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Precision instruments supplied with standard detachable copper chisel face bits. Standard temp. 360°C at 19/23/27 watts. Special temps. from 250°C/410°C.

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Models required _____

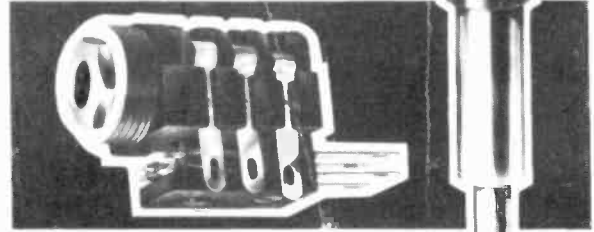
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Are you alright for Jacks?



Ask for Rendar Jack plugs and sockets at your local stockist. They come in a wide variety of configurations, and in cases of difficulty can be ordered DIRECT from the Rendar factory.

Standard, mini and sub-miniature sizes ... plugs in both screened and unscreened versions ... socket bodies in high melting point thermoplastic ... several unique features (some protected by UK and US Patents) ... Post Office and NATO specifications.

If you want to study all the facts and figures, all the ingenious construction details, send for the Rendar Electronic Components Catalogue of technical data sheets covering their entire range of products.

The cost of the catalogue is 25p, including P & P, and it's money very well spent!



RENDAR

Rendar Instruments Ltd., Victoria Road
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Cables: Rendar, Burgess Hill

SOUND BARGAINS

GIANT POWER MULTI-WAVEBAND COMMUNICATIONS RECEIVER
WITH 3 IN 1 AC/DC POWER SUPPLY SYSTEM
MAINS/BATTERY plus BUILT-IN BATTERY BOOSTER

BEST OF ALL WORLDS

VHF, FM, AM, A.F.C., AIR BAND, PUBLIC SERVICE AND WEATHER BANDS

OUR PRICE £10.50
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THIS NEW 1978 RADIO. No less than 3 VHF BANDS. Picks up Aircraft Transmissions, Pop Pirates, Taxis, Ambulances, Local Rad's, Continental and all BBC, VHF Stations, plus fascinating Public Service Transmissions we are not allowed to mention! Even TV sound in certain areas. PLUS A SPECIAL WEATHER-BAND. Frequency ranges: MW 540-1600 KHZ, FM 88-108MHZ, Airband 108-145 MHZ, VHF 145-175MHZ, 23 semi-conductors—12 transistors, 11 diodes and thermistors. Automatic frequency control. 31" telescopic aerial. Runs off mains AC 230/250 volts or off 4 U2 batteries, or use re-chargeable nickel alkali cell. Finished in strong leather grained case with carrying handle. Approx. size 10 1/2" x 6 1/2" x 3 1/2". Written guarantee. Special magnetic ear-piece for personal listening, dry batteries FREE. HURRY! Limited quantity only from Marktyme. Money back guarantee.

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Tune into the world with this amazing communications receiver. A truly exceptional unit in performance and looks—leatherette with stainless steel trim. Looks good anywhere. Use either as a portable with standard batteries or plug it directly into 220-240 volt domestic mains supply. 14 Transistors; 9 diodes; 1 thermistor. Internal ferrite rod antenna plus telescopic aerial. Separate tone, volume and tuning controls with push-button selectors for the 8 WAVEBANDS. Complete with Hi-Fi earphone for personal listening. Frequency ranges: Long wave 150-350Kcs. Medium 353-1615Kcs. Marine 1.6-4.5Mcs. Short Wave 12-24Mcs. FM/VHF 88-108Mcs. Aircraft 108-135 Mcs. PUBLIC SERVICE BANDS 135-174Mcs. Fully guaranteed.

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OUR PRICE £28.95
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Tune into the world with this amazing communications receiver. A truly exceptional unit in performance and looks—leatherette with stainless steel trim. Looks good anywhere. Use either as a portable with standard batteries or plug it directly into 220-240 volt domestic mains supply. 14 Transistors; 9 diodes; 1 thermistor. Internal ferrite rod antenna plus telescopic aerial. Separate tone, volume and tuning controls with push-button selectors for the 8 WAVEBANDS. Complete with Hi-Fi earphone for personal listening. Frequency ranges: Long wave 150-350Kcs. Medium 353-1615Kcs. Marine 1.6-4.5Mcs. Short Wave 12-24Mcs. FM/VHF 88-108Mcs. Aircraft 108-135 Mcs. PUBLIC SERVICE BANDS 135-174Mcs. Fully guaranteed.

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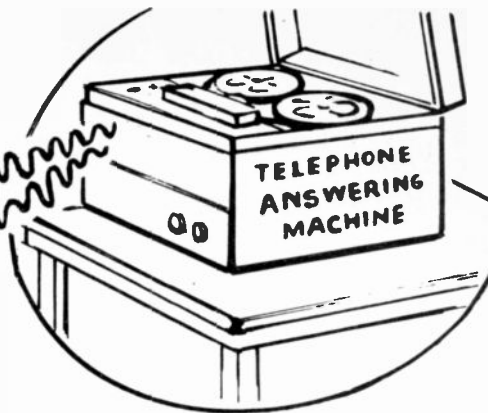
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It would help us considerably if we knew whether this was your first Home Radio Components Catalogue. If it is, please place a tick in the box.

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It's late at night but that doesn't stop our young electronics enthusiast from ordering some urgently required components. He just dialled 01-648 8422 and telephoned his requirements, knowing that our Answering Machine will store his message ready for us to deal with next morning. As a seasoned member of our Credit Account Service he is well aware of the advantages it brings him. He has, for instance, a free supply of our pre-paid envelopes and order forms, for use when it suits him better to write his requirements rather than telephone them. This alone saves him quite a bit. He averages four orders a month and simply sends us a single cheque or postal order. *Without* our Credit Account Service his monthly cost would be: Four stamps at 3 pence each...12p, four cheques or postal orders at 5 pence each...20p, four envelopes 2p. Total, 34 pence. Over the year, quite an item! Not to mention his *time* spent in buying the stamps, envelopes and postal orders!

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PLEASE ADD 10p TO ORDERS UNDER £2.

Catalogue which contains data sheets for most of the
components listed will be sent free on request.
10p stamp appreciated.

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RESISTORS

½W Iskra high stability carbon film—very low noise—capless construction.
¼W Mullard CR25 carbon film—very small body size 7.5 x 2.5mm. ¼W 2%
Electrosil TRS.

Power watts	Tolerance	Range	Values available	Price
↓	5%	4.7Ω-2.2MΩ	E24	1-9p 100+ p
↓	10%	3.3MΩ-10MΩ	E12	1-9p 0-8p
↓	2%	10Ω-1M	E24	3-5p 3-0p
↓	10%	1Ω-3.9Ω	E12	1-0p 0-8p
↓	5%	4.7Ω-1MΩ	E12	1-0p 0-8p
↓	10%	1Ω-10Ω	E12	6p 5-5p

Quantity price applies for any selection. Ignore fractions on total order.

DEVELOPMENT PACK

0.5 watt 5% Iskra resistors 5 off each value 4.7Ω to 1MΩ.
E12 pack 325 resistors £2.40. E24 pack 650 resistors £4.70.

POTENTIOMETERS

Carbon track 5kΩ to 2MΩ, log or linear (log ½W, lin ½W).
Single, 12p. Dual gang (stereo), 40p. Single D.P. switch 24p.

SKELETON PRESET POTENTIOMETERS

Linear: 100, 250, 500Ω and decades to 5MΩ. Horizontal or vertical P.C.
mounting (0-1 matrix).
Sub-miniature 0-1W, 5p each. Miniature 0-25W, 6p each.

TRANSISTORS

AC107	15p	BC107	10p	BF195	15p	OC81	12p	2N3703	12p
AC126	12p	BC108	10p	BFY50	22p	OC82D	12p	2N3704	13p
AC127	12p	BC109	10p	BFY51	22p	OC871	40p	2N3705	12p
AC128	12p	BC147	10p	BFY52	22p	ORP12	50p	2N3706	11p
AC131	12p	BC148	13p	BSY56	32p	2N2369	16p	2N3707	12p
AC132	12p	BC149	13p	OC26	45p	2N2646	60p	2N3708	10p
AD140	50p	BC157	13p	OC28	45p	2N2926E	9p	2N3709	11p
AD161	33p	BC158	13p	OC35	45p	2N2926O	9p	2N3710	11p
AD162	36p	BC159	13p	OC42	12p	2N2926V	9p	2N3711	11p
AF114	20p	BD131	75p	OC44	12p	2N2926G	10p	2N4062	12p
AF115	20p	BD132	75p	OC45	12p	2N3054	58p	ZTX302	15p
AF116	20p	BF179	32p	OC70	12p	2N3055	60p	ZTX500	16p
AF117	20p	BF181	25p	OC71	12p	2N3442	140p	ZTX503	16p
AF118	38p	BF194	15p	OC72	12p	2N3702	13p	40362	58p

ZENER DIODES

400mW 5% 3-3V to 30V, 15p.

LINEAR IC's (DIL)

709 50p 741 50p
710 50p 748 50p

DIL SOCKET

14 and 16 pin
16p

DIODES

RECTIFIER

BY127	1250V	1A	12p	OA85	7p
BZY10	800V	6A	25p	OA90	5p
BZY13	200V	6A	20p	OA91	7p
IN4001	50V	1A	7p	OA202	7p
IN4004	400V	1A	8p	IN4148	5p
IN4007	1000V	1A	12p	BA114	8p

BRUSHED ALUMINIUM PANELS

12in x 6in=25p; 12in x 2½in=10p; 9in x 2in=7p.

SLIDER POTENTIOMETERS

86mm x 9mm x 16mm, length of track 59mm.

SINGLE GANG, 10K, 25K, 100K log. or lin. 40p.

DUAL GANG, 10K + 10K etc. log. or lin. 60p.

KNOB FOR ABOVE 12p.

FRONT PANEL 65p

18 Gauge panel 12" x 4" with slots cut for use with slider pots. Grey or matt
black finish complete with fixings for 4 pots.

MULLARD POLYESTER CAPACITORS C296 SERIES

400V: 0.001μF, 0.0015μF, 0.0022μF, 0.0033μF, 0.0047μF, 2½p, 0.0068μF, 0.01μF,
0.015μF, 0.022μF, 0.033μF, 3p, 0.047μF, 0.068μF, 0.1μF, 4p, 0.15μF, 6p, 0.22μF, 7½p,
0.33μF, 11p, 0.47μF, 13p.
160V: 0.01μF, 0.015μF, 0.022μF, 0.033μF, 0.047μF, 0.068μF, 3p, 0.1μF 3½p, 0.15μF, 4p,
0.22μF, 5p, 0.33μF, 6p, 0.47μF, 7½p, 0.68μF, 11p, 1.0μF, 13p.

MULLARD POLYESTER CAPACITORS C280 SERIES

250V P.C. mounting: 0.01μF, 0.015μF, 0.022μF, 3p, 0.033μF, 0.047μF, 0.068μF, 4p,
0.1μF, 4p, 0.15μF, 0.22μF, 5p, 0.33μF, 6p, 0.47μF, 8p, 0.68μF, 11p, 1.0μF, 13p,
1.5μF, 20p, 2.2μF, 24p.

MYLAR FILM CAPACITORS 100V,

0.001μF, 0.002μF, 0.005μF, 0.01μF, 0.02μF
2½p, 0.04μF, 0.05μF, 0.068μF, 0.1μF, 3½p.

CERAMIC DISC CAPACITORS

100pF to 10,000pF, 2p each.

ELECTROLYTIC CAPACITORS—MULLARD C426 SERIES

6p each

(μF/V): 10/2.5, 40/2.5, 80/2.5, 160/2.5, 320/2.5, 500/2.5, 8/4, 32/4, 64/4, 125/4, 250/4,
400/4, 6/4, 6/4, 25/6, 4, 50/6, 4, 100/6, 4, 200/6, 4, 320/6, 4, 4/10, 16/10, 32/10, 64/10,
125/10, 200/10, 2.5/16, 10/16, 20/16, 40/16, 80/16, 125/16, 1.6/25, 6.4/25, 12.5/25,
25/25, 50/25, 80/25, 1/40, 4/40, 8/40, 16/40, 32/40, 50/40, 0.64/64, 2.5/64, 5/64, 10/64,
20/64, 32/64.

MULLARD C437 SERIES

100/40, 160/25, 250/16, 400/10, 640/6, 800/4, 1000/2.5, 9p, 100/64, 160/40, 250/25,
400/16, 640/10, 1250/4, 1000/6, 4, 1600/2.5, 12p, 160/64, 250/40, 400/2.5, 640/16,
2000/4, 1000/10, 1600/6, 4, 2500/2.5, 15p, 250/64, 400/40, 640/25, 3200/4, 1000/16,
1600/10, 1000/6, 4, 4000/2.5, 18p.

ELECTROLYTIC CAPACITORS Miniature P.C. mounting

5p each.

(μF/V): 10/12, 50/12, 100/12, 200/12, 5/25, 10/25, 25/25, 100/25.

VEROBOARD

2½ x 3½	0.1	15	22p
2½ x 5	0.15	21p	24p
3½ x 3½	0.15	21p	24p
3½ x 5	0.25	28p	28p
17 x 2½	75p	57p	78p
17 x 3½	100p	82p	60p
17 x 5 (plain)	—	60p	Plug 12p. Socket 8p.
17 x 2½ (plain)	—	42p	4 way screened cable 15p/metre
2½ x 5 (plain)	—	12p	6 way screened cable 22p/metre
2½ x 3½ (plain)	—	11p	
Pin insertion tool	32p	52p	
Spot face cutter	42p	42p	
Pkt. 50 pins	20p	20p	

JACK PLUGS AND SOCKETS

Standard screened	18p	2.5mm insulated	8p
Standard insulated	12p	3.5mm insulated	8p
Stereo screened	35p	3.5mm screened	13p
Standard socket	15p	2.5mm socket	8p
Stereo socket	18p	3.5mm socket	8p

D.I.N. PLUGS AND SOCKETS

2 pin, 3 pin, 5 pin 180°, 5 pin 240°, 6 pin
Plug 12p. Socket 8p.

BATTERY ELIMINATOR

£1.50
9V mains power supply. Same size as PP9 battery

THERMISTORS

VA10665 15p

VA1077 15p

R53 £1.35

COMPACT CASSETTES—IN PLASTIC LIBRARY BOX

C95 65p

C120 85p

LARGE (CAN) ELECTROLYTICS

1600μF	64V	74p	3200μF	16V	50p
2500μF	40V	74p	4500μF	16V	50p
2500μF	50V	58p	4500μF	25V	£1.68
2500μF	64V	80p	5000μF	50V	£1.10
2800μF	100V	£3.00			

HIGH VOLTAGE TUBULAR CAPACITORS—1,000 VOLT

0.01μF	10p	0.047μF	13p	0.22μF	20p
0.022μF	12p	0.1μF	16p	0.47μF	22p

POLYSTYRENE CAPACITORS 160V 2½p

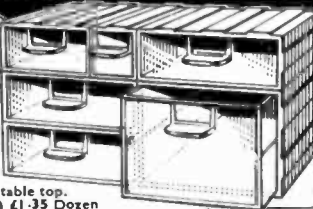
10pF to 1,000pF E12 Series values 4p each.

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drawers have label
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up any size cabinet
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SINGLE UNITS (5" x 2¼" x 2¼") £1.35 Dozen
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DOUBLE TREBLE 2 draws in one outer case (6D2) £3.65
for 8 extra large size (6D1) £3.30 for 8.

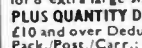
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takes the wraps off

UNISOUND a new concept in stereo



The whole system is complete including superb cabinets in simulated teak—just simply screw together the components and you save pounds! Amplifier is based on the famous Mullard Unilex system. Garrard 2025TC turntable complete with stereo ceramic cartridge, teak simulated plinth and tinted acrylic cover. Plus the big 13" x 8" EMI twin cone speakers ready for mounting in their elegant cabinets which simply need screwing & gluing together.

Easy to follow step-by-step instructions guide you quickly and effortlessly to taking the wraps off truly realistic stereo sound.

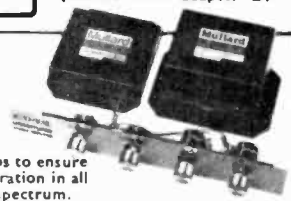
£25 complete plus £2.80 p. & p.

Diamond Stylus £1.25 extra
Power output: 4 watts per channel into 8 ohms
Input: 120 mV (for ceramic cartridge). Stereo Headphones with adapter £4

R T V C

UNISOUND MODULES ONLY-£6.95

If you prefer, you can buy the three modules—pre-amplifier, power supply/dual power amplifier, and control panel—by themselves for only £6.95. P. & P. 50p extra. Their overall specification is the same as shown for the complete Unisound console using the highly efficient I.C. monolithic power chips to ensure very low distortion at all power levels, correct operation in all ambient temperatures, full power over the audio spectrum. See below for address.



THE PULLMAN PB PUSH BUTTON CAR RADIO KIT

Apart from the output stage, which is an integrated circuit, the only other electronic components that need soldering are some capacitors, resistors, etc. The kit includes a pre-built RF tuner unit, and fully modulated IF stages which are pre-aligned before despatch. As well as electronic components, this kit also contains 2 diamond-spun aluminium knobs, elegant matching front panel, dial, washers, screws and wire.

The Pullman PB is suitable for 12 volt working with both negative and positive earth. It covers the full medium and long wave bands. Four push-buttons for medium wave, one for long wave. It is permeability tuned



If you can solder on printed circuit board, you can build this push-button car radio kit. It's simple—just follow the step-by-step instructions

and sturdily constructed. Output is a full 2.5 watts into an 8 ohm speaker. But the Pullman PB will operate into any loud-speaker from 8 to 15 ohms. Power consumption is less than 1 amp.

* Circuit diagram and comprehensive instructions 50p, free with parts.

Radio & TV Components (Acton) Ltd.
21E High Street, Acton, London W3 6NG.
323 Edgware Road, London W2.

Mail Orders to Acton.
Terms C.W.O.
All enquiries S.A.E. Goods not despatched outside U.K.

PRICE ONLY
£7.00 + p&p 50p

THE PULLMAN PB CAN BE MOUNTED IN ANY STANDARD SIZE DASH PANEL AND IT HAS AN ILLUMINATED TUNING SCALE FOR EASY READING AT NIGHT. CHASSIS SIZE IS: 7" WIDE, 2" HIGH AND 4 1/16" DEEP (EXCLUDING FRONT PANEL, ETC.)

8ohm speaker, with baffle and fixing strips. £1.50 post free if bought with the kit

* Car aerial £1.25 p.p.

R T V C

GSPK (sales)

quite simply-the best

RESISTORS

FULL RANGE OF ISKRA CARBON
1/5 W (range 4.7 ohms to 470K) 1p each
1 W and 1/2 W (range 4.7 ohms to 10 Mega) 1p each
1 W (range 4.7 ohms to 10 Mega) 2p each
2 W (range 4.7 ohms to 10 Mega) 3p each

FILM RESISTORS

Iskra Miniature High Stability carbon Film Resistors with negligible noise factor.
All Resistors \pm 5% (except values over 4.7 Meg). These Resistors are even lower in price than most 10% and older carbon composition types.

PRE-SET POTENTIOMETERS

Standard values of pre-sets from 100 ohms to 5 Meg. Standard/miniature 7p each Sub-miniature 5p each

SIEMENS PROFESSIONAL CAPACITORS

POLYCARBONATE AND POLYESTER

Voltage	Capacitance	Price
100v	0.1 μ F	6p
100v	0.15 μ F	6p
100v	0.22 μ F	6p
100v	0.33 μ F	9p
100v	0.47 μ F	10p
100v	0.68 μ F	15p
250v	0.01 μ F	5p
250v	0.015 μ F	5p
250v	0.022 μ F	5p
250v	0.047 μ F	6p
250v	0.088 μ F	6p
250v	0.1 μ F	6p

Voltage	Capacitance	Price
10v	22 μ F	7p
10v	47 μ F	11p
10v	10 μ F	7p
25v	100 μ F	9p
25v	220 μ F	11p
25v	470 μ F	14p
25v	1000 μ F	22p
25v	2200 μ F	42p
35v	4.7 μ F	7p
35v	22 μ F	14p
100v	10 μ F	8p
100v	22 μ F	9p
100v	47 μ F	14p

SPECIAL INTRODUCTORY OFFER

FREE with all orders value £5 or over we will give absolutely free one GSPK P.C. Kit for making your own printed circuits (normal retail price £1-95). Hurry! Offer valid for limited period only.



SEMICONDUCTORS

Here are just a few examples of our LOW Semiconductor prices. Many more semiconductors available all at equally sensational prices NOW.

1+	25+		1+	25+		1+	25+
AC127	24p	BZY98C			OC76	22p	21p
AC128	19p	Series E12			OC170	24p	21p
AC178	15p	(2-7v-30-0v)	10p	9p	1N4001	6p	5p
ACY18	18p	NKT210	24p	19p	1N4002	6p	5p
AD161	27p	NKT211	24p	19p	1N4003	7p	6p
AD162	27p	NKT212	24p	19p	1N4004	8p	7p
AF139	28p	NKT213	24p	19p	1N4005	10p	9p
BC107	9p	NKT214	19p	17p	1N4006	12p	11p
BC108	8p	NKT218	24p	19p	1N4007	15p	18p
BC109	9p	NKT219	24p	19p	1N4148	4p	3p
BC147	8p	NKT223	26p	20p	2N1302	16p	15p
BC148	8p	NKT224	21p	19p	2N1304	21p	20p
BC149	8p	NKT242	14p	12p	2N1613	14p	13p
BCY70	14p	NKT243	51p	44p	2N1711	18p	14p
BCY71	20p	NKT401	70p	59p	2N2904	29p	28p
BDY72	14p	NKT402	75p	59p	2N2905	24p	22p
BDY70	81p	NKT403	64p	50p	2N2906	19p	18p
BFX29	24p	NKT453	41p	33p	2N2907	22p	21p
BFX30	24p	OA47	6p	5p	2N3053	17p	16p
BFY50	19p	OA79	6p	5p	2N3054	48p	47p
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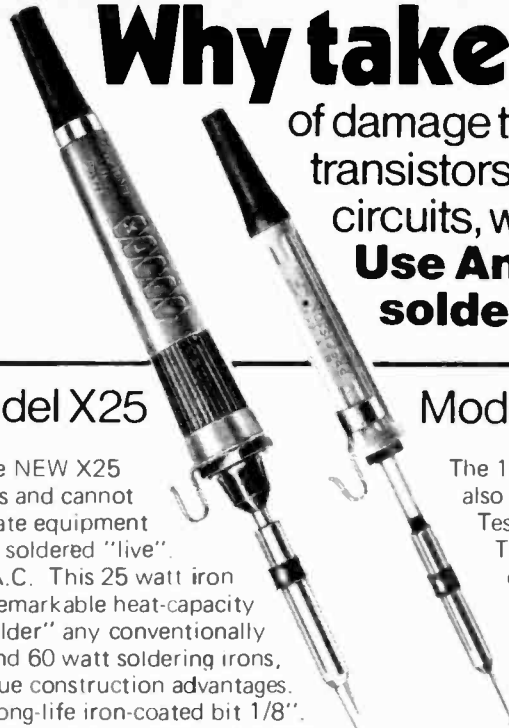
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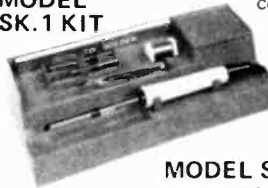
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2N1893	54p	2N4061	11p	AC176K	17p	BA130	8p	BCY30	49p	EA403	10p	OC36	60p
2N2147	114p	2N4062	11p	AC187K	17p	BA145	21p	BCY31	60p	E3623	41p	OC41	42p
2N2218	33p	2N4124	18p	AC188K	23p	BA155	15p	BCY70	18p	E3701	18p	OC42	42p
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C	1/2W	5%	4.7 Ω-10M Ω	E24	1-2	1	0.9
C	1W	5%	10 Ω-10M Ω	E12	2-5	2	1.8
MO	1/2W	2%	10 Ω-1M Ω	E24	4	3	2 nett
WW	1W	10% ± 1/20 Ω	0.22 Ω-3.9 Ω	E12	7	7	6
WW	3W	5%	1 Ω-10K Ω	E12	7	7	6
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A precision made pocket sized test meter, ideally suited for testing electronic circuits or electronic appliances. Supplied complete with test lead and batteries. RANGES—DC Voltages: 10, 50, 250, 1,000V (1,000 opV). AC Voltage: 10, 50, 250, 1,000V (1,000opV). DC Current: 1mA, 100mA. Resistance: 0-150K ohms. Decibel: -10 to +22dB (at AC 10V range) £2-47. P. & P. 25p.

MULTIMETER 20,000 O.P.V.
Features large easy-to-read meter, wide choice of ranges. With test leads, batteries and manual. Size 4½" x 3½" x 1". RANGES D.C. Voltages 0-5-25-50-250-500-2500V. A.C. Voltages 0-15-50-100-500-1000V. D.C. Current: 0-50µA 2.5mA-250mA. Resistance: 0-5000 ohms 0-5 megohms (500 ohms and 50 Kohms, at centre scale). Capacity: 10µF to -0.01µF, 0.01µF to -1µF. Decibels -20 to +22dB. £4-90. P. & P. 25p.



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Fitted two 2½in tweeters and crossover network. Impedance 8 or 15 ohm. Handling capacity 10W. Brand new. £3-47 P. & P. 50p



PREMIER HI-FI OFFERS

- Rogers Ravensbrook II Stereo Amplifier teak **£38-50**
- Rogers Ravensbourne Stereo Amplifier teak **£49-00**
- Metsound ST20E Stereo Amplifier teak **£25-50**
- Goldring GL72 less cartridge **£22-00**
- Garrard SP25 III with Goldring G800 cartridge **£15-00**



GARRARD SP25 MK III SINGLE RECORD PLAYER FITTED GOLDRING 800 MAGNETIC STEREO CARTRIDGE. COMPLETE IN TEAK PLINTH WITH COVER.
Total list price over £34.

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Garrard AP76 less cartridge **£18-80**

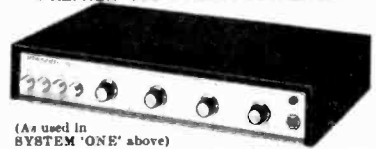
Garrard 401 Transcription Unit List £40-15 **£27-40**

Garrard 2025 T/C with Stereo Ceramic Cartridge **£8-50**
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Carriage and Insurance 60p extra any item.

CARTRIDGE BARGAINS!
Goldring G800H £5.00; G800 £5.50; G800E £9.50; SHURE M3D £4.00; M44E £5.75; M55E £6.50; M75EII £10.90. P. & P. 10p

PREMIER 800 STEREO AMPLIFIER



(As used in SYSTEM "ONE" above)

A truly high quality stereo amplifier—compare the specification, compare the price. Output: 5 watts per channel. Frequency response: 30-20,000 Hz = 2 db. Distortion: 1% Output Impedance 8 ohms nom. Inputs equalized to R.I.A.A. Magnetic 4mV. Ceramic 100mV. Tuner 100mV. Tape 100mV. Tape out 150mV. Din sockets for inputs and outputs. Controls: Bass, Treble, Volume, Balance, Selector, Mono/Stereo switch. Stereo headphone socket. Attractive slim line design black leatherette cabinet with aluminium front panel. Size 12½" x 6½" x 2½".

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VERITAS V-149 MIXER

Battery operated 4-channel audio mixer providing four separate inputs. Size 6 x 3 x 2½in. suitable for crystal microphone low impedance microphone with transformer, radio, tape, etc. Max. input 1.5v. Max. output 2.5v. Gain 6 dB. Standard jack plug socket inputs, phonoplugs output. Attractive teak wood grain finish case. **MONO MODEL £3** **STEREO MODEL £3.47** P. & P. 15p



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24 Hour Rixie Digital Clock Kit We Supply:
★ A complete set of components
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Enables you to work your transistor radio, amplifier, or cassette, etc. from A.C. mains through this compact eliminator. Just by moving a plug you can select the voltage you require—6v, 7½v or 9 volts. This means all your transistor power pack applications can be handled by this one unit. Approx. size: 2½" x 2½" x 3½". **OUR PRICE—£2.75p** + 10p. P. & P. Same model suitably wired for the Philips Cassette—**£3.00** + 10p. P. & P.



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Ideal for all those multi-way connections. This plug couples with a standard 8-pin valve holder. Plug .. 13p. Socket .. 6p. Please include 4p p. & p.

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9x5—10p 12x12—30p
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An Audio Amplifier designed around the TAA621 Linear I.C.:—
Supply Voltage .. 9-24V
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Ideal Amplifier for radios, record players, stereo units, etc.
Full technical data and diagrams with each module. All guaranteed and a bargain at **£2.63** + 5p P. & P.



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5K Log or 5K
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Up to 3 Pots. Please add 5p. P. & P.

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British made Relays. Brand new range of 250V. 1-5A contacts and suitable for fitting on 1m Veroboard.
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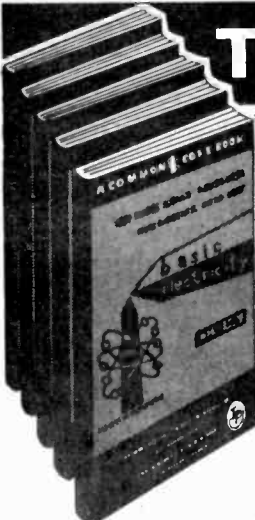
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B81	10	Reed Switches, mixed types large and small	50p
B99	200	Mixed Capacitors. Approx. quantity, counted by weight	50p
H4	250	Mixed Resistors. Approx. quantity counted by weight	50p
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H9	2	OC71 Light Sensitive Photo Transistor	50p
H12	50	NKT155/259 Germ. diodes, brand new stock clearance	50p
H28	20	OC200/1/2/3 PNP Silicon uncoated TO-5 can	50p
H30	20	1 Watt Zener Diodes. Mixed Voltages 6.8-43V.	50p
H35	100	Mixed Diodes. Germ. Gold bonded, etc. Marked and Unmarked.	50p
H38	30	Short lead Transistors, NPN Silicon Planar types.	50p

UNMARKED UNTESTED PAKS

B66	150	Germanium Diodes Min. glass type	50p
B83	200	Trans. manufacturers' rejects all types NPN, PNP, Sil. and Germ.	50p
B84	100	Silicon Diodes DO-7 glass equiv. to OA200, OA202	50p
B86	50	Sil. Diodes sub. min. 1N914 and 1N916 types	50p
B88	50	Sil. Trans. NPN, PNP equiv. to OC200/1 2N706A, BSY95A, etc.	50p
B1	50	Germanium Transistors PNP, AF and RF	50p
H6	40	250mW. Zener Diodes DO-7 Min. Glass Type	50p
H17	20	3 amp. Silicon Stud Rectifiers, mixed volts	50p
H15	30	Top Hat Silicon Rectifiers. 750mA. Mixed volts	50p
H16	8	Experimenters' Pak of Integrated Circuits. Data supplied	50p
H20	20	BY126/7 Type Silicon Rectifiers 1 amp plastic. Mixed volts.	50p
H34	15	Power Transistors, PNP, Germ. NPN Silicon TO-3 Can.	50p

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AC127	0-17	OC171	0-23
AC128	0-15	OC200	0-25
AC176	0-20	OC201	0-25
ACY17	0-20	2G301	0-13
AF239	0-30	2G303	0-13
AF186	0-20	2N1302-3	0-15
AF139	0-30	2N1306-5	0-17
BC154	0-20	2N1306-7	0-20
BC107	0-10	2N1308-9	0-22
BC108	0-10	2N3819FET	0-40
BC109	0-10	2N4416FET	0-35
BC169	0-12	Power Transistors	
BF194	0-15	OC20	0-50
BF274	0-20	OC20	0-50
BFY50	0-15	OC23	0-30
BSY25	0-13	OC25	0-25
BSY26	0-13	OC26	0-25
BSY27	0-13	OC28	0-30
BSY28	0-13	OC35	0-25
BSY29	0-13	OC36	0-37
PSY95A	0-10	AD149	0-30
OC41	0-15	AU710	1-25
OC44	0-13	25034	0-25
OC45	0-10	2N3055	0-50
OC71	0-10	Diodes	
OC72	0-10	AY42	0-10
OC81	0-13	OA95	0-07
OC81D	0-13	OA79	0-07
OC83	0-18	OA81	0-07
OC139	0-13	IN914	0-06

F.E.T. PRICE BREAKTHROUGH!!

This field effect transistor is the 2N3823 in a plastic encapsulation, coded as 3823E. It is also an excellent replacement for the 2N3819. Data sheet supplied with device. 1-10 30p each, 10-50 25p each, 50+ 20p each.



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NOW We introduce a Transistorised Ignition that is NOT a Kit at LESS than 10p price! The Super Spark, Mark II, is ready to go. Installation time—10 minutes. It operates on a unique and newly discovered principle that drives a standard ignition coil with a fantastic peak of 400V. The solid impact gives 45,000 Volts right to the sparking plug and gives cooler running, longer plug life, more M.P.G. and greater B.H.P. Contact breaker life is extended indefinitely and no visible burning will ever take place. The circuitry is all silicon solid state and is engineered for top dependable performance on any car with standard ignition coil. 4 and 6 cylinder. Every unit is tested before despatch and each carries a full guarantee. Gives a full spark at up to 8,000 RPM!

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OC71 or 72 Fully Tested Unmarked	5p	5p	4p
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OA47 Gold-Bonded Diodes, Marked and Tested	3p	3p	2p
1-watt Zener Diodes 7.5, 24, 27, 30, 36, 43 Volts	5p	4p	3p
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5L403C Audio Amp, 3-Watts	1-50	1-37	1-32
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Six speeds are available 600, 850 and 1,100 r.p.m. and 8,000; 12,000 & 16,500 r.p.m. shaft is 1/2 in. diameter 230/240v. Its speed may be further controlled by the use of our Thyristor controller. Very powerful and useful motor size approx. 2 in. dia. x 5 in. long. Price £8p plus 25p postage and insurance.

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Precision made—as used in record decks and tape recorders—ideal also for extractor fan, blower, heaters, etc. New and perfect. Snip at 50p. Postage 15p for first one then 5p for each one ordered.

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DRY FILM Lubricant. In aerosol can for easy application and for putting lubricant into places where the normal oil can not reach. Home and everyday uses. We have purchased a large quantity of these from the Liquinator and are able to offer them to you for about half of the original list price. 30p per (8 oz.) can or 12 cans for £2 post paid. The lubricant is I.C.I. Fluon L169.

CARD OPERATED SAFE

All electronic parts to make this £4-50.

AMPLIFIER CASE

Teak veneer on 1" ply, modern appearance and design. Size—front 15" x 4 1/2" deep x 8 1/2". Limited quantity £1-25 each plus 25p post and insurance.

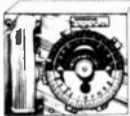
KITS FOR PREVIOUS PROJECTS

Unless otherwise stated, kits contain electronic parts only. The case and special items can be obtained locally. Also batteries are not included. Kits may be returned for refund if construction has not been started. We reserve the right to substitute components should deliveries be protracted so as to avoid undue delay.

HOME SENTINEL INTRUDER ALARM	£3-75
SNAP INDICATOR	75p
WINDSCREEN WIPER CONTROL	£2-00
RECORD PLAYER	£5-50
(amplifier components only)	
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ASTRON RADIO	£3
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SIGNAL INJECTOR	80p
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LIGHT TO SOUND CONVERTER	£1-70
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MAINS TRANSISTOR POWER PACK

Designed to operate transistor sets and amplifiers. Adjustable output 6v., 9v., 12 volts for up to 800mA (class B working). Takes the place of any of the following batteries: PP1, PP3, PP4, PP6, PP7, PP9 and others. Kit comprises: mains transformer rectifier, smoothing and load resistor, condensers and instructions. Real snip at only 85p, plus 20p postage.



24-HOUR TIME SWITCH

Made by Smiths, these are AC mains operated, NOT CLOCKWORK. Ideal for mounting on rack or shelf or can be built into box with 13A socket. Two completely adjustable time periods per 24 hours. 5A changeover contacts will switch circuit on or off during these periods. £2-95 post and ins. 25p. Additional time contacts 50p pair.



TREASURE TRACER MARK II

Complete kit (except wooden battens) to make the metal detector similar to that described editorially in Practical Wireless August issue. £2-95 plus 20p post and insurance.

MULLARD I.F. MODULE

This is a fully screened intermediate frequency module for amplification and detection of f.m. signals at 10.7MHz and a.m. signals at 470kHz. The first stage is used as an i.f. amplifier for f.m. and a self oscillating mixer for a.m. operation, in conjunction with an external oscillator coil. 75p each. 10 for £6-75. 100 for £62-50. With connection dia.

COMPUTER TAPE

2,400ft of the Best Magnetic Tape money can buy—users claim good results with Video and sound. 1in. wide £1-00 plus 30p post and insurance, with cassette. 1/2 in wide £1-00 plus 30p post and insurance with cassette. Spare spools and cassettes—1in 75p, 1/2 in. 75p each plus 20p post and insurance.

THIS MONTH'S SNIP HONEYWELL THERMOSTAT

Made by Honeywell for normal air temperatures 40°-80°F (5-25°C). This is a precision instrument with a differential which can be adjusted to better than 1.5°F. A mercury switch breaks on temp. rise—the switch is operated by a coiled bi-metal element and adjustable heater is incorporated for heat anticipation. Elegantly styled and encased in an ivory plastic case with clear plastic windows thermometer above and switch setting scale below—size approx 3-8" x 3-2" x 1-4" deep—can be mounted on conduit box or directly on wall. Price £1-25 each or ten for £11-25.

CENTRIFUGAL FAN

Mains operated, turbo-blower type. Pressed steel Housing contains motor and aluminium impeller. Motor is 1/10th hp giving considerable air flow but virtually no noise. Approx. dimensions 10 1/2" wide by 12" dia. Outlet into trunking 10 1/2" x 4 1/2". £4-95 + £1.

THE FULL-FSTEREO SIX

THE AMPLIFIER

REBINATION OF THE YEAR You will be amazed at the fullness of reproduction and at the added qualities your records or tuner will reproduce. Built into metal chassis ready for mounting on plinth this amplifier uses an integrated solid state circuit with an output power of 6W R.M.S. split over the two channels. The amplifier is ideal for

use with normal pick-ups and tuners. It has a double wound mains transformer and ganged volume and tone controls—also switching for Mono to Stereo, tuner or pick-up. UNREPEATABLE PRICE is £8-50 plus 20p post and insurance. Simulated Teak cabinet ready for mounting amplifier £1-95 (posted free when ordered with chassis).

WEATHER STATION LIGHT METER DRILL CONTROLLER

to receive these kits, send the quoted approx. price and any difference will be adjusted.

DIAL THERMOMETER

Reading from 200-520°F used on Tricity and other cookers. This has a flange and can be mounted through a 1 1/2" hole or alternatively it can just be rested on the object whose temperature it is required to measure. Size 2" x 1" overall diameter. Depth 1 1/2" below and 1 1/2" above mounting panel. Price 80p each or 10 for £7-50p.

MULLARD, AUDIO AMPLIFIER MODULE

Uses 4 transistors, and has an output of 750mW into 8 ohms speakers. Input suitable for crystal mic. or pick-up 9V battery operated. Size 2 1/2 in long x 1 1/2 in wide x 1 in high. SPECIAL SNIP PRICE 80p each. 10 for £6-40, 100 for £50.

CAPACITOR DISCHARGE CAR IGNITION

This system which has proved to be amazingly efficient and reliable was first described in the *Wireless World* about a year ago. We can supply kit of parts for an improved and even more efficient version (*Practical Wireless*, June). Price £5-95 plus 30p post. When ordering please state whether for positive or negative systems. Also available, ready made ignition systems for 6V vehicles £5-50 plus 30p.

ELECTRONIC IGNITION

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 including probe tube and crystal earpiece. £3—twin stetho instead of earpiece 75p extra—post and ins. 20p.

Where postage is not stated then orders over £5 are post free. Below £5 add 50p. Semi-conductors add 5p post. Over £1 post free. B.A.E. with enquiries please.

QUICK CUPPA

Mini Immersion Heater, 350w 200/240v. Boils full cup in about two minutes. Use any socket or lamp holder. Have at bedside for tea, baby's food, etc. £1-25, post and insurance 14p. 12v. car model also available same price. Jug heater £1-50 plus p. & p. 14p



MAINS OPERATED SOLENOIDS

Model 779—small but powerful 1" pull—approx. size 1 1/2" x 1 1/2" 60p. Model 400/1 1/2" pull. Size 2 1/2" x 2" x 1 1/2" 75p. Model TT10 1 1/2" pull. Size 3 x 2 1/2" x 2 1/2" £1-80 plus 30p post and ins.

MAINS RELAY BARGAIN

Special this month are some single, double and treble pole changeover relays. Contacts rated at 15 amps. Operating coil wound for 240V. A.C. Good British Make. Unused. Size approx. 1 1/2" x 1". Open construction. Single pole 25p each 10 for £2-25 Double pole 35p each 10 for £3-15

DRILL CONTROLLER

NEW IKW MODEL

Electronically changes speed from approximately 10 revs. to maximum. Full power at all speeds by finger-tip control. Kit includes all parts, case, everything and full instructions. £1-50 plus 15p post and insurance. Made up model also available. £2-25 plus 15p post & p.



SLIDE SWITCHES

Slide Switch, 2-pole changeover panel mounting by two 6B.A. screws. Size approx. 1in x 1in rated 250V lamp. 6p each. 10 for 54p, 100 for £5-10, 500 for £24. Ditto as above but for printed circuit 8p each 10 for 48p, 100 for £4-25. Sub Miniature Slide Switch, DPDT 19mm (1in approx.) between fixing centres. 15p. each or 10 for £1-00.

LIGHT CELL

Almost zero resistant in sunlight increases to 10 K Ohms in dark or dull light. Epoxy resin sealed. Size approx. 1in dia. by 1/2 in thick. Rated at 500 MW, wire ended. 45p with circuit. Also ORP12 light cell 45p.

TELESCOPIC AERIAL

for portable, car radio or transmitter. Chrome plated—6 sections, extends from 7 1/2 to 47 in. Hole in bottom for 6B.A. screw, 25p. KNUCKLED MODEL FOR F.M. 50p.

0-8 AMMETER

2in square full vision for flush mounting. Moving iron instrument. Ideal for charger. Price 45p each. 10 for £3-90.



EXTRACTOR FAN

Cleans the air at the rate of 10,000 cubic ft. per hour. Suitable for kitchens, bathrooms, factories, changing rooms, etc., it's so quiet it can hardly be heard. Compact, 5 1/2" casing with 5 1/2" fan blades. Kit comprises motor, fan blades, sheet steel casing, pull switch, mains connector, and fixing brackets, £5 plus 36p post and ins.

BALANCED ARMATURE UNIT

500 ohm, operates speaker or microphone, so useful in intercom or similar circuits. 25p each. £3-90 doz.

MICRO SWITCH

5 A changeover contacts, 8p each, £1 doz. 15 amp. Model 10p each or £1-00 doz.

MINIATURE WAFER SWITCHES

2 pole, 2 way—4 pole, 3 way—3 pole, 3 way—4 pole, 3 way—2 pole, 4 way—3 pole. 4 way—2 pole 5 way—1 pole, 12 way. All at 80p each, £1-00 for ten, your assortment.

REED SWITCHES

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All with 0-250 Volt primaries
Miniature
 MM6 6 volts, 500 mA + 6 volts,
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 MM12 12 volts, 250 mA + 12 volts,
 250 mA
 MM20 20 volts, 150 mA + 20 volts,
 150 mA
 £1 29 plus 13p p. & p.

L.T.
 LT1 6-3 volts, 1-5 Amps 75p plus
 18p p. & p.
 LT2 6-3 volts, 3-0 Amps 80p plus
 26p p. & p.
 LT3 12 volts, 1-5 Amps 80p plus
 26p p. & p.

LT4 12 volts, 3-0 Amps £1 32
 plus 30p p. & p.
LTS 9-0-9 volts, 0-5 Amps 75p
 plus 21p p. & p.
LT6 12-0-12 volts, 1-0 Amp 95p
 plus 26p p. & p.
LT7 30-0-30 volts, 1-0 Amp £1 87
 plus 30p p. & p.

Multi-tapped
 MT30/2 0-12-15-20-24-30 volts,
 2-0 Amps £1 95 plus
 30p p. & p.
 MT60/1 0-5-20-30-40-60 volts,
 1-0 Amp £1 97 plus
 30p p. & p.
 MT60/2 0-5-20-30-40-60 volts,
 2-0 Amps £2 90 plus
 34p p. & p.

Charger
 CTJ01 1 Am, £1 00 plus 26p p.&p.
 CTJ02 2 Amp £1 25 plus 30p p.&p.
 CTJ03 4 Amp £1 50 plus 30p p.&p.
 Secondarys: 0-5-11-17 volts

Auto-transformers
 AT30 30 Watts £1 18 plus 30p
 p. & p.
 AT75 75 Watts £1 85 plus 30p
 p. & p.
 AT150 150 Watts £2 55 plus 34p
 p. & p.
 AT300 300 Watts £4 75 plus 42p
 p. & p.
 AT1000 1000 Watts £8 90 plus 62p
 p. & p.

All shrouded with terminal blocks.
 AT30 0-110-240 volts. All others
 0-110-200-220-240 volts
Speaker matching transformer
 Tapped 3, 8, 16 Ω. Will match
 almost any speakers to any amplifier.
 15 Watts max. 90p plus 20p p. & p.

ALUMINIUM BOXES
 with lids and screws
 Type Length Width Depth Price p.&p.
 GB7* 5½in 2½in 1½in 38p 15p
 GB8* 4in 4in 1½in 38p 15p
 GB9* 4in 2½in 1½in 38p 13p
 GB10* 5½in 4in 1½in 44p 18p
 GB11 4in 2½in 2in 38p 13p
 GB12 6in 3in 3in 33p 13p
 GB13 6in 4in 2in 53p 18p
 GB14 7in 5in 2½in 63p 19p
 GB15 8in 6in 3in 81p 26p
 GB16 10in 7in 3in 92p 26p
 * These sizes
 fit standard
 veroboards



EQUIPMENT CASES
 with sloping front panel
 Type Height Width Depth Price p.&o.
 SF1 2in 5½in 2½in 45p 12p
 SF2 2in 7½in 3½in 60p 16p
 SF3 2in 9½in 4½in 75p 19p
 Plain aluminium. Stove-
 enamelled silver-grey
 hammer finished, 20p extra



CONSOLE CASES
 in plain aluminium, ideal for mixers,
 instruments, etc.
 Type Width A B C D Price p.&p.
 GB20 8in 9in 3½in 2in 3in £1 42 30p
 GB21 10in 9in 3½in 2in 3in £1 58 30p
 GB22 12in 9in 3½in 2in 3in £1 72 30p



VEROBOARD
 Size: 0-1 matrix 0-15 matrix
 2½in x 3½in 22p 16p
 2½in x 5in 24p 25p
 3½in x 3½in 24p 25p
 3½in x 5in 27p 29p
 17in x 2½in 75p 57p
 17in x 3½in £1 75p
 Pins—either size: packet of 36, 18p

ELECTROLYTICS

1µF 450V	19p	1,000µF 25V	27p
2µF 500V	20p	1,000µF 50V	39p
4µF 450V	14p	2,000µF 25V	36p
8µF 450V	16p	2,000µF 50V	53p
16µF 450V	17p	2,500µF 25V	45p
25µF 25V	7p	2,500µF 50V	60p
25µF 50V	8p	3,000µF 25V	48p
32µF 450V	24p	5,000µF 25V	55p
50µF 50V	10p	5,000µF 50V	98p
100µF 25V	10p	8-8µF 450V	18p
100µF 50V	10p	8-16µF 450V	20p
250µF 25V	12p	16-16µF 450V	27p
250µF 50V	17p	16-32µF 450V	63p
500µF 25V	18p	32-32µF 450V	49p
500µF 50V	25p	50-50µF 350V	38p

MINIATURE ELECTROLYTICS
 1µF 63V 6p 10µF 64V 7p
 2 2µF 63V 6p 16µF 40V 7p
 4µF 40V 7p 30µF 15V 7p
 4 7µF 63V 6p 47µF 16V 7p
 8µF 15V 7p 47µF 25V 6p
 8µF 40V 7p 68µF 16V 6p
 10µF 25V 6p 100µF 10V 6p
ENTIRE MULLARD C15106/017 RANGE ALSO STOCKED

CASSETTE OWNERS!
 For Philips and similar cassette recorders.
 PU12 Power unit for connection to 12V + or -
 - E car electrical systems, £3-25
 giving 7½V, stabilised output.
 PU14 As above but switched for £5-10
 6V, 7½V or 9V output.
 PP75 Mains power supply, output £1-95
 7½V d.c.
 All units are complete with cable and plug.

VARIABLE POWER SUPPLY
 Input: 240V, a.c.
 Output: Switched 3, 4, 5, 6, 7, 5, £4-20
 9, 12 volts d.c. at 500mA

BATTERY ELIMINATORS
 suitable for transistor radios and similar
 light current equipment
 PP6 Input 240 volts A.C. Output 6 volts D.C.
 PP9 Input 240 volts A.C. Output 9 volts D.C.
 Price £1 50 plus 12p p. & p.

NEW ILLUSTRATED 1972-73 CATALOGUE
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 Post Free 15p

PANEL FUSEHOLDERS
 For 20 mm fuses 15p
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CONTROLS, Log. or Lin.
 Single, less switch, 15p
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 5k Ω, 10k Ω, 25k Ω, 50k Ω, 100k Ω, 250k Ω,
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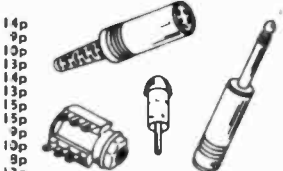
RESISTORS
 Carbon
 All 5%, high-stability, E12 values.
 ¼W, 1p; ½W, 1p; 1W, 4p; 2W, 6p
 Wire-wound
 5W, 10p; 10W, 12p

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 material. Please send 4p for samples, sizes and
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BONDED ACRYLIC FIBRE
 B.A.F. wadding, 18in wide, 1in thick. The
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PLUGS

Car aerial
 Co-axial
 D.I.N. 2 pin (speaker) 10p
 D.I.N. 3 pin 13p
 D.I.N. 4 pin 14p
 D.I.N. 5 pin, 180° 13p
 D.I.N. 5 pin, 240° 15p
 D.I.N. 6 pin 15p
 Jack, 2½mm unscreened 10p
 Jack, 2½mm screened 10p
 Jack, 3½mm unscreened 10p
 Jack, 3½mm screened 12p
 Jack, ½in unscreened 12p
 Jack, ½in screened 22p
 Jack, stereo, unscreened 20p
 Jack, stereo, screened 35p
 Phono, plastic top 5p
 Phono, plated metal 12p
 Phono, fitted 4ft lead 9p
 Wander, red or black 3p
 Banana 4mm, red or black 5p



SOCKETS
 Car aerial 8p
 Co-axial, surface 8p
 Co-axial, flush 9p
 D.I.N. 2 pin (speaker) 10p
 D.I.N. 3 pin 9p
 D.I.N. 5 pin, 180° 9p
 D.I.N. 5 pin, 240° 9p
 Jack, 2½mm 10p
 Jack, 3½mm 10p
 Jack, ½in unscreened 15p
 Jack, ½in switched 17p
 Jack, stereo, switched 24p
 D.I.N. 3 pin 5p
 Phono, single 5p
 Phono, 2 on a strip 7p
 Phono, 3 on a strip 9p
 Phono, 4 on a strip 10p
 Wander, single, red or black 5p
 Wander, twin strip 7p
 Banana 4mm, red or black 6p

CAPACITORS

2-2pF 500V S/M	7½p	0-0027µF 500V S/M	15p
3-3pF 500V S/M	7½p	0-003µF 500V Cer.	5p
5pF 500V S/M	7½p	0-0033µF 500V Poly.	6p
10pF 125V P.S.	5p	0-0033µF 1,000V MDC	6p
10pF 500V S/M	7½p	0-0036µF 500V S/M	15p
15pF 125V P.S.	5p	0-0047µF 125V P.S.	9p
15pF 500V Cer.	5p	0-0047µF 500V Poly.	6p
18pF 500V S/M	7½p	0-0047µF 500V S/M	20p
22pF 125V P.S.	5p	0-0047µF 1,000V MDC	6p
22pF 500V S/M	7½p	0-005µF 100V Mylar	3p
25pF 500V S/M	7½p	0-005µF 500V Cer.	5p
27pF 500V Cer.	4p	0-0068µF 125V P.S.	10½p
33pF 125V P.S.	5p	0-0068µF 500V Poly.	6p
33pF 500V S/M	7½p	0-0082µF 125V P.S.	10½p
33pF 500V S/M	7½p	0-0082µF 500V S/M	30p
47pF 125V P.S.	5p	0-01µF 18V Disc	4p
47pF 500V Cer.	4p	0-01µF 125V P.S.	10½p
50pF 500V S/M	7½p	0-01µF 1,000V MDC	4p
56pF 500V S/M	7½p	0-01µF 250V M.F.	3p
68pF 125V P.S.	5p	0-01µF 400V Poly.	3p
68pF 500V S/M	7½p	0-01µF 500V Cer.	5p
75pF 500V S/M	7½p	0-01µF 500V S/M	30p
82pF 500V S/M	7½p	0-01µF 600V MDC	7p
100pF 125V P.S.	5p	0-01µF 1,600V Poly.	3p
100pF 500V S/M	7½p	0-015µF 1,000V MDC	9p
100pF 500V Cer.	5p	0-033µF 250V M.F.	4p
120pF 500V S/M	7½p	0-033µF 400V Poly.	4p
150pF 125V P.S.	5p	0-033µF 400V Poly.	4p
150pF 500V Cer.	5p	0-047µF 1,000V MDC	9p
180pF 500V S/M	7½p	0-047µF 250V M.F.	4p
200pF 500V S/M	7½p	0-047µF 400V Poly.	4p
220pF 125V P.S.	5p	0-047µF 12V Disc	6p
220pF 500V Cer.	5p	0-047µF 160V Poly.	3p
250pF 500V S/M	7½p	0-047µF 250V M.F.	3p
270pF 500V Cer.	5p	0-047µF 400V MDC	4p
300pF 500V S/M	7½p	0-047µF 600V MDC	8p
330pF 125V P.S.	5p	0-047µF 1,000V MDC	10p
330pF 500V S/M	7½p	0-1µF 30V Disc	6p
390pF 500V S/M	7½p	0-1µF 250V M.F.	4p
470pF 125V P.S.	5p	0-1µF 400V Poly.	5p
470pF 750V Disc	8p	0-1µF 600V MDC	10p
500pF 500V S/M	7½p	0-1µF 1,000V MDC	13p
560pF 500V S/M	7½p	0-1µF 250V M.F.	5p
680pF 125V P.S.	5p	0-22µF 160V Poly.	6p
680pF 500V S/M	7½p	0-22µF 250V M.F.	5p
820pF 500V S/M	7½p	0-22µF 400V Poly.	6p
0-001µF 100V Mylar	6p	0-22µF 1,000V MDC	15p
0-001µF 125V P.S.	5p	0-33µF 250V M.F.	8p
0-001µF 400V Poly.	3p	0-47µF 250V Poly.	8p
0-001µF 500V S/M	10p	0-47µF 400V Poly.	15p
0-001µF 500V Cer.	5p	0-47µF 1,000V MDC	20p
0-001µF 1,000V MDC	6p	1-0µF 250V M.F.	15p
0-0015µF 400V Poly.	3p		
0-0015µF 500V S/M	10p		
0-0015µF 500V Cer.	5p		
0-0018µF 500V S/M	10p		
0-002µF 100V Mylar	3p		
0-002µF 500V Cer.	5p		
0-0022µF 125V P.S.	6p		
0-0022µF 500V S/M	10p		
0-0022µF 1,000V MDC	6p		

Note:
 S/M = silver mica 1% tol.
 P.S. = polystyrene 2½% tol.
 MDC = a.c. rating = 300V.
 M.F. = Mullard min. foil.
 Cer. = ceramic.

LOUDSPEAKERS

7 x 4 ins.	3 Ω	£1 12	8 x 5 ins.	3 Ω	£1 85
	8 Ω	£1 12		8 Ω	£1 77
	15 Ω	£1 40		15 Ω	£1 70
1½ x 6 ins.	3 Ω	£2 32	8 in. round	3 Ω	£2 10
	8 Ω	£2 32		8 Ω	£2 50
	15 Ω	£2 32		15 Ω	£2 10

Please add 20p p. & p. to all speakers

MAIL ORDERS: Some items have a post and packing charge shown against them. Where p. & p. is not shown the charge is 12p for any selection. When both classes of goods are ordered the charge is 12p plus any p. & p. charges shown. (Overseas extra.) Telephone 01-692 4412

everyday electronics

PROJECTS...
THEORY.....

CONVERSATION PIECE

We talk about it a lot. Usually to complain, more rarely to praise. Countless conversations have been sustained on this single topic alone. Weather.

All the paraphernalia of modern science and technology is harnessed in the cause of weather forecasting. Earth satellites report by radio what their electronic instruments detect high up in the atmosphere and computers devour this data and then produce their predictions.

From such sophisticated methods, let us now come back to earth and see what can be done in the ordinary garden or backyard, with some quite simple electronics. The *Weather Station* featured this month is not a scientific instrument of known and precise accuracy. Neither is it, on the other hand, simply a toy. With its convenient remote monitoring unit, the study of the weather can become a new absorbing interest.

THE MEANS

The means, no less than the end, are of interest, too. The *Weather Station* employs sensors and transducers that convert physical phenomena such as light, heat, moisture, and wind speed and direction into electric currents. These electric signals are used to produce a visual indication on a meter.

Employed here in this simple system are the same basic principles that are exploited on a far grander scale in all manner of advanced electronic equipments used for industrial and professional purposes.

The *Weather Station* might well provide valuable meteorological data to back-up that casual conversation in pub or train. It will certainly give the student of electronics a convincing demonstration of the inter-action between natural forces and certain electronic devices. Properties that provide the key to much modern technology.

RESIST!

At least one reader has noted that for the resistor, EVERYDAY ELECTRONICS uses a circuit symbol different to that recommended as first choice by the British Standards Institute.

We are not by nature rebels, but in this instant we do feel that the long established British zig-zag is, by far, a superior representation of the resistor (and its properties) than that nondescript oblong box, long favoured by the Continentals and more recently imported into the U.K.

If the pint is sacrosanct, and Parliament decrees that it shall remain despite impending national conversion to metric measurement, then surely the same privilege should be accorded to the traditional British resistor symbol!



Our September issue will be published on Friday, August 18

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.. EASY TO CONSTRUCT
.. SIMPLY EXPLAINED

VOL. 1 NO. 10

AUGUST 1972

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what a BIND!

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An Easi-Binder is now available handsomely finished in orange de luxe Balacron with black lettering on the spine. It holds 12 issues of Everyday Electronics.

Order your binder from Binding Dept., IPC Magazines Ltd., Carlton House, 68, Great Queen Street, London W.C.2.

The price is 88p, including postage and packing.



DRILL DRILL SPEED

THIS Drill Speed Controller is an extremely useful addition to the handyman's workshop. The unit will provide continuous control of speed of any a.c. mains operated series wound brush motor—most commonly used in hand electric drills and food mixers. Speed control is from approximately half full speed (which could be in excess of 1,000 r.p.m.) down to less than 15 r.p.m. The advantage of using electronic control is that one can obtain this dramatic variation without necessarily losing torque.

Even the newcomer to electronics will probably be surprised by the absolute simplicity of the circuit to be described (only five "electronic" components are used) and the unit can be made in one evening for a fraction of the cost of a commercially made equivalent. Making use of a standard electrical wall box simplifies mechanical construction and gives a very professional looking end product.

THE THYRISTOR

A thyristor or controlled silicon rectifier (CSR) is used to control the main current supplied to the motor; as this may be a new component to some readers we shall briefly describe the functions of this type of device.

Its symbol and designation are shown, together with a typical type in Fig. 1. The similarity of its symbol to that of a diode is deliberate because, to some extent, it shows similar properties. The anode and cathode are the main electrodes through which current can be made to pass and the third electrode—the gate—is used to effect control of this current.

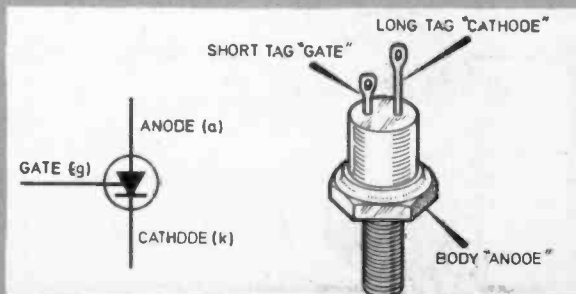
If connected into a circuit passing alternating current the thyristor presents a high resistance when the cathode is positive with respect to the

anode (just like a conventional diode) but unlike a conventional diode it also presents high resistance the other way. If, however, the anode is made positive with respect to the cathode and at the same time the gate is made positive with respect to the cathode the device will pass current in the forward biased direction. The reverse characteristic is not affected by the gate.

The interesting thing about a thyristor is that once it starts to pass forward current it will continue to do so even though the positive signal on the gate is removed; the only way the device can be "turned off" is for the current passing through it to fall below a certain value—this is called the holding current.

If we were using a direct current supply we would somehow have to interrupt the flow of current; in the case of a.c., however, the direction of current flow is reversed during every cycle of the mains and this effectively breaks the flow and the device will turn off. The thyristor then stays off until such time that the gate is once more made positive with respect to the cathode.

Fig. 1. Circuit symbol and typical controlled silicon rectifier.



CONTROLLER

Electronic speed control for small electric drills and food mixers.

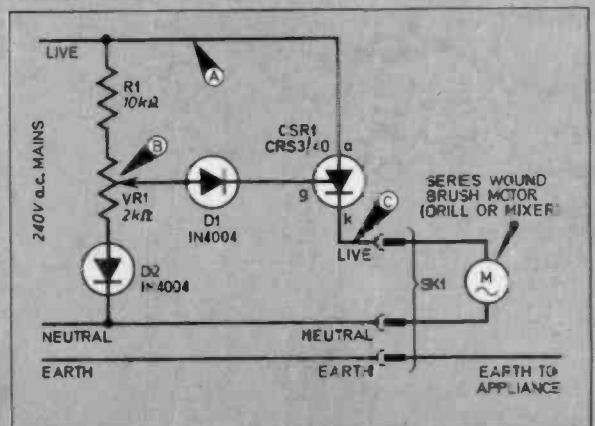
By Mike Hughes

THYRISTOR TYPE

Unlike a transistor the thyristor has no linear slope to its characteristic and is either presenting very high or very low resistance to the flow of current. This means that there is never a great deal of power dissipated within the device and its temperature does not rise excessively even though it may be handling high currents at high voltages.

The thyristor we shall use (CRS3/40) has reverse and forward blocking voltages of 400 volts and when switched on can handle currents up to 3 amps. To switch on we must make the gate at least 2 volts more positive than the cathode and allow at least 20 milliamps gate current to flow for about 1.5 microseconds (this is approximately the time it takes the device to switch on and for holding current to be

Fig. 2. Circuit diagram of the Drill Speed Controller.



Approximate
cost of
components
£2.10 inclusive

established). The holding current minimum value is approximately 10mA—if the anode/cathode current falls below this level the device turns off.

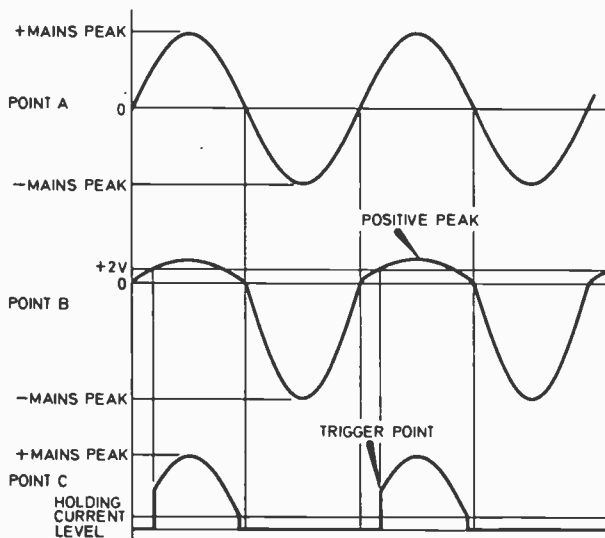
CIRCUIT DESCRIPTION

The circuit of the speed controller is shown in Fig. 2. The simplicity of the circuit is a little deceiving because the way it works is not quite as obvious as you might think at first sight. As we shall be operating from alternating current we shall assume that all voltages and waveforms are described relative to the "neutral" line, i.e., the line feeding the cathode of D2 and the motor. The "live" line will thus alternate from positive to negative.

During negative half cycles CSR1 will be reverse biased and can never be made to conduct therefore no power will be fed to the motor. For identical reasons D2 will not pass current therefore there is no dissipation within R1 and VR1.

During the first positive half cycle the potential difference across CSR1 will build up in the forward biased direction but as yet no conduction will take place. However, while this is happening D2 becomes forward biased and the potential at the wiper of VR1 (point B) will be rising in a positive direction—the peak voltage it can rise to is set by the potential divider effect of the wiper's position. As no current is, as yet, flowing through the motor the potential at the cathode of the thyristor will be the same as at the cathode of D2, thus we can say that the

Fig. 3. In the absence of feedback voltage, these graphs show the voltage variation at points A, B and C. The points in time over which the trigger point can be controlled are from zero to halfway through the positive half cycle.



potential at point B is rising positive with respect to the cathode and D1 becomes forward biased.

As soon as the potential at point B rises to about 2 volts positive with respect to the cathode of CSR1 (assuming the wiper has been set at a position where this can happen) the thyristor will start to conduct and the full mains voltage appears across the motor.

Diode D1 now becomes reverse biased and no more gate current flows but because the thyristor is passing much more than the holding current it does not turn off. All this happens before the mains positive half cycle has reached its peak.

As the positive half cycle returns towards zero the current through the motor will fall—eventually to below the holding current—and the thyristor switches off; it stays off during the negative half cycle and in the absence of any other effects would be triggered on again some time during the first half of the next positive half cycle.

FEEDBACK

By adjustment of VR1 one can alter the position in time of the instant point B reaches 2 volts relative to the time of the start of the positive half cycle; thus we can control the length of time before the thyristor is triggered and mains is applied to the motor during the early part—the first 90 degrees—of the cycle. If we trigger early in the cycle more total power will be fed to the motor than if we triggered later.

Because, at best, only the positive half cycles can be used to power the motor it will not run at its full speed because we are halving the total energy supplied. By adjusting the total energy fed to the motor by setting VR1 at different levels we can influence the speed but at the expense of torque.

This circuit however goes quite a bit further and compensates for the apparent loss of torque at low speeds. This is brought about by a signal that is fed back to our circuit from the drill itself.

There is always a certain amount of remnant magnetism left in the iron that makes up the field coil of a motor and if the armature is spun within this remnant field the motor will behave like a dynamo producing an output voltage—in a series wound brush motor this will be in the form of a d.c. level and will be directly proportional to the speed at which the armature is turning.

You can see this effect quite easily if you connect a 10V d.c. meter across the input leads to the motor (it must not of course be plugged into the mains while doing this) and spin the chuck—if it is a drill—by hand. Remember while doing this to press the starting switch otherwise no current can flow through the meter! Even at low speeds you can detect several volts.

Components . . .

SEE
**SHOP
TALK**

Resistor

R1 10k Ω 5W wirewound

Potentiometer

VR1 2k Ω 2W wirewound

Semiconductors

CSR1 CRS3/40 or any 400V 3A thyristor

D1 IN4004

D2 IN4004

Miscellaneous

3 inch length of 2 inch wide tag strip, small aluminium bracket—for mounting CSR1, insulated knob—preferably push-on type, MK double wall box type 2025, MK 13 amp unswitched socket, MK standard cover plate, three core mains cable—length as required, two 4BA countersunk screws—to mount circuit board, short length of connecting wire, grommet, mains plug—fused 13 or 15A type.

the cathode; thus firing during this positive cycle will occur later (it might not even occur at all if the wiper of VR1 is set low down). This reduces the energy fed to the motor and it will slow down until the next cycle when the "back voltage" produced will be less and triggering will occur slightly earlier in the cycle.

If the motor is subjected to heavy torque there will be a tendency for the motor to slow up dramatically during the freewheeling (negative) half cycle and thus the feedback voltage will be less allowing extra energy to be fed in when the next trigger cycle comes along. This extra energy will compensate for the increase in torque.

The net effect of this is that the motor will keep running at its lower speed but the amount of energy being fed to it will be hunting up and down as torque is applied and removed. The speed is altered simply by setting the potential at which point B can fire the thyristor.

When running at very low speeds with very little torque applied the freewheeling action of the armature may continue over several full cycles before extra energy is applied. The motor will appear to "hunt." The effect is known as "skip cycling" and is inherent to this sort of circuit; as soon as torque is applied the skip cycling will stop and very steady low speed operation will take place.

The waveforms at points A, B and C are shown in Figs. 3 and 4, these may help in explaining the method of operation.

TORQUE

If we assume that this can happen to the motor in our circuit a rather interesting state of affairs is set up. During the negative half cycle following the first cycle when we set the motor going the armature will freewheel because of its inertia and now instead of the potential at the cathode of the thyristor being the same as that of the cathode of D2 (as was the case before switch on) the potential at point C will be a few volts positive—depending on the actual speed of rotation of the armature during its freewheeling action.

This voltage will be maintained well into the next positive half cycle. This means that the potential at B will have to rise to a higher level if the gate is to be made 2V more positive than

CONSTRUCTION

All components are mounted on a 3 inch length of 2 inch wide tag board which will ultimately be mounted in one half of an MK double wall box. The advantage of using this box is that not only does it make a very convenient and nice looking housing but is amply insulated because you must remember that all the

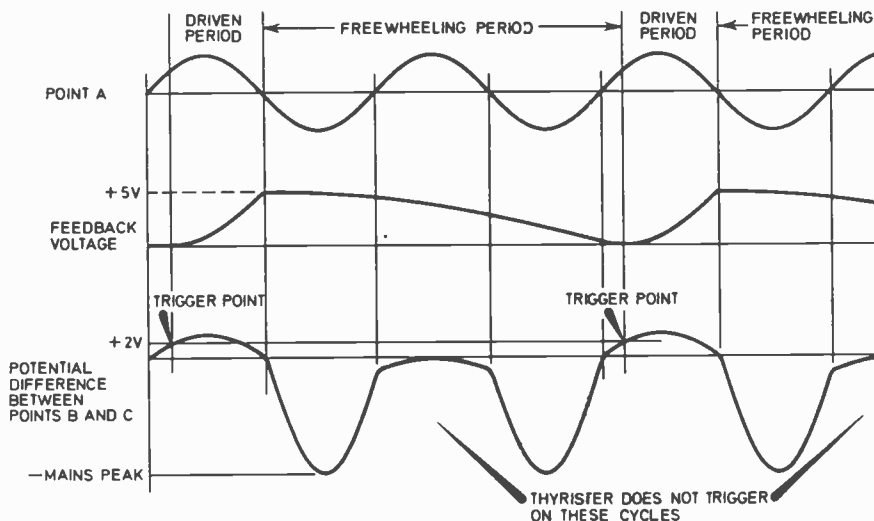


Fig. 4. A typical example of low torque allowing the feedback voltage to suppress triggering for the whole of one cycle (skip cycling).

DRILL SPEED CONTROLLER

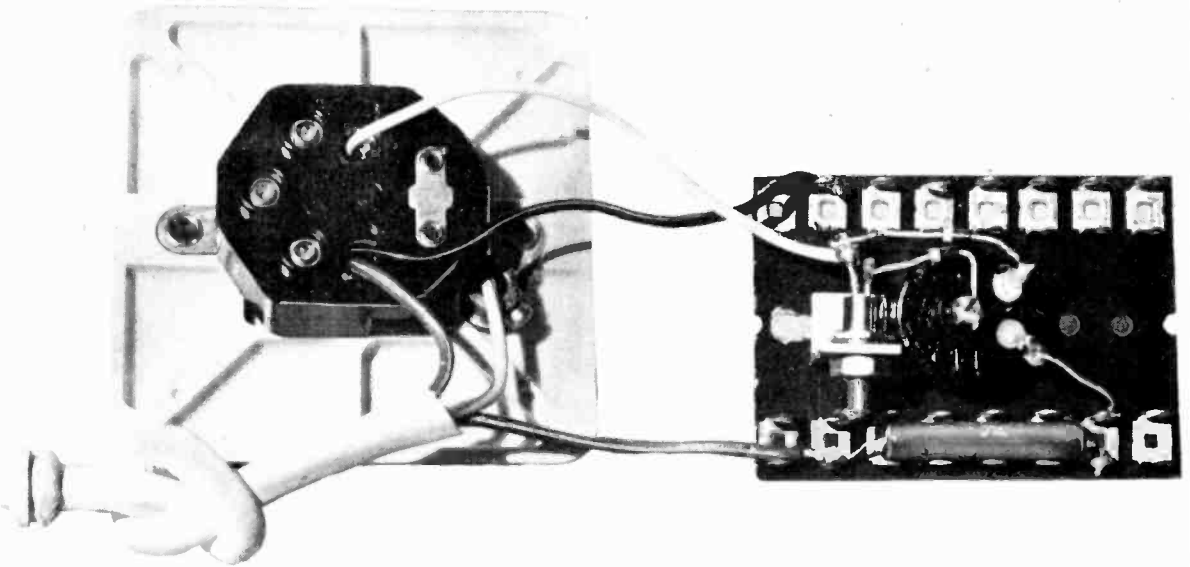
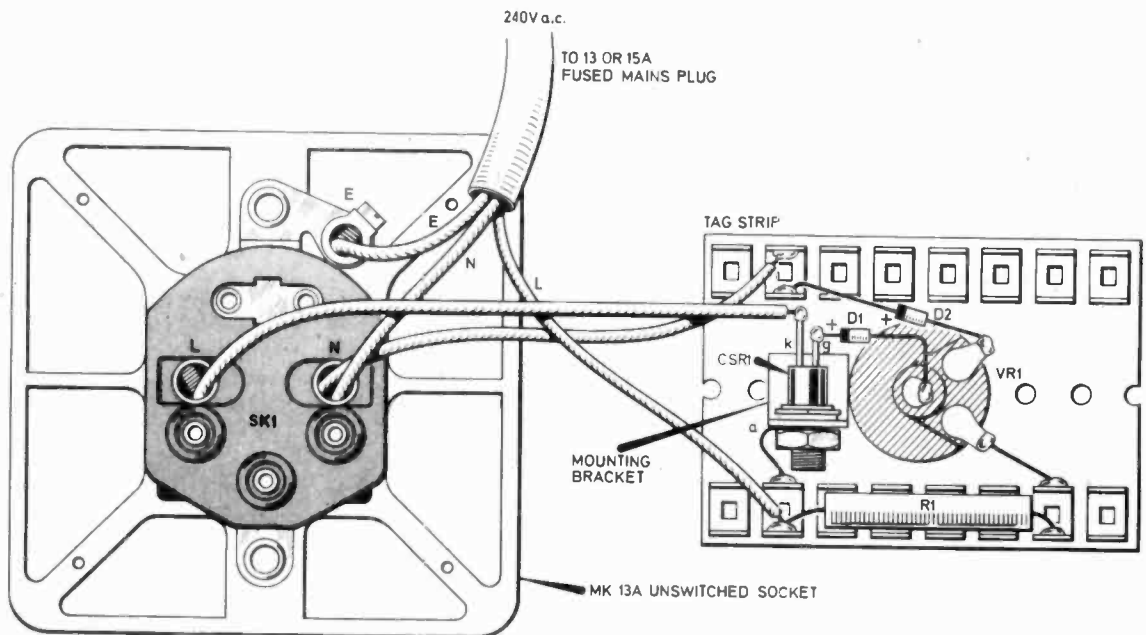


Fig. 5. Complete layout and wiring of the Drill Speed Controller.



circuitry is live to mains voltages.

The thyristor is mounted on a small aluminium bracket that is bolted to the tag board. The bracket acts as a small heat sink and easily disposes of any heat generated by the thyristor. Resistor R1 must be a 5 watt wirewound device and VR1 should have a rating of at least 2 watts and again should be wirewound. There is quite some latitude in the ohmic value of the latter.

If you cannot get a 2 kilohm potentiometer any value up to 5 kilohm will do but the range of control will tend to be cramped towards one end of the movement. The diodes D1 and D2 must be capable of withstanding full peak mains voltage and although the current passed is comparatively small the most convenient devices are 1N4004 one amp rectifiers, which are easily obtainable and relatively cheap.

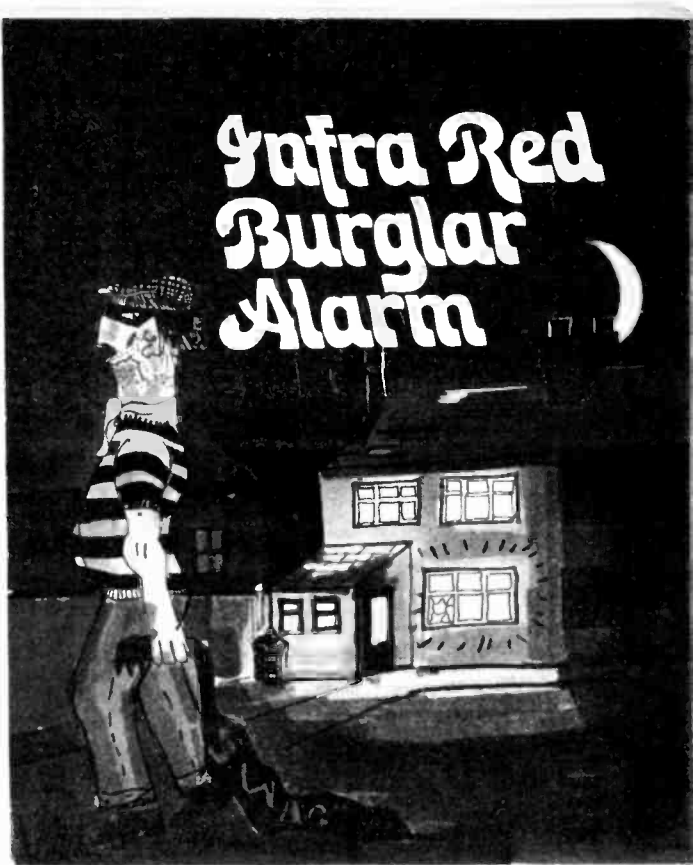
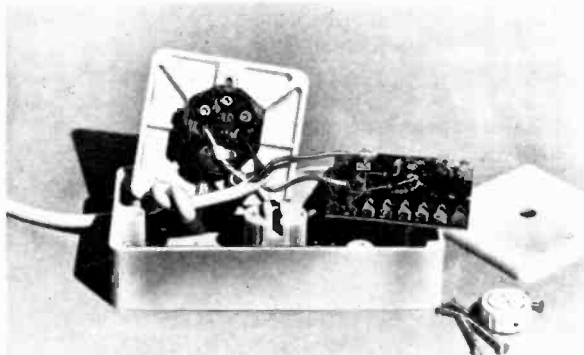
Mains input to the unit is from a 13 or 15 amp fused plug connected to a flying lead entering the case through a grommet. The output to the motor is via a standard MK 13A socket that conveniently bolts into the other half of the box.

Once the component board is completed and wired to the socket (Fig. 5) it should be fixed—using countersunk screws—to two of the recessed tapped holes of the box and a standard cover plate is drilled to allow the spindle of the potentiometer to protrude. Screw the cover plate into position using the other two tapped holes and fix an insulated knob on to the shaft. **Make sure that no metal parts of the potentiometer can be touched just in case there is an internal short.**

OPERATION

When using the controller with an electric drill it is just as well to remember that, although the drill may be turning at low speed, if the torque applied is high you might be applying more electrical energy than you think and as some drills have a cooling fan coupled with the armature there could be an increase in temperature of the drill itself.

Provided common sense is used this does no more harm than the occasional overload but if you allow overheating to persist without sufficient cooling time you could burn out the armature! ☐



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Capacitance Meter

Sort out any unknown or unmarked capacitors with values up to $3\mu\text{F}$ with this meter. Simple to use the meter will form an excellent piece of test gear for the work bench.

Lw/Mw Radio Tuner

A simple long and medium waveband tuner for use with any amplifier, tape recorder or record player.

All in the
September
Issue of



On sale Friday August 18.

Mit Construction



by Brian Walters

Do you envy those fortunate folk who own the last word in test or hi-fi equipment? Do you sometimes wish that you could enjoy the same standard of professionalism in your home? If only it was not so expensive. Well now you can; your equipment may not be to the very highest standards, but price for price it will be of a higher standard than ordinary equipment.

You can do this by taking advantage of the many types of construction kits for radio, hi-fi and electronic equipment that are advertised by many firms and, more particularly, for hi-fi, the v.h.f. radio tuner and record player kits available in many types, prices and sizes.

CONSTRUCTION

It is not necessary for you to have a degree in electronic engineering, or that you should be a specialist in electrical equipment. Many of the kits now on sale are easy to build, both in time and effort, and will provide a great deal of pleasure, both in the building, and in their use afterwards.

Why build a kit? Here are two reasons: firstly, there is a saving in cash, exactly how much will depend on the piece of equipment you intend to build.

If you were to build, say, a high quality record

player, while it would not necessarily be cheaper than a commercial record player, it would certainly have a better performance than a comparably priced commercial unit.

Secondly, you could of course build to your own design, but in the first place this assumes that you have the knowledge to design such a unit and, secondly, although you might well end up with a sophisticated design, the finished unit would probably have a distinctly "home made" appearance. Kits do have the considerable advantage of professionally styled appearance, which would otherwise be difficult to achieve at home.

Quite apart from the knowledge that you will have created something that will be acceptable to your family and friends, when the time comes, who would be better qualified to service it than the man (or woman) who built it.

TYPES

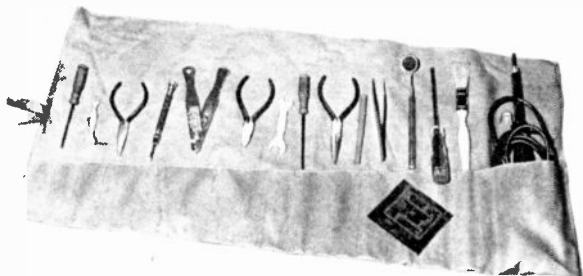
Basically kits come in two types: The "little bits" type, in which, when you open the box,

The heading photograph shows a Transona Five radio kit from Radio Exchange Co., under construction. This type of kit is suitable for a first project.

you find yourself with all the individual components, one at a time, and the obvious assumption that you have enough electrical knowledge to sort them all out for yourself.

Then there are the "big bits" type where, on opening the box, you find yourself the proud possessor of a number of ready wired panels, or modules, which need only be connected together, to make whatever it was you had in mind. This type is very much more simple and quicker to assemble.

These are the two fundamental types, and which one you decide to buy would depend on your present knowledge, and/or whether you wish to learn as you build. Some kits, especially some of the "little bits" types are very instructive, while the others enable you to put the equipment together in the shortest possible time, and with the least chance of errors in assembly.



The very comprehensive tool kit sold by Heath (Gloucester) Ltd. This firm market "Heathkit" kits.

TOOLS

It will be necessary for you to have some small hand tools, which should include, a small electric soldering iron, of about 25 watts with a 3/16 inch diameter bit, a pair of small wire cutters, a pair of small tapered nosed pliers, and one or two screwdrivers. Most of which with the possible exception of the soldering iron, you probably own already.

A multimeter is not absolutely essential, but it is highly desirable. This piece of equipment is moderately expensive (about £8 for a reasonable meter), but with care, should last for years. It would justify itself during its lifetime, merely on the strength of the many checking jobs it would simplify.

SOLDERING

Do not be afraid of that soldering iron. Soldering is not the exact science that it is sometimes made out to be, and with modern resin cored solder and the correct iron, for the type of work you would have to do, nothing could be simpler, providing you use a little care and common sense.

When making soldered joints, there are three

golden rules. First, make sure that the two pieces of material you wish to solder together are clean. That is, free from grease and free from insulation material like wax, enamel or any form of plastic. The second rule is **never ever** use any solder or flux on any electronic equipment except the resin cored type specifically sold for the purpose.

Thirdly, put the solder on to the joint, and not on to the iron. Allow the solder to flow around the joint, but be very careful not to overheat the components you are soldering.

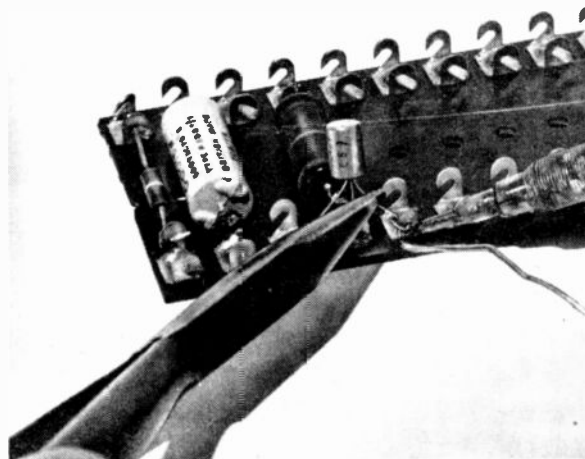
It is better to use a hot iron "quickly," than a cooler iron which must be held onto the joint for a longer time, thus allowing the heat to travel along the wire to the component, which may become almost as hot as the solder and be permanently damaged. This is very important with transistors.

It would be a good idea, if necessary, to practice making soldered joints with odd lengths of wire, before you start assembly of your kit.

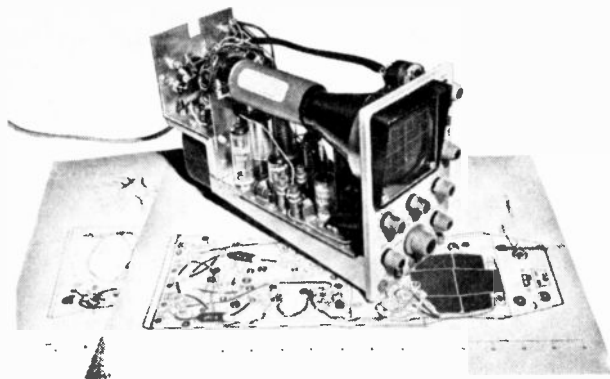
HEAT SHUNT

Using a "heat shunt," your long nosed pliers, held on the component lead between the component and the soldering iron, to keep the heat away from the comparatively fragile component, will save a lot of worry. A heat shunt should always be used when soldering transistors.

When completed, the soldered joint should be bright and shiny, and not crystalline as it would be if you moved the two parts before the solder has had time to cool and set. The photograph shows how to use a heat shunt and a good finished joint.



Photograph showing how to use a pair of pliers as a heat sink for soldering transistors.



A rather more ambitious kit, the Heathkit service oscilloscope. A large saving can be made by constructing your own test equipment of this type.

HIGH VOLTAGE

It is as well at this stage, to realise that there is some element of danger in most electrical or electronic equipment; if you are worried about building mains powered equipment, then all is not lost. There are still the transistor radio kits for you to build.

These transistor radios often provide added facilities not found on commercial types and are in every sense portable, as well as being free of high voltages. One of the many small radio kits available would make a good first project to get you used to the techniques.

COST

There would seem at first sight to be a very large difference in the cost of kits from the various manufacturers. The reason for this apparent difference can often be seen in the manuals provided with the kits.

Some manufacturers supply a very comprehensive book, which will provide all the information you could possibly need, both in the theory and the practice of building their kit. This applies particularly to the "little bits" kits, although there are some kits which are obviously intended for those who have already a working knowledge of electronics, and thus have only a limited amount of information.

The module type kit will generally provide a book or data sheet that will tell you what is required to connect up the separate panels, and a few do give a basic description of how the equipment works, but not a full description of the theory.

So, before you buy, ask to see the manual, and see if you can understand what is expected of you. You do not have to understand how the equipment functions, but you must understand how to put the parts together. Generally, the more expensive kits have the more informative manuals.

AFTER SALES SERVICE

Some suppliers provide a repair service for their customers, but if you can understand what is needed you should not need their help, with a consequent saving in time, effort and money. You will also get greater enjoyment from having built the equipment unaided. Nevertheless, check that your kit could be repaired by the supplier, should you have trouble.

It would be advisable, if you have never built any electronic equipment before, to start with a small kit, as previously indicated. The confidence you will obtain, plus the experience, will stand you in good stead if and when you want to build something more ambitious. But whatever you do, do not rush the job.

UNENDING

There is one snag; the process seems to be never ending, when you have improved your record player, you will feel that you ought to bring your radio up to the same standard, and then your loudspeaker system up to a quality that will do justice to the equipment you have already built. Or you might wish to construct some test equipment for your workshop, the possibilities are endless.

You can spread the cost, and for that matter the time, over as long a period as you wish.

Finally, comes the compensation for all your effort, when you have built it, whatever it may be, and your friends show their interest, you will have the satisfaction of telling them not where you bought it, but who built it. □



The Radio and TV Components Unisound stereo record player. This kit is of the module type which can be assembled in a relatively short time.

Everyday Electronics, August 1972



SINCE we seem to have more than enough news of suppliers and new products this month we will quickly get down to buying problems for the constructional projects and then look at the news. There is just one point that has come to light from last months articles; the 0.5 μ F tantalum capacitor specified for the *Shaver Inverter* is not readily available. A 0.47 μ F type can be used and it does not in fact have to be tantalum.

Through The Lens Light Meter

Although the *Through The Lens Light Meter* is very simple to build, when properly calibrated and used it could prove invaluable. One important factor in the construction of this unit is the camera design and how it affects the layout of components in the case.

The case used for the prototype was originally a clear plastic box with hinged lid but any small box will do and some of the slide boxes supplied by film developing firms may be suitable.

Buying problems should be limited to the microswitch and the meter. Although there are many microswitches available a small one must be found if the case size is to be kept small. Different shops sell different types and if you want a small one unfortunately you will just have to look around until you find one—the current and voltage rating are not important in this design.

The meter is of course the most

expensive part of this unit and will probably cost about £2. One of the SEW MR38P, 100 μ A types will be suitable. However, if you can find a small 100 μ A meter (moving coil type) cheaper, then this would be suitable. The scale will have to be recalibrated so do not worry about how it is designated when you buy it.

Drill Speed Controller

No problems with buying for the *Drill Speed Controller*, the case can be obtained from most electrical suppliers as can the socket and blank panel used, if the supplier does not have these items he should be able to order them for you. It is worth noting that all the MK parts can either be obtained in white or cream and a better appearance will result if you get all one colour. Fixing screws should be supplied with the socket and cover plate.

The CSR (thyristor) used can be any 400V, 3A type if the CRS3/40 is not available. Just in case anyone is wondering, this unit is not suitable for use as a light dimmer but we may publish such a design in the future.

Weather Station

Not really any actual problems with buying for the *Weather Station* but a few points that must be noted. Firstly the two pots used for the wind direction vanes, these must be easy to turn, be of such a design that the stops can be removed and be of carbon construction—not wire wound. We have found that the plastic spindle types often fill all these requirements and two of these should be modified as indication in the article.

The motor used for the wind-speed section can be any small model makers motor; the method of securing this to the case will vary according to the motor used. The three cup rotor can be fabricated from any suitably shaped items but a kit of all the rotor parts and the two windvanes is available from Kaspex, 16, Seymour Road, Tilbury, Essex RM18 7AP at a cost of 50p, including postage—mail order only.

When buying the moving coil meter look for the cheapest 1mA design with a large scale; this scale will have to be redesignated for each range of the instrument. The case used for housing the monitor unit in the prototype was

purchased from G. W. Smiths but we believe a number of other firms can also supply this case.

New Products

For all newcomers to stereo hi-fi reproduction. Linear have announced a low cost amplifier providing 5 watts output (they do not state if this is an r.m.s. or peak figure—or the speaker impedance used), with a frequency range of 20Hz, to 20kHz (this is not the same thing as frequency response). Price is £17.50 which seems reasonable but we would like to see proper figures quoted, not nondescript ones. Linear give a 12 month inclusive guarantee—more literature from your local dealer or Linear Products Ltd., Electron Works, Armley, Leeds, LS12 3SA.

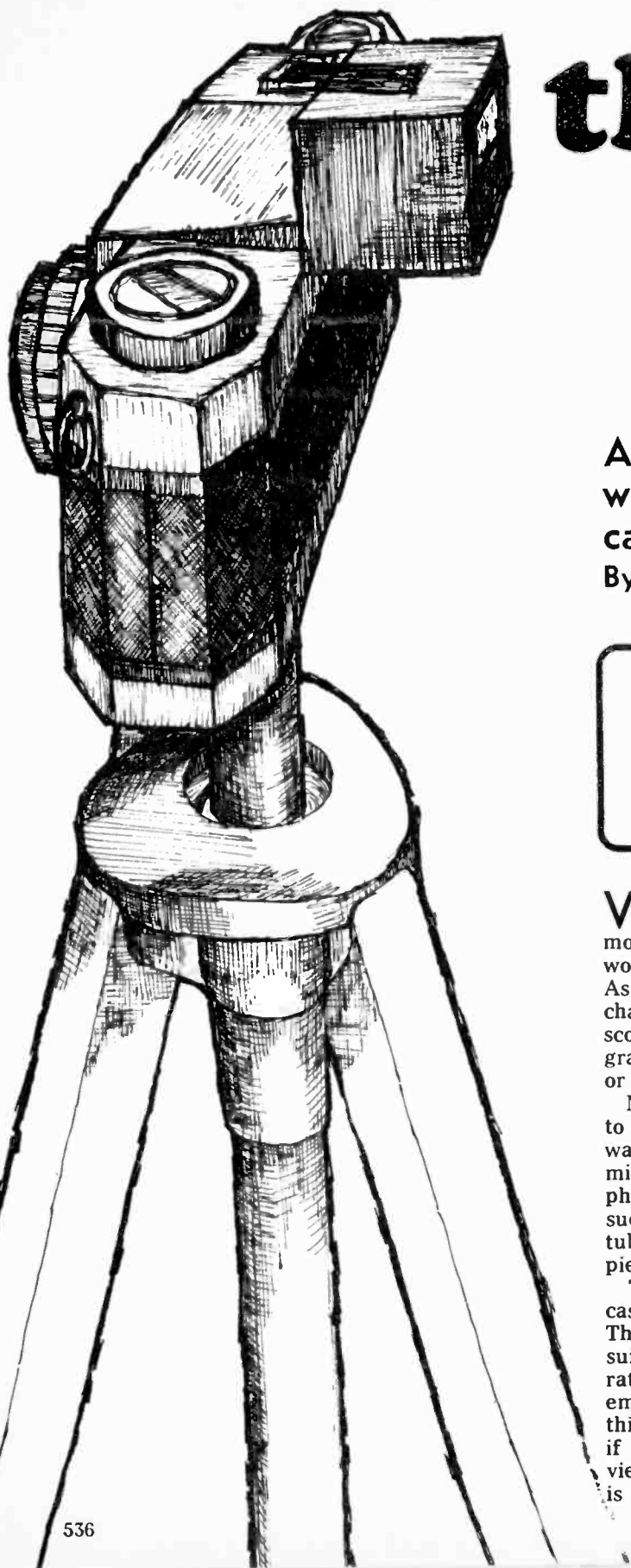
A 12V Invader soldering iron has recently been introduced by Adcola products, who advertise in our pages. Designed to operate from a 12V car or boat battery, the iron is available in two sizes, $\frac{3}{16}$ and $\frac{1}{4}$ inch bit diameter, rated at 23 and 27 watts respectively. The iron is provided with crocodile clip connections, 12ft of lead and a fire resistant transit cover which fits over the element and bit, allowing the iron to be stored away without having to wait for it to cool down. The $\frac{3}{16}$ inch bit model costs £2.37 and the $\frac{1}{4}$ inch model £2.47.

Suppliers

Two news items concerning suppliers, the first, which is of general interest, is that G. W. Smiths and the Laskys group have merged. These are probably the two largest companies retailing hi-fi equipment and electronic components. It has been stressed by the officials of Audiotronic Holdings Ltd., a new company formed to amalgamate the two companies, that there will be no change in trading policy or shop names etc. A possibility arising from the merger is the opening of a new shop somewhere outside the London area, but this may be well into the future.

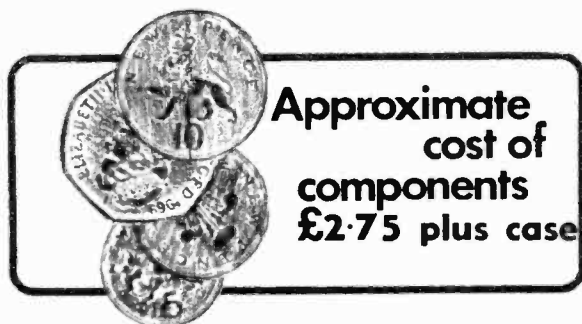
Of more direct interest to readers is the opening of a new shop by Henry's Radio Ltd. at 404-406, Edgware Road, London, W.2. This new branch should have been open a few weeks when you read this; it will carry mainly components plus audio equipment and test gear.

through



A simple light meter for use with single lens reflex cameras.

By E. B. Eves



WITH the dramatic fall in price which has taken place over the last few years many more people own single lens reflex cameras than would have seemed likely even five years ago. As most of these cameras are fitted with interchangeable lens systems there is a much greater scope for using a camera for "unusual" photography, employing the use of extension tubes or telephoto lenses.

Many people use their cameras as an extension to another hobby. In this connection bird watching and other naturalist pastimes come to mind in conjunction with a camera and telephoto lens, while many collectors of small items such as stamps and coins, make use of extension tubes to take close-up pictures of their specimen pieces.

The main problem which arises in both these cases is that of finding the correct exposure. The technique of taking several exposures is suitable if cheap film is being used but becomes rather expensive if colour or special films are employed. The meter described below overcomes this problem, although it is only really suitable if the camera is being used on a tripod, as the viewfinder has to be obscured while the meter is in use.

the lens light meter

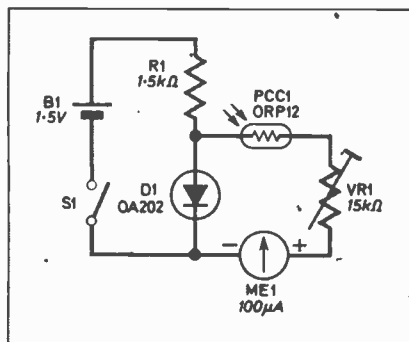


Fig. 1. Complete circuit diagram of the Through The Lens Light Meter.

THE CIRCUIT

The circuit is a simple one using a photo conductive cell, a meter, a silicon diode, a battery and two resistors, one fixed and one variable. The circuit is shown in Fig. 1.

To describe the action of this simple circuit let us assume that it is in two parts, the first consisting of B1, S1, R1 and D1. It will be seen that with S1 closed, current will flow around the circuit since D1 is forward biased. In this condition the diode, which is a silicon type, will always have a voltage of approximately 0.6 volts across it.

It is this small voltage that is measured by the second part of the circuit which is a low range voltmeter formed by PCC1, VR1 and ME1. Once VR1 is set the voltmeter will read a value dependent on the resistance of PCC1; the voltage being measured is always steady at 0.6 volts. Since the resistance of PCC1 varies in proportion to the level of light falling on its surface ME1 will, in fact, indicate the light level.

THE CASE

The construction of the case depends on the type of camera to which the device is to be fitted. The case shown in Fig. 2 was designed to fit a camera where the accessory shoe is mounted directly above the eyepiece.

The only requirement is that when clipped into the shoe the grommet surrounding PCC1 must be centred against the view-finder. The micro-switch S1 is depressed by the pressure against the camera and "automatically" switches the circuit on. The case used can be any plastic or metal case of minimum dimensions 2 inches by 1³/₄ inches by 1³/₄ inches but this size will depend on the meter available.

CONSTRUCTION

The components can be mounted as shown in Fig. 2. The photo-conductive cell must be provided with sufficient lead length to allow it to be positioned as described above.

Start construction by mounting S1, PCC1, ME1 and B1 inside the case, B1 can be mounted by a small Terry clip with a flat brass connector at each end, held in place with foam rubber glued to the side of the case.

Next attach R1 and VR1 as shown, connect up S1 and PCC1 and finally solder in diode D1 using a pair of long nose pliers held on the wires to prevent heat from the soldering iron damaging the diode.

COMPONENTS

The photo-conductive cell PCC1 is an ORP 12 or similar type. The meter can be any small inexpensive 100μA moving coil type. The front of the meter is removed to allow a paper scale

to be fitted over the existing one.

Alternatively if some care is taken a slot can be cut in the upper edge of the front cover, when it is removed, using a hot sharp knife blade and finishing with fine sand paper, in such a way that a very thin piece of aluminium, sprayed with white paint and calibrated (on both sides if required), can be slid in over the top of the existing scale and beneath the pointer of the meter, Fig. 3. By this means scales calibrated for different film speeds may be prepared and fitted easily. The method of calibration will be described later in the text.

The variable resistor should be a 15 kilohm carbon skeleton preset type mounted in such a way that it can be set by means of a screw-driver.

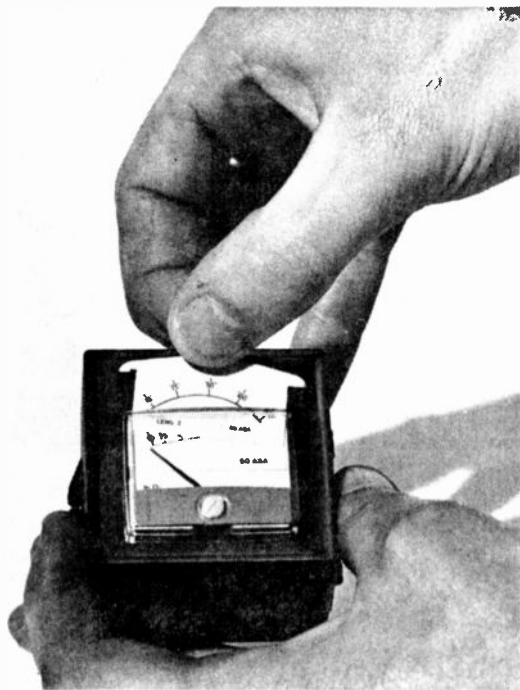


Fig. 3. Method of inserting various scales in the meter movement.

SETTING UP AND CALIBRATING

When the circuit has been wired up and checked the photocell should be pointed into a fairly dark corner and the micro-switch pressed. The meter should give a reading and moving the unit about should change this reading as the light level changes. If this is not the case the circuit should be re-checked. The light meter may now be mounted on the camera which should be set on a tripod with the normal lens fitted, pointing at a plain white surface.

The camera need not be focused, indeed, if the surface is not uniform the camera being out of focus as far as possible would be an advantage. The white surface should be illuminated, preferably by normal daylight. The meter will

give a reading dependent on the light level.

An ordinary light meter is used to determine the light level from the surface at the camera. The camera is then set up using this reading. at $\frac{1}{100}$ of a second, for the film normally used.

The needle on the light meter is set to centre scale by means of the resistor VR1. The point at which the needle rests must be marked $\frac{1}{100}$. If the aperture is now opened by exactly one stop the needle will move, its new position should be marked $\frac{1}{200}$, if closed to one stop below the original the scale must be marked $\frac{1}{50}$. This is repeated at one stop intervals until a scale as shown in the photograph is obtained.

The scale is now calibrated for the chosen film speed, other scales may be made by setting the camera to a chosen aperture and marking the scale with the corresponding shutter speed, the variable resistor must not be altered after the initial calibration, and can be sealed with a spot of candle wax dropped, hot, onto the centre of the preset.

If two film speeds are normally used the scales for them may be marked on one scale.

USING THE METER

When the meter has been completed an easy check can be carried out to see if the calibration is correct. The camera is mounted on a tripod with the normal lens fitted and a meter reading of the exposure required is taken by means of a normal light meter. The meter described above is then fixed to the camera and the aperture adjusted until each speed in turn is reached. The corresponding aperture should coincide with the required exposure as found by the other meter.

In general, to use the through the lens meter a shutter speed is selected, the camera focused on the subject and the aperture adjusted until the needle rests on the selected shutter speed

Components **SEE SHOP TALK**

Resistor

R1 1.5k Ω $\frac{1}{4}$ W \pm 10% carbon

Variable Resistor

VR1 15k Ω skeleton preset

Diode

D1 OA 202 or any small silicon diode

Miscellaneous

PCC1 ORP 12 photo-conductive cell

ME1 100 μ A moving coil meter, small type

B1 1.5V HP7 battery

S1 S.p.s.t. miniature micro-switch or small push button

Case (see text), grommet to hold PCC1, wire, metal for battery connectors and mounting bracket, fixings for mounting bracket, small Terry clip

through the lens light meter

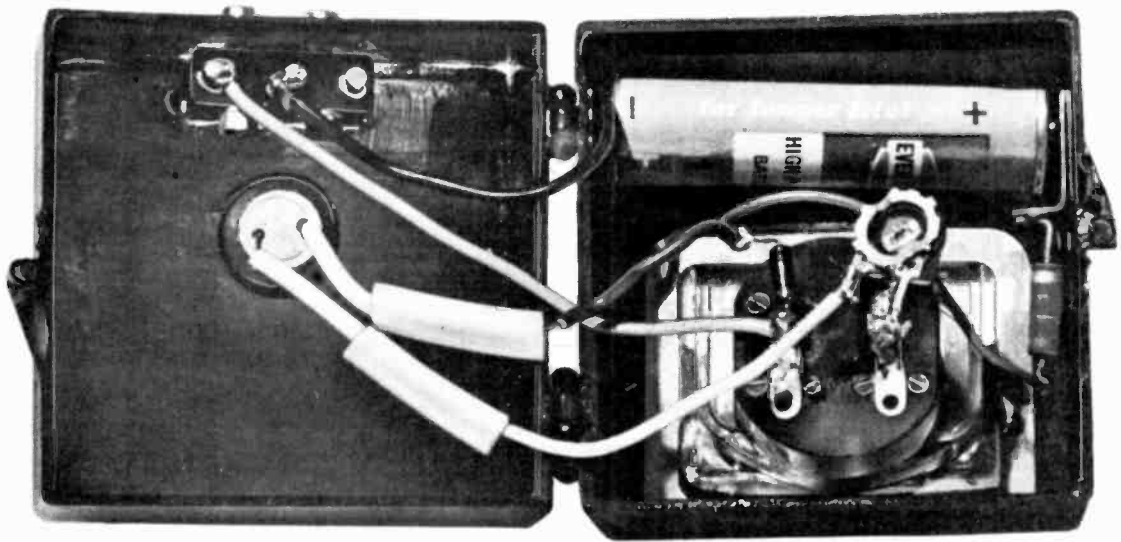
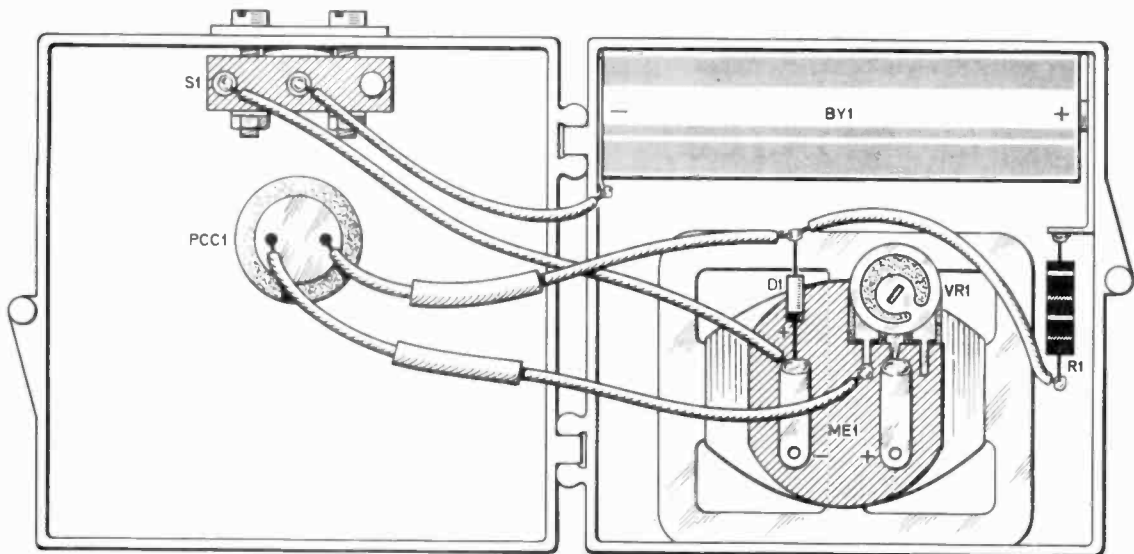


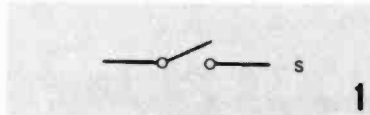
Fig. 2. Complete construction and wiring details of the Through The Lens Light Meter.



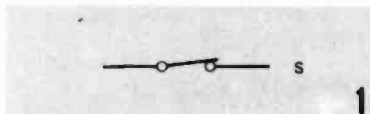


guide to circuit

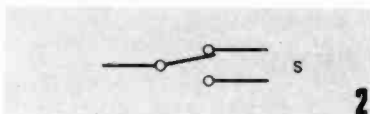
Switches



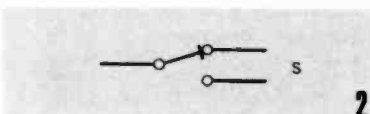
Single pole single throw make contact



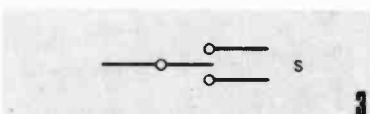
Single pole single throw break contact



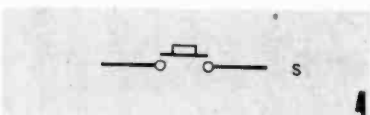
Single pole double throw change-over break before make



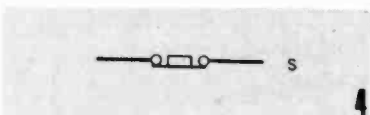
Single pole double throw change-over make before break



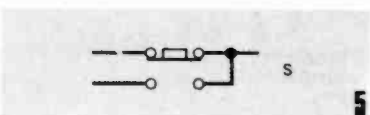
Single pole double throw centre off



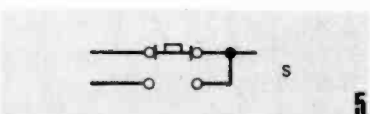
Single pole push to make contact



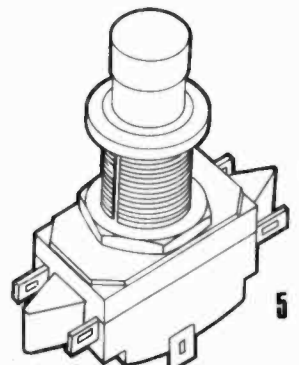
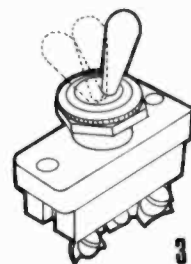
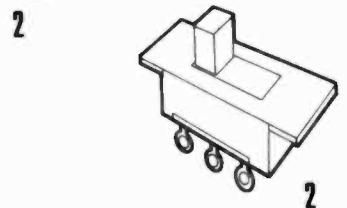
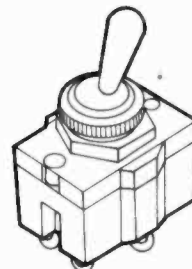
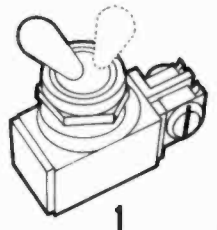
Single pole push to break contact



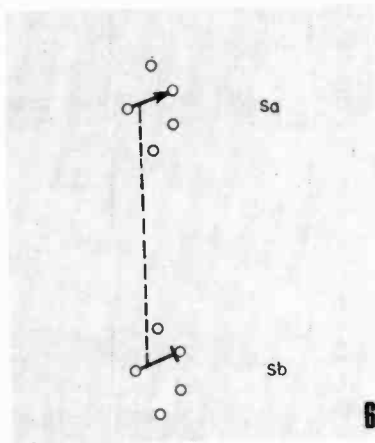
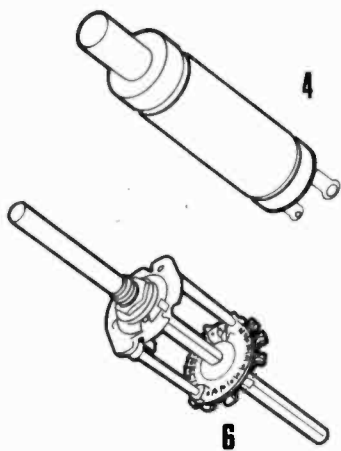
Single pole push button change-over break before make



Single pole push button change-over make before break

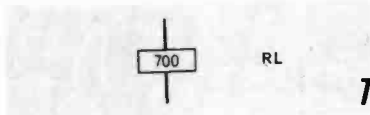


symbols . . . part 3

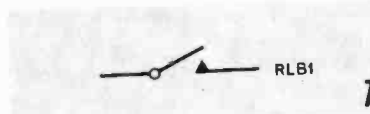
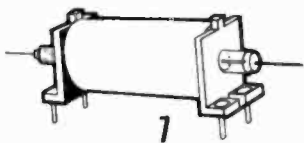


Double pole multi-way switch (usually rotary). Having one break before make pole and one make before break pole. Each pole has a suffix letter after the switch number. The dotted line indicates that two or more poles are operated simultaneously

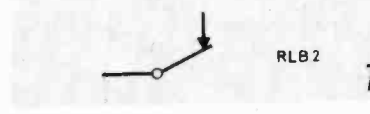
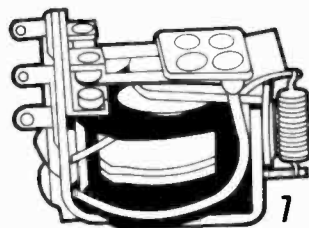
Relays



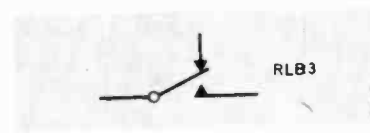
Relay coil with resistance indicated in ohms. Relay coils are annotated RLA, RLB, etc. The number of contact sets operated by the coil is shown under the coil annotation e.g. $\frac{RLB}{5}$



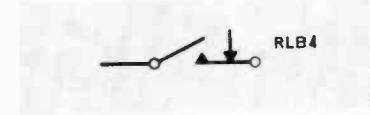
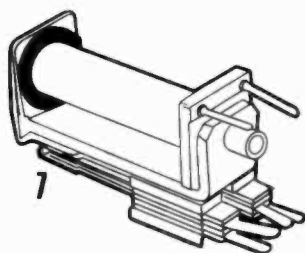
Make contact



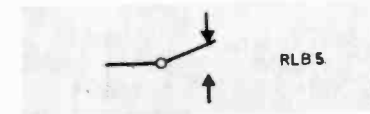
Break contact



Changeover break before make contact



Changeover make before break contact



Changeover, both sides stable—no normal rest position.

ELECTRONIC CIRCUITS -
..... IN THEORY and PRACTICE

TEACH-IN

... FOR BEGINNERS

By Mike Hughes M.A.



10 REACTANCE & INDUCTANCE

THIS month we'll begin with an experiment to illustrate a.c. resistance. You will need a reasonably high resistance a.c. voltmeter. This is to show that although a capacitor will block the flow of direct current, alternating current appears to flow.

Make the circuit of Fig. 1 and measure the r.m.s. a.c. voltages at points A and B. You should find that (making allowances for experimental error and component tolerances) that the a.c. potential at point B is approximately half that at point A. This means that current must be flowing "through" C1 otherwise the potential at B would be the same as at A.

As the potential we measure is approximately half the supply voltage, this means that the resistance of C1 to the flow of current must be approximately half the total resistance of R1 and C1 in series.

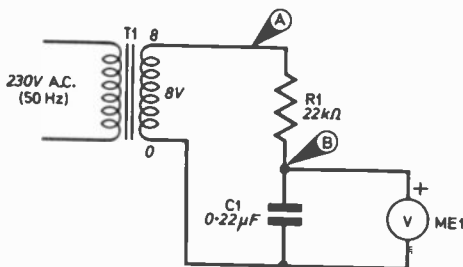


Fig. 1. Circuit diagram for experiment to illustrate capacitor reactance and impedance. Capacitor C1 must not be an electrolytic. Try different values of C1.

AC RESISTANCE

Resistance to a.c. by a capacitor is not a simple thing like that of a normal fixed resistor, because it will vary with frequency. Its effect is very similar and hence we measure it in ohms, but, we also have to state at what frequency we are quoting the value.

To distinguish it from conventional resistance we call this effect of the capacitor, "reactance" and it can be fairly easily calculated for a given value of capacitance at a certain frequency from the following expression:

$$\text{Reactance of capacitor } X_c = \frac{1}{2\pi \times f \times C}$$

Where X_c is in ohms, π is the constant 3.142, f is the frequency in Hz and C is the value of the capacitor in farads.

Thus we can calculate the reactance of our 0.22 μ F capacitor at 50Hz:

$$X_c = \frac{1}{2\pi \times 50 \times 0.00000022} \\ = \text{approx } 14,000 \text{ ohms or } 14 \text{ kilohms}$$

We therefore say that the reactance of a 0.22 μ F capacitor at 50Hz is approximately 14 kilohms.

Do you notice, though, that this is much less than half the total resistance of R1 and X_c added together. When dealing with capacitors and resistors in series we cannot simply add resistance to reactance to obtain what you might call the total resistance. We have to do it in a much more roundabout fashion and the end result

(although still measured in ohms) is called the "impedance" and is usually given the symbol Z .

For a single resistor and single capacitor in series the impedance Z is calculated as

$$\text{Impedance, } Z = \sqrt{(R^2 + X_c^2)}$$

where Z , R and X_c are measured in ohms.

This means that the impedance Z of our circuit is:

$$\begin{aligned} &= \sqrt{(22,000 \times 22,000 + 14,000 \times 14,000)} \\ &= \sqrt{484,000,000 + 196,000,000} \\ &= \sqrt{680,000,000} \\ &= \text{approximately } 26,000 \text{ ohms or } 26 \text{ kilohm} \end{aligned}$$

You can now see that the reactance of our capacitor is just over half the total impedance of the circuit and this is why the r.m.s. voltage we measured at point B was approximately half the supply voltage.

FERRITE TRANSFORMER

Last month we saw that when we connected a d.c. source of current across the primary side of a transformer, we got a momentary voltage generated across the secondary. We must now look at this a little closer and see which way the current in the secondary flows when the primary is connected a given way round.

It is a little difficult to do this with the Friedland transformer because it is not obvious which way the turns go round the core. To simplify matters it is best if we make a very crude transformer for ourselves.

For this you will need about 6 inches of $\frac{3}{8}$ inch diameter ferrite aerial rod and some 28 or 30 swg enamelled copper wire (a 2oz reel of this will be ample).

CONSTRUCTION

Anchor the free end of the copper wire to the ferrite rod with Sellotape—leaving about 6 inches flying for later connections—and wind 200 turns of wire over a length of about 1 inch. The turns can be wound on top of each other. When you have done this anchor the last turn in place and cut the wire—again leaving about 6 inches free.

Leave a gap of about $\frac{1}{2}$ inch and wind an identical coil on the same rod adjacent to the first but make sure that the turns go round the rod exactly the same way as before, see Fig 2(a). We now have a simple transformer with a turns ratio of 1:1. We must hasten to add that this assembly is only applicable to our experiment and you should not use this technique for making a power or mains transformer!

Fig. 2(b) is the schematic of this transformer; notice the black spots at one end of each of the windings. These denote the wires leading into the "start" of each coil (i.e. the wires you anchored to the ferrite rod as you started to wind each coil). It is most important in this

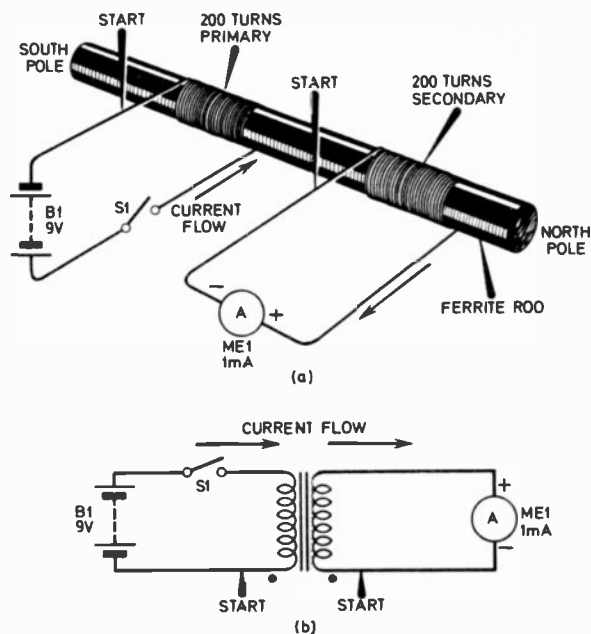


Fig. 2(a). The experimental transformer wound on six inches of ferrite aerial rod. (b) Shows the schematic diagram with designations for the start of each winding. Arrows show direction of current flow when the circuit is "made". The current through the secondary reverses when the primary circuit is broken.

experiment that you can recognise these leads.

Before proceeding further you must remove the insulating enamel from the four ends. This can be done by scraping gently with a razor blade or rubbing with fine emery cloth.

Now decide which of the two coils you will call the primary and which the secondary, and then connect the secondary across the 1mA meter on the Demo Deck with the start end going to the negative terminal. The negative terminal of a 9V battery should be connected to the start of the primary.

When you complete the primary circuit, by connecting up the positive terminal of the battery, watch the meter very carefully. You will see a very small kick in a positive direction which very rapidly falls back to zero. Now disconnect the battery and you get a slight "kick" in the negative direction—just as we had last month only the "kicks" are not so strong.

INDUCTION—MUTUAL INDUCTANCE

Now we know the sense of the windings we can see that a change in current flowing one way round the core in the primary gives rise to a build up of magnetisation of the core (for the direction of current flow we are considering the north pole of the magnet is as shown in

Fig. 2) which in turn causes a momentary current to flow in the secondary—but in the opposite direction around the core. This effect is called “induction”.

We say that the “signal” in the secondary is “induced” by the change of current in the primary. If the secondary coil was connected to a very fast reading voltmeter and we were able to control the rate of build up of the primary current, you would see that the output voltage was proportional to the rate of change of primary current.

Secondary voltage, $V = M \times \text{Rate at which primary current changes}$

V is measured in volts, the primary rate of change in amperes per second, and M is a constant of proportionality set by the numbers of turns on each coil, the distance between the coils, the dimensions of the coils and the magnetic properties of the core.

We call the constant, M , the “mutual inductance” (between the two coils in question). This is measured in units called henries (abbreviation “H”) and frequently we come across mH (millihenries) and μH (microhenries).

One henry is the mutual inductance which will cause an output voltage of one volt when the primary current changes at the rate of one ampere per second.

SELF INDUCTANCE

Now imagine a single turn on the primary and a single turn (having the same winding sense) on the secondary—Fig. 3.

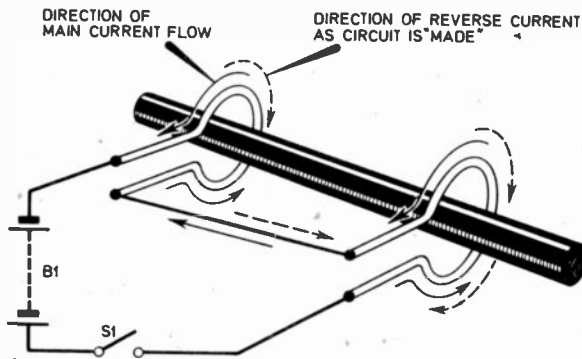


Fig. 3. The main current from the battery through the first turn induces a reverse current in the second turn as the circuit is “made”. This resists the build-up of the main current, this effect is called reactance. The influence of the turns on each other is called self inductance.

Let us connect the first turn to the second turn (exactly as if we had wound on two adjacent turns) and pass a current through both. The change in current through the first will still induce a reverse current in the second and this induced current will oppose the flow of the

original current—because the two turns are connected in series.

This means that as we try to generate a fast change of current the inductance between the two turns will try to oppose it; this slows up the rate at which our “primary” current can build up. In effect the two turns work together to resist the flow of current—especially if we try to make the current change fast. The faster the change in current we apply the stronger will be the opposing current and hence this resistance.

This obviously is not a simple sort of resistance because it is generated by the “self induction” between the two turns and has nothing directly to do with the material from which the wire is made.

As with capacitors rates of change affect the degree of this resistance and hence we call the effect reactance. It is still measured in ohms with a symbol X_L . To differentiate between mutual and self inductance we designate the term L to the latter. It is still measured in units, or fractions, of henries and is dependent on the number of turns, their spacing, diameter, and the properties of the core. The higher the self inductance the greater the reactance of the coil for a given rate of change of current.

An inductance may have a very low resistance to direct current, but if we try to pass alternating current its resistance increases—we call this form of resistance “reactance” and this increases with frequency.

We can calculate the reactance of a coil if we know its inductance from the following expression

$$X_L = 2\pi fL$$

where X_L is the reactance measured in ohms, π is our old friend 3.142, f is the frequency at which we want to know the reactance, and L is the inductance in henries.

If we have an inductor in series with a resistor in a circuit we cannot simply add the value of the resistor to the reactance of the inductor to obtain the total resistance to a.c. current flow. As with the capacitor, we have to calculate the impedance. The formula is very similar:

$$Z (\text{impedance}) = \sqrt{R^2 + X_L^2}$$

SERIES AND PARALLEL

If you have several inductors in series (provided they are physically far enough apart to prevent mutual inductance) you can simply add the values of inductance together to find the total effect:

$$L_{\text{total}} = L_1 + L_2 + L_3 + \dots +$$

For inductors in parallel

$$\frac{1}{L_{\text{total}}} = \frac{1}{L_1} + \frac{1}{L_2} + \frac{1}{L_3} + \dots +$$

HIGH VOLTAGE

If we have a large inductor in transistor circuits that switch currents on and off very fast we can sometimes have a problem.

If you pass a reasonably heavy current through an inductor and then break the circuit very quickly, the energy that is stored within the magnetised core will fall and while doing so will try and generate a reverse current; but as the circuit is broken the current cannot flow anywhere and we can momentarily generate a very high voltage across the ends of the inductor.

We can do a simple experiment to demonstrate this. You will need the Friedland bell transformer a 9V battery and a 60 to 70V neon bulb (it should be a "bare" neon and not the type with a built in resistor as used for panel indicators).

Connect the neon across the primary (mains) side of the bell transformer and then connect the battery up across the same terminals—do not connect anything to the secondary. see Fig. 4.

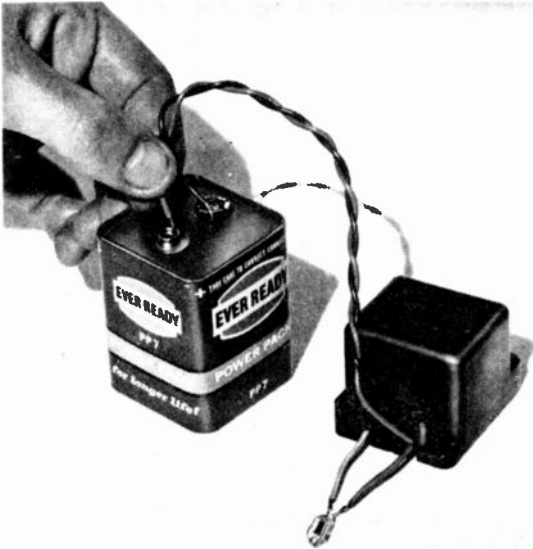


Fig. 4. Experiment to show that a momentary high voltage can be developed across the terminals of a high value inductor when the current suddenly stops flowing.

The neon does not light up because we are only supplying 9V to the circuit and the bulb needs at least 60/70V across it before it will glow. Now quickly disconnect one terminal of the battery and watch the bulb, but do not hold the bare wires, otherwise you will get a small electric shock; you should see a brief "flash" indicating that for a fraction of a second the voltage across the ends of the transformer primary (our indicator), must have risen to a value greater than 70V.

If you could make and break the circuit very quickly you would see a steady glow from the neon. You can do this by using a buzzer that

runs from batteries. Connect the neon directly across the coil and connect the battery.

You should see a steady glow from the bulb indicating the continuing recurrence of the high voltage caused by the inductance of the buzzer's coil and the constant making and breaking of the circuit by the contacts. Incidentally it is this high voltage that causes the sparking across the gap of the contacts.

Sometimes you will see the specification for a switch that says it may only be used to switch d.c. with non-inductive loads. This means that the contacts are not made to withstand the sparking that can be caused.

DIODE SHUNT ACROSS RELAY

Quite often a transistor is used to control the current flowing through the coil of a relay—a typical circuit is shown in Fig. 5.

If the transistor is made to switch off very fast by removing the base current, the potential across the coil will momentarily shoot up to a value much greater than the supply voltage in such a way that the potential at the end connected to the collector of the transistor will go more positive than the positive rail. In severe cases this might momentarily exceed the collector base reverse breakdown voltage and the transistor might be destroyed.

To prevent the collector going any more positive than the positive rail, designers sometimes incorporate a diode across the relay coil. This diode has no effect on the normal working of the circuit but will act as a short circuit to reverse voltages generated across the coil.

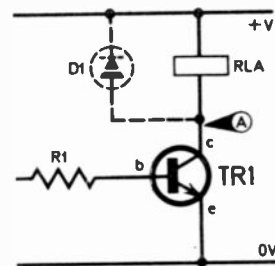


Fig. 5. When a transistor switches off very quickly, the voltage at point A can rise to a positive value much higher than the supply voltage. Sometimes a diode, D1, is connected across the relay coil to "short circuit" this high voltage pulse and thus protect the transistor.

PHASE SHIFT

There is another very important effect which we have not yet covered. This is to do with the fact that we cannot simply add reactance to resistance to find the total effective resistance of a circuit.

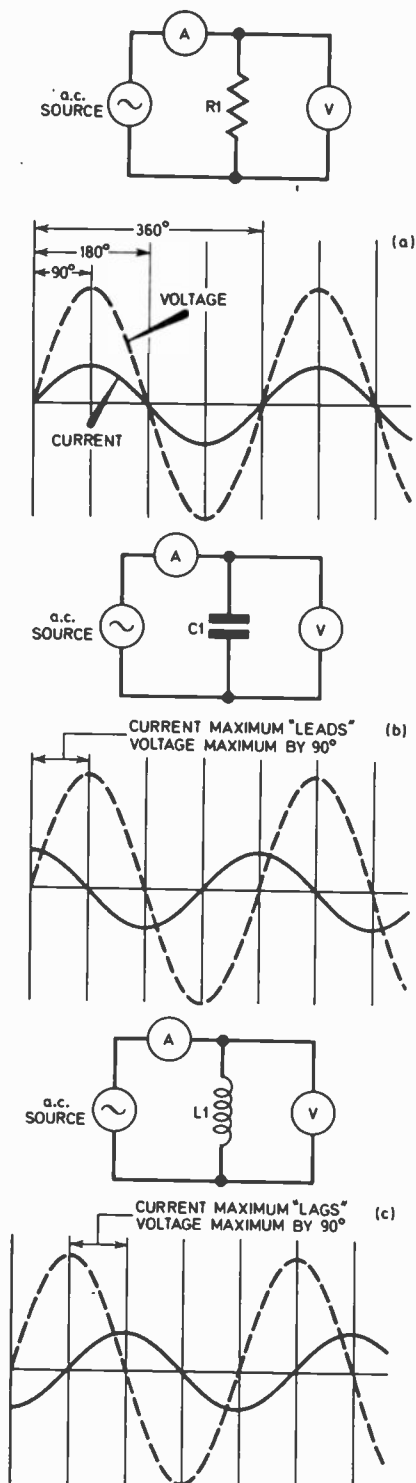


Fig. 6. Voltage and current phase relationships. (a) For a resistor, current and voltage are in phase. (b) For a capacitor, the current flowing "through" it leads the voltage across it by 90 degrees of angle ($\pi/2$). (c) For an inductor, the current flowing through it lags the voltage across it by 90 degrees ($\pi/2$).

In Fig. 6(a), (b), (c) we show a resistor, a capacitor and an inductor respectively connected across a source of a.c. voltage. In the case of the resistor we can say that at any instant in time the current flowing through the resistor is directly proportional to the voltage; i.e. when the voltage is maximum positive, when the voltage is zero the current is zero.

This is shown graphically by the superimposed voltage and current waveforms. We say the voltage and current are "in phase".

When the voltage across the capacitor is zero, but rising from negative to positive, most current will be flowing into it, but as the voltage across it reaches maximum (i.e. the capacitor is fully charged in one direction) the charging current falls to zero.

As the voltage falls from maximum positive towards zero, the capacitor in effect discharges and current starts to flow in the opposite direction (i.e. becomes negative).

We can say that as the voltage passes through zero but is rising in a positive direction we get maximum positive current; when the voltage reaches maximum we get zero current and when the voltage passes through zero in a negative direction we get maximum negative current. This means there is a shift in phase between the maximum current and voltage.

The shift is a quarter of a wavelength which is 90 degrees or $\frac{\pi}{2}$ radians. We say by definition that the current "leads" the voltage by 90 degrees.

The male and female approach works here because the opposite happens with an inductor. We get maximum rate of change of current when the current waveform passes through zero. If the current is rising in the positive direction this gives us maximum positive voltage across the inductor. As the current passes through maximum, the rate of change momentarily becomes zero (it stops at the maximum before coming down again) and this gives rise to zero voltage. As soon as the current passes through zero in a negative direction we get maximum negative voltage, and so on. Again there is phase shift between the voltage and current but this time the current "lags" behind the voltage by 90 degrees.

RESISTOR-CAPACITOR-INDUCTOR COMBINATION

The reason why we could not simply add resistance to reactance for a resistor/capacitor or a resistor/inductor circuit was because of the relative phase shifts between voltage and current waveforms. Likewise there is a phase shift between an inductive and a capacitive circuit only more so—180 degrees—so therefore we cannot simply add together the reactance of a capacitor to that of an inductor in series.

Table 1: Comparison of some capacitor and inductor properties

Capacitors	Inductors
A capacitor will not pass d.c. A capacitor passes high frequency a.c. easily The reactance of a capacitor decreases as the frequency increases	An inductor passes d.c. easily An inductor is a very poor conductor of a.c. The reactance of an inductor increases as frequency increases
Formula for reactance	$X_L = 2\pi fL$
$X_c = \frac{1}{2\pi fC}$	Series connection
$\frac{1}{C_{total}} = \frac{1}{C_1} + \frac{1}{C_2} + \dots$	$L_{total} = L_1 + L_2 + \dots$
Parallel connection	$\frac{1}{L_{total}} = \frac{1}{L_1} + \frac{1}{L_2} + \dots$
$C_{total} = C_1 + C_2 + \dots$	High inductance gives high reactance
High capacitance gives low reactance	

Strangely enough (and this is difficult to prove without fairly complicated mathematics) we have to subtract the reactance of one from the other.

The formula for calculating total circuit impedance becomes:

$$Z = \sqrt{R^2 + (X_L - X_c)^2}$$

Next month: Amplification. Additional components required for next month: microphone insert type ACOS MIC 43-3 or Duvidal CM20; resistors: 3.3 megohm (1 off), 1 megohm (1 off), 330 ohm (1 off).



Ruminations

By Sensor

Summer Is Icumen In

I have just finished a spell of home decorating—three weeks of painting and papering—which has stopped me from completing any of the four electronic construction projects that I have on hand at present. For me, home decorating is a continuous process with long troughs of low level activity and occasional high peaks of short duration. It is one of the latter that has just been completed.

My gardening follows a similar pattern, so that the "seed-time and harvest" of the good husbandman could be more accurately described in my garden as "weed-time and putrefaction". Since I bought an electric lawn mower my schoolboy son mows the lawn

regularly and I recommend other fathers to follow my action.

Weeding is a problem to which I have not found an answer, apart from getting down onto one's knees and digging them out or preferably, getting one's wife to do it (and there's nothing novel about that!). I use various weed-killers and find them effective but they have their limitations and bring their own problems.

Back To Work

So; having, as it were, subcontracted most of the gardening, I folded up the pasting table and turned again to the bench. What a mess! Why does my bench gather all the family's rubbish?

The surface was covered with items ranging from eggs (a pullet's first and a goose's), an old blackbird's nest, two strings of beads, seashells, an old teapot, through a variety of household utensils needing attention to a couple of electric motors awaiting assembly. The whole was overlaid with a fine layer of sawdust, ac-

quired during my last session with the circular saw. My own neglected projects were not in evidence—a second layer had built up over them.

Have you noticed that if you leave a job undone long enough the need for it often disappears? Indeed, it can become impossible to carry on with it due to the parts becoming obsolete and unobtainable—and that doesn't take long these days.

Well, then, what is to be done about those unfinished jobs? I think that one must be ruthless; remove from the bench all things not immediately required (put them into the children's bedrooms), select one job that is possible to finish and concentrate on that, do not allow yourself to be persuaded into anything else, be single-minded to the point of selfishness. Set yourself a reasonable time for completion and stick to it.

If you find the method works, let me know, perhaps I'll try it myself!

WEATHER STATION

by D. T. Goodwin B.Sc.

A simple device using basic electronic principles for measuring some basic weather parameters.

How convenient it would be to know the weather details at the push of a button (or the throw of a switch), whilst sitting comfortably at home. The complete Weather Station is in two parts, that is to say, it is built in two separate cases, one (the transducer case) to be installed outside in an unsheltered unobstructed position, and joined by several wires or multicore cable to the monitoring case located inside the house or laboratory.

CIRCUITS

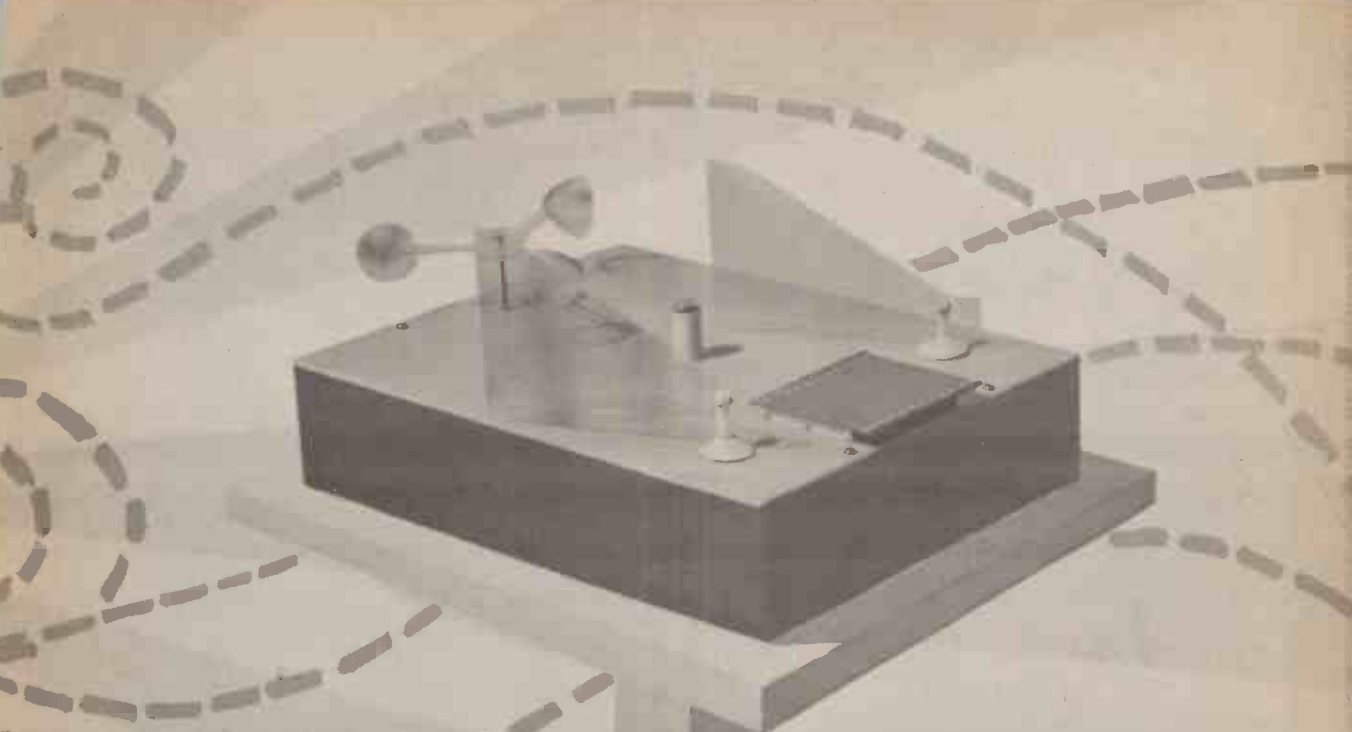
The complete circuit diagram for the Weather Station is given in Fig. 1. It is seen to consist of five separate and independent units wired together around a three-pole-four-way wafer switch S2. These units are: rain indicator, temperature monitor, wind speed and direction indicator, and a light intensity indicator.

In the prototype, with the exception of the rain indicator, the units share the meter ME1 via switch S2 which is used to select the parameter to be measured.

RAIN INDICATOR

The rain indicator circuit has been designed so that when rain or moisture falls on the Veroboard sensor, the lamp LP1 on the control box front panel lights up. The components of the rain indicator consist of TR1 and TR2 directly coupled, R1, R2, LP1 and the Veroboard sensor.

With S1 switched on, and under dry conditions (no moisture on the sensor) the base of TR1 is virtually open circuit i.e. no base current flows.



Under this condition no emitter current flows in TR1, and hence no base current in TR2. Transistor TR2 is thus off—no current flows through the lamp.

When moisture (rain) bridges the sensor, the very high resistance between the adjacent strips of the sensor is greatly reduced and base current flows in TR1, allowing emitter and collector current flow.

This condition allows base current to flow in TR2 thus turning the latter on and illuminating the lamp.

If it is found that the sensitivity of the sensor is too high, it can be reduced by inserting a 5 kilohm preset potentiometer (wired up as a variable resistor) in series with R1; adjust to the required sensitivity.

With no moisture on the sensor, the unit is very economical, current drain from the battery being minimal and due only to the leakage of the transistors.

However, when it is raining, current drain is considerable and for this reason it is advisable to switch S1 off.

If desired, the lamp may be replaced by a suitable relay that can be used to switch on an audible alarm.

TEMPERATURE INDICATOR

Ambient temperature is indicated on ME1 with S2 in position 1.

The unit utilises the variation of resistance with temperature in a device called a thermistor. The type used in the prototype is one whose resistance decreases with increasing temperature. It is used, with R4 to form a potential divider chain.

The Zener diode, D1, together with its series resistor R3, produces 3.3 volts across the transistor and the potential divider chain. This lower voltage helps to reduce the effect of self-heating of the thermistor.

As the temperature increases, the resistance of RTH1 drops and more base current flows in TR3, and therefore, more emitter and collector current flows. The collector current flows through ME1 and can be varied by VR1.

To calibrate the temperature scale, a conventional thermometer is needed (unless it is only coarsely calibrated as in the prototype as "cold" "warm" "hot" and "very hot," by trial and error on days of these descriptions).

If we are only concerned in measuring outdoor temperatures, then 40 degrees Centigrade is a suitable figure to make as our full-scale deflection on ME1 (in the U.K. that is).

Place the conventional thermometer alongside RTH1 on the "transducer box" with S2 in position 2, and bring up a heat source in the vicinity of the thermometer and RTH1 (the bulb of a table lamp is a good source of heat) and adjust VR1 so that the meter reads full scale when the thermometer indicates 40 degrees Centigrade. Mark this position on the meter scale with 40. Repeat this procedure working down in five degree steps.

WIND SPEED

The wind speed is indicated on ME1 with S2 in position 2.

This is quite a straightforward device that uses a small d.c. motor rated at between 3.6 volts as a generator—this was found to be satisfactory in the prototype.

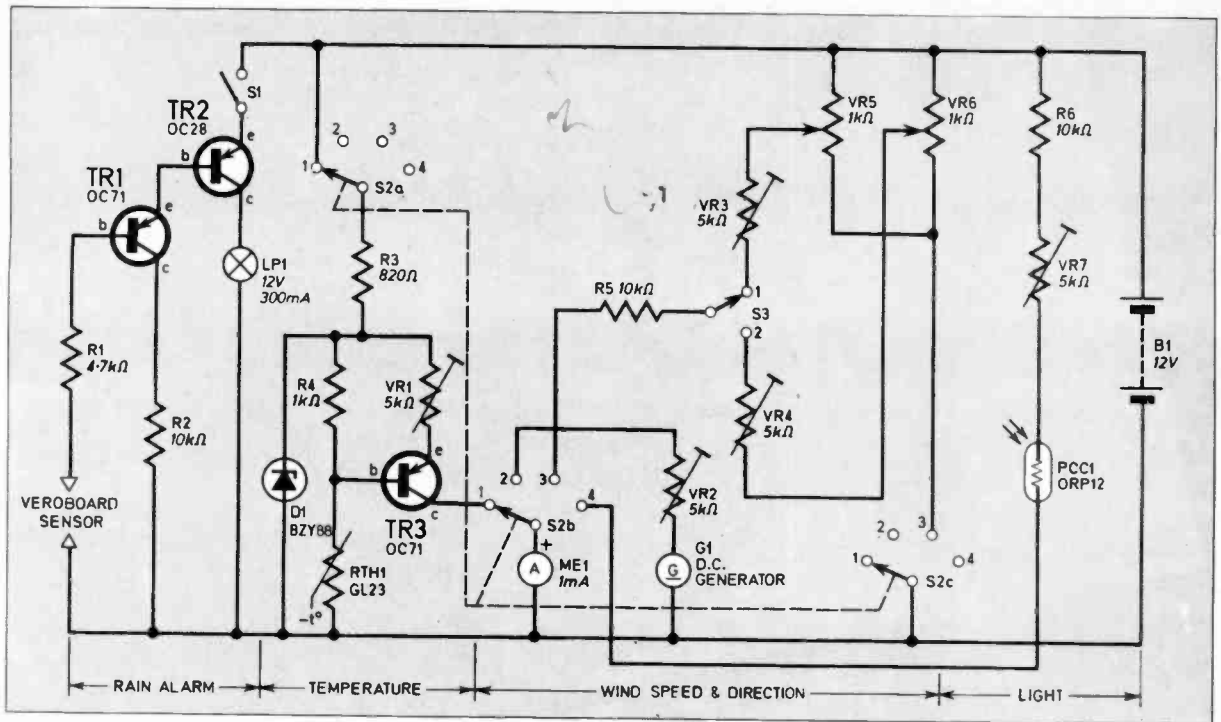


Fig. 1. The complete circuit diagram of the simple Weather Station.

The rotor containing the wind cups is connected to the shaft of the generator, and as the wind carries the cups round, a current is generated which passes through the meter via VR2.

The variable resistor VR2 controls the current flowing into the meter and should be adjusted such that when the rotor is spinning at maximum wind velocity the current flowing is 1mA.

The meter scale can be calibrated in several ways: in the prototype it was carried out by experiment on days of different wind strength, i.e. "light," "blowy," "strong," "gale," and the face marked accordingly.

Alternatively, if an accurate method of producing or calculating a wind speed in m.p.h. is known (such as a wind tunnel or mounting on a car and driving at an observed speed on a still day) the scale may be calibrated in m.p.h.

WIND DIRECTION

Wind direction is indicated on ME1 with S2 in position 3.

The combination of R5 with each of VR3 and VR4 in series with the meter converts ME1 to a voltmeter than can be adjusted (by means of VR3 and VR4) to read 10-15V full scale.

The full battery supply of 12V is across VR5 and VR6. Depending on the position of S3, the meter records the voltage at the wiper of VR5 or VR6 relative to the negative line.

The wind direction vanes are connected to the spindles of VR5 and VR6.

Two vanes (with potentiometers) have been used to eliminate the small portion on the potentiometers which will not give a reading when the stops have been removed, see later.

The two potentiometers are mounted in approximate opposite directions to each other. Only one is used at a time, S3 being employed to change from one to the other when one goes into the null region. In fact, it is advisable, for accurate measurements, to switch S3 when the needle is near to either end of the direction indicator scales.

There are two scales, one for each switch position and these should be calibrated as follows; for the upper scale (1), set S3 in position 1, and VR3 to maximum resistance. Position VR5 vane so that ME1 reads a maximum. Adjust VR3 so that this maximum is full scale.

Repeat this for the other vane using VR4 with S3 in position 2. Return S3 to position 1.

Rotate the vane on VR5 so that a small fraction above zero is shown on ME1. Mark this point on the meter face with one of the four compass points, i.e. N, E, S or W—say N for example.

Now turn the vane through 90 degrees clockwise and mark the new needle position E. Rotate a further 90 degrees and mark S. Another 90 degrees rotation gives the W position.

Turn the vane back to the S position. Switch S3 to position 2, and position VR6 so that the needle lines up with the N position on the upper scale with the vanes in the same

Components....

Resistors

- R1 4.7k Ω ✓
- R2 10k Ω
- R3 820 Ω ✓
- R4 1k Ω
- R5 10k Ω
- R6 10k Ω
- All $\frac{1}{2}$ watt $\pm 10\%$

SEE
**SHOP
TALK**

Potentiometers

- VR1 5k Ω skeleton preset
- VR2 5k Ω skeleton preset
- VR3 5k Ω skeleton preset
- VR4 5k Ω skeleton preset
- VR5 1k Ω linear carbon
- VR6 1k Ω linear carbon
- VR7 5k Ω skeleton preset

Light Dependant Resistor

- PCC1 ORP12

Semiconductors

- TR1 OC71 germanium pnp ✓
- TR2 OC28 or AD142 or similar
- TR3 OC71 germanium pnp ✓
- D1 BZY88 C3V3 400mV Zener diode X

Thermistor

- RTH1 GL23 glass bead type

Switches

- S1 S.P.S.T. toggle or slide
- S2 Three-pole-four-way wafer
- S3 S.P.D.T. toggle or slide

Miscellaneous

- ME1 1mA meter
- LP1 Lamp 12V 300mA plus panel type holder
- G1 Generator 3-6V d.c.—see text
- B1 Battery 12V—use PP1 6V (2 off in series)

Veroboard 0.15 inch matrix: control box 30 x 10 holes, rain sensor 24 x 20 holes (approx.); Rotor cups and vanes; $\frac{1}{4}$ inch clear Perspex or similar material; pointed knob; materials for transducer box; control box case, 5 x 5 x 8 $\frac{1}{2}$ inches with sloping front panel.

direction. Mark S on the lower scale (2), and then carry out similar rotations to those above for marking the lower scale W, N, and E respectively.

Secure VR5 and VR6 in these positions.

LIGHT LEVEL INDICATOR

The light level is indicated on ME1 with S2 in position 4.

The circuit utilises a photoconductive cell, PCC1, whose resistance varies with light intensity from approximately 10 megohm in dark conditions to about 75 ohm in bright light.

As the light intensity varies so the total resistance of the circuit R6, VR7 and PCC1 in series

varies, affecting the magnitude of the current flowing through ME1.

Once again, the maximum current flow should be 1mA. To realise this condition VR7 should be set so that 1mA flows when very bright sunlight is incident on PCC1.

To do this set VR7 at a maximum (i.e. 5 kilohm) and point PCC1 at the sun on a clear summer day. Now adjust VR7 so that the reading is full scale.

The full scale position should be marked "very sunny" and the zero position "dark".

For intermediate intensities it is suggested that these be marked "dull," "bright," "sunny," the positions being determined by days when these light intensities are evident.

METER DISPLAY

A suggested meter-scale is shown in Fig. 2. It consists of five bands to represent each of temperature, light, wind speed and wind direction (upper and lower which are used in conjunction with S3, see above).

It is suggested that these concentric bands are all firstly drawn together on a piece of plain paper and then pasted in position over the original scale.

Pencil markings will be sufficient to locate positions which can then be inked over neatly or printed with Letraset.

The start and end positions of the new scale must coincide with the original "zero and full scale" positions of the meter.

CONSTRUCTION-CONTROL BOX

The layout of the components on the Veroboard is shown in Fig. 3.

The circuitry in the control box is built on a piece of 0.15 inch matrix Veroboard size 30 by

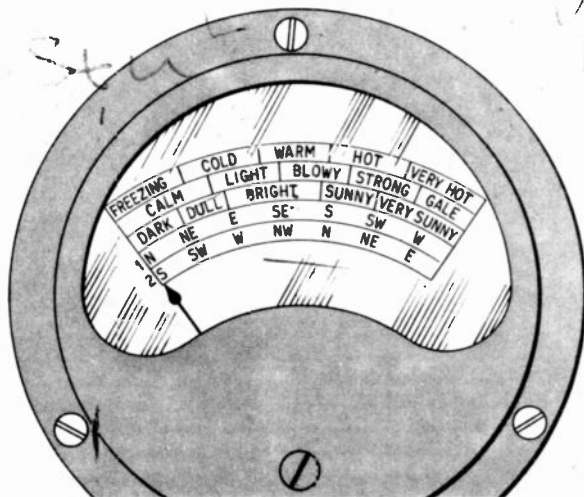


Fig. 2. A suggested meter scale display as used in the prototype. The individual scales will have to be calibrated as described.

10 holes with the copper strips cut as detailed.

Begin assembly by fixing TR2 in position and carefully soldering. The collector of TR2 is its casing and this connection is made via a small nut and bolt through a solder tag. This connection is also made through the Veroboard at position G1/F1 by drilling a hole to take the bolt used. Continue by soldering the resistors and potentiometers in places as shown in Fig. 3.

Remember that the potentiometers are being used as variable resistors therefore only one outside leg is used with the middle leg. The redundant leg should be bent upwards away from the board, making sure neighbouring components are not touched.

Now attach the switches, S1, S2 and S3, the lamp holder and bulb, and the meter to the front panel as shown in Fig. 4, and wire them to the Veroboard as indicated. Next wire the 10 wires from the Veroboard and panel components to the 10 way terminal block, mounted on the back of the case. All wires will need to be about 6 to 9 inches long. Connect the battery leads to the Veroboard.

The transistors TR1 and TR3 and the Zener diode, D1, should now be soldered in position—remember to use a heat shunt on each lead otherwise damage to these devices may result.

TRANSDUCER BOX

In the prototype, the components were all mounted on the top panel (approximate size 13 x 10 inches) of a Perspex case. Perspex was

chosen for the transducer box because of its excellent weather resistant properties. Any other case material may be used but it will probably need a good coat of paint to protect it.

If a metal case is used some method of insulating the nut, bolt and solder tag connections to RTH1 and the Veroboard sensor must be employed.

The positioning of the components in the prototype is indicated in Fig. 5. This is not critical but there are some important points to watch.

The rotor should not be too close to the vanes such that its rotation will cause the direction vanes to be affected.

The photocell PCC1 should be in an unobstructed position of daylight. Shadows from the rotor or vanes should not be allowed to fall on it at any time.

DIRECTION POTENTIOMETERS

Before assembly of the transducer components, VR5 and VR6 must be modified.

They must be dismantled and their stops removed.

With all potentiometers there is a gap between the two ends (start and finish) of the carbon tracks; this must be bridged with an insulating material otherwise the slider will get stuck in this gap and erroneous measurements will be taken. A suitable material for this is Araldite. Fill the gap, smooth over and leave to set. Ensure, when dry, that the slider can move across this region with minimum pressure.

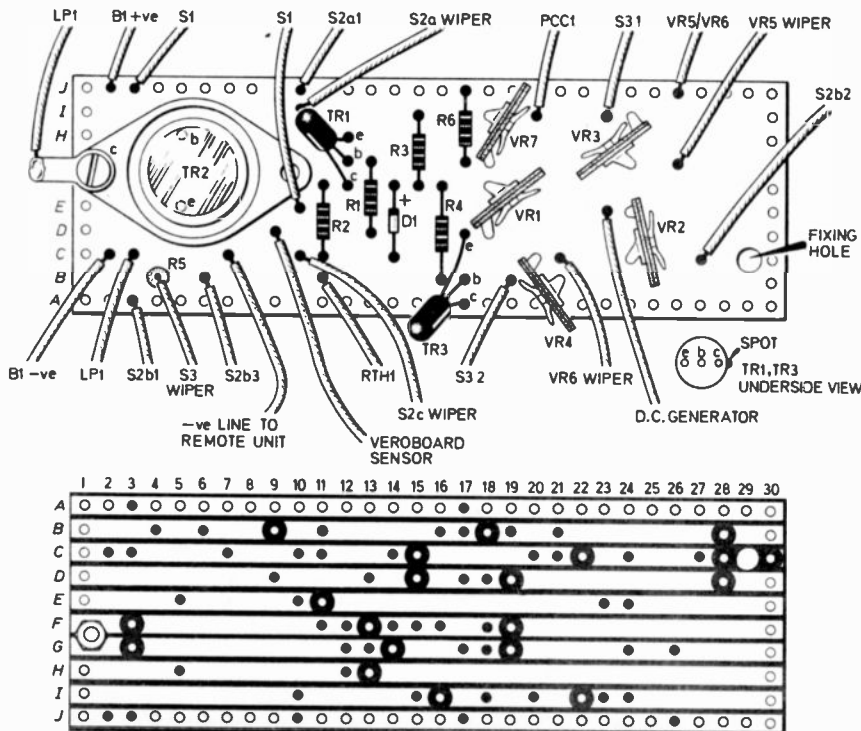


Fig. 3. The layout of the components on the Veroboard for the control box, and the regions of copper strip to be removed from the underside.

weather station

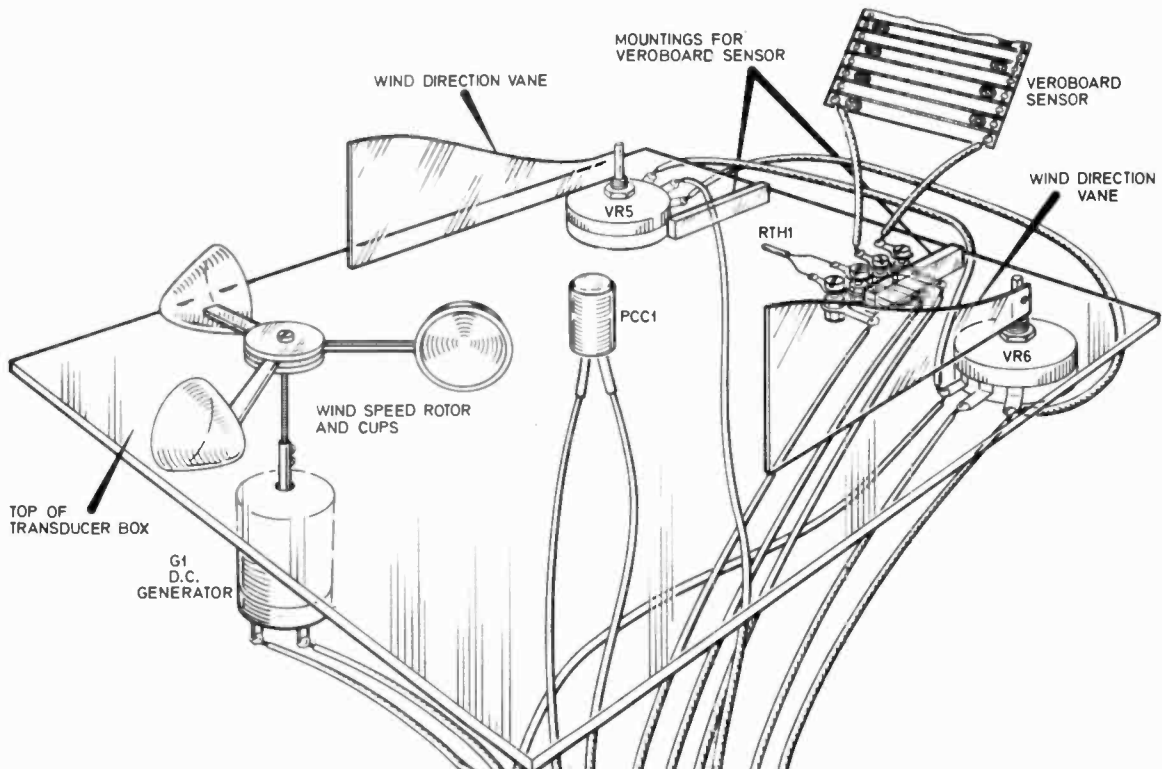
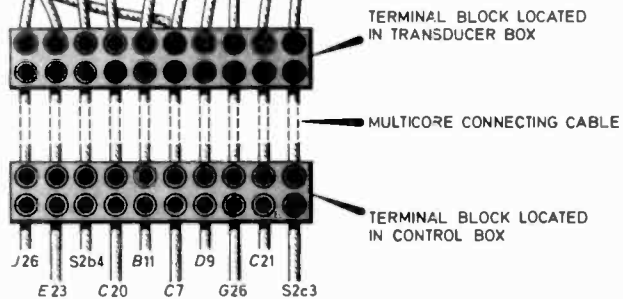
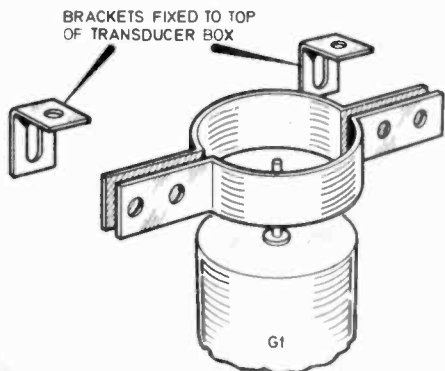
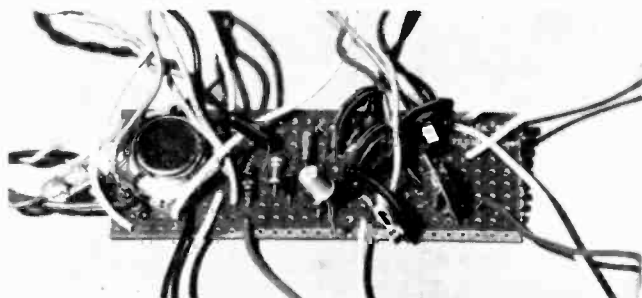


Fig. 5 (right). The positioning of the "transducer" components, vanes and rotor assembly and wiring on the top panel of the prototype transducer box. Perspex was used to resist weather deterioration.

Fig. 6 (below). An adjustable bracket for securing a cylindrical d.c. generator to the top panel. Dimensions to be determined by generator used.



Photograph showing the Veroboard details.



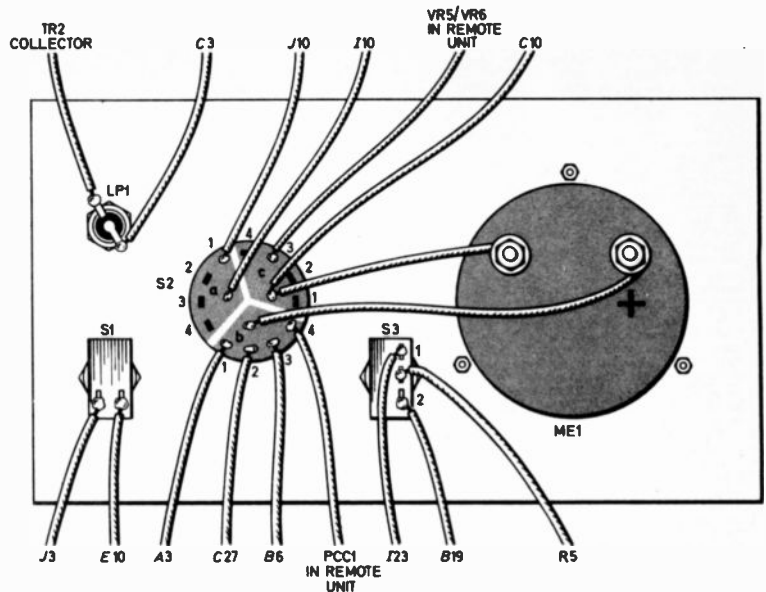


Fig. 4. The positions of the components and the wiring on the back of the control box front panel. Note the meter polarity. The layout is not critical and may be changed to suit individual requirements.

ROTOR CUPS AND VANES

The cups and vanes used in the prototype are made of Perspex (see *Shop Talk* for details).

If desired the cups can be made from suitable plastic egg cups by cutting away the base of the egg cup and filing smooth.

The dimensions of the direction vanes are not critical, except that they should, for efficient and speedy alignment, be triangular in shape, as shown in Fig. 5. These can be bolted to the flat sides of the spindles of VR5 and VR6, suitable holes being drilled in the spindles to accommodate the fixings.

LIGHT CELL AND RAIN SENSOR

The light cell can be mounted in any unshadowed position. In the prototype its position was central on the top panel and raised by means of a short length of plastic tubing.

A suitable sensor can be made from Veroboard cut and soldered as shown in Fig. 5, approximate size 3½ by 3 inches. In the prototype, tapped Perspex ¼ x ¼ x 2 inches was glued to the base of the sensor and this was screwed in position on the top panel. The thermistor, RTH1, is located under this sensor for convenience and protection.

GENERATOR FIXING

Motors suitable for use as the generator G1 are available in all shapes and sizes. The one used in the prototype is cylindrical, and is attached to the top panel by means of the adjustable bracket shown in Fig. 6. This can be modified to suit different generator shapes.

The rotor may be attached to the generator shaft by fixing a long thin brass bolt through the centre of the rotor system and uniting this to the generator shaft with a spindle coupling.

WIRING

When all the components have been fixed in their final positions on the transducer box, wiring may be carried out in accordance with the wiring diagram of Fig. 5. All wires go to the terminal block located inside the transducer box.

The two boxes are best and easiest united using a long length of multicore cable passed out through a grommet in the transducer box—the length depending on the final position of the two boxes.

The cable must contain at least 10 insulated wires. This type of cable is available from some of our advertisers.

TESTING AND SETTING UP

When the two parts have been connected, the wiring should be thoroughly checked out before switching on.

When you are satisfied that wiring is correct switch on and test each discrete unit individually and calibrate as detailed earlier.

It only remains now for the transducer box to be placed in position in the right direction. This is done with the aid of a magnetic compass.

With S3 in position 1, and S2 turned to the "wind direction" position, point the narrow end of VR5 vane in a due east direction and hold in this position while turning the transducer box until the needle on the meter indicates east (E). Secure the transducer box in this position.

Small plastic cups (such as those used in bottle tops) can be fitted over the wind speed and direction spindles so that no rain or moisture will run down the spindles into the "electronic" parts. A small amount of grease or Vaseline placed around the spindle bases will also provide protection.

The Weather Station is now complete. □

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16/450V	12p	100/50V	47p	32+32/450V	33p
32/450V	25p	8+8/450V	18p	350+50/325V	50p
25/25V	10p	8+16/450V	20p	32+32+32/350V	43p
50/50V	10p	16+16/450V	25p	100+50+50/350V	48p
100/25V	10p	32+32/350V	25p		

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2500mF. 50V. 62p; 3000mF. 25V. 47p; 50V. 65p.
5000mF. 6V. 25p; 12V. 42p; 25V. 75p; 35V. 65p; 50V. 95p

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range axial lead 6p each
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SILICON RECTIFIERS

Table of silicon rectifiers with columns for PIV, price, and manufacturer code.

DIODES & RECTIFIERS

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10 watt 5% (up to 25kΩ only); 10p

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THEY MADE THEIR MARK

№4 Ohm

By J. E. Gregory

TABLE I THE OHM (Ω)

THIS month we move to Germany, to hear about the man who gave his name to the unit of resistance, Georg Simon Ohm, and his now famous law (see Table 1).

The Ohm family lived in Erlangen, South Germany with their two sons Georg and Martin. Ohm senior was in business in a modest way as a locksmith, his wife complimented the family income by taking lodgers and it was one of these who was to influence the eldest son Georg, born March 16, 1787, in his early years.

It was expected that Georg being the eldest would take over the family business, but having been inspired by the student lodger to study he entered the local university. He was a competent pupil, and a natural born teacher, and on completing his course, accepted in 1817, at the age of 30, the post of professor of mathematics at the Jesuits college in Cologne.

OHM'S LAW

During this time he set his mind to many problems contained in mathematics, physics, and the new power electricity. It was at Cologne he learnt how the "Flux of Heat" in a metal bar is directly proportional to the difference of temperature between its ends, and then, influenced by the journals of Schweigger and Poggendorf the German physicists which had appeared in 1825. Ohm sought to discover what laws regulated the flow of electricity in a conductor.

His results were published in Berlin in 1827 in a pamphlet with the title "Die Galvanische Kette Mathematisch Bearbeitet" which roughly translated means "The Mathematical Works of the Gal-

The oldest and one of the most important electrical "laws" was formulated by Georg Ohm, and the unit of resistance—the ohm—is named after him. This is used to measure the value of the resistor, the most commonly used of all electronic components.

Ohm's law illustrates that the resistance of a conductor is equal to the voltage across it divided by the current flowing through it. When the resistance is in ohms the voltage is in volts, and the current in amps.

The Omega sign (Ω) used for the ohm was suggested by Sir William Henry Preece the British electrical engineer and wireless telegraphy pioneer, whilst lecturing to Indian telegraph service cadets at the Hartley College, Southampton in 1867.

vanic Chain". The theory Ohm proposed set out that the electric current in a conductor is directly proportional to the difference of potentials between its ends.

The publication of the pamphlet caused a major upset in German scientific circles, people said Ohm was mad, and his law absurd, he was even forced to resign his post at Cologne.

For six years he was an outcast doing very little scientific work then in 1833 he obtained a post at Nuremberg polytechnic.

RECOGNITION

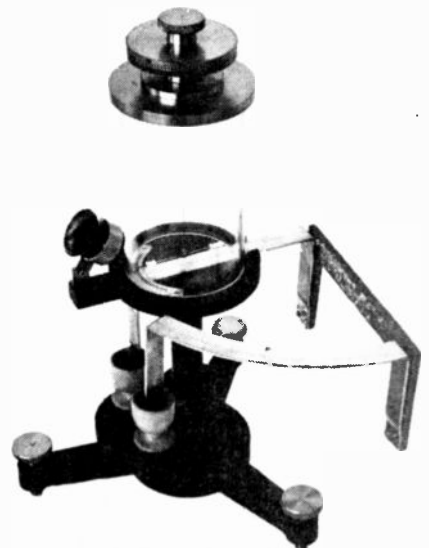
Gradually, however, the pamphlet began to get a wider circulation and his law was being quoted. Then, quite suddenly in 1841, came the first official recognition, Ohm was awarded the Copley medal of the Royal Society and made a foreign member of the society.

This recognition from Britain, and one of Europe's oldest scientific societies inspired Ohm to return to his work. He published a number of papers on mathematics and a memoir on interference in uniaxial crystals.

Ohm's apparatus used in his work with his law on the Galvanic circuit.

In 1849 he was appointed to the important post of conservator at the physical collection at Munich, and in 1852 professor of experimental physics in the high school at Munich, he started work on a text book of physics which was published in 1854 just before he died of apoplexy brought on by overwork, on July 7.

Thus at 67 died the man who in the face of great opposition took the first steps towards the formulation of the laws of the electric current.



Photograph: Crown copyright Science Museum, London.

REMEMBER
TO USE THE
POSTCODE



Readers Letters

Resistor Symbols

I have read every issue of *EVERYDAY ELECTRONICS* and I have only just noticed, in reading your *Guide To Circuit Symbols*, that you have been using the old symbol for resistors (a zig-zag line). I use many drawings of electronic circuits in my work and all up to date drawings now use the B.S. symbol (an oblong box) for a resistor. Whether this is done on purpose, to make it plain for the beginner I do not know, but I just thought I would point it out to you.

K. C. Vicars,
Portsmouth.

The symbol we use is given by B.S. as an alternative; see this month's editorial for comment.

That 15p Effort

As one who was brought up on thermionic valves and was introduced to electronics largely through your parent magazine, P.E., I should like to add to the congratulations you have received on the success of E.E.

Although I have experimented with radio for over 25 years, it is thanks to your magazine that I am beginning to feel at home with solid state devices.

Unfortunately, some of your ungrateful critics have yet to learn to walk before they can run, and it is hardly the function of E.E. to provide detailed modifications and servicing for commercial devices. Lack of effort, indeed, Mr. Alexander! Some people do not realise how much effort must go into making E.E. the best value on the bookstall—and all for 15p a month!

Mr. D. B. Lyall,
Cheltenham.

Modification

It may be of interest to you that the circuit given in the May issue of your magazine for a *Bee*

Counter was used as the basis of a paper counting machine for our school magazine. I had been planning to make such a device using a photocell, one transistor amplifier and a relay, thus operating a magnetic counter. Your circuit was a welcome alternative, being less bulky and requiring only one power source.

I built the circuit as described and arranged that the light beam should be broken by the sheet of paper falling vertically onto a chute which guided it into an output tray. In practice this arrangement failed to operate because of the small change in light level brought about by the sheet of paper.

This was due to two factors: firstly the paper is rather thin, and secondly, the interference from the room lighting which was not interrupted by the paper. Thus the circuit had to be made more sensitive to smaller changes in light level. To do this I introduced a further stage of amplification using a second OC72 and its two associated resistors. With this slight modification a very successful paper counting device was constructed.

I continue to be impressed with the variety of useful projects that you publish and wish you all success in future publications.

R. Anderson,
Leeds.

"B" Class

We followed with great interest your article on the electronic *Bee Counter*. However, we thought your entrance and exit labels a little strange because we don't know a lot of bees capable of reading and writing.

Of course, we have heard that the educational system has been greatly modified in the United Kingdom of late, presumably the "A" class is now reserved for

people and the, dare we say it, "B" class, for insects.

Five unreadable signatures,
No address.

We must admit that we do not know of any educated bees, but if you know some—as you infer—we are sure many bee keepers would be interested. Perhaps you could tell us how the bees can read the signs when they are inside the hive?

To be more serious, if you look at page 380 you will find that the caption to the photograph refers to the labels, thus constructors (not bees) are made fully aware of which aperture is which.

Transistor Holders

I have a query to put to you. When I was at school, 15 years ago, transistors had just come into general use, and I had many knowledgeable friends who tried to introduce me to the hobby of electronics; unfortunately I never quite got to grips with the practical side and so never got going. This is why your magazine is so helpful to me, for example I now understand for the first time in my life how to solder a good joint.

My query is this; these friends of mine at school were unanimous in recommending the use of transistor-holders, to avoid the dangers of soldering direct to the leads; as you do not seem to mention these, I am wondering whether there is some good reason that their use has been discontinued.

N. E. Goller,
London, N.W.3.

Transistor holders are still available and can be used on almost any project if desired. However if some care is taken when soldering, the transistors should not be damaged in any way. Silicon transistors can of course stand much more heat than the original germanium types.

Rain Wanted

How lucky you are in the UK., you get your June issue in June. Here, the April issue has just hit the bookstalls. It's worth waiting for though. For years now, I've been wading through electronics magazines but the penny didn't drop until your *Teach-In* penetrated my grey matter.

Project 605 the new simple way to assemble Sinclair high fidelity modules



For several years now you have been able to assemble your own high fidelity system to world beating standards using Sinclair modules. We have progressively improved these technically but hitherto the method of assembly at your end has remained the same – there has been no alternative to a soldering iron. Now for those who prefer not to solder, there is an alternative – Project 605.

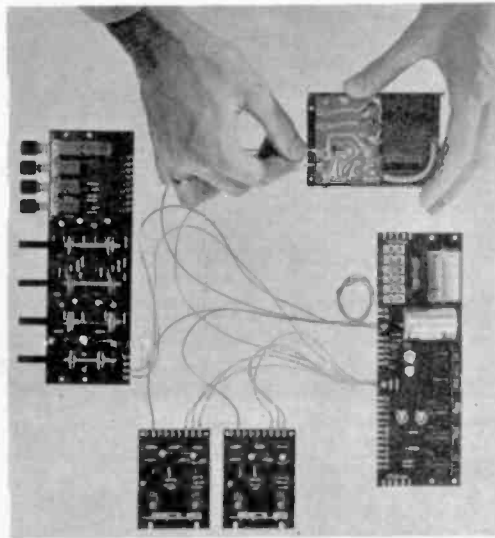
In one neat package you can now obtain the four basic Project 60 modules plus a fifth completely new one – Masterlink – which contains all the input sockets and output components you previously bought separately. Also in the Project 605 pack are all the inter-connecting leads, cut to length and fitted at each end with plugs which clip straight onto the modules, eliminating soldering completely. The pack contains everything you need to build a complete 30 watt stereo amplifier together with a clear well illustrated Instruction Book. All you have to do is to arrange your modules in the plinth or case of your choice and then clip them together – the work of a few minutes.

Your hi-fi system will, as we said, match the finest in the world and you can add to it at any time to increase power or extend the facilities. For example a superb stereo FM Tuner unit is obtainable for only £25.

Guarantee If within 3 months of purchasing Project 605 directly from us, you are dissatisfied with it, we will refund your money at once. Each module is guaranteed to work perfectly and should any defect arise in normal use we will service it at once and without any cost to you whatsoever provided that it is returned to us within 2 years of the purchase date. There will be a small charge for service thereafter. No charge for postage by surface mail. Air-mail charged at cost.

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Distortion – better than 0.2% under all conditions.

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Channel matching within 1dB.

Front panel – brushed aluminium with black knobs.

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7"	1800'	£2.94	£1.79	7"	2400'	£3.69	£2.25

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1 watt 2% carbon	1p each
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range 2-7 Ω to 10 M Ω type TR5	
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Carbon track 5K to 2M Ω
Log or Linear
Single 12p. Dual gang (stereo) 40p
Any type with D.P. switch 12p extra

I agree with your reader who asked for more mathematical tolerance. It became necessary for me to take a refresher course in Algebra so that I could follow your development of equations in the resistors in parallel bit.

Perhaps you are not so lucky there in the old country, we don't have that awful problem of where to go and what to buy when stocking up for one of your projects. It's a case of "shop a" or "shop b" or write off to the Eastern States, some 3000 miles away, and wait several weeks.

Your *Rain Warning Alarm* appealed to me and after wrecking it with reverse battery connections as per your erroneous instructions, I eventually got it working. Just one problem though. Its been installed on the roof for about 2 months now—but it hasn't rained!

How about a pull out data page suitable for clipping into a workshop manual. Such information as colour codes, transistor base connections, fundamental circuits like the diode pump, hints, tips and short cuts gathered together in one handy cover would be a boon for the likes of me who hit a problem and have to go searching through piles of magazines to find a clue to what could be wrong.

Ray Foster,
Western Australia.

To be correct our June issue is on sale during May in this country. By the time you read this you should have the Constructors Companion, presented free with the May issue—we hope this will meet your needs.

Prices

As many other readers have said, your magazine is a good one and has cleared up a few mystifying points. But now I would like to clear up a point myself, just in case someone got the wrong idea about New Zealand from Mr. J. Koppard's letter in E.E. April 1972. New Zealand is not a pin prick on the map down under where people walk round in grass skirts, but a modern thriving country.

The price of the OC71 is something of a mystery to me. Here in Auckland an average OC71 cost 70c or 35 English pence, not as cheap as in England but still a far cry from £3. I do not know

the price of an OC71 in Wellington but since Wellington is the capital of N.Z., I doubt if the price would be higher.

My guess is that the price or type of article was confused somewhere along the line, but if this is not the case then Mr. J. Koppard paid an extra £2.65p to a very low dealer.

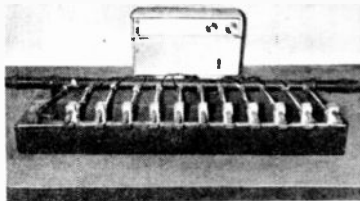
E. Van Dyke,
New Zealand.

Gas Station!

Sensor should eat his words. I have enclosed a photograph of a gas operated radio which the East Midlands Gas Board uses for demonstration. What is more, the device even works on natural gas.

G. A. Bolton
Shepshed,
Leicestershire.

Sensor did not say that it could not be done, merely that "there are limits to what can be done by gas". However we thank you for the inclusion of the photograph, which we show below.



Electronic Course

During the last two years, I have been running a course in basic electronics for the student with a non-vocational background. This course has a great deal in common with the "Teach-In" articles that you have been publishing since November 1971, and it has been suggested to me

If you write to us for advice, and wish to have a personal reply you must include a s.a.e. Unfortunately, we cannot prepare special designs, circuits or wiring diagrams, to meet individual requirements nor can we supply back issues or answer queries concerning commercial equipment, or subjects or designs not published by us.

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that your readers may be interested.

The course is based on attendance at the college for one evening per week (7.00-9.00 p.m.) for 24 weeks and runs from September to Easter. There is a strong practical background to the instruction, and demonstrations and experiments are conducted almost every night of the course.

I hope you find this suggestion of interest.

H. May,
Head of Electrical Trades
Department,
Gateshead Technical College,
Durham Road,
Gateshead.

Thanks

Further to my letter in the June issue, I now know the secrets of *Snap Sequence, Indicator* and *Home Sentinel*, thanks to an unknown reader who rang me and sent me the first issue.

I would like to refund the postage to him, and also return his magazine (if he would like it back) if he will let me know his address. I am afraid I put the phone down before I realised I didn't know who it was.

R. Brown,
Burton-on-the-Wold.

Component Export

We would be obliged if you could put us in touch with some firms in the UK who would be interested in the export of electronic components and gadgets to an electronic agency here.

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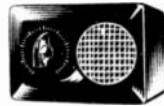
only £2-75



Anyone from 9 years up can follow the step-by-step, easy as ABC fully illustrated instructions. No soldering necessary. 76 stations logged on rod aerial in 30 mins.—Russia, Africa, USA, Switzerland, etc. Experience thrills of world wide news, sport, music, etc. Eavesdrop on unusual broadcasts. Uses PPS battery. Size only 3" x 4 1/2" x 1 1/2" **ONLY £2-75 + 20p p. & p.** Kit includes cabinet, screws, instructions, etc. (Parts available separately).

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CAN'T SLEEP AT NIGHTS? DO YOU WAKE UP IN THE NIGHT AND CAN'T GET OFF TO SLEEP AGAIN? WOULD YOU LIKE TO BE GENTLY SOOTHED OFF TO SATISFYING SLEEP EVERY NIGHT? Then build this ingenious electronic sleep inducer. *It even stops by itself so you don't have to worry about it being on all night!* The loudspeaker produces soothing audio-frequency sounds, continuously repeated—but as time goes on the sound gradually becomes less and less—until they eventually cease altogether, *the effect it has on people is amazingly very similar to Anaprox.* A control is provided for adjusting the length of times, etc., all transistor, can be built by anyone over 12 years of age in about two hours. No knowledge of electronics or radio needed. Extremely simple, easy-to-follow, step-by-step, fully illustrated instructions included. *No soldering necessary.* Works off standard batteries, extremely economical. Size only 3" x 4 1/2" x 1 1/2"—take it anywhere. Kit includes case, nuts, wire, screws, etc. **SEND £3-25 + 25p p. & p.** (parts available separately).

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1 amp.	\$2-80	300V. D.C.	\$2-80
5 amp.	\$2-80	15V. A.C.	\$2-80
15 amp.	\$2-80	300V. A.C.	\$2-80
30 amp.	\$2-80	8 Meter 1mA	\$2-87
20V. D.C.	\$3-80	VU Meter	\$3-37
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500mA	\$1-60	15 amp.	\$1-60
750mA	\$1-60	20 amp.	\$1-60
1 amp.	\$1-60	30 amp.	\$1-60
2 amp.	\$1-60	5V. D.C.	\$1-60
5 amp.	\$1-60	10V. D.C.	\$1-60
10 amp.	\$1-60	15V. D.C.	\$1-60
3V. D.C.	\$1-60	20V. D.C.	\$1-60
10V. D.C.	\$1-60	30V. D.C.	\$1-60
15V. D.C.	\$1-60	100-0-100μA	\$1-75
20V. D.C.	\$1-60	200μA	\$1-75
30V. D.C.	\$1-60	500μA	\$1-65
10V. D.C.	\$1-60	100-0-500μA	\$1-60
15V. A.C.	\$1-70	1mA	\$1-60
20V. A.C.	\$1-70	1-0-1mA	\$1-60
30V. A.C.	\$1-70	2mA	\$1-60
50V. A.C.	\$1-70	5mA	\$1-60
150V. A.C.	\$1-70	10mA	\$1-60
300V. A.C.	\$1-70	20mA	\$1-60
500V. A.C.	\$1-70	50mA	\$1-60
8 Meter 1mA	\$1-70	100mA	\$1-60
VU Meter	\$2-10	150mA	\$1-60

Type MR.52P. 2 1/2 in. square fronts.

50μA	\$2-10	10V. D.C.	\$2-80
80-0-80μA	\$2-60	20V. D.C.	\$2-80
100μA	\$2-60	50V. D.C.	\$2-80
100-0-100μA	\$2-60	300V. D.C.	\$2-80
500μA	\$2-60	15V. A.C.	\$2-10
1mA	\$2-60	300V. A.C.	\$2-10
5mA	\$2-60	8 Meter 1mA	\$2-10
10mA	\$2-60	VU Meter	\$3-30
50mA	\$2-60	1 amp. A.C.*	\$2-80
100mA	\$2-60	5 amp. A.C.*	\$2-80
500mA	\$2-60	10 amp. A.C.*	\$2-80
1 amp.	\$2-60	20 amp. A.C.*	\$2-80
5 amp.	\$2-60	30 amp. A.C.*	\$2-80

Type MR.52P. 2 1/2 in. square fronts.

50μA	\$2-25	5 amp.	\$1-70
80-0-80μA	\$2-10	10V. D.C.	\$1-60
100μA	\$2-10	20V. D.C.	\$1-60
100-0-100μA	\$1-87	50V. D.C.	\$1-60
500μA	\$1-87	300V. D.C.	\$1-60
1mA	\$1-75	15V. A.C.	\$1-80
500-0-500μA	\$1-70	300V. A.C.	\$1-80
1mA	\$1-70	8 Meter 1mA	\$1-85
5mA	\$1-70	VU Meter	\$2-25
10mA	\$1-70	1 amp. A.C.*	\$1-70
50mA	\$1-70	5 amp. A.C.*	\$1-70
100mA	\$1-70	10 amp. A.C.*	\$1-70
500mA	\$1-70	20 amp. A.C.*	\$1-70
1 amp.	\$1-70	30 amp. A.C.*	\$1-70

Type MR.52P. 3 1/2 in. x 3 1/2 in. fronts.

50μA	\$2-77	10V. D.C.	\$2-80
80-0-80μA	\$2-75	20V. D.C.	\$2-80
100μA	\$2-75	50V. D.C.	\$2-80
100-0-100μA	\$2-65	150V. D.C.	\$2-80
200μA	\$2-65	300V. D.C.	\$2-80
500μA	\$2-40	15V. A.C.	\$2-30
500-0-500μA	\$2-30	50V. A.C.	\$2-30
1mA	\$2-30	300V. A.C.	\$2-30
5mA	\$2-30	500V. A.C.	\$2-30
10mA	\$2-30	8 Meter 1mA	\$2-37
50mA	\$2-30	VU Meter	\$3-37
100mA	\$2-30	50mA A.C.*	\$2-30
500mA	\$2-30	100mA A.C.*	\$2-30
1 amp.	\$2-30	200mA A.C.*	\$2-30
5 amp.	\$2-30	500mA A.C.*	\$2-30
10 amp.	\$2-30	1 amp. A.C.*	\$2-30
15 amp.	\$2-30	5 amp. A.C.*	\$2-30
20 amp.	\$2-30	10 amp. A.C.*	\$2-30
30 amp.	\$2-30	20 amp. A.C.*	\$2-30
50 amp.	\$2-30	30 amp. A.C.*	\$2-30
8V. D.C.	\$2-30		

"SEW" BAKELITE PANEL METERS

Type MR.55. 3 1/2 in. square fronts.

25μA	\$2-50	1 amp.	\$1-95
50μA	\$2-75	2 amp.	\$1-95
50-0-50μA	\$2-35	5 amp.	\$1-95
100μA	\$2-35	15 amp.	\$1-95
100-0-100μA	\$2-25	30 amp.	\$1-95
500μA	\$2-30	50 amp.	\$1-95
1mA	\$1-95	5V. D.C.	\$1-95
1-0-1mA	\$1-95	10V. D.C.	\$1-95
5mA	\$1-95	20V. D.C.	\$1-95
10mA	\$1-95	50V. D.C.	\$1-95
50mA	\$1-95	150V. D.C.	\$1-95
100mA	\$1-95	300V. D.C.	\$1-95
500mA	\$1-95	50V. A.C.*	\$1-95
1 amp.	\$1-95	20 amp. A.C.*	\$1-95
1-0-1mA	\$1-85	150V. A.C.*	\$1-95
5mA	\$1-85	300V. A.C.*	\$1-95
10mA	\$1-85	500mA A.C.*	\$1-95
50mA	\$1-85	1 amp. A.C.*	\$1-95
100mA	\$1-85	5 amp. A.C.*	\$1-95
500mA	\$1-85	10 amp. A.C.*	\$1-95
		20 amp. A.C.*	\$1-95
		30 amp. A.C.*	\$1-95
		50 amp. A.C.*	\$1-95
		VU Meter	\$2-10

Type MR.55. 3 1/2 in. square fronts.

25μA	\$2-50	1 amp.	\$1-95
50μA	\$2-75	2 amp.	\$1-95
50-0-50μA	\$2-35	5 amp.	\$1-95
100μA	\$2-35	15 amp.	\$1-95
100-0-100μA	\$2-25	30 amp.	\$1-95
500μA	\$2-30	50 amp.	\$1-95
1mA	\$1-95	5V. D.C.	\$1-95
1-0-1mA	\$1-85	10V. D.C.	\$1-95
5mA	\$1-85	20V. D.C.	\$1-95
10mA	\$1-85	50V. D.C.	\$1-95
50mA	\$1-85	150V. D.C.	\$1-95
100mA	\$1-85	300V. D.C.	\$1-95
500mA	\$1-85	50V. A.C.*	\$1-95
		20 amp. A.C.*	\$1-95
		150V. A.C.*	\$1-95
		300V. A.C.*	\$1-95
		500mA A.C.*	\$1-95
		1 amp. A.C.*	\$1-95
		5 amp. A.C.*	\$1-95
		10 amp. A.C.*	\$1-95
		20 amp. A.C.*	\$1-95
		30 amp. A.C.*	\$1-95
		50 amp. A.C.*	\$1-95
		VU Meter	\$2-10

*MOVING IRON—ALLOTHERS MOVING COIL
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SEW EDUCATIONAL METERS



Type ED.107. Size overall 100mm x 90mm x 108mm. A new range of high quality moving coil instruments ideal for school experiments and other bench applications. 3" mirror scale. The meter movement is demonstrate internal working. Available in the following ranges:

50μA	\$5-00	20V. d.c.	\$4-40
100μA	\$4-85	50V. d.c.	\$4-40
1mA	\$4-40	300V. d.c.	\$4-40
80-0-80μA	\$4-85		
1-0-1mA	\$4-40	Dual range	
5mA d.c.	\$4-40	100mA/5A d.c.	\$4-85
5A d.c.	\$4-40	5V/50V d.c.	\$4-85
10V d.c.	\$4-40		

EDGWISE METERS

Type PE.70. 9 17/32 in. x 1 15/32 in. x 2 1/2 in. deep.

50μA	\$3-10	500μA	\$2-75
50-0-50μA	\$2-00	1mA	\$2-45
100μA	\$2-00	300V. A.C.	\$2-45
100-0-100μA	\$2-00	VU Meter	\$3-40
200μA	\$2-00		

Send for illustrated brochure on SEW Panel Meters—discounts for quantities.

MULTIMETERS for EVERY purpose!

ROUND SCALE TYPE PENCIL TESTER MODEL TS.68



Completely portable, simple to use pocket sized tester. Ranges: 0/3/30/300V AC and DC at 2,000 o.p.v. Resistance 0-20K ohms. ONLY \$1-97 P. & P. 13p



HIOKI MODEL 780X 20,000 O.P.V. Overload protection. 5/25/100/500/1000 VDC. 10/50/250/1000 VAC. 50 mA/250 mA. 20K/2 meg ohm. -5 to +62db. \$4.97. P. & P. 15p.

SKYWOOD SW-500

50K Ω/Volt. Mirror scale DC Volts 0.5/3/12/30/300/600. DC Current 20mA/6/600mA Resistance 10K/100K/1 Meg/10 Meg. Decibels -20 to +57 db. \$7.50. P. & P. 15p.



Model S-100TR MULTIMETER TRANSISTOR TESTER 100,000 o.p.v. MIRROR SCALE OVERLOAD PROTECTION 0/12—6/3/12/30/120/600 V DC. 0/12/600-2A/12/30-1A/12 Amp. DC. 0/10K/1 MEG/100 MEG. -70 to +70 db. 100 Ω mΩ. Transistor tester measures Alpha, beta and Ico. Complete with batteries, instructions and leads. \$13.50. P.P. 25p.



MODEL 5025 57 Ranges. Giant 5 1/2 in. Meter, Polarity Reverse Switch. Sensitivity: 50K/Volt D.C. 5K/Volt A.C. D.C. Volts: -125, -25, 1.25, 5, 10, 25, 50, 125, 250, 500, 1,000V. A.C. Volts: 1.5, 3, 5, 10, 25, 50, 125, 250, 500, 1,000V. D.C. Current: 25, 50mA, 2.5, 5, 25, 50, 250, 500mA, 5, 10 amp. Resistance: 2K, 10K, 100K, 1MEG, 10MEG. Decibels: -20 to +85 dB. \$12.50. P. & P. 17p.



MODEL 500 30,000 O.P.V with overload protection mirror scale 0/3/2-5/10/25/100/250/500/1,000 V. D.C. 0/2.5/10/25/100/250/500/1,000V. A.C. 0/50/50/50/500/500mA. 12 amp. D.C. 0/80K/6 Meg/60 Meg Ω. \$8.71. Post paid.

TE22 SINE SQUARE WAVE AUDIO GENERATORS

Sine: 20cps to 200 kc/s on 4 bands. Square: 20cps to 30 kc/s. Output impedance 5,000 ohms, 200/250V. A.C. operation. Supplied brand new and guaranteed with instruction manual and leads. \$17-50. Carr. 37p.



TKK LAB TESTER—100,000 O.P.V. 6 1/2 in. Scale buzzer short circuit Check. Sensitivity: 100,000 O.P.V. D.C. 5K Ω/Volt A.C. D.C. Volts: 5, 2.5, 10, 50, 250, 500, 1,000V. A.C. Volts: 3, 10, 50, 250, 500, 1,000V. D.C. Current: 10, 100μA, 1μA, 10, 500mA, 2.5, 10 amp. Resistance: 1K, 10K, 100K, 10MEG, 100MEG Ω. Decibels: -10 to +49 db. Plastic Case with Carrying Handle. Size 7 1/2 in. x 3 1/2 in. \$18.90. P. & P. 25p.

TE-20D RF SIGNAL GENERATOR

Accurate wide range signal generator covering 120 Kc/s-500 Mc/s on 6 bands. Directly calibrated Variable R.F. attenuator, audio output. Xtal socket for calibration. 220/240V. A.C. Brand new with instructions. \$15. Carr. 37p. Size 140 x 215 x 170 mm.

RUSSIAN 22 RANGE MULTIMETER

Model L-437 10,000 o.p.v. A first class portable instrument manufactured in the U.S.S.R. to the highest standards. Ranges: 2-5/10/50/250/500/1000V D.C. 2-5/10/50/250/500/1000V A.C. DC Current 100-1000μA/1000μA/1A. Resistance 300 ohms/3/30/300K/3M Ω. Complete with batteries and test leads, instructions and sturdy steel carrying case. OUR PRICE \$25-97 P. & P. 25p.

BELCO DA-20 SOLID STATE DECADE AUDIO OSCILLATOR

New high quality portable instrument. Sine 1 Hz to 100 KHz. Square 20 Hz to 20 KHz. Output max +10 dB (10 K ohms). Operation 220/240V. A.C. Brand new with instructions. \$15. Carr. 37p. Price \$27-50. Carr. 25p.

TO-3 PORTABLE OSCILLOSCOPE

3in. tube V amp. Sensitivity 0.1v p-p/CM. Bandwidth 1.5 cps-1.5 MHz. Input imp. 2 meg Ω 20pF X amp. sensitivity 0.5v. p-p/M. Bandwidth 1.5 cps-800K Hz. Input imp. 2 meg Ω 20pF. Time base, 5 ranges 10 cps-300 KHz. Synchronization. Internal external. Illuminated scale 140 x 215 x 330 mm. Weight 13 1/2 lb. 220-240V. A.C. Supplied brand new with handbook. \$40-00. Carr. 50p

240° Wide Angle 1mA Meters

MW1-6 60mm square \$3-97
 MW1-8 80mm square \$4-97
 P. & P. extra

HONEYWELL DIGITAL VOLTMETER VT.100

Can be panel or bench mounted. Basic meter measures 1 volt D.C. but can be used to measure a wide range of AC and DC volt, current and ohms with optional plug in cards. Specification: Accuracy: ± 0.2% ± 1 digit. Resolution: 1mV. Number of digits: 3 plus fourth overrange digit. Overrange: 100% (up to 1.999). Input Impedance: 1000 Meg ohm. Measuring cycle: 1 per second. Adjustment: Automatic zeroing, full scale adjustment against an internal reference voltage. Overload: to 100V. D.C. Input: Fully floating (3 poles). Input power: 110-230V. A.C. 50/60 cycles. Overall size: 5 1/2 in. x 2 1/2 in. x 3 1/2 in. AVAILABLE BRAND NEW AND FULLY GUARANTEED AT APPROX. HALF PRICE. \$49-97. Carr. 50p.

TRANSISTORISED L.C.R. A.C. MEASURING BRIDGE

A new portable bridge offering excellent range and accuracy at low cost. Ranges: R. 1 Ω-11-1 meg Ω. L. 1 Ω-111 Ω. C. 6 Ranges ± 1% ± 100 pF ± 1100mFd. 6 Ranges ± 2%. TURNS RATIO 1:1/1000-1:1100. 6 Ranges ± 1%. Bridge voltage at 1,000 cps. Operated from 9 volts. 100μA Meter indication. Attractive 2 tone metal case. Size 7 1/2 x 5 x 2 1/2 in. \$20. P. & P

SEMI-CONDUCTORS/VALVES

ALL DEVICES BRAND NEW AND FULLY GUARANTEED

Transistors	2N3416	2N3417	2N3418	2N3419	2N3420	2N3421	2N3422	2N3423	2N3424	2N3425	2N3426	2N3427	2N3428	2N3429	2N3430	2N3431	2N3432	2N3433	2N3434	2N3435	2N3436	2N3437	2N3438	2N3439	2N3440	2N3441	2N3442	2N3443	2N3444	2N3445	2N3446	2N3447	2N3448	2N3449	2N3450	2N3451	2N3452	2N3453	2N3454	2N3455	2N3456	2N3457	2N3458	2N3459	2N3460	2N3461	2N3462	2N3463	2N3464	2N3465	2N3466	2N3467	2N3468	2N3469	2N3470	2N3471	2N3472	2N3473	2N3474	2N3475	2N3476	2N3477	2N3478	2N3479	2N3480	2N3481	2N3482	2N3483	2N3484	2N3485	2N3486	2N3487	2N3488	2N3489	2N3490	2N3491	2N3492	2N3493	2N3494	2N3495	2N3496	2N3497	2N3498	2N3499	2N3500																																																																																						
20301	20p	2N3416	22p	2N3417	22p	2N3418	22p	2N3419	22p	2N3420	22p	2N3421	22p	2N3422	22p	2N3423	22p	2N3424	22p	2N3425	22p	2N3426	22p	2N3427	22p	2N3428	22p	2N3429	22p	2N3430	22p	2N3431	22p	2N3432	22p	2N3433	22p	2N3434	22p	2N3435	22p	2N3436	22p	2N3437	22p	2N3438	22p	2N3439	22p	2N3440	22p	2N3441	22p	2N3442	22p	2N3443	22p	2N3444	22p	2N3445	22p	2N3446	22p	2N3447	22p	2N3448	22p	2N3449	22p	2N3450	22p	2N3451	22p	2N3452	22p	2N3453	22p	2N3454	22p	2N3455	22p	2N3456	22p	2N3457	22p	2N3458	22p	2N3459	22p	2N3460	22p	2N3461	22p	2N3462	22p	2N3463	22p	2N3464	22p	2N3465	22p	2N3466	22p	2N3467	22p	2N3468	22p	2N3469	22p	2N3470	22p	2N3471	22p	2N3472	22p	2N3473	22p	2N3474	22p	2N3475	22p	2N3476	22p	2N3477	22p	2N3478	22p	2N3479	22p	2N3480	22p	2N3481	22p	2N3482	22p	2N3483	22p	2N3484	22p	2N3485	22p	2N3486	22p	2N3487	22p	2N3488	22p	2N3489	22p	2N3490	22p	2N3491	22p	2N3492	22p	2N3493	22p	2N3494	22p	2N3495	22p	2N3496	22p	2N3497	22p	2N3498	22p	2N3499	22p	2N3500	22p

Integrated Circuits	FJ1111	FJ1112	FJ1113	FJ1114	FJ1115	FJ1116	FJ1117	FJ1118	FJ1119	FJ1120	FJ1121	FJ1122	FJ1123	FJ1124	FJ1125	FJ1126	FJ1127	FJ1128	FJ1129	FJ1130	FJ1131	FJ1132	FJ1133	FJ1134	FJ1135	FJ1136	FJ1137	FJ1138	FJ1139	FJ1140	FJ1141	FJ1142	FJ1143	FJ1144	FJ1145	FJ1146	FJ1147	FJ1148	FJ1149	FJ1150	FJ1151	FJ1152	FJ1153	FJ1154	FJ1155	FJ1156	FJ1157	FJ1158	FJ1159	FJ1160	FJ1161	FJ1162	FJ1163	FJ1164	FJ1165	FJ1166	FJ1167	FJ1168	FJ1169	FJ1170	FJ1171	FJ1172	FJ1173	FJ1174	FJ1175	FJ1176	FJ1177	FJ1178	FJ1179	FJ1180	FJ1181	FJ1182	FJ1183	FJ1184	FJ1185	FJ1186	FJ1187	FJ1188	FJ1189	FJ1190	FJ1191	FJ1192	FJ1193	FJ1194	FJ1195	FJ1196	FJ1197	FJ1198	FJ1199	FJ1200																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
CA3000	180p	FJ1111	70p	SN7437	64p	CA3001	180p	FJ1112	70p	SN7440	20p	CA3002	180p	FJ1113	70p	SN7441	20p	CA3003	180p	FJ1114	70p	SN7442	20p	CA3004	180p	FJ1115	70p	SN7443	20p	CA3005	180p	FJ1116	70p	SN7444	20p	CA3006	180p	FJ1117	70p	SN7445	20p	CA3007	180p	FJ1118	70p	SN7446	20p	CA3008	180p	FJ1119	70p	SN7447	20p	CA3009	180p	FJ1120	70p	SN7448	20p	CA3010	180p	FJ1121	70p	SN7449	20p	CA3011	180p	FJ1122	70p	SN7450	20p	CA3012	180p	FJ1123	70p	SN7451	20p	CA3013	180p	FJ1124	70p	SN7452	20p	CA3014	180p	FJ1125	70p	SN7453	20p	CA3015	180p	FJ1126	70p	SN7454	20p	CA3016	180p	FJ1127	70p	SN7455	20p	CA3017	180p	FJ1128	70p	SN7456	20p	CA3018	180p	FJ1129	70p	SN7457	20p	CA3019	180p	FJ1130	70p	SN7458	20p	CA3020	180p	FJ1131	70p	SN7459	20p	CA3021	180p	FJ1132	70p	SN7460	20p	CA3022	180p	FJ1133	70p	SN7461	20p	CA3023	180p	FJ1134	70p	SN7462	20p	CA3024	180p	FJ1135	70p	SN7463	20p	CA3025	180p	FJ1136	70p	SN7464	20p	CA3026	180p	FJ1137	70p	SN7465	20p	CA3027	180p	FJ1138	70p	SN7466	20p	CA3028	180p	FJ1139	70p	SN7467	20p	CA3029	180p	FJ1140	70p	SN7468	20p	CA3030	180p	FJ1141	70p	SN7469	20p	CA3031	180p	FJ1142	70p	SN7470	20p	CA3032	180p	FJ1143	70p	SN7471	20p	CA3033	180p	FJ1144	70p	SN7472	20p	CA3034	180p	FJ1145	70p	SN7473	20p	CA3035	180p	FJ1146	70p	SN7474	20p	CA3036	180p	FJ1147	70p	SN7475	20p	CA3037	180p	FJ1148	70p	SN7476	20p	CA3038	180p	FJ1149	70p	SN7477	20p	CA3039	180p	FJ1150	70p	SN7478	20p	CA3040	180p	FJ1151	70p	SN7479	20p	CA3041	180p	FJ1152	70p	SN7480	20p	CA3042	180p	FJ1153	70p	SN7481	20p	CA3043	180p	FJ1154	70p	SN7482	20p	CA3044	180p	FJ1155	70p	SN7483	20p	CA3045	180p	FJ1156	70p	SN7484	20p	CA3046	180p	FJ1157	70p	SN7485	20p	CA3047	180p	FJ1158	70p	SN7486	20p	CA3048	180p	FJ1159	70p	SN7487	20p	CA3049	180p	FJ1160	70p	SN7488	20p	CA3050	180p	FJ1161	70p	SN7489	20p	CA3051	180p	FJ1162	70p	SN7490	20p	CA3052	180p	FJ1163	70p	SN7491	20p	CA3053	180p	FJ1164	70p	SN7492	20p	CA3054	180p	FJ1165	70p	SN7493	20p	CA3055	180p	FJ1166	70p	SN7494	20p	CA3056	180p	FJ1167	70p	SN7495	20p	CA3057	180p	FJ1168	70p	SN7496	20p	CA3058	180p	FJ1169	70p	SN7497	20p	CA3059	180p	FJ1170	70p	SN7498	20p	CA3060	180p	FJ1171	70p	SN7499	20p	CA3061	180p	FJ1172	70p	SN7500	20p	CA3062	180p	FJ1173	70p	SN7501	20p	CA3063	180p	FJ1174	70p	SN7502	20p	CA3064	180p	FJ1175	70p	SN7503	20p	CA3065	180p	FJ1176	70p	SN7504	20p	CA3066	180p	FJ1177	70p	SN7505	20p	CA3067	180p	FJ1178	70p	SN7506	20p	CA3068	180p	FJ1179	70p	SN7507	20p	CA3069	180p	FJ1180	70p	SN7508	20p	CA3070	180p	FJ1181	70p	SN7509	20p	CA3071	180p	FJ1182	70p	SN7510	20p	CA3072	180p	FJ1183	70p	SN7511	20p	CA3073	180p	FJ1184	70p	SN7512	20p	CA3074	180p	FJ1185	70p	SN7513	20p	CA3075	180p	FJ1186	70p	SN7514	20p	CA3076	180p	FJ1187	70p	SN7515	20p	CA3077	180p	FJ1188	70p	SN7516	20p	CA3078	180p	FJ1189	70p	SN7517	20p	CA3079	180p	FJ1190	70p	SN7518	20p	CA3080	180p	FJ1191	70p	SN7519	20p	CA3081	180p	FJ1192	70p	SN7520	20p	CA3082	180p	FJ1193	70p	SN7521	20p	CA3083	180p	FJ1194	70p	SN7522	20p	CA3084	180p	FJ1195	70p	SN7523	20p	CA3085	180p	FJ1196	70p	SN7524	20p	CA3086	180p	FJ1197	70p	SN7525	20p	CA3087	180p	FJ1198	70p	SN7526	20p	CA3088	180p	FJ1199	70p	SN7527	20p	CA3089	180p	FJ1200	70p	SN7528	20p

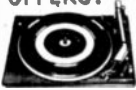
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EM80	45p	EM81	45p	EM82	45p	EM83	45p	EM84	30p	EM85	45p	EM86	45p	EM87	45p	EM88	45p	EM89	45p	EM90	45p	EM91	45p	EM92	45p	EM93	45p	EM94	45p	EM95	45p	EM96	45p	EM97	45p	EM98	45p	EM99	45p	EM100	45p	EM101	45p	EM102	45p	EM103	45p	EM104	45p	EM105	45p	EM106	45p	EM107	45p	EM108	45p	EM109	45p	EM110	45p	EM111	45p	EM112	45p	EM113	45p	EM114	45p	EM115	45p	EM116	45p	EM117	45p	EM118	45p	EM119	45p	EM120	45p	EM121	45p	EM122	45p	EM123	45p	EM124	45p	EM125	45p	EM126	45p	EM127	45p	EM128	45p	EM129	45p	EM130	45p	EM131	45p	EM132	45p	EM133	45p	EM134	45p	EM135	45p	EM136	45p	EM137	45p	EM138	45p	EM139	45p	EM140	45p	EM141	45p	EM142	45p	EM143	45p	EM144	45p	EM145	45p	EM146	45p	EM147	45p	EM148	45p	EM149	45p	EM150	45p	EM151	45p	EM152	45p	EM153	45p	EM154	45p	EM155	45p	EM156	45p	EM157	45p	EM158	45p	EM159	45p	EM160	45p	EM161	45p	EM162	45p	EM163	45p	EM164	45p	EM165	45p	EM166	45p	EM167	45p	EM168	45p	EM169	45p	EM170	45p	EM171	45p	EM172	45p	EM173	45p	EM174	45p	EM175	45p	EM176	45p	EM177	45p	EM178	45p	EM179	45p	EM180	45p	EM181	45p	EM182	45p	EM183	45p	EM184	45p	EM185	45p	EM186	45p	EM187	45p	EM188	45p	EM189	45p	EM190	45p	EM191	45p	EM192	45p	EM193	45p	EM194	45p	EM195	45p	EM196	45p	EM197	45p	EM198	45p	EM199	45p	EM200	45p	EM201	45p	EM202	45p	EM203	45p	EM204	45p	EM205	45p	EM206	45p	EM207	45p	EM208	45p	EM209	45p	EM210	45p	EM211	45p	EM212	45p	EM213	45p	EM214	45p	EM215	45p	EM216	45p	EM217	45p	EM218	45p	EM219	45p	EM220	45p	EM221	45p	EM222	45p	EM223	45p	EM224	45p	EM225	45p	EM226	45p	EM227	45p	EM228	45p	EM229	45p	EM230	45p	EM231	45p	EM232	45p	EM233	45p	EM234	45p</

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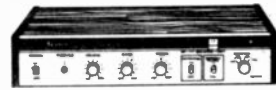
BBE	
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310	\$9-40
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GL75	\$29-05
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LID75	\$33-55
LID72	\$33-55
G99	\$22-50
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GL45P	\$54-30
LID85	\$4-80
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OUR PRICE £19.50 Carr. 37p.

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Garrard 8P25 111/M44-7	\$20-35
Garrard 8P25 111/M44-E	\$22-30
8P25 111/1800 (Play on P&C)	\$19-75
Garrard AP76/3000	\$29-50
Garrard AP76/M75E	\$32-95
Garrard AP76/M75EJ	\$34-90
BBR McDonald MP60/AT55	\$19-25
Golding GL72/G800	\$24-50
Golding GL75/G800	\$29-70
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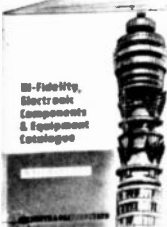
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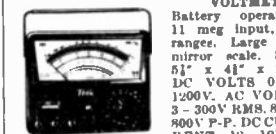
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6 TRANSISTOR HIGH QUALITY TUNER. SIZE ONLY 6x4x2 1/2 in. 3 I.F. stages. Double tuned discriminator. Simple output to feed most amplifiers. Operates on 9 V battery. Coverage 88-108MHz. Ready built ready for use. Fantastic value for money. £6-37†. P. & P. 12p. Stereo multiplex adaptors £4-97†.

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8 Amp	8 Amp
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12 Amp	12 Amp
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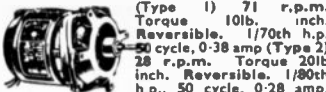
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AC277 20p	BF242 18p	OC155 25p	
AC278 20p	BF243 18p	OC156 25p	
AC279 20p	BF244 18p	OC157 25p	
AC280 20p	BF245 18p	OC158 25p	
AC281 20p	BF246 18p	OC159 25p	
AC282 20p	BF247 18p	OC160 25p	
AC283 20p	BF248 18p	OC161 25p	
AC284 20p	BF249 18p	OC162 25p	
AC285 20p	BF250 18p	OC163 25p	
AC286 20p	BF251 18p	OC164 25p	
AC287 20p	BF252 18p	OC165 25p	
AC288 20p	BF253 18p	OC166 25p	
AC289 20p	BF254 18p	OC167 25p	
AC290 20p	BF255 18p	OC168 25p	
AC291 20p	BF256 18p	OC169 25p	
AC292 20p	BF257 18p	OC170 25p	
AC293 20p	BF258 18p	OC171 25p	
AC294 20p	BF259 18p	OC172 25p	
AC295 20p	BF260 18p	OC173 25p	
AC296 20p	BF261 18p	OC174 25p	
AC297 20p	BF262 18p	OC175 25p	
AC298 20p	BF263 18p	OC176 25p	
AC299 20p	BF264 18p	OC177 25p	
AC300 20p	BF265 18p	OC178 25p	
AC301 20p	BF266 18p	OC179 25p	
AC302 20p	BF267 18p	OC180 25p	
AC303 20p	BF268 18p	OC181 25p	
AC304 20p	BF269 18p	OC182 25p	
AC305 20p	BF270 18p	OC183 25p	
AC306 20p	BF271 18p	OC184 25p	
AC307 20p	BF272 18p	OC185 25p	
AC308 20p	BF273 18p	OC186 25p	
AC309 20p	BF274 18p	OC187 25p	
AC310 20p	BF275 18p	OC188 25p	
AC311 20p	BF276 18p	OC189 25p	
AC312 20p	BF277 18p	OC190 25p	
AC313 20p	BF278 18p	OC191 25p	
AC314 20p	BF279 18p	OC192 25p	
AC315 20p	BF280 18p	OC193 25p	
AC316 20p	BF281 18p	OC194 25p	
AC317 20p	BF282 18p	OC195 25p	
AC318 20p	BF283 18p	OC196 25p	
AC319 20p	BF284 18p	OC197 25p	
AC320 20p	BF285 18p	OC198 25p	
AC321 20p	BF286 18p	OC199 25p	
AC322 20p	BF287 18p	OC200 25p	
AC323 20p	BF288 18p	OC201 25p	
AC324 20p	BF289 18p	OC202 25p	
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AC365 20p	BF330 18p	OC243 25p	
AC366 20p	BF331 18p	OC244 25p	
AC367 20p	BF332 18p	OC245 25p	
AC368 20p	BF333 18p	OC246 25p	
AC369 20p	BF334 18p	OC247 25p	
AC370 20p	BF335 18p	OC248 25p	
AC371 20p	BF336 18p	OC249 25p	
AC372 20p	BF337 18p	OC250 25p	

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7400	Quad 2-input NAND gates	20p	18p	14p	10p	8p
7401	Quad 2-input open collector NAND gates	20p	18p	14p	10p	8p
7402	Quad 2-input NOR gates	20p	18p	14p	10p	8p
7403	Quad 2-input open collector NAND gates	20p	18p	14p	10p	8p
7404	Hex inverters	20p	18p	14p	10p	8p
7405	Hex inverters with open collector output	20p	18p	14p	10p	8p
7410	Triple 3-input NAND gates	20p	18p	14p	10p	8p
7413	Dual 4-input Schmitt triggers	30p	27p	25p	22p	20p
7420	Dual 4-input NAND gates	20p	18p	14p	10p	8p
7430	Single 8-input NAND gates	20p	18p	14p	10p	8p
7440	Dual 4-input NAND buffer gates	20p	18p	14p	10p	8p
7442	BCD-Decimal decoder/Nixie driver	75p	72p	70p	60p	55p
7443	BCD-Decimal decoder (4-10-line) TTL O/P	75p	72p	70p	60p	55p
7447	BCD-Decimal 7 seg. decoder/indicator driver	1-75	1-60	1-45	1-30	1-15
7448	BCD-Decimal 7 seg. decoder/driver TTL O/P	1-75	1-60	1-45	1-30	1-15
7450	Expand dual 2-input AND-OR-INVERT gates	20p	18p	14p	10p	8p
7451	Dual 2-wide 2-input AND-OR-INVERT gates	20p	18p	14p	10p	8p

Build yourself a TRANSISTOR RADIO

NEW! ROAMER 10 WITH VHF INCLUDING AIRCRAFT

10 TRANSISTORS. 9 TUNABLE WAVEBANDS, MW1, MW2, LW, SW1, SW2, SW3, TRAWLER BAND, VHF AND LOCAL STATIONS AND AIRCRAFT BAND

Built in Ferrite Rod Aerial for MW/LW. Retractable, chrome plated Telescopic Aerial, for peak short wave and VHF listening. Push Pull output using 600mw Transistors. Car Aerial and Tape Record Sockets. Switched Earpiece Socket complete with Earpiece. 10 Transistors plus 3 Diodes. 8" x 2 1/2" Speaker. Air Spaced ganged Tuning Condenser with VHF section. Volume on/off, Wave Change and Tone Control. Attractive Case in black with silver blocking. Size 9" x 7" x 4". Easy to follow instructions and diagrams. Parts price list and easy build plans 30p (FREE with parts).

Total building cost

£8-50

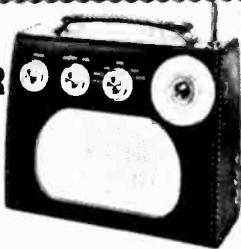
P. P. & Ins. 50p

(Overseas P. & P. £1)



ROAMER EIGHT Mk I

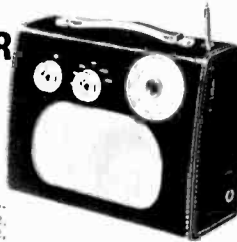
NOW WITH VARIABLE TONE CONTROL



7 Tunable Wavebands: MW1, MW2, LW, SW1, SW2, SW3 and Trawler Band. Built in Ferrite Rod Aerial for MW and LW. Retractable chrome plated Telescopic aerial for Short Waves. Push pull output using 600mw Transistors. Car aerial and Tape record sockets. Selectivity switch. Switched earpiece socket complete with earpiece. 8 transistors plus 3 diodes. 8" x 2 1/2" Speaker. Air spaced ganged tuning condenser. Volume/on/off, tuning, wave change and tone controls. Attractive case in rich chestnut shade with gold blocking. Size 9 x 7 x 4in. approx. Easy to follow instructions and diagrams. Parts Price List and Easy Build Plans 25p (FREE with parts).

Total building cost **£6-98** P. P. & Ins. 41p. (Overseas P. & P. £1)

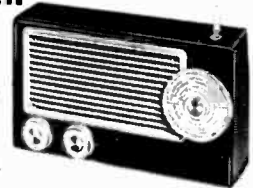
ROAMER SEVEN MK IV



7 Tunable Wavebands: MW1, MW2, LW, SW1, SW2, SW3 and Trawler Band. Extra Medium waveband provides easier tuning of Radio Luxembourg, etc. Built in ferrite rod aerial for MW and LW. Retractable 4 section 24in. chrome plated telescopic aerial for SW. Socket for Car Aerial. Powerful push-pull output. 7 transistors and 2 diodes. 8" x 2 1/2" speaker. Air spaced ganged tuning condenser. Volume/on/off, tuning and wave change controls. Attractive case with carrying handle. Size 9 x 7 x 4in. approx. Easy to follow instructions and diagrams. Parts price list and easy build plans 15p (FREE with parts). Earpiece with plug and switched socket for private listening. 30p extra.

Total building costs **£5-98** P. P. & Ins. 41p. (Overseas P. & P. £1)

ROAMER SIX



6 Tunable Wavebands: MW, LW, SW1, SW2, Trawler band plus an extra M.W. band for easier tuning of Luxembourg, etc. Sensitive ferrite rod aerial and telescopic aerial for Short Waves. 3in. Speaker. 8 stages—6 transistors and 2 diodes. Attractive black case with red grille, dial and black knobs with polished metal inserts. Size 9 x 5 1/2 x 2 1/2in. approx. Easy build plans and parts price list 15p (FREE with parts). Earpiece with plug and switched socket for private listening 30p extra.

Total building costs **£3-98** P. P. & Ins. 20p. (Overseas P. & P. £1)

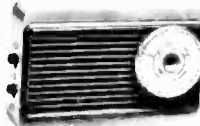
POCKET FIVE



3 Tunable Wavebands: MW, LW, Trawler Band with extended M.W. band for easier tuning of Luxembourg, etc. 7 stages—5 transistors and 2 diodes, supersensitive ferrite rod aerial, fine tone moving coil speaker. Attractive black and gold case. Size 5 1/2 x 3 1/2 x 3/4in. Easy build plans and parts price list 10p (FREE with parts). Earpiece with plug and switched socket for private listening 30p extra.

Total building costs **£2-29** P. P. & Ins. 21p. (Overseas P. & P. 63p)

TRANSONA FIVE



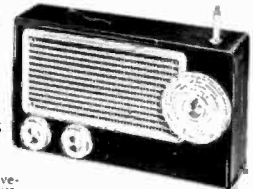
5 TRANSISTORS AND 2 DIODES

3 Tunable Wavebands: MW, LW and Trawler Band. 7 stage—5 transistors and 2 diodes, ferrite rod aerial, tuning condenser volume control, fine tone moving coil speaker. Attractive case with red speaker grille. Size 6 1/2 x 4 1/2 x 1 1/2in. Easy build plans and parts price list 10p (FREE with parts). Earpiece with plug and switched socket for private listening 30p extra.

Total building costs **£2-50** P. P. & Ins. 22p. (Overseas P. & P. 63p)

TRANS EIGHT

8 TRANSISTORS and 3 DIODES



6 Tunable Wavebands: MW, LW, SW1, SW2, SW3 and Trawler Band. Sensitive ferrite rod aerial for M.W. and L.W. Telescopic aerial for Short Waves. 3in. Speaker. 8 improved type transistors plus 3 diodes. Attractive case in black with red grille, dial and black knobs with polished metal inserts. Size 9 x 5 1/2 x 2 1/2in. approx. Push pull output. Battery economiser switch for extended battery life. Ample power to drive a larger speaker. Parts price list and easy build plans 25p (FREE with parts). Earpiece with plug and switched socket for private listening 30p extra.

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| TRANSONA FIVE <input type="checkbox"/> | ROAMER SIX <input type="checkbox"/> |
| POCKET FIVE <input type="checkbox"/> | EDU-KIT <input checked="" type="checkbox"/> |

Parts price list and plans for

Name **STUART Pearce**
Address **Cropwell House Selston Lane annesley wood House**

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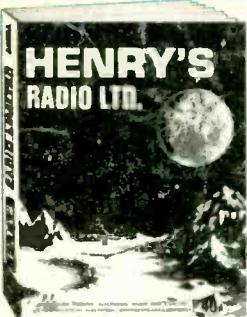
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