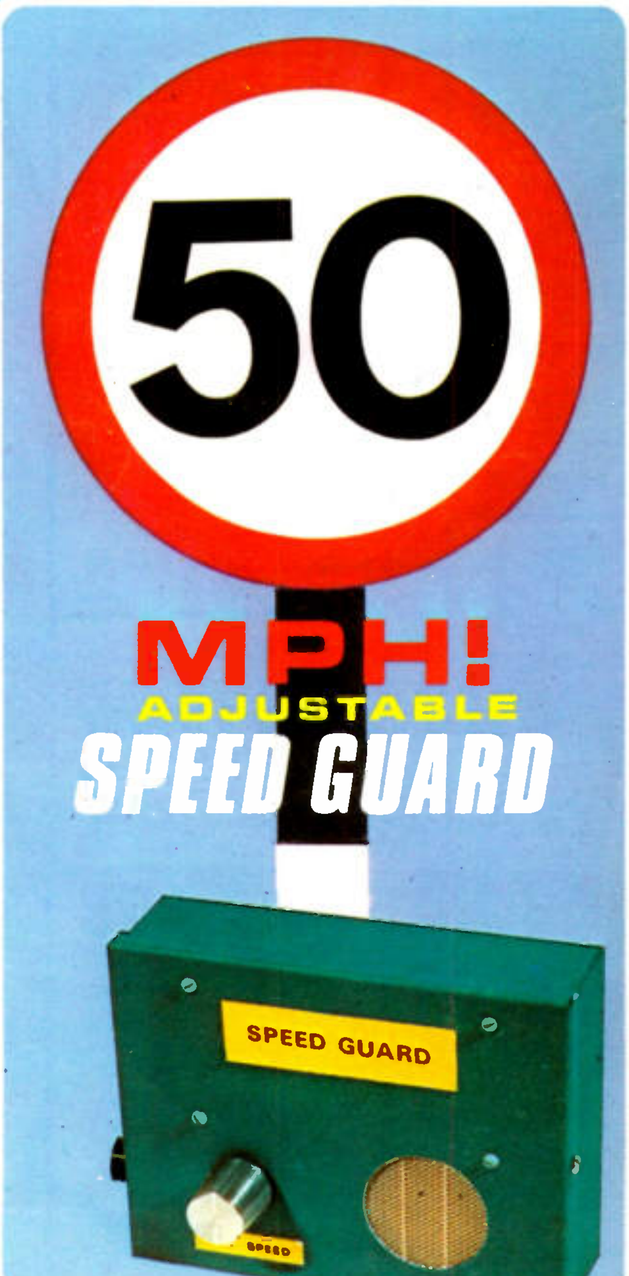
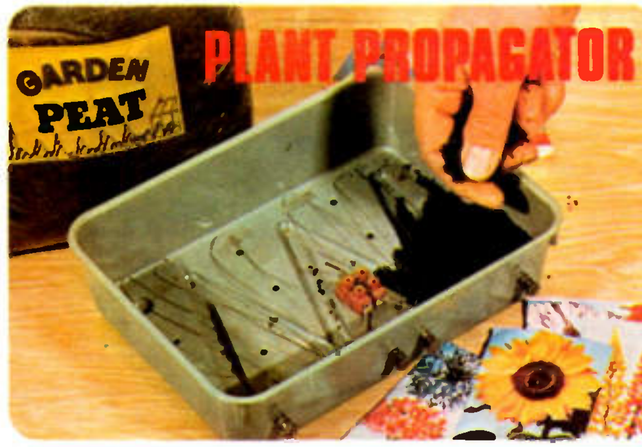
An exciting hobby.... for everyone

everyday electronics

MAR. 74
20p





Free INSIDE...

INTEGRATED CIRCUIT
DATA CHART

everyday electronics

VOL. 3 NO. 3 MARCH 1974

FREE INSIDE

INTEGRATED CIRCUIT DATA CHART

CONSTRUCTIONAL PROJECTS

GENERAL FEATURES

Publisher's Annual Subscription Rate, including postage to any part of the world, £2·95. International Giro facilities Account No. 5122007. State reason for payment "message to payee". Address to Everyday Electronics, Subscription Department, Carlton House, Great Queen Street, London, WC2E 9PR. Binders for volumes 1 to 3 (state which) and indexes for volume 1 available for £1.25 and 11p respectively, including postage, from Binding Department, at the above address.

We are unable to supply back copies of Everyday Electronics or reprints of articles and cannot undertake to answer readers' letters requesting designs, modifications or information on commercial equipment or subjects not published by us. An s.a.e. should be enclosed for a personal reply. Letters concerning published articles should be addressed to: The Editor, those concerning advertisements to: The Advertisement Manager, both at the address shown opposite.

See Page 147 for more details

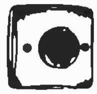
KITS FOR PREVIOUS PROJECTS

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.

If reprint of data is required add 10p

HOME SENTINEL. "Ward off the unwanted intruder" No elaborate setting up or wiring required. Kit of parts £4·35.
"SNAP" INDICATOR. Press your button first and your opponent is blocked also suitable for Quiz games and reaction testing. Kit of parts £1·10.
RECORD PLAYER. Good quality at a reasonable price good enough for classical records and pop. Kit of parts £6·10.
WINDSCREEN WIPER CONTROL. Wet dirty road Drizzle Fog Smeared screen Scraping wipers combat these with add-on wiper control. Kit of parts £2·50.
FUZZ BOX. Add weird and interesting effects to guitar playing with this solid state Fuzz box. Kit of parts £2·50.
PHOTOGRAPHIC COLOUR TEMPERATURE METER. Must for colour photographer get the colours right gives quick indication of filters necessary for correction in any light. Can be used with natural or Studio lighting. Kit of parts £3·58
ASTRON M.W. RADIO. A simple M.W. reflex circuit receiver easy to build £3·30.
REMOTE TEMPERATURE COMPARATOR. Measures small temperature changes in liquids or gasses fish tank, photographic solution thermostatically controlled rooms etc. Kit £5·25.
RAIN WARNING ALARM. Keep your washing dry with this automatic alarm device. Kit £2 20
WAA WAA PEDAL. Add excitement and sound vibration to your music. Kit £3·50.
ELECTRO LAUGH. Laughter simulator also useful electronic alarm. Kit of parts £2·20.
SOIL MOISTURE METER. Many plants are killed through over-watering this meter measures soil moisture at root depth probes can be left permanently beside the plant – indicator remotely housed could monitor several plants. Kit £3·90.
SIGNAL INJECTOR. A useful pocket instrument for fault finding in radios and amplifiers. Kit £1·10
BABY ALARM. Keep a check on the kids this device will give you peace of mind as you watch T.V. Kit £4·40.
SIMPLE CALCULATOR. Teaching aid for multiplication can be used for quick checks. Kit £3·10
POWER SUPPLY UNIT. Just right for testing low voltage circuits a simple stabilised supply providing 0-16 volts D.C. continuously variable. Kit £5·20.
METAL LOCATOR. A simple easy to construct self-contained metal locator giving a meter indication of buried metal. Kit £5·00.
AUDIO TONE GENERATOR. Makes electronic music covers range from 50 2000 hz. Specifically designed for use with tape recorder. Kit £2·25
LIGHT TO SOUND CONVERTER. Produces an audio tone the frequency of which is dependent on the light level. Kit £2·15.
SHAVER INVERTER. Provides 240v 50hz from 12 volt car battery gives approx. 10 watts which is enough for most shavers. Kit £4·35.
ELECTRONOME. Electronic Metronome with pulse frequency continuously variable from 40 225 beats per minute. Kit £2·15.
THROUGH LENS LIGHT METER. A simple light meter for use with single lens reflex camera. Kit £4 35.
MEDIUM AND LONG WAVE RADIO TUNER. A simple radio tuner for use with almost any amplifier. Kit £3·25.
INFRA RED BURGLAR ALARM. Uses an invisible, reflected beam to detect intruders when beam is intercepted a power output is switched on for up to one minute. Kit £4·35.
CASSETTE TAPE POWER SUPPLIES. Two units to power a cassette tape player or recorder one from the mains. Price £2·50. Two from the car battery price £1·40.
REACTOMATIC. A reaction testing game that can also be a quiz answering indicator. Kit £3·30.
ELECTRONIC MOUSE TRAP. A humane mouse trap catches them alive so that you can release them in the park. Kit £3·25.
TRANSISTOR TESTER. A rapid tester for checking most transistors tests transistors in an oscillator circuit and gives audible indication of goodness. Kit £2 15.
BIT SAVER. Prolongs life of soldering iron bit prevents pitting. Kit £1 95.
ICE WARNING DEVICE. A device that can be set to indicate 'ice' conditions or similar temperature levels. Kit £1·55.
AUDIO COLOUR UNIT. Add a colour dimension to your audio equipment. This unit will modulate three lamps in accord with Bass middle and treble notes of any music. Kit of parts £7·20.
U.H.F. T.V. AERIAL. A simple aerial for U.H.F. to reception on your band could improve your reception immensely. Kit £1·65.
DAMP LOCATOR. Easily carried in your pocket this little unit gives visible indication of damp. Kit £1·25.
ENLARGER & EXPOSURE METER. For D.I.Y. photographer £5·00.
EGG TIMER. Simple timer with audible warning. £4 15.

THYRISTOR LIGHT DIMMER



Domestic model for any lamp up to 250 watt. Mounted on switch plate to fit in place of standard switch. Virtually no radio interferences. Price £2·95. Industrial model 5 amp module with control knob not on switch plate £3·30.

DISTRIBUTION PANELS

Just what you need for work bench or lab. 4 × 13 amp sockets in metal box to take standard 13 amp fused plugs and on/off switch with neon warning light. Supplied complete with 6 feet of flex cable. Wired up ready to work. £2·50 plus 25 p P. & P.

CD CAR IGNITION

This system which has proved to be amazingly efficient. We offer kit of parts as P.W. Circuit £6·55 plus 20p p. & p. Deluxe model with prepared circuit board £7·95. When ordering please state whether for positive or negative systems.

TEACH IN '74

A new beginners series started with the October issue of this magazine, we will be supplying all the parts for this. The initial kit covering all components required for the first 6 months is available post and VAT included—price £7. A special feature about our version of this kit is the 4½" × 3" meter 0–100uA meter. As the author says, a large meter is so much easier to read than a small one.

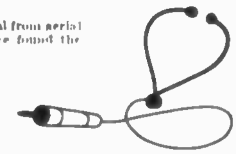
MIGHTY MIDGET

Probably the tiniest possible radio as described in Practical Wireless, January '73. All electronic parts £2 20 post paid

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 £1·95 plus 13p post and insurance Made up model also available. £2·95 plus 25p post & p

RADIO STETHOSCOPE

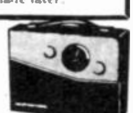


Easiest way to fault find traces signal from aerial to speaker when signal stops you've found the fault. Use it on Radio, TV amplifier, anything – complete kit comprises two special transistors and all parts including probe tube and crystal earpiece. £2·20 twin stethoset instead of earpiece 83p extra post and ins. 20p.

SPEED GUARD
PLANT PROPAGATOR
A.F. OSCILLATOR

To receive parts for these and other feature projects, send the quoted approximate amounts and any cash adjustment can be made later.

GOOD COMPANION



We can now offer these again in i.c. version using Ferranti ZN414 and Mullard AF Modules 1172. Excellent tone wood cabinet. Cabinet size approx. 11in wide × 8in. high × 3in. deep. Complete assembly instructions £5·75 plus 25p post and ins.

STANDARD WAFER SWITCHES

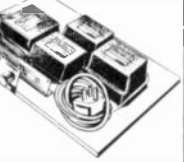
Standard size 1¼" wafer– silver-plated 5-amp contact, standard ¼" spindle–2" long with locking washer and nut.

No. of Poles	2 way	3 way	4 way	5 way	6 way	8 way	9 way	10way	12way
1 pole	44p	44p	44p	44p	44p	44p	44p	44p	44p
2 poles	44p	44p	44p	44p	44p	44p	44p	77p	77p
3 poles	44p	44p	44p	44p	77p	77p	77p	£1·04	£1·04
4 poles	44p	44p	44p	77p	77p	77p	77p	£1·32	£1·32
5 poles	44p	44p	77p	77p	£1·04	£1·04	£1·04	£1·60	£1·60
6 poles	44p	77p	77p	77p	£1·04	£1·04	£1·04	£1·87	£1·87
7 poles	77p	77p	77p	£1·04	£1·32	£1·32	£1·32	£2·15	£2·15
8 poles	77p	77p	77p	£1·04	£1·32	£1·32	£1·32	£2·42	£2·42
9 poles	77p	77p	£1·04	£1·04	£1·60	£1·60	£1·60	£2·70	£2·70
10 poles	77p	77p	£1·04	£1·32	£1·60	£1·60	£1·60	£3·00	£3·00
11 poles	77p	£1·04	£1·04	£1·32	£1·87	£1·87	£1·87	£3·25	£3·25
12 poles	77p	£1·04	£1·04	£1·32	£1·87	£1·87	£1·87	£3·52	£3·52

SWITCH TRIGGER MATS

So thin is undetectable under carpet but will switch on with slightest pressure. For burglar alarms, shop doors, etc. 24in × 18in £1·69. 13in × 10in £1·21.

MULLARD UNILEX STEREO SYSTEM



There is no doubt that it is a good system, we believe that for the money it is without comparison. We demonstrate gladly at our Tamworth Road depot. Prices of the individual items for this:

1 Unilex Amplifier	Ref. EP.9000	£1·60
1 Unilex Amplifier	Ref. EP.9000	£1·60
1 Unilex Pre-Amp	Ref. EP.9001	£1·98
1 Unilex Power Unit	Ref. EP.9002	£2·53
1 Control panel kit with spun aluminium faced knobs	.. .. ..	£3·30

Or the complete outfit £11·30 post paid.
Pair of 15 ohm speakers made by E.M.I. are also available if required, price £3·30 the pair. No extra postage if ordered with the above, otherwise add 25p.

KITS FOR PREVIOUS PROJECTS CONT. FROM LEFT HAND COL.

NEON NOVELTY. Interesting modern ornamental device £1·65.
INDICATOR AUDIBLE WARNING. Add this audible warning device to car indicators or dash panel warning lights and your attention will be instantly drawn to the warning lamp kit. £1·20.
NIGHT LIGHT SWITCH. A simple control to dim a lamp. Kit £1·10.
GENERAL PURPOSE AMPLIFIER. An audio amplifier of reasonable quality for use with radio tuners audio oscillators, record decks electric guitars, etc. Kit £4·90.
HOME INTERCOM. Keep in touch with this simple, easily connected good quality two way intercom. Kit £4·00
FLASHING LIGHT METRONOME. For use in the musical field and the laboratory where an audible not on click could get lost or become annoying. Kit £1·40.
MINI ORGAN. A three octave, stylus operated organ neatly and simply constructed on a printed circuit board. Kit £4·75.
RAIN ALARM II. Sounds an audible alarm as soon as the first rain drops fall. Kit £3·00.
CASSETTE AMPLIFIER. Boosts the output from cassette tape recorders and transistor radios. Kit £4·50.
AUDIO SIGNAL MIXER. Where you want to mix speech and music, and to fade them in and out no tape enthusiast should be without this. Kit £3·90.
AUTO FAN. A thermostatic control for car engine fan, gives quicker warming up time, etc. Kit £2·35.
SLAVE FLASH. Photos taken with a single flash have a "flat" appearance – a second flash correctly positioned overcomes this. This unit enables a second (or third) flash to be automatically triggered. Kit £1·85.
ELECTRONIC DOORBELL. Not in fact a bell but an electronic circuit that produces an unusual sound when the button is pressed. Kit £4·00.
WAA WAA. Add another sound dimension to your guitar or organ. Kit £1·50.
I.C. RADIO. A fantastic personal radio uses a special I.E., is small, easy to build, yet gives excellent results. Kit £3·10.
AQUARIUM THERMOSTAT. A very sensitive electronic thermostat. Can also be used for other applications requiring fine control of temperature. Kit £2·85.
TRAIN CONTROLLER. With most control there is considerable loss of power on low speeds this unit overcomes this problem and makes slow speed realistic. Kit £3·15.
3 GANG TUNING CONDENSERS. 500pf each section ideal for transmitter or communications receiver. 61p.
STEREO HEADPHONE ADAPTER. Enables one or two sets of stereo headphones to be used with an amplifier. £1·85.
4 BAND TRF RECEIVER. Receives amateur, shipping and normal medium wavebands. £3
GAS ALARM. A simple alarm detects gases, vapours and smoke. £5·90
3 BY 3 GAME. Adds fun to any game which uses dice, or is novel game for two players. £3·10
AUTO-WATERING FOR PLANTS £2·80.
TREMELO UNIT £2·10.
BABY SNATCH ALARM £2·00.

OUR 1974 CATALOGUE LISTING HUNDREDS OF BARGAINS. NOW AVAILABLE. PRICE 30p. POST PAID.

RECORD PLAYBACK HEADS (TRUVOX)

Individual prices of these are:
2 track record playback heads 50p each
4 track record playback heads 78p each.
Erase heads are also available separately—
2 track 33p 4 track 55p

RESETTABLE FUSE

How long does it take you to renew a fuse? Time yourself when next one blows. Then reckoning your time at £1 per hour see now quickly our resettable fuse (auto circuit breaker) will pay for itself. Price only £1·10 each or £12 per dozen, specify 5, 10 or 15 amp —*simply fit in place of switch.*

HEATERS AND ELEMENTS

Tangential Heater Unit, 2KW, price £2·75 plus 40p post, etc. Tangential Heater Unit, 3KW, price £3·88 plus 40p post. etc. Control Switch for above 44p each. 300 watt Heat and Light Lamp. price 99p plus 25p post. 5KW Blower Heater, price £19·19. 1000 watt Heat and Light Tube (Mullard) with special holder and terry clips, price £2·20 plus 30p post. 2000 watt Mouldable Metal Clad Element. 8 ft. long—£1·10. Radiant Cooker Rings, 2000 watt, 83p each 1000 watt Fire Spirals, 22p each. 750 watt Flat Elements, 33p each. Black Heat Element Metal Clad 900 watt 14" × 1¼"—88p each. Oven Element Metal Clad, 2000, watt, "W" shaped, 14½" long × 9" wide 93p each.

NEED A SPECIAL SWITCH

Double Leaf Contact. Very slight pressure closes both contacts. 8p each 10 for 60p. Plastic pushrod suitable for operating. 6p each. 10 for 54p.

TERMS:—Please add 10% V.A.T. and also send postage where quoted.

J. BULL (ELECTRICAL) LTD.

(Dept. E.E.), 7 Park Street, Croydon CRO 1YD

Callers to: 102 3 Tamworth Road, CROYOON.

LASKYS

INCORPORATING LASKYS RADIO AND G. W. SMITH & CO. (RADIO).

Send s.a.e. for 8 page list of Semi-Conductors & Valves

NEW SINCLAIR PROJECT 80 HI-FI MODULES & PACKAGES

Z40 Power Amplifier	£5.45
Z60 Power Amplifier	£6.95
Stereo 80 Pre-Amplifier	£11.95
Active Filter Unit	£6.95
Project 805	£26.95
PZ5 Power Supply	£4.98
PZ6 Power Supply	£7.98
PZ8 Power Supply	£7.98
2 x Z40/Stereo 80/PZ5	£25.00
2 x Z40/Stereo 80/PZ6	£27.75
2 x Z60/Stereo 80/PZ8	£30.45
Transformer for PZ8	£4.05

POST & PACKING 35p each

AT201 Decade ATTENUATOR

Frequency range 0–200kHz. Attenuator 0–111dB, 0.1dB steps. Impedence 600 ohms. Input power maximum 30dBm. Size: 180 x 90 x 55mm.

OUR PRICE £12.50 P&P 37p

BELCO Sine Square Wave CR OSCILLATOR

Sine 18 x 200,000Hz Square 18 x 20,000 Hz. Maximum output +10dB (10k ohms) Operates from internal batteries. Attractive two tone case. Size: 196 x 127 x 50mm

OUR PRICE £17.50 P&P 17p

SWR METER Model SWR3

Handy SWR meter for transmitter antenna alignment, with built-in field strength meter. Accuracy 5%, Impedence 52' Indicator 100uA DC. Full scale 5 section collapsible antenna. Size 145 x 50 x 60mm.

OUR PRICE £4.25 P&P 25p

MODEL TE15 GRID DIP METER

Transistorised. Operates as Grid Dip, Oscillator, Absorbtion Wave Meter and Oscillating Detector. Frequency range 440kHz–280MHz in six coils. 500uA meter. 9V battery operation. Size: 180 x 80 x 40mm.

OUR PRICE £15.00 P&P 20p

BV05 Vernier TUNING DIAL

App. 7:1 ratio planetary drive vernier dial. Log scale 0–180 degrees. Blank scales 1–5. Dial size 128 x 76mm. Overall size 190 x 117 x 41mm. deep including knob and coupling. ¼" diam. shaft

OUR PRICE £1.62 P&P 15p

YAMABISHI VARIABLE VOLTAGE TRANSFORMERS

Excellent quality at low cost. All models—Input 230V 50/60Hz. Variable output 0–260V

MODEL S260 GENERAL PURPOSE BENCH MOUNTING

		P&P
1A	£8.75	30p
2.5A	£10.00	35p
5A	£14.70	37p
8A	£25.50	50p
10A	£28.10	75p
12A	£29.50	100p
20A	£72.50	125p
25A	£72.50	130p
40A	£103.10	150p

MODEL S260B

2.5A	£8.75	30p
1A	£10.00	35p

POWER RHEOSTATS

High quality ceramic construction. Windings embedded in vitreous enamel. Heavy duty brush wiper. Continuous rating. Wide range available ex-stock. Single hole fixing. ¼" diameter shafts. Bulk quantities available.

25 WATT 10/25/50/100/250/500/1000 Ohms. £1.15 P&P 10p

50 WATT 10/25/50/100/250/500/1000/2500/5000 Ohms. £1.62 P&P 10p

100 WATT 1/5/10/25/50/100/250/500/1000/2500 Ohms. £2.34 P&P 15p

RUH6 Reflex Horn Speaker

Built-in driver unit. Impedence 16 ohms. Power rating 10W. Response 380–7000Hz. Size app. 6" x 6". Weather and shock protected.

OUR PRICE £4.97 P&P 30p

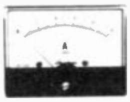
SEW CLEAR PLASTIC PANEL METERS

USED EXTENSIVELY BY INDUSTRY, GOVERNMENT DEPARTMENTS, EDUCATIONAL AUTHORITIES ETC.

Over 200 ranges in stock—other ranges to order. Quantity discounts available. Send for fully illustrated brochure.

*Items with asterisk are Moving Iron type, all others are Moving Coil

CLEAR PLASTIC MODEL SD640
Size: 85 x 64mm



50uA	£3.35
100uA	£3.30
200uA	£3.30
500uA	£3.25
50-0-50uA	£3.35
100-0-100uA	£3.30
1mA	£3.20
5mA	£3.20
10mA	£3.20
50mA	£3.20
100mA	£3.20
500mA	£3.20
1A DC	£3.20
5A DC	£3.20
10A DC	£3.20
5V DC	£3.20
20V DC	£3.20
50V DC	£3.20
300V DC	£3.20
15V AC	£3.30
300V AC	£3.30
VU Meter	£3.45

CLEAR PLASTIC MODEL SW100
Size: 100 x 80mm

50uA	£4.55
100uA	£4.35
500uA	£4.10
50-0-50uA	£4.35
100-0-100uA	£4.30
1mA	£3.85
1A DC	£3.95
5A DC	£3.95
20V DC	£3.95
50V DC	£3.95
300V DC	£3.95
300V AC	£4.00
VU Meter	£4.75

EDGWISE MODEL PE70
Size: 90 x 34mm

50uA	£4.15
100uA	£3.95
200uA	£3.75
500uA	£3.50
50-0-50uA	£3.95
100-0-100uA	£3.85
1mA	£3.50
300V AC	£3.50
VU Meter	£4.25

MODEL ED107 EDUCATIONAL METER
Size: 100 x 90 x 150mm including terminals

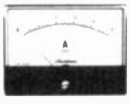
A range of high quality moving coil instruments ideal for school experiments and other bench applications. 3" mirror scale. The meter movement is easily accessible to demonstrate internal working.

50uA	£7.60
100uA	£7.05
50-0-50uA	£7.05
1A DC	£6.55
5A DC	£6.55
5V DC	£6.55
10V DC	£6.55
15V DC	£6.55
20V DC	£6.55
50V DC	£6.55
300V DC	£6.55
500mA/5A DC	£7.70
5V/50V DC	£7.70
5V/15V DC	£7.70
1A/15A DC	£7.70

CLEAR PLASTIC MODEL 85P
Size: 120 x 110mm

50uA	£4.85
100uA	£4.70
200uA	£4.45
500uA	£4.30
50-0-50uA	£4.70
100-0-100uA	£4.45
500-0-500uA	£4.30
1mA	£4.30
1-0-1mA	£4.30
5mA	£4.30
10mA	£4.30
50mA	£4.30
100mA	£4.30
500mA	£4.30
1A DC	£4.30
5A DC	£4.30
15A DC	£4.30
30A DC	£4.35
10V DC	£4.30
20V DC	£4.30
50V DC	£4.30
150V DC	£4.30
300V DC	£4.30
15V AC	£4.35
300V AC	£4.35
S Meter 1mA	£4.30
VU Meter	£5.00
1A AC	* £4.30
5A AC	* £4.30
10A AC	* £4.30
20A AC	* £4.30
30A AC	* £4.30

CLEAR PLASTIC MODEL SD830
Size: 110 x 83mm



50uA	£3.75
100uA	£3.70
200uA	£3.65
500uA	£3.45
50-0-50uA	£3.75
100-0-100uA	£3.70
1mA	£3.40
5mA	£3.40
10mA	£3.40
50mA	£3.40
100mA	£3.40
500mA	£3.40
1A DC	£3.40
5A DC	£3.40
10A DC	£3.40
5V DC	£3.40
10V DC	£3.40
20V DC	£3.40
50V DC	£3.40
300V DC	£3.40
15V AC	£3.65
300V AC	£3.65
VU Meter	£3.85

CLEAR PLASTIC MODEL 45P
Size: 50 x 50mm

50uA	£3.00
100uA	£2.85
200uA	£2.75
500uA	£2.70
50-0-50uA	£2.90
100-0-100uA	£2.75
500-0-500uA	£2.65
1mA	£2.65
5mA	£2.65
10mA	£2.65
50mA	£2.65
100mA	£2.65
500mA	£2.65
1A DC	£2.65
5A DC	£2.65
10V DC	£2.65
20V DC	£2.65
50V DC	£2.65
300V DC	£2.65
15V AC	£2.70
300V AC	£2.70
S Meter 1mA	£2.75
VU Meter	£3.00
1A AC	* £2.65
5A AC	* £2.65
10A AC	* £2.65
20A AC	* £2.65
30A AC	* £2.65

CLEAR PLASTIC MODEL 38P
Size: 42 x 42mm

50uA	£2.80
100uA	£2.70
200uA	£2.65
500uA	£2.50
50-0-50uA	£2.75
100-0-100uA	£2.65
500-0-500uA	£2.50
1mA	£2.50
1-0-1mA	£2.50
2mA	£2.50
5mA	£2.50
10mA	£2.50
20mA	£2.50
50mA	£2.50
100mA	£2.50
150mA	£2.50
200mA	£2.50
300mA	£2.50
500mA	£2.50
750mA	£2.50
1A DC	£2.50
2A DC	£2.50
5A DC	£2.50
10A DC	£2.50
15A DC	£2.50
20A DC	£2.50
3V DC	£2.50
10V DC	£2.50
15V DC	£2.50
20V DC	£2.50
50V DC	£2.50
100V DC	£2.50
150V DC	£2.50
300V DC	£2.50
500V DC	£2.50
750V DC	£2.50
15V AC	£2.55
50V AC	£2.55
150V AC	£2.55
300V AC	£2.55
500V AC	£2.55
S Meter 1mA	£2.55
VU Meter	£2.90

CLEAR PLASTIC MODEL SD460
Size: 59 x 46mm

50uA	£3.10
100uA	£3.05
200uA	£3.00
500uA	£2.80
50-0-50uA	£3.10
100-0-100uA	£3.05
1mA	£2.85
5mA	£2.85
10mA	£2.85
50mA	£2.85
100mA	£2.85
500mA	£2.85
1A DC	£2.85
5A DC	£2.85
10A DC	£2.85
5V DC	£2.85
10V DC	£2.85
50V DC	£2.85
300V DC	£2.85
15V AC	£3.00
300V AC	£3.00
VU Meter	£3.20

POSTAGE & PACKING 15p

CLEAR PLASTIC MODEL 65P
Size: 86 x 78mm

50uA	£4.10
100uA	£3.45
200uA	£3.35
500uA	£3.05
50-0-50uA	£3.45
100-0-100uA	£3.40
500-0-500uA	£2.85
1mA	£2.85
5mA	£2.85
10mA	£2.85
50mA	£2.85
100mA	£2.85
500mA	£2.85
1A DC	£2.85
5A DC	£2.85
10A DC	£2.85
15A DC	£2.85
20A DC	£2.85
30A DC	£3.10
50A DC	£3.20
5V DC	£2.85
10V DC	£2.85
20V DC	£2.85
50V DC	£2.85
150V DC	£2.85
300V DC	£2.85
15V AC	£3.10
50V AC	£3.10
150V AC	£3.10
300V AC	£3.10
500V AC	£3.10
S Meter 1mA	£3.15
VU Meter	£4.10
1A AC	* £2.85
5A AC	* £2.85
10A AC	* £2.85
20A AC	* £2.85
30A AC	* £2.85
50mA AC	* £2.85
100mA AC	* £2.85
200mA AC	* £2.85
500mA AC	* £2.85

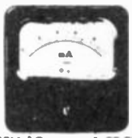
BAKELITE MODEL S80 Enlarged Window
Size: 80 x 80mm

50uA	£3.85
100uA	£3.75
500uA	£3.35
50-0-50uA	£3.75
100-0-100uA	£3.65
1mA	£3.00
1A DC	£3.30
5A DC	£3.30
20V DC	£3.30
50V DC	£3.30
300V DC	£3.30
300V AC	£3.30
VU Meter	£4.05

CLEAR PLASTIC MODEL 52P
Size: 60 x 60mm

50uA	£3.85
100uA	£3.30
500uA	£2.90
50-0-50uA	£3.35
100-0-100uA	£3.25
1mA	£2.75
5mA	£2.75
10mA	£2.75
50mA	£2.75
100mA	£2.75
500mA	£2.75
1A DC	£2.75
5A DC	£2.75
10V DC	£2.75
20V DC	£2.75
50V DC	£2.75
300V DC	£2.75
15V AC	£2.85
300V AC	£2.85
S Meter 1mA	£2.85
VU Meter	£3.95
1A AC	* £2.75
5A AC	* £2.75
10A AC	* £2.75
20A AC	* £2.75
30A AC	* £2.75

BAKELITE MODEL 65 Size: 80 x 80mm



25uA	£5.05
50uA	£3.90
100uA	£3.30
500uA	£3.00
50-0-50uA	£3.35
100-0-100uA	£3.30
500-0-500uA	£2.85
1mA	£2.85
1-0-1mA	£2.85
5mA	£2.85
10mA	£2.85
50mA	£2.85
100mA	£2.85
500mA	£2.85
1A DC	£2.85
2A DC	£2.85
5A DC	£2.85
15A DC	£2.85
30A DC	£2.85
50A DC	£2.85
5V DC	£2.85
10V DC	£2.85
20V DC	£2.85
50V DC	£2.85
150V DC	£2.85
300V DC	£2.85
30V AC	* £2.85
50V AC	* £2.85
150V AC	* £2.85
300V AC	* £2.85
500V AC	£2.85
VU Meter	£4.00
1A AC	* £2.85
5A AC	* £2.85
10A AC	* £2.85
20A AC	* £2.85
30A AC	* £2.85
50A AC	* £2.85
500mA AC	£2.85
50mV DC	£3.20
100mV DC	£3.20

240° Wide Angle 1mA METERS

MW 1–6 60x60mm £3.97 P&P 15p

MW 1–8 80x80mm £4.97 P&P 15p

AUTO TRANSFORMERS

0/115/250V. Step up or step down. Fully shrouded.

80W	£2.75	P&P 18p
150W	£3.50	P&P 18p
300W	£4.50	P&P 23p
500W	£6.95	P&P 33p
1000W	£9.50	P&P 38p
1500W	£12.50	P&P 43p
2250W	£20.95	P&P 50p
5000W	£44.95	P&P £1

Also see following pages

ALL PRICES EXCLUDE VAT

LASKYS

INCORPORATING LASKYS RADIO AND G. W. SMITH & CO. (RADIO).

SINCLAIR CAMBRIDGE CALCULATOR

To build yourself. Complete kit of parts with step by step instructions to build a full specification pocket sized calculator.

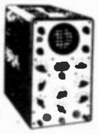
OUR PRICE £24.95 P&P free

ALSO AVAILABLE READY BUILT
Recommended Price £29.95
OUR PRICE £27.20 P&P 25p

Also available–
SINCLAIR EXECUTIVE
Recommended Price £39.00
OUR PRICE £35.45 P&P 25p

SINCLAIR EXECUTIVE with MEMORY
Recommended Price £49.00
OUR PRICE £40.75 P&P 25p

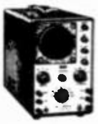
C15 PULSE OSCILLOSCOPE



For display of pulsed and periodic waveforms in electronic circuits. VERT. AMP Bandwidth: 10MHz. Sensitivity at 100kHz VRMS/mm: 0.1–25. HOR. AMP. Bandwidth: 500kHz. Sensitivity ay 100kHz VRMS/mm: 0.3–25. Preset triggered sweep 1–3000usec. Free running 20–200 kHz in nine ranges. Calibrator pips. 220 x 360 x 430mm. 115–230V AC.

OUR PRICE £39.00 Carr. paid

TO3 Portable OSCILLOSCOPE



3" tube. Y amp sensitivity 0.1Vp-p/CM. Bandwidth 1.5Hz–1.5MHz. Input Impedance: 2 MOhms, 25pF. X amp. sensitivity: 0.9Vp-p/CM. Bandwidth 1.5Hz–800kHz. Input impedance 2 Meg Ohms, 20pF. Time base, five ranges 10Hz to 300kHz. Synchronisation, Internal or external. Illuminated scale 140 x 215 x 330mm. Weight 15½lbs. 220/240V AC. Supplied brand new with handbook.

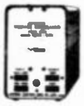
OUR PRICE £52.50 P&P 50p

RUSSIAN C116 Double Beam OSCILLOSCOPE

5 MHz pass band. Separate Y1 and Y2 amplifiers. Rectangular 8" x 4" CRT. Calibrated triggered sweep from 0.2usec to 100 milli-sec/cm. Free running time base, 50Hz–1MHz. Built-in time base Calibrator and amplitude Calibrator. Supplied complete with all accessories and instruction manual.

OUR PRICE £87.00 Carr. paid

MCA220 Automatic Voltage Stabiliser



Input 88–125V AC or 176–250 V AC. Output 120V AC or 240V AC. 200V A rating.

OUR PRICE £11.97 P&P 50p

PS1008 Regulated POWER SUPPLY UNIT

Solid state. Output 6, 9 or 12V DC up to 3 Amp. Meter to monitor current. Input 220/240V AC. Size: 100 x 82 x 150mm.

OUR PRICE £11.97 P&P 25p

PS200 Regulated POWER SUPPLY UNIT

Solid state. Variable output 5–20V DC up to 2 Amp. Independent meters to monitor voltage and current. Output 220/240V AC. Size: 180 x 136 x 98mm.

OUR PRICE £19.95 P&P 25p

EMI LOUDSPEAKERS

Model 350 13 x 8" with single tweeter/crossover 20–20,000Hz. 15 watts RMS. Available 8 or 15 ohms.

OUR PRICE £7.25 each P&P 37p

Model 450 13 x 8" with twin tweeter/crossover. 55–13,000Hz. 8 watts RMS. Available 8 or 15 ohms

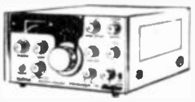
OUR PRICE £3.62 each P&P 25p

Also see previous pages

ALL PRICES EXCLUDE VAT

SUPER VALUE TOP QUALITY TRIO communications equipment

TRIO JR599 RECEIVER



Nine wave-bands covering 1.8–29.7 MHz, 144–146MHz and 10MHz WWV SSB, CW, AM and FM. AF output is more than 1 watt. S Meter. Squelch control. BFO. Variable AF and RF controls. 4–16 ohm output and jack for phones. Power requirement 100/240V AC, 12/14V DC. Size: 270 x 140 x 310mm.

Our Price £132.50 CARR. PAID

TRIO 9R59DS RECEIVER

Four bands covering 550kHz to 30 MHz continuous and electrical bandspread on 10, 15, 20, 40, and 80 mtrs. 8 valve plus 7 diode circuit. 4 to 8 ohm output and phone jack. SSB–CW, ANL, variable BFO. S Meter and separate band spread dial. IF frequency 445kHz, audio output 1½ watt. Variable RF and AF gain controls. 115/250V AC, with instructions.

Our Price £42.50 CARR. PAID

TRIO JR310 SSB RECEIVER

Covers 3.5, 7, 14, 21, 28, 28.5 and 29.1MHz bands and WWV 15MHz. SSB, AM and CW. AF output more than 1W. Crystal controlled BFO for SSB. S Meter, ANL etc. AC 110/120–220/240V. Size: 330 x 179 x 310mm.

OUR PRICE £75.00 Carr. paid

TRIO TR2200 RECEIVER

Fully transistorised portable VHF transceiver Will transmit and receive on six channels between 144–146MHz. 1 watt transmitter. 12V DC internal or external supply. Built-in charger for Ni-Cad cells. Power/volume switch, squelch control, channel selector, mic. socket, earphone/external speaker socket. Complete with microphone and 144.48, 144.72 & 145.32 crystals. Size: 134 x 58 x 180mm.

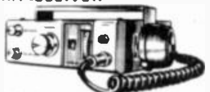
OUR PRICE £79.50 Carr. paid

UNR30 RECEIVER

Four bands covering 550 KHz/30MHz BFO. Built-in speaker. Operates from 220/240V AC. Brand new with instructions.

OUR PRICE £15.75 P&P 37p

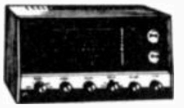
BELTEK W5400 CAR TRANSCEIVER



Solid state mobile transceiver for 12 volt DC neg. Transmits and receives on any 12 of 28 channels between 144 and 146MHz. Power output 10W and 1W switchable. Controls: On/off/volume, squelch and channel selector. Internal 3" speaker. Complete with dynamic mic. PTT switch, three sets of crystals for 144.48, 144.6 and 145MHz, mounting bracket and instructions. Size: 150 x 70 x 220mm.

OUR PRICE £75.00 P&P 50p

LAFAYETTE HA600 Receiver



General coverage 150–400kHz, 550 kHz–30MHz. FET front and 2 mechanical filters, product detector. Noise limiter, variable BFO, S Meter, Bandspread and RF gain. 220/240V AC or 12V DC. Brand new with instructions.

OUR PRICE £50.00 P&P 50p

SH628 STEREO HEADPHONES

Outstanding value. With soft ear pads and adjustable headband. 8–16 ohms. 20–20,000Hz. Complete with lead and stereo plug.

OUR PRICE £1.87 P&P 30p

LH02S STEREO HEADPHONES

Light weight headphones with padded ear pieces. 4/16 ohms 20–20,000Hz. Complete with 6' lead and plug.

OUR PRICE £1.97 P&P 30p

TE1018 Deluxe Mono High Impedance Headset.

Sensitive magnetic headset with soft ear pads. Impedance 2,600 ohms (600 ohms DC). Frequency response: 200–4,000Hz.

OUR PRICE £2.25 P&P 30p

OH02S STEREO HEADPHONES

Wonderful value and excellent performance combined. Adjustable head band. Impedance 8 ohms 20–12,000Hz. Complete with lead and plug.

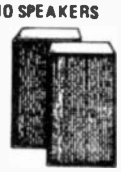
OUR PRICE £2.25 P&P 30p

BH001 HEADSET and Boom Microphone

Moving coil. Ideal for language teaching, communications etc. Headphone impedance 16 ohms. Microphone impedance 200 ohms.

OUR PRICE £5.95 P&P 30p

SPECIAL BARGAIN !! STEREOSOUND SPEAKERS



Matched pair of stereo bookshelf speakers. Deluxe teak veneered finish. Size: 368 x 229 x 190mm. 8 ohms. 8 watts RMS. 15 watts peak. Complete with Din lead.

OUR PRICE £12.95 P&P 50p

HIGH QUALITY CONSTRUCTION KITS

JOSTY KIT

WE ARE APPOINTED STOCKISTS AT ALL BRANCHES

All kits are complete with comprehensive easy to follow instructions and covered by full guarantee.

Post and Packing 15p per kit.

AF20 Mono amplifier	£4.80
AF30 Mono pre-amplifier	£2.61
AF310 Mono amplifier	£5.91
AT5 Auto light control	£2.58
AT30 Photo cell switch unit	£5.70
AT50 400W Light dimmer/speed control	£4.80
AT55 1,300W Light control/speed control	£5.70
AT56 2,200W Light dimmer/speed control	£6.90
AT60 1 channel light control	£7.80
AT65 3 channel light control unit	£14.55
HF61 MW transistor radio	£3.33
HF65 FM Transmitter	£2.70
HF75 FM transistor radio	£2.88
HF310 FM tuner unit	£15.81
HF325 Deluxe FM tuner unit	£24.12
HF330 FM stereo decoder	£9.96
HF395 Aerial amplifier for AM/FM bands I, II, & III	£1.77
GP310 Stereo pre-amplifier	£21.27
GU330 Tremolo unit	£7.50
NT10 PSU 100mA/9–12V	£6.15
NT300 Professional stabilised PSU, 2 x 30V, 2.2A	£12.51
NT305 Transistor converter 12/15V AC/DC to 6V, 7.5V or 9V DC	£4.50
NT310 PSU 240V AC to 2 x 18V DC at 2A	£4.80
NT315 PSU 240V AC to 4.5–15V DC at 500mA	£9.57
AE1 100mW output stage	£1.65
AE2 Pre-amplifier	£1.26
AE3 Diode receiver	£2.00
AE4 Flasher	£1.09
AE5 Astable multivibrator	£1.06
AE6 Monostable multivibrator	£1.02
AE7 RC generator	£1.06
AE8 Bass filter	99
AE9 Treble filter	99
AE10 CCIR filter	99

NEW FROM JOSTY-KIT 'Amateur Electronics'

The professional book for the amateur –covers the subject from basic principles to advanced electronic techniques. Complete with circuit board for making ten of the kits listed above.

OUR PRICE £3.30 (No VAT)
P & P 25p plus VAT

FRUSTRATED EXPORT ORDER !!

Philco Ford 5245 Mains Tape Recorder.

2 track BSR deck with push button controls for easy operation. Tape counter and volume control Complete with hand microphone, direct recording lead, 1,200' reel of tape and spare reel. 200/250V AC. Fully guaranteed.

OUR PRICE £17.50 P&P 75p

Philco Ford 5248 Mains Tape Recorder.

Four track, two speeds. Piano key type controls, tape counter, record ing level meter, volume and tone controls etc. Complete with hand, microphone lead for direct recording 1,800' of tape and spare reel. 200/250V AC. Fully guaranteed.

OUR PRICE £27.50 P&P 75p

KE630 3 Station INTERCOM

Master and two sub-stations. Can be used on desk or wall mounted. Complete with cable and batteries

OUR PRICE £5.25 P&P 50p

SPECIAL PURCHASE!!

BSR 8 Track Player Chassis

Famous BSR 8track chassis as used in model TO8S complete with silver and black escutcheon, ready to fit into cabinet. Output 125mV. 240V AC. Overall size app. 195 x 215 x 80mm.

OUR PRICE £8.95 P&P 50p

MP7 MIXER-PREAMPLIFIER

5 Microphone inputs each with individual gain controls enabling complete mixing facilities. Battery operated. Size: 235 x 127 x 76mm. Inputs: Mics. 3 x 3mV 50k; 2 x 3mV 600 ohms. Phono. Mag. 4mV 50k; Phono Ceramic 100mV 1 Meg. Output 250mV 100k.

OUR PRICE £8.97 P&P 20p

FM TUNER CHASSIS

6 transistor high quality tuner. Size only 153 x 101 x 63mm 3 IF stages. Double tuned discriminator. Ample output to feed most amplifiers. Operates on 9V battery. Covers 88–108MHz. Ready built, ready for use. Fantastic value for money.

OUR PRICE £5.95 P&P 20p

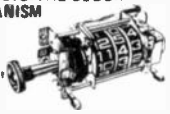
A1018 FM TUNER

Specification as above FM chassis but complete in cabinet with on/off switch. Size: 184 x 85 x 127mm.

OUR PRICE £9.65 P&P 30p

Stereo multiplex adaptor £4.97

OT55B DIGITAL CLOCK MECHANISM



Features 24 hour alarm setting with built in buzzer On/off and auto alarm 'sleep' switch. Illuminated rotary dial with hours, minutes and seconds. Automatically turns off radio, TV, light etc. and with auto-switching will turn on again when required. 240V AC operation. Switch rating 250V. 3 Amp.

OUR PRICE £5.95 P&P 30p

BINATONE OS100 Digital Clock

240V mains operation. Ivory case with large clear numbers for hours, minutes and seconds. Size 150 x 76 x 82mm.

OUR PRICE £4.50 P&P 30p

AUDIOTRONIC AHA101 Stereo Headphone Amplifier

All silicon, transistor amplifier operates from magnetic, ceramic or tuner inputs with twin stereo headphone outputs and separate volume controls for each channel. Operates from 9V battery. INPUTS: 5mV and 100mV. OUTPUT: 50mV per channel.

OUR PRICE £7.50 P&P 20p

A complete kit!

The kit comes to you packaged in a heavy-duty polystyrene container. It contains all you need to assemble your Sinclair Cambridge.
Assembly time is about 3 hours.

Contents:

1. Coil.
2. Large-scale integrated circuit.
3. Interface chip.
4. Thick-film resistor pack.
5. Case mouldings, with buttons, window and light-up display in position.
6. Printed circuit board.
7. Keyboard panel.
8. Electronic components pack (diodes, resistors, capacitors, transistor).
9. Battery clips and on/off switch.
10. Soft wallet.

This valuable book – free!
If you just use your Sinclair Cambridge for routine arithmetic – for shopping, conversions, percentages, accounting, tallying, and so on – then you'll get more than your money's worth.

But if you want to get even more out of it, you can go one step further and learn how to unlock the full potential of this piece of electronic technology.

How? It's all explained in this unique booklet, written by a leading calculator design consultant. In its fact-packed 32 pages it explains, step by step, how you can use the Sinclair Cambridge to carry out complex calculations.

sinclair

Sinclair Radionics Ltd, London Road,
St Ives, Huntingdonshire
Reg. no: 699483 England
VAT Reg. no: 213 8170 88

Why only Sinclair can make you this offer
The reason's simple: only Sinclair – Europe's largest electronic calculator manufacturer – have the necessary combination of skills and scale.

Sinclair Radionics are the makers of the Executive – the smallest electronic calculator in the world. In spite of being one of the more expensive of the small calculators, it was a runaway best-seller. The experience gained on the Executive has enabled us to design and produce the Cambridge at this remarkably low price.

But that in itself wouldn't be enough. Sinclair also have a very long experience of producing and marketing electronic kits. You may have used one, and you've almost certainly heard of them – the Sinclair Project 60 stereo modules.

It seemed only logical to combine the knowledge of do-it-yourself kits with the knowledge of small calculator technology.
And *you* benefit!

Take advantage of this money-back, no-risks offer today
The Sinclair Cambridge is fully guaranteed. Return your kit within 10 days, and we'll refund your money without question. All parts are tested and checked before despatch – and we guarantee a correctly-assembled calculator for one year.

Simply fill in the preferential order form below and slip it in the post today.

Price in kit form: £24·95 + £2·50 VAT. (Total: £27·45)
Price fully built: £29·95 + £3·00 VAT. (Total: £32·95)

EE 3 74

To: Sinclair Radionics Ltd, London Road, St Ives, Huntingdonshire, PE17 4HJ

Please send me

☐ a Sinclair Cambridge calculator kit at £24·95 + £2·50 VAT (Total: £27·45)

☐ a Sinclair Cambridge calculator ready built at £29·95 + £3·00 VAT (Total: £32·95)

*I enclose cheque for £ , made out to Sinclair Radionics Ltd, and crossed.

*Please debit my *Barclaycard/Access account. Account number ______

Name ______

Address ______

*Delete as required.

PLEASE PRINT

everyday electronics

CLASS DISTINCTION

Things aren't always what they appear to be. This certainly applies in the case of electronic circuits. For example, when trying to classify projects into "simple" or "complex" just what criteria does one apply? A cursory inspection of a circuit diagram and a count of the components does not necessarily provide a true guide, especially where integrated circuits (i.c.'s) are included.

Clearly there are two different methods by which an electronic project can be "weighed." One is by considering, in its entirety, the electronic system involved. This provides an instructive insight into the fundamental principles upon which the project is based, and certainly is a rewarding exercise for the serious student.

The second method relies upon consideration of the purely material form of the project, and is based essentially upon the number and nature of the components employed. For the general constructor this is the more realistic yardstick to adopt. The degree of complexity in actual building terms is, after all, the most important factor he is concerned with, apart from cost.

But, in the end, is there any significant difference between these two methods of project appraisal, it might be asked. Well the difference is very real. And it is increasing by leaps and bounds thanks to the wider use of integrated circuits. More circuit complexity in fundamental design, but without corresponding increase in constructional work. It may seem impossible, but it is really true.

As a case in point, take a look at this month's *Speed Guard*. In purely electronic terms the system employed is of a reasonably complex nature, and the diagrams may be a little off-putting to the less experienced. But further inspection reveals that the complexity lies mainly within the two i.c.'s. These components (complete circuits or building blocks in their own right) can be viewed quite simply as black boxes. Their internal operation can be taken for granted. To the constructor they are just other components.

The more theoretically minded may shrink from this pragmatic approach. But it makes sense for the average person who wants to utilise and enjoy electronics in the fullest manner possible.

Fred Bennett

Our April issue will be published on Friday, March 15

Everyday Electronics, Fleetway House, Farringdon Street, London, E.C.4. Phone: *Editorial* 01-634-4452; *Advertisements* 01-634-4202.

TEST GEAR FIVE

AUDIO FREQUENCY OSCILLATOR

Features variable output level and frequency continuously variable from 10 to 10,000Hz.

PRACTICAL construction projects often involve checking out various parts of the circuit to see if they are working properly. An Audio Frequency Oscillator and a pair of earphones can be used for testing circuits for amplification. Although the oscillator described in this article is very simple to build, it gives a very useful range of frequency and voltage. It uses any supply voltage between 18 and 30 volts, its output being virtually unaffected by the voltage of the supply. The *Power Supply Unit* described in last month's issue provides a suitable source. The unit employs an integrated circuit which gives a simple, but high quality oscillator.

THE INTEGRATED CIRCUIT

The integrated circuit comprises a high gain amplifier with two inputs; pin 2 is a negative feedback input and pin 3 is a signal input, the negative feedback controls the gain. The principle of this amplifier is illustrated in Fig. 1.

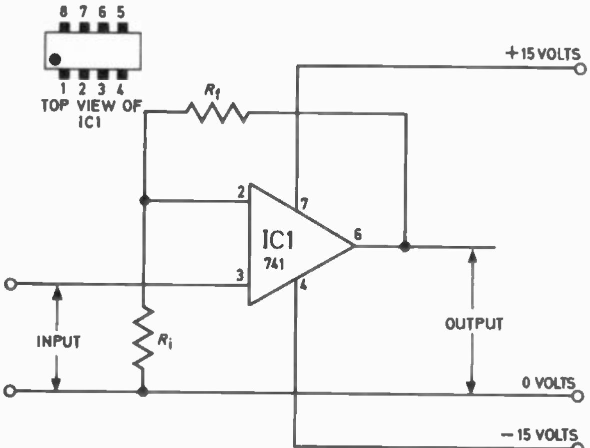


Fig. 1. A fundamental configuration for the 741 when used as an amplifier.

The ratio of resistors R_f and R_i sets the gain which may have any value from 2 to 100, according to the formula:

$$\text{Gain} = 1 + \frac{R_f}{R_i}$$

Note: R_i must always be greater than 500 ohms.

If both R_i and R_f were 1 kilohm, then the gain would be 2. However, if R_f was increased to 100 kilohm then the gain would be 101. By this means the integrated circuit may be used in a variety of different circuits requiring an amplifier. On no account should any connection be made to pins 1 and 5 as they are connected internally.

THE OSCILLATOR

The complete circuit diagram of the oscillator which incorporates the integrated circuit is shown in Fig. 2. This particular oscillator is called a *Wien Bridge Oscillator*. The ratio of R4 and thermistor RTH1 in series with R5 determines the gain according to the above formula.

The thermistor RTH1 is a vital component, without which the oscillator will not function. The thermistor in this circuit stabilises the out-

Approximate cost of components including V.A.T.

£6.60 plus case

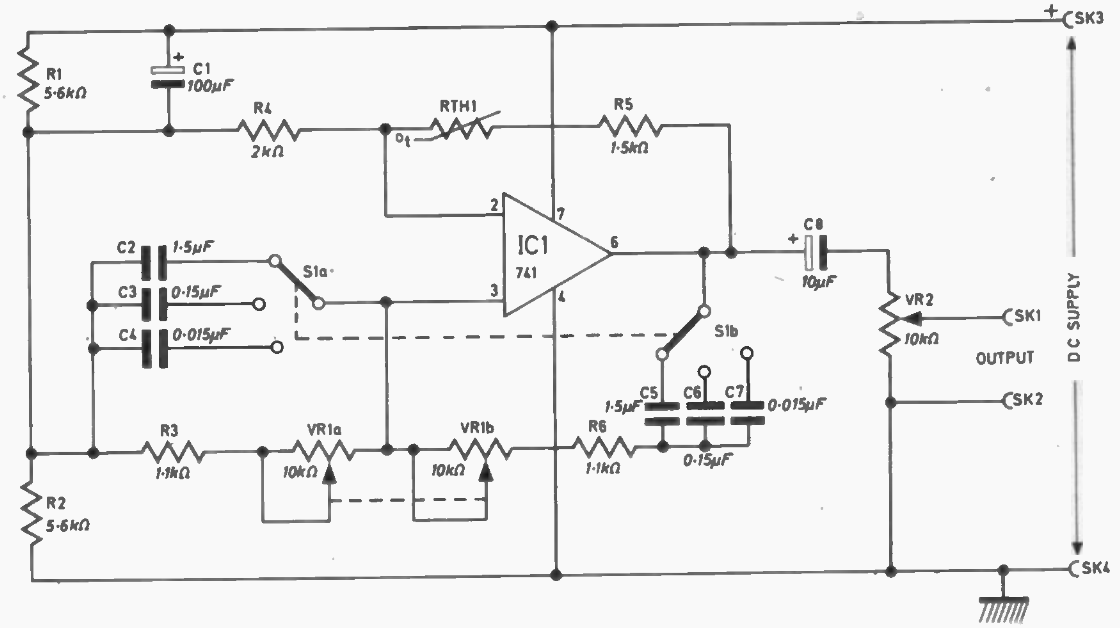


Fig. 2. The complete circuit diagram of the Audio Frequency Oscillator.

put oscillation, exchanging it for a resistor produces a distorted output signal.

With S1 in the x10 position the feedback from the output through C5, R6 and the twin gang potentiometer VR1 to pin 3 of the integrated circuit produces oscillation. With this network positive feedback occurs at one frequency only. The frequency corresponding to the minimum setting of VR1 is given by the formula below.

$$\text{Frequency} = \frac{1}{2\pi\ C5\ R6}$$

This is the higher frequency, 100Hz, on this range of the switch S1.

When VR1 is turned to its maximum resistance, the minimum frequency is given by

$$\text{Frequency} = \frac{1}{2\pi C5\,(R6+VR1)}$$

giving 10Hz.

On the other two ranges, (a) x100, (b) x1000 the minimum and maximum frequencies are (a) 100Hz and 1000Hz, (b) 1000Hz and 10,000Hz respectively.

Incorporating R1, C1 and R2 into the circuit enables the oscillator to work from a single supply, and so makes it possible to use the *Power Supply Unit* described in last month's issue. When using the latter to supply power to the Audio Frequency Oscillator be sure to connect the *negative* terminal to earth.

The oscillator output is coupled via C8 to potentiometer VR2 which adjusts the signal output from zero to about 4·5V r.m.s.

Components ....

SEE
SHOP TALK

Resistors

R1 5·6kΩ
R2 5·6kΩ
R3 1·1kΩ
R4 2kΩ
R5 1·5kΩ
R6 1·1kΩ
All ¼W ±10% carbon

Potentiometers

VR1 10kΩ + 10kΩ twin ganged semi-precision eg. Colvern CLR 4049/15 or /18
VR2 10kΩ linear

Capacitors

C1 100μF 25V elect.
C2 1·5μF
C3 0·15μF
C4 0·015μF
C5 1·5μF
C6 0·15μF
C7 0·015μF
(C2–C7: 2% or 5%)
C8 10μF 25V elect.

Miscellaneous

RTH1 thermistor type R54
ICI 741 differential operational amplifier 8 pin d.i.l.
S1 two-pole three-way rotary
SK1, 2, 3, 4 screw terminal/socket, one black, one green, two red (4 off) Veroboard 0·1in. matrix 24 strips × 44 holes; Veropins (6 off); 8 pin d.i.l. socket; knobs (3 off); aluminium sheet for dial; rubber grommet; 6BA nuts, bolts, washers and stand-off pillars.

CONSTRUCTION DETAILS

The prototype Audio Frequency Oscillator was housed in an identical instrument case to that used for the *Power Supply Unit* featured in EVERYDAY ELECTRONICS last month.

The unit is to be built on 0·1in. matrix Veroboard and Veropins are used for flying lead connections. The layout of the components on the top side of the board and the breaks in the copper strips on the underside of the board are shown in Fig. 3.

Make the breaks on the underside of the board and drill the two fixing holes as detailed and then insert and solder the Veropins as indicated.

It can be seen that an 8 pin d.i.l. socket is used for IC1 thus eliminating contact of the soldering iron with the integrated circuit and avoiding the risk of thermal damage. The use of a socket also simplifies replacement should the need arise. The i.c. should not be in the socket when the latter is being soldered in position.

Now position and solder the i.c. holder, resistors, capacitors and themistor as indicated in Fig. 3. Next prepare the front panel as indicated in Fig. 4 and secure all the panel mounted components in position as shown. Now wire up to the component board.

The two leads emerging from the front panel and labelled "supply leads" should be about 75cm long and be terminated in banana plugs or spade terminals, one red and one black if being powered by the *Power Supply Unit*, or suitable battery connectors. Power supply to other units may be obtained from the terminals SK3 and SK4. If a number of units are connected in this fashion the system could interact and oscillate, so one must watch for this fault and if in doubt connect each unit *directly* to the *Power Supply Unit*.

Now insert IC1 in its socket, taking note of polarity—indicated by an indentation near pin 1 and then secure the component board to the inside base of case by means of two 6BA nuts, bolts and stand-off pillars.

CALIBRATION

To make the dial for the frequency selector, cut a 55mm diameter disc from a piece of thin gauge aluminium and drill a 7mm diameter hole at its centre. Now glue a control knob at the centre of the disc aligning with the hole.

A full-size drawing of the frequency scale is shown in Fig. 5; this should be cut-out or copied and glued to the disc, the dial is then complete.

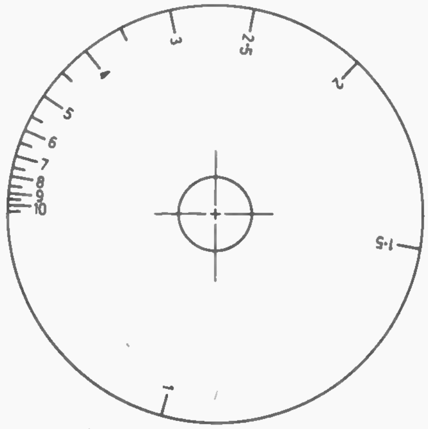
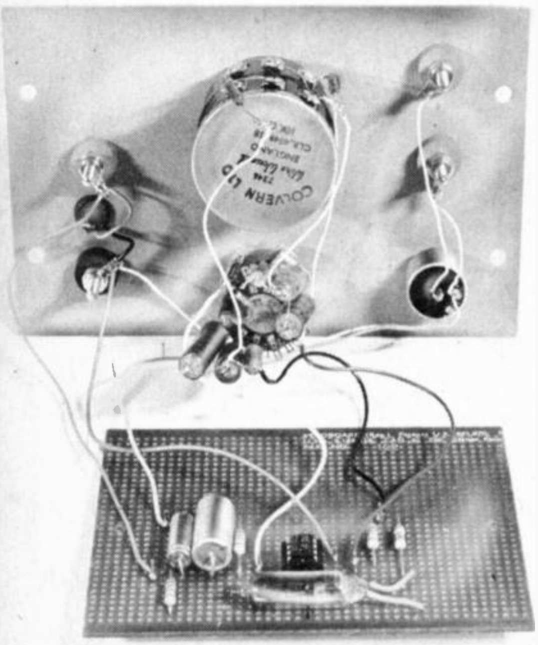


Fig. 5. Full-sized dial details.

Now mark the front panel with an arrow head pointing towards VR1 spindle at about 32mm from the latter, see Fig. 6. Turn VR1 fully anticlockwise, place the dial assembly on VR1 spindle and align the "1" on the dial with the



Photograph of the completed component board and front panel.

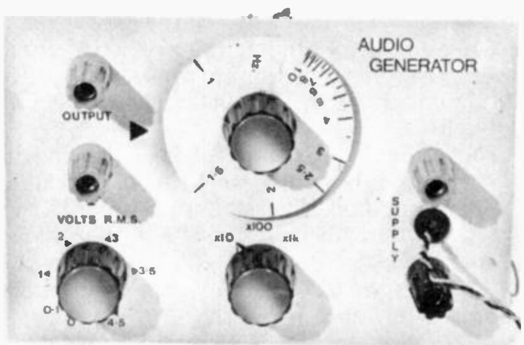


Fig. 6. Details of front panel labelling.

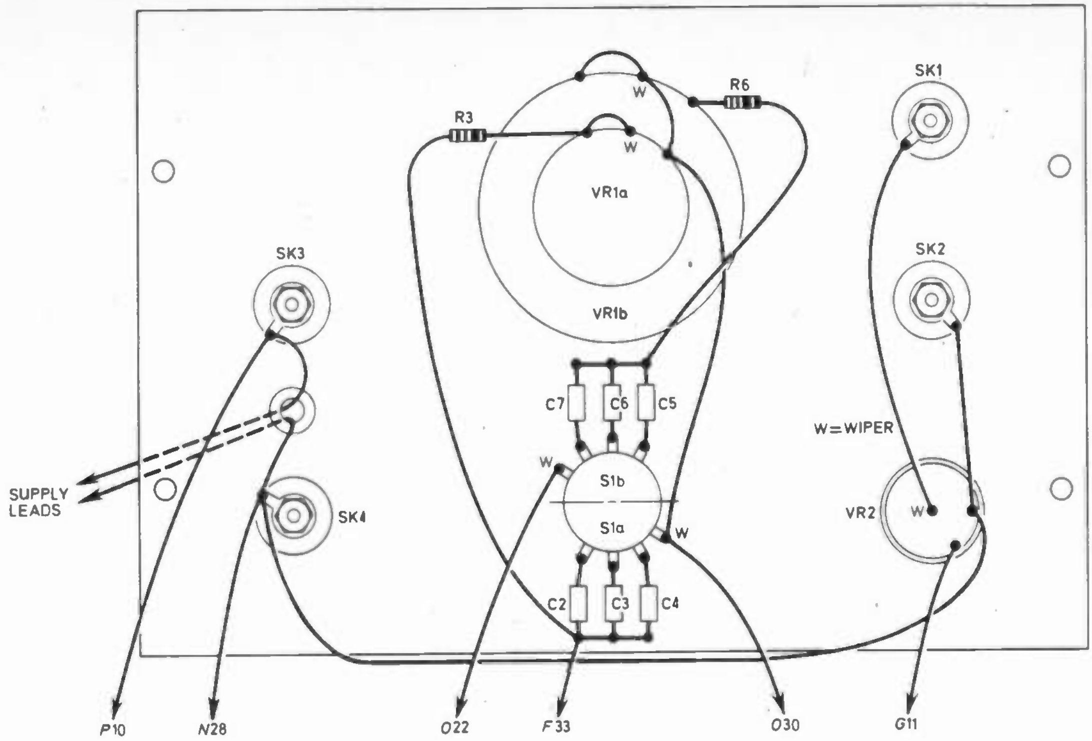
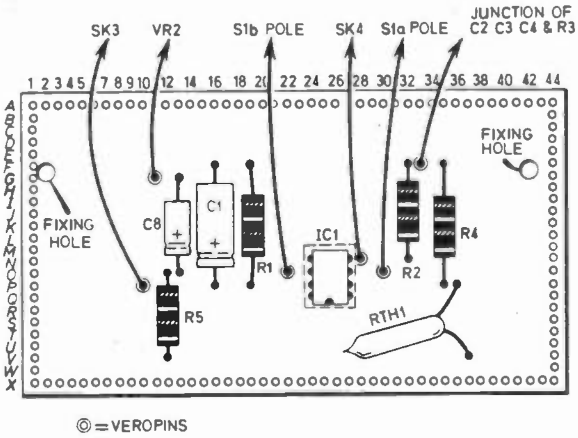


Fig. 4 (above). Wiring up details on the rear of the front panel.



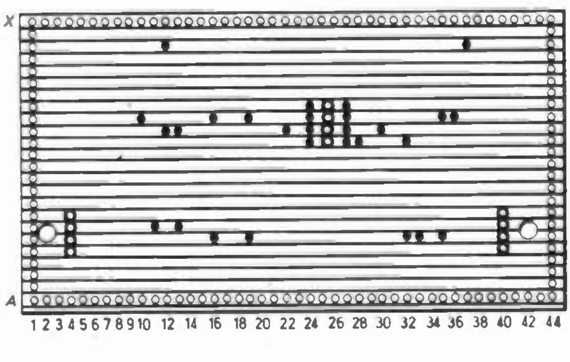


Fig. 3 (left). The layout of the components on the topside of the Veroboard, and the breaks along the copper strips to be made on the underside.

AUDIO FREQUENCY OSCILLATOR

arrow. At this position secure the dial assembly to VR1 spindle.

The calibration details for the output voltage level control are given in Table 1. Mark a zero in the approximate position to that shown around the control knob in Fig. 6 and then use a protractor to mark off the various levels, in a clockwise direction, according to Table 1.

Table 1: Output level calibration.

Angle of rotation (degrees of arc)	Output voltage level (volts r.m.s.)
0	0
6·6	0·1
66·6	1
133·2	2
199·8	3
233	3·5
300	4·5

These markings, as all the others on the front panel are best done with Letraset as on the prototype; this gives a very neat and professional appearance.

Turn VR2 fully anticlockwise and place the knob on the spindle; rotate the knob so that its pointer is aligned with the "0" of the scale and secure the knob in this position.

The three positions of the switch S1 and other markings should now be made, using Letraset, to complete the project.

TESTING THE OSCILLATOR

First check the wiring very carefuly against the wiring up diagram of Fig. 4. Tick each wire and connection off on the diagram as you check it. Secondly, check each solder joint to see that it is clean and shiny and that the solder has run onto the component wire properly.

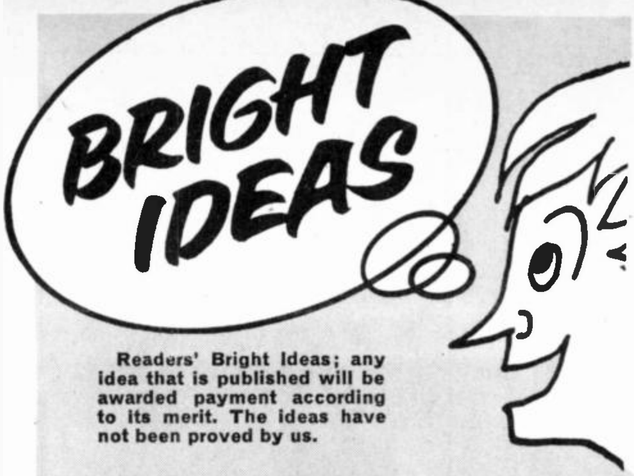
Check that all the Veropins have been soldered in position—a push fit is not enough. Finally, make sure that the integrated circuit is in the socket the right way round.

The power supply for the Audio Frequency Oscillator can be either batteries eg. two PP9 batteries in series, or use can be made of the *Power Supply Unit* described last month.

Whichever power supply system is used, connect to the Audio Frequency Oscillator and connect a high impedance set of earphones across the output sockets, SK1 and SK2.

Turning the frequency selector dial in a clockwise direction should increase the pitch of the tone heard in the earphones; switching S1 in a clockwise direction should also increase the pitch.

If VR2 is turned in a clockwise direction, the volume should increase for all range and dial settings.



Readers' Bright Ideas; any idea that is published will be awarded payment according to its merit. The ideas have not been proved by us.

An inexpensive and attractive indicator lamp can be fitted into an aluminium or plastic panel by simply drilling a hole of about 3mm diameter and filling it with clear epoxy adhesive.

The front of the hole is covered with insulating tape before it is filled with the transparent adhesive such as Devcon Five Minute Epoxy. When this has hardened the tape is removed, leaving the finished "lens" flush with the panel and almost invisible until illuminated by a neon or filament bulb from behind. If desired the lamp can be embedded in the epoxy.

P. Albericii, Stockport, Cheshire.

When building electronic devices on Veroboard or printed circuit board, it is often necessary to leave the item for several weeks in an unfinished state due to lack of components etc.

During this time, the board which was initially bright and clean loses its clean appearance and sometimes becomes so tarnished (oxidation) that it is impossible to solder in any other parts until the board has been cleaned.

Since cleaning is difficult and dangerous, in so far as delicate components are concerned, I have found it convenient to use an aerosol of hair laquer to lightly cover the copper strips on the underside of the board.

Most brands of laquer if sprayed on thinly are sufficient to prevent oxidation of the copper, but do not prevent solder adhering, and a good sound soldered joint can be made.

C. Taylor, Ripley, Derbys.

PLEASE TAKE NOTE

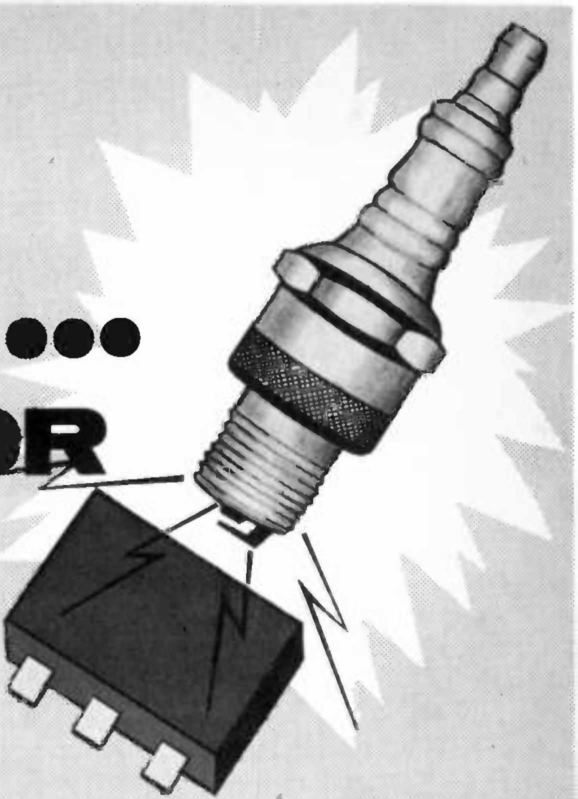
A potential construction hazard with the *Power Supply Unit* featured in last months issue has been brought to our attention.

With the type of transformer used in the prototype, where the windings are terminated on tags fixed to the front and rear of the transformer, it is possible to obtain a dangerous short circuit if the transformer is not positioned very carefully so as to provide adequate clearance between itself and the front and rear panel mounted components when the latter are bolted in position.

To avoid this, use a transformer with its connections taken to a tag panel on the top of the transformer or omit the neon indicator and mount the on/off switch in its place.

Values for R1 and R3 were shown correctly on Fig. 2, not in the components list.

NEXT MONTH...



TRANSISTOR ASSISTED IGNITION

An inexpensive, easy to build unit that will save wear and sparking at the points and enable engine tune to be maintained for long periods.

LIGHT POWERED RECEIVER

A medium wave receiver that requires no batteries. Works off sunlight or room lighting.

Special Pull-Out Feature
TEST GEAR

e e TEST GEAR FIVE *3rd. Instrument* **ELECTRONIC VOLTMETER**

Subject to the current national industrial situation at the time of going to press

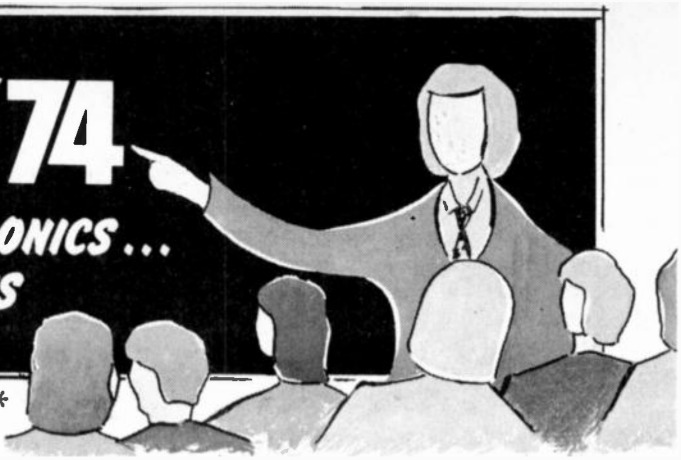
everyday electronics

APRIL ISSUE ON SALE FRIDAY, MARCH 15

NEW PRICE 20p.

TEACH-IN '74

FOR BEGINNERS IN ELECTRONICS... THEORY AND EXPERIMENTS



TUTOR: PHIL ALLCOCK*

LESSON 6 Basic Circuits

THIS month we investigate some very useful circuits that are often used as parts of larger systems. Each circuit has a well defined function and a thorough study of each one will amply repay the time spent. Each circuit is treated essentially from an experimental point of view and can be built on the Tutor Board using the existing range of components.

The operation of each circuit is investigated and verified by actual measurements using the Tutor Board system. **Future articles in the Teach-In '74 series may involve the purchase of certain additional components and these will be announced at least one month in advance of the actual requirement so that readers can obtain the necessary items in time.**

EMITTER FOLLOWER

Our first circuit, the emitter follower, is aptly named as it is really a single transistor stage in which the voltage at the emitter (output) point follows any changes that occur at the base (input). Fig. 6.1 illustrates the basic arrangement that we shall use.

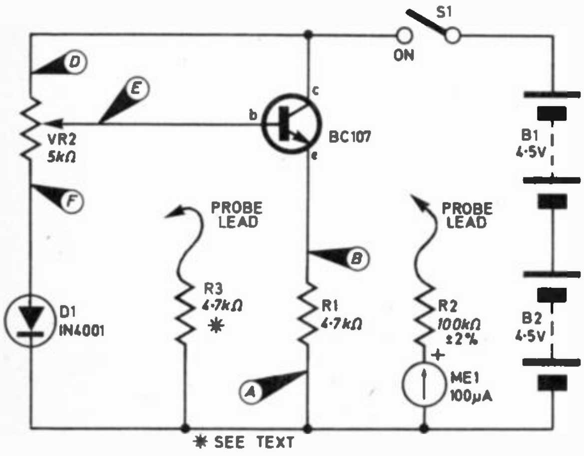


Fig. 6.1. Basic emitter follower.

The base voltage of TR1 (BC107) can be varied by means of VR2 (5 kilohm). When the slider of the potentiometer is turned to point F the voltage fed to the transistor is just the diode forward voltage of approximately 0·6 volts. This is about the same as the emitter-base voltage of a conducting transistor and so TR1 will be on the verge of conduction. If VR2 is turned in a clockwise direction the base voltage, measured with respect to battery negative point *A*, will increase from 0·6 volts to 9 volts. If we assume that the emitter-base voltage of TR1 is constant at 0·6 volts the increase in base voltage must be accompanied by the flow of emitter current so that an equal voltage drop appears across the 4·7 kilohm emitter resistor, R1.

For example if VR2 was set to give a base voltage of 5·3 volts the voltage across the emitter resistor would be 4·7 volts and the emitter current would be 1 mA. If the base voltage is varied by means of VR2 the emitter voltage will follow the changes produced at the base and it is this action which gives the circuit its name. As far as changes in voltage are concerned the voltage gain, or amplification, of this circuit is unity. Voltage gain is defined as the output voltage change divided by the input voltage change. Note that the base and emitter voltages are always offset by about 0·6 volt even though the gain is unity.

What value can there be in using such a circuit if the gain is only unity? To seek the answer it will be convenient to test the circuit out in a simple experiment.

TEST CIRCUIT

Arrange the components on the Tutor-Board to match the schematic of Fig. 6.1. (By now you should be getting used to this transformation of the theoretical schematic diagram into an

* North Staffordshire Polytechnic *(Any communications arising from the Teach-In '74 series must be addressed to Everyday Electronics, Fleetway House, Farringdon Street, London E.C.4).*

actual experimental arrangement of components. If you are still experiencing some difficulty it will help to plan the layout on paper first, try to plan a layout yourself and then compare it with Fig. 6.3. Also build the 0-10V voltmeter circuit and connect the negative side to point *A*.

Using the (red) probe lead for the positive side of the voltmeter measure the voltages V_{EA} and V_{BA}, for two different settings of VR2. Verify that your circuit behaves as described above. At this stage it is possible to check both the input-output offset, the "following" action and the voltage gain.

SECOND PROBE

For the next part of the test, one end of a second 4·7 kilohm resistor should be connected to point *A* and the other end should be joined to the spare (black) voltmeter probe lead. This lead is required so that the resistor can be connected to either the base or the emitter of the transistor whilst observing the meter reading. First, set VR2 to make $V_{BA}=5$ volts and then make a temporary connection with the resistor probe lead first to E and then to *B*. The voltmeter connection must be left unchanged so that the value of V_{BA} can be taken for each position of the resistor probe lead.

When the resistor is across E*A* the voltage V_{BA} will drop due to the loading of the 5 kilohm potentiometer by the extra 4·7 kilohm resistor. However when the resistor is connected at the emitter, the voltage V_{BA} will barely change and it may be difficult to detect any movement of the meter pointer.

VOLTAGE GENERATOR

The emitter follower output terminal behaves as a nearly perfect voltage generator having a very low effective internal resistance since any tendency for the emitter voltage to change will be counteracted by a change in emitter current. The emitter voltage will only alter if the base voltage changes and since the additional 4·7 kilohm resistor at the emitter only doubles the already small base current the base voltage will be almost constant.

The transistor supplies the extra current required by the added 4·7 kilohm resistor and 99 per cent (or more) of this extra current flows from the battery via the collector and emitter leads. The increase in base current, to account for the remaining 1 per cent (say), has negligible effect on the base voltage. In fact, using these typical percentages the extra base current is seen to be approximately the current that would be required by a resistance of about 470 kilohm connected across E*A*. Thus any additional load resistance at the emitter appears transformed by the factor $(1+\beta)$, or $(1+h_{FE})$ when considered from the base.

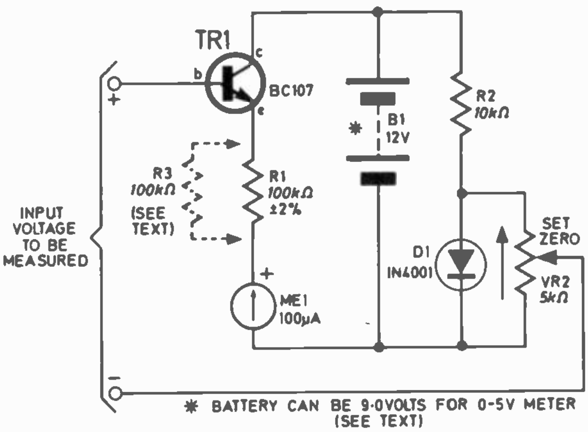


Fig. 6.2. Emitter follower used as a voltmeter.

ISOLATION

The emitter follower thus behaves as a buffer or isolating stage and can be used to supply voltages to relatively low resistance loads without incurring any excessive loading effects on the input source. In many applications the base of the emitter follower is connected directly to the source if a suitable "d.c. bias" voltage level exists. Fig. 6.2 illustrates a circuit example in which the emitter follower is used to make an electronic voltmeter that takes less than 1μA from the source at full scale deflection.

The battery voltage for the emitter follower must be greater than the maximum voltage to be measured, which, in this case is 10 volts. The 5 kilohm potentiometer allows a fraction of the diode voltage drop to be used to compensate for the V_{be} offset and can be set to give a zero meter reading with the input leads shorted. The compensation is only approximate since the value of V_{be} will change slightly over the 100μA range of meter current

The 5 kilohm potentiometer is rotated in the direction shown by the arrow until the pointer just begins to move from its zero position. The circuit can be operated at 9V, using the two 4·5 volt batteries of Tutor Board, to make a 0 to 5 volt electronic meter by connecting a second 100 kilohm ±5 per cent resistor in parallel with the 100 kilohm ±2 per cent meter resistor, see Fig. 6.5.

Try using this electronic meter to measure the voltage of a previously charged 1000μF capacitor. If the capacitor is momentarily connected across *one* battery it will charge up to 4·5 volts. This voltage can then be observed using the electronic meter. Avoid touching the capacitor or voltmeter leads as moist skin will provide a discharge path. If the capacitor has good insulation it may take at least an hour for the capacitor to fully discharge due to the very small input current required to operate the meter. (If the h_{FE} of your BC107 is, say, 400 the base current would be approximately 0·25μA for a 5 volt full scale reading. This corresponds to an effective input resistance of 20 megohms and a discharge time constant of 20,000 seconds!

BISTABLE CIRCUIT

The bistable circuit derives its name from the fact that two distinct stable operating conditions exist (bistable=two stable states). A typical circuit is shown in Fig. 6.4 and can be built on the Tutor Board for experimental purposes. The circuit is symmetrical in that the components on one side of the circuit are the mirror image of those on the other side excepting the battery and switch. Each of the two possible states requires one transistor to be on whilst the other is off.

To indicate the state of the transistors we are using the 6V lamps as "collector load" resistors. If the on transistor is made to pass sufficient current the lamp will light and this then indicates the on state for that transistor. The circuit can be made to change from one stable state to the other by creating a suitable disturbance. To illustrate this process wire up the circuit on the Tutor Board, check all connections and then close the switch S1.

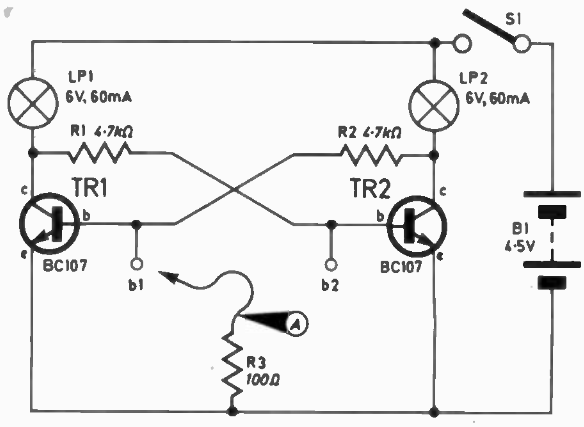


Fig. 6.4. Basic bistable circuit.

Only one of the two lamps should light. Using one of the probe leads connected to point *A*,

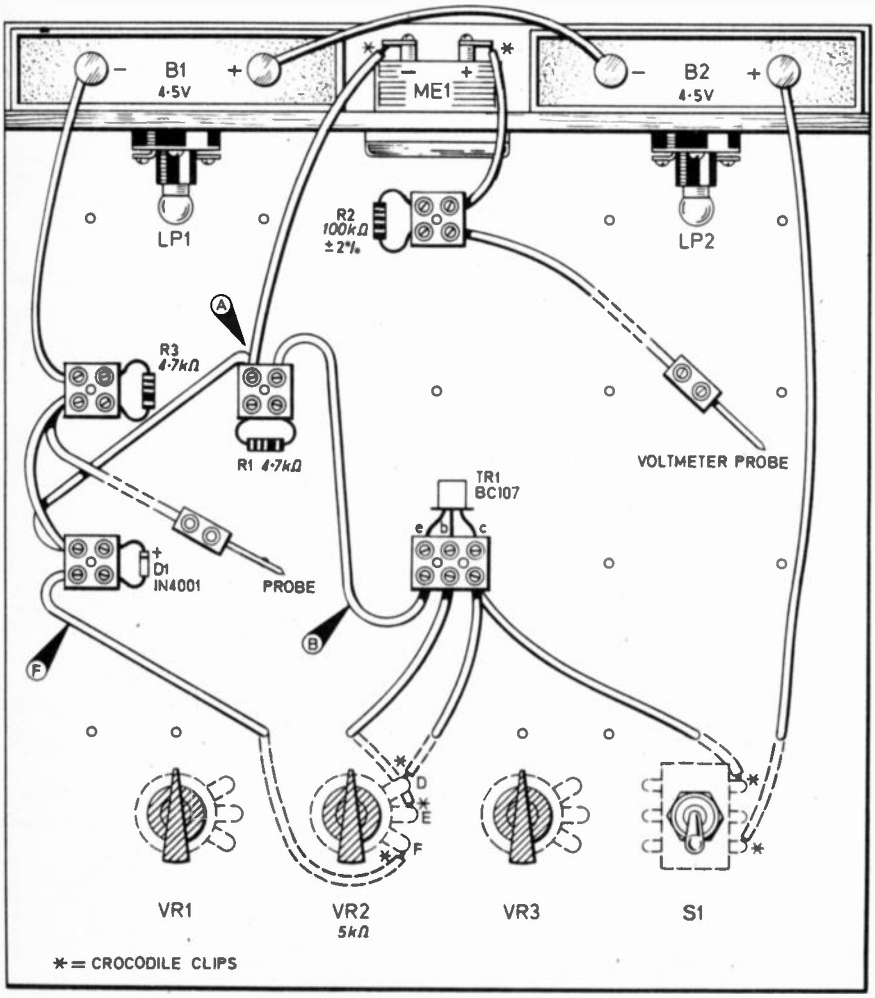


Fig. 6.3. Layout and wiring on the Tutor Board for the circuit shown in Fig. 6.1.

touch the base lead (b1 or b2) of the on transistor briefly. The circuit should change state and the previously off lamp should now be lighted. The circuit can be made to switch back and forth by touching the probe on points b1 and b2 in turn. Note that the circuit will only change state if the probe is connected to the base of the on transistor. This switching action can be compared with the action of a domestic light switch which has two stable positions and must be pushed in the correct direction if the toggle is to move to its alternative position.

It is not difficult to see how the circuit works. If TR1 is assumed to be on, with the resistor values used the transistor must be saturated and hence its V_{ce} will be about 200mV. This is insufficient to allow TR2 to turn on and so negligible current flow occurs in this transistor. Because of this, the base of TR1 is effectively connected via the lamp (cold resistance) and the 4·7 kilohm to +4·5 volts which gives a base current of about 1mA. This ensures that TR1 is held saturated. The probe simply "shorts" the base/emitter junction of the on transistor with 100 ohms and turns it off. The cross coupling to the other transistor base causes this transistor to switch to the on state.

More complex versions of this circuit are widely used in logic or digital systems, such as data processing or computing equipment, and are often made in the form of an integrated circuit. The basic behaviour is however very similar to that described above.

SCHMITT TRIGGER

The Schmitt trigger circuit, illustrated in Fig. 6.6, is similar to the bistable but the switching action depends on the voltage applied at the input, V_{in}. Only one transistor is on at any time but the state of the circuit can be controlled by changing V_{in}.

Build the circuit on the Tutor Board and carefully check all wiring. Set VR2 so that V_{in} is zero (slider E to end F) and set the control VR1 so that the emitters of TR1 and TR2 are joined together (slider B to end A). In this position the potentiometer simply acts as a 100 ohm resistor

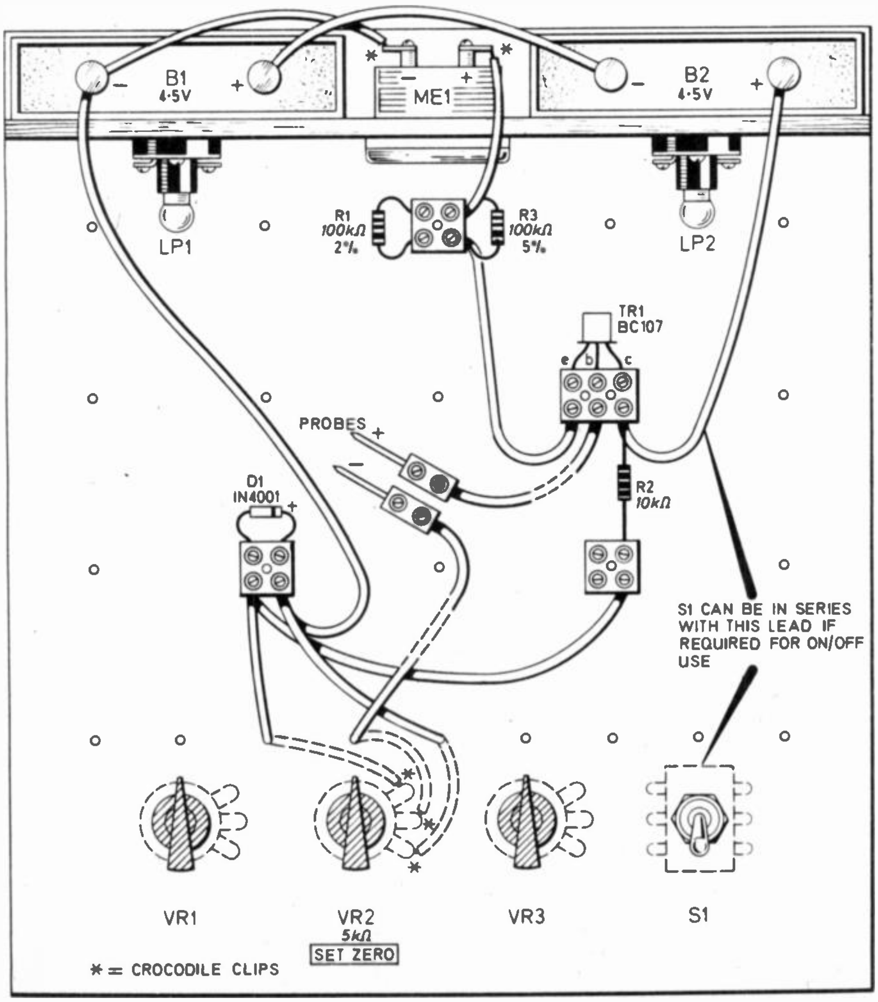


Fig. 6.5. Tutor Board layout and wiring for Fig. 6.2.

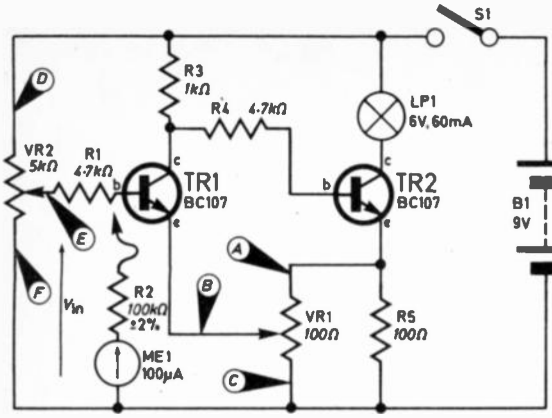


Fig. 6.6. Basic Schmitt trigger circuit.

in parallel with R5, also 100 ohms, to give an effective emitter resistance of 50 ohms. Operate the switch S1 and check that the lamp LP1 lights.

Transistor TR1 will be off since the current in TR2 produces a voltage drop across the effective emitter resistance (50 ohms) which makes point A positive with respect to C. Since V_{in} is set to zero, the voltage V_{AC} appears as a *reverse* bias across the base-emitter junction of TR1. Note that TR2 derives its base current via R3 and R4.

The usual 0-10V voltmeter circuit should be used to measure the voltages at the various points in the circuit, to verify the above statements. Make a list of all the voltages so that they can be compared with other readings, taken at the same points later on. Table 6.1 illustrates one way of setting out the information derived from these measurements.

SWITCHING

To demonstrate the switching action of the circuit hold the voltmeter (positive) lead to point E at the end of R1 and *slowly* rotate VR2 in a clockwise direction. The voltmeter should indicate the rising input voltage V_{in}. At about 3·5 volts the lamp LP1 will suddenly turn off and the meter reading will fall to approximately 3·2 volts. In this state TR1 is on and TR2 is off. Without disturbing the setting of VR1 measure the voltages at the points mentioned in Table 6.1 and record your results in the right hand column. A comparison of the "before and after" readings at each point will verify that the transistors have in fact changed states.

Reconnect the voltmeter to point E and slowly rotate VR2 anticlockwise towards its initial position. The lamp will remain off until V_{in} reaches a voltage of about +1·2 volts at which level the circuit returns to its former condition with LP1 and TR2 on and TR1 off.

What caused the circuit to change over? With V_{in} set to zero we know that TR1 is reverse biased by about 3 volts and so V_{in} must be

Table 6.1: Schmitt Trigger Circuit Voltage Levels

(1) Test Point	(2) Voltages Note (c)	(3) Voltages Note (d)
	(Typical values)	
TR1 base	0 V	
TR1 collector	+8·0 V	
TR1 emitter	+3·0 V	
TR2 base	+3·6 V	
TR2 collector	+3·2 V	
TR2 emitter	+3·0 V	
Battery terminals	+9·0 V	

Notes
- (a) All voltage readings taken with 0-10V voltmeter circuit, with respect to battery negative (C).
- (b) VR2 set for maximum "feedback".
- (c) Column (2) relates to $V_{in}=0$.
- (d) Column (3) to be used for voltage readings measured, as per text, when circuit has just switched over.

raised to slightly more than this level before TR1 can conduct. Once TR1 starts to conduct its collector current produces a voltage drop across R3 which lowers the base voltage of TR2. The emitter voltage of TR2 "follows" the change at the base, just as in the emitter follower circuit, and as a result TR1 turns further on since the reverse bias voltage V_{AC} is now less than the previous 3·0 volts. This process is regenerative and a rapid change over occurs. The increase in the base current of TR1 causes the voltage at point E to fall slightly.

To restore the initial circuit conditions it is necessary to reduce V_{in} to the point at which TR1 starts to turn off. Since the on current in TR1 is much less than that for TR2 and LP1, the voltage "threshold" at which the circuit restores to normal is much lower than the previous switching threshold at 3·5V. Note that the lower on current in TR1 is mainly due to the use of a 1 kilohm collector load whereas the load for TR2 is about 100 ohms due to the lamp (hot) resistance. Readers will probably have realised by now that the potentiometer VR1 determines the amount of reverse bias fed back from TR2 to the base-emitter junction of TR1. The experiment can be repeated with VR1 set mid way to give 50 per cent of the feedback voltage used in the first tests i.e. about 1·5 volts. The switching thresholds for this setting should be approximately +2·0 volts (lamp turns off) and +1·1 volts (lamp turns on).

ACTION SUMMARY

The behaviour of the Schmitt trigger is summarised in Fig. 6.7 where the arrows indicate the direction of the various voltage or current changes. The "width" of the loop represents

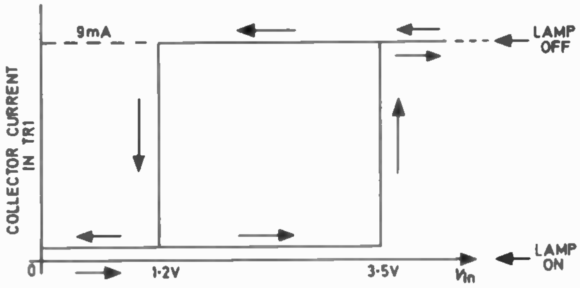


Fig. 6.7. Summary of Schmitt trigger action.

the voltage difference between the two thresholds and is sometimes called backlash or hysteresis. Reducing the setting of VR1 to give less feedback mainly affects the right hand threshold.

The diagram illustrates an important feature of Schmitt trigger circuits namely that when V_{in} is between the thresholds, the circuit can be in *either* state. Which state occurs in practice depends on the "previous history" of V_{in}. and this feature is a simple form of memory. The bistable circuit also exhibits a similar property and is widely used in digital systems such as computers for this reason.

The "block diagram" of Fig. 6.8 shows how a triangular shaped input voltage waveform can be connected to a rectangular pulse waveform by using a Schmitt trigger circuit as a voltage dependent switch.

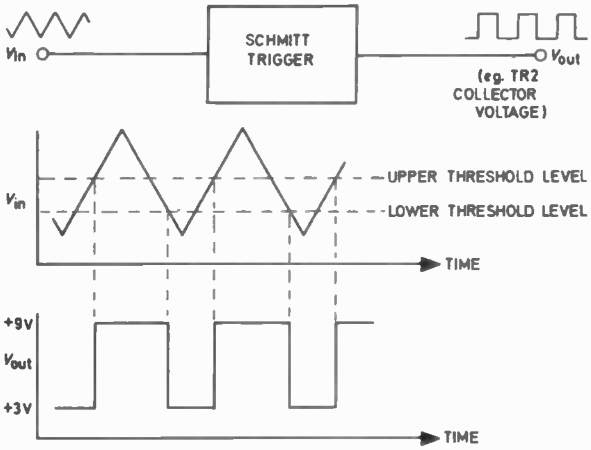


Fig. 6.8. Typical application of Schmitt trigger.

Note: Some readers may find this month's work more difficult than that given in previous parts of the Teach-In '74 series. Do not try to rush the experiments; make sure that you understand each test before proceeding to the next stage. This is a good time to review all the work that has been presented so far. Concentrate on any topics that you find difficult and your efforts will be well worth while.

Why not write to us and let us know how you are getting on?

Next month we shall examine the operation of two more circuits known as the monostable and astable multivibrator.

Ruminations

By Mrs. Sensor

Sockets

Sensor is swotting and has asked me to stand-in for him. I wondered what to say, my experience of electronics has receded into the dim and distant past, the breathtaking new inventions of my time are now the exhibits of the museums and I am lost in the modern world of transistors, integrated circuits and the like. No, my best idea is to speak as the beneficiary of years of d.i.y. electronics from the days of our first "hand-built" television set in our first home, to the present time of piped music for the "beef-on-the-hoof" in the farm buildings.

The t.v. was unique, requiring a good six square feet of floor space, everything visible and handy to repair in times of need. I think I do remember the cabinet, some light-oak faced board and a few sticks of 1 inch by 1 inch tucked away in the spare room. Yes, it helped to make quite a reasonable bookcase eventually. Our son's arrival necessitated the encapsulation of the t.v. and it was surprising what a big sitting-room we had.

Eight years in the one house saw a marvellous transformation, I could stand anywhere in any room and plug in my vacuum without taking a single step. In the garage the story was the same, he could drill, solder, use his lathe, light up all corners and warm himself by the electric fire, all at one and the same time. But alas, came the day when there was no more space for sockets so we moved to a brand-new house where each room was provided with one socket, excepting the lounge which had two, one at each end.

Dangerous Wires

There followed the years of the home-built radiogram, the electronic organ (never completed) and the radio transmission to all rooms. During that time a funny thing happened, I discovered that there were two d.i.y. enthusiasts in the house and the smaller of the two had very peculiar ideas about my height, there were dozens of gracefully draped wires all around the house, all at jugular vein height as far as I was concerned. But those days are in the past now, he can Sellotape his wires to the ceiling without recourse to steps.

The skirting of our second house filled up over the years and reading the house-agents blurb when we put it up for sale, one had the impression of lots of misprints regarding power points.

Now a third domain, crying out for attention. I thought the two-foot thick walls might have been a deterrent but no, here we go again.

SHOP TALK

By Mike Kenward

WITH, we hope, the worst part of the winter behind us we can start looking forward to the spring and perhaps to a more settled industrial situation and fewer shortages. Perhaps by the time this is published we will be able to obtain "normal" amounts of petrol once again, however, it is unlikely that we will ever get it at the old price. This fact alone makes the *Speed Guard* a worthwhile project, plus the fact that it could save an endorsement by drawing your immediate attention to excess speed within any limit.

Speed Guard

The *Speed Guard* is the first project we have published that uses more than one integrated circuit and is probably near the limit of complexity for an EE project! Provided some care is taken when handling the i.c.s, and that sockets are used to hold them, most constructors should have little difficulty with construction of this project.

The 555 i.c. is available under a number of different codes—see wall chart—but is usually listed by suppliers as the 555. The type used in the *Speed Guard* is an 8 pin dual-in-line package and it will be easier to follow our layout if this type is obtained—the 7400 is a 14 pin dual-in-line package.

A 35 ohm or greater impedence speaker should be used (up to about 80 ohms) and a number of quite small types are available from various suppliers. It is also a good idea to include a 1 amp line fuse in the supply and a holder for this is available from car accessory shops. Ask for a line fuse holder as used for car radios.

Audio Frequency Oscillator

Some components used in the *Audio Frequency Oscillator* are, as far as we can tell, only available from one supplier. Electrovalue, 28 St Judes Road, Englefield Green, Egham, Surrey can supply the R54 thermistor, Home Radio can supply the Colvern twin gang potentiometer (±2 per cent tolerance).

The Wima capacitors are recommended as these are ± 5 per cent tolerance, if you have difficulty getting these, Combined Electronic Services, Spare Sales Department, 604 Purley Way, Waddon, Croydon CR9 4DR can supply at 22p each for 1·5μF, 12p each for the other values, plus V.A.T., a 40p handling charge is added to each order. As mentioned last month the Olsen case type 25A with louvres is available for £3·45 including postage packing and V.A.T. from Olsen Electronics Ltd., 5 Long Street, London E.2.

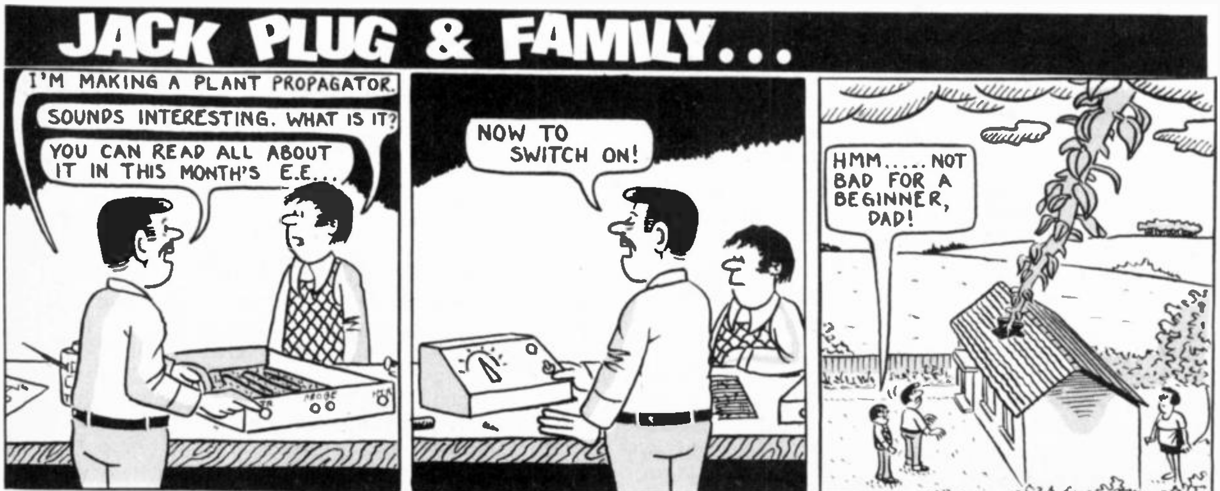
Also last month we stated that the knobs were available from Re-An Products, Burnham Road, Dartford, Kent. This is not in fact the case although Re-An do make similar knobs and a skirt with indicator line is available. The knobs are type R62 with black skirts with indicator, they cost 14p each plus 20p post and packing, plus V.A.T. on total. Top cap colours available are red, blue, green, yellow and black—state your requirements with the order.

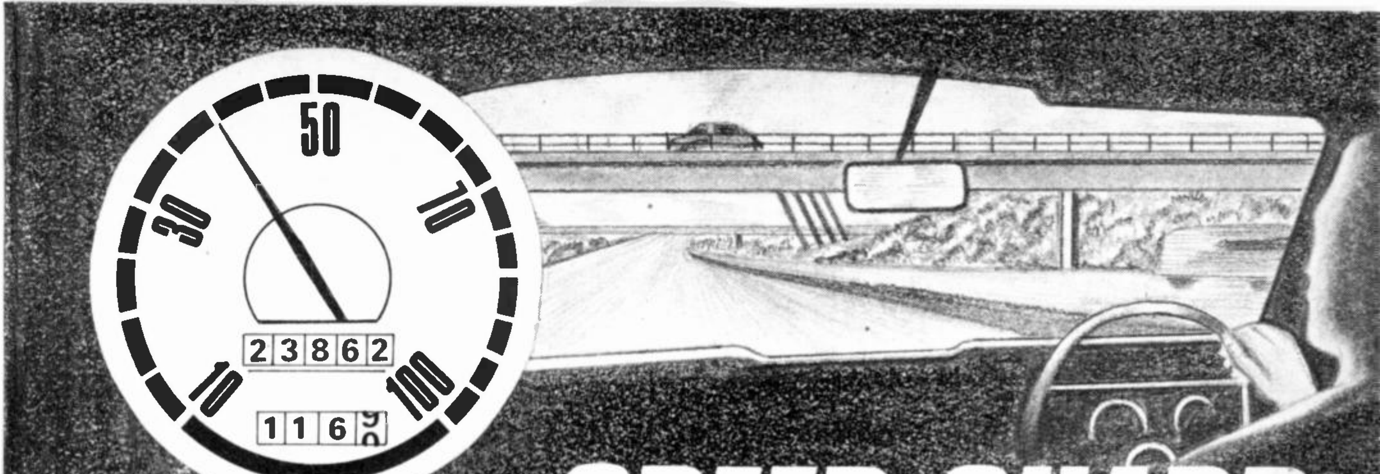
The actual knobs on the prototype units are made by Elma and are available from Farnell Electronic Components Ltd., Canal Road, Leeds LS12 2TU but they cost in the region of 35p each plus a 25p small order surcharge —for orders under £5. The large knobs are 70-21-¼ inch, top caps are 1450-21, pointers 1451-21, small knobs 70-14-¼ inch, caps 1450-14 and the pointers 1451-14. Top caps are used for all knobs, pointers for most—the tuning dial does not have a pointer.

Plant Propagator

All the electronic components for the *Plant Propagator* should be readily available—the heater wire may have to be obtained by buying a small bar element, they are fairly cheap.

There are a variety of seed trays available from hardware shops and flower shops but do not get one so big that the heater cannot heat all the soil.





SPEED GUARD

BY MIKE HUGHES

Gives an audible tone when preset speed limit is exceeded.

During times of fuel shortage this device is a useful aid to fuel economy for the motorist. Under normal conditions it can be extremely useful to the driver who constantly uses motorways and runs the risk of accidentally exceeding the 70 miles per hour speed limit—or as it is now during the fuel crisis, 50 miles per hour.

The device works from a signal picked up off a spark-plug lead and uses this to sense the rate of revolution of the engine—which is directly related to the car's speed when in top gear.

When a certain rate of revolution (set by a preset control within the Speed Guard) is exceeded, a small loudspeaker produces a shrill and uncomfortable wail inside the car's saloon. This warning cannot be ignored and the only way to stop the noise is to reduce speed.

ENGINE SPEEDS

In theory any speed can be set ranging from a few miles per hour up to 70 or more; however, because the device is working from the engine's revolutions, it is a little inconvenient to set it for speeds less than 40 miles per hour because it could trigger when accelerating away in low gear. Obviously the minimum effective speed for which it can be used will depend upon the gear ratio range of the vehicle and whether or not you are a "quick off the mark" driver.

To some extent rapid acceleration is just as much a fuel waster as high speed driving hence a warning of excessive revs in low gear might be a useful reminder to some drivers.

As an example of the "tripping" speeds in different gears the author had the prototype installed in a Zephyr 4 with the alarm set to sound at 50 miles per hour in top gear. The maximum speeds that could be obtained in lower gears without the alarm going off were approximately: 1st gear—12 m.p.h.; 2nd gear—20 m.p.h.; 3rd gear—35 m.p.h.; Top gear—50 m.p.h.

In practice there is a slight delay before the unit switches in therefore a short duration of excess speed will not affect the alarm (about 2 seconds) but there is a penalty at the other end; because of hysteresis in the electronic triggering of the alarm, the driver must reduce his speed to about 15 per cent less than the trigger speed to shut off the alarm. There is, thus, a built in incentive to keep a steady speed just **below** the maximum set.

With the prototype unit the speed is set by an infinitely variable knob on the front panel and this is convenient for experimental purposes; however it is possible—for those of weak will—to cheat the alarm by manually increasing the setting of speed. Those who fall into this category ought to use a preset control that is lockable and only adjustable with a screwdriver.

CIRCUIT THEORY

Not only is the project useful from its application but it contains some interesting circuitry which—on the face of it—is quite complex for the beginner but nevertheless is very straight-

Approximate cost of components including V.A.T.

£3.60 plus case

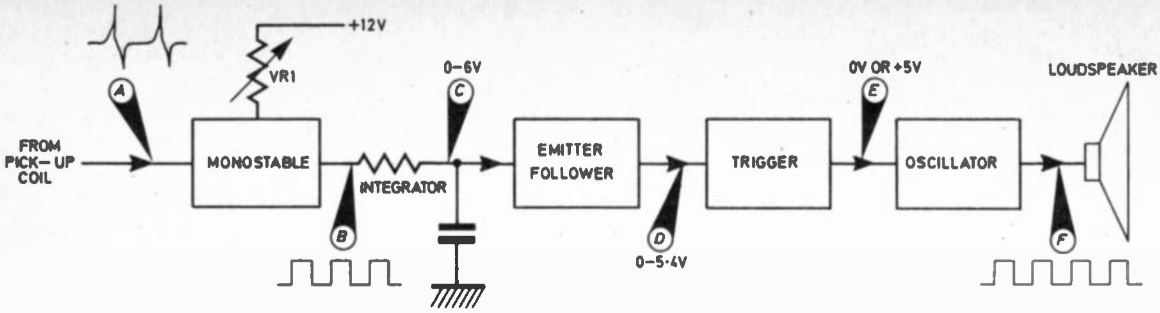


Fig. 1. Block diagram of the Speed Guard. Waveform at point F only occurs if speed exceeds preset maximum.

forward to make because use is made of integrated circuits.

The complete system is shown in Fig. 1 in block schematic form. Engine revolution pick-up is effected by about six turns of insulated wire round one of the spark-plug leads. Every time this plug sparks, a very fast pulse is fed into the unit (signal *A*). When the pulse goes in a negative direction it triggers a monostable circuit which produces a positive going pulse of fixed time duration; this duration can be preset by VR1 which forms the speed setting control.

At slow engine revs the mark/space ratio of this signal will be small (signal *B*) but as the speed increases the amount of time this signal is at 0V will reduce while the time at the positive level will remain the same; the mark space ratio thus increases. This signal is fed to a simple capacitor charge/discharge circuit, called an integrator, and depending on the respective mark/space ratio the capacitor will receive an average higher or lower charge, shown as a voltage which can be in the range of 0 to about +6V.

To prevent any following circuitry affecting the controlled discharge rate of the capacitor, the voltage that is built up across it—as speed increases—is fed to a high input resistance current amplifier (an emitter follower) the output of which is shown as a similar range of voltage swing (signal *D*). This voltage is used to trip a Schmitt Trigger that operates on an input voltage of about 2V in the upwards going direction and reverts at a level of about 1·8V. The output of the trigger will thus be in one of two possible states (a) +5V if the signal *D* is above +2V and (b) 0V if *D* is below 1·8V The signal *E* from the trigger is used to switch an oscillator on and off and the latter drives the loudspeaker.

If the speed set control VR1 is fixed at some level, and the car's speed increases above this equivalent setting, the circuit is designed so that the voltage at *D* exceeds 2V and the output from the trigger point *E* goes to +5V which switches on the oscillator.

It takes a couple of seconds for the integrator to give a steady output at each speed hence there is a short delay before the alarm sounds. When the car's speed decreases there is again a short delay in the integrator but the voltage at *D* has to fall below 1·8V before the trigger reverts and switches off the oscillator. This is how the built in penalty comes about.

Components....

SEE **SHOP TALK**

Resistors

R1 470kΩ
R2 1kΩ
R3 22kΩ
R4 10kΩ
R5 1kΩ
R6 470Ω
R7 2·7kΩ
R8 2·7kΩ
R9 120Ω ½W
R10 100Ω ½W
All ± 10% ¼W carbon unless stated otherwise

Capacitors

C1 680pF polystyrene
C2 0·22μF (see text)
C3 47μF elect. 12V
C4 0·1μF
C5 0·1μF
C6 1000μF elect. 6V
C7 2·2μF polyester or elect. 10V

Semiconductors

TR1 BC108 *npn* silicon
D1 IN4148
D2 IN4148
D3 IN4148
IC1 NE555 or MC1455
IC2 SN7400

Miscellaneous

VR1 100kΩ linear carbon potentiometer
LS1 50mm diameter with coil impedance greater than 35 ohms
SK1 coaxial socket
PL1 coaxial plug
FS1 1A line fuse and holder
Veroboard, 0·1in. matrix 40 holes x 19 strips; i.c. sockets 8 pin d.i.l. and 14 pin d.i.l. (1 off each); tag post; rubber grommet; knob; grille for loudspeaker; metal case.

CIRCUIT OPERATION

The complete circuit diagram of the Speed Guard is shown in Fig. 2 and might look rather unfamiliar to many readers; this is because of the fact that integrated circuits are used. The alphabetically designated points of Fig. 1 are repeated in Fig. 2 to help the reader.

The monostable is made from a very versatile integrated circuit known as the 555 shown as IC1. It draws its power through pins 1 (0V) and 8 (+12V). Note that this is desirable to connect pin 4 to +12V as well. It is triggered by a negative going signal into pin 2 and this is provided by the coupling circuitry from the pick up coil.

Diodes D1 and D2 are there to prevent any very high induced voltages in the coil damaging IC1. The output from the monostable is taken from pin 3 at the bottom end of its output load resistor, R2. The monostable's dwell time is set by VR1, R4 and C2 (a note about the capacitor later).

Components R3 and C3 form the simple integrator circuit already mentioned and this is directly coupled to the base of TR1 connected as an emitter follower.

The integrated circuit IC2 is a standard SN7400 transistor transistor logic (t.t.l.) NAND gate—in fact there are four gates. This device is normally found in logic circuits and is used in an unusual fashion in this application.

The two left hand gates are cross coupled with R6 to form a very simple Schmitt Trigger. It is essential to use D3 in one of the input lines otherwise the circuit will not trigger reliably. The value of R6 is quite critical because it sets the hysteresis of the trigger; reduce its value and there will be a larger gap between the upwards and downwards triggering levels.

The remaining two gates in the package are capacitively cross coupled with C4 and C5 to make a free running (astable) multivibrator operating at a high audio frequency.

The oscillator will only work when the input at pin 12 is at +5V and this is obtained from the output of the trigger.

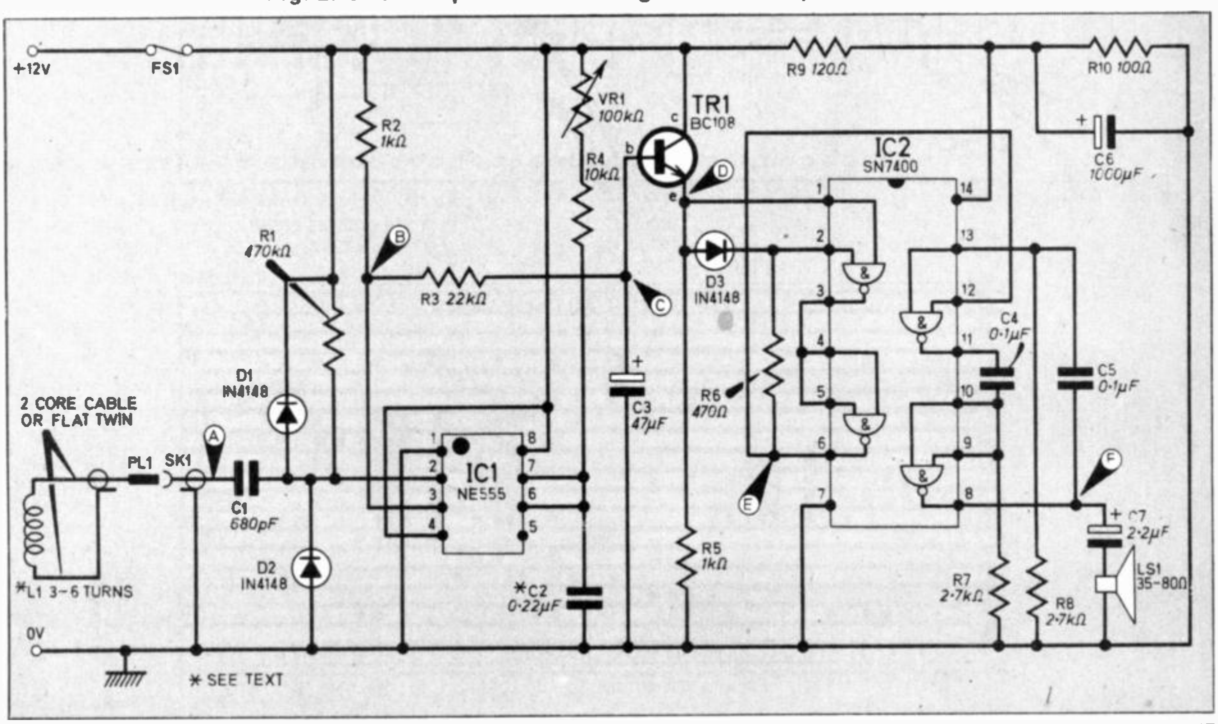
It is important to note that IC2 requires a power supply of +5V and this is obtained from the potential divide action of R9 and R10 in association with the reservoir capacitor C6. These two resistors must be of at least half-watt rating.

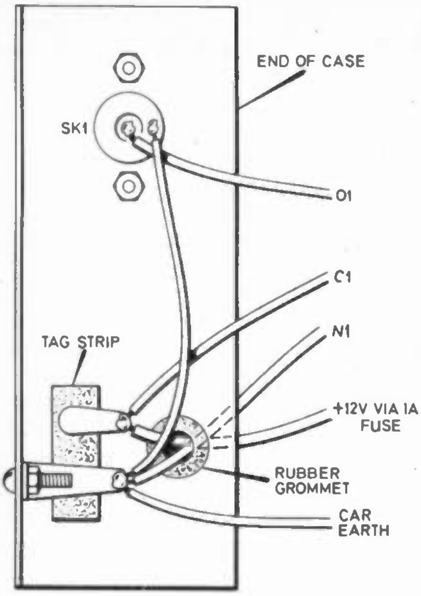
Drive to the loudspeaker is taken from the output of the oscillator at pin 8 through the coupling capacitor C7. Under **no circumstances** should a loudspeaker of less than 35 ohms be used otherwise the integrated circuit could be permanently damaged. To be safe it is preferable to use a miniature 75 ohm device. Provided this advice is adhered to the integrated circuit is quite capable of producing a high amplitude "squeal" without any further form of amplification.

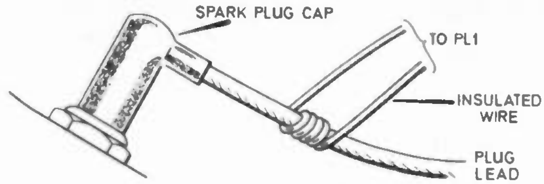
CONSTRUCTION

In the prototype, the circuit board and associated components were mounted in an aluminium case that can be screwed under the dashboard. Although a coaxial plug and socket is used to accept the lead from the pick-up coil,

Fig. 2. The complete circuit diagram of the Speed Guard.





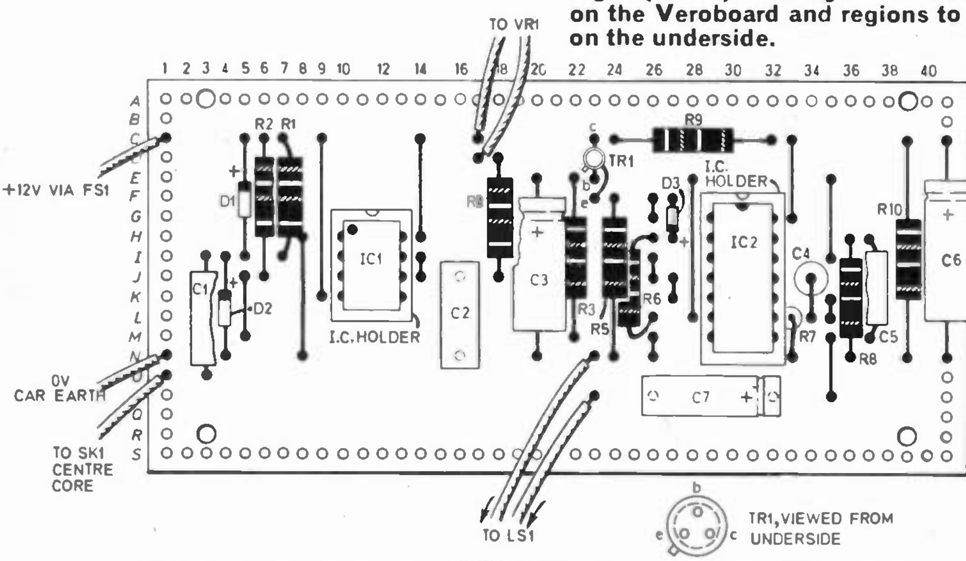


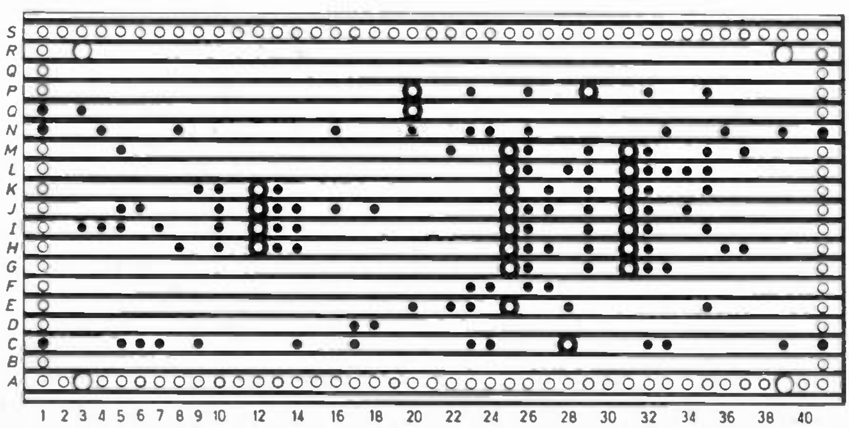
Shows the method of wrapping the pick-up coil around the spark plug lead.

SPEED GUARD

Fig. 4 (left). Wiring details in the case.

Fig. 3 (below). The layout of the components on the Veroboard and regions to be removed on the underside.





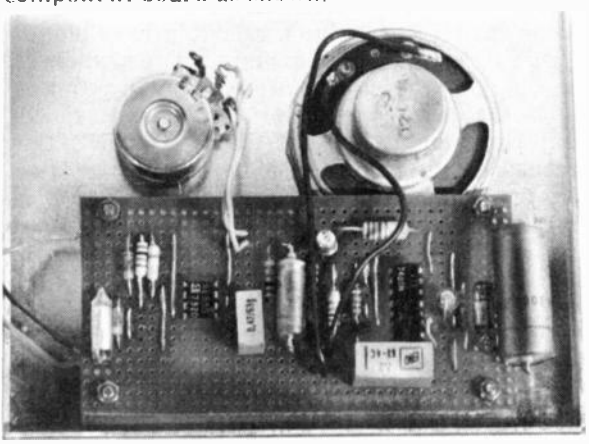
do **not** use screened cable for the lead. The internal capacity of the cable can, in some instances, shunt the induced signal to ground. Capacitor C7 was a polyester type in the prototype but an electrolytic will do just as well, but take note of its polarity.

The prototype Speed Guard was built on a piece of 0·1in matrix Veroboard size 19 strips by 40 holes. The layout of the components on the topside of the board and breaks in the copper strips on the underside are shown in Fig. 3.

Begin construction by making the necessary breaks along the copper strips as detailed and then drill the four fixing holes, one near each corner as shown.

Now position and solder the i.c. holders and link wires followed by the resistors and capacitors. With the aid of a heatshunt, solder in position the diodes and transistor.

Next secure VR1 and LS1 with speaker grille in place as indicated below. Fix the rubber grommet, coaxial socket SK1 and earthing tag in position and wire up all the components and component board as shown.



Photograph of the component board.

CONNECTING TO CAR

Although primarily designed for a negative earth 12V system, the unit can be converted to positive earth by returning the positive rail to the earthing tag inside the box and connecting the flying power input leads to the car's electrical system accordingly. The circuit is **not** suitable for 6V systems.

Ideally the live power lead should come from a point that is automatically switched on when the ignition switch is turned thus the circuit is only active whenever the engine is running. The twin wire running to the pick-up coil should avoid as much of the other car wiring as possible —to avoid stray pick up of other signals—and in particular should be kept as far away as possible from other plug leads or the centre h.t. lead into the distributor. Working off the plug signal, removes any problem with four or six cylinder engines—a spark pulse is produced for every **second** revolution of the engine (assuming four-stroke action).

Obviously different cars have a vast range of revolutions for given road speeds. Some cars may naturally rev too high for accurate adjustment of VR1. If that is the case C2 should be reduced in value to 0·1μF.

TESTING

When the unit is first installed it can be quickly tested for function at tick over revs by increasing the value of VR1 to maximum while maintaining a constant engine speed. At some setting the oscillator tone will be heard in the loudspeaker. Reduce the value of VR1 slightly and the sound will stop but will then be found to start again if the throttle is opened slightly. Be prepared for the slight delay in response—as already mentioned.

To set the unit for a pre-set speed (say 50 m.p.h.) drive as steadily as possible at 50 m.p.h. on the open road with VR1 set at **minimum** resistance and **slowly** increase its value until the alarm **just** triggers. Reduce speed to about 45 m.p.h. and the tone should stop; increase speed and it should trigger again at 50 m.p.h.

It should be stated that the unit is sensitive to temperature variations and the exact triggering speed could vary by up to 10 per cent in extremes of temperature; however, if the electronics are kept inside the saloon most cars reach a normal temperature within a few minutes of running and the error associated with temperature variation should not be excessive.

PICK-UP COIL

Some experimentation might be worthwhile deciding on the best number of turns for the pick-up coil; for the prototype six turns were found to be ample but the number and position of them will depend on the efficiency of the ignition coil and the points.

If the car is badly tuned or misfiring there could be errors associated with this monitoring method but there again one object of the project is to effect fuel economy and first and foremost —to this end—is a correctly tuned engine! ▣

Photograph of the completed unit.

PLANT PROPAGATOR

By D.T. GOODWIN B.Sc.

A temperature controlled heated tray for raising seeds.

It is a well-known fact that plants grow much better if their climate is stable and without the wide temperature fluctuations that can occur in this country. It would therefore seem sensible to provide some form of temperature control, especially when trying to raise seeds.

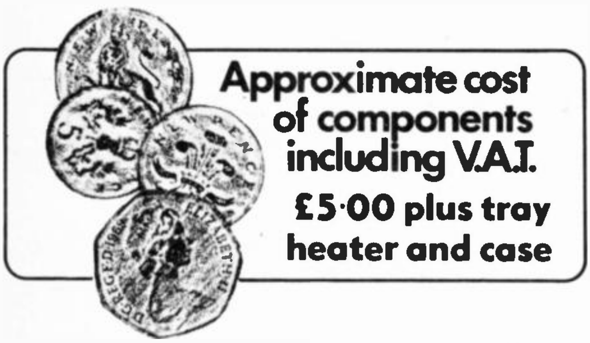
There are many plant propagators on the market but although these reduce the severity of the temperature fluctuations they do not remove them completely. With this simple heating system a fairly constant temperature can be maintained and more successful seed raising should follow.

TEMPERATURE CONTROL CIRCUITRY

The control circuitry is shown in Fig. 1. The heart of the whole device is a glass bead thermistor RTH1. As the temperature increases the resistance of the thermistor decreases and so the potential at the base of TR1 increases. When this value is greater than the potential at the base of TR2 then the current that is drawn by R2 passes through TR1 instead of TR2. This causes R3 to bias off TR3 which in turn switches off TR4 and consequently the heater.

As the thermistor cools down TR2 takes over and so the heater is switched on again. This process will keep the propagator at a fairly constant temperature, the temperature being set by VR1 which determines the potential at which the two transistors TR1 and TR2 reverse rolls. With the values chosen quite a large temperature variation can be covered and this can be set to suit the particular plant types being cultivated.

The whole device runs off a 12 volt 1 amp (approx.) d.c. supply and, as this is a comparator type circuit, there is no need for elaborate stabilisation. Therefore the power supply shown in Fig. 1 is suitable for this device.



HEATER

There are many heating elements readily available on the market that are suitable for this device but they all require adaption for use in a low voltage circuit. Insulation is not really of much importance in the heater as it is operated at such a low voltage.

Two elements that immediately spring to mind are the wire from an electric bar fire and a piece of electric blanket heater wire. The bar fire wire has the advantage that to provide a 1 amp heater current a reasonably long length of wire is required, but it is uninsulated, whereas the blanket wire is insulated and only requires about half the current for the same heat, its equivalent length is thus about half too; this means that it would need to heat twice the area. The fire wire also has the advantage that it is readily available and for this reason was chosen. The system is adaptable to most heaters.

A length of wire of approximate resistance 12 ohms should be unwound from a 1 kilowatt fire-bar (approx 1·7 metres). This should then be placed in the pattern shown in Fig. 2 on top of a layer of peat and small pebbles (it may be easier

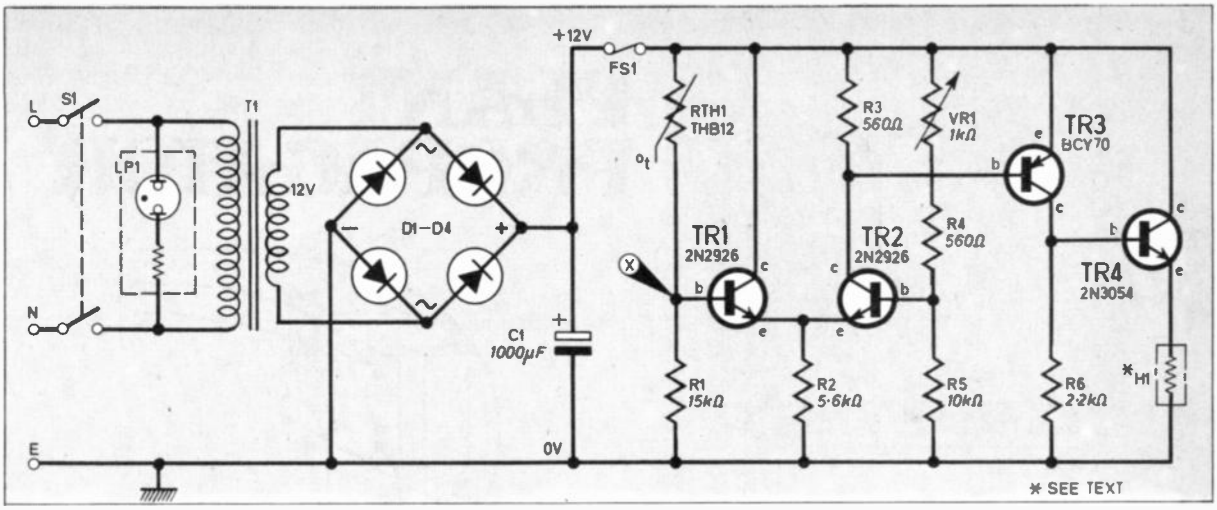


Fig. 1 Circuit diagram of the Plant Propagator. The components to the left of FS1 form the power supply, those to the right the control circuitry.

to straighten the wire before attempting this). The two ends of the wire are then soldered to two terminals mounted on the side of the seed tray, and the heater is then ready for use.

MOUNTING THE PROBE

The thermistor probe should be mounted as near the centre of the tray as possible to ensure an overall reading, it should also be placed central with respect to the heating wires. The thermistor is held in a terminal block with two wires going to two terminals on the side of the tray. It is best to try and insulate this sensor from the possible effects of watering, etc.

CONSTRUCTION

All the electronics (apart from the thermistor, heater, transformer and rectifier) can be mounted on a piece of 0·15 inch matrix Veroboard. The layout is shown in Fig. 3. This can then, together with the transformer, be mounted in the control box. The box can be any metal or plastic case that is large enough to house all the components. If a metal case is used this should be earthed with a three-core mains lead and fused three-pin plug—a 1 amp fuse is adequate.

SETTING UP AND CALIBRATION

To set up the device simply connect the four wires from the control box to the seed tray and switch on, setting the required temperature with VR1. To calibrate it simply place a thermometer in the soil around about the centre of the tray (taking care not to disturb the thermistor) and read off the temperature for certain settings of the pot after allowing time for the soil to warm up. It is helpful to put a voltmeter across the heater when setting up and calibrating so that the temperature at which the heater switches off can easily be seen.

With the components shown a temperature range of about 60 degrees F to 100 degrees F should be attainable although the upper figure is dependent on the efficiency of the heater and on losses through the propagator. ▣

Components....

Resistors
R1 15kΩ
R2 5·6kΩ
R3 560Ω
R4 560Ω
R5 10kΩ
R6 2·2kΩ
All ¼W ±10% carbon

SEE **SHOP TALK**

Capacitor
C1 1,000µF elect. 15V

Semiconductors
TR1 2N2926 (orange) silicon *npn*
TR2 2N2926 (orange) silicon *npn*
TR3 BCY70 silicon *pnp*
TR4 2N3054 silicon *npn*
D1–D4 Any 50 p.i.v., 1·5 amp (or greater) bridge rectifier

Miscellaneous
S1 d.p.d.t. mains toggle switch
T1 240V primary 12V, 1·5A secondary transformer
FS1 1 amp fuse and holder
RTH1 THB12 bead type thermistor (Henry's Radio)
VR1 1kΩ carbon potentiometer
H1 heating element—see text
LP1 panel mounting neon indicator with built in resistor.
Veroboard 25 holes × 16 strips × 0·15 inch matrix, aluminium for TR4 heatsink, approx 70mm × 35mm × 22s.w.g., connecting wire, case, knob for VR1, plant tray, connecting terminals for tray (4 off), 2 way connector block.

PLANT PROPAGATOR

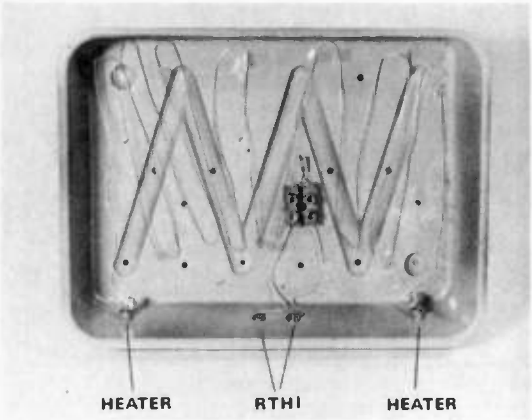


Fig. 2. Seed tray layout and wiring.

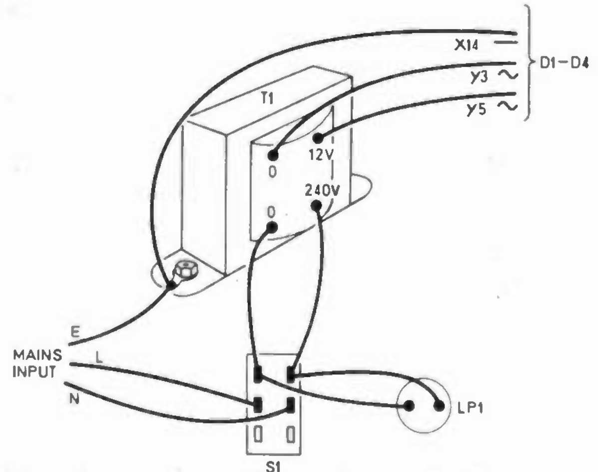
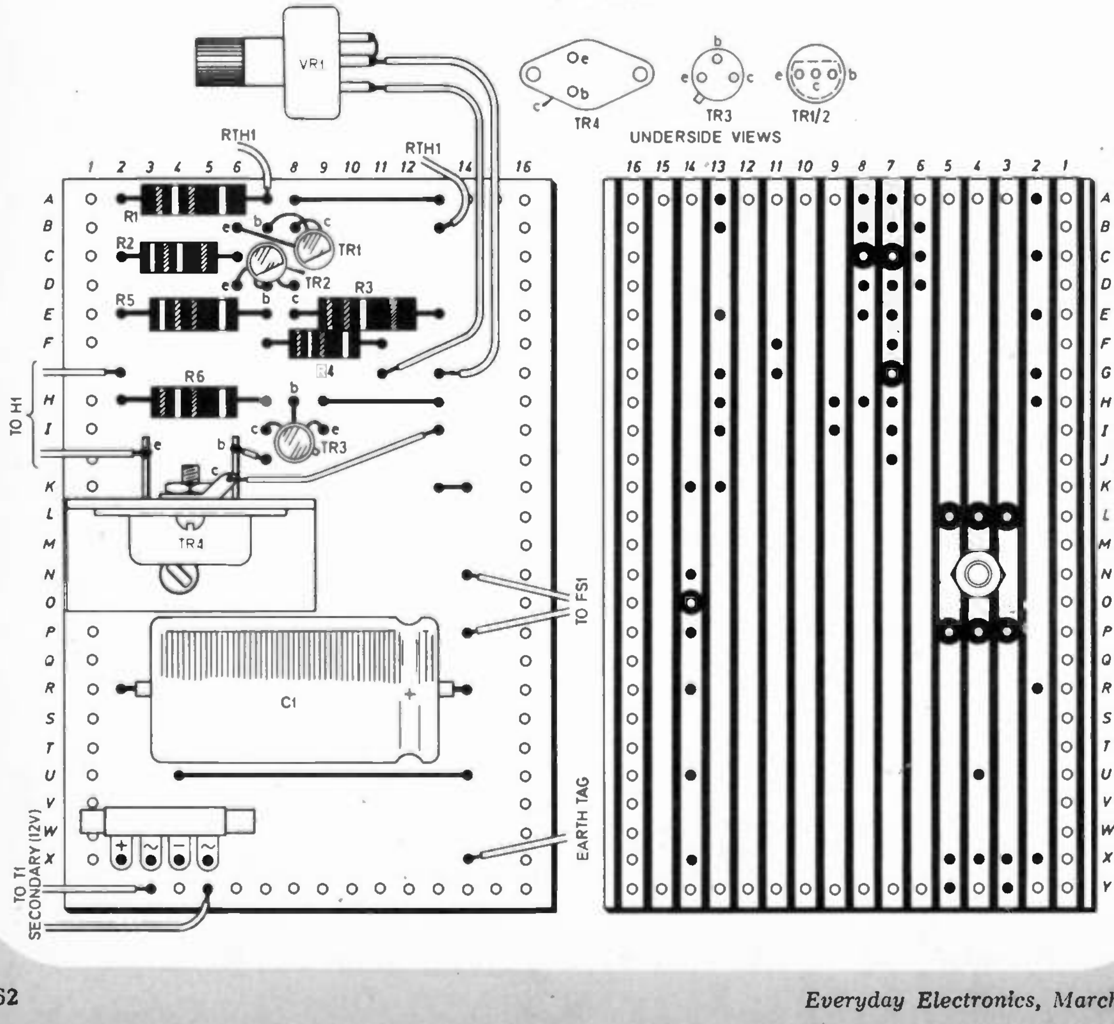


Fig. 3. Veroboard layout and wiring (below) and transformer connections (above). TR4 is mounted on a small heat sink made from a strip of aluminium bent at one end with holes drilled to clear the emitter and base leads and for the mounting screws.



SEMICONDUCTOR PRIMER

By A.P. STEPHENSON

6 ■ CORRECT TRANSISTOR SUPPLY POLARITIES

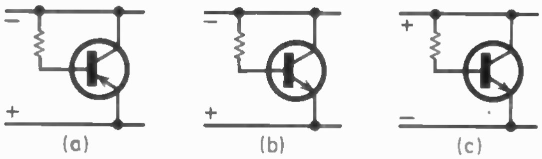
PROBLEM

In each circuit shown, (Fig. 6.1 a—i), state if collector current is flowing or not.

Also state, in one sentence, the guiding points which directed your answers.

(a) = yes (b) = no (c) = yes (d) = yes (e) = no (f) = no (g) = no (h) = no (i) = no

The correct collector supply rail polarity must obey the conventional current direction, and the base resistor must be returned to the collector end.



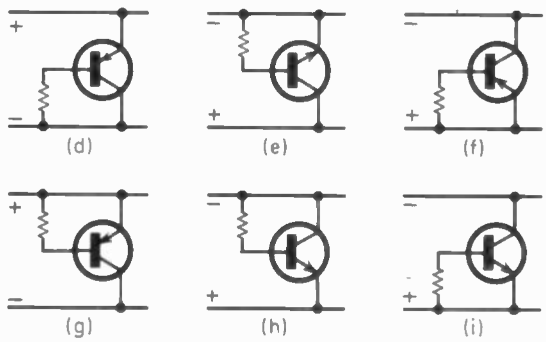


Fig. 6.1. Collector current will flow in only some of these configurations.

7 ■ HOW A TRANSISTOR AMPLIFIES

Consider the following arrangements, (Fig. 7.1). Note the arrows are showing *electron* flow.

The base material is *p* type and is made *very thin.*

With no forward bias on base (switch open) no current flows at all, because the two diodes are back to back.

With forward bias on base (switch closed) electrons in the emitter are pulled into the base, forming base current. But any electron reaching the base is FAR MORE LIKELY TO TRAVEL ON TO THE COLLECTOR, SINCE IT IS AT A *HIGHER POSITIVE* POTENTIAL THAN THE BASE.

Thus only a few electrons turn "left", most of them carry straight on.

Thus, switching on a *small* base current has released a *large* collector current.

The transistor is therefore a **current amplifier!**

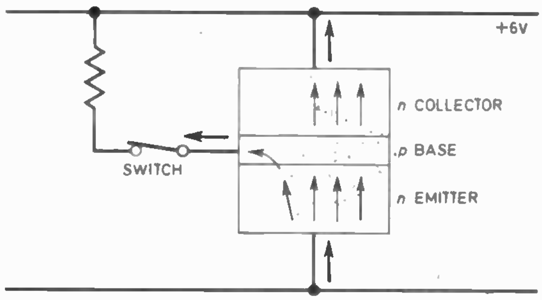


Fig. 7.1. Electron flow in an *npn* transistor.

8 ■ THE THREE CURRENTS IN A TRANSISTOR

The following equation describes the distribution of currents in a transistor.

Emitter current = base current + collector current

or in symbols,

$$I_e = I_b + I_c$$

These currents flow as indicated in Fig. 8.1.

If the I_c is 5mA and h_{fe} is 100, the base current $I_b = \frac{5}{100}$mA $= 0{\cdot}05$mA. The emitter current $= I_b + I_c = 0{\cdot}05 + 5$.

Therefore, **emitter curent = 5·05mA.**

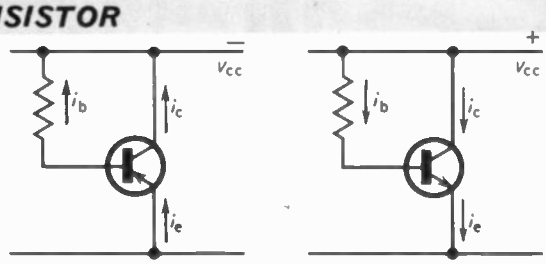
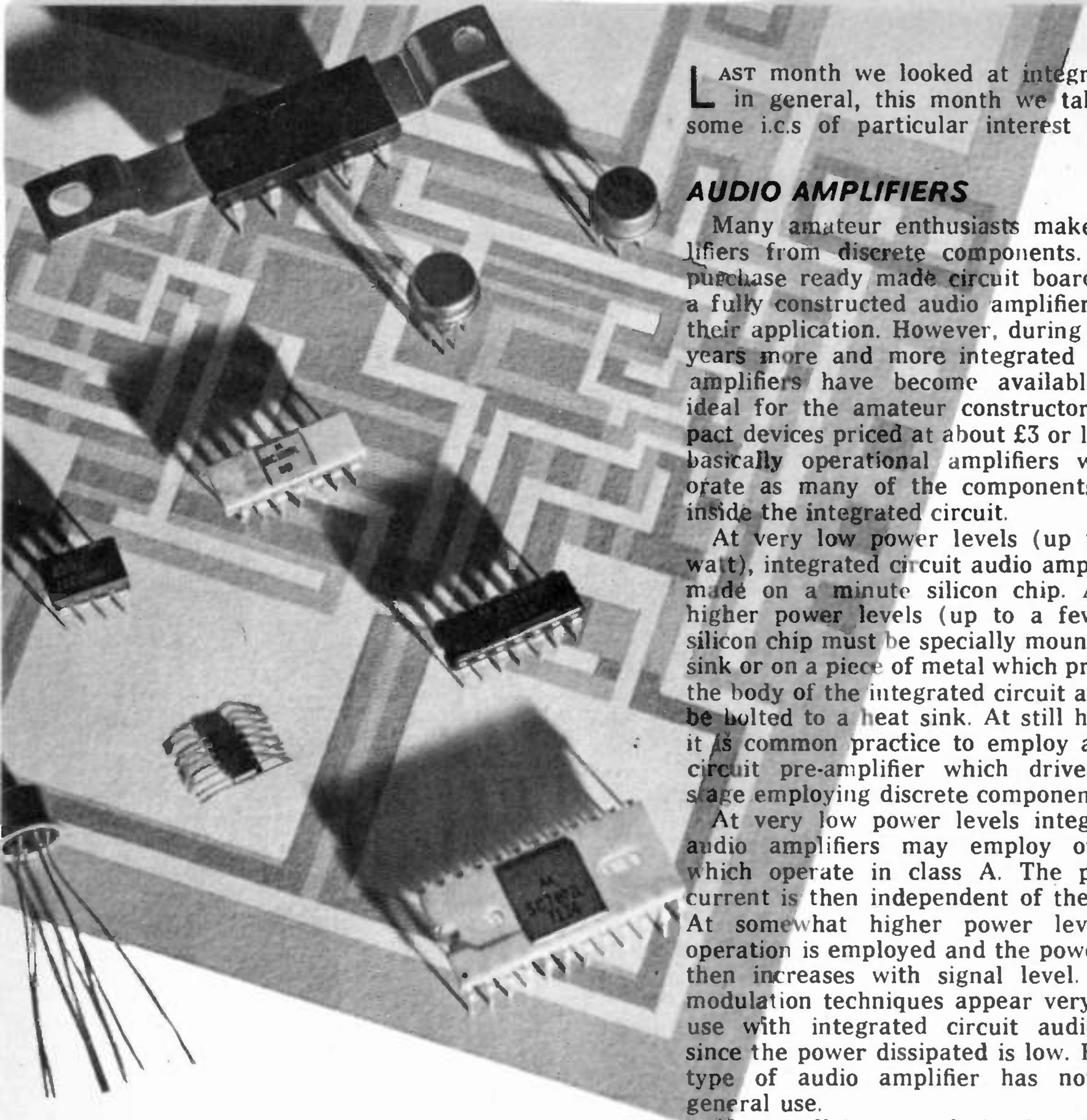


Fig. 8.1. Current flow in *pnp* and *npn* transistors.



Introduction to INTEGRATED CIRCUITS 2

By J. B. DANCE M.Sc.

LAST month we looked at integrated circuits in general, this month we take a look at some i.c.s of particular interest to amateurs.

AUDIO AMPLIFIERS

Many amateur enthusiasts make audio amplifiers from discrete components. Others may purchase ready made circuit boards containing a fully constructed audio amplifier suitable for their application. However, during the past few years more and more integrated circuit audio amplifiers have become available. They are ideal for the amateur constructor, being compact devices priced at about £3 or less. They are basically operational amplifiers which incorporate as many of the components as possible inside the integrated circuit.

At very low power levels (up to about 0·1 watt), integrated circuit audio amplifiers can be made on a minute silicon chip. At somewhat higher power levels (up to a few watts) the silicon chip must be specially mounted on a heat sink or on a piece of metal which protrudes from the body of the integrated circuit and which can be bolted to a heat sink. At still higher powers it is common practice to employ an integrated circuit pre-amplifier which drives an output stage employing discrete components.

At very low power levels integrated circuit audio amplifiers may employ output stages which operate in class A. The power supply current is then independent of the signal level. At somewhat higher power levels, class B operation is employed and the power dissipation then increases with signal level. Pulse width modulation techniques appear very suitable for use with integrated circuit audio amplifiers, since the power dissipated is low. However, this type of audio amplifier has not come into general use.

Almost all integrated circuit audio amplifiers require various external components, mainly capacitors. It is not possible to incorporate the large value capacitors required for use in audio amplifiers in a micro-miniature silicon chip of an integrated circuit and they must therefore be connected externally. Some types of thick-film hybrid circuits are available in which sub-miniature capacitors are mounted inside the package.

AMPLIFIER I.C.S.

We will now consider an audio amplifier which is much used by the amateur constructor, the SN76013 which is the same device as the Super IC12. This device can supply up to about 6 watts of power into an 8 ohm speaker.

The SN76013 is shown on the Integrated Circuit Data Chart presented free with this issue. It can be seen that a finned aluminium heat sink is fitted onto the back of the integrated circuit module. There are twelve connecting pins arranged in a dual-in-line configuration with a gap of two pins in the centre of each of the two lines of pins.

CIRCUIT

The internal circuit of the SN76013 is quite complex and it is not necessary to understand its operation in order to use this amplifier, but the following brief notes may interest some of the more experienced readers.

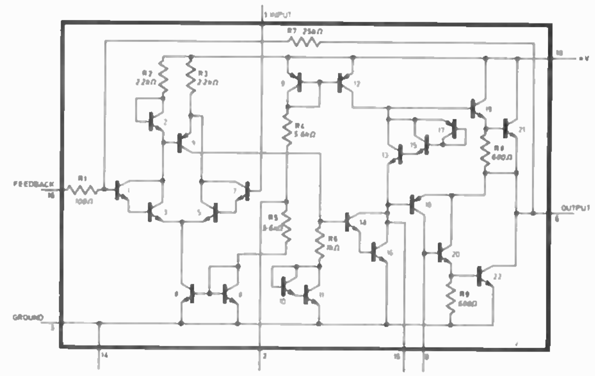


Fig. 2. Circuitry of the SN76013.

Transistors TR1 and TR3, Fig. 2, form a Darlington amplifier which, together with the Darlington amplifier TR5 and TR7, forms a differential long-tailed pair input stage. Transistor TR4 (biased by TR8) forms the constant current source for the long-tailed pair.

The differential output from the long-tailed pair stage is fed to the emitter-base junction of TR6 and the output from the latter is fed to the Darlington pair TR14 and TR16, TR12 acts as a constant current load to this pair. Transistors TR19, TR21, TR18, TR20 and TR22 are connected in a conventional quasi-complementary class AB output stage.

Overall negative feedback is taken through R7 to the input of pin 16. In the external circuit a resistor is also used to apply more negative feedback from the output to pin 16.

A simple circuit with typical component values for use with the SN76013 is shown on the chart.

OUTPUT POWER

The power output obtainable from the SN76013 depends on the speaker impedance and the power supply voltage. The maximum permissible power supply voltage is 28V and the minimum recommended 8V. The maximum output power for a 28V supply is obtained with a 6 ohm load and is about 7·6 watts. The output power falls to 6 watts with an 8 ohm speaker and to 4·7 watts for a 15 ohm speaker, both with a 28V supply. These maximum power levels can be obtained with a 30mV input signal.

The sensitivity of the SN76013 is adequate for use with a high output crystal pick-up or a ceramic record player cartridge, even when one allows for the fact that an input of 250mV is required to overcome the losses in the frequency compensation circuits between the pick-up and the input of the amplifier.

SL402D and SL403D

The Plessey type SL402D and SL403D audio amplifiers are somewhat smaller than the Texas SN76013, but they must be fitted to a heat sink. The SL402D can provide an output of up to 2·5W and the SL403D an output of up to 3·5W. They are used as class AB amplifiers.

The shape of these amplifiers is shown on the chart. It can be seen that a 10-pin dual-in-line encapsulation is employed with brackets designed for bolting to an external heat sink.

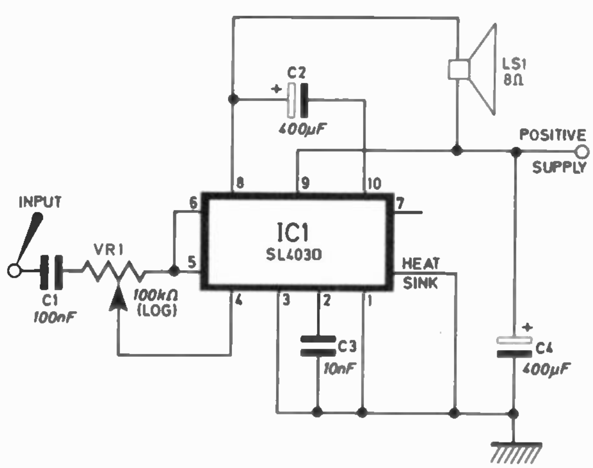
An interesting feature of these amplifiers is the use of an internal silicon controlled rectifier to protect the unit against short circuiting of the output. If such a short occurs, the power supply must be momentarily interrupted to reset the silicon controlled rectifier. The maximum operating supply voltage for the SL402D is 14V and for the SL403D 18V.

The simplest type of circuit used with these amplifiers is shown in Fig. 3. Only four capacitors and a potentiometer (the volume control) are required.

THE LM380N

Another integrated circuit audio amplifier which is ideally suitable for the amateur constructor is the National Semiconductor type LM380N. It has been designed so that a minimum number of external components are required and can provide 2W into an 8 ohm loudspeaker when operated from an 18V supply.

Fig. 3. Simple circuit employing an SL403D amplifier.



The LM380N device has thermal overload protection; that is, an internal circuit is included which will prevent damage from occurring if the components on the internal silicon chip become too hot. In addition, the LM380N includes short circuit protection; it will not therefore be damaged if the output is accidentally shorted to ground.

This audio amplifier has a 14-pin dual-in-line encapsulation with the connections shown on the chart. If the input signal is fed to pin 2, the output voltage will be in phase with the input. However, the input signal may be fed to the inverting input at pin 6, in which case the output signal will be 180 degrees out of phase with the input.

The LM380N includes internal feedback resistors which ensure that it has a fixed voltage gain of 50 (or 34db). Although this fixed gain reduces the versatility of the device somewhat, it does enable it to be used with a minimum number of external components and makes it more attractive for many purposes.

The LM380N can dissipate up to about 1·3W without any heat sink. If one wishes to operate it at its maximum power level for an appreciable time, pins 3, 4 and 5 and pins 10, 11 and 12 should be soldered to external heat sinks.

The circuit of a complete audio amplifier using the LM380N is shown in Fig. 4; it is outstanding for its simplicity. The components R1 and C2 (shown dotted) increase the stability at high frequencies. The minimum recommended operating voltage is 8V and the absolute maximum operating voltage 22V; however, it is wise to regard 18V as the upper limit to prevent possible damage to the device during voltage surges.

When the input is fed to pin 2, the other input at pin 6 may be left unconnected, but sometimes it is better to return it to earth either directly or through a capacitor or resistor. When the input is fed to pin 6, pin 2 should be returned to earth in one of these ways.

If the average input potential is the same as that of the negative line, no capacitor need be placed in series with the input. The input impedance is 150 kilohms.

If a mains power pack is used to supply a LM380N, any hum on the power supply line tends to appear at the output. This hum can be reduced by a very large factor (about 40db) by connecting a capacitor of about 5μF from pin 1 to ground.

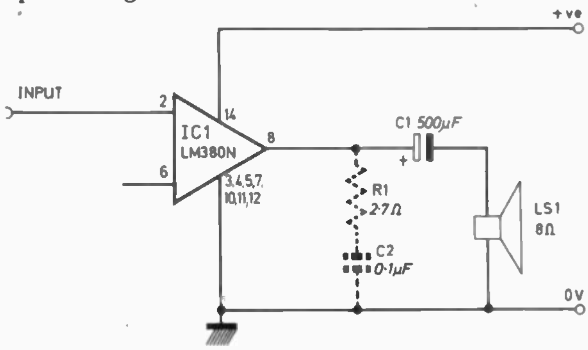


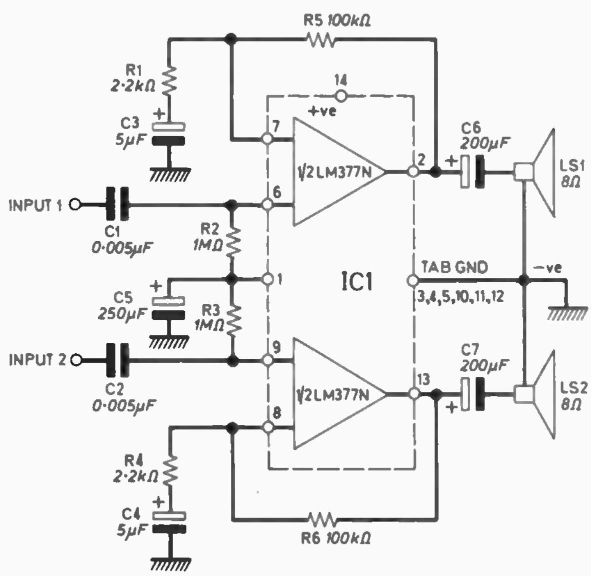
Fig. 4. Circuit using an LM380N.

DUAL POWER AMPLIFIER

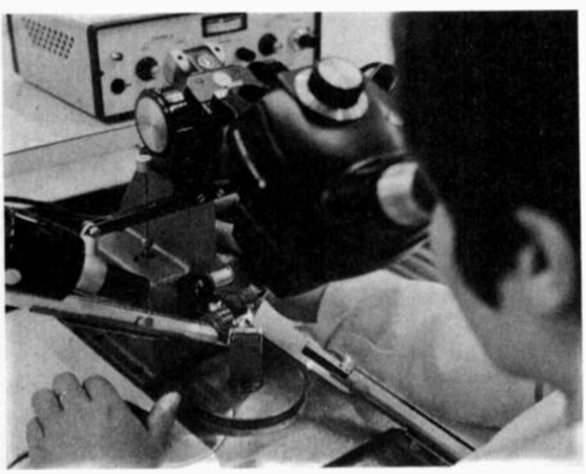
The National Semiconductor LM377N is a 14-pin dual-in-line device which contains two separate high gain audio power amplifiers in a single encapsulation. Each amplifier will provide an output of up to at least 2W (typically 2·5W) into an 8 or 16 ohm loudspeaker.

This device is intended mainly for use in stereo radio receivers, stereo record players, tape recorders, etc. Both amplifiers are fully protected against accidental short circuiting of

Fig. 5. Circuit of a stereo amplifier using an LM377N.



Photograph showing an integrated circuit being connected to the package pins.



SAXON

Money saving high performance audio equipment
DIRECT FROM OUR OWN FACTORY

POWER AMPLIFIER MODULES : : POWER SUPPLY UNITS

Better performance; better value. In 3 useful sizes

BRIEF SPECIFICATION:
OPEN AND SHORT CIRCUIT PROTECTION, plus proof against over-dissipation and faulty inductive loads in the SA.100.
Response 15-40,000Hz ±1dB
Distortion 0·2% at 1kHz
Loads 4 to 16 ohms
Noise Better than −75dB
Size 4½" x 4" x 1" (SA100)
4" x 3" x 1" (SA35/SA50)
Circuits, connecting instruction and application data free with all modules.

SA35
35 watts RMS. Uses 7 transistors and 7 diodes. Carr. paid **£4·45**

SA50
50 watts RMS. 7 transistors, 7 diodes. Carr. paid **£5·65**

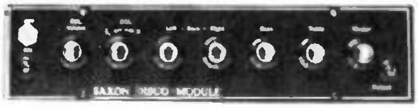
SA100
100 watts RMS. 11 transistors, 6 diodes. Carr. paid **£10·90**

Unstabilized supply for 2 SA35s or one SA50 for 4Ω Carr. 30p
PU45 **£4·90**
Unstabilized supply for one or two SA50 for 8Ω or SA100 power amps Carr. 40p
PU70 **£7·75**
Stabilized module for two SA35's or one or 2 SA50 (4Ω) Carr. free
PS45 **£3·50**
Transformer for above, heavy duty Carr. 30p
MT45 **£2·85**
Stabilized supply module for one or two SA50's (8Ω) or SA100's Carr. free
PS70 **£4·90**
MT70 Transformer for PS70 Carr. 40p **£4·90**

ALL ON GLASS FIBRE P.C. BOARDS, TESTED AND GUARANTEED

SAXON CONTROL UNITS

MONO AND EXCITING NEW STEREO VERSION



Stereo version now has mic. override and case. Two decks, and full headphone monitoring. Stereo model mains operated. 17½" x 3" x 4" deep. White on black facia. Controls: Left/Right deck-fader, volume, bass, treble. Headphone Selector and volume. Microphone volume, bass, treble, mains on/off. Mono version (illustrated) has no mic. input and runs from PP.9 (or equivalent) battery.
COMPARABLE TO UNITS AT OVER TWICE THE PRICE.

MONO
For 9V. operation. No mic. input.
£6·50
(Carr. 20p)

STEREO Mk. 2
With mic. override and case. For A.C. mains.
£19·75
(Carr. 30p)

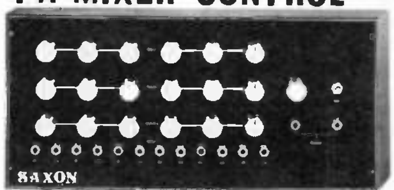
MICROPHONE BARGAINS

A.K.G. D.190C
One of the world's best in its class. The choice of professionals. Carr. paid
£19·50

General Purpose
A professional standard mic. Robust and fine quality. Dynamic. Carr. paid **£9·90**

TWO NEW PA/MIXER CONTROL UNITS

Using grouped pairs of inputs and outputs (high Z and low Z inputs) with individual bass, treble and volume controls on each pair, plus master control. These low-noise Saxon units will feed all makes of amplifiers, making them ideal for clubs, discos, etc. Standard jack sockets. Compact design. In strong metal cases. All units guaranteed for 3 years.



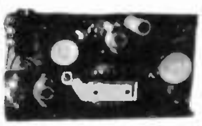
● **M.4H**
4 high Z, 4 low Z inputs, 4 sets of controls. Case 14" x 8" x 2½". Carr. paid. **£18·50** + V.A.T.

● **M.6HL**
Case 18" x 8" x 2½". 12 inputs (6 high Z, 6 low Z). Carr. paid. **£27·50** + V.A.T.

● **CHANNEL SECTION**
modules, for building your own mixer. Gain—16 x (24dB). Tone controls—18bB swing. Carr. paid. **£3·50** + V.A.T.

120 & 160 WATT MODULE

Rugged class A driver stage, low distortion parallel push-pull output, into an eight ohm load. 4 TO3 can (115 watt) output transistors.



Freq. response: 20-20,000Hz ±2dB
Input sensitivity: 200mV into 10K
Module and power supply. (Carr. 40p)
£18·95
160 watt version with power supply. (Carr. 50p)
£27·90

SOUND & LIGHT UNITS

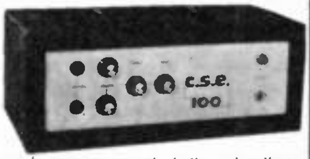
3 channel model handles up to 3kW (3000 watts) of lighting and incorporates versatile sound control for professional standards.

SINGLE CHANNEL UNIT
Operates from 5 to 100 watt amplifiers. Supplied for bass note operation, is easily adapted for treble or mid-range at a cost of about 5p. Carr. paid **£7.50**

3 CHANNEL UNIT
Bass, middle and treble as well as master controls. 2 amplifier sockets. Up to 3kW lighting load. Smartly finished steel case. Carr. 30p **£19.75**

COMPLETE AMPLIFIERS

SAXON CSE 100



In black vynide case, represents better value than ever, delivering up to 100 watts music power and continuous signal outputs of 70 watts RMS. Two individually controlled inputs with wide range bass and treble controls. Carr. free **£34·90**

SAXON 100

With an RMS output of 120 watts speech and music, 100 watts continuous power, four individually controlled FET input stages and wide range bass and treble controls, this amplifier offers quality and reliability at low cost. Carr. free **£48·50**

LOUDSPEAKERS

British-made bargains.
12" 25 watt 8/15 ohms £8·95 carr. 30p.
15" 50 watt 8/15 ohm £14·50 carr. 50p.
12" 40 watt 15,000 gauss magnet system 8/15 ohm £11·50 carr. 40p.

V.A.T

Prices quoted do NOT include Value Added Tax. 10% must be added to total value of order, including postal or carriage charges

S.A.E. brings latest Saxon Bargain List.
●
Please include S.A.E. with your enquiries.
●
Prices subject to alteration without prior notice

Orders and personal shoppers to:
SAXON ENTERTAINMENTS LTD., 331 Whitehorse Rd., W. Croydon, Surrey. CRO 2HS.
Telephone 01-684 6385
Hours 9.30 a.m.-5.30 p.m.
TRADE & EXPORT ENQUIRIES INVITED

TERMS OF BUSINESS
Cash with order (C.W.O.) For C.O.D. please add 35p extra, cash by regd. letter, please

its output and, in addition, against overheating of the silicon chip.

The minimum recommended supply voltage is 10V and the absolute maximum permissible supply voltage 26V. Under no signal conditions the device requires about 15mA, but this rises to about 1A at high power levels.

The amplifiers have a high input impedance (3 megohms). The gain is set by the values of two external resistors.

The connections of the LM377N are unfortunately shown incorrectly on the chart, the base should be C. A single device of this type can be used in the circuit of Fig. 5 as the power amplifier stages of a stereo system. The gain is equal to R5/R1=R6/R4=45.

The bias supply from pin 1 must be used to supply both of the inputs at pins 6 and 9. In Fig. 5 this bias is applied via R2 and R3 to the respective amplifiers.

The LM377N can also be used as the driver stage in high power audio amplifiers if it is employed to feed two suitable high power output stages.

THE TBA800

Another well-known integrated circuit audio amplifier is the SGS-Ates type TBA800; it can feed up to 5W of power into a 16 ohm loudspeaker when the circuit is operated from a 24V supply.

The TBA800 is encapsulated in a plastic case which has its connecting pins in the quad-in-line configuration. Quad-in-line devices are like dual-in-line ones, but alternate pins are bent so that they are at different distances from the body of the device. Thus when one looks at one end of the device, one sees four separate lines of pins; hence the name quad-in-line.

In addition to its connecting pins, the TBA800 has two metal tabs at the centre of each side of the device. These cooling tabs (which should be connected to the negative line) enable the device to provide up to 2·5W of power to an 8 or 16 ohm loudspeaker without any additional heat sink. If a TBA800 is to be used at a higher power level for more than a very short time, the metal tabs should be connected to an external heat sink. They may, for example, be soldered to the copper of a printed circuit board.

TBA810S and TBA810AS

The SGS-Ates TBA810S has the same type of encapsulation as the TBA800, but is a lower voltage, higher current device. It can drive up to 7W into a 4 ohm loudspeaker when a 16V supply is used and the cooling tabs are connected to a suitable heat sink.

The TBA810S is especially suitable for use in car radio receivers, since it can provide up to 4·5W into a 4 ohm loudspeaker when it is operated from a 12V car supply.

The TBA810AS is electrically similar to the TBA810S, but it has flat tabs with a hole drilled in each so that an external heat sink can be bolted to the tab.

A typical circuit for the TBA810S or TBA810AS is shown in Fig. 6. The minimum supply voltage is 4V and the absolute maximum 20V.

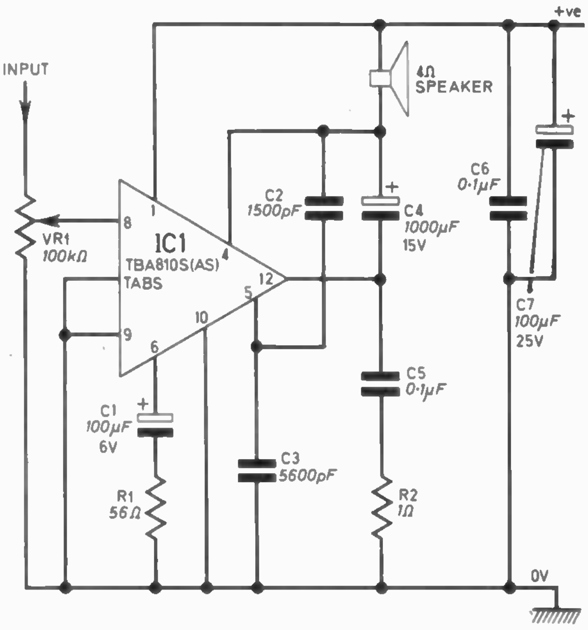


Fig. 6. Circuit for use with the TBA810S.

It should be noted that the TBA800 is suitable for 16 ohm loudspeakers, since it is a relatively high voltage device, whereas the high current output available from the TBA810 devices renders them more suitable for 4 ohm loudspeakers.

HIGHER POWER DEVICES

SGS-Ates will soon offer a type TCA940 amplifier which can drive a 4 ohm loudspeaker at the 10W level when fed from an 18V supply. The company have also developed a 20W amplifier which is expected to be produced in the fairly near future.

DIODE PROTECTION

If the power supply is accidentally applied to an integrated circuit audio amplifier with a reversed polarity, the device will normally be destroyed within a few milliseconds. Constructors are therefore advised to put a diode in the positive supply line, since this diode will prevent appreciable reverse current from flowing if the supply is accidentally connected with the wrong polarity. Obviously the diode must be connected the correct way round and must be able to pass a continuous current equal to the maximum current passed by the device.

The diode may be removed after the initial experiments if there is no longer any possibility of the power supply being applied with the wrong polarity.

RF/IF AMPLIFIERS

Radio and intermediate frequency amplifiers using integrated circuits are now becoming more common. In general integrated circuits for high frequency amplification employ several transistors per stage. It is not easy to incorporate tuned circuits in a silicon chip and therefore possible alternatives are being investigated.

Many types of high frequency amplifier are available, such as the RCA type CA3053 and the Plessey type SL612. The Mullard TAD100 unit can be used in amplitude modulated radio receivers for handling the signal from the mixer-oscillator stage up to the audio driver stage when used with suitable external components.

Various manufacturers have designed integrated circuits for use in v.h.f. receivers. For example, the Signetics N511A is a 14-pin dual-in-line circuit which enables only one coil with a single winding to be used in the f.m. limiter and detector stages of a receiver. It can also be employed in television sound channels and in communication receivers, etc.

THE ZN414

The ZN414 is one of the most interesting integrated circuits for the amateur constructor. It contains ten transistors in a miniature transistor-like case with three connecting leads.

When the ZN414 is connected to a ferrite aerial, a tuning capacitor, a bias resistor, two capacitors and a 1·3V battery, it provides a signal which can drive a magnetic earpiece. Full constructional details of such a receiver were given in the September 1973 issue of this journal and the device will therefore not be discussed in detail here.

The ZN414 can also be used as an i.f. amplifier in a.m. superheterodyne receivers. Further details are available in a booklet published by Ferranti Ltd., Gem Mill, Chadderton, Oldham, Lancs.

OTHER RADIO DEVICES

The TBA651 is an integrated circuit which is used to carry out the whole of the radio and intermediate frequency processes in a medium/long wave superheterodyne receiver.

The device combines the functions of r.f. amplifier, oscillator, mixer, i.f. amplifier and automatic gain control. It has been designed for use in both car radios and in high quality receivers.

The TBA651 will operate from supply voltages between 4·5V and 18V, consuming only 11·5mA. The device is encapsulated in a 16-pin quad-in-line case.

Another well-known device is the TAA661B f.m./i.f. amplifier and detector which is suitable for use in television sound and in f.m. receivers. The use of this device enables the detector transformer to be eliminated, whilst the output signal can be used to drive an audio amplifier directly. Detector alignment is carried out by the adjustment of a single coil—a point which should appeal to the amateur constructor.

The TDA1200 is a recently developed device for use as an f.m. radio i.f. system. It is a complex integrated circuit which includes f.m. amplification and detection, inter-channel muting for silent tuning, automatic frequency control, delayed automatic gain control, switching of a stereo decoder and driving a field strength meter.

This 16-pin dual-in-line device is suitable for use in high fidelity car radio and communications receivers.

Many other integrated circuits for radio and television use have come onto the market within the last few years. They will enable the cost of consumer devices to be kept lower than they otherwise would have been by minimising labour costs.

The Signetics integrated circuits types NE560B, NE561B and NE562B enable complete f.m. i.f. strips (including the demodulator) to be constructed without any inductors. They employ circuits known as phase locked loops.

VOLTAGE REGULATORS

Another important use of integrated circuits is for voltage regulation in power supplies. One merely connects the circuit to the output of a smoothed power supply in order to obtain a highly regulated output with an extremely low hum level. These voltage regulators are themselves ideal for use in the very stable power supplies required to drive some types of integrated circuit.

TIMER

A timer integrated circuit recently introduced by the Signetics Company is particularly versatile. It can be used to obtain delays of microseconds to hours and the delay is almost independent of the supply voltage. The type number is NE555V for the dual-in-line 8-lead package.

Integrated circuits have made a very great impact on a wide variety of circuits, only a few of which have been mentioned in this article. The rapid fall of prices during the last few years make them components which can really appeal to the amateur experimenter as well as to the professional engineer. ▣

DOWN TO EARTH

By GEORGE HYLTON

"Transistor data always gives current amplification, never voltage amplification. Yet in practical circuits it is voltage gain which matters. Can the voltage gain be derived from the current gain?"

The reason why no information about voltage gain is given in the transistor makers data is that you don't need it. Or, rather, it's assumed by the makers that you already have it, in your head.

Show a competent transistor circuit designer the audio amplifier of Fig. 1, and ask him what is the voltage gain. After about ten seconds, he'll say, "About 120", and he'll be right.

You can do it, too. The magic formula is: multiply the d.c. voltage drop across the collector load resistance (in kilohms) by 40. This is the voltage gain. In Fig. 1, the voltage drop across the 1 kilohm emitter resistor is 1 volt, so the emitter current is 1 milliamp. The collector current must be nearly the same, so the drop across the 3 kilohm collector load R3 is 3V. Gain is 3 x 40 = 120.

COMPLICATIONS

We don't propose to go into the rather complicated reasons for this very simple relationship. The important thing is that it is true of all bipolar transistors, whether *pnp*, *npn*, silicon or germanium. It's also true that it's only an approximation, and gives accurate results only when the transistor is used in normal circuits with only a few volts across the load resistance.

What's 'normal'? Well, Fig. 1 is normal, assuming that TR1 is an ordinary small signal audio transistor such as BC108 or 2N2926. But if the supply voltage were 50V and the drop across R3 were 30V the gain would not be 1200, as predicted by the formula, but a lot less.

One has to be sensible, too. In Fig. 1 there's no external load resistance, only R3. If you short the output terminals (giving an external load of 0 ohms!) there can be no output voltage. So the external load, if used, matters, and will reduce the output and voltage gain.

If an external load of 3 kilohms were connected (i.e., equal to R3), then the a.c. part of the output current would divide itself equally between the two loads and the output and gain would be halved. (This implies that R3 and the external load are in parallel to the signal current. That is so, because the two loads are tied together at one end by the output capacitor and at the other by the power supply.

In practice, the external load (let's call it R_l) may not be equal to R3. To find the gain for any value of R_l, first use the magic formula for the gain with no load then multiply the answer by $R_l/(R_l + R3)$.

MULTI STAGE

In a multi-stage amplifier (Fig. 2), the "external load" on the first stage is the input impedance of the second stage. In practical circuits, this input impedance is so much smaller than the collector load resistance of the previous stage that to all intents and purposes the whole of the a.c. current from TR1 goes into the base of TR2. It is then amplified h_{fe2} times (h_{fe2} = current amplification factor of TR2) before passing through the final (3 kilohm) load resistance to set up the output voltage.

To calculate the overall gain we need to know the a.c. collector current of TR1 rather than its a.c. collector voltage. There is another magic formula which gives you the a.c. collector current: $40.I_{c1}.V_{in}$, where I_{c1} is the number of milliamps of d.c. collector current of TR1. This leads to an expression for the overall voltage gain.

Voltage gain = $40 I_{c1}.h_{fe2}R_{l2}$ where R_{l2} is the final load in kilohms (in, Fig. 2, 3 kilohms). If $h_{fe2} = 100$ and $I_{c1} = 100\mu A$ or 0·1mA, the overall gain is: 40.0·1.100.3 = 1200.

Like the previous formulae, this is an approximation (and errs on the side of optimism).

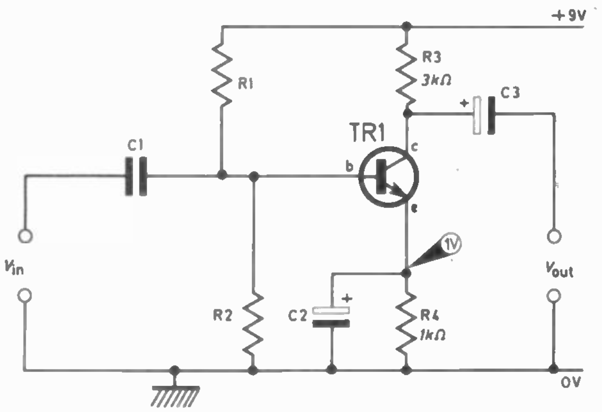


Fig. 1. Single stage amplifier

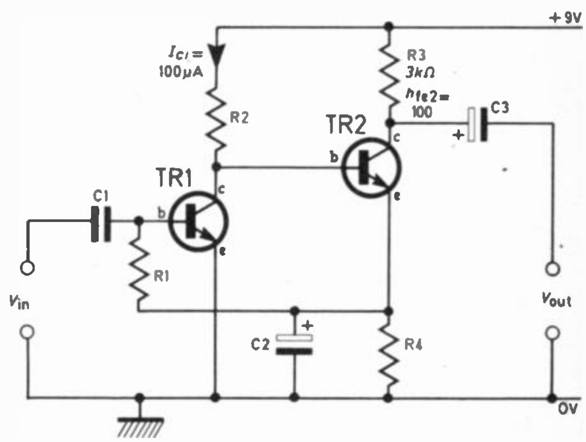
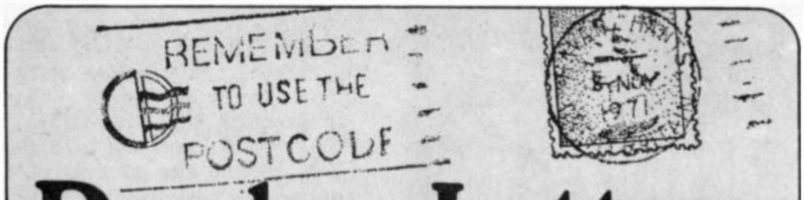


Fig. 2. Two stage amplifier



Readers Letters

I.C.'s and valves

I have a complete set of EVERYDAY ELECTRONICS and I am pleased with it although I would like to see a general broadening of your horizons in other fields past and future; in this I am referring to the lack of projects using integrated circuits and valves and also the lack of explanation of these devices.

Perhaps such devices could be explained in the next term of Teach-In '74. Also could you start a sound-effects series, in particular an "electronic echo". On the whole I like this magazine.

R. Leyland Zlitrm,
Auckland,
Australia.

You will be pleased to see that we are using integrated circuits in two of our constructional projects this month.

Detailed explanations of the functioning within the i.c. package however are not given and as a rule the i.c. will be treated as a black-box whose overall performance and operation only are described. The reason for this should be made clear in the series Introduction to Integrated Circuits which started last month.

At the other end of the line, i.e. valves, we cannot envisage using valves in any E.E. projects—although it is not an impossibility.

Your idea for a sound effects series has been noted and we shall be looking into this in the future.

Veroboard

I have recently started reading your magazine, and wish to build some of the projects detailed. However, as a raw beginner, only knowing the basic theory learned at school, I wonder if you would explain to me Veroboard diagrams as I do not understand what copper strips should be removed, and which ones left in place. Also how do you remove the copper.

D. Nicholson,
Cardiff.

Constructional projects built on Veroboard usually show two views of the board, one from the topside showing component positions and a view of the underside showing the copper strips.

The copper strips are shown as white strips on a black background. Breaks are shown along the strips as white holes on a black background and these breaks can be made by using a "spot-face cutter" a tool made for this job, or a small drill bit of diameter larger than the width of the copper strip.

Other information given on the underside view is the solder point of a component or flying lead to the copper strip; this is indicated by a black dot along the strip.

Inverter

I have been a regular reader of your magazine for some time now, and at present intending to build a d.c. to a.c. inverter as described in one of your earlier issues. However, I would like to build it so that the output would be around 240 volts 50 cycles and about 100 watts minimum (from 12 volt car battery).

As I am a newcomer to electronics through your magazine, I feel confident that you will be able to advise me as to where I might be able to obtain instructions to build such an inverter, or if possible how to modify your published design to meet the output required.

J. Henderson,
Ayrshire.

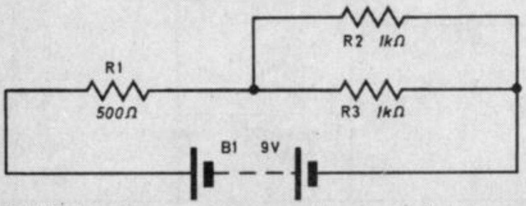
The inverter you refer to was published in the July 1972 issue of E.E. and cannot be modified easily to obtain the required power output.

However, a 100 watt inverter was featured in Practical Electronics February 1973.

What do you know?

OHMS LAW

1. What would you expect the potential difference across a 3·9 kilohm resistor to be if 150 microamps were flowing through it.
2. What current would flow in R3 in Fig. 1.



3. What wattage resistors would you use for those shown in Fig. 1.
4. If R3 in Fig. 1 is removed what effect would it have on the current flow in R1.

ANSWERS

1. $V = IR = 3{\cdot}9 \times 150 \times 10^{-3} = 0{\cdot}585$V.
2. Total circuit resistance = 1kΩ, total circuit current $= \frac{9}{1\times10^3} = 9$mA. Therefore current flow in R3 = 4·5 mA.
3. Dissipation in R1 $= I^2R = (9 \times 10^{-3})^2 \times 500 =$ 0·0405W. Hence ¼W or ⅛W resistors are quite adequate. Since R2 and R3 are higher resistance and are passing less current their dissipation will be lower and once again ¼W or ⅛W resistors will suit.
4. If R3 were removed the overall circuit resistance would become 1·5kΩ and current would be $\frac{9}{1{\cdot}5\times10^3} = 6$mA. Therefore current flow in R1 would drop from 9mA to 6mA.

The largest selection

BRAND NEW FULLY GUARANTEED DEVICES

Type	Price p	Type	Price p	Type	Price p	Type	Price p	Type	Price p
AC107	22	AD161 and		BC150	20	BD131	55	BF182	44
AC113	20	AD162(MP)	75	BC151	22	BD132	66	BF183	44
AC115	22	ADT140	55	BC152	19	BD133	72	BF184	28
AC117K	32	AF114	27	BC153	31	BD135	44	BF185	33
AC122	13	AF115	27	BC154	33	BD136	44	BF187	30
AC125	19	AF116	27	BC157	20	BD137	50	BF188	44
AC126	19	AF117	27	BC158	13	BD138	55	BF194	13
AC127	20	AF118	39	BC159	13	BD139	61	BF195	13
AC128	20	AF124	33	BC160	50	BD140	66	BF196	16
AC132	16	AF125	33	BC161	55	BD155	88	BF197	16
AC134	16	AF126	31	BC167	13	BD175	66	BF200	50
AC137	16	AF127	31	BC168	13	BD176	66	BF222	£1·05
AC141	20	AF139	33	BC169	13	BD177	72	BF257	50
AC141K	32	AF178	55	BC170	13	BD178	72	BF258	66
AC142	20	AF179	55	BC171	16	BD179	77	BF259	94
AC142K	28	AF180	55	BC172	16	BD180	77	BF262	61
AC151	17	AF181	55	BC173	16	BD185	72	BF263	61
AC154	22	AF186	55	BC174	16	BD186	72	BF270	39
AC155	22	AF239	41	BC175	24	BD187	77	BF271	33
AC156	22	AL102	72	BC177	21	BD188	77	BF272	88
AC157	27	AL103	72	BC178	21	BD189	83	BF273	39
AC165	22	ASY26	28	BC179	21	BD190	83	BF274	39
AC166	22	ASY27	33	BC180	27	BD195	94	BFW10	66
AC167	22	ASY28	28	BC181	27	BD196	94	BFX29	30
AC168	27	ASY29	28	BC182	11	BD197	99	BFX84	24
AC169	16	ASY50	28	BC182L	11	BD198	99	BFX85	33
AC176	22	ASY51	28	BC183	11	BD199	£1·05	BFX86	24
AC177	27	ASY52	28	BC183L	11	BD200	£1·05	BFX87	27
AC178	31	ASY54	28	BC184	13	BD205	88	BFX88	24
AC179	31	ASY55	28	BC184L	13	BD206	88	BFY50	22
AC180	22	ASY56	28	BC186	31	BD207	£1·05	BFY51	22
AC180K	32	ASY57	28	BC187	31	BD208	£1·05	BFY52	22
AC181	22	ASY58	28	BC207	12	BDY20	£1·10	BFY53	19
AC181K	32	ASY73	28	BC208	12	BF115	27	BPX25	94
AC187	24	ASZ21	44	BC209	13	BF117	50	BSX19	17
AC187K	25	BC107	12	BC212L	12	BF118	77	BSX20	17
AC188	24	BC108	12	BC213L	12	BF119	77	BSY25	17
AC188K	25	BC109	13	BC214L	16	BF121	50	BSY26	17
ACY17	28	BC113	11	BC225	28	BF123	55	BSY27	17
ACY18	22	BC114	17	BC226	39	BF125	50	BSY28	17
ACY19	22	BC115	17	BC301	30	BF127	55	BSY29	17
ACY20	22	BC116	17	BC302	27	BF152	61	BSY38	20
ACY21	22	BC117	20	BC303	35	BF153	50	BSY39	20
ACY22	18	BC118	11	BC304	40	BF154	50	BSY40	31
ACY27	20	BC119	33	BC440	34	BF155	77	BSY41	31
ACY28	21	BC120	88	BC460	40	BF156	53	BSY95	14
ACY29	39	BC125	13	BCY30	27	BF157	61	BSY95A	14
ACY30	31	BC126	20	BCY31	29	BF158	61	Bu105	£2·20
ACY31	31	BC132	13	BCY32	33	BF159	66	C111E	55
ACT34	23	BC134	20	BCY33	24	BF160	44	C400	33
ACY35	23	BC135	13	BCY34	28	BF162	44	C407	28
ACY36	31	BC136	17	BCY70	16	BF163	44	C424	28
ACY40	19	BC137	17	BCY71	22	BF164	44	C425	55
ACY41	20	BC139	44	BCY72	16	BF165	44	C426	39
ACY44	39	BC140	33	BCZ10	22	BF167	24	C428	22
AD130	42	BC141	33	BCZ11	28	BF173	24	C441	33
AD140	53	BC142	33	BCZ12	28	BF176	39	C442	33
AD142	53	BC143	33	BD115	68	BF177	39	C444	39
AD143	42	BC145	50	BD116	88	BF178	33	C450	24
AD149	55	BC147	11	BD121	66	BF179	33	MAT100	21
AD161	39	BC148	11	BD123	72	BF180	33	MAT101	22
AD162	39	BC149	13	BD124	76	BF181	33	MAT120	21

Type	Price p	Type	Price p	Type	Price p	Type	Price p	Type	Price p
MAT121	22	2G308	39	2N2192	39	2N3391A	18	2N4062	13
MJE2955	95	2G309	39	2N2193	39	2N3392	16	2N4284	19
MJE3055	62	2G339	22	2N2194	39	2N3393	16	2N4285	19
MJE3440	55	2G339A	18	2N2217	24	2N3394	16	2N4286	19
MPF102	46	2G344	20	2N2218	22	2N3395	19	2N4287	19
MPF104	41	2G345	18	2N2219	22	2N3402	23	2N4288	19
MPF105	41	2G371	18	2N2220	24	2N3403	23	2N4289	19
OC19	39	2G371B	13	2N2221	22	2N3404	31	2N4290	19
OC20	70	2G373	19	2N2222	22	2N3405	46	2N4291	19
OC22	52	2G374	19	2N2368	19	2N3414	17	2N4292	19
OC23	54	2G377	33	2N2369	16	2N3415	17	2N4293	19
OC24	62	2G378	18	2N2369A	16	2N3416	31	2N5172	13
OC25	42	2G381	18	2N2411	27	2N3417	31	2N5294	60
OC26	32	2G382	18	2N2412	27	2N3525	83	2N5457	35
OC28	55	2G401	33	2N2646	52	2N3614	74	2N5458	35
OC29	55	2G414	33	2N2711	23	2N3615	82	2N5459	44
OC35	46	2G417	28	2N2712	23	2N3616	82	2N6211	75
OC36	55	2N388	39	2N2714	23	2N3646	10	2S301	55
OC41	22	2N388A	61	2N2904	19	2N3702	13	2S302A	46
OC42	27	2N404	22	2N2904A	23	2N3703	13	2S302	46
OC44	17	2N404A	31	2N2905	23	2N3704	14	2S303	61
OC45	14	2N524	46	2N2905A	23	2N3705	13	2S304	77
OC70	11	2N527	54	2N2906	17	2N3706	13	2S305	86
OC71	11	2N598	46	2N2906A	20	2N3707	14	2S306	86
OC72	16	2N599	50	2N2907	22	2N3708	09	2S307	86
OC74	16	2N696	14	2N2907A	24	2N3709	10	2S321	62
OC75	17	2N697	15	2N2923	16	2N3710	10	2S322	46
OC76	17	2N698	27	2N2924	16	2N3711	10	2S322A	46
OC77	28	2N699	39	2N2925	16	2N3819	31	2S323	62
OC81	17	2N706	09	2N2926(G)	14	2N3820	55	2S324	77
OC81D	17	2N706A	10	2N2926(Y)	12	2N3821	39	2S325	77
OC82	17	2N708	13	2N2926(O)	11	2N3823	31	2S326	77
OC82D	17	2N711	33	2N2926(R)	11	2N3903	31	2S327	77
OC83	22	2N717	39	2N2926(B)	11	2N3904	33	2S701	46
OC139	22	2N718	27	2N3010	77	2N3905	31	40361	44
OC140	22	2N718A	55	2N3011	16	2N3906	30	40362	50
OC169	28	2N726	31	2N3053	19	2N4058	13		
OC170	28	2N727	31	2N3054	51	2N4059	11		
OC171	28	2N743	22	2N3055	55	2N4060	13		
OC200	28	2N744	22	2N3391	16	2N4061	13		
OC201	31	2N914	16						
OC202	31	2N918	33						
OC203	28	2N929	23						
OC204	28	2N930	23						
OC205	39	2N1131	22						
OC309	44	2N1132	24						
OCP71	48	2N1302	16						
ORP12	48	2N1303	16						
P20	55	2N1304	19						
P21	50	2N1305	19						
P346A	22	2N1306	23						
P397	46	2N1307	23						
ST140	14	2N1308	26						
ST141	19	2N1309	26						
TI843	33	2N1613	22						
UT46	30	2N1711	22						
ZN414	£1·20	2N1889	35						
2G301	21	2N1890	50						
2G302	21	2N1893	41						
2G303	21	2N2147	79						
2G304	27	2N2148	63						
2G306	44	2N2160	66						

DIODES AND RECTIFIERS

AA119	9	BY133	23	OA70	8
AA120	9	BY164	55	OA79	8
AA129	9	BYX38/30	46	OA81	8
AAY30	10	BYZ10	39	OA85	10
AAZ13	11	BYZ11	33	OA90	7
BA100	11	BYZ12	33	OA91	7
BA116	23	BYZ13	28	OA95	8
BA126	24	BYZ16	44	OA200	7
BA148	16	BYZ17	39	OA202	8
BA154	13	BYZ18	39	SD10	6
BA155	16	BYZ19	31	SD19	6
BA156	15	CG62		1N34	8
BY100	17	(OA91 Eq.)	6	1N34A	8
BY101	13	CG651		1N914	7
BY105	19	(OA70-OA79		1N916	7
BY114	13	Eq.)	7	1N4148	7
BY126	16	OA5	39	1S021	11
BY127	17	OA58L	23	1S951	7
BY128	17	OA10	39		
BY130	18	OA47	8		

LINEAR I.C's—FULL SPEC.

Type No.	Price 1	25	100+
72702	50p	48p	45p
72709	35p	33p	30p
72710	45p	43p	40p
72741	40p	38p	35p
72741C	45p	43p	40p
72741P	38p	36p	34p
72748P	38p	36p	34p
SL201C	59p	45p	40p
SL701C	50p	45p	40p
SL702C	50p	45p	40p
TAA263	80p	70p	60p
TAA293	£1·00	95p	90p
TAA350A	£1·85	£1·80	£1·70
µA703C	280	26p	24p
µA709C	35p	33p	30p
µA711	45p	43p	40p

NUMERICAL INDICATOR TUBES

CD66 .. .. £1·87
GR116 .. .. .. £1·70
3015F Minitron .. .. £1·50

All indicators 0-9 + Decimal point. All side viewing. Full data for all types available on request.

ZN414 .. .. .. £1·20 each
I.C. Radio Rec. incl. full cir. data.

DTL 930 SERIES LOGIC I.C's

Type	Price 1	25	100+
BP930	15p	14p	13p
BP932	16p	15p	14p
BP933	16p	15p	14p
BP935	16p	15p	14p
BP936	16p	15p	14p
BP944	16p	15p	14p
BP945	30p	28p	25p
BP946	15p	14p	13p
BP948	30p	28p	25p
BP951	70p	65p	60p
BP962	15p	14p	13p
BP9093	45p	43p	40p
BP9094	45p	43p	40p
BP9097	45p	43p	40p
BP9099	45p	43p	40p

Devices may be mixed to qualify for quantity price. Larger quantity prices on application. (DTL 930 Series only).

VOLTAGE REGULATORS

TO.3 Plastic 1·5 Amps
UA.7805. 5v. (Equiv. to MVR 5V) £1·76
UA.7812. 12v. .. .. MVR 12V) £1·76

R.T.L. LOGIC I.C's

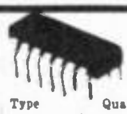
	Price each 1–24	25–99	100 up
UL900	38p	36p	29p
UL914	38p	36p	29p
UL923	55p	51p	49p

DUAL-IN-LINE SOCKETS.

14 & 16 Lead Sockets for use with DUAL-IN-LINE I.C's. TWO Ranges PROFESSIONAL & NEW LOW COST.

PROF. TYPE No.	1–24	25–99	100up.
TSO 14 pin type	33p	30p	27p
TSO 16	38p	35p	32p
LOW COST No.			
BPS 14	16p	14p	12p
BPS 16	17p	15p	13p

74 Series T.T.L. I.C's



BI-PAK STILL LOWEST IN PRICE. FULL SPECIFICATION GUARANTEED. ALL FAMOUS MANUFACTURERS

Type	Quantities 1	25	100+	Type	Quantities 1	25	100+	Type	Quantities 1	25	100
	£ p	£ p	£ p		£ p	£ p	£ p		£ p	£ p	£ p
7400	0·18	0·17	0·16	7448	1·10	1·07	1·05	74122	1·50	1·45	1·40
7401	0·18	0·17	0·16	7450	0·18	0·17	0·16	74123	3·00	2·90	2·80
7402	0·18	0·17	0·16	7451	0·18	0·17	0·16	74141	0·85	0·82	0·79
7403	0·18	0·17	0·16	7453	0·18	0·17	0·16	74145	1·65	1·55	1·45
7404	0·18	0·17	0·16	7454	0·18	0·17	0·16	74150	2·90	2·80	2·70
7405	0·18	0·17	0·16	7460	0·18	0·17	0·16	74151	1·10	1·05	1·00
7406	0·39	0·34	0·31	7470	0·32	0·29	0·27	74153	1·30	1·20	1·10
7407	0·39	0·34	0·31	7472	0·32	0·29	0·27	74154	1·98	1·90	1·75
7408	0·20	0·19	0·18	7473	0·41	0·39	0·35	74155	1·50	1·45	1·35
7409	0·20	0·19	0·18	7474	0·41	0·39	0·35	74156	1·50	1·45	1·35
7410	0·18	0·17	0·16	7475	0·50	0·48	0·46	74157	2·00	1·90	1·80
7411	0·28	0·27	0·26	7476	0·44	0·43	0·42	74160	2·10	2·00	1·90
7412	0·39	0·34	0·31	7480	0·74	0·71	0·64	74161	2·10	2·00	1·90
7413	0·32	0·31	0·30	7481	1·30	1·25	1·20	74162	4·40	4·15	3·85
7416	0·48	0·44	0·42	7482	0·96	0·95	0·94	74163	4·40	4·15	3·85
7417	0·48	0·44	0·42	7483	1·20	1·15	1·05	74164	2·20	2·10	2·00
7420	0·18	0·17	0·16	7484	1·10	1·05	1·00	74165	2·20	2·10	2·00
7422	0·55	0·53	0·50	7485	3·50	3·30	3·30	74166	3·20	3·10	3·00
7423	0·55	0·53	0·50	7486	0·35	0·34	0·33	74174	2·50	2·40	2·30
7425	0·55	0·53	0·50	7489	4·00	3·75	3·50	74175	1·75	1·65	1·55
7426	0·50	0·46	0·44	7490	0·74	0·71	0·64	74176	1·85	1·75	1·65
7427	0·50	0·46	0·44	7491	1·10	1·05	1·00	74177	1·85	1·75	1·65
7428	0·55	0·53	0·50	7492	0·74	0·71	0·64	74180	1·50	1·40	1·30
7430	0·18	0·17	0·16	7493	0·74	0·71	0·64	74181	5·00	4·50	4·00
7432	0·50	0·46	0·44	7494	0·85	0·82	0·75	74182	2·00	1·90	1·75
7433	0·75	0·73	0·70	7495	0·85	0·82	0·75	74184	3·20	3·10	3·00
7437	0·70	0·68	0·65	7496	0·96	0·93	0·86	74190	2·15	2·10	2·00
7438	0·70	0·68	0·65	74100	1·50	1·45	1·40	74191	2·15	2·10	2·00
7440	0·18	0·17	0·16	74104	1·07	1·04	1·00	74192	2·15	2·10	2·00
7441	0·74	0·71	0·64	74105	1·07	1·04	1·00	74193	2·15	2·10	2·00
7442	0·74	0·71	0·64	74107	0·44	0·42	0·40	74194	2·98	2·86	2·75
7443	1·20	1·15	1·10	74110	0·60	0·55	0·50	74195	2·00	1·95	1·90
7444	1·20	1·15	1·10	74111	1·38	1·27	1·21	74196	1·95	1·90	1·85
7445	1·98	1·95	1·90	74118	1·10	1·05	1·00	74197	1·95	1·90	1·85
7446	1·20	1·15	1·10	74119	1·50	1·40	1·30	74198	5·00	4·75	4·50
7447	1·10	1·07	1·05	74121	0·50	0·48	0·45	74199	5·00	4·75	4·50

Devices may be mixed to qualify for quantity price. (TTL 74 series only) data is available for the above series of I.C's in booklet form. Price 13p.

ALL PRICES INCLUDE VAT.

-the lowest prices!

BRAND NEW TEXAS GERM. TRANSISTORS
Coded and Guaranteed

Pak No.		EQVT
T1	8 2G371B	OC71
T2	8 D1374	OC75
T3	8 D1216	OC81D
T4	8 2G381T	OC81
T5	8 2G382T	OC82
T6	8 2G344B	OC44
T7	8 2G345B	OC45
T8	8 2G378	OC78
T9	8 2G399A	2N1302
T10	8 2G417	AF117

All 55p each pak

ND 120 NIXIE DRIVER TRANSISTOR. Suitable replacement for BSX 21, C 407, 2N 1893 120vcb.

1	25	100+
0·19	0·17	0·16

Sil. trans. suitable for P.E. Organ. Metal TO-18 Eqvt. ZTX300 6p each. Any Qty.

GP 100 TO3 METAL CASE GERMANIUM
Vebo = 80V. Vceo = 50V. I.C. = 10 amps. Ptot = 30W. hfe = 30–170.
Replaces the majority of Germanium power transistors in the OC, AD and NKT range.

1	25	100+
0·48	0·44	0·40

GP 300 TO3 METAL CASE SILICON
Vebo = 100V. Vceo = 60V I.C. = 15 amps. Ptot = 115W. hfe = 20. 100fT. = 1MHz. Suitable replacement for 2N 3055, BDY 11 or BDY 20.

1	25	100+
0·55	0·53	0·51

NEW 8th EDITION
250 pages
TRANSISTOR EQUIVALENTS BOOK. A complete cross reference and equivalents book for European, American and Japanese Transistors. Exclusive to BI-PAK. £1·85 each.

A LARGE RANGE OF TECHNICAL AND DATA BOOKS ARE NOW AVAILABLE EX STOCK. SEND FOR FREE LIST.

UT 46 UNIJUNCTION TRANSISTORS
Direct replacement for T18 43rand BEN 3000 also electrically equivalent to 2N2646

1	25	100+
0·30	0·28	0·22

GENERAL PURPOSE NPN SILICON SWITCHING TRANS. TO-18 SIM. TO 2N706/8. BSY-27/28/95A. All usable devices no open or short circuits. ALSO AVAILABLE in PNP Sim. to 2N2906, BCY70. When ordering please state preference NPN or PNP.

		£p
20	For	0·55
50	For	1·10
100	For	1·92
500	For	8·25
1000	For	14·30

SIL. G.P. DIODES £p

300mW	30	0·55
40PIV(Min.)	100	1·65
Sub-Min.	500	5·50
Fully Tested	1,000	9·90

Ideal for Organ Builders.

R 2400 TO3 NPN SILICON HIGH VOLTAGE
Vebo = 250V. Vceo = 100V. I.C. = 6 amps. Ptot = 30W. hfe = typ.20 fT = 5MHz.

1	25	100+
0·55	0·50	0·44

AD161/162

PNP
M/P COMP GERM TRANS. OUR LOWEST PRICE OF 75p *PER PAIR.*

LOOK FOR OUR
AUDIO & ELECTRONIC COMPONENTS
ADVERTISEMENTS
in PRACTICAL ELECTRONICS
RADIO CONSTRUCTOR

SILICON PHOTO TRANSISTOR. TO-18 Lens end NPN Sim. to BPX25 and P21. BRAND NEW. Full data available. Fully guaranteed.

Qty.	1-24	25-99	100 up
Price ea.	69p	44p	38p

QUALITY TESTED SEMICONDUCTORS

Pak No.		Price £p
Q1	20 Red spot transistors PNP	0·55
Q2	16 White spot R.F. transistors PNP	0·55
Q3	4 OC 77 type transistors	0·55
Q4	6 Matched transistors OC44/45/81/81D	0·55
Q5	4 OC 75 transistors	0·55
Q6	5 OC 72 transistors	0·55
Q7	4 AC 128 transistors PNP high gain	0·55
Q8	4 AC 126 transistors PNP	0·55
Q9	7 OC 81 type transistors	0·55
Q10	7 OC 71 type transistors	0·55
Q11	2 AC 127/128 Complementary pairs PNP/NPN	0·55
Q12	3 AF 116 type transistors	0·55
Q13	3 AF 117 type transistors	0·55
Q14	3 OC 171 H.F. type transistors	0·55
Q15	7 2N2926 Sil. Epoxy transistors mixed colours	0·55
Q16	2 GET880 low noise Germanium transistors	0·55
Q17	5 NPN 2 × ST.141 & 3 × ST.140	0·55
Q18	4 MADT'S 2 × MAT 100 & 2 × MAT 120	0·55
Q19	3 MADT'S 2 × MAT 101 & 1 × MAT 121	0·55
Q20	4 OC 44 Germanium transistors A.F.	0·55
Q21	4 AC 127 NPN Germanium transistors	0·55
Q22	20 NKT transistors A.F. R.F. coded	0·55
Q23	10 OA 202 Silicon diodes sub-min.	0·55
Q24	8 OA 81 diodes	0·55
Q25	15 IN914 Silicon diodes 75 PIV 75mA	0·55
Q26	8 OA95 Germanium diodes sub-min IN69	0·55
Q27	2 10A PIV Silicon rectifiers IS425R	0·55
Q28	2 Silicon power rectifiers BYZ 13	0·55
Q29	4 Silicon transistors 2 × 2N696, 1 × 2N697, 1 × 2N698	0·55
Q30	7 Silicon switch transistors 2N706 NPN	0·55
Q31	6 Silicon switch transistors 2N708 NPN	0·55
Q32	3 PNP Silicon transistors 2 × 2N1131, 1 × 2N1132	0·55
Q33	3 Silicon NPN transistors 2N1711	0·55
Q34	7 Silicon NPN transistors 2N2369, 500MHz (code P397)	0·55
Q35	3 Silicon PNP TO-5. 2 × 2N2904 & 1 × 2N2905	0·55
Q36	7 2N3646 TO-18 plastic 300 MHz NPN	0·55
Q37	3 2N3053 NPN Silicon transistors	0·55
Q38	7 NPN transistors 4 × 2N3703, 3 × 2N3702	0·55

ELECTRONIC SLIDE-RULE
The MK Slide Rule, designed to simplify Electronic calculations features the following scales: Conversion of Frequency and Wavelength. Calculation of L, C and fo of Tuned Circuits. Reactance and Self Inductance. Area of Circles. Volume of Cylinders. Resistance of Conductors. Weight of Conductors. Decibel Calculations. Angle Functions. Natural Logs and 'e' Functions. Multiplication and Division. Squaring, Cubing and Square Roots. Conversion of kW and Hp. A must for every electronic engineer and enthusiast. Size: 22 cm × 4cm. Complete with case and instructions. Price each: £3·69

KING OF THE PAKS Unequalled Value and Quality

SUPER PAKS NEW BI-PAK UNTESTED SEMICONDUCTORS

Money back refund if not satisfied

Pak No.	Description	Price £p
U 1	120 Glass Sub-Min. General Purpose Germanium Diodes	0·55
U 2	60 Mixed Germanium Transistors AF/RF	0·55
U 3	75 Germanium Gold Bonded Sub-Min. like OA5, OA47	0·55
U 4	40 Germanium Transistors like OC81, AC128	0·55
U 5	60 200mA Sub-Min. Silicon Diodes	0·55
U 6	30 Sil. Planar Trans. NPN like BSY95A, 2N706	0·55
U 7	16 Sil. Rectifiers TOP-HAT 750mA VLTG. RANGE up to 1000	0·55
U 8	50 Sil. Planar Diodes DO-7 Glass 250mA like OA200/202	0·55
U 9	20 Mixed Voltages, 1 Watt Zener Diodes	0·55
U10	20 BAY50 charge storage Diodes DO-7 Glass	0·55
U11	25 PNP Sil. Planar Trans. TO-5 like 2N1132, 2N2904	0·55
U12	12 Silicon Rectifiers Epoxy 500mA up to 800 PIV	0·55
U13	30 PNP-NPN Sil. Transistors OC200 & 28 104	0·55
U14	150 Mixed Silicon and Germanium Diodes	0·55
U15	25 NPN Sil. Planar Trans. TO-5 like BFY51, 2N697	0·55
U16	10 3 Amp Silicon Rectifiers Stud Type up to 1000PIV	0·55
U17	30 Germanium PNP AF Transistors TO-5 like ACY 17-22	0·55
U18	8 6 Amp Silicon Rectifiers BYZ13 Type up to 600 PIV	0·55
U19	25 Silicon NPN Transistors like BC108	0·55
U20	12 1·5 Amp Silicon Rectifiers Top Hat up to 1000 PIV	0·55
U21	30 AF. Germanium Alloy Transistors 2G300 Series & OC71	0·55
U23	30 MADT's like MHz Series PNP Transistors	0·55
U24	20 Germanium 1 Amp Rectifiers GJM Series up to 300 PIV	0·55
U25	25 300 MHz NPN Silicon Transistors 2N708, BSY27	0·55
U26	30 Fast Switching Silicon Diodes like IN914 Micro-Min.	0·55
U27	12 NPN Germanium AF Transistors TO-1 like AC127	0·55
U29	10 1 Amp SCR's TO-5 can, up to 600 PIV CRS1/25-600	1·10
U30	15 Plastic Silicon Planar Trans. NPN 2N2926	0·55
U31	20 Silicon Planar Plastic NPN Trans. Low Noise Amp 2N3707	0·55
U32	25 Zener Diodes 400mW DO-7 case 3–18 volts mixed	0·55
U33	15 Plastic Case 1 Amp Silicon Rectifiers IN4000 Series	0·55
U34	30 Silicon PNP Alloy Trans. TO-5 BCY26 28302/4	0·55
U35	25 Silicon Planar Transistors PNP TO-18 2N2906	0·55
U36	25 Silicon Planar NPN Transistors TO-5 BFY50/51/52	0·55
U37	30 Silicon Alloy Transistors SO-2 PNP OC200, 2S322	0·55
U38	20 Fast Switching Silicon Trans. NPN 400 MHz 2N3011	0·55
U39	30 RF. Germ. PNP Transistors 2N1303/5 TO-5	0·55
U40	10 Dual Transistors 6 lead TO-5 2N2060	0·55
U41	25 RF Germanium Transistors TO-1, OC45, NKT72	0·55
U42	10 VHF Germanium PNP Transistors TO-1 NKT667, AF117	0·55
U43	25 Sil. Trans. Plastic TO-18 A.F. BC113/114	0·55
U44	20 Sil. Trans. Plastic TO-5 BC115/116	0·55
U45	7 3A SCR. TO66 up to 600PIV	1·10

Code No's. mentioned above are given as a guide to the type of device in the pak. The devices themselves are normally unmarked.

FULL RANGE OF ZENER DIODES VOLTAGE RANGE 2-33V. 400mW (DO-7 Case) 12p ea. 1½W (Top-Hat) 18p ea. 10W (SO-10 Stud) 32p ea.

NEW LOW PRICED TESTED S.C.R.'s

PIV	1A TO5	3A TO66	5A TO66	5A TO64	7A TO48	10A TO48	16A TO48	30A TO48
50	0·26	0·28	0·39	0·39	0·52	0·55	0·59	1·27
100	0·28	0·37	0·52	0·52	0·55	0·64	0·70	1·54
200	0·39	0·41	0·54	0·54	0 63	0·67	0·83	1·76
400	0·48	0·52	0·62	0·62	0·74	0·83	1·03	1·93
600	0·59	0·63	0·75	0·75	0·85	1·07	1·38	—
800	0·70	0·77	0·88	0·88	0·99	1·32	1·65	4·40

SIL. RECTS. TESTED

PIV	300mA	750mA	1A	1·5A	3A	10A	30A
50	0 04	0·06	0·06	0·08	0·16	0·23	0·66
100	0·04	0·07	0·06	0·15	0·18	0·26	0·83
200	0·06	0·10	0·07	0·16	0·22	0·27	1·10
400	0·07	0·15	0·08	0·22	0·30	0·41	1·38
600	0·08	0·18	0·11	0·26	0·38	0·50	2·05
800	0·11	0·19	0·12	0·28	0·41	0·61	2·20
1000	0·12	0·28	0·16	0·33	0·51	0·70	2·75
1200	—	0·37	—	0·42	0·63	0·83	—

INTEGRATED CIRCUIT PAKS

Manufacturers "Fall Outs" which include Functional and Part-Functional Units. These are classed as 'out-of-spec' from the maker's very rigid specifications, but are ideal for learning about I.C's and experimental work.

Pak No.	Contents	Price	Pak No.	Contents	Price	Pak No.	Contents	Price
UIC00	= 12 × 7400	0·55	UIC46	= 5 × 7446	0·55	UIC90	= 5 × 7490	0·55
UIC01	= 12 × 7401	0·55	UIC48	= 5 × 7448	0·55	UIC91	= 5 × 7491	0·55
UIC02	= 12 × 7402	0·55	UIC50	= 12 × 7450	0·55	UIC92	= 5 × 7492	0·55
UIC03	= 12 × 7403	0·55	UIC51	= 12 × 7451	0·55	UIC93	= 5 × 7493	0·55
UIC04	= 12 × 7404	0·55	UIC53	= 12 × 7453	0·55	UIC94	= 5 × 7494	0·55
UIC05	= 12 × 7405	0·55	UIC54	= 12 × 7454	0·55	UIC95	= 5 × 7495	0·55
UIC06	= 8 × 7406	0·55	UIC60	= 12 × 7460	0·55	UIC96	= 5 × 7496	0·55
UIC07	= 8 × 7407	0·55	UIC70	= 8 × 7470	0·55	UIC100	= 5 × 74100	0·55
UIC10	= 12 × 7410	0·55	UIC72	= 8 × 7472	0·55	UIC121	= 5 × 74121	0·55
UIC20	= 12 × 7420	0·55	UIC73	= 8 × 7473	0·55	UIC141	= 5 × 74141	0·55
UIC30	= 12 × 7430	0·55	UIC74	= 8 × 7474	0·55	UIC151	= 5 × 74151	0·55
UIC40	= 12 × 7440	0·55	UIC76	= 8 × 7476	0·55	UIC154	= 5 × 74154	0·55
UIC41	= 5 × 7441	0·55	UIC80	= 5 × 7480	0·55	UIC193	= 5 × 74193	0·55
UIC42	= 5 × 7442	0·55	UIC81	= 5 × 7481	0·55	UIC199	= 5 × 74199	0·55
UIC43	= 5 × 7443	0·55	UIC82	= 5 × 7482	0·55			
UIC44	= 5 × 7444	0·55	UIC83	= 5 × 7483	0·55	UICXI	= 25 Assorted	
UIC45	= 5 × 7445	0·55	UIC86	= 5 × 7486	0·55		74's	£1·65

Packs cannot be split, but 25 assorted pieces (our mix) is available as PAK UIC X1·

POST OFFICE TELEPHONE DIALS 60p each.

F.E.T.'S

2N3819	31p	2N5458	35p
2N3820	55p	2N5459	44p
2N3821	30p	BFW10	66p
2N3823	31p	MPF105	41p

CADMIUM CELLS
ORP12 48p

FREE
One 55p Pak of your own choice free with orders valued £4 or over

DIACS
FOR USE WITH TRIACS.
BR100 (D32) 41p each

10 amp POTTED BRIDGE RECTIFIER on heat sink. 100PIV. 99p each

TRIACS

VBOM	2A TO-5	6A TO-66	10A TO-48
	£p	£p	£p
100	83	55	83
200	55	66	99
400	77	83	1 21

2N3055

115 WATT SIL POWER NPN 55p EACH

2 Amp. BRIDGE RECTS.

50 v RMS	35p	each
100 v RMS	40p	,,
400 v RMS	50p	,,

Size 16 mm × 16 mm.

D1699 NPN SILICON DUAL TRANSISTOR
(Similar to 2N2060)

1	25	100+
0·28	0·26	0·23

B1P 19/20 TO3 NPN PLASTIC SILICON
Vebo = 100V. Vceo = 50V. I.C. = 10 amps. Ptot 50W. hfe = typ. 100 fT = 3MHz.

1	25	100+
0·38	0·35	0 32

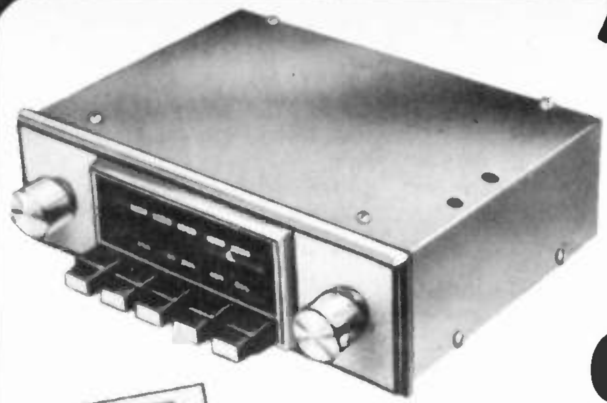
B1P 19/20 Matched Pair

1	25	100
0 66	0·61	0 55

Giro No. 388-7006
Please send all orders direct to warehouse and despatch department

BI-PAK

P.O. BOX 6, WARE · HERTS
Postage and packing add 11p. Overseas add extra for airmail.
Minimum order 55p. Cash with order please.
Guaranteed Satisfaction or Money Back



Remember! one of the Top Ten Accessory Awards from Motor *magazine*

PUSH BUTTON* CAR RADIO KIT

BUILD YOUR OWN TOURIST PUSH BUTTON CAR RADIO

Technical specification:
1.) **Output** 2.5 watts R.M.S. into 8 ohms. For 12 volt operation on negative or positive earth.
2.) **Integrated circuit** output stage, pre built three stage IF Module.
Controls Volume, manual tuning and five push buttons for station selection, illuminated tuning scale covering full medium and long wave bands.
Size Chassis 7 ins. wide, 2 ins. high and 4 $\frac{5}{16}$ ins. deep approx.

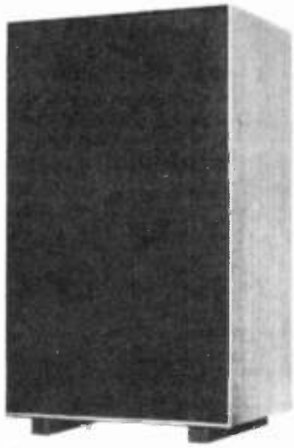
NOTE: The ability to solder on a printed circuitboard is necessary to complete this kit successfully. Circuit diagram and comprehensive instructions 55p free with kit.

Car Radio Kit
£6.60 + 55p. postage & packing.

Speaker including baffle and fixing strips
£1.65 + 23p. postage & packing.

Recommended Car Aerial - fully retractable and locking.
£1.35 post paid.

THE ULTIMATE COMPLETE SPEAKER SYSTEM EMI LE 315



A professional standard five way speaker system with enclosure giving top quality performance.
Enclosure Dimensions
approx. (3 ft. × 2 ft. × 1 ft.).
Drive Units
Hand built – 15" diameter bass with 3" voice coil.
– two 5" diameter Mid Range units.
– two $3\frac{1}{4}$" HF. units.
plus matching crossover panel with two variable potentiometers for mid and high frequency adjustment.
Powder Handling
Continuous rating 35 W rms., Peak power rating 70 W.
Frequency Response
20 Hz 20,000 Hz.

Recommended retail selling price, £86·00.

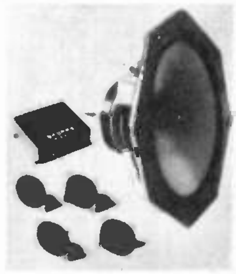
Our price £45·00 + £3.50 postage & packing.

EMI SPEAKERS

FANTASTIC REDUCTION

15" 14A/780. Bass unit on a rigid diecast chassis. Superior cone material handles up to 50 watts RMS, and is treated to give a smooth frequency response. Resonance 30 Hz. flux density 360,000 Maxwells. Impedance at 1 kHz is 8 ohms. 3" voice coil.

Recommended retail price £40·80.
OUR PRICE £18·70 + £1·50 p & p



950 Kit – Five matched speakers and crossover unit for handling up to 45 watts, frequency response from 20 to 20,000 Hz.
Huge 19" × 14" (approx.) high efficiency Bass-Speaker with 16,500-gauss magnet built on a heavy diecast frame.
The four 10,000 gauss tweeters, each $3\frac{1}{4}$" dia. approx., are fed by the crossover which critically adjusts signal for maximum fidelity. Impedance at 1 kHz is 8 ohms. Bass coil 2", others 0·5". Recommended list price £44·00.

OUR PRICE £25·00 + £1·50 p & p Special Offer.

BARCLAYCARD

Just write your order giving your credit card number
DO NOT SEND YOUR CARD

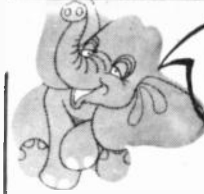
- Mail orders to Acton. Terms C.W.O. All enquires Stamped Addressed Envelope. Goods not despatched outside U.K.
- Leaflets available for all items listed. Send stamped addressed envelope.

R T V C

Radio and TV Components (Acton) Ltd.
21 High Street, Acton, London W3 6NG(E)
323 Edgware Road, London W2
Edgware: 9 a.m.-5.30 p.m. Half day Thurs.
Acton: 9.30 a.m.-5 p.m. Closed all day Wed.

Henry's

PANEL METERS · TRANSFORMERS · CONTROLS · RELAYS
IRONS · TOOLS · VALVES · POT CORES MOST TYPES OF COMPONENTS
You need a catalogue! 55p post paid complete with Discount Vouchers



UK's LARGEST RANGE OF KITS & GADGETS

TEST EQUIPMENT

MULTIMETERS

(carr. etc. 30p)

M2t0	20K/Volt Slimline	6·75
TLH33D	2K/Volt Robust	7·50
U437	10K/Volt Steel case. AC up to 40 KHz	4·95
U4324	20K/Volt with AC current ranges	8·00
AFt05	50K/Volt	11·95
U4313	20K/Volt AC current. Steel case	10 50
U4341	Plus Built in transistor tester	10·50
Model 500	30K/Volt	9·95

OTHER EQUIPMENT

SE250B	Pocket Signal Injector	2·10 carr. 15p
SE500	Pocket Signal Tracer	1 79 carr. 15p
TE15	Grid Dip meter 440kHz–280mHz	15·00 carr. 30p
TE40	AC Millivoltmeter 1·2mHz	18·95 carr. 35p
TE65	28 Range valve voltmeter	19 95 carr. 40p
TE20D	120kHz–500mHz RF Generator	1'·95 carr. 40p
TE22D	20Hz–200kHz Audio Generator	19·95 carr. 40p
SE350A	Deluxe Signal Tracer	12 50 carr. 20p
SE400	Volts/ohms/R-C sub./ RF field/RF gen.	14·75 carr. 20p

New Revolutionary Supertester 680R

680R Multi-tester
£18 50

Accessories

Transistor tester	11 00
Electronic voltmeter	18·00
Ampclamp	11·95
Temperature probe	11·95
Guass meter	11·95
Signal Injector	5·95
Phase Sequence	5·95
EHT Probe	5·95
Shunts 25/50/100A	4·50

A SELECTION OF INTERESTING ITEMS

C3025	Compact transistor tester	6·30 p & p 15p
E1300	Mono mag. cart. preamp.	2·75 p & p 15p
E1310	Stereo mag. cart. preamp.	4·67 p & p 25p
Easiphone telephone amplifier		7·95 p & p 25p
D1203	Teleamp. with PU coil	4 49 p & p 20p
LL1	Door Intercomm. and chime	7·95 p & p 25p
Chattalite (lights as you talk)		13·00 p & p 20p
1 Kw Dimmer/controller		3·00 p & p 10p
9" Twin spring unit	For	3·30 p & p 15p
16" Twin spring unit	Reverbs	6·85 p & p 25p
Car Tachometer Electronic		8·95 p & p 15p
VHF 105 Aircraft Band Corrector		4·50 p & p 15p
B2005 4 Ch. mic. mixer		3·75 p & p 15p
B2004 2 ch. Stereo mixer		5·95 p & p 15p
PK3 Kit. Etch your own printed circuits		£1 50 p & p 20p

BUILO THIS RAOIO

Portable MW / LW radio kit using Mullard RF/IF module. Features MW — bandspread for extra selectivity. Slow motion tuning. Fibre glass PVC cabinet. 600MW output. All parts £7·98 (battery 22p), carr. etc. 32p.

EXCLUSIVE: SPECIAL OFFERS

MW/LW CAR RADIO + or − Earth with speaker and fixings. £6·50 carr./packg. 30p.

8 TRACK CAR STEREO (− Earth) with speakers in Pods & fixings. £12·50 carr/packg. 40p.

Portable Battery Cassette Tape Player £7·25.

Car Lighter Plug and adaptor for all cassette and radio 6/7½/9 volt output (state width) £1·95 each

Rotel Stereophones

RH630	£4·50
RH700	£6·75
RH430	£3 30

Rotel RA310 15+15 watt Stereo Amplifier (List £52·00) £34·52.

Wein W500 Battery/Mains Cassette Recorder £12·75

AKAI GXC40 Stereo cassette recorder. £59·95 carr/packg. 50p.

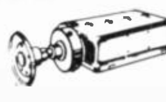
Pair Akai ADM microphones. £6·95 carr/packg. 20p.

PORTABLE CASSETTE TAPE PLAYER— for car or carry around. £7·25 carr/packg. 20p.

HANIMAX BC808 POCKET CALCULATOR WITH % KEY. £28·95.

SPECIAL PURCHASES

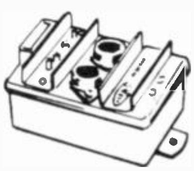
UHF TV TUNERS CHANNELS 21 TO 64



Brand new transistorised geared tuners for 625 Line Receiver IF output. £2·50. Post 20p.

EASY TO BUILD KITS BY AMTRON— EVERYTHING SUPPLIED

Model No.		
310	Radio control receiver	2·98
300	4-channel R/C transmitter	5·95
345	Superhet R/C receiver	5·95
455	AM signal generator	12·33
65	Simple transistor tester	1·40
115	8 watt Amplifier	3·00
120	12 watt amplifier	4·70
125	Stereo control unit	5·70
130	Mono control unit	3·00
605	Power supply for t15	4·55
610	Power supply for 120	4·55
615	Power supply for 2 x 120	5·73
230	AM/FM aerial amplifier	2·93
240	Auto packing light	5·00
275	Mic. preamplifier	6·08
570	LF generator 10Hz–1mHz	15·80
575	Sq. wave generator 20Hz–20Khz	14·00
590	SWR meter	12·85
620	Ni-CAD Charger 1·2–12v	8·00
630	STAB Power supply 6-12v 0·25-0-tA	8·15
690	DC motor speed Gov.	2·87
700	Electronic Chaffinch	7·00
705	Windscreen wiper timer	6·80
760	Acoustic switch	19 75
780	Metal Detector (electronics only)	9·65
790	Capacitive Burglar alarm	6·95
835	Guitar preamp.	4·25
840	Delay car alarm	6·15
875	CAP. Discharge ignition for car engine (–Ve Earth)	13 15
80	Scope Calibrator	2·25
255	Level indicator	6·15
525	120–160mHz VHF timer	11·30
715	Photo cell switch	7·79
795	Electronic continuity tester	4·30
860	Photo timer	13·25
871	Slide projector auto feed control	7·t5
235	Acoustic Alarm for driver	7·60
465	Quartz XTAL checker	8·75
220	Signal Injector	2·30
390	VOX	15·50
432	Testakit	19·30
670	Buffer Battery Charger	6·55
885	Capacitive Contact Alarm	6·25
850	Electronic Keyer	18·75
820	Electronic Digital Clock	50·50



ALL KITS OFFERED SUBJECT TO STOCK AVAILABILITY

Prices correct at time of preparation. Subject to change without notice.

BUILD THIS TUNER

MW/LW Radio Turner to use with any amplifier. Features Mullard RF/IF module Ferrite aerial, built in battery. Excellent results. Size 7" x 2¾" x 3½". All parts £4·85, carr. 15p.

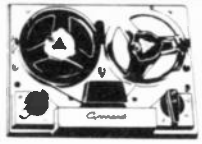
MULTI-USE & RADIONIC KITS

10-1	10 Projects	3·00
50-1	10 Projects	8·00
150-1	150 Projects	13·20
Telephone Communicator		7·20
X20	20 (Elec.) } Projects	4·95
X40	40 (radio) } Projects	9·45

(carr./packing 40p)

All transistor circuits with hand books

All types offered subject to availability. Prices correct at time of press E & OE. 10% VAT TO BE AOOEO TO ALL OROERS. UK post etc. 15p per order unless stated.



GARRARD BATTERY TAPE DECK

GARRARD 2 speed 9 volt tape decks. Fitted record/play and oscillator/Erase heads. Wind and rewind controls. Takes up to 4" spools. Brand new complete with head circuits.
£9·50 carr. 30p

TOP QUALITY SLIDER CONTROLS

60mm stroke high quality controls complete with knobs (post, etc. t5p any quantity).

Singles Log and Lin 5K, 10K, 22K, 50K, 100K, 250K, 500K, 1 Meg. 45p each.

Ganged Log and Lin 10K, 22K, 50K, 100K, 250K, 65p each. (Quantity discounts available)

Complete with knobs.

MARRIOT TAPE HEADS

4 TRACK MONO or 2 TRACK STEREO
't7' High impedance £2·00
't8' Med. Impedance £2·00
R730/E73 2 track mono Record/Erase low imp. 75p pair.
Erase Heads for '17' and 't8' 75p
'63' 2 track mono, Hi imp. £1·75
'43' Erase Head for '63' 75p
(Post, etc. 15p any quantity).

SINCLAIR, MINIATURE AMPLIFIERS & TUNER/DECODER

AMPLIFIERS (carr., etc. 20p)

4-300, 0·3 watt 9 volt	1·75
t04, 1 watt 9 volt	2·80
304, 3watt 9 volt	2·95
555, 3 watt 12 volt	3·10
E1208, 5 watt 12 volt	5·19
608, 10 watt 24 volt	4·19
410, 10 watt 28 volt	4·95
E1206, 30 watt 45 volt	9·95
E1210, 2½ + 2½ watts 12 volt	7 25
RE500, 5 watt IC mains operated Amplifier with controls	£6·30
SAC14, 7 + 7 watt Stereo with controls	£8·79
SAC13, t5 + 15 watt Stereo with controls	£11·75
SP40-5 2Z40/Stereo 80/PZ5	25·00
SP40-6 2Z40/Stereo 80/PZ6	27·75
SP60 2Z60/Stereo 80/PZ8	39 45

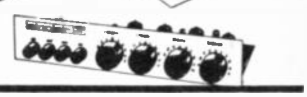
(Transformer PZ8 3 95)

SINCLAIR (carr. 20p) **PROJECT 60**

Z30 3·57 Z50 4·37
Stereo 60 Preamp. 7·97
PZ5 £3·97, PZ6 £6·37
PZ8 (for Z50) £4·77 (TRANS £2·95)
AFU £4·45

New SINCLAIR PROJECT 80

Stereo Preamp.	11·95
Audio Filter Unit	8·95
Z40 15 Watt Amp.	5·45
Z60 25 Watt Amp.	8·95
PZ5 Mod. for 1 on 2 Z40	4·98
PZ6 Mod. (S Tab) 1 on 2 Z40	7·98
PZ8 Mod. (S Tab) 1 on 2 Z60	7·98
TRANSFORMER FOR PZ8	3·95
Project 605 Kit	19·95
Project 805	26·95



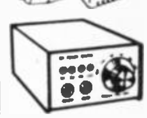
POWER SUPPLIES FOR EVERY PURPOSE

(All cased unless stated chassis)

470C 6/7½/9 volt 300 MA (includes Multi-Adaptor for Tape Recorders, etc.)	2·15 post 20p
Car Lighter Voltage Adaptors 300mA (State voltage 6v, 7½v, 9v)	1·95 ea. post 25p
SC202 3/6/7½/9 volt 400mA	3·35 carr. 30p
HC244R Stabilised version	4·35 carr. 30p
P500 9 volt 500mA	2·00 post 20p
P11 24 volt 500mA (chassis)	2·00 post 20p
P15 26/28 volt 1 amp (chassis)	2·00 post 20p
P1080 12v 1 amp (chassis)	4·25 post 20p
P1061 45v 0·9 amp (chassis)	7·50 post 20p
P12 4½–12 volt 0·4–t amp	7·15 post 30p
SE101A 3/6/9/12 volt 1 amp (Stab.)	19·30 post 25p
RP164 6/7½/9/12 1 amp (Stab.)	10·20 post 30p

FIBRE OPTICS

0·01 Diam. Mono Filament £1·50 per 25 metre reel
0·13 Diam. 64 Fibres Sheathed. £1·00 per metre
SPRAYS 15mm Diam. Mares Tails £9·50.



Henry's RADIO LIMITED
EDGWARE ROAD, W2

SEE FACING PAGE FOR ADDRESSES

Everyday Electronics Classified Advertisements

RATES: 9p per word (minimum 12 words). Box No. 20p. extra. Semi-display—£6·00 per single column inch. Advertisements must be prepaid and addressed to Classified Advertisements Department, "EVERYDAY ELECTRONICS," I.P.C. Magazines Ltd., Fleetway House, Farringdon Street, London EC4A 4AD.

BOOKS

WORLD RADIO TV HANDBOOK 1974, £3·15. How to Listen to the World, £2. Delivery and VAT included. Please send 3p for full list. David McGarva. PO Box 114P, Edinburgh EH1 1HP.

FOR SALE

PROFESSIONALLY made Tutor Board. Varnish insulation. All main holes drilled. £1 incl. p&p. B. H. Malme, 'Newhaven', Mill Lane, East Runton, Norfolk.

UNUSED DEMO DECK plus every issue of Everyday Electronics. Offers: 28 Sutton Drive, Cullingworth, Near Bradford, Yorkshire.

LOUDSPEAKERS—new from £1. Full range 8in, 4/8Ω, 10WRMS, 60Hz Bass Resonance, £2·75. All components, Catalogue 10p. L-State Electronics, Discove Cottage, Bruton, Somerset.

RECEIVERS and COMPONENTS

MUST GO! Electronic components. Pots, resistors, capacitors, etc. Send large stamped, addressed envelope for list. P. FASOLI, 28 Middleham Street, Manchester M14 7NG.

7LB ASSORTED COMPONENTS £1·65 c.p.
3LB ASSORTED COMPUTER PANELS £1·65 c.p.
3 ASS. M.C. METERS 2"–3" £1·15 (25p).
SILICON DIODES 650V 1½A. 35p (5p).
COMPUTER PANELS 5-BC108, Diodes 4-55p (10p). LARGE PANELS, average 40 transistors, loads of hi-stabs, etc. 85p (25p).
COPPER CLAD PAX. PANELS 5½" x 5½" 6-45p c.p.
VALUPAKS—from 25 to 75p. Send 10p for lists of these and panels etc. Refund on purchase.
J.W.B. RADIO
3 Barnfield Crescent, Sale, Cheshire M33 1NL
Postage in brackets — Mail order only

COMPONENTS GALORE. Pack of 500 mixed components manufacturers surplus plus once used. Pack includes Resistors, carbon and W.W., capacitors various, transistors, diodes, trimmers, potentiometers etc. Send £1+10p p. and p. c.w.o. to CALEDONIAN COMPONENTS, Strathore Road, Thornton, Fife.

TUNBRIDGE WELLS, components from Teleservice, 108 Camden Road, Tunbridge Wells, Kent. Telephone 31803.

MISCELLANEOUS

BUILD THE TREASURE TRACER MK III Metal Locator

- Varicap tuning
- Britain's best selling metal locator kit
- Weighs only 22oz.
- Speaker and earphone operation
- Knocks down to only 17in.
- Prebuilt search coil assembly
- Thoroughly professional finish
- As seen on BBC1 and BBC2 TV
- You only need soldering iron, screwdriver, pliers and snips
- Five transistor circuit

Send s.a.e. for leaflet

Complete kit Post 35p £9·80 — Built, tested and guaranteed Post 35p £13·75

MINIKITS ELECTRONICS,
35b LANGLEY DRIVE, WANSTEAD
LONDON, E11 2LN (Mail order only)

BATTERY ELIMINATOR KITS. Our well-known Mini Mains Pack Kits now complete with drilled insulated base 32 x 55mm. Fits into space of most large transistor batteries. Easy wiring instructions. Safe, silent mains transformer, silicon rects, smoothing capacitor, all top grade. For any ONE of these voltages (state which): 3V, 300mA max.; 6V, 180mA; 9V, 120mA; 18V, 60mA. 1·50 VAT included. By mail only, UK post 5p. Amatronix Ltd., 396 Selsdon Rd., South Croydon, Surrey CR2 0DE.

BEGINNERS, we exist for you. Instruction, components, constructional kits. Send S.A.E. to Electrolern, Lyburn Lodge, Nomansland, Wiltshire.

CONSTRUCTION AIDS. Screws, nuts, spacers, etc., in small quantities. Aluminium panels punched to spec. or plain sheet supplied. Fascia panels etched aluminium to individual requirements. Printed circuit boards-masters, negatives and boards, one-off or small numbers. Send 6p for list. RAMAR CONSTRUCTOR SERVICES, 29 Shelbourne Road, Stratford-on-Avon, Warks.

DIRECT FROM MANUFACTURER—a comprehensive catalogue of UHF & VHF/FM aerials, fixing brackets, chimney lashings, clamps, masts, amplifiers, cable, etc., for the D.I.Y. enthusiast. Complete with useful installation hints. Send 3p stamp to CLAYDEW ENTERPRISES, (EE), 261 Hardess Street, London S.E.24.

RADIO & TELEVISION AERIAL BOOSTERS £2·95p, five television valves 45p. 50p bargain transistor packs, bargain £1 resistor and capacitor packs. UHF-VHF televisions £7·50, carr. £1·50p. S.A.E. for 3 leaflets. ELECTRONIC MAIL ORDER (BURY) LTD., Bridge Street, Ramsbottom, Bury, Lancs.

DON'T LOOK

unless you can resist the temptation to get these super 'attention-getters':

★ Pocket-sized MAXI-VOLT Big ½inch Spark Generator (instant 15,000 volts!). Ready-made, needs no batteries. Carry it around anywhere. Only weighs about 3 oz. (85g.) send £1·35 for your Maxi-Volt now!

★ Unique TRANSMITTER/RECEIVER Kit. No licence examinations or tests required to operate this transistorised equipment. Easy to build. Get transmitting. Send £5·90 for yours now!

★ Psychedelic MINI-STROBE Kit. Take a pocket-sized lightning storm to Disco's and parties. 'Brain-freeze' 'em with vari-speed stop-motion flashes. Includes super case too. Send £2·20 now!
(All prices include V.A.T., packing, and postage.)

Send remittance to:
BOFFIN PROJECTS,
4 CUNLIFFE ROAD,
STONELEIGH, EWELL, SURREY
(Mail order only)
Or for more details, send 15p for lists, plus free design project sheet.

7lb BARGAIN PARCELS

Hundreds of new resistors, capacitors, pots, switches. Also crystals, computer panels & loads of odds & ends. Only £1·65 (40p)

COMPUTER PANELS

Wide variety from 5p at shop for callers. Or in packs: 3lbs asstd. panels £1 (30p); 7lb £2 (40p); 56lb £13 (c/pd); 12 high quality panels with trimpots, IC's, power transistors etc. £2 (30p). 50 panels £7 (60p); Pack of boards containing at least 500 components inc at least 50 transistors 60p (20p).

3W TAPE AMPLIFIERS

Very sensitive 4 valve amplifier with tone & volume controls giving 3 watts into 3 ohms. Only £1·65 (40p); Also available in cabinet with 7 x 4" speaker and non-standard tape deck. Mains operated, fully tested. £3 (£1 up to 200 miles, £1·20 over) Suitable cassette £1 (30p). Spare head 30p.

NEW COMPONENTS: 741C 8 pin DIL or TO99 32p; BC107 8p, 14 for £1; OC71 ditto; OC140 25p; OC170 15p; BFY18 12p; 2N3055 35p; XC121 5p; 400V 5A SCR 60p; Crofon 64 filament light guide £1/metre.

SURPLUS COMPONENTS: 500 asstd resistors £1 (20p); 300 capacitors all types £1 (30p); 25 10X crystals 75p (30p); 40 asstd. pots £1 (30p).

VAT NOT INCLUDED—ADD 10% TO TOTAL.
Carr in brackets, small parts 4p. SAE List.

GREENWELD ELECTRONICS [EE11]

24 Goodhart Way, West Wickham, Kent, BR4 0ES.
Shops at 21 Deptford Broadway, SE8, Tel 01-692 2009 & 38 Lower Addiscombe Rd, Croydon.

SERVICE SHEETS

SERVICE SHEETS for Televisions, Radios, Transistors, Tape Recorders, Record Players, etc., from 5p with free Fault-Finding Guide, S.A.E. orders/enquiries. Catalogue 15p. Hamilton Radio, 47 Bohemia Road, St. Leonards, Sussex. Telephone Hastings 29066.

WANTED

E.E. VOL. 1 & 2 WANTED.—Andreas Follesdal, Bridge House, Wootton, Woodstock, Oxon.

TURNTABLE for Philips AG.2121 Disc-Jockey Record Player. Box No. 1.

EDUCATIONAL

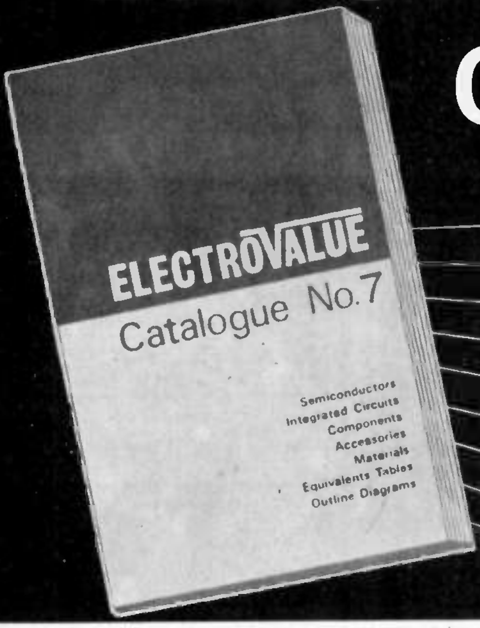
CITY & GUILDS EXAMINATIONS. Make sure you succeed with an ICS home study course for C & G Electrical Installations, Telecommunications Technicians and Radio Amateurs. Free details from:—International Correspondence Schools. Dept. 731D. Intertext House, London SW8 4UJ.

HOLIDAY FOR BOYS 14/16 years, August 1974. Tuition and practical work in electronics, radio production and tape recording, engineering (Karting) and photography. 11 days in Norfolk—£17·50. Write for free brochure: INTER-SCHOOL CHRISTIAN FELLOWSHIP, c/o 1, Hubbard Road, London SE27 9PJ.

COLOUR TV SERVICING. Make the most of the current boom. Learn the technique of servicing Colour & Mono TV sets through new home study courses, approved by leading manufacturers. Also radio and audio courses. Free details from:—International Correspondence Schools. Dept. 731D2. Intertext House, London SW8 4UJ.

ELECTROVALUE

CATALOGUE 7



An A to Z guide to component buying

On the index page of Catalogue 7, between "Aluminium Boxes" and "Zener Diodes" are over 200 references to contents amounting in all to thousands of items, classified, described, often illustrated, and priced. There are many technical diagrams and data. At 25p, Catalogue 7 is excellent value by any standard. With the 25p Refund Voucher it costs you virtually nothing when you order £5-worth or more.

25p INCLUDING 25p REFUND VOUCHER ALLOWABLE ON ORDERS £5 OR MORE NET VALUE

★ A SELECTION FROM EV CATALOGUE 7

TRANSISTORS
and semi-conductors of many types from simple diodes to ICs photo-sensitive devices, threshold switches, etc. etc.

MINITRON DIGITAL INDICATORS
30151F Seven segment filament, compatible with standard logic modules. 0–9 and decimal point. 9mm characters in 16 lead DIL **£1·20**
Suitable BCD decoder driver 7447 **£1·15**.
3015G showing + or — & 1 & dec. pt. **£1·20**.

DALY ELECTROLYTIC CAPACITORS
in cans, plastic sleeved
1000mF/25V **28p** 1000/50 **41p** 5000/100 **£2·91**
5000mF/25V **62p** 2000/50 **57p**
5000/50 **£1·18**

POLYESTER CAPACITORS TYPE C.280
Radial leads for P.C.B. mounting. Working voltage 250V d.c.
0·01, 0·015, 0·022, 0·033, 0·047 ea. **3p**
0·068, 0·1, 0·15 ea. **4p**
0·22 **5p**; 0·33 **7p**; 0·47 **8p**; 0·68 **11p**; 1·0 **14p**; 1·5 **21p**; 2·2 **24p**.

SILVERED MICA CAPACITORS
Working voltage 500V d.c.
Values in pFs—2·2 to 820 in 32 stages, each **6p**.
1000, 1500 **7p**; 1800 **8p**; 2200 **10p**; 2700, 3600 **12p**. 4700, 5000 **15p**; 6800 **20p**; 8200, 10,000 **25p**.

POTENTIOMETERS
ROTARY, CARBON TRACK, Double wipers for good contact and long working life

P.20 SINGLE linear 100 ohms to 2·2 megohms, ea. **14p**.
P.20 SINGLE log. 4·7 Kohms to 2·2 megohms, ea. **14p**.
JP.20 DUAL GANG linear 4·7 Kohms to 2·2 megohms, ea. **42p**.
JP.20 DUAL GANG log. 4·7 Kohms to 2·2 megohms, ea. **48p**.
JP.20 DUAL GANG Log/antilog 10K, 22K, 47K 1 megohm only ea. **46p**.
JP.20 DUAL GANG antilog 10K only, **48p**.
2A DP mains switch with any of above **14p** extra.
Decades of 10, 22 and 47 only available in ranges above.

SLIDER POTENTIOMETERS
Linear or log. 10K to 1 meg. in all popular values ea. **30p**.
Escutcheon plates, black, white or light grey, ea. 10p
Control knobs blk/wht/red/yel/grn/blue/dk. grey/lt grey, ea. **6p**.

ELECTROLYTIC CAPACITORS
Axial Lead

µF	3V	6·3V	10V	16V	25V	40V	63V	100V
0·47	—	—	—	—	—	—	11p	8p
1·0	—	—	—	—	—	11p	—	8p
2·2	—	—	—	—	11p	—	8p	9p
4·7	—	—	—	11p	—	8p	9p	8p
10	—	—	—	—	8p	9p	8p	8p
22	—	—	8p	—	9p	8p	8p	10p
47	8p	—	9p	8p	9p	8p	10p	13p
100	9p	8p	8p	8p	9p	10p	12p	19p
220	8p	8p	9p	10p	10p	11p	17p	28p
470	9p	10p	10p	11p	13p	17p	24p	45p
1,000	11p	13p	13p	17p	20p	25p	41p	—
2,200	15p	18p	23b	26p	37p	41p	—	—
4,700	26p	30p	39p	44p	58p	—	—	—
10 000	42p	46p						

This is EV Service

DISCOUNTS
Available on all items except those shown with NETT PRICES. 10% on orders from £5 to £15. 15% on orders £15 and over.

PACKING AND POSTAGE FREE
in U.K. For mail orders for £2 list value and under, there is an additional handling charge of 10p.

GUARANTEE OF QUALITY
All goods are sold on the understanding that they conform to manufacturers' specifications and satisfaction is guaranteed as such—no rejects, 'seconds' or sub-standard merchandise is offered for sale.

V.A.T. *Prices quoted do not include V.A.T., for which 10% must be added to total nett value of order. Prices subject to alteration without notice. S.A.E. with written enquiries please*

RESISTORS

Code	Watts	Ohms	1–9	10–99	100 up (see note below)
C	1/20	82–220K	9	8	7·5
C	1/3	4·7–470K	1·3	1·1	0·9 nett
C	1/2	4·7–10M	1·3	1·1	0·9 nett
C	3/4	4·7–10M	1·5	1·2	0·97 nett
C	1	4·7–10M	3·2	2·5	1·92 nett
MO	½	10–1M	4	3·3	2·3 nett
WW	1	0·22–3·9	9	8	8
WW	3	1–10K	7	7	6
WW	7	1–10K	8	8	8

Codes: C—carbon film, high stability, low noise. MO—metal oxide, Electrosil TR5, ultra low noise. WW—wire wound, Plessey.
Values: All E.12 except C1/3, C3/4, MO 1/2
10, 12, 15, 18, 22, 27, 33, 39, 47, 56, 68, 82 and their decades.
E24; as E12 plus 11, 13, 16, 20, 24, 30, 36, 43, 51, 62, 75, 91 and their decades.
Tolerances: All 5% except MO 1/2 at 2%, WW. at 10% ± 0·05Ω
Prices are in pence each for quantities of the same ohmic value and power rating. NOT mixed values. (Ignore fractions of one penny on total value of resistor order.)
100 price rates for units of 100 only.

ZENER DIODES full range E24 values: 400mW. 2·7V to 36V, 14p each; 1W: 6·8V to 82V, 21p each; 1·5W: 4·7V to 75V, 48p each. Clip to increase 1·5W rating to 3 watts (type 266F) 4p.

TRANSFORMERS—MAINS

MT3 30V/2A plus 4 taps	£3·70
MT103 50V/1A plus 4 taps	£3·40
MT104 50V/2A plus 4 taps	£4·70
MT127 60V/2A plus 4 taps	£5·10
13TO5 13V/½A, CT	£1·68
28TO5 + 12V, 2-0-2V	£1·70

GIRO ACCOUNT No. 38/671/4002
All postal communications, mail orders etc. to Head Office at Egham address, Dept EE.3.

ELECTROVALUE LTD

28, ST. JUDES ROAD, ENGLEFIELD GREEN EGHAM, SURREY TW20 0HB
Telephone Egham 3603 Telex 264475

NORTHERN BRANCH: 680, Burnage Lane, Burnage Manchester M19 1NA
Telephone (061) 432 4945

Hours of business 9-5.30 p.m., 9-1.30 Sat. Manchester closed 1-2 p.m. daily.

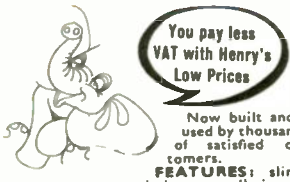
U.S.A. CUSTOMERS are invited to contact ELECTROVALUE AMERICA, P.O. Box 27, Swarthmore PA 19081.

Published approximately the third Friday of each month by IPC Magazines Ltd., Fleetway House, Farringdon Street, London, E.C.4 4AD. Printed in England by Index Printers Ltd., Dunstable, Beds. Sole Agents for Australia and New Zealand—Gordon & Gotch (A/Sia) Ltd. South Africa—Central News Agency Ltd. Publisher's Subscription Rate (including postage): For one year to any part of the world £2·95. Everyday Electronics is sold subject to the following conditions, namely that it shall not, without the written consent of the Publishers first given, be lent, resold, hired out or otherwise disposed of by way of Trade at more than the recommended selling price shown on the cover, and that it shall not be lent, resold or hired out or otherwise disposed of in a mutilated condition or in any unauthorised cover by way of Trade, or affixed to or as part of any publication or advertising, literary or pictorial matter whatsoever.

Published approximately the third Friday of each month by IPC Magazines Ltd., Fleetway House, Farringdon Street, London, E.C.4 4AD. Printed in England by Index Printers Ltd., Dunstable, Beds. Sole Agents for Australia and New Zealand—Gordon & Gotch (A/Sia) Ltd. South Africa—Central News Agency Ltd. Publisher's Subscription Rate (including postage). For one year to any part of the world £2·95. Everyday Electronics is sold subject to the following conditions, namely that it shall not, without the written consent of the Publishers first given, be lent, resold, hired out or otherwise disposed of by way of Trade at more than the recommended selling price shown on the cover, and that it shall not be lent, resold or hired out or otherwise disposed of in a mutilated condition or in any unauthorised cover by way of Trade, or affixed to or as part of any publication or advertising, literary or pictorial matter whatsoever.

Henry's

DONT RELY ON YOUR MEMORY
BUY NOW AT BARGAIN PRICES
Order your latest Henry's Catalogue Price 55p post paid complete with Discount Vouchers



BUILD THE TEXAN

20 + 20 WATT IC STEREO AMPLIFIER

As featured by Practical Wireless 1972

Now built and used by thousands of satisfied customers. **FEATURES:** slim design, overall size in cabinet 15½in × 2¾in × 6½in 6-IC's, 10 transistors, stabilisers, Gardeners low field transformer, Fibre Glass PC Panel, complete chassis work. Now available built and tested as well as in kit form.

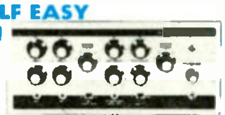
HIGH QUALITY & STABILITY ARE PREDOMINATE FEATURES—DEVELOPED TEXAS ENGINEERS FOR PERFORMANCE, BY RELIABILITY AND EASE OF CONSTRUCTION. **FACILITIES.** On/off switch indicator, headphones socket, separate treble, bass, volume and balance controls, scratch and rumble filters, mono/stereo switch, input selector; Mag. P.U., Radio Tuner, Aux. Can be altered for Mic, Tape, Tape-head, etc. Constructional details Ref. No. 21, 30p. Distributed by Henry's throughout UK.

FREE Teak cabinet with complete kit.

KIT PRICE **£28·50** (+ VAT + 50p carr/packing) or

built and tested **£35·00** (+ VAT + 50p carr/packing) as illustrated

EARN YOURSELF EASY MONEY, WITH PORTABLE DISCO EQUIPMENT



DISCO MINI: A complete portable disco, fitted mixer/preamp, 2 decks all facilities ..	£98·50
As above but with Slider Controls ..	£118·50
100 watt amplifier for above	£42·50
SDLS100: 100 watt mixer/amplifier with slider controls	£69·00
R50: 50 watt mixer/amplifier	£49·50
R100 100 watt mixer/amplifier	£57·50
DISCO AMP: 100 watt mixer/amplifier chassis unit	£73·00
DISCO MIXER/PREAMPLIFIERS (O/P for up to 6-100 watt amplifiers):	
SDLI (rotary controls):	£49·50
SDLII (slider controls):	£58·50
DISCO VOX (slider controls): The complete disco preamp.	£72·00
DJ100: 100 watt power amplifier for above	£49·50
DJ30L: 3 channel 3kW sound to light ..	£36·00
DJ40L: as 30L plus built-in microphone ..	£47·50
DIMAMATIC. 1kW adjustable speed auto dimmer	£25·00
Carlsbro Reverberation Unit	£44·00
SCENE STROBE	£19·00
ROAD STROBE	£25·00
SUPER STROBE	£45·00
Disco anti-feedback microphone	£11·95
Colt 150 watt liquid wheel projector ..	£22·50
150 watt QI liquid wheel projector ..	£50·00
150 watt QI cassette wheel projector ..	£50·00
Spare Effects and Liquid cassettes, large range of patterns	£6·00
Mini spot bank fitted 3 lamps	£12·95
Auto Trilite (mini with flashers)	£17·00
Bubblemaster with 1 gal. liquid	£41·15

MIXERS/MICS/SPEAKERS/LIGHTING
U.K.'s largest range of Disco lighting
6in liquid wheels .. .. £5·00

FREE STOCK LIST Ref. No. 18 ON REQUEST AKG/RESLO/DJ/CARLSBRO/EAGLE CHASSIS AND COMPLETE SPEAKER SYSTEMS, MEGAPHONES, TURNTABLES, PUBLIC ADDRESS COMPONENTS, MICS., STANDS, MIXERS, CABINETS

All prices carr. paid (UK) (VAT EXTRA).
Barclaycard/Access call, write or phone your order 01-723 6963—easy terms for callers.

EXCLUSIVE DECCA KELLY SPEAKERS

12 watt speaker Tweeter systems. 8in Bass/Midrobe and Melinex Domed HF radiator plus crossover £12·50 per pair of systems (carr/packg. 40p) or built into veneered cabinets, size 18 × 12 × 6½in. £19·50 pair (carr. £1).

HI-FI TAPE EQUIPMENT

U.K.'s largest range with discounts and demonstrations for callers. Latest stock lists on request (Ref. No. 17). Phone 01-402 4736 for Barclay/Access Card, Direct orders and latest prices.

TRANSISTORS/ SEMICONDUCTORS

U.K.'s largest range for every application. Small quantity discounts. Also Trade, Export and Industrial enquiries invited. Latest stock list (Ref. No. 36). Including valves on request.

ELECTRONICS SUPPLIES

Specialists in electronics for more than 30 years. Trade and industry supplies — every type of component and equipment.

SINCLAIR PROJECT 80

Stereo Preamplifier ..	£11·95
Audio Filter Unit ..	£6·95
Z40 15 watt Amplifier	£5·45
Z60 25 watt Amplifier	£6·95
PZ5 Mod. for 1 or 2 Z40	£4·98
PZ6 Mod. (5 Tab) 1 or 2 Z40	£7·98
PZ8 Mod. (5 Tab) 1 or 2 Z60	£7·98
TRANSFORMER FOR PZ8	£3·95
NEW FM TUNER ..	£11·95
STEREO DECODER	£7·45

All items post paid.

BUILD THE NEW HENELEC STEREO FM TUNER

A completely new high stability stereo FM tuner. Features variable capacity diode tuning, stabiliser power supply, IC Decoder, high gain low noise. IF stages. LED indicators, Tuning meter, AFC, Easy to construct and use. Mains operated. Slim modern design with fibre glass PC, teak cabinet, etc. Available as a kit to build or ready built. Overall size: 8in × 2¾in × 6½in. Produced to give high performance with a realistic price. (Parts list and constructional details Ref. No. 5, 30p.) Henry's are sole distributors UK and Europe.

Kit Price **£21·00** (+ VAT)
or built and tested **£24·95** (+ VAT)

LIVING SOUND LOW NOISE TOP QUALITY CASSETTES MADE BY EMI TAPES LTD. TO INTERNATIONAL STANDARDS ESPECIALLY FOR HENRY'S. ALL POST PAID LESS THAN ½ REC. PRICES. COMPLETE WITH LIBRARY CASES.

	3 for	6 for	10 for	25 for
C60	£1·00	£1·80	£2·80	£6·75
C90	£1·33	£2·57	£4·20	£10·25
C120	£1·62	£3·15	£5·00	£12·25

Quantity and trade enquiries invited.

LEARN A LANGUAGE—complete with phrase book. German, French, Spanish, Italian. £1·36 per course. £5 for any 4.

LOW COST HI-FI SPEAKERS SPECIAL OFFERS

EMI 13in × 8in—full range speakers (post 20p each or 30p pair); *150TC—8 ohms Twin Cone 10 watt, £2·20 each or £4 pair; *450 10 watt c/o Twin Tweeters 3, 8 or 15 ohms, £3·50 each or £6·90 pair; EW 15 watt 8 ohms c/o Tweeter, £4·30 each or £7·90 pair; 350 20 watt c/o Tweeters 8 or 15 ohms, £7·50 each or £14·20 pair.
* Polished wood cabinet £4·80, post 35p.

8 ohms full range (post 20p)
FR4 4in 5 watt, £4; FR65 6½in 10 watt, £5·50; FR8 8in 15 watt, £6·95; FR23 9 × 6in 15 watt, £6·00.

BASS AND MID RANGE—8 ohms (post 20p)
AA12 5in 15 watt, £3·30; B110 5½in 15 watt, £5·60; B200 8in 15 watt, £6·45; B139/2 13in × 8in 30 watt LF, £10·25.

TWEETERS AND CROSSOVERS (post 20p)
K2006 10 watt 8 or 15 ohms, £2·10; FHT6 15 watt 8 ohms, £3·30; K2011 30 watt 8 ohms, £4·75; T27 KEF, £4·25; Axent 100 30 watt 8 ohms £4·90; K4009 1kHz/5kHz c/o, £2·20; SN75 3kHz var. c/o, £2.

SPEAKER KITS (carr. etc. 35p)
20-2 8in 30 watt, £10 each; 20-3 8in 40 watt, £15 each; LINTON 2 20 watt, £15·95 pair; GLENDALE 3 30 watt, £28·95 pair; DOVEDALE 3 50 watt, £42 pair; KEF KK2, £20·40 each; KEF KK3, £32 each.

BUILD YOURSELF A POCKET CALCULATOR

A complete kit, packaged in a polystyrene container and taking about 3 hours to assemble—that's the Sinclair Cambridge pocket calculator from Henry's. Some of the many features include interface chip, thick-film resistor pack, printed circuit board, electronic components pack. Size: 4⅜in long × 2in wide × ⁱ¹⁄₁₆in deep. Free of charge with the kit for the more advanced technologist is a 32-page booklet explaining how to calculate Logs, Tangents, Sines, etc.

Price **£24·95** (+ VAT)
Also assembled ready to use **£27·20** (+ VAT)

10% VAT TO BE ADDED TO ALL ORDERS. EXPORT SUPPLIED. Prices and descriptions correct at time of proof. Subject to change without notice E & O E. See pages 180 and 181 of this magazine.

Like a permanent job at Henry's? Experienced and trainee salesmen required. Tel. 01-402 8791.

Henry's RADIO LIMITED
EDGWARE ROAD, LONDON W2

404-406 Electronic Components and Equipment 01-402 8381
309 PA - Disco - Lighting High Power Sound 01-723 6963
303 Bargains Store (Callers only)
Home and Car Entertainment Centres London and branches now open
120 Shaftesbury Avenue, London W1 01-437 9692
104 Burnt Oak Broadway, Burnt Oak, Edgware 01-952 7402
190-194 Station Road, Harrow, Middlesex 01-863 7788/9
354-356 Edgware Road, London W2 01-402 5854/4736

All mail to
303 Edgware Road,
London W2 1BW
All stores open 9 am to 6 pm six days a week
Hi-Fi - Tape Equipment Discount Stock List Free at all stores