorrows licenced Amateurs. If Mr Miller wants a copy of my letter to the RSGB handing out Bricks and Bouquets I will gladly send him one. A. J. Lees (Bournemouth).

#### Toothless dog

Your comments in the editorial of the July PW are most unfair. You conclude the editorial by saying: "isn't that why we voted these people into Parliament—or have I got democracy all wrong?" Indeed you have got democracy wrong, Mr. Flowers, for you advocate compulsory membership of the RSGB who are in no way democratic and represent the minority of amateurs and an even minute minority of the general public. So how can you now speak of democracy?

If you believe that the government is not democratic then the RSGB must be less democratic, for on any major policy it does not take a vote or a general opinion, even within its own membership. For example, who wants repeaters on the 2m band? The RSGB don't really know, as the membership has never voted on it or even had a survey done. Also, what of the opinion of non-members? It is, I am afraid, a classic case of the very, very, noisy minority again. So if the RSGB follows this lead who wants to be a member and worse still a compulsory member?

The next statement is, "but the RSGB fights for the amateur bands." Oh! no it does not, only as a toothless dog. For it has no power or enforcement to back it up. It may well do better if it allowed, as trades unions do, some equal say from official

branches (not clubs) with a set voting system on major issues, to include non-members also.

I hope you publish this letter for it is very rare that anyone writes against the RSGB. However, I feel the time has come for some sensible comments to be made and questions asked.—
A. Leaver G4ECB (Colne).

#### Too true

Mr. Alexander Dodd makes several statements in his letter "Valves" published in the September issue of PW one of which absolutely must be challenged. He complains about the lack of "Wireless" in a magazine of that title, purely on the basis that there are no valves to be found in the circuits, and that there is therefore no "Wireless". Surely, Mr. Dodd, you are aware that the first wireless sets used semiconductors in the form of crystal detectors and the valve was a later intruder. Thank goodness, I say, we have got rid of those nasty new-fangled valves and gone back to good old semiconductors.

He has, however, got a point when he queries the existence of the twin "Practicals", Wireless and Electronics. An example may be found in the issue in which his letter appeared, the PW "Easybuild Video Writer". Now had this article been about the display of characters using "Wireless Telegraphy", i.e. Teletext, then no-one could complain. Since, however, no "Wireless Telegraphy" is involved, Mr. Dodd's point is sustained, though not for the reason he states.

That is not so say that there is not room for more general articles. I for one am quite happy with the present content as my interest does not lie with wireless. Others may have different views, of course. I feel that the title of "Practical Wireless" is misleading for historical reasons. Of course "Wireless World" has a similar problem, and indeed both of these publications would have very limited appeal if they stuck purely to "Wireless Telegraphy". I can't think of a better title, though, and I suspect we will have to live with status quo. R. I. Harcourt B.Sc (Thornton Heath).

# Dear Practical Wireless Reader.

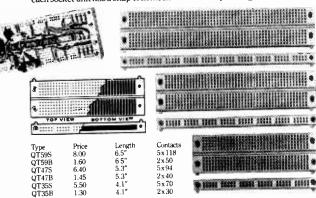
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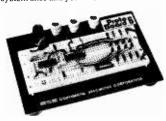
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1A3 60 6BC8 90 6K8GT 55 12E1 3 50 35C5 80 DK40	-70
1A5GT 55 6BE6 40 6L1 2.50 12J5GT 40 35D5 90 DK92	1.00
1A7GT 60 6BH6 70 6L6GC 70 12J7GT 70 35L6GT 80 DK96	-70 l
1B3GT 55 6BJ6 65 6L7 60 12K5 1 50 35W4 55 DL96	-éŏ
1H5GT 80 6BK7A 85 6L18 80 12K7GT 50 35Z3 80 DM70	-80
1L4 25 6BQ7A 60 6L19 2.00 12K8 75 35Z4GT 70 DM71	1.75
1N5GT 75 6BR7 1 00 6LD20 80 12Q7GT 50 35Z5GT 80 DY87/	
1R5 50 6BR8 1.25 6N7GT 70 12SC7 50 42 1.50 DY802	
184 40 6B87 1.70 6Q7G 50 128G7 55 43 1.25 E80CC	2.50
1U4 70 6BW6 1 00 6Q7GT 50 128H7 50 50B5 95 E80CF	
1U5 85 6BW7 65 6Q7(M) 65 128J7 60 50C5 70 E80F	2.20
	1.20
	-70
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	80
	-40
4CB6 75 6CL8A 95 6V6GT 55 20L1 1 20 2158G 60 EA76	1 30
5CG8 -75 6CM7 1.00 6X4 -45 20P1 1.00 807 1.10 EABC8	
5R4GY 1 00 6CU5 90 6X5GT 45 20P3 1 00 1625 2 50 EAC91	-55
5U4G 60 6D3 75 7B6 80 20P4 84 1625 2 50 EAF42	-70
5V4G 60 6DE7 90 7B7 80 20P5 1 60 5702 1 80 EAF80	
5Y3GT 55 6DT6A 85 7H7 80 25A6G 70 5763 1.65 EB34	-30
5Z3 1 00 6EW6 85 7R7 2 00 25L6G 70 6057 1 00 EB91	-17
5Z4G 48 6E5 1.00 7Y4 .80 25Y5G .60 6060 1.00 EBC41	-75
5Z4GT 55 6F1 80 7Z4 80 25Z4G 50 6067 1.00 EBC81	-45
6/30L2 79 6F6G 60 8D2 50 25Z5 75 7193 60 EBF80	-40
6A8G 1.40 6F13 .90 9D7 .70 25Z6G .80 9002 .55 EBF83	-45
6AC7 55 6F14 90 10C2 -70 28D7 2.00 9006 45 EBF89	-40
6AG5 35 6F15 75 10DE7 80 30A5 75 ACPEN 1.20 EBL21	2.00
6AG7 60 6F18 60 10F1 67 30C15 77 AC6PEN 60 EC86	-84
6AH6 -70 6F23 -65 10F9 -65 30C17 -77 AL60 1-20 EC88	64
6AJ5 70 6F24 80 10F18 65 30C13 1 00 ARP3 60 EC92	-55
6AK5 45 6F25 1.00 10LD11 75 30F5 70 ATP4 50 ECC33	2.00
6AK6 70 6F28 74 10P13 80 30FL13 70 AZ1 50 ECC35	2.00
6AM8A 70 6F32 70 10P14 2.50 30FL14 1.00 AZ31 80 ECC40	90
6AN8 70 6G6G 60 12A6 65 30L15 75 AZ41 50 ECC81	.84
6AQ5 47 6GH8A 80 12AC6 80 30L17 70 B36 75 ECC82	84
6AR5 80 6GK5 75 12AD6 80 30P4MR 98 BL63 2.00 ECC83	-84
6AS7G 1.00 6GU7 90 12AE6 80 30P12 74 CL33 1.75 ECC84	35
6AT6 50 6H6GT 30 12AT6 45 30P19/ CY1C 1.00 ECC85	-35
	1 25
6AV6 50 6J6 35 12AV6 60 30P4 90 CY31 70 ECC86	51
CASTO A CANADA CONTRACTOR OF LOCAL CONTRACTOR	
6AX4 75 6JUSA 90 12BE6 55 30PL14 1 29 DC90 70 ECC807	1.40

ECF80	-50	EMM803	PCC85 47	PY800 -40	U191 -50	AC166 -30	BF185 -47
ECF82	-50	2.50	PCC88 -61	PY801 -40		AC168 -44	
ECF86	-80	EY51 .45	PCC89 -49	PZ30 50		AC176 -64	BFY51 -28
ECH21	2.00	EY81 45	PCC189 -52	QQV03/10	U403 -90	AC177 -32	BFY52 23
ECH 35	1.60	EY83 -60	PCF80 40	2.00		ACY17 30	BY100 21
ECH42	-71	EY84 1.20	PCF82 45	Q895/10	: U801 80	ACY18 23	BY114 21
ECH81	-35	EY86/7 -87	PCF84 70	1.00		ACY19 23	BY126 18
ECH83	-50	EY88 55	PCF86 57	Q8150/15	VP23 65	ACY20 21	BY127 21
ECH84	-50	EY91 .50	PCF200 1.00	1.80		ACY21 23	BYZ10 30
ECL80	-45	EZ40 -52	PCF201 1-00	QV06/20	VR105 -50	ACY22 18	BYZ11 30
ECL82	-40	EZ41 -52	PCF801 -49	8.60		ACY28 21	BYZ12 80
ECL83	-74	EZ80 32	POF802 54	R19 75		AD140 .42	BYZ13 80
ECL84	-65	EZ81 -32	PCF806 58	TH233 1.00		AD149 58	F8Y11A 26
ECL85	-70	GY501 .85	PCH200	TP2620 1.00		AD161 53	FSY41A 26
ECL86	-50	GZ32 -60	1.00	UABC80 -45		AD162 -53	OA9 14
EF22	1.00	GZ33 1-80	PCL82 40	UAF42 -70		AF114 -30	OA47 19
EF40	-78	GZ34 ·75	PCL83 -49	UBC41 -50		AF115 -18	OA70 18
EF41	.75	GZ37 1·10	PCL84 -46	UBC81 -55		AF117 .23	OA73 18
EF42	-90	HABC80 -80	PCL86 -54	UBF80 -50		AF121 35	OA79 11
EF73	1.75	HL23DD	PCL805 -60	UBF89 -89		AF125 -20	OA81 11
EF80	-29	-68	PEN25 1-00	UBL21 2:00		AF126 .21	OA85 11
EF83	1.25	HL41DD	PEN45 1.00	UC92 -50		AF180 56	OA90 14
EF85	-36	1.00	PEN45DD	UCC84 -90		AF186 -64	OA91 11
EF86	45	HL42DD	1.00	UCC85 -45		BA115 16	0A95 11
EF89	-32	1.00	PEN46 -60	UCF80 -80		BA116 21	OC44 12
EF91	-50	HN309 1.70	PEN453DD	UCH21 2:00		BA129 14	OC45 18
EF92	-50	HVR2 1.00	2.00	UCH42 -71	2N2297 -26	BA130 -12	OC46 18
EF97		HVR2A	PENDD-	UCH81 45		BA153 -18	OC70 14
EF98	90	1.00	4020 1.00	UCL82 45		BC107 -14	0C71 18
EF183	-86	KT41 1.00	PFL200 -70	UCL83 -57	2N3121 2-90	BC108 -14	OC72 18
EF184		KT66 3.00	PL33 -50	UF41 70		BC109 -14	OC74 28
EF804	1.75	KT81 2.00	PL36 -60	UF42 -80		BC113 -30	OC75 13
EH90		KT88 5.75	PL81 -49	UF80 -40		BC115 -18	OC76 18
EL32	-60	KTW61	PL81A -58	UF85 -50		BC116 -30	OC77 -82
EL34	-90	1.50	PL82 -87	UF89 45		BC118 -26	OC78 18
EL35	8.00	KTW62	PL83 45	UL41 70		BCY10 53	OC78D 18
EL37	3.00	1.50	PL84 -50	UL84 -48		BCY12 -58	OC81 18
EL41	-57	KTW63	PL504/500	UM80 -60		BCY33 -23	OCSID 18
EL81	65	1.20	90	UY41 -50		BCY34 -26	OC82 18
EL83		MHLD6	PL305 1.55	UY42 -50	AC127 -20	BCY38 -26	OC82D 13
EL84	34	-99	PL508 1.00	UY85 -85	AC128 -23	BF158 -21	OC83 -28
EL86		MU14 1-15	PL509 1.55	U10 1.00	AC132 -28	BF159 -30	OC84 28
EL95	-67	P61 -60	PT4D 1.00	U12/14 1-15	AC154 -30	BF163 .23	OC123 -26
		PABC80 -45	PY33/2 -50	U19 4-00	AC156 23	BF173 44	OC169 -26
		PC86 62	PY80 50	U25 ·71	AC157 -30	BF180 -35	
EM80		PC88 -62	PY81 -40	U26 60	AC165 -30		
EM81		PC92 55	PY82 40	U33 1.75	1		
EM83		PC95 -70	PY83 44	U35 1.75	MATCHED T	RANSISTOR	SETS:—
EM84		PC97 -39	PY88 40	U37 2.00	LP15 (AC113	. ACI54. ACI	7. AA120) - 61p
		PC900 -40	PY500A	U45 1 20		C81D & 2/00	
EM87		PCC84 39	1.09	U81 80	1/OC44 & 2	/OC45, 50p.	1/OC82D. &
	- 20 !				2/OC82 56p.	Set of 3/OC8	3·76p.

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# AMATEUR RADIO SATELLITES RESTEVENS G2BVN

RECENT articles in Practical Wireless have described professional communications satellites and their applications. It is the object of this article to provide basic information concerning amateur radio satellites and when and how they may be heard. Radio amateurs have been interested in space phenomena since the appearance of Sputnik 1 in 1957. Prior to the actual launch the journal of Soviet radio amateurs published information to aid amateurs in receiving signals from the satellite. By this means reporting on a scale far beyond professional capabilities was made available.

# **HISTORY**

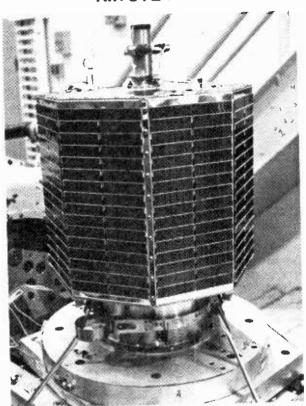
In 1960 a group of radio amateurs on the West coast of the USA formed the Project Oscar Association. OSCAR is an acronym for Orbiting Satellite Carrying Amateur Radio. The object was to design and build satellites for use in the amateur bands to enable radio amateurs everywhere to make contributions to space technology. Early satellites, both Soviet and American, were devices transmitting telemetry and beacon-type signals. The communication era had not yet arrived.

The first Oscar was placed into orbit by a Thor-Agena vehicle launched from the Vandenberg air force base in December 1961. The 10lb satellite transmitted information about its internal temperature for 277 revolutions. OSCAR 3 was launched into a polar orbit in March 1965 and was the first amateur communications satellite. In addition to a translator in the 144MHz band it also transmitted information about battery voltage and spacecraft

temperature.

The Radio Amateur Satellite Corporation was formed early in 1969 to co-ordinate space projects both nationally and internationally. AMSAT, as it is known, now has national organisations in many countries throughout the world, including the UK. The first satellite project carried through by AMSAT was OSCAR 5, designed and built by students at Melbourne University in Australia. This was a beacon-type device launched in early 1970 as a secondary payload on a Tiros-M mission carrying a weather satellite.

OSCAR 6 is a communications satellite launched aboard a Thor-Delta vehicle, again carrying a weather satellite as the primary payload. OSCAR 6 satellite carries a translator and an advanced telemetry and message storage system. It has long exceeded its anticipated life and this has been achieved only by continuous ground control enabling the spacecraft batteries to satisfy the demands made upon them. Solar cells can only be charged when the satellite is in sunlight and therefore a careful balance between charge and discharge,



The OSCAR 7 satellite undergoing vibration tests prior to launch. The solar cells form the outside skin of the package.

caused by usage, must be maintained. This requirement is the reason for the reduced operating schedule shown in the accompanying table.

OSCAR 7 is also a solar powered satellite but carrying two frequency translators, beacons and an advanced telemetry system. Launched aboard a Delta vehicle with two professional satellites, it was placed into an orbit similar to that of OSCAR 6. OSCAR 7 was built by radio amateurs in Australia, Canada, W. Germany and the USA. It was the culmination of a four-year project and its professional equivalent would have cost about two million dollars. Funds came from individuals and organisations sympathetic to the project and aerospace companies donated space-qualified components and equipment.

In addition to the many thousands of contacts made through the translators of the two satellites by radio amateurs, students in all parts of the world have been able to study space science with the aid

of OSCARS 6 and 7.

	OSCAR 1	OSCAR 2	OSCAR 3	OSCAR 4	OSCAR 5
Launched End of radio	12 December 1961	2 June 1962	9 March 1965	21 December, 1965	23 January 1970
life Orbit	1 January 1962 inclined 81° at	20 June 1962 inclined 73° at	24 March 1965	16 March 1966 inclined 26° at	15 March 1970
Initial apogee	equator 450km	equator 417km	975km	equator elliptical	inclined 102° at equator 1500km
Type of radio equipment	telemetry beacon	telemetry beacon	repeater	200-35000km translator	telemetry beacon
carried Frequency (MHz)	144 · 98	144 · 99	144/145	144 input 431 output	144 · 05 and 29 · 45
Aerial	monopole	monopole	four monopoles	four monopoles	1 ¼ monopole (vhf)
Results	more than 5000 reports received from 600 stations in 28 countries	more than 6000 reports received	Some 100 stations in 16 countries communicated through the satellite including two-way trans-Atlantic contacts	about a dozen two- way contacts in- cluding the first direct satellite communication between the USA and the USSR.	dipole (hf) the first amateur satellite to:— (1) be ground con- trolled. (2) be self- stabilised (3) have multi- channel telemetry

# LISTENING TO OSCAR

Complicated equipment is not needed to listen to the two satellites. The two basic essentials are a shortwave receiver covering the amateur 10 metre band (28 to 30MHz) and a receiving aerial. Most modern receivers of the general coverage type cover the amateur 10m band and it is then only necessary to check the calibration to ensure that you are listening for OSCAR signals at the right spot on the dial. You will see from the details of OSCAR 6 and 7 that the 10m frequencies are not precisely the same for each satellite. You should also note that the beacon frequencies are different. The beacon of OSCAR 6 is often quite weak but you should have no problem at all in hearing the beacon of OSCAR 7 on 29 502MHz. The beacon will often be heard when there are no communication signals being received by the satellite receiver.

With some of the older general coverage receivers the sensitivity on 10m may be sufficient for you to hear only the strongest signals through OSCAR. In these circumstances a small 10m pre-amplifier is recommended and this should be connected between your aerial and your receiver. A pre-amplifier made specially for OSCAR use is available from Hamgear Electronics of Norwich, or it is a relatively simple matter to construct such a unit from published information.

The receiver should have a beat-frequency oscillator (BFO) to enable single-sideband (SSB) and morse (CW) transmissions to be correctly received. Almost all the radio amateurs who communicate through the satellite by telephony use SSB. For both OSCAR 6 and 7 your receiver control should be in the upper sideband (USB) position. When the signals are first heard from the satellite it will probably be 3000 to 3500 kilometres away. In the overhead position the distance of the satellite will be only about 1460km. Therefore, the signals from the satellites can be expected to be relatively weak at first, increasing in strength as the satellite comes towards your receiving system and then gradually dropping in signal strength as the satellite goes

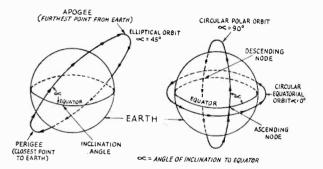
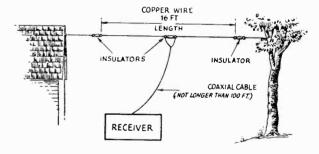


Illustration of terms used to describe satellite characteristics.



A simple OSCAR receiving system.

away to the north. Due to an effect known as "doppler shift" you will find it necessary to adjust the frequency of your receiver by a small amount during the passage of the satellite.

## WHEN TO LISTEN

The Table shows some suggested times when it will be convenient for most people to listen to the OSCAR satellites. Of course, OSCAR 7 can be heard during the morning periods when it is on the north-south path but at this time most people will be otherwise engaged. Once the satellite has

# SUMMARY OF SATELLITES NOW IN ORBIT

	OSCAR 6	OSCAR 7
Launched Orbit Apogee Perigee Period Velocity Longitude Increment Beacon	15 October 1972 inclined 101 at equator 1456km 1451km 114-994 minutes 7-111km/sec 28-74° per orbit 29-45MHz	15 November 1974 inclined 101° at equator 1450km 1450km 114-944 minutes 7-136km/sec 28-73° per orbit 29-502MHz (mode A) 145-972MHz (mode B)
Translator (MHz)	145-90 to 146-00 input/29-45 to 29-55 output	435·100MHz (mode A) 145·85 to 146·95 input/29·40 to 29·50 output (mode A) 432·125 to 432·175 input/145·975 to 145·925
Satellite availability	Mondays, Thursdays and Saturdays ascending mode passes in later afternoons and evenings	output (mode B) Every day except Wednesdays. Satellite is in mode A on odd days of the year; mode B on even days.

# WHEN TO LISTEN FOR THE OSCAR SATELLITES

# OSCAR 6 (29 45 to 29 55MHz)

Day	Date	Orbit number	equatorial crossing	listen between
Thursday	11 November	18635	1952 at 356°	2000 and 2015
Saturday	13 November	18660	1947 at 354°	1955 and 2010
Monday	15 November	13685	1942 at 353°	1950 and 2005
Thursday	18 November	13722	1837 at 337°	1845 and 1900 (overhead at 1854)
Saturday	20 November	13747	1831 at 336°	1840 and 1855 (overhead at 1849)
Monday	22 November	13772	1826 at 334°	1835 and 1850 (overhead at 1843)
		OSCAR	7 (29·4 to 29·5MHz)	
Friday	12 November	9122	1947 at 346°	1955 and 2010 (overhead at 2004)
Sunday	14 November	9147	1941 at 345°	1950 and 2005 (overhead at 1958)
Tuesday	16 November	9172	1935 at 343°	1945 and 2000 (overhead at 1952)
Thursday	18 November	9197	1928 at 342°	1935 and 1950 (overhead at 1945)
Saturday	20 November	9222	1922 at 340°	1930 and 1945 (overhead at 1939)
Monday	22 November	9247	1915 at 338°	1925 and 1940 (overhead at 1932)

The satellites will be on a South-North path during all of the above orbits. All times are GMT.

been heard it will re-appear approximately 115 minutes later at a position 28° further west. If you are interested in listening to orbits in addition to those shown in the Table then a calendar of orbital predictions is obtainable from AMSAT-UK whose address is given later in this article.

Before the end of the year a booklet will be available which will give all the orbits of OSCARs 6 and 7 for the whole of 1977. However, with the availability of pocket calculators it is a very simple procedure to determine the time and crossing of satellite orbits once a reference orbit is available as a starting point. Any of the figures in the column headed "equatorial crossing" in the Table may be used as reference orbits and as a starting point for calculations. Remember to add 28° and 115 minutes for each successive orbit.

The satellites are at an altitude of approximately 1460km and terrestrial stations can be received up to 4000km away from the satellite. Two stations each at the extreme range of the satellite i.e. 4000km can communicate through OSCAR thus giving a total possible range distance of about 8000km. The satellites are constantly moving along their orbital paths and therefore stations located in different parts of

the world come in and are heard through the satellite, disappearing some minutes later when new stations will be heard. As an example of what can be done G3IOR has effected two-way communication with stations in nearly 80 countries through the OSCAR satellites.

# FURTHER INFORMATION

The amount of literature now available on space science is vast. However a great deal of it relates to professional projects and is often difficult to follow by a person not a specialist in these matters. The Radio Society of Great Britain publishes a booklet entitled Keeping Track of Oscar which contains a great deal of basic information and costs 40p (post paid). The address of RSGB is 35 Doughty Street, London, WCIN 2AE. Available from the same source is the polar stereographic map, necessary if one is interested in plotting the OSCAR orbits, which costs 35p.

If one is interested in obtaining the basic details of the behaviour of space satellites, which applies to both amateur radio and professional devices,

continued on page 674

# Vagaries of WHF (Contd.)

# Ron HAM F.R.A.S.\*

HF National Field Day is an important event in the RSGB's Contests Calendar. Normally held in September, this year it was held on July 3/4 fortunately coinciding with a mild tropospheric opening giving that "something extra" to a normally exciting competition.

According to the writers trusty barograph, the roots of this opening can be traced back to midnight on June 23rd when the atmospheric pressure began a gradual rise from  $30 \cdot 2''$  to  $30 \cdot 35''$  by noon on the 28th, where it remained until noon on the 30th. Around 1800 on the 30th, the pressure began falling, the most vulnerable time for a VHF/UHF disturbance, and reached  $30 \cdot 1''$  around 2000 on July 3rd, see Fig. 1.

Signs for Field Day looked good on July 2nd, when, at 0839, the writer, at his home in Sussex, received a 559 signal from GB3EM (432.91MHz.) with only a dipole feeding the receiver, and by 2300 this signal was 599. This may well have been the first VHF NFD to take place with temperatures up in the 90's.

The opening eased on the 4th while the pressure remained steady  $(30 \cdot 1'')$ , but things livened up between the 5th and 8th coinciding with a further gradual decline in pressure to  $30 \cdot 0''$  at noon on the 8th. Signals from the Emley Moor beacon were heard on the 5th, 6th and 7th and up to a dozen Continental FM broadcast stations were heard in Sussex between 88-100MHz each day.

# SPORADIC-E

July is accepted as the third month of the sporadic-E "season", and like previous years there have been frequent upsets to terrestrial radio signals in the 4m and 6m bands. The most prominent disturbances were during the early morning of the 1st and 17th, the early evening of the 25th On each

occasion the writer checked 65 to 73MHz using an Eddystone 770R, fed with a horizontal dipole, and received strong signals from east-European broadcast stations

Strong signals on the R1 television frequencies (Vision  $49.75 \mathrm{MHz}$ , Sound  $56.25 \mathrm{MHz}$ ) were prominent at the least hint of a sporadic-E disturbance and signals from E2 sound  $(53.75 \mathrm{MHz})$  were heard on July 2, 11, 16, 22, 23, and 25 while the usual crop of continental RT stations were heard disturbing Band 1.

# 10M BAND

A 599 signal from the German beacon DL0IGI was heard on the 17 days indicated in Fig. 2, and it is worth noting that this signal is mainly heard during the early morning. The signal from 5B4CY was heard less frequently and averaged about 559. Both of these beacons are a valuable indicator for the prevailing condition on "ten".

# **AUGUST**

THE writer's Hammarlund HQ-180 spends most of its working life idling around the beacon frequencies in the 10m band and reference to Fig. 3 will show that signals from beacon stations were heard on eight days during August, DL0IGI on each day except the 10th and 5B4CY on days 5, 10 and 22. Suddenly, at 0745 on the 22nd a very strong burst of solar noise swamped the 10m band for several minutes proving how right it is to leave a receiver monitoring the band to catch the unexpected. Later, around midday, the writer was on the South Downs using a low-band Cambridge in his capacity as an ATC radio instructor, when a massive burst of solar noise, lasting for 16 minutes, came from the speaker, and this with only a rod aerial on top of the vehicle. On arrival home the radio

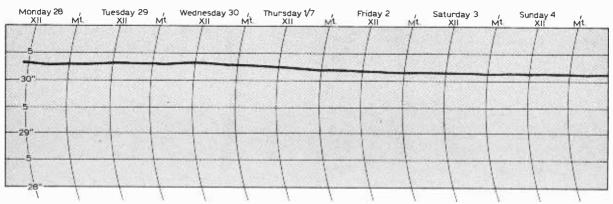


Fig. 1. Barograph chart covering period of National Field Day in July when conditions were above normal.

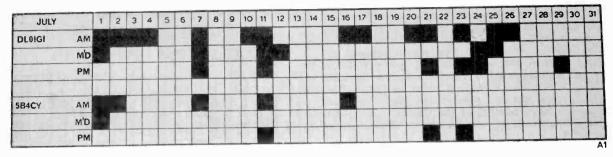


Fig. 2. Reception of the 10m beacon stations DL0IGI and 5B4CY provides a good guide to conditions.

telescope charts were examined and this hefty burst had been recorded at both 95 and 136MHz.

Although this was an isolated event the solar noise storm which began on July 31st continued for 11 days, Fig. 3, during which time several individual bursts were recorded in addition to the high radio noise level. This noise storm was the first since the end of March and was associated with a large sunspot which may well have been the first of the new solar cycle.

# DX FOR BREAKFAST

The daily routine listen on Band II around 0730 revealed that a VHF lift lasting for two or three hours occurred every morning between the 10th and

18th inclusive, bringing strong signals from between four and fourteen continental broadcast stations into southern England between 88 and 100MHz. During the same early morning periods, except for 10th and 17th, a picture was received in Sussex from the Midlands (IBA Ch.8) on 189MHz with only a dipole feeding the receiver. It is always worth the DXers while to take an early morning listen around Band II when the atmospheric pressure is high and the weather is hot and settled, which was the case over the southern half of England and parts of Europe for most of August.

The stage was set for a tropo-opening when the atmospheric pressure, already high, began to rise around 0100 on the 18th, Fig. 4, then dithered around 30.4" for about 24 hours before it started a gradual

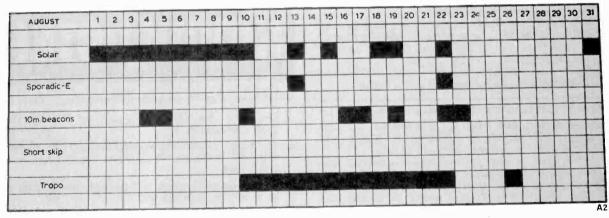


Fig. 3. Summary chart of several types of VHF activity during August.

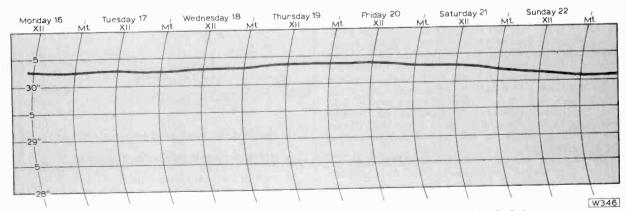


Fig. 4. Chart of barometric pressure in August, the effects of the changes being described in the text.

fall. Early on the 19th, the VHF's opened up and Band II was the first to suffer as signals from Continental broadcast stations poured into southern England, often overpowering the UK stations!

The reader will see the relationship between the falling pressure and the increase in numbers of continental stations in Band II if he compares the table in Fig. 3 with the barograph chart in Fig. 4. This tropo-opening was on a predominant north/east path because a large number of the Continental stations were of German origin and further proof came in the 2m band when a 589 signal from DLOPR (144-910 MHz) was heard from the evening of the 19th to the early hours of the 21st. UK radio amateurs took advantage of the good conditions to work some Continental DX on 2m.

An almost identical opening, with German FM in Band II accompanied by a 599 signal from DLOPR occurred during the early morning of the 26th and lasted for a couple of hours. Periodically on days 19, 20 and 21 strong signals were received on 70cm from GB3SC (432·89MHz) and GB3EM (432·910MHz) with only a dipole feeding the receiver.

# SPORADIC-E

Apart from minor disturbances to signals in the 4m and 6m bands during the mornings of the 13th and 22nd, the amateurs who use the 4m band should have had a peaceful month, free from the upsets caused by sporadic-E.

\*Faraday, Greyfriars, Storrington, Sussex RH20 4HE.

Readers experiencing unusual reception of stations on the VHF/UHF bands of the nature described by Ron Ham in the first two articles are invited to send brief reports to him at the above address. NOT to the Editorial offices!

If there is sufficient response a regular feature could be compiled for inclusion in PW—Editor.

AMATEUR RADIO SATELLITES—contd. from page 671 then recommended reading is Artificial Satellite Observing by H. Miles, published by Faber and Faber in 1974 at a cover price of £5·50.

AMSAT-UK is the national organisation of the Radio Amateur Satellite Corporation and is the means of exchanging information on radio amateur satellites between interested users. It is also the basis of the UK satellite construction group. Further information may be obtained from P. Gowen, G3IOR, 17 Heath Crescent, Hellesdon, Norwich, Norfolk, NR6 6XD. Any enquiries should be accompanied by a s.a.s.e. The address of the USA organisation is AMSAT, PO Box 27, Washington, DC 20044, USA.

Up-to-date information regarding satellite availability and orbital data can be obtained by listening to the RSGB News Bulletins which are transmitted in the 2/80m amateur bands on Sunday mornings. Also on Sunday mornings at 1015 local time is the AMSAT-UK net on 3780kHz SSB when orbital data for the following week is transmitted. On Sunday evenings at 1930 local time there is an OSCAR net on 144-28MHz with the net control station located in SW London.

So why not have a listen for OSCAR? Irrespective of propagation conditions you will hear stations from Africa, Asia, N. America and Europe in communication through a satellite built by amateurs for amateurs. Good listening!

# PW TECHNICROSS PUZZLE

Solution to No. 16 presented last month

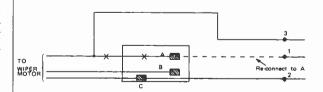




# 'Interwipe' Car Electronics project sheet, Oct. 76

- The Doram box should be numbered 509-989 (114 x 55 x 64mm).
- The relay contacts RLA1 N/O and N/C are shown reversed on the circuit diagram. The PCB drawing is correct.
- Fig 6—connections to a 3-contact switch should be as the drawing below:—

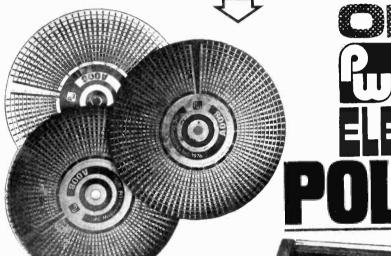
AMENDMENT TO INTERWIPE SWITCH DRAWING INCORRECTLY DRAWN ON P.W. PROJECT SHEET.



- 1. Remove Contact A from Switch and connect to Contact 3 of Relay.
- 2. Connect Contact 1 of Relay to Contact A of Switch.
- 3. CONTACT B IS LEFT UNTOUCHED.
- Connect an extra lead from Contact C of Switch to Contact 2 of Relay.

PINTED GIRCUIT DISC'S

PRACTICAL WIRELESS



ELECTRONIC POLYPHON

Remember your first thrill on hearing a musical box? Remember your disappointment when the reeds broke?

Now you can recapture that authentic Polyphon sound for yourself or your family knowing that there are no reeds to fail and, with a little practice, you can create and play your own tunes.

also:

OSCILLOSCOPE CALIBRATOR

PW 'ICELERT'

BLACK~ICE WARNING DEVICE

ON SALE IN DECEMBER

# CHROMACHASE

# PART 1

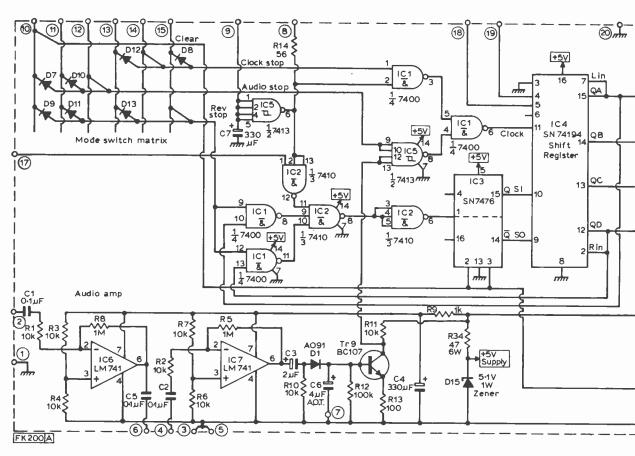
# WILLIAM BEAN

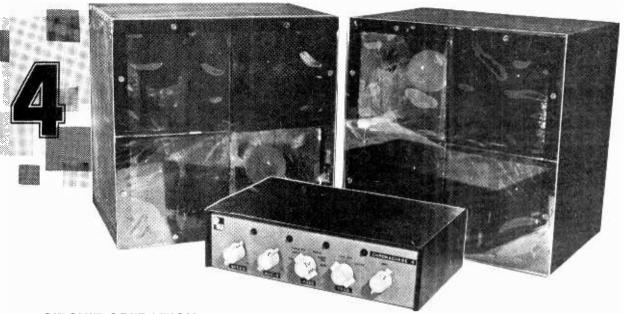
IGHT chasers are the latest generation of sound to light display units to appear at parties and discotheques. This chaser, in common with many of the others, owes its existence to the advances in TTL (Transistor-Transistor Logic) modules. The unit has four light channels, four light sequences and can be triggered by five different modes. The chase can be initiated by an external audio signal, including microphone and stereo speakers, or from an internal clock which can vary the speed of the chase from one step a second to 20 steps a second.

One advantage of the chaser over the more

familiar sound-to-light unit is that the chaser does not vary intensity with sound or frequency, but provides movement or colour changes to music. This means that if the music stops the hall is not plunged into darkness.

Although the control unit is essential, the main attraction is the display and some thoughts on displays are given later in the article. The design load for each channel is 1 kilowatt and the unit will deliver that load indefinitely but, to keep the mains current to manageable levels, a maximum of 750 watts per channel is recommended.

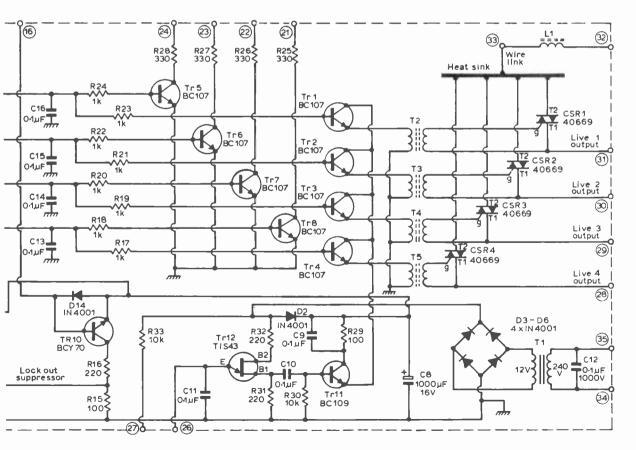




# CIRCUIT OPERATION

Reference to the block schematic, Fig. 2, shows that the circuit could be split into two sections, one dealing with the electronic programme generation and the other with lamp driving and monitoring.

Fig. 1. The circuit diagram of the components on the PCB. The numbers in circles refer to pins along the side of the board. The external connections to these pins are shown in Figs. 5 and 7.



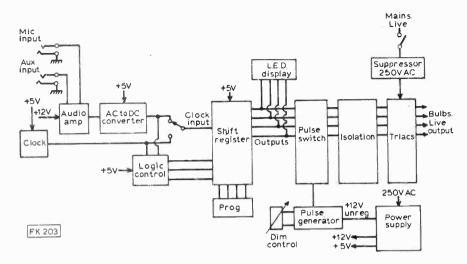


Fig. 2. The block schematic of the complete unit, excluding the lamp displays.

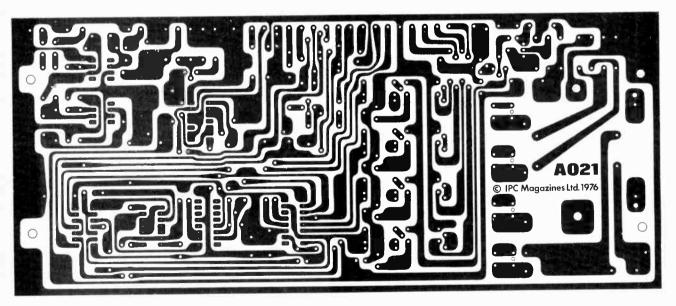
Consider the lamp driving and monitoring first. Fig. 1, shows that the four output lines of IC4, (QA, QB, QC, and QD) drive transistors Tr5, 6, 7 and 8 which, in turn, drive the panel mounted LEDs. These LEDs therefore give an indication of the state of the output lines of IC4. Apart from following the lamps during operation they play a significant part in the setting-up procedure.

In addition to driving the LED transistors, the output lines of IC4 enable or inhibit Tr1, 2, 3 and 4. If it is assumed for the minute that the Dim control is at maximum, then the pulse transformers, T2, 3, 4 and 5, will pass or not pass current depending on the condition of the bases of Tr1, 2, 3 and 4. The secondaries of the pulse transformers are used to trigger the Triacs CSR1, 2, 3 and 4 and the Triacs switch the mains to display lamps.

It was assumed in the previous paragraph that the Dim control was set to maximum. The action of the control and the Pulse Generator are considered next.

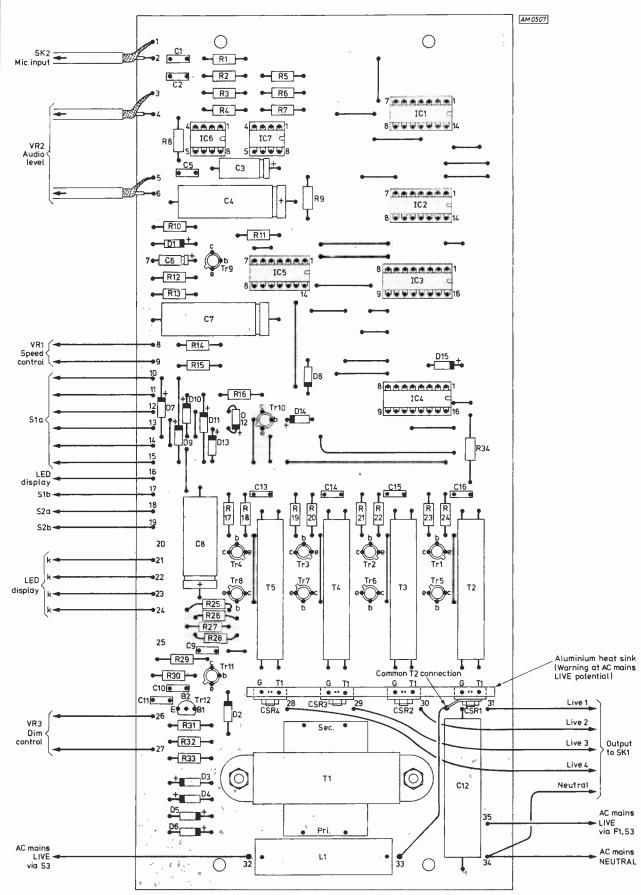
The section of Fig. 1 involved is Tr11, Tr12 and their associated components. A unijunction device, Tr12, provides the active element in the generation of the pulses. By connecting its B2 lead to an unsmoothed supply rail the output pulses are locked to the mains. Phase shift is achieved by varying VR3, the Dim control. R33 prevents the emitter of Tr12 being connected to the supply rail when VR3 is at its minimum setting. The output of Tr12, at B1, is coupled to Tr11, which conducts for a period depending on the setting of VR3. The output of Tr11 is fed, in parallel, to the gating transitors Tr1, 2, 3 and 4 and if any of them have the enabling input on its base, current flows in the primary of the associated transformer.

For the remainder of the circuit, reference to Fig. 2 shows that there are two options for driving the shift register (being from an internal clock or from an external audio source), a logic section for selection of the mode of operation, a programme switch



▲ Fig. 3. The wiring pattern of the PCB. Note that this drawing is not full size. For scaling up, the true size is 10½ ins by 4½ ins.

Fig. 4. The component overlay showing location and orientation of the components on the board. The wiring pattern is shown to assist assembly.



and a reversible shift register.

The internal clock is made up of one half of IC5, a schmitt trigger, and VR1 with C7. The time constant of VR1/C7 determines the repetition rate of the clock since it fixes the time taken to pass the switching points of IC5. Because the charging current is taken from the output of IC5, which performs an inverting function in addition to its schmitt action, the circuit performs as a realistic clock.

The audio amplifier consists of the two linear amplifiers, IC6 and IC7, together with their associated components. VR2 is an audio level control between the two stages, each of which has a gain of +40dB. The output of IC7 is fed to a positive sensing, time constant network of D1, C6, Tr9 and R13, with D1 and C6 performing the sensing and with C6 and R13 giving the time constant. Although R12 is across C6. its effect is not significant in determining the time constant. The value of C6 may need to be adjusted to achieve optimum sensitivity but 4uF was found to be satisfactory in the units built by the author and this has been called for in the parts list. The DC produced is used to switch Tr9 and the output of Tr9 is shaped by the second half of IC5. The input to this half of IC5 is gated with the output of the Mode switch, S1, and the resultant output fed to pin 4 of IC1.

Similarly, the output from pin 6 of IC5 is gated with output of S1 (pin 2 and 1 of IC1) and its output fed to pin 5 of IC1. This section of IC1 acts as an "or" gate and is used to drive the clock input of

IC4.

The QA and QD outputs of the reversible shift register, IC4, are gated with S1 by the remaining two sections of IC1, pins 9/10 and 12/13 respectively. The output of the internal clock, pin 6 of IC5, is gated with S1b in a section of IC2, pins 1, 2 and 13, and the output of this gate, together with those at pins 8 and 11 of IC1 are themselves gated by IC2, pins 9, 10 and 11. The output of this gate, appearing at pin 8, is inverted by the remaining section of IC2 and the inverted output provides the clocking pulses for IC3, a JK Preset Flip-Flop. The Q and Q outputs of IC3 are directly coupled to pins 10 and 9 of IC4 and determine the direction of progression of IC4. Thus, each pulse applied to pin 1 of IC3 will reverse the direction in which the chase goes.

# \* components list

### Off board items

Case, to suit, Type RB4 from Marshalls Ltd., or Type P.J.5 from Watford Electronics. (Size 280mm  $\times$  150mm  $\times$  75mm  $=11'' \times$  6''  $\times$  3''). PCB, from Readers PCB Service (see ad.), Variable Resistors; VR1, 1k $\Omega$  lin; VR2, 100k $\Omega$  log; VR3 100k $\Omega$  lin with switch. Switches; S1, 2 pole 6 way, rotary; S2, 3 pole 4 way, rotary (only 2 poles used). Panel mounting fuse holder. 1A fuse to suit holder. Sockets; SK1, International Octal; SK2, mono jack socket; SK3, stereo jack socket. Plugs; PL1, International Octal; PL2, mono jack; PL3, stereo jack. Indicators, 4 LEDs, 0.2'' Dia., with fixing washers. 5 knobs to suit controls. 4 rubber feet for case. 13A mains lead. Pubber grommet to suit mains lead. Metal strip for heat sink, 75mm  $\times$  20mm  $\times$  3mm (3"  $\times$   $\frac{\pi}{2}$ "  $\times$   $\frac{1}{6}$ "). Crystal microphone insert, Acos type 43. 4 stand-offs, 6BA  $\times$   $\frac{\pi}{2}$ ".

# **★ components list**

On the b			
Resisto	rs	Capa	citors
R1	10kΩ	C1	0·1μF
R2	10kΩ	C2	0·1μF
R3	10kΩ	C3	2μF, 16V
R4	10kΩ	C4	330μF, 16V
R5	1ΜΩ	C5	0·1μF
R6	10kΩ	C6	4μF, 16V
R7	10kΩ	C7	330μF, 16V
R8	1ΜΩ	C8	1000μf, 16V
R9	1kΩ	C9	0·1μF
R10	10kΩ	C10	0·1μF
R11	10kΩ	C11	0·1μ <b>F</b>
R12	100kΩ	C12	0·1μF, 1000V
R13	100kΩ	C13	0·1μF
R14	56Ω	C14	0·1µF
R15	100Ω	C15	0·1μF
R16	220Ω	C16	0·1μF
R17	1kΩ	All (	0·1μF capacitors, except
R18	1kΩ	C12,	have 4mm pin centres.
R19	1kΩ	Items	
R20	1kΩ		hall Ltd. are O.K. All
R21	1kΩ		tors, except R34, are 5%,
R22	1kΩ	₹W.	
R23	1kΩ		
R24	1kΩ		
R25	330Ω		
R26	330Ω		
R27	330Ω 330Ω		
R28 R29	100Ω		
R30	10022 10kΩ		
R31	220Ω		
R32	220Ω		
R33	10kΩ		
R34	47Ω 10%, 6	W	
	nductors	Tr1	BC107
D1 D2	OA90 1N4001	Tr2	BC107
D2	1N4001	Tr3	BC107
D3	1N4001	Tr4	BC107
D4 D5	1 N4001	Tr5	BC107
D6	1N4001	Tr6	BC107
D7 )	any	Tr7	BC107
D8	cheap	Tr8	BC107
D9	silicon	Tr9	BC107
D10	diode,	Tr10	
D11	e.g.	Tr11	
D12	1N914,	Tr12	
D13	1N4148.	1000	
D14	1N4001	IC1	SN7400
D15	Zener, 5·1		SN7410
Lettrick	1W	IC3	SN7476
CSR1		IC4	SN74194
CSR2		IC5	SN7413
CSR3		IC6	LM741
CSR4		IC7	LM741
	,		oded by RCA and is now
T2800D	Devices m	av he	supplied with either code
1 2000	er can be u		

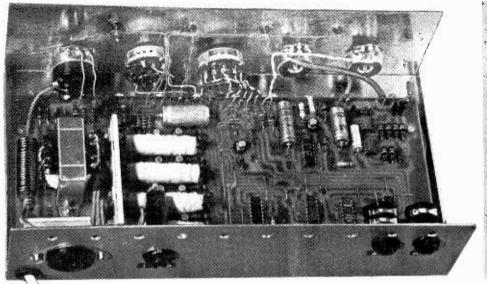
Wound components

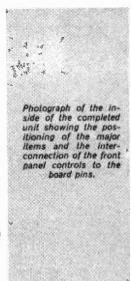
Mains transformer. Secondary, 12V at 0.5A, fixing centres 53mm Doram code 980-675 and 980-681 are O.K. (Wire 675 in series and 681 in parallel).

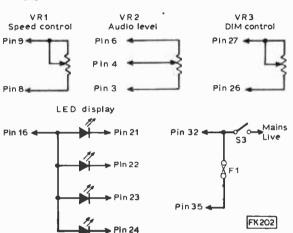
T2 Pulse transformer. Home made. Primary and secondary each 25 turns of 28 standard wire gauge, enamelled copper wire on a 35mm(1½") by 10mm (½") ferrite rod.

Suppression choke. Home made. 20 turns

or 14 SWG, enamelled copper wire on a 35mm by 10mm ferrite rod.







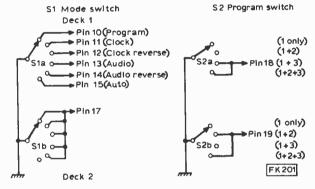


Fig. 5. The wiring of the front panel controls and their connections to the PCB.

## POWER SUPPLY

There are two power supplies for the unit, one being the mains and the other being low voltage DC.

The mains is fed to the lamps in the display via the Triacs and, in order to prevent switching spikes being imposed on the mains, a suppression choke is included in series with the line supply.

To provide the low voltages required for the electronics, the mains is stepped down by transformer T1. The 12V secondary output is bridge rectified by diodes D3, 4, 5 and 6. The unsmoothed, pulsating DC is used for Tr12, giving mains synchronisation of the dimming control. Initial smoothing for the rest of the circuitry is by D2 and C10, this being satisfactory for Tr11. Further smoothing is provided by R9 and C4 for use with the audio amplifiers. Finally R34 and D15 set the 5V required by the remaining ICs.

# CONSTRUCTION

The assembly has been kept as simple as possible by producing a PCB with the majority of the intercomponent wiring in its pattern. (See Fig. 3.)

Since most of the components are mounted on the board, and Fig. 4 shows the locations and orientation of them, construction should present no difficulties. It is suggested that the wire links are inserted and soldered first and components added according to size (i.e. transformer last).

Do not connect the Triac heat sink to L1 at this stage.

Interconnections from the board to the various case mounted items should be easy using Fig. 5 but the photos should also help. If the wires from board to case are kept short the unit will look more attractive but the assembly into the case will be more difficult.

A full size print of the wiring pattern on the PCB is available. To obtain a copy please send a large stamped addressed envelope and a cheque or postal order, value 25p, to Practical Wireless (Chroma-

chase), Fleetway House, Farringdon Street, London EC4 4AD.

This article will be concluded next month.

# SERIES 5- Dechology



THIS series of articles is based on the S-DeC solderless breadboard. Components are simply plugged into holes on the DeC by their own leads. The holes are connected together underneath the surface by sockets wired up in a pattern shown on the upper surface of the DeC.

When you have constructed the project you can either unplug the components and use them again, or purchase a piece of Super Solder Board for 30p. The Super Solder Board has holes and connecting copper tracks, and the pattern exactly matches those on the S-DeC. If you want to keep your project working and/or put it into a case, then simply transfer the components from the S-DeC to exactly the same holes on the Super Solder Board, turn the Board over and solder the components permanently into place.

This first project is called Guardian Angel. The title derives from a kindly angel who always watches over sleeping children. However, the project does have other applications.

# **Wasted power**

A common problem with many young children is that they want a light left on before they will even attempt to get to sleep. This light is commonly switched off again by a parent on retiring for the night. The majority of lights left on for children are ordinary household bulbs—say 40W. Also, this remains on from early evening (bedtime) until 11 or 12 o'clock when the parent goes to bed and remembers to switch it off. The majority of children are asleep within half an hour or so of going to bed, which means that power used by the 40W "night light" is wasted.

The Guardian Angel changes all that. Basically it comprises a small torch/cycle bulb plus some very simple electronics. Upon switching the device on, the bulb will glow to its full brilliance. Gradually—so gradual as to be virtually imperceptible, the bulb will

become dimmer and dimmer until finally it goes out completely.

# **Circuit details**

The circuit employed is extremely simple using only five components plus a battery, although a small power supply would probably be advisable if the project is to be wired permanently.

The three transistors are connected in a very high gain compound configuration. The last of these, Tr3, drives the small cycle bulb LP1. The first transistor has its base connected to a capacitor the other end of which goes to the positive side of the battery. Since transistor Tr1 is directly connected to Tr2, which in turn has its emitter directly fed to Tr3, then the base of Tr1 is the point which determines what happens in the rest of the amplifier.

At switch on, the bulb immediately lights to its full brilliance. The input voltage applied to the

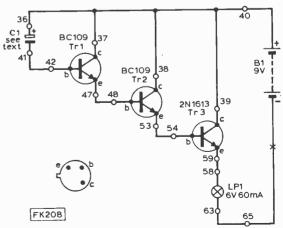


Fig. 1: Circuit diagram, showing the simple nature of the Guardian Angel. A 6V 60mA bulb is suggested for LP1 in order that Tr3 runs cool.

# you will need . . .

Tr1 BC109 C1 4·7µF tantalum
Tr2 BC109 L1 6V 60mA bulb
Tr3 2N1613 B1 9V battery (FP9)
One S-DeC and one Super Solder Board.

amplifier can only reach the base of Tr1 via the capacitor C1. As the amplifier draws its very tiny current, capacitor C1 gradually charges up. Note that the positive side of the capacitor is connected directly to the positive 9V line while the negative side goes to the base of Tr1.

With the base of Tr1 at some positive potential the lamp will glow because the transistor Tr1 is biased "on". But as the capacitor gradually charges up, the base side, the negative side of C1, gets more and more negative thus the base of Tr1 becomes less and less positive causing the current through the bulb to get less and less.

It might be easier to consider the capacitor plus the first two transistors as being replaced by a potentiometer across the positive and negative rails and with its wiper arm connected to the base of Tr3. The charging of C1 would then be analogous to simply turning the wiper of the pot away from the positive rail and downwards thus making the base of Tr1 more and more negative.

# S-Dec holes

Referring to the circuit diagram of Fig. 1, the clear circles with numbers are the numbered holes on the S-DeC which the relevant component(s) are plugged into. For example, the bulb is plugged into S-DeC holes 58 and 63. The last transistor, Tr3, is

the value of the capacitor C1. In the prototype a  $4\cdot7\mu F$  was used. Provided this was a tantalum capacitor, then the light would gradually dim and go out over the period of one hour. Electrolytic capacitors did not give reliably repeatable times due, no doubt, to their leakage being greater than that of tantalums. Using two electrolytics marked  $22\mu F$  gave widely different times.

Other time periods can be easily achieved by simply altering the value of C1. Just unplug the  $4.7\mu$ F capacitor from holes 36 and 41, and plug a different capacitor into exactly the same holes.

Note: tantalum capacitors have a positive and negative lead. It is essential that they are inserted into the circuit the correct way round. If a tantalum capacitor is inserted in the wrong polarity (i.e. the wrong way round) it is easily damaged.

# **Power requirements**

Using a 6V supply, other capacitor values tried gave time periods as follows:  $1\mu F$  (10 minutes);  $0.22\mu F$  (6 minutes);  $0.1\mu F$  ( $2^{1}_{4}$  minutes).

The circuit was found to work well on either 6V or 9V. Under no circumstances should more than 9V be used with this circuit nor should bulbs with current ratings greater than 100mA be used. The battery used in the prototype was a large 9V unit (PP9) and the bulb was a 6V 60mA cycle bulb. On test a 6V 100mA bulb was found to work well and these are commonly obtainable from most cycle stores. It is suggested that a 6V 60mA bulb is preferred since these will draw less current and Tr3 will run cooler.

The actual lead identification on the three transistors is identical. Looking at the underside of the transistors and counting from the pip/protrusion clockwise the leads are emitter, base, collector,

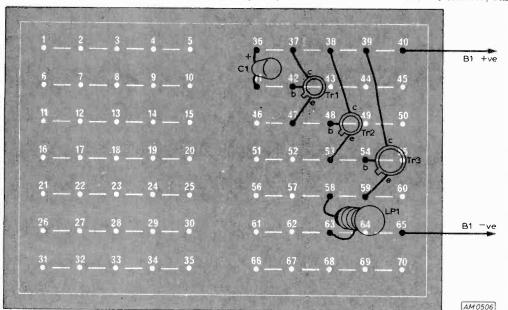


Fig. 2: Full size drawing of the S-DeC, giving the connection points for the three transistors, C1 and

plugged into S-DeC holes 39 (collector), 54 (base) and 59 (emitter). Once these two components have been plugged in, the connections below the surface of the S-DeC will automatically connect the emitter of Tr3 to one side of the bulb.

The time which the light remains on, or rather the time which it takes to go out is determined by A last thought. To switch the light back on again and restart the cycle, simply short the two leads of C1 together for a moment—just a touch will do.

Good luck with the first project. Next month there's a special S-DeC project for Christmas: A Christmas Pudding Saver which can also be usefully employed as a Pubometer.

One of these

Take a look at the labels. Each one a formula for making you forget the stresses and strains of modern living.

The message of each name is: make something. Make a digital clock . . . make a coffee table . . . make some new sounds. The sheer concentration involved in constructional projects like these smoothes away the tensions.

Any one of these "Practical" magazines packs so many hours of creative satisfaction that it could make a new man of you.

## TELEVISION

December issue The art of alignment, audio circuits for the constructor and servicing the Philips 68 Colour Chassis and the Philips 320. OUT NOVEMBER 15

# PRACTICAL ELECTRONICS

Projects for constructing a Gamesmachine that produces random numbers for Dice, Roulette and the Pools and a Metal Locator that is ideal for the home improvement enthusiast. OUT NOVEMBER 12



December issue How to make a Chromachaser for flashing lights at discos, a VHF Converter Start of a new
'S Deck Projects' series.
OUT NOVEMBER 5

# PRACTICAL HI-FI & AUDIO

HI-FI & AUDIO
December issue
Ten loudspeakers
undergo the ultimate
test—line Wesus
repurent guide to
music centres and
complete audio systems.
A new series starting
on choosing
a hi-fi system.
OUT NOVEMBER 12

### EVERYDAY ELECTRONICS

December issue
Two hig projects:
how to make a
Mini Organ and a
'Scrabble' Timer.
Start of a new
series explaining
the mathematics
used in electronics. OUT NOVEMBER 19



OR CHIEFE



# PRACTICAL WOODWORKING

December issue
Contents include a
variety of Christmas gifts
to make, a toy farm
and a timber wagon
for modellers, a stereo storage stand to build and a carving project. OUT NOVEMBER 19

Pick up a'Practical'and be a new man

# DUESSOUR - LICELEUS - LESSOUR - LESS

# PART 5

# M.J.HUGHES M.A., C.Eng. MIERE

This, the last major board of the project, contains a number of different circuits. It accepts the signals that have been generated elsewhere and combines them to produce the final video output signals that generate the character information for display on the screen.

As on the previous boards, the intercomponent wiring is by etched tracks on both sides of copper clad epoxy resin board. Fig. 22 gives the main body of the wiring whilst the remaining sections are on the component side, as shown in Fig. 23. Connections between the two sides are made by means of stakes. Before assembly starts the construction notes for the previous boards should be read.

ICs 38 to 44 are MOS devices and subject to damage from static electricity. Do not remove them from their protective packing until required and make sure that your body is discharged of any static before handling them. It is highly recommended that sockets are used for these devices.

# RANDOM ACCESS MEMORY

Perhaps the most significant circuit is that associated with the memory section which is shown in Fig. 24. The main Random Access Memory comprises six integrated circuits (IC38-IC43). Each of these packages will store 1,024 binary bits of information—in other words each unit contains what amounts to 1,024 flip flops which can be individually set or reset

We use six separate circuits because each ASCII code that has to be memorised is made up of six bits. Each of the RAM circuits looks after ONE bit of the ASCII code—for example you will see that bit 1 from the keyboard is fed to the data input of IC38, bit 2 to the identical input of IC39 etc. In effect we apply the six bit ASCII code from the keyboard to all six memory ICs in parallel for memorising. As each circuit has 1,024 memory locations we can thus record 1,024 separate "6 bit" codes each of which describes a single character that is to be displayed.

Our display has a capacity for 512 characters (16 lines each having 32 characters) and so we have enough memory capacity for TWO full pages of text. More will be said about this later. Clearly we cannot have 1,024 separate inputs for each of the "flips flop" memory locations in each chip so we

# **★** components list

### Memory Board Resistors R8 100Ω 10%, ½W R9 330Ω 10%, ‡W R10 470Ω 10%, ‡W R11 330Ω 10%, ‡W R12 330Ω 10%, ‡W R14 330Ω 10%, †W Capacitors C3 10µF, 12V, Tubular, wire ended C4 47µF, 12V, Tubular, wire ended Semiconductors IC38 Intel 2102-2 or Texas Instruments TMS4034 IC39 Random Access Memories. 1C40 NOTE. These are 650nS access time devices. IC41 Although faster devices may be used, on no account try to use slower devices. IC43 IC44 General Instruments RO-3-2513 Read Only Memory Character Generator NOTE. There are other character generator ICs on the market but they may not have the same power requirements or pin connections and their access times may be different IC45 SN74174 IC46 SN74151 IC47 SN7410 1C48 SN7474 IC49 SN7404 1C50 SN7400 IC51 SN7430 SN7430 IC52 IC53 SN7430 IC54 SN7430 IC55 SN7410 Miscellaneous. Printed Circuit Board, See Readers PCB Service ad. DIL sockets, 1 off 24 pin, 8 off 16 pin, 9 off 14 pin Board pins. Tinned copper wire for staking

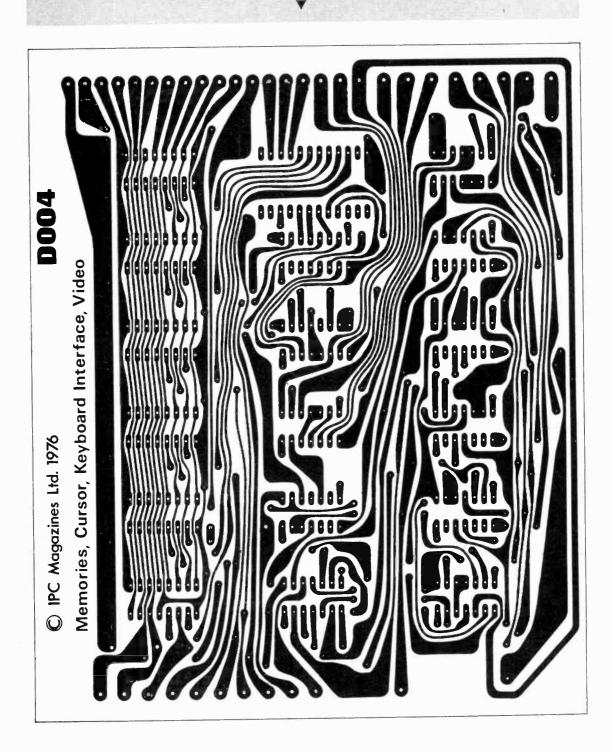
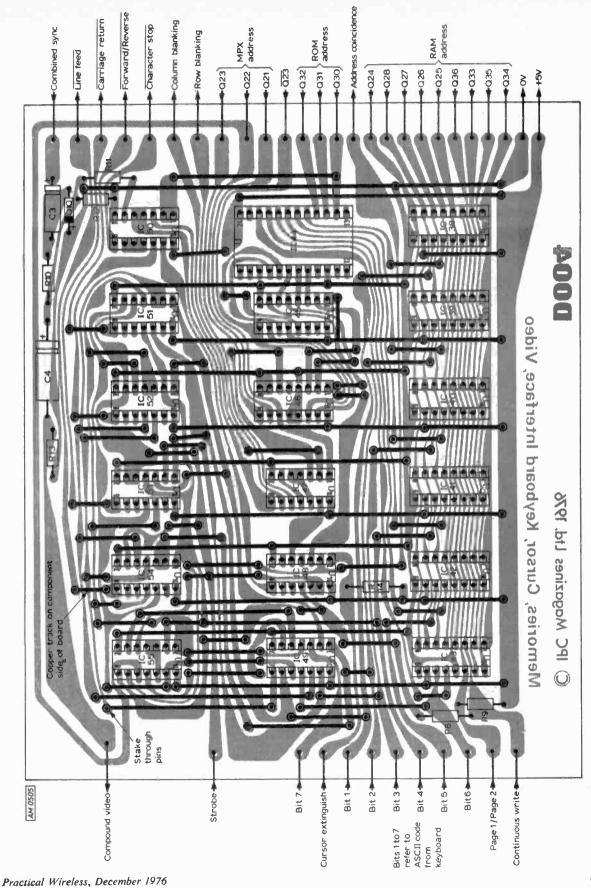


Fig. 23. The component side of the board. Note the polarity of C3 and C4 and the reversed orientation of IC44.



use the principle of Addressing that has already been described. By using an Address Word we can activate any of the flip flops to accept data that is fed into the common data input.

To describe 1,024 separate memory locations we need a binary code that has a capacity of counting up to the number 1024. Those that have an understanding of binary numbers will appreciate that this needs 10 binary bits. For example the code 0000000001 represents 1,000000010 represents 2 and so on up to 1111111111 which is 1,023. We get 1,024 codes by using an address of "All Zeros" to make up the full complement.

The inputs which accept the address codes can be clearly seen in Fig. 24 and as mentioned previously the codes are generated by the Address Counter. The following table shows the pin designations for the RAM address inputs with reference to our specialised address codes:

ADDRESS CODE BIT	PIN	NUMBER
Column Addresses		
Q24 (least significant bit)		8
Q25		4
O26		5
Ö27		6
Ŏ28		7
Row Addresses		
033		2
034		1
O35		16
036		15
Page 1/Page 2 Address (Most s	ig. bit	t) 14

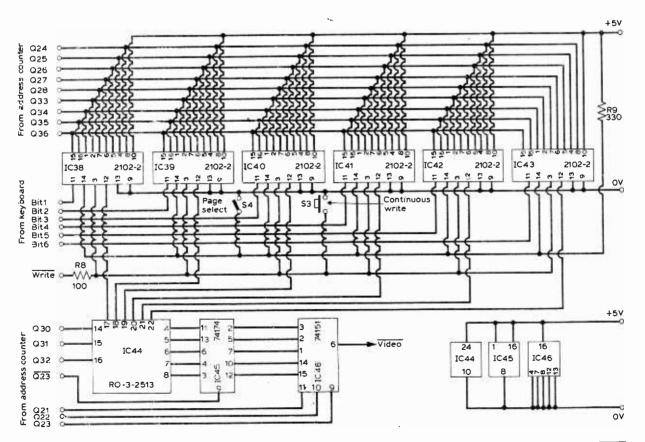
Notice that we only generate nine address lines from the counter. The permutations of these codes make up a total of 512 character addresses (sufficient to describe one full page of text) and we use a manually generated tenth code (Page 1/Page 2) to select one or the other group of 512 depending on which "Page" of data we wish to operate on. This latter code is generated by the switch S4.

We feed the identical address codes to all six integrated circuits because, of course, we shall be requiring to record or read six bits at the same time to make up the proper ASCII code.

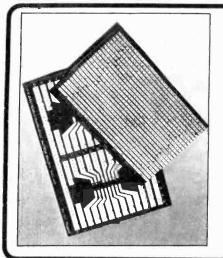
Apart from the power supply inputs to the memory chips at pins 9 and 10 there are only three other connections that ought to be understood. These are Read/Write at pin 3. Chip Enable at pin 13 and Data Out at pin 12.

When the Read/Write input is held at "1" any data on the input of the RAM is prevented from entering the memory. Only when this signal goes to "0" will the state of the data be read into the location of the memory that is being addressed at that time. Under normal circumstances the Write signal entering this part of the circuit is at logic level "1" as the memory is usually in "Read" mode—outputting data for display purposes. Only when a keyboard character is depressed does the Write signal go to "0" which allows the data to be written into the memory location that is being addressed at that moment of time.

Fig. 24. The RAM addressing and the Read circuitry.



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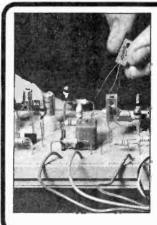
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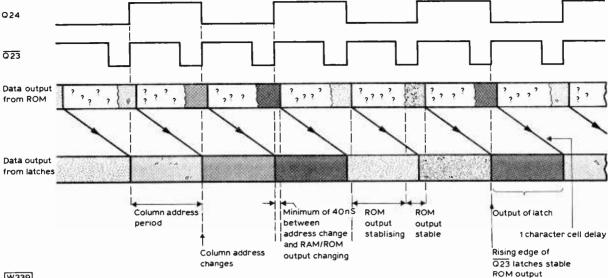
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W339

Fig. 25. Diagramatic representation showing how the slowly stabilising ROM output is caught by the latches on receipt of Q23 and given a character cell delay.

# CHIP ENABLE

The Chip Enable input would normally be used if several RAMs were connected in parallel at each significant bit of the ASC11 word-this technique would be used if the memory needed extending. In this application we do not need to select one of several chips so this input is kept permanently at logic level "0".

# DATA OUT

The outputs of each of the six significant bits of memory (pin 12 of each RAM) are fed to the six data inputs of the Read Only Memory (IC44) where the code is converted to give a five bit output word that describes the state of each picture point of a character cell row. The row in question is selected by the ROM Address code-Q30, Q31 and Q32which comes from the Address Counter.

# DISPLAY DELAY

It has been mentioned previously that there is a significant delay between accessing the right location in the RAM and obtaining the five bit output of the ROM. It is therefore necessary for the memory "Accessing" to be carried out a finite period of time BEFORE we start to display the character information on the screen. By using the MEDIUM SPEED RAM that is specified (NOTE THAT SLOWER CHEAPER VERSIONS OF THE 2102 MIGHT GIVE RISE TO PROBLEMS!) the  $1.5\mu$ S of a character cell width is more than enough time thus we address the RAM during the time of the character cell immediately prior to the time of the cell in which we want it to appear.

To produce this single cell delay we make use of five D Type latches in IC45. The outputs of these latches will take up the state of the inputs when the input clock makes a "0" to "1" transition. Note, with reference to Fig. 25, that the Q23 signal makes this transition at the end of a cell and thus is an ideal clock signal.

Some people might query that this clock edge is changing at the same time as the address of the RAM is changing and that this might give rise to ambiguities. In theory this is true but in practice there is a minimum of 40ns between the input address to the RAM changing and the output following suit. The rise time of Q23 is much faster than this so we are guaranteed to catch the data of the "previous" adress each time. The output data from IC45 is held valid for a complete character cell width until O23 comes round for the second time.

## LATCH SERIALISATION

The stable five bits from the latch then have to be serialised in the right sequence to give a time sequential pattern of picture points to make up the character cell row. They are fed to the inputs of the multiplexer (IC46).

Remember, however, that the first picture point in every character cell row must be a blank as this forms the gap between adjacent characters (it also prevents any truncation of active picture point data which might otherwise occur during the time the latches are stabilising). We therefore make sure that the first bit of data to be serialised by the multiplexer is a "0". A permanent zero level is applied to the input of pin 4 (shown connected to ground in the inset to Fig. 24).

Pins 3, 2, 1, 15 and 14 carry the five variable data bits and these are serialised in that order. The two remaining unused inputs of the multiplexer (pins 12 and 13) are connected to ground as is the strobe input (pin 7). The sequence of selecting the data inputs is carried out by the Multiplexer Address lines (Q21, Q22 and Q23).

The SN74151 multiplexer IC has two possible outputs; one has the same sense as the input data while the other provides the data in inverted form. We use the latter ouput because we need to "OR" the video information, so produced, with the Cursor signal which is generated in a later part of the circuitry. We therefore call the output of IC46

The design details for the remaining circuits on this board will be given in the January issue



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Tape Auxiliary	100mV 1–100mV	>70dB 60dB-	10KΩ 200KΩ	Children 10.6
	1	70dB	1 3	
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Distortion 0.04% at 1KHz; Output 1v r.m.s. into 10KΩ:

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# by Eric Dowdeswell G4AR

The NFORTUNATELY I was not able to get along to the RSGB Show at Alexandra Palace and to judge from my correspondence I missed meeting some of you, for which my sincere apologies. Seems the Show didn't quite get airborne! Seems ridiculous that a difference of opinion between the RSGB and the Amateur Radio Retailers Assoc. as to whether the traders would support the Show or not could not have been settled earlier, to enable it to have been cancelled, if necessary. As usual, those that pay the money, to the RSGB or to the traders, suffered!

Right chaps! Summer's over so let's get down to some serious listening for the next few months. You should have been out in the glorious sunshine putting up new aerial systems and polishing up the old ones. Get an ATU if you haven't already got one and make sure that the long wire is pulling its weight on all the HF bands. Get that countries prefix list up-to-date so that you won't be astonished when that AC4 turns out to be in W-land.

A crystal calibrator providing check points on 100kHz and 10kHz is invaluable and might stop some of you having implicit faith in your set's dial readings, which is very unwise even with the best of sets. I haven't yet had the chance of laying hands on any of the new receivers that are being advertised but I must admit to being aghast at one which has triple conversion! It has long been my contention that the only answer for a quiet receiver with virtually no spurious responses is single conversion at a high IF, probably around 9MHz where filters are available. I had hoped that we had heard the last of double and triple conversions a long time ago. Now it's all back and in solid state. UGH! This month's puzzle! Why was 9MHz, and sometimes 5.5MHz, chosen for the IF in some amateur HF band transceivers? Try juggling with the two frequencies.

John Moore of Leicester sends what may be his last log and letter for quite a while. He's getting hitched but it's good to see he is sticking to his guns 'til the last minute! Strangely, he made a 15m converter for his home-made 20m set and then found the band to be pretty dead, apart from a few S. Americans and Africans. John commented on the bad

behaviour of certain stations in the pile-ups but, as I have told him, a lot depends on the DX op. If he takes control of the situation and works stations only on the frequency he nominates then all should go well.

In Colne, Lancs., Richard Berry A8994 has been on 2m quite a bit, but bemoans the lack of SSB signals. Local lads tried to convince him that "FM is best" but he notes that they all have smart little commercial rigs, so perhaps they are biased! Michael Walker of Leeds hopes to start an RAE course this autumn. He had thoughts about CBing then decided. very wisely, to get on and get a proper licence! He has a CR70A and has been playing around for about a year before making his mind up. You won't regret it, Michael.

Our first "first timer" this month is Graham Carrington who hails from Hucknall, Notts., where he uses a Trio 9R59DS and a long wire on 160m, doublets for 20 and 15m and a trapped job for 10m. He is another looking forward (?) to taking the RAE 'ere long. Alan Doherty sends in his last log for a while as he lowers his aerials and departs for New Zealand, as reported last month. Just as well, he says, with Force 8 to 9 Atlantic gales just down the road in Portrush, Co. Antrim!

Stephen Budd A8713 just missed last month's issue with his news that the WWV standard frequency station is to close down! It's not quite so bad OM, I understand it is certain propagation forecasts, useful to amateurs, that are being cut out. Could be worse! Stephen is busy filling out some 2000 QSL cards when he has nothing else to do. He's chasing the CQ Counties Award. When you get your ticket OM you can try working them!

The autumn newsletter of DADARS, Derby and District ARS, is full of juicy dates for the winter

# **BROADCAST BANDS**

Short Wave Reports by the 15th of the month to Derek Bell, c/o Practical Wireless, Fleetway House, Farringdon Street, London, EC4A 4AD. Medium Wave Logs to Charles Molloy, 132 Segars Lane, Southport, PR8 3JG.

# **AMATEUR BANDS**

Logs covering any amateur band/s in band/ alphabetical order by the end of the month to Eric Dowdeswell G4AR, Silver Firs, Leatherhead Road, Ashtead, Surrey, KT21 2TW.



season with technical matters nicely leavened with cheese and wine evenings and Ladies' Nights. Always a good idea to look after those that sharpen our pencils and bring us coffee during field days and contests! So trot along any Wednesday night to 119 Green Lane, or contact my old friend Fred Ward G2CVV. 5 Uplands Avenue. Littleover. Derby. for more details.

Another old friend, R. Holmay G2DYM, is going into business selling aerial systems, including those particularly suited to the SWL. He has some pretty definite ideas about aerials that keep down the QRM from colour TV timebases, which could interest some readers of this column. Write to G2DYM at The Old Saw Mills, Whiteball, Wellington, Somerset. Robin Bayley (Albrighton) was unlucky to find himself as the only candidate on the local RAE course, consequently cancelled. Good to know he is busy looking down at the CW end of the bands and finding some interesting DX there. Could use some more CW reports for a change. Robin uses a Marconi R1475 set with a long wire. Martin Sole A9065 runs a Trio JR310 in Peterborough plus a 66ft. end-fed aerial and a helical whip, with a preselector in between. He hopes to be on 2m also very soon. He admits failing the RAE but promises success in December. We'll be rooting for you OM!

In Harrogate Steve Cottis A8961 is proudly admiring his first award, the ISWL ITU Zones Award. He bemoans the 20p cost of IRC's from the PO! Certainly can get very costly, collecting awards these days, P. W. Turner BRS36843 in Bishops Stortford is another we must wish well in the next RAE. He enjoyed the RSGB 2m contest and hopes to come well up in the lists. Sorry I cannot comment on your score but suggest you look up the results of the previous similar contest.

The Pioneer Radio Club GM4AVH was pleased with the little plug I gave them last year so let's do it again! Present project in hand is a transceiver for the club station so if you are in the Edinburgh area why not pop in to the Gilmerton Church Hall in Ravenscroft Street any Tuesday evening around 7.30 or write to Sec. R. Henderson GM4DTJ at 2 Burdiehouse Avenue. Edinburgh EH17 8AW.

Our sympathies must go out to **David Peck** of Cambridge whose house was gutted by fire but he and the family got out safely. He now has an FRG7 and 130ft, aerial at his new QTH and has resumed listening. The last epistle of the month is from Steve Budd, again, and tells the sad news of the ill-health of Geoff Watts of DX News Sheet fame. Unless he can reduce the 80hrs/week work load it will certainly have to fold, which would be a great loss.

# Log Extracts (All SBB)

R. Bayley:—80m CW FL8CE PY7PO UA9CM 40m KL7KV LU2BB 20m AP2AD CT2AP EA6CF FP8DH VE8RE.

M. Sole:—20m EP2HE HC1QRC 15m CE3IF KV4AD YB2SV/4U ZS2ND 10m F0CFB/FC OY1A.

- S, Cottis:—20m HZ1TA JT1AS KL7BVY TA2BK VE8ML VP2SV VR4DX 15m VQ9HCS 5Z4QQ 9V1SV.
- P. W. Turner:—2m GW8IZS/P DJ9DX/LX/P GD3SLH/P GW3WRA/P.
- J. Hodgson:—20m CT2BB HI8EL HK4BTY VP9HM 7X4MD
- S. Budd:—80m FG7AR/FS7 HZ1AB (now RIP, I'm sorry to report) VP1MPW VP2AA 9M2PV 40m HK4DEG KZ5HP VK7GK ZL1-2-3-4 6W8FP 20m FO8EX HL9TJ JW7FD (Bear Is.) VR3AK VS6DA 15m VQ9DF YB0ACG ZB2FX 9X5AV 2m ON6UG PA0CIS.



# SHORT WAVE BROADCASTS by Derek Bell

MBARRASSMENT is defined in many ways; to Radio Norway it is the puff of black smoke that put their new 250kW transmitter off the air during recent high power tests! So reports Robin Bayley of Albrighton, Wolverhampton. Thus it is that Radio Norway is now on reduced power but running its normal schedule. "Get well soon" cards can be sent to Radio Norway, Oslo 3, Norway! Meandering into "Charles Molloy" land we find our second definition of this state of mind in the offices of the local radio station who found that the newspapers that were to be scanned to provide material for a "Weekly review of the local press" had been sent to the local fish and chip shop!

NHK Japan has produced a colourful set of leaflets that are well worth sending for. NHK have services in English from 0630 to 0830 on 15325 and 15430 but if you are one of those DXers that like the unusual then try for their North, Central, South American and Hawaiian service in English on 15195, 15420, 17725 and 17825 from 0100 to 0300. These are obviously not beamed to Europe but under certain conditions this winter it may be possible to pull them in.

Nicholas King of Rangiora, New Zealand, who belongs to the North Canterbury Amateur Radio Club, has built the General Coverage RX featured recently in PW and finds that he cannot buy the coils required to finish the set. This to me seems unusual since surely the inhabitants of NZ do not all build coil-less radios! However, that is the situation and Nicholas now has his set languishing on the shelf for want of these components. So can any of you "Home Brew" specialists assist and tell us the name of a firm that can supply coils to fit the RF stage of a mute Kiwi Receiver? (Why not try Denco, as stated in the article, at 357 Old Road, Clacton, Essex?—AED.)

Roy Patrick of Derby highlights one of the phenomena of summer propagation in his log of the signals pulled in by his National R1400 portable while the set was on holiday with him in Wales:—

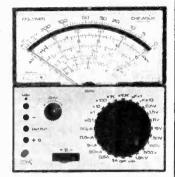
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Roy mentions that while he had an excellent signal in Wales from SBC the same station, despite its high power transmitters, was not heard in Derby. M. G. Hayman, of London, has logged Radio Kiev on the 9485 freq. at 1940 using a HAC Mk2 receiver hanging on the end of a 70ft long wire with a 20ft one on the side and an old TV aerial to fill in the gaps. Similarly Jim Coombs of Walsall logged Kiev on the 49 metre band on his 1950's built Armstrong that sucks in the signals via 100ft long wire. That must be some garden! Jim is seeking information on the ex-RAF 1392D set, in order to put right a fault in the circuit.

Our final item this month concerns the 10th birth-day of the Radio Berlin International DX Club. During November they are to broadcast the 250th DX club programme and issue three special QSL cards to mark the occasion. I may have a go for them myself, being somewhat of a nut for commemorative cards, but, with my luck, I will probably get all of one sort! Be that as it may we must say "Happy Birthday" to RBI, there cannot be many stations whose DX shows go so far back. The address for RBI is 116 Berlin Nalepastrasse 18-50 DDR. They run transmitters ranging from 5 to 500kW, at Leipzig and at a town that rivals that one in Wales (and you wont get me to quote it!) called Konigswusterhausen!

With that I will declare the meeting closed for this month and wish 73s to you and yours.

# **MEDIUM WAVE DX**

by Charles Molloy

THE winter DX season on the medium waves starts with a good bag of readers' letters. John Wildey (Doncaster) has a Grundig Satellit 2000 and a 30ft longwire aerial which is strung between house and garden shed. With this combination he logged WOR on 710kHz, WINS on 1010 and WNEW on 1130, all three stations being in New York City. John gives details of the programmes heard which should be of interest to DXers who have never heard North America on the medium waves and do not know what to expect. On WOR at 0200 John heard a talk on psychology, on WNEW at 0235 a baseball match "Cardinals v. Mets", adverts for a finance company, an interview programme and a weather

report, From WINS at 0300 came the stock market report; WINS is an all-news station.

Ian Rennison mentions that North American has started early this year, CJON being heard at quite good strength on most evenings. His list of catches to date includes CBN on 640kHz, CKVO on 710, WABC 770, CJON 930, CHNS 960, WINS 1010, WBZ 1030, MNEW 1130, CBT 1140. WCAU 1210, WKLX 1350, WMEX 1510 all heard on a Trio 9R59D receiver with loop and differential amplifier. Ian says that this year is the first time he took advantage seriously of Ramadan for DXing and he sends a list of 25 DX stations logged which include Bonabe, Iran on 634kHz, Amman, Jordan on 800, Kikuk, Iraq on 1360 and Libya (either Sabha or Benghazi) on 1570.

Finally, Ian refers to his tape recorder which he finds invaluable for DXing. He wonders how many readers find themselves busy writing details for a reception report when their pens run dry or they run out of paper. All you have to do is to note the times when the tape was switched on and off. Important identifications that were missed can be replayed until they are clear. Ian, like the writer, always has a tape recorder coupled to the receiver when DXing.

Old timer F. F. Shortridge writes again from Llandudno Junction to say that his AR88 needs attention and while waiting for a repair he has been trying for North America with a small Vesta Vixen 6 transistor portable which he obtained from a department store. This receiver has sockets for Aerial and Earth and when joined to a 200ft outdoor aerial which is shaped into a square, it pulled-in WINS 1010, CJON 930, WNEW 1130 and CHNS 960. He says that there are so many stations on the band these days that QRM makes it impossible to receive North American DX as it was 40 years ago. At that time he

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heard KTMS in Hot Springs, KSL Salt Lake City, KNX Hollywood, WSM Nashville and WENR Chicago. (KSL, and WSM are still heard occasionally in the UK.)

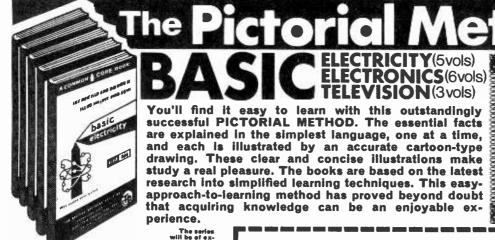
Ricky Henman (Sheffield) asks "do you need a good receiver designed for DXers to DX on the medium waves?" The previous log from F. F. Shortridge illustrates the value of a really good aerial which, if connected to a simple receiver, will produce at least some DX. A good receiver will help too. Not everyone has the space to put up an outdoor aerial. John Timms (London) who lives in a bedsitter is constructing a medium wave loop which is a good alternative to a longwire and in some respects is superior.

Fifteen year old Paul Boyd (Carlisle) is a newcomer to the band, with his Realistic Astronaut 4 connected to a 100ft long wire he pulled-in Trans World Radio in Monte Carlo on 1466 and the Voice of America in Rhodes on 1259, A good start, Paul! With your aerial you should be able to hear North America when the long winter nights are here. Try around 2300 for CJON in St John's Newfoundland on 930kHz.

Alan Spencer who lives at Ryhall, in Lincolnshire. has finished building a loop which he uses with a Bush TR90C receiver. Stations logged include VOA Rhodes on 1259kHz, the Deutsche Welle relay in Malta on 1570 and AFN outlets on 872, 935, 1106 and 1142. Being able to null out stations on the same frequency is a great advantage reports Alan and he continues "I have been listening regularly to Radio Sweden in English on about 1330kHz. This frequency is not listed in the World Radio Handbook nor is it announced at the end of the programme, which starts at 1100". Has any reader heard this transmission? It might be a spurious signal of some sort as the Swedish Foreign Service has a shortwave transmission in English from 1100 to 1130.

Roy Patrick has been on holiday at Towyn, in Wales, and like a good DXer took a receiver with him, a National R1400 portable. This is one of the better type of portables which has an RF stage and an "S" meter and is quite a powerful DX tool on the medium waves. Using this receiver with its internal aerial Roy pulled in the Trans World Radio high power station at Bonaire in the Netherland Antilles, which lie off the north coast of South America. The station is on 800kHz with a power of 500kW. There is a lot of interference on 800 which can be nulled-out with a loop or a ferrite rod aerial.

David Bellmer asks if there is a DX club in operation in Lancashire. Can readers in Lancashire help? David's address is 21 Brabazon Place, Marsh Green, Wigan, Lancs. Robin Bayley of Kingswood School, Allbrighton, uses a Marconi Tuner Amplifier with an outdoor aerial and a Grundig "Prima Boy" with internal aerial for his DXing. Stations logged include Riyadh in Saudi Arabia on 587kHz, and CX10 in Montevideo, Uruguay, on 730. Robin is a regular listener to Sweden Calling DXers which is broadcast in English every Tuesday on 1178kHz at 2315.



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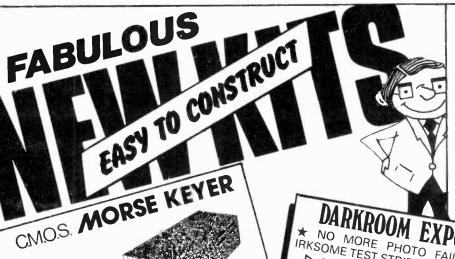
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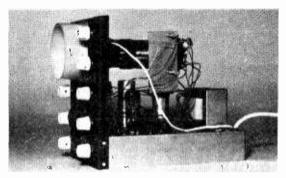
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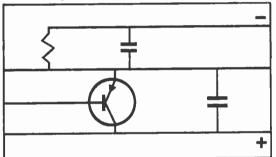
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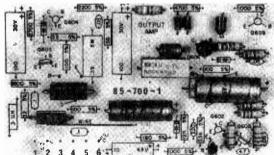
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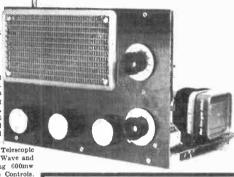
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707	0.95	0.2 Red	0.13
727	1.98	0·2 Green	0.20
728	1 - 95	0-2 Clear	0.14
747	1 - 85	0.00	
780	1 - 85		

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401 0-16	(Basic clock chip giving 6 digi
402 0·16 403 0·16	displays) Socket 0-45
	MM5316£5-21
405 0-18	(Sophisticated device including
406 0:51	siarm)
407 0·18 408 0·18	Socket for MM5316 0-80

0.18	SOCKET FOR MI	M0316 0 80	
0.16			
0·25 0·25	LINEARIC	CS .	
0.72	LINEAR	ICS	
0.43	307		0.85*
0·43 0·16	380	14 Pin Dil	0.90*
0.38	565	8 Pin Dil	0.45
0.40	565	14 Pin Dil	2.00°
0.30	586	8 Pin Dil	1.50°
0.48	867	8 Pin Dil	2.00°
0·53 0·15	709	8/14 Pin Dil	0.35
0.37	741	8/14 Pin Dil	0.28
0.49	748	8 Pin Dil	0.35
0.35	3900	14 Pin Dil	0.70*
0.35	CA3045		0.85
0·16 0·76	CA3046		0.50°
0.65	MC1304		1 - 56
1.50	MC1307P		1-17*
2.58	MC1458P		0.77
0.81	MC1496L		1 - 10*
0·81 0·85	3N75324		2 - 55
0.18	SN75451		0.89*
0.18	SN75452		0.89*
0.18	TAA300		1 - 61
0.18	TAA310A		1 - 38
0.32	TAA560		0.45

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FULLY TESTED BUT UN-MARKED, SIMILAR TO 2N3055 EXCEPT VCEO > 50V HFE > 20 @3 Amps. 5 pcs for £1-86

20 pcs for £3:40 50 pcs for £7-50 100 pcs for £13-86

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OON) LTD.				IE	RS	
יייין בוטי	AC126 AC127	0.18	BD181 BD182	0.88	OA80 OA81 OC41 OC42 OC48 OC70 OC71 OC72 OC84	0.08
		0.13	BD183 BD232	0.87	OC41	0·18
	AC141 AC141 K	0·18 0·28	BD233	0.48	OC44	0-12
10A 18A ) (TO220) (TO84)	AC142 AC142K AC178	0-18	BD238	0.90.	OC70	0·10 0·10
0-47 0-96	AC176	0.18	BD184 BDY20	0.80° 1.20 0.80 0.60 0.65	OC72	0.55
0-84 1-02 0-88 1-14	AC176K	0.28	BDY88 BDY60 BDY61	0.80	OC84 SC40A	0·14 0·73
0.98 1.40	ACIST ACIST	0·28 0·18		0.65	8C40B	0.81
1-26 1-80	AC188 AC188 AC188K AD140	0.25	BF178 BF179	0.28	SC40F	0 · 88 0 · 68
LATEDTAB)	ADIAR	0.80	BF194 BF198	0·10° 0·10°	9C84 8C408 8C408 8C40D 8C40F 8C41A 8C41B 8C41D 8C41F	0.70
	AD143 AD149	0.48	BF106 BF107	0.12°	SC41F STR	0.88 0.80 0.20
(b) (a) (b)	AD161 AD162	0·38 0·38	BF224J	0.12*	TIPERA	0.44
0-83 1 01 1 01	AL102 AL103	0.95	BF244 BF267	0·17°	TIP29A TIP30A TIP31A	0-82
0·87 1·17 1·17 1·19 1·70 1·74	AF114 AF115	0.20	BF258 RF337	0.35	TIPSEA TIPSA	0.84
1.50 2.11 2.17	AF116 AF117	0.50 0.50		0·17° 0·26	TIPSEA TIPSA TIP41A TIP42A	0·64 1·05 0·68 0·72
ed under column	AF118	0.80	BFW60 BFX29 BFX30 BFX64 BFX68 BFX88 BFX88	0.30	IN2069	0.14
under column (b). required.	AF139 AF239	0.87	BFX65	0.25	IN2069 IN2070 IN4001 IN4002	0·18 0·04*
	BC107 BC107B	0.08 0.08 0.08	BFX88 BFY50	0.50	IN4002 IN4003 IN4004	0.04° 0.05° 0.06° 0.07°
Special Offer	BC108 BC109	0.08	BFY62	0·18 0·19	IN4008	0.08° 0.08°
Red Led	BC109C BC117 BC125	0.12	BFY64 BFY90	0.35	IN4006 IN4007	0.09*
RL209	BC125	0.18° 0.20°	BR100 BFY39	0.20	2N696 2N697	0-14
10p Axial lead	BC125 BC141	0.52	BSX19	0.16	2N706	0.10
ar part part with	BC142 BC143	0.53	BSX20 BSX21	0-18	2N929 2N930	0-14
	BC144	0.30	BSY95A		2N1131	0.15
	BC147 BC148	0.08°	BT106 BT107	1.00	2N1132 2N1304	0.16 0.20
THAV	BC149 BC152	0.09°	BT108 BT109	1.60	2N1305	0.20
9711.99	BC153	0.18°	BT116	1.00	2N1711 2N2102	0·18 0·44
WHILL	BC157 BC158	0.08° 0.08°	BU105 BU105/00	1.80*	2N2369 2N2369	0-14
THE RESERVED	BC159	0.08°	BU126	1.60*	2N2484	0.18
REGULATORS	BC150 BC161	0·32 0·38	BU204 BU208	1.60° 2.60°	2N2646 2N2905	0·30 0·18
723 0·45 1 amp Plastic	BC168B	0.00°	BY206	0.18	2N2905A	0.22
7805 1-50	BC182 BC182L	0·11° 0·11°	BY207 BYX36-	0.20°	2N2926R 2N29260	
7812 1:50 7815 1:50	BC183	0·10° 0·10°	300	0.120	2N2926Y	
7818 1-50	BC183L BC184	0.11*	900 900	0·16° 0·16°	2N2926G 2N3053	0.10
LM340-8 1 35 LM340-12 1 85	BC164L BC207B	0.110	1200 BYX38-	0.21*	2N3054 2N3055	0.40
LM340-15 13-5 LM340-18 1-35	BC212	0.11*	300	0.50	2N3440	0.56
LM340-18 1·35	BC212L BC213	0.11*	900 900	0.55	2N3442 2N3525	t · 20 0 · 60
	BC213L	0.120	1200	0.65	2N3570	0.80
SPECIAL	BC214L	0·14° 0·14°	BZX81 8 Zeners	Series 0-20	2N3702 2N8703	0·10° 0·10°
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1A TO3 5V	BC327	0.18*	C106A C106B	0·40 0·45	2N3714 2N3718	1 · 08 1 · 18
£1·25	BC328 BC337	0·16° 0·17°	C106D C106F	0.50	2N3718 2N3771	1.28
	BC338	0.170	CR\$1/05	0.25	2N3772	1.60
8 Pin 0-12	BCY30 BCY31	0.65	CRS1/10 CRS1/20		2N3773 2N3819	2·10 0·28°
14 Pin 0:13	BCY32	0.60	CRS1/40	0.40	2N3904	0.16°
16 Pin 0-16 24 Pin 0-45	BCY33 BCY34	0.55	CRS1/60 CRS3-05		2N3906 2N4124	0·11° 0·14
40 Pln 0-80	BCY38	0.5;	CRS3-10	0.45	2N4290	0.12
	BCY39 BCY70	1 · 15 0 · 12	CRS3-20 CRS3-40		2N4348 2N4870	1 · 20 0 · 35°
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E2:25°

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## 20x20 Watt STEREO AMPLIFIER

Superb Viscount IV unit in teak-finished cabinet, Black fascia with aluminium rotary controls and pushbuttons, red mains indicator and stereo jack socket Function switch for mic, magnetic and crystal pick-ups, tape, tuner, and auxiliary. Rear panel features two mains outlets, DIN speaker and input sockets plus fuse, 20+20 watts rms, 40+40 watts peak,

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for only £80, you get the 20+20 watt Viscount IV amplifier, a pair of our 12-wattrms Duo Type IIb matched speakers; a BSR MP 60 type deck complete £8000 with magnetic cartridge. de luxe plinth and cover.

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Comprising our 20+20 watt Viscount IV amplifier; a pair of our large Duo Type III matching speakers which handle 20 watts rms each; and a BSR MP 60 type deck with magnetic cartridge, £9200 de luxe plinth and cover

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SPEAKERS Two models - Duo IIb. teak veneer, 12 wat rins, 24 watts peak, 18½" x 13½" x 7½" approx.

234 PER PAIR

Duo III. 20 watts. rms, 40 watts peak 27"x 13"x11%" + n & n.

£48 £7.50 PER PAIR

TURNTABLE Popular BSR MP 60 type, complete with magnetic cartridge, diamond stylus, and de luxe, plinth and cover,

+ p & p. £3.50 VALUE





1x30 AMPLIFIER KIT Specially designed by RT-VC for the experience constructor, this kit comes complete in every detail. Same facilities

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rms, 60+60 peak

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Again, this kit is specially designed for the experienced constructor — for mounting into his own cabinet Features include solenoid-assisted AUTO-STOP, 3-digit counter, record/replay PC board, mains transformer and input and output £3250 controls. AC BIAS AND ERASE. + p & p. £1.50



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**TOURIST IV PUSH BUTTON CAR RADIO KIT** 

(Motor Top 10 Award)

Complete with speaker, baffle and fixing strips. The Tourist IV – for the experienced constructor only. The Tourist IV has five push buttons, four medium band and one for long wave band

The tuning scale is illuminated and attractive soun atuminium control knobs are used for ual turner and volume central he modern style facia has been designed to blend with most car interiors and the finished radio will slot into a standard car radio aperture. Size approx  $\mathcal{T}^*$  x  $\mathcal{T}^*$  x  $\mathcal{A}^*$  Power Supply Norminal 12 voits positive or negative each (aftered internally). Power Output 4 warrs into 4 ohms

£10.50 + p&p £1.50



#### 35-WATT DISCO AMP

Here's the mono unit you need to start off with. Gives you a good solid 35 watts rms, 70 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. £2750 + p&p.

70 and 100 WATT DISCO AMPLIFIERS

Brilliantly styled for easy disco performance! Sloping fascia, so that you can use the controls without fluss or bother. Brushed aluminium fascia and rotary controls. Five smooth-acting, vertically mounted 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-£4900 versa. Pre-fade level control (PFL) lets YOU hear next disc + p & p. £3.00 before fading it in. VU meter monitors output level. 70

watts rms, 140 watts peak All the big features a outout. on the 70-watt disco on me /U-watt disco amplifier, but with a massive 100 watts rms, 200 watts



PORTABLE DISCO CONSOLE

with built-in pre-amplifiers

decks. Plus all the controls and features you

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Specially designed by RT-VC for cost-conscious hi-fi enthusiasts, these kits incorporate two teak-simulate enclosures, two EMI 13" × 8' (approx.) woofers, two 31/4" (approx.) tweeters and a pair of matching crossovers. Easily constructed, using a few basic tools. Supplied complete with an easy-to-follow circuit diagram, and crossover components. Input 15 watts rms, 30 watts peak, £2550 + p & p. PER PAIR each unit. Cabinet size

When you are looking for a good speaker, why not build your own from this kit. It's the unit which we supply with the above enclosures. Size 13" × 8" (approx.) EMI woofer, 31/4" (approx.) tweeter, and matching crossover. £750 + p&p.

Power handling capacity
15 watts rms, 30 watts peak.

PER SET

'COMPACT' FOR TOP VALUE

EAKER KITS

How about this for incredible 15-WATT KIT YOU CAN hold of high efficiency units for no CHASSIS FORM DO BETTER only £ £7.50 — just what you need for low-power amplification. come to you ready mitred and professionally finished. Each cabinet measures 12" × 9" × 5" (approx.) deep, and is finished in Rosewood. Complete with two 8" (approx.) speakers £750 for max. power handling of 7 watts

p&p €1,70

per pair

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This matching loudspeaker system is hand-made, as only Decca know how, built to a specification,

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Zym 30p secn.

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Mobile Converters, 24V DC input 13-8V at approx 3-4A DC output, fully stabilised, £3-50 each (ideal for running 12V car radio from 24V lorry battery).

We now stock Spiralux Tools for the electronic enthusiast. Screwdrivers, Nut Spanners, 8A and Metric sizes, pop rivet guns, etc. S.A.E. for list.

Miniature earphones with min. jack plug, 2 for 50p + 12‡% VAT.

I.F. Cans, in square, suitable for rewind, 6 for 30p + 121% VAT.

TWIN 1.F. CANS, approx. 1in × ‡in × 1in high around 3-5-5MHz, 2 separate transformers in 1 can. Internally screened, 5 for 50p + 12‡% VAT.

Dubliter Electrolytics, 50uF, 450V, 2 for 50p.
Oubliter Electrolytics, 100uF, 275V, 2 for 50p.
Pleasey Electrolytics, 470uF, 63V, 3 for 50p.
TCC Electrolytics, 1000uF, 30V, 3 for 60p.
TCC Electrolytics, 1000uF, 30V, 3 for 60p.
Pleasey Electrolytics, 1000uF, 30V, 40p each (3 for 51).
Dubliter Electrolytics, 5000uF, 50V, 60p each.
Dubliter Electrolytics, 5000uF, 50V, 60p each.
TTE Electrolytics, 6800uF, 52V, high grade, screw terminals, with mounting clips, 50p each.
Pleasey Electrolytics, 10,00uF at 83V, 75p each.
Pleasey Electrolytics, 10,00uF at 83V, 75p each.
Pleasey Cathodray Capacitors, 0-0.4uF at 12:5kV
CC. Screw terminals, 2tt-56 each.
PLEASE ADD 12;% VAT TO ALL CAPACITORS

A LARGE RANGE OF CAPACITORS AVAILABLE AT BARGAIN PRICES, S.A.E. FOR LIST.

TV PLUGS AND SOCKETS
TV Plugs (metal type), 5 for 50p.
TV Sockets (metal type), 4 for 50
TV Line Connectors (back-to-bi

TV Line Connectors (back-to-back sockets), 4 for 56p. Please add 124% VAT.

PLUGS AND SOCKETS
N-Type Plugs 50 ohm. 80p each, 3 for £1:56,
N-Type Sockets (4-hole chasais mounting), 50
ohms (a small coax lead type), 50p each
PL259 Plugs (PTFE), brand new, packed with
reducers, 85p or 5 for £3.
SO239 Sockets (PTFE), brand new (4-hole fixing
type), 80p each or 5 for £2:25.
ZS-way ISEP Plugs and Sockets, 40p set (1 plug
+ 1ak1).
Plugs and sockets sold separately at 25p each.

+ takt).
Plugs and sockets sold separately at 25p each.
Bulgin Round Free Skts. 3 pin, for mains input
on teat equipment, etc., 25p each.

WELLER SOLDERING IRONS
EXPERT. Built-in-spotlight lituminates work
platol grip with fingeric letiger. High efficiency
copper soldering lip.
EXPERT SOLDER GUN. 08:50 + VAT (54p)
MARKSMAN SOLDERING IRONS
SPISO 15W US + VAT (54p)
SP250 25W US + VAT (54p)
SP250 C5W US + VBT (54p)
SP250 C5W US + VBT (54p)

SPASS 29W 13T VAT (45P)
SPASS 29W 13T VAT (45P)
SPASS 29W 20T 13T VAT (25P)
SPASS 29W 20T 13T VAT (25P)
SPASS 37W 20T 13T VAT (35P)
SPASS 37W 20T 13T VAT (35P)
MT0 10T 40W 45P + VAT (45P)
MT0 10T 40W 45P + VAT (35P)
MT0 10T 40W 45P + VAT (45P)
MT0 10T 40

MULTICORE SOLDER Size 5 Savbit 18 a.w.g. in alloy diapenser, 32p + VAT (3p). Size C19AV16 Savbit 18e.w.g., 56p + VAT (4p). Bize 12 SAVBIT 18e.w.g. on plastic reel £1:80 + VAT (18p)

PRICE: £37.90 + VAT

'Wireless World' May, June, July '78

Typical performance Noise reduction better than 9dB weighted

Dynamic Range > 90dB

30mV sensitivity

Clipping level: 16-5dB above Dolby level (measured at 1% third har-monic content)

Harmonic distortion 0-1% at Dolby level (typically 0-05% over most of band, rising to a maximum of 0-12%)

Signal-to-noise ratio: 75dB (20Hz to 20kHz, signal at Dolby level) at Monitor output

Terms of Business: CASH WITH ORDER, MINIMUM ORDER \$1. ALL PRICES INCLUDE POST & PACKING (UK ONLY). SAE with ALL ENQUIRIES Please. PLEASE ADD VAT AS SHOWN. ALL GOODS IN STOCK DESPATCHED BY RETURN. CALLERS SATURDAYS ONLY 9.30-12.00, 1.30-5.00.

## Dolby™ Noise Reducer Kit



Trademark of Dolby Laboratories Inc

The latest addition to our exclusive range of matching high fidelity units.

The Dolby Noiss Reduction System is designed to reduce background noise on open reel or cassette tape recorders. Used in the signal path to and from the tape recorder, the unit will encode (Dolbylee) signals during recording, and, during playback, may be used to decode either your own encoded material, or commercially available Dolby encoded cassettes.

- switching for both encoding (low-level h.f. compression) and decoding
- a switchable f.m. stereo multiplex and bias filter
- provision for decoding Dolby f.m. radio transmissions (as in USA)
- no equipment needed for alignment
- suitability for both open-reel and cassette tape machines check tape switch for encoded monitoring in three-head machines

The kit includes:

- -complete set of components for stereo processor
- -regulated power supply components
- board-mounted DIN sockets and push-button switches
- --fibregiass board designed for minimum wiring --soild mahogany cabinet, chassis, twin meters, front panel, knobs, mounting screws and nuts

Calibration tapes are available for open-reel use and for cassette (specify which) PRICE £2:00 + VAT\*

### S-2020TA STEREO TUNER/AMPLIFIER KIT

SOLID MAHOGANY CABINET

A high-quality push-button FM Varicap Stereo Tuner with Interstation mute combined with a 20W r.m.s. per channel Stereo Amplifler.



PRICE: £53:95 + VAT

THD < 0.1% @ 20W
Tuner S/N 30dB @ 1.2µV
(mono)
Toroldal Transformer

Please add VAT at 121% unless marked thus \* when 8% applies We guarantee full after sales technical and servicing facilities on all our kits

INTEGREX LTD.

Please send SAE for complete lists and specifications
Portwood Industrial Estate, Church Greeley,
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**QV\* MODULES FOR COST-CONSCIOUS CONSTRUCTORS** 

STIRLING SOUND policy is to ensure customer satisfaction by designing and making their products in their own factory in Essex and selling direct. Production control-checked throughout. All QV Modules are compatible within the range and with much other equipment.



Combined pre-amp with active tone-control circuits. ±15dB at 10Khz treble and 30 Hz bass. Stereo. Vol./balance/treble/bass. 200mV out for 50mV in. Takes 10-16V. £7-80

\$8.100 Active tone control, stereo. ±15dB on bass and on £1.60

\$8.101 Pre-amp for ceramic cartridges, radio, tape. Stereo.
Passive tone control circuit shown in data supplied
£1.60

UNIT ONE

\$5.102 Stereo pre-amp for low output magnetic P.Us. R.I.A.A. cor-rected. Linear feedback facility.



#### POWER AMPLIFIERS

\$8.103 3 watt r.m.s. mono I.C. with built-in current, short, and thermal protection £1:75

£3 · 75 55.103-3 Stereo version of above

SS.105 5 watts r.m.s. into 4 ohms, using 12V £2.25

SS.110 10 watts r.m.s. using 24V and 4 ohm load £2 · 75

SS.120 20 watts r.m.s. into 4 ohms, using 34V £3 .00

The above all measure 89 x 50 x 19mm (31 x 2 x 1 ins) Suitable power supplies will be found in the accom-



SS.110

#### FM TUNING MODULES

\$8.201 Front end tuner, slow geared drive, two gang, A.F.C. facility. Tunes 88-108 MHz £5.00

\$5.202 i.F. amplifier. Metering and A.F.C. facilities £2.65

\$8.203 Stereo Decoder for use with the above or other FM mono tuners. A LED may be £3 · 85

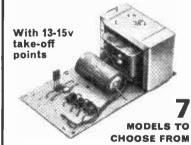
#### **★ THE BUILT-IN QV FACTOR**

ins Stirling Sound's guarantee of QUALITY AND VALUE to give you to-day's t value all round.

A member of the Bi-Pre-Pak group 220-224 WEST ROAD, WESTCLIFF-ON-SEA, ESSEX SS0 9DF PERSONAL CALLERS WELCOME Telephone: Southend (0702) 46344

TODAY'S BEST VALUE IN POWER SUPPLY UNITS

15 45V supply such as SS345. Ideal for small discos and P.A. 101 x 76 x 19mm (4" x 3" x ½")



Complete with mains transformers and low volt takeoff points. (except SS.300) All at 8% V.A.T.

rate. Add 50p for p/p any model. SS.312 12V/1A £3 · 75\* SS.318 18V/1 A £4-15\* SS.324 24V/1A £4 · 60\* SS.334 34V/2A £5 · 20\* SS.345 45/V2A £6 · 25 \* £6 .75\*

SS.309 Power stabilising unit 10-50V adjustable for adding to unstabilised supplies. Built-in protection against short circuit (p/p 35p) £3 · 25

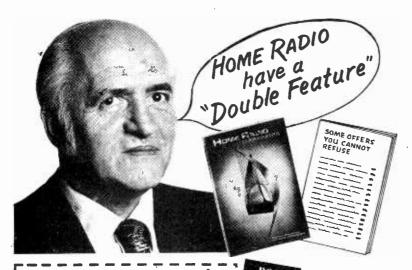


#### 88,310/50 Stabilised power supply with variable output from 10 to 50V/2A

Built-in protection against short cir-£11 - 951

#### WHEN ORDERING

add 35p for p/p unless stated otherwise. V.A.T. add 121% to total value of order unless price is shown when the rate is 8%. Make cheques, etc. payable to Bi-Pre-Pak Ltd. Every effort is made to ensure correctness of information at time of going to press. Prices subject to alteration without notice



rde your Name and Address in block capitals

HOME RADIO (Components) LTD., Dept. PW 234-240 London Road, Mitcham, Surrey CR4 3MD

London 9129861

By the way, the price of the catalogue is £1 plus 48p for postage and pack-ing. Why hesitate? Send off your cheque or Postal Order for £1-48 today, together with the coupon on the left.

The price of £1:40 applies only to customers to the UK and the BFPO Addresses.

Perhaps you have to be of my vintage to know the phrase "a Double Feature", but up to a few years ago cinemas always ran a main film and a supplementary film. I was reminded of it because with their new catalogue Home Radio Components are now giving away a supplementary catalogue of bargain lines.

It sounds a very practical and sensible idea. After all, most electronic component firms accumulate surplus stocks of various items, and rather than dispose of them, why not offer them to customers at exceptionally low prices? I'm told that this bargain list will continue for several months and be updated from time to time.

No constructor should be without the Home Radio Components Catalogue (it contains 5,000 items clearly listed plus about 2,000 illustrations) but now you have a double incentive for buying one. In addition to getting one of the finest component catalogues available, you also receive a list of bargains at unbelievably low prices. For example. Gemini Mains Transformers: normal price £11.48, bargain list price £5, saving £6.48! This means that with a single purchase from the bargain list you can save the price of your catalogue several times over!

HOME RADIO (Components) LTD. Dept. P.W., 234-240 London Road, Mitcham, CR4 3HD. Phone 01-648 8422



"DELTA" GENUINE TEAK OR PERSPEX CASE

**NON-ALARM** £10.65 VAT £0:85 **ALARM** £12.43 + VAT £1 . 07

including P & P

4 Radiant Red ‡ inch high LEDs. 12hr display with AM/PM indication. Beautiful Burma Teak Case or Pretty Perspex in White, Black, Blue, Red, Green. Power fallure is indicated DELTA DATA:

MODULES:

White, Black, Blue, Red, Green. Power failure is indicated by flashing display, Kits can be bought-without case: Non Alarm £9:00 Alarm £12:50 inclusive.
Buy a working tested module and fit your own case. Non Alarm £9:50. Alarm £13:00. Or put it with our case parts @ £4:32 and save on complete clock price.
Complete Clock ready built. 2 yr guarantee. Non Alarm £13:50 Alarm £16:50.
Pulsed tone. Tilt operated 10 minute 'Snooze' period. Single switch setting Optional extra mercury switch (45p) allows Alarm reset by tilting clock. Digit brightness is automatically controlled to suit lighting level.

"ALPHA" CHRISTMAS

READY BUILT:

ALARM FEATURES:

4 Glowing Green † high digits 12 or 24 hour. Non Alarm. £11.00 inc. Built & Tested module plus perspex case.

NOVUS CALCULATORS: 650: £5-40

4510: £16-20 850: £6.75 6030 : £21 · 60

Send payment with order. SAE for complete range of clocks, calculators and components.

PULSE ELECTRONICS LTD DEPT. PW4, 202 SHEFFORD ROAD. CLIFTON, SHEFFORD, BEDS. Telephone Hitchin (0462) 814477

## & S. T.V. COMPONENTS

8 Cavendish Crescent, Deacons Hill Road, Elstree, Herts.

Tel. 01-953 9724 or 01-207 0520

Opening shortly Trade Counter at 3 High Street, Elstree where there will be a MAD MAD sale incl. Valves, TV Panel Boards, L.O.P.T.S., Tuners, Droppers, Condensers. Telescopic aerials. Cabinets and a host of other components and accessories

#### TRANSISTORS & I.C's

AC 127	16p	BD 124	78p	BY 238	[ 11p
AC 128	18p	BD 131	40p	OA 90	8p
AC 188	13p	BD 132	40p	2N1711	30p
AD 149	47p	BDX 32	£2·10p	R2010B	£1.90p
AD 161	40p	BF 180	29p	TAA550	40p
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AF 139	33p	BF 197	14p	TBA480Q	£1-10p
AF 178	48p	BF 336	35p	TBA520Q	£2-30p
AF 239	40p	BF 337	40p	TBA530Q	£1-70p
BC 107	13p	BFY 50	22p	TBA540Q	£2 00p
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BC 148	8p	BY 126	11p	TCA270Q	£2·80p
BC 159	13p	BY 127	14p	SN76013ND	£1:00p
BC 187	18p	BY 164	40p	ETTR6016	£2·80p

(Many other transistor devices available) (Colour Triplets from £4:20)

#### WHOLESALERS, RENTAL COMPANIES AND TRADERS SUPPLIED-SPECIAL QUOTATIONS GIVEN

Discounts given on 100 lots or 100 mixed lots. Certain stock lines available at generous discount. Enquiries invited.

#### ALL GOODS BRANDED OF HIGH QUALITY AND NEW

Please add 121% for V. A.T. Minimum order £3:00. Under £10:00 please add 25p P&P. Terms of business C.W.O.

CONTROL DRILL **SPEEDS** 

#### DRILL CONTROLLER

Electronically changes Electronically changes speed from approximately 10 revs to maximum. Pull power at all speeds by finger-tip control, Kit includes all parts, case. everything and full instructions \$3.46 including post & VAT. Made up model \$1.00 extra.

#### MAINS TRANSISTOR PACK

Designed to operate translator sets and amplifiers. Adjustable output 6v., 9v., 12 volts for up to 500m A (class B working). Takes the place of any of the rollowing batteries: PPI, PP3, PP4, PP6, PP7, PP9 and others. Kit comprises: main transformer rectifier, smoothing and load resistor condensers and instructions. Real snip at only \$1.50 VAT & Postage 50p.

#### RADIO STETHOSCOPE



Easiest way to fault find, traces signal from aerial to speaker, when signal stops you've found the fault. Use it on Radio, TV. amplifier, anything. Complete kit comprises two special transistors and all parts in-

o special transistors and all parts in-cluding probe tube and crystal ear-piece, £2.95, twin stetho-set instead of earpiece. £1.00

#### MICRO SWITCH BARGAINS

Rated at 5 amps 250 volts, ideal to make a switch panel for a calculator and for dozens of other applications. of other applications.

Parcel of 10 for £1.00, VAT and post part.

#### MOTORISED DISCO SWITCHES

With six 10 amp changeover switches. Multi adjustable switches are rated at 10 amp each so a total of 2000w's can be controlled and this would provide a magnificent display. For mains operating £4.25 post & VAT Pald, Ditto 9 switch £4.95 Post & VAT Pald. DITTO BUT 12 SWITCH £5.75 POST & VAT PAID.



#### AMMETERS

Ideal for chargers etc. 2" sq. full vision 0.8 amp 95p. 1½" round 0.2 amp 55p. 0.3 amp 65p. 0.4 amp 75p. Post & VAT 25p each.

#### MAINS OPERATED SOLENOIDS



| Model 772—small but powerful | 1ln. pull—approx. size 1½ × 1½ × 1½ × 1½ ln. \$1.00 | Model 4001/−iln. pull. Size 2½ × ≥ × 14ln. \$1.00 | Model TT1—1½ ln. pull. Size 3 × 2½ × 2in. \$2.50 | Prices include VAT & postage.

#### SOUND TO LIGHT UNIT

Add colour or white light to your amplifier. Will operate 1, 2 or 3 lamps (maximum 450W). Unit in box all ready to work. 27.95 plus 95 vAT & Postage



#### RELAY BARGAIN

Type 600 relay with twin 500 ohm colls which may be joined in series or parallel thus relay will operate off voltages between 5 and 30 volts DC. Price 44p each, 10 for £4 post and VAT paid.

#### **BATTERY CONDITION TESTER**



Made by Mallory but suitable for all batteries made by Ever Ready and others, most of which are zinc carbon types but also zinc carbon types but also mercury manganese—nlead—allyer oxide and alkaline batteries may be tested. The tester puts a dummy load on the battery and the meter scale indicates the condition depending upon "replace" "weak" or "good". The section reads complete in its case, size 34 × 64" × 2" with leads and prod. 24-50 post & VAT paid.

#### **BATTERY CHARGER**

Famous Atlas in metal cas with meter, output lead terminated by crocodile clips. For 6 or 12V charging simply by changing plug on front panel. Ready built new and still \$2.95 plus £1 Post & VAT



#### HONEYWELL PUSH BUTTON PANEL MOUNTING MICRO SWITCH



1-2-3 Bank, each Bank consisting of the changeover micro switch rated at 10 amps 250 volts. Through panel fixing by 2 lock nuts complete with black 1" diameter knob. Prices: 1 bank 40p—2 bank 55p-3 bank 70p.

#### MULLARD UNILEX

A mains operated 4 + 4 stereo system. Rated one of the finest performers in the stereo field this of the linest performers in the stereo field this would make a wonderful gift for almost any one in easy-to-assemble modular form and complete with a pair of Ceiestion speakers normally £8. This should sell at about £30—but due to a special bulk buy and as an incentive for you to buy this month we offer the system complete at only £18-50 including VAT and postage.



#### TANGENTIAL HEATER UNIT

This heater unit is most efficient, and quiet running. Is as fitted in Hoover and blower heaters costing £15 and more. Comprises motor, impeller. 2kW element and 1kW element allowing switching 2kW element and lkW element allowing switching 1, 2 and 3kW and with thermal safety cut-out. Can be fitted into any metal line case or cabinet. Only needs control switch. \$5-83 plus VAT & post £1. 2kW Model as above except 2kW \$4-25 plus VAT & post £7. 2kW \$6.00 plus VAT & post 75p. Don't miss this. Control Switch \$4p. P. & P. 40p.

#### ISA ELECTRICAL PROGRAMMER



Learn in your sleep; Have radio playing and kettle boiling as you wake—switch on lights to ward off intruders—have a warm house to come home to. All these and many other things you can do if you invest in an electrical programmer. Clock by fanous maker with 15 amp. on/off switch. Switch-on time can be set anywhere to stay on up to 6 hours. Independent 60 minute memory jogger. A beautiful unit. Price \$29.95, VAT & Postage 60p, or with glass front, chrome bezel. \$1.50 extra.

#### ROOM THERMOSTAT

Famous Satchwell, elegant design, intended for wall mounting. Will switch up to 20 amps at mains voltage, covers the range 0-30°C. Special snip this month \$8.50, post and VAT paid.

#### SMITHS CENTRAL HEATING CONTROLLER Price 27-50 including VAT and postage.

RANDALL CENTRAL HEATING CONTROLLER Price \$6'50 including VAT and postage

#### **CENTRIFUGAL BLOWER**



MIRIATURE mains driven blower centrifugal type blower unit by Woods. Powerful but specially built for quick running—driven by cushloned induction motor with specially built low noise bearings. Overall elze 44" × 4". When mounted by flange, air is blown hinto the equipment but to suck air out, mount from centre using clamp. Ideal for cooling electrical equipment of fitting into a cooker hood, film drying cablnet or for removing flux sincke when soldering etc. etc. A real bargain at \$3.30. 60p post & VAT.

#### THIS MONTH'S SNIP

**MAINS RELAYS** 



With triple 10 amp changeover contacts—operating coil wound for 230 volts AC, chassis mounting, one serew fixing, ex unused equipment 60p each, 10 for \$5 post and VAT paid.

#### HORSTMANN 24-HOUR TIME SWITCH

With 6 position programmer. When fitted to hot systems this could programme as follows:

gramme	Hot Water	Central Heating
0	Off	Off
1	Twice Daily	Off
2	All Day	Off
3	Twice Daily	Twice Daily
4	All Day	All Day
5	Continuously	Continuously

Suitable, of course, to programme other than central heating and hot water, for instance, programme upstairs and downstairs electric heating or heating and cooling or taped nusic and radio. In fact, there is no limit to the versatility of this Programmer. Mains operated. Size 3ln × 3ln × 2ln deep. Price \$5-50. 80p Post and VAT. as illustrated but less case

#### SHORTWAVE CRYSTAL SET

Although this uses no battery it gives really amazing results. You will receive an amazing assortment of stations over the 19, 25, 31, 29 metre bands. Kit contains chassis front panel and all the parts \$1.90—crystal earphone 559 including VAT and postage.



PAPST MOTOR
West German make, these fine motors are noted for their performance and reliability. Special features are the rotating heavy outer which acts as a flywheel to eliminate wow and flutter and switchable reversing.
We have four types in stock, all 1350 revs., including starting capacitor.

- capacitor.
  (1) Reference No. KLZ 20.50-4, 230 volts 50HZ, price £5-50
  (2) Reference No. KLZ 32.50-4, 230 volts 50HZ, price £6-50
  (3) Reference same as above, 115 volts 50HZ, price £2-50
  (4) Reference same as above, 110 volts 60Hz, price £2-50
  Post and VAT 80p each extra.

PANEL METER SNIP
Japan 'made 2" X11" full vision flush mounting, 100uA f.s.d.—scale
engraved DB easily changeable as perspex cover simply clips on. A real
snip 21-75 poet and VAT paid, or 10 for \$15 poet and VAT paid.

TERMS: Where order is under \$5 please add 40p surcharge to offset packing ехреплея

## J. BULL (ELECTRICAL)

(Dept. P.W.), 103 TAMWORTH ROAD. CROYDON CR9 ISG.

#### ITS FREE!

Our monthly Advance Advertising Bargains List gives details of bargains arriving or just arrived—often bargains which sell out before our advertisement can appear—Its an interesting list and its free—just send S.A.E. Below are a few of the Bargains still available from previous lists.

previous lists,

Spit motor with Carter gear box. Probably one of
the best spit motors made. Originally intended
to be used in very high priced cookers. however,
this can be put to plenty of other uses, for instance
your garden barbecue or to drive a colour disc
for a dance or display or to drive a tumber for
stone pollshing; in fact, there is no end to its
uses. Normal mains operation. Special price during
May and June \$2.50 + 20p, post 30p + 2p.

Pulse transformer with circuit for sound to light unit. It is a very simple circuit and all parts are readily obtainable from us or you may already have them in your junk box. Price of the trans-former with circuit 75p, post and VAT paid.

ORF 12 light cell. This device has been going for some years now but it has not been bettered and new applications keep being found for it. We have good stocks, price 65p + 5p.

Throat mikes. These are an ex WD item as used by air crew on their intercom, but being electromagnetic they also serve as pick-ups on musical inatruments, taking to passengers on motor bike and no doubt many other use. Price 60p a pair + 15p

12½ wait speaker bargain, 8" round mid-range, made for high price hi-fi outfit, a really super speaker, \$3 + 37p, post 60p + 15p.

O.G.P. photo transistor by Mullard, very popular for circuits such as infra-red burglef slarms, smoke detectors, etc. A big buy enables us to offer at the very favourable price of 25p each — 2p, or 5 for 21

Component boards, mainly ex computer, these contain many useful parts and represent fantastic value at 5 for \$\frac{1}{2} + 8p\$. We guarantee the 5 would be different. You would receive ICs etc., variable controls with long leads and so are easy to remove and re-use. Post 50p - 4p.

Microwitch bargain, made by Pye, Honeywell, Burgess and similar first class makers originally for the Post Office, in fact they have been fitted to Post Office Equipment which was never put into use. They are a changeover microwitch with 10 amp contacts offered at the very low price of 20 for \$1 + 50. Post 440. 35. 20 for £1 + 8p. Post 40p + 3p.

Ferrite pot core (Vinkor) made by Mullard, maker's ref. No. LA 14107402K, circular, size approx. 11° x ±", a size which is the same as the one specified for the Scorpio car ignition system. Price only 50p + 4p per pair. Post 15p + 1p.

12v DC motor made by Smiths, powerful, ideal for car blower; motor size 4" long x 5" clameter, \frac{1}{2}" spindle, \frac{1}{2}" long. \frac{22}{22}. + 16p. Post 40p + 3p.

spindle, 14' long, 28. + 16p. Post 40p + 3p.
Thermostat with capilliary with sensor joined by
approx. 1 metre of capilliary covering the temperature range 0-170°C capable of switching 16 amps
at 250v. Made by the famous Ranco Company
with screwed thread and spindle rather like a
volume control—has dozens of applications.
Offered at only 75p + 6p. Post 12p + 1 p.

Aerials. For medium and long wave, wound and fitted on territe rod. 6" long by \(\frac{1}{2}\)" diameter. Price 60p + 15p Post 10p + 5p.

Dial thermometer by Rototherm, indicates from 50F to 250F, dial size 3½", chrome and glass front 75p + 6p. Post 10p + 1p.

709 + 09. Fost 109 + 19.

Instrument Mains Transformer, 6.3v at \$\frac{1}{2}\$ amp and 115v at 100n.A. This is an upright mounting open construction, small size (2\frac{1}{2}\$ x 2\frac{2}{2}^\*\$ x 2\frac{1}{2}^\*\$. Price \$\frac{1}{2}\$ 1-40 + postage and VAT 60p. DITO, 6.3v at 1 amp and 150v at 200m.A. This is a fully shrouded upright mounting transformer, size approx. 2\frac{1}{2}^\*\$ x 3" x 3". Price \$\frac{1}{2}\$ 1-95 + post and VAT 88p.

Instrument power supply nounted on a chassis size 9 x 2 x 2 x 4 x. This is suitable for instruments which use valves and hs AC output of 8 x at 1 amp and a fully smoothed DC output of 150v and 200v. Price 25.50 + post and VAT 74p.

FM Band amplifier. This is a 4 valve amplifier tunable to cover FM and nearby frequencies. Tuning is by lecherilines in fully screened compartments and the whole is mounted on a heavy metal chassis size 9" x 2" x 24" x 5". This requires a separate power supply of 150 v DC at 100 mA and 6:3V at 1 amp. Price 23.75 + post and VAT \$1.58.

Instrument case, grey steel finish size 9½" x 32" x 21". These cases are not secondhand but come from partly assembled equipment, so the front panel has a few holes already punched through. However, these are very suitable for toggle switches, etc. There are no really big holes, 509 each + post and VAT 36p.

each + post and VAT 36p.

Clock switch for Tricity cooker, made by Smiths and probably a replacement in many other cookers. This has clock in the centre and the two controls switches on the right-hand side. The top control switch sets the on-off times and is in finitely adjustable over the 12 hours: No glass front, but you could take this off your existing clock. Price \$1.75 each + post & V.A.T. \$8p.

SMITHS 24-HR TIMER HEART really the "Autoset" without its plastic case. This is a 24 hr twice on, twice off, clock switch which will repeat until re-programmed. Switches rated at 15 amps. Limited supplies.

PRICE \$4.45 INCL. POST & VAT.

### **INVERTORS**



240v-50Hz from your 12v car battery

All above invertors are in kit form but may be purchased built up in metal case and ready for use. Price list sent on receipt of s.a.e. Prices include p. and p.

#### P.W. AUTOMATIC EMERGENCY SUPPLY

240v-50Hz-150 watt inverter with built in battery charger. In event of power failure switches over automatically from battery charging to inverter operation. Cct. as appeared in Dec. 72 P.W. Complete kit of parts (excluding meter) £24·50 plus £1·70p.p.

FLUORESCENT LIGHT INVERTER KIT
8 watt-12v-Fluorescent light, suitable for
tents, caravans, houses, boats and secondary
lighting for factories, hotels, &c.
12"-8 watt £3:90 + 35p p. & p. Built up
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TRANSFORMERS AND COILS

Both high volume and small order capacity available.

Special offer. Miniature mains transformer 6-0-6v-6vA. 85p + 10p p. & p.

# P.E. ORION STEREO AMPLIFIER



20+20 Watts r.m.s. into 8 ohm load. Distortion less than  $0\cdot01\%$  100Hz–10kHz. Frequency response  $\pm$  1dB 20 Hz to 20kHz. Hum level virtually nil with volume full on.

This is a power amplifier of superb quality incorporating the very latest design features. Professional hi-fl enthusiasts have classed it as fantastic and real value for money. The CCT incorporates a low flux transformer and inputs for disc, tape, tuner, etc.

Complete kit of parts including slim line bookend case, silk screened front panel and knobs £47·30 inc. VAT and p. & p.

The bookend case, I.C's and semiconductors, P.C. board, Transformer, etc. may be purchased separately if desired. Send S.A.E. for further information.

#### INSTRUMENT CASES

Bookend Amplifier and attractive styled Instrument Cases available. Send S. and A. envelope for Price List.

### **ASTRO IGNITION**



7

ASTRO IGNITION SYSTEM Complete kit of parts for this proven and tested system £10.45 inc.VAT Ready built with only two connections to alter £13 75 inc. VAT. Thousands have used this system both home and abroad. Consider these advantages-more power, faster acceleration, fuel economy, excellent cold starting, smoother running, no contact breaker burning. Also because of the high energy spark the fuel mixture can be made weaker giving further economy and fewer plug problems. Fitting time when built 5 minutes approx. Please state whether positive or negative earth.

TRADE and EXPORT ENQUIRIES WELCOMED ON ALL PRODUCTS

ASTRO ELECTRONICS Springbank Road, West Park CHESTERFIELD. 31475



THE Manta"
CAPACITIVE DISCHARGE ELECTRONIC
IGNITION UNIT

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WE ARE PLEASED TO ANNOUNCE THAT THE "MANTA" — ONE OF THE HIGHEST QUALITY IGNITION UNITS AVAILABLE — IS NOW SUPPLIED IN KIT FORM

CONSTRUCT THIS TOP PERFORMANCE IGNITION UNIT AND BENEFIT FROM IMPROVED PETROL CONSUMPTION, SMOOTHER RUNNING AND INSTANT STARTING FOR YOUR VEHICLE.

KIT PRICE (INCLUDING POSTAGE AND PACKING, V.A.T., FULL ASSEMBLY AND INSTALLATION INSTRUCTIONS)

ONLY £16.50

(Ready made unit available at £19.85, including V.A.T., postage and packing)

Send S.A.E. today for full details of this top quality unit to:-

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C US 4 CMOS

	X	71 %	11	SERVI		4		MOS!
1	4%	WYY	DI:	SCOUNT	s!	7		1103:
4000	0 20	4039	3 09	4081	0 - 24	14505	4:38	'E' LED Displays
4001	0.20	4040	1 · 19	4082	0 - 24	14506	0.57	DL-704E 0·3" 70p
4002	0.20	4041	0-93	4085	0 80	14507	0 - 60	DL-707E 0·3" 70p
4006	1 - 31	4042	0.93	4086	0 - 20	14508	3.08	DL-728E 2 x 0 5"
4007	0 20	4043	1 - 12	4089	1.74	14510	1 · 51	1 · 80
4008	1 07	4044	1.04	4093	6.89	14511	1 - 74	DL-727E 2 x 0·5"
4009	0.60	4045	1 54	4094	2.08	14512	1.03	1 80
4010	0 60	4046	1 48	4095	1.16	14514	3 - 47	DL-750E 0 6 1 50
4011	0.20	4047	1.01	4096	1 - 16	14515	3.47	DL 747E 0 6" 1 50
4012	0 20	4048	0.60	4097	4.13	14516	1 - 51	Red Leds
4013	0.60	4049	0.60	4098	1 - 22	14517	4 - 02	0 1" 15p
4014	1.12	4050	0 60	4099	2.03	14518	1 - 39	0 2 15p
4015	1 - 12	4051	1:04	40101	1 - 76	14519	0.57	
4016	0.60	4052	1 - 04	40102	2.16	14520	1 - 39	Clock Chips
4017	1 - 12	4053	1-04	40103	2-16	14521	2.77	AY-5-1224A 3 50
4018	1 - 12	4054	1 20	40104	2.26	14522	2.15	MK50253 5 50
4019	0-60	4055	1 -46	40107	0.66	14526	2.15	Soldercon Pins
4020	1 · 24	4056	1 - 46	40108	6-18	14527	1 - 76	100 60p
4021	1-12	4057	29 - 81	40109	2 - 21	14528	1 - 22	1000 4 00
4022	1 . 07	4059	6 20	40181	4 - 30	14529	1 72	2500 8 75
4023	0 · 20	4060	1 - 24	40182	1.73	14530	0.95	DIL Sockets
4024	0.87	4061	25 - 60	40194	2 - 26	14531	1.74	8 Pin 12p
4025	0 · 20	4062	10-10	40257	2 - 26	14532	1 - 39	
4026	1.92	4063	1 22	4700	1 - 75	14534	8-15	14/16 Pin 15p
4027	0 60	4056	0 - 69	7083	4 25	14536	4 00	Red Acryllc Filter
4028	1-00	4067	4-13	14160	1.18	14537	13-17	For LED displays
4029	1 - 27	4068	0-24	14161	1-18	14539	1 - 24	157 x 92 x 3mm 70p
4030	0 60	4089	0.24	14162	1-18	14541	1 62	Push Switches
4031	2.46	4070	0 - 65	14183	1.18	14543	1 - 82	Type SW9 15p
4032	1-19	4071	0.24	14174	1.08	14549	4-10	
4033	1 . 55	4072	0 · 24	14175	1 - 04	14552	10 - 50	Op-Amps
4034	2.11	4073	0 24	14194	1-17	14553	4 - 66	CA3130
4035	1 - 31	4075	0 - 24	14490	6 - 51	14554	1-67	(COS/MOS) 1:00
4036	3 08	4076	1 - 71	14501	0 · 20	14555	1 . 01	CA3140
4037	1 06	4077	0.65	14502	1 38	14556	1 01	(BI/MOS) 95p
4038	1 - 20	4078	0-24	14503	0.75	14557	4 · 65	741 Minidip 25p

Terms: C.W.O. Add VAT to all prices at 8%. Post etc. U.K. 25p + 2p = 27p per order. All orders processed same day. Official Govt. 'Varsity, Poly etc. orders (written or telephoned) welcome.

### GREENBANK ELECTRONICS (Dept. W12P)

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### **NEW MULLARD & MAZDA VALVES**

All individually boxed. Full trade discounts to bona fide companies. Prices on application.

#### **EXPRESS** POSTAGE

15p for 1 Valve. Each additional Valve add 2p in UK

PY500 1.10 PY81/800 0.59 PY801 0.53 8P41 8.00 8P61 0.85

6J5M 6J5G 6J6 6J7G 6J7M 6K6GT 6K7G

0.80 0.80

DM70	0.69	EF80	0.62	PCC84	0.84	PL504	1.40	30C15/	
DY86/7	0.70	EF83	1.10	PCC85	1.02	PL508	1.78	PCF800	
DY802	0.58	EF85	0.70	PCC88	0.98	PL509	2.83	30C17	1.29
EB91	0.97	EF86	1-78	PCC89	0.97	PL802	2.83	30C18/	
EBC81	0-89	EF89	1.78	PCC189	1.22	PY33	0.78	PCF805	
EBF80	0.68	EF91	1.85	PCF80	0.84	PY81/800		30F5/PF8	
EBF83	0.66	EF92	1.51	PCF82	1.87	PY82	0.70		1.85
EBF89	0.50	EF95	1.68	PCF86	0.97	PY86/7	70p	30FLI/	
		EF183	0.98	PCF200	1.50	PY88	0.84	PCE800	
EC86	0.82	EF184	0.98	PCF201	1.50	PY500A	1.50	30FL2	1.02
EC88	0.86	EH90	1.22	PCF801	0.97	PY800	0.72	30FL/12	1.44
EC90	0.94	EL34	1.40	PCF802	1.02	PY801	0.72	30FL14	1.20
EC97	0.69	EL36	1.50		0.97	U26	1.22	30L1/PCC	84
ECC81	0.70	EL84	0.70	PCF806		U191	1.17		0.68
ECC82	0.70	EL86	1.40	PCH200	1.73	U193	0.58	30L15/	
ECC83	0.70	EL95	1.02	PCL82	0.84				1.35
ECC84	0.68	EM81	1.24	PCL83	0.97	UBC81	0.80	30L17	1.12
ECC85	1.02	EY51	0.89	PCL84	0.98	UBF89	0.85	30P4MR	1.63
ECC88	1.22	EY86	0.50	PCL85	0.72	UCC85	0.66	30P1Z/	
ECC189	0.77	EY86/87	0.70	PCL86	0.97	UCH81	1.78	PC801	1.22
ECF80	0.68	EY88	0.81	PCL805/8		UCL82	1.02	30P19/	
ECF82	0.90	EZ80	0.84	PD500	2.62	UCL83	1.02	PC802	1.08
ECF86	0.76	EZ81	0.70	PFL200	1.23	UL84	1.23	30PL1/	
ECH81	1.73	GY501	1.78	PL36	1.40	UY85	0.73	PCL801	1.85
ECH83	1.08	GZ34	1.22	PL81	1.23	6/30L2/		30PL13/	
ECH84	1.50	OC83	0.60	PL81A	1.40	ECC804		PCL800	1.47
ECL80	1.02	PC86	1.40	PL82	0.48	6F23/EF8	12	30PL14/	
ECL82	0-69	PC88	1.40	PL83	1.78		1.16	PCL88	1.72
ECL83	0.93	PC97	0.70	PL84	1.02	30C1/PCF		30PL15	1.44
ECL86	0.82	PC900	0.84	PL500	1.40		0.84		

#### **NEW VALVES**

Individually boxed and BP41 SP61 T41 guaranteed but of European or other origin at greatly reduced prices. Quotations for any Valve not listed 10.00 10 guaranteed but of Euro-

			ed b				U14 U25	0.75	6K7G 6K7M	0.85
	pean	or	othe	r o	rigin	at	U26 U191	0.85	6K8G 6K8M	0.45
							UABC80	0.40	6K25	1.00
	great	ly –	reauc	ea	price	3S.	UAF42	0.75	6L6G	1.25
	-	_			-		UBC41	0.60	6L6GC	0.80
	Quota	atic	ns	TO	r a	ny	UBC81	0.80	6Q7G	0.40
	-					-	UBF80	0.50	6Q7M	0.60
	valve	n	ot lis	ted			UBF89	0.50	68L7GT	0-86 0-86
							UCC85	0.80	68N7GT 68Q7GT	0.40
		1.00		1.50	N78	7.50	UCH42 UCH81	0.80	6U5G	1.50
		1.00		1.25	OA2	0.45	UCL82	0.40	6V6G	0.80
		1.40		0.85	OB2	0-45	UCL83	0.70	6V6GT	0.60
		1.50		0.45	PC86	0-65	UL41	0.85	6X4	0-46
		1.00		0.50	PC88		UF89	0.50	6X5G	0.45
		0.40		0.40	PC97 PC900	0.55	UL41	0.85	6X5GT	0.55
		0.60		0.80	PCC84	0.45	UL84	0.50	7B6	0.80
		1.85		0.45	PCC88	0.68	UY41	0.55	7B7	0.80
		0.60		0.80	PCC89	0.58	UY85	0.45	7C5	2.00
		0.50	EF183	0-40	PCC189	0.65	VR105/30		7C6	1.00
		1.00	EF184	0-40	PCF80	0.40	VR150/30		7H7 7R7	0-80 1-80
		0.75	EL32	0.60	PCF82	0.48	1R5	0-50	787	2.25
	DL92	0.50	EL33	8.00	PCF86	0.65	185 1T4	0-10	7¥4	0.80
		0.85	EL34	0.70	PCF801	0.50	384	0.50	12AT6	0.44
		0-55	EL36	0 60	PCF802	0.55	3V4	0.85	12AT7	0-45
		0-45	EL37	3-40 0-90	PCF805	0-90	5R4GY	1-20	12AU6	0.80
		0-45	EL41 EL42	1.65	PCF806	0.80	5U4G	1.25	12AU7	0.88
		0-47	EL84	0.85	PCF808 PCL82	0.45	5U4GB	0.70	12AX7	0.88
		0.70	EL95	0.60	PCL83	0.70	5Y3GT	0-85	12BA6	0.50
		0.80	EM80	0.55	PCL84	0.50	5Z4G	0.98	12BE6	0.60
		1.00	EM81	0.60	PCL85	0.60	6/3OL2 6AK5	0.45	80C1 80C15	0-40 1-00
		0.75	EM84	0.40	PCL86	0.50		2-00	80C17	1.00
	EBC81	0-40	EM85	1.00	PCL805/8	5	6AM5 6AQ5	0.50	80C18	0.90
		0.40	EM87	1.00		0.60	6AB7G	1 00	30F5	1.00
	EBF83	0.40	EY51	0.45	PD500	1.50	6AT6	0.60	30FL1	1.00
	EBF89	0.88	EY86	0.50	PEN45	0.85	6AU6	0-40	80FL2	1.00
	EBL31	2.00	EZ40	0.60	PL36	0.68	6BA6	0-88	80FL14	1.00
	ECC81	0-45	EZ41 EZ80	0.75	PL81	0.55	6BE6	0-48	30L15	0.95
	ECC82	0.88	EZ81	0.81	PL82	0.50 0.50	6BH6	0.75	30L17	0.95
	ECC88	0.88		0.80	PL83 PL84	0-50	6BJ6	0.75	30P4MR 30P12	1-80
	ECC84 ECC85	0-85	GY501 GZ30	0.65	PL500	0.85	6BQ7A	0.55 2.00	30P19	0.95
	ECC88	0.60	GZ32	0.65	PL504	0.85	6BR7 6B87	1.40	30PL1	0.95
	ECH35	1.50	GZ34	0.75	PL508	0.90	6BW6	1.00	30PL13	1 10
	ECH42	0.85	HN309	1.50	PL509	1.55	6BW7	1.00	30PL14	1.10
	ECH81	0-35	KT61	8-40	PL802	2.00	6C4	8-40	35W4	0.60
ı	ECH83	0.50	KT66	3-40	PX 25	8.50	6CD6G	1.60	35Z4GT	0.70
ŀ	ECL80	0-60	KT81(7C5		PY33	0.68	6CH6	2.20	50CD6G	1.20
ĺ	ECL82	0-48	KT81	1.75	PY81	0.50	6CW4	4.00	807	1.00
ı	ECL83	0.75	KT88	4.00	PY82	0.45	6F23	0.90	SISITT	17.50
ľ	ECL86	0.55	KTW61	1.50	PY83	0.50	6F25	1.00	813UBBR 866A	2-00
L	ECLL800	8.20	MU14	1.00	PY88	0.68	6F28	0.75	A000	x-00

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15p per order in UK

All transistors, I.C's offered are new and branded. Manufactured Mulby lard, Texas, RCA, Ferranti. Motorola. ITT. -Fairchild, Lucas, etc. Quantity discounts on

-	2.00		_				0141		. 9
AA119	0.07	BD131	0.40	Faircl	hild	, Lı	ıcas	s. e	tc.
AAZ13	0.18	BD132	0.40						
AAZ15	0.12	BF115	0.20	Quan	titv	dis	COL	nts	on
AC107	0.75	BF167	0.20						•
AC126	0.25	BF173	0.25	applic	cati	on.			
AC127	0.25	BF179	0.30	• •					
AC128	0.22	BF180	0.30	OA200	0.10	ZTX501	0.13	2N2905	0.30
AC176	0.27	BF181	0.30	OA202	0.10	ZTX503	0.16	2N2905A	0.25
AC187	0.25	BF194	0.10	OC16	1.25	ZTX531	0.25	2N2906	0.22
AC188	0.25	BF195	0.10	OC20	2.00	ZTX550	0.18		
ACT21	0.55	BF197	0.12	OC23	2.25	IN914	0.06	2N2926	0.15
ACY39	1.00	BF200	0.32	OC25	0.65	1N4001	0.07	2N3053	0.20
AD140	0.65	BF861	0.25	OC28	0.75	1N4002	0.07	2N 3055	0.60
AD149	0.65	BFB98	0.25	OC35	0.75		0.08	2N3525	0.90
AD161	0.45	BFW10	0.61	OC36	0.75	1N4004	0.08		
AD162	0.45	BFX29	0.28	OC42	0.50	1N4005	0.09	2N3614	1.00
AF115	0.25	BFX88	0.25	OC44	0.45	1N4006	0.10	2N3615	1.10
AF116	0.25	BFY50	0.21	OC45	0.45	1N4007	0.11	2N3702	0.18
AF117	0.25	BFY51	0.21	OC71	0.25	1N4009	0.08	2N3703	0.13
AF186	1.60	BFY52	0.23	OC72	0.45	1N4148	0.08	2N3704	0.15
AF239	0.45	BR100	0.40	OC76	0.45	18921	0.08	2N3705	0.13
ASY27	0.45	BY100	0.45	OC77	0.75	182033	0.20	2N3706	0.13
ASY28	0.25	BY126	0.12	OC81	0.50	IB2051A	0.20	2N3707	0.13
BA102	0.25	BY127	0.12	OC81D	0.28	IB2100A	0.50	2N3708	0.09
BA115	0.15	BFX61 se		OC81Z	1.00	183010	0.25	2N3709	0.12
BC107	0.14	TO PERSON	0.20	OC83	0.55 1.50	2N696	0.20	2N3710	0.13
BC108	0·14 0·15	BZY88 ser		OC140 OC170	0.20	2N697	0.17	2N3711	0.13
BC109 BC113	0.15	CRS1-05	0.12	OC171	0.50	2N706 2N706A	0·12 0·12	2N3819	0.37
	0.22	CR81-40	0-60	OC200	1.00			2N3820	0.55
BC117 BC143	0.30	CR83-05	0.45	OC200	1.75	2N1131	0.23 0.25	2N3823	0.60
BC147	0.10	CR83-40	0.75	OC202	1.50	2N1132 2N1302	0.30	2N3903	0.15
BC148	0.08	MJE340	0.42	OC202	1.50	2N1302 2N1303	0.40	2N3904	0.15
BC169C	0.15	MJ E370	0.65	OCP71	1.25	2N1303	0.45	2N3905	0.17
BC182	0.18	MJE520	0.60	ORP12	0.80	2N1305	0.45	2N3906	0.17
BC182L	0.12		1.25	ORP60	0.65	2N1306	0.50	2N4058	0.16
BC184L	0.13	MJE3055	0.75	TIC44	0.30	2N1307	0.50	2N 4059	0.12
BC338	0.15	MPF102	0.40	TIC226D	1.40	2N1308	0.50	2N4060	0.13
BCY32	1.00	MPF103	0.40	TIL209	0.22	2N1309	0.50	2N4061	0.13
BCY33	0.70	MPF104	0.40	TIP42A	0.70	2N1613	0.21	2N4062	0.14
BCY34	0.75	MPF105	0.40	ZTX107	0.10	2N1614	0.45	2N4289	0.30
BCY70	0.18	NKT404	1.25	ZTX108	0.10	2N2147	1.20	3N125	1.75
BCY71	0.22	OA5	0.75	ZTX300	0.12	2N2160	0.75	3N141	0.80
BCY72	0.17	OA10	0.55	ZTX 301	0.13	2N2369A	0.25	40360	0.40
BCZ11	1.25	OA79	0.12	ZTX 302	0.17	2N2646	0.50	40361	0.45
BD121	1.55	OA81	0.15	ZTX304	0.22	2N2904	0.25	40362	0-40
BD124	0.75	OA91	0.07	ZTX 500	0.12	2N2904A	0.25	40430	0.85
8N7400	0.16		0.40		0.47	BN74145	1.26		2.00
GN7401	0.16	BN7430	0.14	BN7490	0.85	GNITALKO	1.775	BN74100	0.00

BN7416 BN7417 BN7420 BN7422 BN7423	0.86 0.86 0.16 0.25 0.87	8N7470 0- 8N7473 0- 8N7474 0- 8N7480 0-	86 8N7 41 8N7 42 8N7 60 8N7 10 8N7	4119 4121 4122 4123	1.68 0.50 0.70 1.00 0.90	DIL SOCKET	rs	8 pin 14 pin 16 pin	15p
8N7405 8N7405 8N7407 8N7407 8N7409 8N7410 8N7411 8N7411	0.23 0.43 0.43 0.26 0.28 0.16 0.25 0.80 0.86	8N7440 0- 8N7441AN 0- 8N7442 0- 8N7450 0- 8N7451 0- 8N7453 0- 8N7454 0-	22 8N7: 8N7: 92 8N7: 79 8N7: 16 8N7: 16 8N7: 16 8N7: 16 8N7:	493 494 495 496 497 4100 4107 4110	0.70 0.80 0.80 0.95 8.87 1.89 0.45 0.58	BN74165 BN74156 BN74157 BN74170 BN74174 BN74175 BN74176 BN74190 BN74191	1 00 0 95 2 52 1 57 1 10 1 26 2 00 2 00	8N74196 8N74197 6N74198 8N74199	1-80 1-20 8-77 2-58
BN7401 BN7402 BN7403 BN7404	0·16 0·16 0·16	BN7430 0- BN7433 0- BN7437 0-	16 BN7	490 491 A N	0.55	8N74150 8N74151 8N74154	1.75 1.00 2.00	BN74193 BN74194 BN74195	8:00 1:80 1:10
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A D149	0 - 50	BC149	0.09	OFFERS	BYX36-69	00	TBA5300	Ĵ1·50
AD161	0.35	BC158	0.15			0.15	TBA5400	
AD162	0.35	BC159	0.12	Mullard	BZX61c1	60-19	TBA5500	2.50
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BC107	0.09	BF186	0.25		TIP29C		1 CA2/03	2.15
						0 - 38		
BC108	0.09	BF194	0 · 10		TIP30B	0.48	TCA640	2.10
BC108C	0.11	BF195	0.10	,	TIP30C	0.48	TCA650	2-10
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(µF)	gion	(man	) each	0.01-0.2	£1 28	75 p	50p			
.,	L	D		0-22-0-47	£1.32	77p	51p			
0·1µF	27	12.7	68p	0.68µF	£1:44	84p	56p			
0 15µF	27	12.7	80p	1.0µF	\$1.56	91p	60p			
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0.47µF	33	19	£1·10	4.7µF	42-82	£1.88	£1.28			
$0.5 \mu F$	33	19	\$1.16	6.8µF	23-48	£2.32	\$1.47			
0.68µF	50·8 50·8	19 19	£1.25 £1.37	10µF	\$4.98	£3.32	£2-01			
1·0μF 1·5μF	50.8	25.4	\$1.64	15µF	£7-14	£4.76	42-88			
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AC107" 16 BC140" 34 BF175" 25 MPSU52 60 T1S49 39 2N3011" 30 AC117" 35 BC142" 24 BF177" 25 MPSU52 60 T1S50 47 2N3053" 41 AC125" 32 BC143" 24 BF178" 25 MPSU52 60 T1S74 47 2N3054" 49 AC125" 32 BC143" 7 BF189" 33 OC28" 35 T1S74 47 2N3054" 49 AC125" 32 BC144" 77 BF189" 33 OC28" 35 T1S74 47 2N3055" 49 AC127" 18 BC146 7 BF189" 33 OC28" 35 T1S74 47 2N3055" 40 AC127" 18 BC146 7 BF189" 33 OC28" 35 T1S74 12 2N3525" 76 AC127" 18 BC146 39 BF182" 33 OC28" 35 T1S74 12 2N3525" 76 AC127" 18 BC146 39 BF182" 33 OC28" 35 T1S74 12 2N3525" 76 AC141" 22 BC146 39 BF182" 33 OC28" 35 T1S74 12 2N3525" 76 AC141" 22 BC146 39 BF182" 33 OC38" 34 ZTX100 15 2N3515" 135 AC141" 22 BC146 39 BF182" 33 OC38" 34 ZTX300 14 2N35161" 135 AC1412" 20 BC157 10 BF184" 32 OC44" 18 ZTX301 14 2N3702 11 AC1428" 31 BC158 10 BF184" 32 OC44" 18 ZTX301 14 2N3702 11 AC1428" 31 BC158 10 BF184" 32 OC44" 18 ZTX303 22 AC176" 18 BC159 13 BF194 10 OC45" 18 ZTX303 22 AC176" 18 BC159 13 BF194 10 OC45" 18 ZTX303 22 AC176" 18 BC160 12 BF196 14 OC70" 35 ZTX311 15 ZN3707 11 AC188" 19 BC167 12 BF196 14 OC70" 35 ZTX311 22 AN3708 10 AC1718 28 BC166C 14 BF189 15 OC71" 23 ZTX301 22 AN3701 12 AC171 35 BC168 12 BF196 15 OC71" 23 ZTX301 12 AC171 35 BC168 12 BF196 15 OC71" 23 ZTX301 12 AC171 35 BC168 12 BF196 15 OC71" 23 ZTX301 12 AC171 35 BC168 12 BF196 15 OC71" 23 ZTX301 12 AC171 35 BC168 12 BF196 15 OC71" 23 ZTX301 12 AC171 35 BC168 12 BF196 15 OC71" 23 ZTX301 12 AC171 35 BC168 12 BF196 15 OC71" 23 ZTX301 12 AC171 35 BC168 12 BF196 15 OC71" 23 ZTX301 12 AC171 32 AC171 35 BC168 12 BF196 15 OC71" 23 ZTX301 12 AC171 32 AC171 3	TRANSISTO	ORS I	P	P 1	TIS49 39	Р
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AC141** 22 BC159** 99 BF182** 33 OC38** 58 ZTX300** 14 2N3102** 13 AC141** 138 BC158** 90 BF184** 312 OC44** 18 ZTX300** 14 2N3103** 12 AC142** 20 BC157** 20 BF184** 312 OC44** 18 ZTX300** 14 2N3103** 12 AC142** 20 BC158** 10 BF184** 312 OC44** 18 ZTX300** 14 2N3103** 12 AC142** 20 BC158** 10 BF184** 312 OC44** 18 ZTX300** 14 2N3103** 12 AC142** 20 BC158** 12 BF195** 10 OC45** 18 ZTX303** 22 N3108** 12 AC187** 18 BC160** 32 BF195** 10 OC46** 35 ZTX311** 15 N3170** 10 AC188** 19 BC167** 12 BF195** 10 OC46** 35 ZTX311** 12 N31708** 10 AC188** 19 BC167** 12 BF195** 10 OC46** 35 ZTX311** 12 N31708** 10 AC188** 19 BC167** 12 BF196** 10 OC70** 35 ZTX311** 22 N31708** 10 AC188** 19 BC167** 11 BF200** 40p OC77** 56 ZTX50** 15 N3170** 10 AC188** 19 BC167** 11 BF200** 40p OC77** 56 ZTX50** 15 2N3171** 12 ACY20** 24 BC171** 11 BF204** 41 OC70** 35 ZTX51** 15 2N3171** 12 ACY20** 24 BC171** 11 BF204** 43 OC81** 22 ZTX500** 17 2N3170** 12 ACY20** 24 BC171** 16 BF256** 31 OC81** 22 ZTX500** 17 2N3170** 12 ACY20** 24 BC178** 16 BF256** 31 OC82** 23 ZTX500** 17 2N3170** 12 ACY20** 24 BC178** 16 BF256** 31 OC82** 23 ZTX500** 17 2N3171** 164** ACY21** 29 BC172** 16 BF256** 31 OC82** 23 ZTX500** 17 2N3171** 164** ACY21** 29 BC172** 18 BF256** 31 OC82** 23 ZTX500** 17 2N3170** 275* ACY22** 16 BC178** 16 BF256** 31 OC82** 23 ZTX500** 17 2N3170** 12 2N320** 24 2N32	AC125° 32	BC143* 24	BF178° 28	OC26° 95	TIS91 24	2N3055° 49
AC141** 22 BC159** 99 BF182** 33 OC38** 58 ZTX300** 14 2N3102** 13 AC141** 138 BC158** 90 BF184** 312 OC44** 18 ZTX300** 14 2N3103** 12 AC142** 20 BC157** 20 BF184** 312 OC44** 18 ZTX300** 14 2N3103** 12 AC142** 20 BC158** 10 BF184** 312 OC44** 18 ZTX300** 14 2N3103** 12 AC142** 20 BC158** 10 BF184** 312 OC44** 18 ZTX300** 14 2N3103** 12 AC142** 20 BC158** 12 BF195** 10 OC45** 18 ZTX303** 22 N3108** 12 AC187** 18 BC160** 32 BF195** 10 OC46** 35 ZTX311** 15 N3170** 10 AC188** 19 BC167** 12 BF195** 10 OC46** 35 ZTX311** 12 N31708** 10 AC188** 19 BC167** 12 BF195** 10 OC46** 35 ZTX311** 12 N31708** 10 AC188** 19 BC167** 12 BF196** 10 OC70** 35 ZTX311** 22 N31708** 10 AC188** 19 BC167** 11 BF200** 40p OC77** 56 ZTX50** 15 N3170** 10 AC188** 19 BC167** 11 BF200** 40p OC77** 56 ZTX50** 15 2N3171** 12 ACY20** 24 BC171** 11 BF204** 41 OC70** 35 ZTX51** 15 2N3171** 12 ACY20** 24 BC171** 11 BF204** 43 OC81** 22 ZTX500** 17 2N3170** 12 ACY20** 24 BC171** 16 BF256** 31 OC81** 22 ZTX500** 17 2N3170** 12 ACY20** 24 BC178** 16 BF256** 31 OC82** 23 ZTX500** 17 2N3170** 12 ACY20** 24 BC178** 16 BF256** 31 OC82** 23 ZTX500** 17 2N3171** 164** ACY21** 29 BC172** 16 BF256** 31 OC82** 23 ZTX500** 17 2N3171** 164** ACY21** 29 BC172** 18 BF256** 31 OC82** 23 ZTX500** 17 2N3170** 275* ACY22** 16 BC178** 16 BF256** 31 OC82** 23 ZTX500** 17 2N3170** 12 2N320** 24 2N32	AC126* 18	BC147 7	BF179° 33	OC28° 58		2N3525* 76
CC141* 22   CC133   90   BF162* 33   CC36* 58   ZTX300   14   SN3702* 17   CC14** 20   BC157   10   BF184* 33   CC44** 21   ZTX300   14   SN3702* 17   CC14** 20   BC157   10   BF184* 33   CC42** 18   ZTX300   14   SN3702* 17   CC14** 20   BC157   10   BF184* 30   CC44** 21   ZTX302   19   ZTX301* 21   ZTX301* 21   ZTX301* 21   ZTX302* 19   ZTX303* 22   ZTX303* 22   ZTX303* 22   ZN3705* 11   CC16** 18   BC169* 32   BF195* 10   CC45** 18   ZTX304* 24   ZN3706* 10   ZTX311* 15   ZTX311* 15   ZN3707* 11   ZC16** 18   BC160* 12   BF195* 10   CC46** 35   ZTX311* 12   ZN3707* 10   ZTX311* 12   ZN3708* 10   ZTX311* 12   ZN3708* 10   ZTX311* 12   ZTX304* 12   ZN3708* 10   ZTX311* 12   ZTX304* 12   ZN3708* 10   ZTX311* 12   ZTX301* 12   ZTX308* 10   ZTX308* 1	AC127* 18	BC148 7	BF180* 33	OC29* 58	Z   X   108   12   Z   X   100   15	2N3614* 115
AC141* (A38   BC154   20   BF183*   32   CC42*   18   ZTX301   14   2N3703   12   2N3704   13   AC142*   20   BC157   10   BF184*   32   CC42*   18   ZTX302   22   2N3705   12   AC162*   18   BC158   12   BF185*   10   CC45*   18   ZTX303   22   2N3705   12   AC167*   18   BC160*   32   BF195*   10   CC45*   18   ZTX303   22   2N3705   12   AC187*   18   BC160*   32   BF195*   10   CC45*   18   ZTX304   22   2N3706   12   AC188*   19   BC167*   12   BF196*   14   CC70*   33   ZTX311   21   2N3707   11   AC182*   13   BF195*   15   CC70*   23   ZTX314   24   2N3708   14   AC192*   24   BC110*   11   BF206*   40   CC70*   23   ZTX314   24   2N3709   0   AC191*   24   BC110*   11   BF224A   15   CC70*   23   ZTX503*   17   2N3710*   12   AC192*   24   BC117*   11   BF224A   15   CC70*   23   ZTX503*   15   2N3711*   12   AC192*   24   BC117*   11   BF224A   15   CC70*   23   ZTX503*   15   2N3711*   12   AC192*   24   BC117*   11   BF224A   15   CC70*   24   ZTX503*   15   2N3711*   12   AC192*   24   BC172*   11   BF24A   15   CC70*   24   ZTX503*   15   2N3711*   12   AC192*   24   BC178*   18   BF250*   34   CC80*   25   ZTX503*   18   2N3772*   175   AC192*   27   AC192*   AC192*   AC192*   AC192*   AC192*   AC192	AC128* 15		BF182* 33		ZTX300 14	2N3615" 135
AC1422** 20 BC157** 10 BF184** 32 CC44*** 18 Z1X302** 19 2N3704** 11 AC1428** 31 BC158** 12 BF185** 30 CC44*** 25 Z1X304** 24 2N3706** 10 AC187** 18 BC160** 32 BF195** 10 CC45** 18 Z1X304** 24 2N3706** 10 AC188** 18 BC160** 32 BF195** 10 CC46** 35 Z1X311** 15 2N3707** 11 AC188** 19 BC160** 12 BF195** 10 CC7** 35 Z1X311** 2N3707** 12 AC1818** 18 BC160** 12 BF195** 10 CC7** 37 Z1X311** 2N3708** 10 AC1818** 18 BC160** 11 BF195** 15 CC7** 27 Z1X341** 21 2N3708** 10 AC1918** 28 BC160** 11 BF204** 40 BF195** 10 CC7** 27 Z1X341** 21 2N3709** 12 AC1918** 28 BC170** 11 BF204** 40 BF195** 34 CC81** 24 Z1X303** 19 2N3710** 12 AC1920** 24 BC171** 11 BF204** 40 BF205** 34 CC81** 22 Z1X303** 19 Z1X717** 164** AC192** 21 BC170** 11 BF204** 40 BF205** 34 CC82** 25 Z1X303** 19 Z1X771** 164** AC192** 21 BC170** 18 BF250** 34 CC82** 25 Z1X550** 47 Z1X3773* 275** AC192** 21 BC170** 18 BF250** 34 CC82** 25 Z1X550** 47 Z1X3773* 275** AC192** 21 BC170** 18 BF250** 34 CC82** 25 Z1X550** 47 Z1X3773* 275** AC192** 21 BC182** 10 BF250** 34 CC82** 25 Z1X550** 42 Z1X37373* 275** AC192** 21 BC182** 10 BF250** 34 CC82** 25 Z1X550** 42 Z1X37373* 275** AC192** 21 BC182** 21 BF250** 34 CC82** 25 Z1X550** 42 Z1X37373* 275** AC192** 21 BC182** 21 BF250** 34 CC82** 25 Z1X550** 42 Z1X37373* 275** AC192** 21 BC182** 21 BF250** 34 CC82** 25 Z1X550** 42 Z1X3737* 275** AC192** 21 BC182** 21 BF250** 34 CC82** 25 Z1X550** 42 Z1X37373* 275** AC192** 21 BC182** 21 BF250** 34 CC82** 25 Z1X550** 40 Z1X3773* 275** AC192** 21 BC182** 21 BF250** 34 CC82** 25 Z1X550** 42 Z1X37373* 275** AC192** 21 BC182** 21 BF250** 34 CC82** 25 Z1X550** 42 Z1X37373* 275** AC192** 21 BC182** 21 BF250** 34 CC82** 25 Z1X550** 42 Z1X37373* 275** AC192** 21 BC182** 21 BF250** 34 CC82** 25 Z1X550** 42 Z1X37373* 275** AC192** 21 BC182**	AC141* K38		BF183* 33		ZTX301 14	
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ACY98 21 BC179- 18 BF259- 38 OC8D- 55 ZTX550 18 ZN3823 42 ACY94 28 BC182 10 BF259- 48 OC83* 22 ZN526* 40 ZN3823 42 ACY94 28 BC182 11 BF595 28 OC8A* 44 ZN526* 40 ZN3823 53 ACY94 28 BC182 12 BF596 29 OC8A* 44 ZN526* 40	ACY21 29	BC172 11			Z1X503 19 ZTX504 47	2N3772* 175
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AD140° 48 BC184L 11 BFR49 25 OC139° 140 2N099° 35 2N3903 15 AD149° 46 BC184L 12 BFR79 25 OC140° 125 2N700° 15 2N3905 17 AD160° 36 BC186 22 BFR80 25 OC141° 157 2N700A° 15 2N3905 17 AF114° 20 BC187° 28 BFX18° 35 OC141° 157 2N700A° 15 2N3905 17 AF114° 20 BC187 28 BFX18° 34 OC170° 30 2N700° 50 2N4037° 39 AF115° 20 BC212 L BFX29° 21 OC171° 30 2N700° 15 2N4058 17 AF117° 23 BC213 11 BFX38° 30 OC211° 125 2N700° 15 2N4066 13 AF117° 23 BC213 11 BFX38° 34 OC20° 155 2N4068 13 AF117° 23 BC213 11 BFX38° 34 OC20° 155 2N4068 13 AF118° 47 BC213L 13 BFX38° 46 OC20° 155 2N4068 13 AF118° 47 BC213L 13 BFX38° 46 OC20° 150 2N810° 32 N4066 13 AF118° 47 BC213L 13 BFX38° 46 OC20° 150 2N810° 32 N4066 13 AF118° 47 BC214L 14 BFX68° 160 OC40° 150 2N810° 18 2N4059 13 AF128° 30 BC238° 18 BFX88° 26 TP290 45 2N800° 16 2N810° 18 AF128° 30 BC238° 18 BFX88° 26 TP290 45 2N810° 22 N810° 22 N810° 27 AF138° 30 BC238° 10 BFX88° 28 TP290 45 2N1131° 19 2N5136 12 AF138° 30 BC238° 10 BFX88° 26 TP290 45 2N1131° 19 2N5136 12 AF138° 70 BC430° 15 BFX88° 26 TP290 45 2N1131° 19 2N5136 12 AF138° 70 BC430° 15 BFX88° 26 TP290 45 2N1130° 22 2N5138° 12 AF138° 70 BC430° 15 BFX88° 26 TP290 45 2N1130° 22 2N5138° 12 AF138° 30 BC338° 80 BFX88° 26 TP290 45 2N1130° 32 2N5136 12 AF188° 46 BC430° 00 BFX88° 26 TP290 45 2N1303° 37 2N5485 34 AF188° 60 BC430° 00 BFX88° 26 TP290 45 2N1303° 37 2N5485 34 AF188° 60 BC430° 00 BFX88° 26 TP290 45 2N1303° 37 2N5485 34 AF188° 60 BC430° 00 BFX88° 20 TP290 45 2N1303° 37 2N5485 34 AF188° 60 BC430° 00 BFX88° 20 TP290 45 2N1303° 37 2N5485 34 AF188° 60 BC430° 00 BFX88° 20 TP290 45 2N1303° 37 2N5485 34 AF188° 60 BC430° 00 BFX88° 20 TP290 45 2N1303° 37 2N5485 34 AF188° 60 BC430° 00 BFX88° 20 TP290 45 2N1303° 37 2N5485 34 AF188° 60 BC430° 00 BFX88° 20 TP290 45 2N1303° 37 2N5485 34 AF188° 60 BC430° 00 BFX88° 20 TP290 45 2N1303° 37 2N5485 34 AF188° 60 BC430° 00 BFX88° 20 TP290 45 2N1303° 37 2N5485 34 AF188° 60 BC430° 00 BFX88° 20 TP290 45 2N1303° 37 2N5485 34 AF188° 60 BC430° 00 BFX88° 20 TP290 40 AF188° 20 AF188° 20 AF188° 20 AF188° 20 AF188° 20 AF	ACY41 28	BC182L 12		OC84N* 44	2N697* 15	2N3824" 89
Description		BC183L 11	BFR39 25	OC123* 118	2N698" 30	2N3000 82
AD161** 36 BC184L 12 BFR/8** 25 OC171** 32 2N706** 15 2N3905* 17 AD162** 36 BC186L 12 BFX/8** 25 OC171** 30 2N706** 56 2N4037** 39 AF115** 20 BC212L 13 BFX/8** 38 OC201** 125 2N706** 56 2N4037** 39 AF115** 20 BC212L 13 BFX/8** 38 OC201** 125 2N706** 50 2N4037** 39 AF115** 23 BC213L 13 BFX/8** 38 OC201** 125 2N706** 28 N406** 13 AF117** 23 BC213L 13 BFX/8** 38 OC201** 125 2N706** 28 N406** 13 AF118** 47 BC213L 13 BFX/8** 40 OC202** 125 2N706** 28 N406** 13 AF118** 47 BC213L 13 BFX/8** 40 OC202** 125 2N706** 28 N406** 13 AF118** 47 BC213L 13 BFX/8** 40 OC202** 150 2N706** 28 N406** 13 AF118** 47 BC214L 14 BFX/8** 34 OC204** 150 2N706** 28 N406** 13 AF128** 30 BC214L 14 BFX/8** 34 OC204** 150 2N706** 28 N406**		BC184 11		OC139° 148	2N699° 45	2N3904 15
AF114*** 20 BC187** 28 BFX18*** 34 OC170** 30 2N707** 39 2N4037** 39 AF115** 20 BC212 L 33 BFX38** 34 OC201** 125 EN708** 15 2N4058* 15 AF116** 20 BC212 L 13 BFX38** 34 OC201** 125 EN718** 18 2N4061** 13 AF117** 23 BC213 L 13 BFX58** 40 OC202** 135 EN718** 21 2N4061** 13 AF118** 47 BC213 L 13 BFX58** 40 OC202** 135 EN718** 34 2N4850** 21 AF118** 47 BC213 L 13 BFX58** 40 OC203** 150 EN718** 34 2N4850** 21 AF121** 30 BC214 L 16 BFX81** 41 OCC770** 50 EN720** 21 2N4072** 65 AF125** 30 BC338** 18 BFX81** 40 OCC770** 50 EN720** 12 N4922** 65 AF125** 30 BC338** 18 BFX81** 24 TF294** 42 EN718** 21 2N518** 21 EN718**	AD161° 36			OC140* 125	2N706* 15	2N3905 17
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AF103** 39 BC441** 30 BFX86** 28 TIP29C 68 2N1131** 19 2N5138 12 2N5179 3 BC462** 30 BFX88** 28 TIP30 52 2N1132** 22 2N5179 22 2N5179 3 BC492** 51 BFX81** 28 TIP30 52 2N1302** 25 2N5180 2N5180 3 BC492** 51 BFX91** 17 TIP30B 64 2N1303** 21 2N5191 2N5191 3 BC492** 65 BFY51** 17 TIP30B 74 2N1303** 21 2N5191 2N5191 3 BC493** 65 BFY52** 17 TIP30B 74 2N1303** 21 2N5305 2N5457 34 AF181** 68 BC494** 80 BFY65** 27 TIP313** 52 2N1305** 32 2N5457 34 AF181** 68 BC494** 80 BFY65** 25 TIP318** 53 2N1307** 37 2N5458 34 AF181** 68 BC494** 80 BFY65** 25 TIP318** 53 2N1307** 37 2N5458 34 AF181** 68 BC494** 80 BFY65** 20 TIP318** 53 2N1307** 37 2N5458 34 AF181** 68 BC492** 18 BC492** 20 TIP328** 63 2N1307** 37 2N5458 34 AF181** 68 BC492** 20 TIP328** 63 2N1618** 179 2N6027* 2N6027* 30 BC492** 20 TIP328** 63 2N1618** 179 2N6027* 2N6027* 30 BC492** 20 TIP328** 63 2N1618** 179 2N6027* 2N6027* 30 BC492** 20 TIP328** 63 2N1618** 179 2N6027* 2N6027* 30 BC492** 20 TIP328** 63 2N1618** 179 2N6027* 2N6028** 2N60207* 2N6028** 2N60207** 2N6028** 2N60207** 2N60207*	AF125* 30	BC307B 15	BFX84* 24	11128 49	2N961* 61 2N987* 56	2N5135 12
AF199 33 BC461* 40 BFX87* 23 TIP30 52 2N1132* 23 2N5179 AF178* 70 BC549C 15 BFX88* 25 TIP30A 56 2N1302* 25 2N5180 AF178* 70 BC549C 15 BFX50* 17 TIP30A 64 2N1303* 21 2N5191 AF179* 70 BC549C 15 BFX50* 17 TIP30C 74 2N1304* 32 2N5305 AF180* 70 BCY30* 55 BFX51* 17 TIP30C 74 2N1304* 32 2N5305 AF181* 48 BCY32* 65 BFX52* 17 TIP30C 74 2N1304* 32 2N5305 AF181* 48 BCY32* 65 BFX52* 17 TIP31* 52 2N1305* 32 2N5305 AF181* 48 BCY32* 65 BFX52* 17 TIP31* 52 2N1305* 32 2N5305 AF181* 48 BCY40* 90 BSY20* 85 TIP318* 58 2N1307* 37 2N5459 AF181* 48 BCY40* 18 BSY20* 85 TIP318* 58 2N1307* 37 2N5459 AF181* 48 BCY59* 18 BSY20* 85 TIP32C* 80 2N1308* 42 2N5459 AF181* 48 BCY59* 18 BSY20* 85 TIP32C* 80 2N1308* 42 2N5459 AF181* 48 BCY59* 18 BSY20* 85 TIP32C* 80 2N1308* 42 2N5459 AF211* 138 BCY59* 18 BSY20* 85 TIP32C* 80 2N1308* 42 2N5459 ASY20* 38 BCY70* 15 BU105* 195 TIP32C* 80 2N16718* 195 40311* 80 ASY20* 40 BCY70* 10 BSY20* 17 P122C* 80 2N16718* 195 40311* 80 ASY20* 40 BCY70* 10 BSY20* 17 P122C* 80 2N16718* 195 40311* 80 ASY20* 20 BD112* 95 MJ2595* 125 TIP32C* 80 2N16718* 196 40316* 38 BC1078* 10 BD112** 95 MJ2595* 125 TIP33C* 122 N22180* 24 40336* 40 A036*	AF126* 30	BC441° 30	I BFX86° 28	T1P29C 68	2N1131* 19	
AF178* 70 BC549C 30 BF509* 77 TIP30B 44 2N1303* 22 2N5180 2N5191 BF108* 70 BC549C 15 BF509* 77 TIP30C 74 2N1304* 32 2N5191 2N5191 BF108* 70 BC549C 45 BF751* 17 TIP30C 74 2N1304* 32 2N5191 2N5	AF139° 33	BC461° 40	BFX87* 23		2N1132* 23	
AF119 70 BCY30* 55 BFY51* 17 TIP30C 74 2N1304* 32 5N15305 AF180* 70 BCY32* 65 BFY52* 17 TIP31* 52 2N1305* 32 2N1505* 32 2N1505* 34 AF181* 48 BCY34* 80 BFY65* 25 TIP31* 52 2N1305* 32 2N1505* 34 AF183* 60 BCY40* 90 BSY28* 54 TIP318* 58 2N1307* 37 2N15459 34 AF183* 64 BCY55* 204 BSY28* 55 TIP31C* 68 2N1307* 37 2N15459 34 AF183* 68 BCY55* 204 BSY28* 55 TIP31C* 68 2N1308* 48 2N1508* 32 2	AF178* 70	BC462* 30	BFX88° 26		2N1302° 25	
AF180* .70  AF180* .70  BCY32* 65  BFY52* 17  TIP31* 52  2N1305* 32  2N34657 44  AF185* 60  BCY40* 90  BSY26* 40  TIP31A* 54  2N1306* 37  2N5459 40  AF185* 60  BCY40* 90  BSY26* 40  TIP31A* 54  TIP32A* 60  TIP3	AF179* 70	BC549C 15	BFY51° 17		2N1304° 32	
AF186* 48 BCY40* 90 BS16* 3** TIF181C* 88 2N130* 3** 2N5459 40 AF230* 38 BCY55* 244 BS178* 85 TIF182** 40 2N5459 40 2N5459 40 AF211* 138 BCY99* 18 BS178* 85 TIF182** 40 2N130* 179 2N5459 40 AF211* 138 BCY99* 18 BS178* 85 TIF182** 40 2N130* 179 2N5459 40 AF212* 138 BCY70** 15 BS178* 17928** 40 2N130** 179 2N140** 179	AF180* 70 AF181* 48	BCY32* 65	BFY52° 17		2N1305° 32	
AF186* 48	AF185* 60	BCY34* 80	BFY65* 25		2N1306* 37	2N5458 34
AFZII 38 BCY59* 18 BSY78* 25 TIP32* 60 2N1613* 170 2N6027 35 AFZII 318 BCY10* 15 BSX20* 20 TIP32* 63 2N1671* 150 40311* 38 AFZII 318 BCY10* 20 BSY95A 18 TIP32A* 63 2N1671* 150 40311* 38 ASY20* 38 BCY71* 20 BSY95A 18 TIP32C* 83 2N1671* 150 40311* 38 ASY20* 40 BCY78* 20 MJ400* 90 TIP32* 95 2N1690* 80 40318* 38 ASY20* 17 BD115* 52 MJ401* 160 TIP33A* 95 2N217* 40 40317* 34 ASY21* 20 BD121* 98 MJ2955* 125 TIP33A* 112 2N221A* 25 40326* 40 BC107* 9 BD121* 98 MJ2955* 125 TIP33A* 112 2N221A* 25 40326* 40 BC107* 9 BD124* 75 MJE370* 68 TIP33C* 120 2N221DA* 24 40327* 46 BC108* 12 BD132* 38 MJE320* 65 TIP34A* 110 2N222DA* 26 40347* 65 BC108C* 12 BD133* 36 MJ2521* 74 TIP35* 219 2N221A* 21 40380* 40 BC1096* 12 BD135* 36 MJ2955* 98 TIP35A* 215 2N221A* 40 40387* 65 BC1096* 12 BD135* 36 MJ2955* 98 TIP35A* 215 2N2308* 20 40361* 40 BC1096* 12 BD135* 36 MJ2955* 98 TIP35A* 215 2N2308* 30 40361* 40 BC1096* 12 BD135* 34 MJE3255* 98 TIP35A* 215 2N2308* 30 40361* 40 BC1096* 12 BD135* 34 MJE3255* 98 TIP35A* 215 2N2308* 30 40361* 40 BC1096* 12 BD135* 34 MJE3255* 98 TIP35A* 215 2N2308* 30 40361* 40 BC1096* 12 BD135* 34 MJE3255* 98 TIP35A* 215 2N2308* 30 40361* 40 BC1096* 12 BD135* 34 MJE3255* 98 TIP35A* 215 2N2308* 30 40361* 40 BC1096* 12 BD135* 34 MJE3255* 98 TIP35A* 215 2N2308* 30 404112* 42 BC1096* 12 BD135* 34 MJE3255* 98 TIP35A* 225 2N2308* 30 40416* 24 BC113* 15 BD138* 34 MPF102* 34 TIP41A* 66 ZN2646* 41 40430* 178 BC115* 18 BD140* 53 MPF106* 50 TIP42B* 82 2N2906* 18 40436* 178 BC115* 18 BD140* 53 MPF106* 50 TIP42B* 82 2N2906* 18 40435* 84 BC115* 18 BD140* 55 MPF107* 50 TIP42B* 82 2N2906* 18 40435* 84 BC115* 18 BD140* 55 MPF107* 50 TIP42B* 82 2N2906* 18 40435* 84 BC115* 18 BD140* 55 MPF107* 50 TIP42B* 82 2N2906* 18 40435* 84 BC115* 18 BD140* 55 MPF107* 50 TIP42B* 82 2N2906* 18 40435* 84 BC135* 15 BP1154* 22 MPSA00* 60 TIS48* 37 2N29260* 8 Matched* Palr* 40530P* 30 MPSA00* 24 TIS48* 37 2N29260* 8 Matched* Palr* 40530P* 30 MPSA00* 24 TIS48* 37 2N29260* 8 MC130P* 30 MPSA00* 24 TIS48* 37 2N29260* 8 MC130P* 30 MPSA00* 24 TIS48* 37 2N29260	AF186* 48	DOVEER 904	BSY29* 85	TIP31C* 68	2N1308° 48	
BC107*		BCY59* 18	BSY78 25	TIP32* 60	2N1613* 170	
BC107*	AFZ12 136	BCY70° 15	BSX20* 20	TIP32A* 63	2N1671* 150	40311* 38
BC107*		BCY72* 15			2N1893° 27	40313* 98
BC107*		BCY78* 20	M.IADO® 90	TIP33° 95	2N2160° 80	40316* 68
BC107*	ASZ21* 220	BD115° 52	MJ491* 160	TIP33A* 95	2N2217° 40	40326° 40
BC1088* 9 BD131* 36 MJE371* 80 TIP34A*115 2N2221A*21 40380* 73 BC108B*12 BD132* 31 MJE321* 81 TIP34B*140 2N222* 2* 1 40380* 74 GR068C*12 BD103* 80 MJE521* 74 TIP34B*140 2N222* 2* 1 40380* 74 GR070** 9 BD13* 80 MJE521* 74 TIP35* 219 2N2303* 250 40361* 40 GR070** 9 BD13* 54 MJE525* 82 TIP35A* 22* 2N2369* 30 40412* 220 EC109C** 12 BD10** 39 MJE3055* 82 TIP35A** 22* 2N2369* 30 40412* 220 EC109C** 12 BD10** 39 MJE3055* 82 TIP35A** 22* 2N2484* 30 40412* 220 EC113* 15 BD13* 42 MPF103* 34 TIP36A** 34 EN2484* 30 40412* 220 EC113* 15 BD13* 54 MPF103* 34 TIP36A** 34 EN2848* 30 40412* 220 EC113* 18 BD140* 60 MPF105* 40 TIP44B** 73 2N2804** 20 40494* 33 EC115* 18 BD140* 53 MPF105* 50 TIP42A** 78 2N2806** 18 40463* 38 EC115* 2* BD145* 55 MPF107* 50 TIP42B** 82 2N2906** 18 40603** 58 EC115* 2* BD145* 55 MPF107* 50 TIP255** 65 2N2907A** 22 40638** 119 EC115* 2* BD145** 55 MPSA06** 24 TIP3055** 50 ZN2907A** 22 40638** 119 EC135* 13 BD161** 15* MPSA05* 24 TIP305** 50 ZN2907A** 22 40638** 119 EC135* 13* BD161** 15* MPSA05* 24 TIS44** 27 ZN29260* 8 Matched** EC135* 15* BF1154** 22 MPSA00** 26 TIS48* 37 ZN29267* 8 10p extra	BC107* 9	BD121- 20	MJE340* 45	TIP33C*120	2N2218A 23	40327 48
BC108B* 12 BD132* 38 MJES20* 85 TJP34B* 140 2N3222* 21 40360* 40 BC108C* 12 BD133* 38 MJES21* 74 TJP35* 219 2N3203* 226 40361* 40 BC109* 9 BD17* 45 MJE2055*98 TJP35* 225 2N2399* 14 40362* 40 MJE2055*98 TJP35* 225 2N2399* 14 40431* 20 BC109C* 12 BD137* 42 MPF102 34 TJP35* 272* 2N2399* 30 40411* 2* 42 BD137* 42 MPF102 34 TJP36* 273* 2N2483* 30 40411* 2* 42 BD138* 43 MPF103 34 TJP36* 2N2483* 30 40412* 42 BD138* 43 MPF103 34 TJP31* 2N2904* 20 40476* 178 BC114* 16 BD139 54 MPF104 40 TJP418* 73 2N2904* 20 40476* 178 BC115* 18 BD108* 00 MPF105 40 TJP428* 73 2N2904* 20 40476* 178 BC115* 20 BD142* 53 MPF106 50 TJP428* 82 2N2906* 18 40495* 84 BC117* 20 BD148* 55 MPF107 50 TJP428* 82 2N2906* 18 40495* 84 BC117* 20 BD148* 55 MPF107 50 TJP428* 82 2N2906* 18 40495* 84 BC137* 2D BD148* 55 MPF107 50 TJP428* 82 2N2907* 22 40638* 118 BC138* 13 BDY61* 115 MPSA55* 24 TJS44* 27 2N29260 8 Matched BC138* 15 BF115* 22 MPSU02* 60 TJS48* 37 2N29280* 8 Matched Palr* 15 BF158* 22 MPSU02* 60 TJS48* 37 2N29280* 8 MC1304P 3690* 375 MPSA102* 20 MPSU02* 60 TJS48* 37 2N29280* 8 MC1304P 3690* 375 MPSA102* 375 MC1304P 3690* 375	BC107B* 10	BD124° 75	MJE370° 68	TIP34* 110	2N2220A°26	40347* 65
BC1096C* 12 BD133* 60 MJES21* 74 TIP35* 219 2N2303* 250 40:901* 40 BC1096* 9 BD13* 45 MJES95*98 TIP35A 225 2N2309* 31 403362* 40 40:902* 40:902* 40:	BC108° 9	BD131* 36	MJE371° 80	TIP34A*115	2N2221 A*21	40360° 40
BC1098* 9 BD135 45 MJE2955*98 TIP35A 225 2N2369* 14 40382* 40 BC1098* 12 BD135 39 MJE2955*98 TIP35C*270 2N2369* 14 40430* 40411* 2* BD136 39 MJE2955*98 TIP35C*270 2N2369* 3 40411* 2* 42 BD137 42 MPF102 34 TIP36A*346 2N2484* 30 40412* 42 BD138 47 MPF103 34 TIP36A*346 2N2484* 30 40412* 42 BD138 47 MPF103 34 TIP41A* 68 CN2546* 40430* 40476 178 BC114 16 BD139 54 MPF104 40 TIP41B* 73 2N2904* 20 40476 178 BC115* 18 BD139 54 MPF105 40 TIP42B* 73 2N2904* 20 40476 178 BC116 18 BD142 53 MPF106 50 TIP42B* 82 2N2906* 18 40495* 84 BC117 20 BD145* 55 MPF107 50 TIP42B* 82 2N2906* 18 40495* 84 BC117 20 BD145* 55 MPF107 50 TIP42B* 82 2N2906* 18 4095* 84 BC117 20 BD145* 55 MPF107 50 TIP42B* 82 2N2907* 22 40503* 15 BC118* 15 BDY17** 195 MPSA05* 24 TIP3055* 50 2N2907* 22 40503** 116 BC135* 13 BDY17** 195 MPSA05* 24 TIS44* 27 2N29260 8 MATCHED BC135* 13 BDY61** 115 MPSA35* 24 TIS44* 27 2N29260 8 MATCHED BC137* 15 BF154** 22 MPSU02* 60 TIS48* 37 2N2926* 8 PAIC** 10p axtra*  TTL 74**  74153 82 4016AE 55 LINEAR IC*S MC1304P 3690* 755 MC1304P 3690	BC108C* 12	BD132* 38	M.IE521* 74	TIP35° 219	2N2303° 250	40361° 40
BC1190C* 12 BD137 42 MPF102 34 T1P36A*346 2N2848* 30 40432* 42 8D213 15 BD138 47 MPF103 34 T1P41A* 66 2N2846* 41 40430* 40 40 8D214 15 BD139 54 MPF104 40 T1P41B* 73 2N2804* 20 40476* 178 BD141 60 MPF105 40 T1P42B* 73 2N2804* 20 40476* 178 BD141 60 MPF105 40 T1P42B* 73 2N2804* 20 40493* BC116 18 BD142 53 MPF106 50 T1P42B* 82 2N2806* 18 40495* B4 BC117 20 BD145* 55 MPF107 50 T1P42B* 82 2N2806* 18 40495* B4 BC117 20 BD145* 55 MPF107 50 T1P42B* 82 2N2806* 12 406803* 18 BC118* 15 BDY17* 195 MPSA05 24 T1P3055* 50 2N2807A*22 406838* 116 BC135* 13 BDY61** 115 MPSA05 24 T1S44 27 2N2826* 10 40673* 116 BC135* 13 BDY61** 115 MPSA05 24 T1S44 27 2N2826* 10 40673* 116 BC135* 15 BF115** 22 MPSA05 26 T1S46* 40 2N2826* R Pair* BC137* 15 BF154** 22 MPSU02 60 T1S48* 37 2N2926* 8 MC1304P 3680* 10 40573* 15 BF155* 22 MPSU02 60 T1S48* 37 2N2926* 8 MC1304P 3680* 10 40573* 15 BF155* 22 MPSU02 60 T1S48* 37 2N2926* 8 MC1304P 3680* 15 MPSA05* 15 MPS	BC109* 9	BD135 45	I MJE2955*98	TIP35A 225	I 2N2369° 14	40362* 40
BC113 15 BD133 47 MPF103 34 T1P41A* 86 2N2846 41 404030* 120 BC114 16 BD139 54 MPF103 34 T1P41A* 86 2N2846* 41 40476 178 BC115 18 BD139 54 MPF105 40 T1P42B* 73 2N2804* 20 40494 93 BC115 18 BD142 53 MPF106 50 T1P42B* 82 2N2804* 24 40494 93 BC117 20 BD145* 55 MPF107 50 T1P42B* 82 2N2806* 18 40949 83 BC117 20 BD145* 55 MPF107 50 T1P2955* 85 2N2807A*22 40893* 116 BC117 20 BD145* 55 MPSA05 24 T1P3055* 50 2N2807A*22 40893* 116 BC119 25 BDY60* 95 MPSA06 24 T1S43 27 2N28266 10 40673* 35 BC135 13 BDY61* 115 MPSA55 24 T1S44 27 2N28260 8 Matched BC135 15 BF1154* 22 MPSU02 60 T1S48 37 2N29267 8 10p extra	BC109B* 12		MJE3055*62	TIP35C*270	2N2483° 30	
BC114 16 BD139 54 MPF104 40 TIP41B* 73 2N2904* 20 40476 176 176 E1616 18 BD140 60 MPF105 40 TIP42B* 78 2N2904* 20 40494 93 84 BC116 18 BD142 53 MPF106 50 TIP42B* 82 2N2906* 18 40495 84 BC117 20 BD148* 55 MPF107 50 TIP285* 81 2N2907* 22 40603* 18 BD142 53 MPF106 50 TIP42B* 82 2N2906* 18 40495 84 BC118 15 BD142* 55 MPF107 50 TIP285* 82 2N2907* 22 406038* 116 BC136 13 BD142* 19 MPSA05 24 TIP3055* 50 2N2907* 22 406038* 116 BC136 13 BD14** 115 MPSA05 24 TIS44 27 2N29260 8 MATCHED BC136 15 BF154* 22 MPSU02 60 TIS48 37 2N2926* 8 MC1304P 3690 BC137 15 BF154* 22 MPSU02 60 TIS48 37 2N2926* 8 MC1304P 3690 M			MPF102 34		2N2484* 30 2N2646* 41	40430* 120
BC115 18 BD140 60 MPF105 40 TIP42A 78 2N2904A=24 40493 33 BC116 18 BD142 53 MPF106 50 TIP42B 82 2N2906* 18 40495 43 BC117 20 BD145* 55 MPF107 50 TIP2955* 65 2N2907* 20 40603* 58 BC118 15 BDY17* 195 MPSA06 24 TIP3055* 50 2N2907* 20 40603* 58 BC119 25 BDY60* 95 MPSA06 24 TIP3055* 50 2N2907* 20 40603* 58 BC136 15 BDY60* 95 MPSA06 24 TIS43 27 2N29260 10 40638* 55 BC135 15 BF115* 22 MPSA06 24 TIS43 27 2N29260 B Matched BC136 15 BF1154* 22 MPSA06 20 TIS46 40 2N2926R B Pair BC137 15 BF154* 22 MPSU02 60 TIS48 37 2N2926Y B 10p axtra	BC114 16		MPF104 40	TIP41B° 73	2N2904° 20	
BC118 15 BDY17* 195 MPSA05 24 TIP3055* 56 2N29074*22 40638* 116 RC119 25 BDY60* 95 MPSA06 24 TIS43 27 2N29266 10 40673* BC135 13 BDY61* 115 MPSA55 24 TIS44 27 2N29260 B Matched BC136 15 BF115* 22 MPSA70 26 TIS46 40 2N29267 B 10p axtra  TTL 74*  74153 82 4016AE 55 LINEARIC'S MC1304P 360p 74154 150 4017AF 95 702 756 MC1304P 360p	BC115 18	BD140 60		TIP42A° 78		
BC118 15 BDY17* 195 MPSA05 24 TIP3055* 56 2N29074*22 40638* 116 RC119 25 BDY60* 95 MPSA06 24 TIS43 27 2N29266 10 40673* BC135 13 BDY61* 115 MPSA55 24 TIS44 27 2N29260 B Matched BC136 15 BF115* 22 MPSA70 26 TIS46 40 2N29267 B 10p axtra  TTL 74*  74153 82 4016AE 55 LINEARIC'S MC1304P 360p 74154 150 4017AF 95 702 756 MC1304P 360p	BC117 20					40603* 58
BC119 25 BDY60* 65 MPSA06 24 TIS43 27 2N2926G 10 406/13* 55 BC135 13 BDY61* 115 MPSA56 24 TIS44 27 2N2926G 10 Matched BC136 15 BF115* 22 MPSA/10 26 TIS46 40 2N2926R 8 Pair BF154* 22 MPSA/10 26 TIS46 37 2N2926R 8 Pair TTL 74* 74153 82 4016AE 55 LINEARIC'S MC1304P 3600 174154 150 L017AF 95 702 750 MC1304P 3600 1800 1800 1800 1800 1800 1800 1800 1		BDY17* 195	MPSA05 24	TIP3055* 50		1 40636* 11 <b>6</b>
BC136 15 BF115° 22 MPSA70 26 TIS46 40 2N2926R B Pair BC137 15 BF154° 22 MPSUO2 60 TIS48 37 2N2926Y B 10p extra  TTL 74* 74154 150 4017 AF 95 702 750 MC1304P 3800 1800 1800 1800 1800 1800 1800 1800	BC119 25	BDY60* 95	MPSA06 24	TIS43 27	2N2926G 10	
BC137 15 BF154* 22 MPSUO2 60 1 TIS48 37 1 2N2926Y 8 1 10p extra  TTL 74* 74153 82 4016AE 55 LINEARIC'S MC1330P 180p 74154 150 4017AF 95 700 756 MC1330P 180p	BC135 13					
TTL 74* 74153 82 4016AE 55 LINEARIC'S MC1304P 360p	BC136 15 BC137 15	BF154* 22	MPSUO2 60	TIS48 37		
74154 150 4017AF 95 702 750 MC1310P 1800			· -			
		74	154 150 40174	AE 95 702	75p MC	21310P 180p

	BC135 BC136	13 15	BDY BF11	5° 2	22 M	PSA PSA	70 26	TIS44 TIS46		2N2928O 2N2926R		Match Pair	
-1	BC137	15	BF15	4.	22 J M	PSU	J2 60 1	TIS48	37	2N2926Y	8 1	10p a	tra
	TTL	. 74	*	1	74153	82	4016A		LINEA	RIC'S		1304P	360p
				36	74154	150	4017A		702	75p		1310P	180p
١	7400	- 14	7474	36	74155 74156	80	4018A	E 86	709C 1		I MC	1312PQ	175p
- 1	7401 7402	14	7476	36	74157	95	4019A	E 48	710*	41p		1458P*	77p
1	7403	16	7480	50	74159	225	4020 A	E 105	741 14 741 C			1496	91 p
	7404	20	7481	114	74160	116	4021 A	E 105	747C	22p		1710CG C4000B	79p 73p
П	7405	22	7482	82	74161	116	4022 A		748C	70p 33p		C6040°	79p
	7406	44	7483	95	74162	116	4023 A		8038C			50253*	550p
П	7407	44	7484	95	74163	116			AY-1-0			2112N	450p
П	7408	26	7485	125	74164	121	4024 A		AY-1-		NE:		160 p
	7409	26	7486 7489	390	74165 74166	120	4025 A			224° 349p		513 A	210p
	7410 7411	15 25	7490	43	74167	362	4026 A			37216 <b>19</b> 5p		555°	41p
	7412	25	7491	80	74170	246	4027 A			3500° 610p		56DB°	99 p
- 1	7413	40	7492	53	74172	590	4028 A		CA301		NES	60*	325p
. 1	7414	74	7493	40	74173	175	4029,A		CA301		NE:		325p
ч	7416	35	7494	85	74174	173	4030 A		CA301			62B*	322p
.	7417	39	7495	73	74175.	90	4033 A	E 130	CA302			65A°	175p
?	7420	16	7496	82	74176	120	4034 A	E 184	CA302			566* 567V*	150p 182p
1	7421	29	7497	262	74177	116	4040 A	E 99	CA302			M2513	750p
i	7422	24	74100 74104	135 48	74180 74181	106	4042 A	E 85	CA303			3402*	255p
٠	7423 7425	30	74105	48	74182	85	4043 A		CA303			114A	2200
٠.	7425	36	74107	33	74184	184	4044 A		CA304			72702	86p
١.	7427	36	74109	64	74185	146	4045A		CA304		SN	72733	125p
	7428	48	74110	54	74188	650			CA304		SN	76003	28 0 p
ı	7430	18	74111	76	74190	194	4046 △		CA307			76013	148p
1	7432	28	74116	198	74191	165	4047 A		CA308			76023	145p
	7433	48	74118	115	74192	120	4049A		CA308	1 190p		76033	225p
	7437	30	74119	185	74193	120	4050 A		CA308	9E 190p		76115 76227	200p
- 1	7438	33	74120 74121	105	74194	120	4054 A		CA309		1 57	A550B	36p
	7440	17	74122	50	74195	95	4055 A		CA312	3E 180p		A621 A	235p
	7441 7442	74	74123	73	74196	118	4056A		CA313			A661A	155p
	7443	130	74125	69	74197	118	4060 A		LM300			A700	253p
	7444	122	74126	65	74198	248	4067 A		LM301			A960	250p
	7445	94	74128	81	74199	240	4069 A		LM301			D100	150p
	7446	116	74132	75	CMO	e	4070 A		LM308			D110	170p
_	7447	82	74136	75			4071 A	E 20	LM318	155p		A120S A540Q	220p
۱	7448	80	74141	72	4000 A		4072 A		LM380	98p		A5500	355p
ı	7450	17	74142	315	4001 A 4002 A	E 10	4076A		LM381	170p		A641B	225p
	7451	17	74143	314	4006A		4081 A		LM741	32p		A651	150p
	7453	17	74144	314	4007 A		4082		LM390	0 54p		A 800	90p
:	7454	17	74145	90	4009 A		4510A		LM390		TB	A810S	105p
•	7460	17		275	4010A		4511 A		M252 A		TB	A820	80p
.			74147		4011A	E 16	4516 A		M253*	750p		A920Q	350p
	7470	32	74148	160	4012A		4518A		MC724			A2020	300p
	7472	28	74150	128	4013A	E 55	4520 A		MC845			A270SC	350p
	7473	32	74151	79	4015A	E 99	4528	E 140	MC130	3L 148p	IZN	414	105p

### WATFORD ELECTRONICS

(Continued from opposite side)

(Conti	nue	a irom	oppo	osite sii	ue)
DIODES AAZ15	15 o	*BRIDG		SCR's*	ors
AEY11	60p	(plastic	case)	1A50V	38 p
BA100	10p	1A50V	21 <sub>D</sub>	1A100V	42p
BA102	10p	1 A100V	240	1 A200V	47p
BY126	12p	1A200V	26p	1 A400 V	52p
BY127	12p	1A400V	31g	1 A600 V	70p
OA9	9p	1A600V	34p	3A50V	38p
OA10	40p	2A50V	33p	3A100V	43 p
OA47	8p	2A100V	44p	3A200V	60 p
OA70	8p	2A200V	46p	3A400V	110p
OA79	12p	2A400V	56 p	3A600V	99 p
O A 81	10p	2A600V	68p	5A400V	105p
OA85	12p	4A100V	65 p	7A400V	125 p
OA90	6р	4A400V	79p	C106D	55p
OA91	6p	4A800V	120p	TIC44	25p
OA95	8p	6A100V	73p	TIC45	45 p
QA200	9p	6A400V	86p	2N4444	191 p
OA202	8p	BY122	54 p		
PL4004	80	BY164	56p	TRIACS	
IN914	4p	ZENERS		3A400V	113p
IN916	5p	Rng:3:3\		6A400V	140p
IN4001/2*	5p	400mW	9p	6A500V	175p
IN4003*	6p	1.3W	17p	8A400V	160p
IN4004/5*	6p		_	10A500V	195p
IN4006/7*	7p	VARICA		15A400V	260p
IN4148	4p	MVAM1	350p	15 A 500 V	285p
3A/100V*	18p	MVAM2	135p	40430	99p
3A/400V*	20p	BB105B	30p	40669	95 p
3A/600V*	27p	Noise D	lada	DIAC*	

ALUM. BOXES	SPEAKERS
with #d* 2½x5½x1½" 50p 4x4x1½" 50p 4x2½x1½" 50p 4x5½x1½" 65p	8Ω 0·3W 2"; 2½" 65p 2·5; 3" 58p
4x2½x2" 50p 5x4x2" 82p 6x4x2" 87p 7x5x2½" 96p	64 Ω 2·5" 65p 4 Ω 4" 125p 4 Ω 7x34" 125p
8x6x3" 118p 10x7x3" 138p 10x41x3" 110p 12x5x3" 117p	8Ω 5W 7" x 4" 175p 16Ω 5W
12x8x3" 199p	7 x 4" 185p

12x8x3"	199p	1 7 x 4	″ 185p
COPPE	R CLA	D BO	ARDS
Flbre	single	dble/	
glass	sided	sided	S.R.B.P.
		78p	71"x81"
6"x12"	115p	160p	40p
Flbre	single	dble/ sided	S.R.B.P. 71"x81"

PEN* +			
PEN +	spare t	ıp qı	75
VEROB	ARD*	Pitch	
	0.1	0.15	0.15
	(coppe	r clad)	(plain
21 x 31"	36p	29p	19p
2½ x 5"	43p	39p	24p
3 x 3 2"	43p	40p	
31 x 5"	48p	53p	34p
21 x 17"	134p	107p	73 p
34 x 17"	173p	143p	95 p
44 x 17"	222p	-	145p
Pkt of 36	pins		28
Spot face	Cutter		52
Pin inser	tion too	Ī	72

KNOBS* fit 1" shaft with grub scr	ews,
except K2 (push fit) & K8 (for slid	ers).
K1 Black or White pointer type	9p
K2 Silm silvered aluminium	10 p
K4 Black serrated. Metal top with	
line Indicator 33mm diam.	22p
K4A As above but 25mm diam,	20 p
K5 Black fluted metal top and skirt	
calibrated 0-10, 37mm diam.	26p
K6 PK2 as K5, pointer on skirt	26 p
K7 Black, knurled, tapered, Metal	
top & skirt. Calib. 0-10, 30mm	25p
K8 Black or silvered for silder pot	10p
K9 Solid Aluminium, Amplifier K	nob,
Professional type, with etch	line
indicator 16.5 x 12mm dlam.	26 p
K10 As above but tapered 18-5 x 1	7mm
diam.	28p
K11 Aluminium, (Top Hat) Kno	
body with 18-5mm skirt. Knot	
Attractive	
Amachive	30p

2.5mm 10p 3.5mm 14p MONO 19p STEREO 28p	body 8p 10p 15p 18p	meta 8p 8p 13p 15p	tal with p break p contacts p 17p	
DIN 2 pin Loudspeaker	PI	ពិទិន	Sockets	
3, 4, 5 (180° & 240°)	12p		8p 10p	
CO-AXIAL (TV)				
PHONO assorted colours Metal screened		9p 2p	5p (Single) 7p (Double) 10p (Triple)	
BANANA 4mm 2mm	9p 15p		10p 15p	

SOCKETS

JACK PLUGS

A-0-50μA A-0-100μA A-0-500μA S each
A-0-100µA A-0-500µA
A-0-100µA A-0-500µA
A-0-500µA
EWISE
32 x 70mm
1A, 0-500#A e £4:14
inel hole
£4-40
prox) £4-65

0-50μA; 0-100μA; 0-500μA £4-40	THE PROPERTY OF
DUAL VU METERS (150/μA approx) £4-8/  TRANSFORMERS* (Mains Prim. 220-240V 6-0-6V 100mA 90p 18-0-18V 1A 275p+ 9-0-8V 75mA 35p 30-0-30V 1A 275p+ 15-0-15V 100mA 185p 9-0-9V 2A 270p+ 1-20-12V 105mA 140p 9-0-9V 2A 270p+ 1-20-12V 105mA 140p 9-0-9V 2A 270p+ 1-20-12V 105mA 140p 9-0-9V 1A 245p+ 15-0-15V 10-3A 198p+ 15-0-15V 1A 245p+ 16-0-24V 0-15-12-0 1A 180	TOGGLE: 2A, 250V IA DP SPST SPST 23p IA DP C/O 144 DPDT 29p JA DP (min) 19 4 polechangeover 48p SPST on/off 44p SPST on/off 44p SPST on/off 44p SPST on/off 52p DPDT 6 tag 59p DPDT Centre off 88p DPDT 6 Tag 85p SWITCHES* PUSH BUTTON: Minlature Non Lockling Push to Make 15p Push to Break ROCKER (white): 10A 250V SP changeover centre off ROCKER: (black) on/off 10A 250V SP CARCER: Illuminated (white) Ilights when on, 3A 240V 48p ROTARY: (ADJUSTABLE STOP) 1 pole/

LAMP HOLDERS AND LAMPS	3.
LES HOLDER Dome shaped, Blue, Green, Yellow, White	Red, 14p
LES BULBS 6v and 12v	9 p
MES HOLDERS Chrome cover, F Amber, Jewelled top	Red or 50 p
MES BULBS 3-5V 6V 12V	9p
NEONS Mains, Sealed with F Sq. Top. Red or Grn. Round Top Neon with leads, 95V AC (No res	Red 24p

•	SWITCHES	SLIDE 250V:	
	TOGGLE: 2A, 250V	1A DP	12p
	SPST 23p	1A DP C/O	14p
1	DPDT 29p	IA DP (mini)	11p
	4 polechangeover58p	4 pole/2 way	19p
	SUB-MIN TOGGLE	PUSH BUTT	
	SP changeover 48p	Spring loader	
	SPST on/off 44p	SPST on/off	55p
	DPDT 6 tag 69p	SPDT C/over	65 p
	DPDT Centre off 88p	DPDT 6 Tag	85p
	SWITCHES PUSI	BUTTON:	
	Miniature Non Locking	,	
	Push to Make 15p	Push to Break	25p
	ROCKER (white): 104	250V	-
d	SP changeover centre		25p
ı	ROCKER: (black) on		200
ı			200
1	ROCKER: Illuminated		
1	lights when on, 3A 240		46p
1	ROTARY: (ADJUST	ABLESTOP) 1 p	ole/

3A/1000V*30p   Z5J	105p   ST	2 25p   Pin i	nsertion tool	72p
OPTO ELECTRONI		LTAGE REGULA	TORS'	
LEDS + Clip   DL728		DIL 45p; 723 T05 53		135p
Til 209 Red14p   DL747	180p   TB.	A625B 95p	MC7815 1 A 15V	140p
0.2" Red 18p XAN3	45 3" T03	Metal Can Type	FT8N24 1 A 24V	140p
Yellow, Green, Gre-			DD TDA1412 ≵A 12V	135p
Amber 21p 6"Gr	een 190p   1A	12V 170	) n	
OCP 70 40p MANS	3610 240p   1A		Variable Type	
OCP 71 850 MANS	3640 240p 1A			240p
ORP 12 68p Minite	on LM	309K 14		240p
ORP 61 50p 3015F		323K 62		260p
2N5777 54p TIL11	1 130p MV			. 1
DL704 75p TIL11;	2 130p MV	R12 170	+1 ·2V to 37V	350p
DL707 75p TIL11-	4 140p Pla	stic Case	LM317H 5W 1-5A	
DL727 180p   T(L11	7 140p MC	7805 1 A 5 V 13		320p
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collector current 400mA. ICBO = 10nA.	6AC7 0.60 6J4 0.75 75C1	0.75 ECL80 0.60 EM84 0.40 PCL200 0.75 UCL82 0.40
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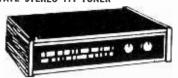
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#### HARVERSONIC MAINS OPERATED SOLID | HARVERSONIC SUPERSOUND STATE STEREO FM TUNER



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Designed and styled to match our 10 + 10 amplifier but will suit any other standard stereo amplifier. The design incorporates the very latest circuitry techniques with high-grain, low noise IF stages. Automatic frequency control to "lock-on" station and prevent drift. IC stereo decoder for maximum stereo separation. L.E.D. for stereo beacon indicator. Nominal output of tuner 100mW. Approximate size 124" wide × 8" deep by 21" high. Supplied ready built, fully tested and fully guaranteed. A/C Mains 200/240V (not available in kit form).

#### SPECIAL OFFER £22.50 + £1.40 p. & p.

#### SPECIAL OFFERS

Mullard LP1159 R.F.-I.F. Double Tuned Amplifier Module for nominal 470 KHz. Slzz approx. 24" × 1½" × 1½" × 4" 7.8 Volt + earth. Brand new pre-aligned. Full specification and connection details supplied. 22 28, P. & P. 12p

Pye VHF/FM Tuner Head covering 88-108 M/Hz. 10-7 M/Hz 1.F. output, 7-8 Volt + earth. Supplied pre-aligned, with full circuit diagram. Connection details supplied. Reautifully. beautifully made with precision-geared FM gang and 323Pf + 323Pf A.M. Tuning gang only £3·15 + P. & P. 35.



#### PRECISION MADE

PRECISION MADE Push Button Switch bank. 8 Buttons giving 16 S/P C/O interlocked switches plus 1 Cancel Button Plus 3 d/p c/o. Overall size  $5'' \times 2\frac{1}{2}'' \times 1''$ . Supplied complete with ne finished switch buttons, 2 for \$1.50 + 200 P & F

#### HI-FI LOUDSPEAKER SYSTEM MK II

Beautifully made, simulated teak finish enclosure with attractive slatted front. Size 16½" high × 10½" wide × 9" deep (approx.). Fitted with E.M. Ceranic Magnet 13" × 8" bass unit, H.F. tweeter unit and crossover. AVALABLE IN NOMINAL 4 Ohm, 8 Ohm or 16 Ohm impedance (state which).

OUR PRICE £12.00 each Carr. £1.90. Cabinet Available Separately \$7.25, Carr. £1.40. Also available in 8 ohms with EMI 13" × 8" bass speaker with parasitic tweeter \$10.25, Carr. £1.90

LOUDSPEAKER BARGAINS
5in. 3 ohm \$1-45, P. & P. 35p, 7 × 4in. 3 ohm \$1-69, P. & P.
48p. 10 × 6in. 3 or 15 ohm \$2.60, P. & P. 75p. E.M. I.
8 × 5in. 3 ohm with high flux magnet \$2.06, P. & P. 50p.
E.M. I. tweeter. Approx. 3 i". Available 3 or 8 or 15 ohms,
\$2.00 + 25p, P. & P.

"POLY PLANAR" WAFER-TYPE, WIDE RANGE ELECTRO-DYNAMIC SPEAKER
Size 112" × 14 | " × 1, 1, 2" deep. Weight 190z. Power handling 20W r.m.s. (40W peak). Impedance 8 ohm only. Response 40 Hr. 20M Hz. Can be mounted on ceilings, walls, doors, under tables, etc., and used with or without battle. Send S.A.E. for full details.
Only 48-40 each + p. & p. (one 75p. two 90p).

Now also available 8''. -8 ohm 10 watts, r.n.s. 20 watt peak 40 Hz-20,000 Hz. Overall depth 1". Ideal for Hi-Fi or for use in cars  $25\cdot10+p$ . & p. (one 35p, two 65p).

#### SPECIAL LINES OFFERED SUBJECT TO STOCK AVAILABILITY

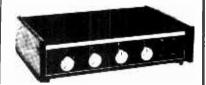
SPECIAL LINES
STOCK AVAILABILITY
HI-Fidelity stereo cassette tape deck transport mechanisms as used in Hi-Fi Music Centres. Electronically
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three dight re-settable counter. Record/Play pre-amps.
Blas oscillator. Record/Play and erase heads etc. Power
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These units are brand new, but untested and are only
offered to the more advanced constructor enthusiast.
PRICE \$16.87 + £1.25 P. & P.
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INTO CORRESPONDENCE ON THESE UNITS.

New but very slightly marked 'GLENBURN' BSR automatic record changer decks fitted with queing level, ightweight arm and ceramic Hi-Fi stereo/compatible cartridge. Can be used for automatic or manual play. PRICE 29-56 + £1'20 P. & P.

Latest model GARRARD 6300 auto/manual changer de-luxe with cueing lever, bias compensator, counter-balanced low resonance arm and fitted with ACOS 104 diamond ceramic stereo cartridge. PRICE ONLY 214:50 £1-50 P. & P

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### 10 + 10 STEREO AMPLIFIER KIT



A really first-class Hi-Fi Stereo Amplifier Kit. Uses 14 transistors including Silicon Transistors in the first five stages on each channel resulting in even lower noise stevel with improved sensitivity. Integrated pre-amp with Bass, Treble and two Volume Controls. Suitable for use with Ceranic or Crystal cartridges—instructions included. Output stage for any speakers from 8 to 15 ohms. Compact design, all parts supplied including drilled metalwork high quality ready drilled printed circuit board with component identification clearly marked, smart brushed anodised aluminlum front panle with matching knobs, wire, solider, nuts, bolts—no extras to buy. Simple step by step instructions enable any constructor to build an amplifier to be proud of. Brief specification; Power output: 14 watts r.m.s. per channel into 5 ohms. Frequency response  $\pm 3dB$  12-30,000 Hz. Sensitivity: better than 80mV into 1M $\Omega$ . Full power bandwidth:  $\pm 3dB$  12-15,000 Hz. Bass boost approx. to  $\pm 12dB$ . Treble cut approx. to -16dB. Negative feedback 18dB over main amp. Power requirements 35v. at 1-0 amp. Overall Size 12°m. x 8°d. x 24°h.

Fully detailed 7 page construction manual and parts list free with kit or send 25p plus large S.A.E.

AMPLIFIER KIT ... £13 (Magnetic input components 33p extra) #13-50 P. & P. 65p 

CABINET #4-85 P. & P. 85p

#### SPECIAL OFFER-only £22:50 if all 3 items ordered at one time plus £1 p. & p.

Full after sales service

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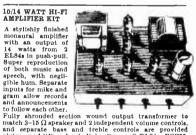


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HSL "FOUR" AMPLIFIER KIT. Similar in appearance to HA34 above but employs entirely different and advanced circuitry. Complete set of parts, etc \$7.00 P. & P. &1-00.

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